Financial Internet Quarterly 2025, vol. 21 / no. 4, p. 39-50
10.2478/fiqf-2025-0026

BRIDGING THE INFORMATION GAP: WHAT ARE THE IMPACTS OF EPCS ON PRAGUE'S RESIDENTIAL MARKET SELLING PRICES?

Tomáš Podškubka[1], Barbora Rýdlová[2], Josef Arlt[3]

Abstract

It is assumed that energy performance certificates (EPC) can promote energy efficiency, increase property values, and improve market liquidity by providing trustworthy energy performance information. This article will provide a comprehensive study of the impact of EPCs on the residential selling prices in Prague, the capital of the Czech Republic. For the analysis, the original dataset was extracted from the publicly accessible sreality.cz portal. The hedonic regression model was applied to evaluate how the EPC influences the selling price of apartments in Prague. The regression analysis results are entirely in line with the analyzed current literature. EPC ratings have been proven to significantly affect the selling price in Prague and several other locations. In the most affluent locations of Prague, i.e., typically historical locations, the EPC ratings have not proved to be a statistically significant price factor because these locations suffer from excess demand and limited supply of properties.

JEL classification: C31, Q40, R21, R31
Keywords: Energy Performance Certificate, Energy Efficiency, Czech Housing Market, Residential Properties, Hedonic Regression Model

Received: 30.01.2025 Accepted: 28.04.2025

Cite this:
Podškubka, T., Rýdlová, B. & Arlt, J. (2025). Bridging the information gap: what are the impacts of EPCs on Prague's residential market selling prices? Financial Internet Quarterly 21(4), pp. 39-50.

[1] Department of Finance and Business Valuation, Faculty of Finance and Accounting, Prague University of Economics and Business, Czechia, email: tomas.podskubka@vse.cz, ORCID: https://orcid.org/0000-0002-8761-2661.
[2] Department of Finance and Business Valuation, Faculty of Finance and Accounting, Prague University of Economics and Business, Czechia, email: barbora.rydlova@vse.cz, ORCID: https://orcid.org/0000-0003-0701-730X.
[3] Department of Finance and Business Valuation, Faculty of Finance and Accounting, Prague University of Economics and Business, Czechia, email: josef.arlt@vse.cz, ORCID: https://orcid.org/0000-0001-8349-7419.

Introduction

The building sector is a critical component in the global effort to mitigate climate change, as it accounts for a substantial share of CO_2 emissions in developed economies. Within the European Union (EU), the Energy Performance Certificate (EPC) system, required by the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED), plays an important role in promoting energy efficiency in buildings.

The importance of EPCs in the EU real estate market is underscored by their role in driving higher property values and improving market liquidity. By making energy efficiency information readily available, EPCs help bridge the information gap between landlords and tenants, as well as buyers and sellers and promote more informed decision-making among market participants. As policymakers and industry stakeholders continue to prioritize energy efficiency, the role of EPCs in shaping the real estate market will become increasingly significant. However, EU energy efficiency regulations are connected with both challenges and opportunities for property developers and investors. While compliance can increase initial costs, the long-term benefits include enhanced property values, access to incentives or green financing, risk mitigation, and alignment with sustainability goals. Given the associated costs and regulatory efforts, it is essential to understand whether EPCs have a positive impact on property prices. This paper aims to clarify this relationship.

The relationship between EPCs and property prices is multifaceted, involving various economic, environmental, and social factors. Empirical evidence from multiple countries indicates that energy-efficient properties have a price premium (see: Table 1 in Literature Review). This suggests that buyers and tenants are willing to pay more for properties with higher energy efficiency, recognizing the long-term cost savings and environmental benefits. In addition to influencing property values, EPCs also impact the liquidity of properties. Energy-efficient houses tend to have shorter marketing periods, making them more liquid than less efficient ones. This increased liquidity can be attributed to the higher demand for energy-efficient properties, as buyers and tenants prioritize lower energy costs and environmental sustainability. Energy-inefficient houses, on the contrary, have longer marketing periods, signaling lower liquidity.

This article will provide a comprehensive study of the impact of EPCs on residential selling prices in Prague, the capital of the Czech Republic. Specifically, it employs a hedonic regression model on an extensive dataset to evaluate how the EPC ratings influence apartment selling prices in Prague, while also considering other factors such as location. It will highlight the potential of EPCs to mitigate information asymmetry as indicated by the theory of information asymmetry and to provide pricing signals as supported by signaling theories. To mitigate the information asymmetry inherent in real estate transactions, the principal relies on specific pricing signals, notably the EPC rating, which serves as an indicator of the anticipated price.

Various studies, which will be further documented in the Literature Review section, have been performed worldwide. The studies emphasize geographic and regional heterogeneity and local submarket variation. Due to these regional specifics, the studies focus on specific areas (locations) rather than using geographically wide-spread data. Most of the European empirical studies cover western European countries. Empirical evidence from CEE countries is missing. This research provides new insight on this region and contributes to the current knowledge from western European countries. Prague's real estate market is quite specific as it is characterized by high prices and a significant affordability gap compared to other major EU cities. The cost of purchasing an apartment in Prague is disproportionately higher relative to average salaries, making it currently one of the least affordable property markets in Europe.

For instance, the Czech Republic ranks second to last among all European countries in the affordability of owning a home. It costs on average more than 13 gross annual salaries to buy a property in the Czech Republic. Prague, along with Amsterdam and Bratislava, is among the European capitals where a high number of annual salaries are needed to own a home (Deloitte, 2025). According to Eurostat (2024), residential real estate prices in the EU increased by 20% in the past 4 years (Q2 2012 - Q2 2024). One of the largest jumps was recorded in the Czech Republic, where prices rose by 45% for this period.

The authors hope their findings will offer valuable guidance for policymakers, real estate professionals, stakeholders in the energy efficiency domain and academia, underscoring the critical role of EPCs in promoting energy-efficient practices and enhancing the value and liquidity of properties driven by higher EPCs.

Literature review

EPCs have become a significant factor in the real estate market, particularly in the context of the EU's directives aimed at improving energy efficiency in buildings. This literature review synthesizes findings from various studies to understand the impact of EPCs on real estate prices. The aim is to cover theoretical explanations, methodological approaches, empirical evidence from different countries, as well as policy implications.

Theoretical explanations

The theoretical explanations for EPCs' impact on real estate prices are rooted in several economic and behavioral theories, including hedonic pricing theory, signaling theory, and the theory of information asymmetry.

Hedonic Pricing Theory posits that the price of a good is determined by the characteristics that it has. The price of a property is influenced by its attributes, such as location, size, age, and energy efficiency. EPCs provide a quantifiable measure of a property's energy efficiency, which can be included in the overall valuation of the property. Fregonara et al. (2015) used hedonic regression analysis to measure the impact of EPC levels on house listing prices in Turin, Italy. The study found that F ratings (denotes inefficient buildings) are strongly correlated with listing prices, while in other ratings the relationship is weak. Cajias and Piazolo (2013) investigated the effect of energy consumption on the financial performance of German residential buildings. They found that energy-efficient buildings yield higher returns and rents, highlighting the financial benefits of energy efficiency. Olaussen et al. (2019) analyzed the role of energy prices in the effectiveness of EPCs in Oslo. The study found that energy performance has little to no effect on transaction prices, suggesting that additional policy measures may be needed to enhance the impact of EPCs.

Signaling Theory suggests that certain attributes of a product can serve as signals to potential buyers about its quality. An EPC can signal to buyers that a property is energy-efficient, which may be associated with lower energy costs and a smaller environmental impact. This signal can enhance the perceived value of the property. Fuerst et al. (2016) investigated the price premium on energy-efficient buildings in Helsinki, Finland. They found a significant price premium for apartments in the top three energy-efficiency categories, suggesting that energy-efficient buildings have signaling value for consumers. Fuerst and Shimizu (2016) analyzed the impact of eco-labels on condominium prices in Tokyo, Japan. They found that eco-labeled buildings command a small but significant premium, driven primarily by wealthier households.

Theory of Information Asymmetry posits that in many transactions, one party has more or better information than the other. EPCs help to reduce information asymmetry in the real estate market by providing standardized information about a property's energy efficiency. This can lead to more informed decision-making by buyers and potentially higher property prices for energy-efficient homes. Amecke (2012) conducted a survey of German homeowners to assess the impact of EPCs on purchasing decisions. The results suggested that EPCs have limited effectiveness, with energy efficiency being a minor purchasing criterion for most buyers. However, the study also highlighted the potential of EPCs to reduce information asymmetry. Murphy (2014) surveyed Dutch private dwelling purchasers to examine the influence of EPCs on their adoption of energy efficiency measures. The study found that the EPC had a weak influence, especially pre-purchase, but could potentially reduce information asymmetry if combined with other instruments.

Behavioral Economic Theory explores how psychological factors and cognitive biases influence economic decision-making. In the context of EPCs, behavioral economics can help explain why some buyers may place a higher value on energy-efficient properties. For example, buyers may perceive energy-efficient homes as more comfortable or environmentally responsible, which encourages them to pay a premium. Warren-Myers et al. (2018) investigated consumers' motivations and experiences in purchasing houses in sustainably certified developments in Australia. The study found that despite low awareness and trust in sustainability ratings, consumers sought value from these credentials, indicating a behavioral preference for energy-efficient homes. Heinzle et al. (2013) conducted a specific survey analysis to ascertain the influence of the Green Mark Scheme on real estate investor behavior in Singapore. The study found significant premiums for different levels of certification, suggesting that behavioral factors play a role in the valuation of energy-efficient properties.

The Capitalization of Energy Savings Theory suggests that the future cost savings from lower energy consumption are reflected in the current property prices. Buyers are willing to pay more for energy-efficient properties because they anticipate lower energy bills in the future, which increases the overall value of the property. Walls et al. (2017) tested for evidence that energy efficiency features are capitalized into home prices in three U.S. metropolitan areas. They found that Energy Star certification is associated with higher sales prices, with local green certifications having even larger impacts. Kholodilin et al. (2017) compared the capitalization of energy efficiency in selling prices and rents in Berlin. They found that energy efficiency is well capitalized in both apartment prices and rents, with a higher implicit willingness to pay in the rental segment.

Green Premium and Brown Discount concepts refer to the price differentials associated with energy-efficient and energy-inefficient properties, respectively. A green premium is the additional amount buyers are willing to pay for energy-efficient properties, while a brown discount is the reduction in price for properties with poor energy performance. Taltavull De La Paz et al. (2019) investigated the existence of a green premium in house prices in Alicante, Spain. The study found that energy efficiency is associated with a price premium, which varies by climatic zones. McCord et al. (2020) applied quantile regression to assess the impact of EPCs on house prices in Belfast, Northern Ireland.

Their findings showed that EPCs are valued differently across price quantiles, with higher impacts at the upper end of the price distribution.

Methodological approaches

The literature review shows that the authors use various methodological approaches. Mostly used is the hedonic regression model that will be applied in this paper too.

Hedonic Regression Models are widely used to analyze the relationship between property characteristics and their prices. These models decompose the price of a property into the value of its individual attributes, such as location, size, age, condition, and energy efficiency. By isolating the effect of EPCs, researchers can determine how much of the property price is attributable to its energy rating. Studies using this approach include Deng et al. (2012), Bonde and Song (2013), Fregonara et al. (2015), Fuerst et al. (2015), Cajias and Piazolo (2013), Kholodilin et al. (2017), Walls (2017), Fuerst (2018), Taruttis (2022) and Gerassimenko et al. (2024), Ghosh et al. (2024), Micelli et al. (2024) and Khazal et al. (2023), using the high-dimensional fixed effects model.

Quantile Regression is used to analyze the impact of EPCs across different points in the price distribution. Unlike traditional regression models that estimate the average effect, quantile regression provides insights into how the impact of EPCs varies across different price levels. Key studies include McCord et al. (2020) and Koengkan and Fuinhas (2022).

Propensity Score Methods are used to control for selection bias and ensure that the comparison between properties with different EPC ratings is fair. By matching properties with similar characteristics, the effect of EPCs on property prices can be isolated more accurately. Wilhelmsson (2019) used this methodology along with other more traditional methods.

Meta-analysis combines the results of multiple studies to provide a comprehensive assessment of the impact of EPCs on property prices. This approach helps to identify general trends and variations across different contexts and methodologies. Studies using this approach are for example Cespedes-Lopez et al. (2019) and Leskinen et al. (2020).

Survey-based Approaches gather data directly from property buyers, sellers, and real estate professionals to understand their perceptions and behaviors regarding EPCs. This method provides insights into the factors that influence decision-making and the perceived value of energy performance. Main proponents are Amecke (2012), Heinzle et al. (2013), Warren-Myers (2018) and Murphy (2014).

Ou et al. (2025) in their scoping review covering 68 European academic studies including 111 models which confirm these prevailing methodologies. They find that over 60 % of studies in Europe used hedonic regression, less than 20 % used the quantile regression and similar extensions of the correlation. In recent studies spatial analysis (Barreca et. al., 2021) is used recognizing the location of the real estate as a key factor impacting the price.

Empirical evidence from various countries

The impact of EPCs on real estate prices has been extensively studied across different countries, revealing a complex picture. Table 1 provides a systematic summary.

Table 1: Reviewed Literature Summary

Country	Author	EPC Impact on Real Estate Price	Method Used
Australia	Fuerst (2018), Warren-Myers (2018)	Mostly yes	Hedonic regression model, survey analysis
Belgium	Gerassimenko et al. (2024)	Yes	Hedonic regression model
Denmark	Murphy (2014)	No	Survey analysis
England	Fuerst et al. (2015)	Yes	Hedonic regression model
England and Wales	Ghosh et al. (2024)	Yes	Hedonic regression model
Europe	Ou et al.(2025)	75% Yes, 25% No	Literature scoping review
Finland	Fuerst et al. (2016)	Yes	Hedonic regression model
Germany	Cajias and Piazolo (2013), Kholodilin et al. (2017), Taruttis (2022), Amecke (2012)	Yes No	Hedonic regression model, survey analysis (Amecke, 2012)

Country	Author	EPC Impact on Real Estate Price	Method Used
Global	Cespedes-Lopez et al. (2019)	Yes	Meta analysis
Hong Kong	Mesthrige and Sze (2013), Hui et al. (2017)	Yes	Hedonic regression model
Ireland	Hyland et al. (2013)	Yes	Hedonic regression model
Italy	Fregonara et al. (2015)	Mostly no	Hedonic regression model
Italy	Barreca et al. (2021)	Mixed results locally diversified	Spatial analysis of data points
Italy	Micelli et al.(2024)	Yes, but local market specifics	Hedonic regression model
Japan	Fuerst and Shimizu (2016)	Yes	Hedonic regression model
Northern Ireland	McCord (2020)	Yes	Quantile regression
Norway	Olaussen (2019)	No	Hedonic regression model
Norway	Khazal and Sønstebø (2023)	Yes	Hedonic HDFE method and panel FE
Portugal	Koengkan and Fuinhas (2022)	Yes	Quantile regression, hedonic regression model
Singapore	Deng et al. (2012), Heinzle et al. (2013)	Yes	Hedonic regression model, survey analysis
Spain	Taltavull De La Paz et al. (2019), Carlos Marmolejo-Duarte (2019)	Yes	Hedonic regression model
Sweden	Wilhelmsson (2019), Bonde and Song (2013)	Mixed No	Propensity score methods along with hedonic regression models Hedonic regression model
United States	Walls et al. (2017)	Mostly yes	Hedonic regression model

Source: Authors' own work.

Collectively, these studies highlight the diverse impacts of EPCs on real estate prices across different countries. While the overall trend suggests mostly a positive relationship between energy efficiency and property values, the extent and nature of this impact vary significantly by region, property type, methodological approach and market conditions. This underscores the importance of considering local contexts when assessing the effects of EPCs on real estate market prices. In line with Ou et al. (2025), it is evident that attention to research has been paid to many western European countries. Ou et al. (2025) suggest that this can be attributed to the public availability and transparency of the EPC labels. They found 80% of 68 total studies come from only 13 European countries with direct public EPC data availability. Only a few studies were published on other countries, like Germany, Finland or Belgium, where the EPC data was collected from indirect resources like real estate agencies web sites. However, there were no studies found for the Central and Eastern European region. Ou et al. (2025) suggest that the language barrier might have contributed to that. However, we have performed a search in both Czech and English language, and we have not found any studies covering the Czech market. Due to the fact that the EPC data are not directly publicly accessible in the Czech Republic, we follow the second manner of data collection using the real estate websites for EPC information collection.

Policy implications

One of the primary policy goals of EPCs is to promote energy efficiency in buildings. By providing standardized information about a property's energy performance, EPCs encourage property owners to invest in energy-efficient upgrades. This can lead to a reduction in energy consumption and carbon emissions, contributing to broader environmental and sustainability goals, Taltavull De La Paz et al. (2019) or Cajias and Piazolo (2013), mandatory disclosure requirements, and minimum energy performance standards, Turley and Sayce (2015) as well as Olaussen et al. (2019) or to a reduction of information asymmetry by providing standardized and transparent information about a property's energy performance. This allows buyers to make more informed decisions and can lead to a more efficient market, Amecke (2012) and Murphy (2014). Policies related to EPCs should also consider social equity concerns, particularly the potential for energy efficiency improvements to unevenly benefit higher-income households to rather benefit lower-income ones. Ensuring that all segments of the population have access to energy-efficient housing is crucial for achieving equitable outcomes, Marmolejo-Duarte and Chen (2019) and Gerassimenko et al. (2024). Additionally, consumers must be aware of and understand the information provided by the EPCs. Policies aimed at enhancing consumer awareness and engagement can help ensure that EPCs achieve their intended goals, Warren-Myers et al. (2018) and Heinzle et al. (2013).

The literature reviewed provides robust evidence that EPCs might positively impact real estate prices, though the extent of this impact varies by region, property type, and methodological approach. Higher EPC ratings generally lead to higher property values, reflecting the market's recognition of the benefits of energy efficiency. The aim of this paper is to try to fill the research gap identified in the current literature, which is the need for more granular data from a different market and climate environment (e.g. Marmolejo-Duarte and Chen (2019), Wilhelmsson (2019) and Taruttis et al. (2022)). Based on a recent scoping review of European academic literature (Ou et al., 2025) there is so far no evidence on the topic from the CEE countries. Therefore, the price impact of EPC ratings on data from Prague will be verified, simultaneously focusing on several micro locations to contribute with data and results from a CEE country.

Data and methodology

Data

The original dataset was prepared through the following methodology. Utilizing a Python script, sales and rental advertisements from the publicly accessible sreality.cz portal, encompassing the entire Czech Republic, were extracted as of 22.09.2023. The acquired data underwent further refinement using Tableau's data editing and visualization software. This software facilitated the geospatial mapping of individual advertisements via GPS coordinates, enabling the addition of the distance from the historic center in each regional capital to each advertisement. Given that not all downloaded advertisements contained essential information for subsequent analysis, only those pertaining to Prague and containing necessary factors as specified below were filtered. This primarily included the price or rent and factors directly influencing these values.

The selected factors were:

1. Total area of the offered apartment in square meters (*area_net*).
2. Average square meters per room (*sqm_room*).
3. Calculated price in CZK per square meter (*price*).
4. Apartment technical condition (*state*).
5. Apartment location (*location*).
6. Energy performance class (*EPC*).
7. Calculated information on whether the apartment have a separate kitchen (*sep_kitch*).

Apartment technical condition is a zero-one variable. The following apartments are marked as 0: good, under reconstruction, very good, before reconstruction. The following apartments are marked as 1: after reconstruction, project, under construction, new construction. Apartment location is a categorical variable taking on values 1, 2, 3, 4, 5, and 6 according to the attractiveness of the city's neighborhoods for housing, see Table 2. Energy performance class has a scale from A to G, which has been transformed into numerical values from 1 to 6 i.e.: 1 = A most energy efficient, 2 = B, 3 = C, 4 = D, 5 = E, 6 = F least energy efficient. Class G - extremely inefficient - were excluded. If the EPC rating is not available when offering an apartment for sale or rent, there is an obligation to declare EPC class G. Consequently, there is a presumption of significant data distortion. Therefore, G classes were excluded from the dataset. Information on whether the apartment has a separate kitchen takes the value 0; suppose there is no separate kitchen. Otherwise, it takes the value 1.

In this article, the sale advertisements for Prague are analyzed and the dataset includes 4,189 advertisements.

Table 2: Prague locations

Number of Location	Description
1 (most attractive)	Dejvice, Hradčany, Malá Strana, Nové Město, Staré Město, Troja, Vinohrady
2	Břevnov, Bubeneč, Karlín, Podolí, Smíchov, Vyšehrad
3	Braník, Ďáblice, Holešovice, Kobylisy, Libeň, Michle, Nusle, Strašnice, Střešovice, Vršovice, Záběhlice, Žižkov

Number of Location	Description
4	Bohnice, Čimice, Hloubětín, Hodkovičky, Hostivař, Kamýk, Košíře, Krč, Malešice, Motol, Prosek, Radlice, Řepy, Stodůlky, Střížkov, Štěrboholy, Veleslavín, Vokovice, Vysočany, Zličín
5	Běchovice, Čakovice, Černý Most, Dolní Chabry, Dolní Měcholupy, Dolní Počernice, Háje, Hlubočepy, Horní Měcholupy, Horní Počernice, Hostavice, Hrdlořezy, Chodov, Klánovice, Koloděje, Kolovraty, Kunratice, Kyje, Letňany, Lhotka, Modřany, Radotín, Ruzyně, Řeporyje, Slivenec, Suchdol, Šeberov, Velká Chuchle, Vinoř, Zbraslav
6 (least attractive)	Dubeč, Cholupice, Jinonice, Kbely, Královice, Křeslice, Liboc, Libuš, Lipence, Lipenice, Lysolaje, Miškovice, Petrovice, Písnice, Pitkovice, Satalice, Sedlec, Sobín, Točná, Třebonice, Třeboradice, Uhříněves, Újezd nad Lesy, Újezd u Průhonic

Source: Authors' own work.

Methodology

To evaluate how the energy performance class influences the selling price of apartments in Prague, the following hedonic regression model is applied:

$$\ln p_i = c + \sum_{j=1}^{k} \beta_j x_{ij} + \varepsilon_i,\ i = 1,\ldots,N \quad (1)$$

where the dependent variable p_i, indexed by apartment (i) represents the price. The independent variables x_{ij} represent *area_net, sep_kitchen, sqm_per_-room*, state, location and variable of interest *EPC*. The parameter *c* is the intercept and β_j, $j = 1, \ldots, k$ are the partial regression parameters. In this model, for a unit increase in the independent variable x_{ij}, the expectation of the dependent variable changes by the percentage $100(e^{\beta j} - 1)$, provided that all other independent variables are held constant. When $|\beta_j| < 0.1$ this percentage approaches to $100\beta_j$. The ε_i are observation-specific zero-mean random error terms, which are a set of equally distributed independent random variables, i.e. $\varepsilon_i \sim IID(0, \sigma^2)$.

It is assumed that the error terms of the regression model (1) are normally distributed. This assumption is necessary to perform correct t-tests for the parameters of this model, when it is violated, the testing criterion:

$$t = \frac{\widehat{\beta}_j}{s_{\widehat{\beta}_j}}$$

can be biased. Heteroscedasticity, the failure to satisfy the condition of constant variances of the error terms (homoskedasticity), i.e., $D(\varepsilon_i) = \sigma^2_i$ can bias the standard error estimates $s_{\hat{\beta}j}$, resulting in incorrect *t*-tests. The presence of autocorrelation of the error terms, i.e. $E(\varepsilon_i\varepsilon_j) \neq 0$, $i \neq j$, can also bias the standard error estimates. Both heteroscedasticity and autocorrelation can further affect the *F*-test and can cause misleading interpretation of the index of determination R^2. Multicollinearity, the high correlation among the independent variables, can lead to inaccurate regression parameter estimates and overestimating their standard errors. It also causes problems with the interpretation of partial regression parameters. Namely, it isn't easy to understand the individual impact of the particular independent variable, provided that the other independent variable is constant when these variables are correlated.

Results

The results of the regression analysis are presented in Table 3. All computations were performed using the software package EViews 13. The Jarque-Bera test (Jarque & Bera, 1980) rejects the hypothesis of error term normality in most cases. However, histograms, skewness and kurtosis of the error terms indicate that their distribution is not far from normal. Since the Central Limit Theorem ensures that normality is not required if the sample size is large enough, it can be stated that non-normality does not distort the obtained results. The Breusch-Pagan-Godfrey (Breusch & Pagan, 1979; Godfrey, 1978) and Glejser tests (Glejser, 1969) reject homoscedasticity hypotheses in most cases. However, for heteroscedasticity to cause diagnostic test distortion , it must be extreme (as noted by Lumley et al., 2002), which is not the case in this study. The data do not contain extreme values, and the distributions of the error terms is close to normal, as mentioned above. The Breusch-Godfrey autocorrelation test (Breusch, 1978; Godfrey, 1978) does not reject the hypothesis of no autocorrelation in all cases.

Table 3: Regression results of log price per square meter in Czech crowns in Prague

	Prague	Location					
		1	2	3	4	5	6
c	11.619***	11.485***	11.691***	11.436***	11.435***	11.398***	11.292***
area_net	1.26E-5	7.83E-5	0.000	0.001**	0.000	-0.001***	-0.000
sep_kitch	-0.019	-0.002	-0.069	-0.017	-0.035	0.022	0.036
sqm_room	0.015***	0.013***	0.009***	0.013***	0.015***	0.018***	0.016***

	Prague	Location					
		1	2	3	4	5	6
state	0.180***	0.266***	0.073*	0.180***	0.178***	0.128***	0.178***
location	-0.056***						
EPC	-0.024***	0.021	-0.001	-0.016	-0.502	-0.064***	-0.026
Mean dep	12.024	12.227	12.154	11.994	12.034	11.967	11.942
SD dep	0.459	0.506	0.381	0.421	0.464	0.493	0.394
R^2	0.491	0.383	0.359	0.482	0.548	0.498	0.487
F-test	672.913***	32.042***	40.147***	169.256***	309.155***	210.649***	57.127***
D-W	1.995	2.981	1.886	2.079	2.115	1.828	2.398
N	4189	264	364	914	1281	1059	307

Notes: 1) The LS point estimates of parameters of regression model (1). 2) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1. 3) Mean dep – mean of the dependent variable, SD dep – standard deviation of the dependent variable, R^2 – index of determination, D-W – Durbin Watson test, *N* – number of observations

Source: Authors' own work.

There is a certain risk of multicollinearity. The explanatory variable *sep_kitchen* is correlated with the variable *state* (-0.4068) and with the *EPC* (0.4108), and the variable *area_net* is correlated with *sqm_per_room* (0.6532). However, the parameter estimates for both variables are, with two exceptions, statistically insignificant, and their exclusion has no effect on the model parameter estimates. The correlation of the *state* with *EPC* (-0.5355) distorts the results, increasing the parameter estimates for *EPC* (decreasing them in absolute value) and increasing the estimates of their standard errors. The solution is to exclude *state* from the model and analyze only the apartments for which *state* takes the value 1 (after reconstruction, project, under construction, new construction). The results of this regression analysis are presented in Table 4.

Table 4: Regression results of log price per square meter in Czech crowns in Prague

	Prague	Location					
		1	2	3	4	5	6
c	11.972***	12.080***	11.881***	11.814***	11.815***	11.728***	11.536***
area_net	3.71E-05	0.001**	0.001	0.001	0.001	-0.001***	-0.001
sep_kitch	-0.055*	-0.189	-0.022	0.034	-0.084	0.013	0.145
sqm_room	0.014***	0.006**	0.008***	0.010***	0.015***	0.018***	0.016***
location	-0.056***						
EPC	-0.080***	-0.039	-0.028	-0.065***	-0.139***	-0.142***	-0.055
Mean dep	12.156	12.417	12.201	12.139	12.186	12.107	12.030
SD dep	0.446	0.499	0.366	0.385	0.439	0.502	0.368
R^2	0.393	0.253	0.301	0.387	0.467	0.408	0.423
F-test	329.703***	10.649***	24.976***	73.744***	178.399***	115.832***	39.508
D-W	1.960	3.969	1.265	2.339	1.886	1.495	1.989
N	2557	131	237	472	818	678	221

Notes: 1) The point estimates of parameters of regression model (1). 2) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1. 3) Mean dep – mean of the dependent variable, SD dep – standard deviation of the dependent variable, R^2 – index of determination, D-W – Durbin Watson test, *N* – number of observations. 4) State: new construction, after reconstruction, project, under construction

Source: Authors' own work.

Results of the adjusted regression analysis contained in Table 4 are entirely in line with the analyzed current literature. This paper has proven that EPC ratings affect the selling price in Prague, taken as one location, and in Locations 3, 4, and 5 with the parameters t-test p-values lower than 0.01. On the other hand, affluent Prague Locations 1 and 2 achieved statistically immaterial results for EPC influence, which can be interpreted such that in prominent locations, real estate supply is limited, and property is scarce, which diminishes the signaling and information asymmetry power of EPCs and boosts the importance of location itself. These findings are directly supported by several authors (e.g. Marmolejo-Duarte & Chen, 2019, Wilhelmsson, 2019 and Taruttis et al., 2022). It is worth noting that the mentioned studies were performed in Spain, Norway and especially Germany, which is a neighboring market for the Czech Republic and the most important trade partner encompassing almost 80% of Czech international trade within the EU. Considering this, comparable regulation applies, and similar real estate patterns can be expected. Correspondingly, the model without separated locations, which was constructed for the whole Prague region, demonstrated the high statistical significance of the parameter estimate of the location factor, which is the most well-known value driver in real estate pricing (Fuerst et al., 2015 or Olaussen et al., 2019).

The notion of asymmetrical effect of EPC is also presented by Fuerst et al. (2016), McCord et al. (2020), and Cespedes-Lopez et al. (2019). Their findings are, however, somewhat different because they claim that only properties with higher EPC scores display positive significant effects at the higher end of the price distribution, but there are also brown discount effects evident for lower-rated properties within F and G-rated EPC properties, which contradicts findings in this paper.

The other influential real estate price driver proved to be the size of the apartment as measured by square meters per room (*sqm_room*). This outcome is also logical and expected as smaller flats are typically sold at a premium to larger ones measured by unit price. The parameter estimates of this factor are statistically significant in all regressions having p-value lower than 0.01.

The parameter estimates of the remaining two explanatory variables (*area_net*, *sep_kitch*) showed predominantly no statistical significance.

Conclusions

The EPC regulation imposed in the EU aims to mitigate climate change and global warming issues. It is assumed that EPCs can promote energy efficiency, increase property values, and improve market liquidity by providing trustworthy energy performance information. However, increased energy efficiency is also associated with higher costs, so the economic rationale behind this idea must be sound. In any case, the energy efficiency of buildings will remain the central focus of EU policymakers, practitioners, and scholars, and the importance of EPCs will continue to increase.

The literature review showed that many authors have already studied this issue. Nevertheless, the results remain inconclusive, and research gaps have been identified. The analyzed papers proved robust evidence that higher EPCs accompany higher real estate prices, though the extent of this impact varies by region, property type, and methodological approach and is somewhat uneven. This paper will address the gap identified in the current literature, which is the need for more granular data from a different market and climate environment (e.g., Marmolejo-Duarte & Chen, 2019, Wilhelmsson, 2019; Taruttis et al., 2022) and provide a sophisticated analysis of the unique data from Prague, Czech Republic. Prague's real estate market is quite specific as it is characterized by high prices and a significant affordability gap compared to other major EU cities. This analysis is framed by the theory of information asymmetry and the signaling theory, as the EPCs should mitigate information asymmetry in the real estate market and signal the energy performance of buildings. Using the most frequent hedonic regression analysis, the relationship between energy efficiency measured by EPCs and property prices on data from Prague while focusing on several micro locations has been tested.

Our results can be summarized in the following three points:

1. EPCs have an impact on prices - EPC in Prague apartments statistically significantly influences the price. This finding holds in 3 out of 6 micro-locations and the Prague region as a whole.
2. The degree of influence differs by micro-location - In the most affluent locations of Prague, i.e., typically historical (central) locations, the EPC ratings have not proved to be a statistically significant price factor. This can be easily explained: these locations suffer from excess demand and limited supply of properties and are usually viewed as seller markets. Buyers have no option but to disregard most typical price drivers and focus only on location. In addition, historical locations are composed of old dwellings, and meeting state-of-the-art building standards through complete refurbishment is a cost and technical issue due to heritage protection.
3. Apartment size also impacts prices - The size of the apartment, measured by square meters per room, was the other statistically significant explanatory variable of real estate prices in Prague. This aligns with theory and market practice, as smaller flats sell at a premium per unit price.

The findings of this study imply that policymakers should continue to promote energy efficiency through EPC regulations and strive to increase public awareness of their long-term benefits, as higher EPC ratings are associated with increased property values. Incentives for property owners to improve their EPC ratings could further enhance these benefits. However, the results of this study suggest that the policy makers should design the EPC related programs taking into account regional market specifics. In Prague's historical center we observed no market driven motivation of the real estate owners for energy performance improvement, since the transaction motives lies in the premium location, the price effect of energy inefficiency proving negligible. Given the unique challenges faced by historical locations, support measures should be directed towards these areas to help property owners compensate excessive costs connected with energy performance improvement of historical buildings and meeting energy efficiency standards without compromising heritage protection.

The limitations of this study rest in the fact that it is focused only on the Prague region while studying other big cities in the Czech Republic could help shape a more complex picture of the EPC's power to explain real estate prices. Moreover, the dataset was compiled at one point in time. Creating a dataset from multiple periods would allow the use of more advanced econometric models incorporating time series analysis. Additionally, more attention could be given to the explanatory variable of technical condition (state) that was abandoned due to its correlation with the EPC explanatory variable. One explanation, which should be investigated in more detail, could be that EPC rating is a proxy for technical condition or vice versa. In other words, higher EPCs can signal a better condition of the real estate. This assumption is based on logical grounds as high EPCs are typically found in newly constructed or wholly refurbished buildings that must meet the current strict EU climate building regulations.

Future research avenues should be explored in exploring long-term price time series that could better capture the complex impacts of EPCs on property values and consider the role of behavioral aspects advocated by behavioral economic theories. Regional data could also be included and explored. Additional attention could also be targeted at comparing whether the EPC's effects on real estate selling prices can also be found in rental prices.

Acknowledgments

The article is prepared as one of the outputs of the research project of the internal grant system of the Faculty of Finance and Accounting, Prague University of Economics and Business, Prague IP 100040.

References

Amecke, H. (2012). The Impact of Energy Performance Certificates: A Survey of German Home Qwners. Energy Policy, 46, 4-14. https://dx.doi.org/10.1016/j.enpol.2012.01.064.

Barreca, A., Fregonara, E. & Rolando, D. (2021). EPC Labels and Building Features: Spatial Implications over Housing Prices. Sustainability, 13(5), 2838-2850. https://dx.doi.org/10.3390/su13052838.

Bonde, M. & Song, H.S. (2013). Is Energy Performance Capitalized in Office Building Appraisals? Property Management, 31(3), 200-215. https://dx.doi.org/10.1108/02637471311321450.

Breusch, T.S. (1978). Testing For Autocorrelation in Dynamic Linear Models. Australian Economic Papers, 17(31), 334 -355. https://dx.doi.org/10.1111/j.1467-8454.1978.tb00635.x.

Breusch, T.S. & Pagan, A.R. (1979). A Simple Test for Heteroskedasticity and Random Coefficient Variation. Econometrica, 47(5), 1287-1294. https://dx.doi.org/10.2307/1911963.

Cajias, M. & Piazolo, D. (2013). Green Performs Better: Energy Efficiency and Financial Return on Buildings. Journal of Corporate Real Estate, 15(1), 53-72. https://dx.doi.org/10.1108/JCRE-12-2012-0031.

Cespedes-Lopez, M.F., Mora-Garcia, R.T., Perez-Sanchez, V.R. & Perez-Sanchez, J.C. (2019). Meta-analysis of Price Premiums in Housing with Energy Performance Certificates (EPC). Sustainability, 11(22), 6303-6327. https://dx.doi.org/10.3390/su11226303.

Deloitte. (2025). Property Index – Real Estate Prices. https://www2.deloitte.com/cz/en/pages/real-estate/articles/cze-index-nemovitosti.html (Accessed: 30.01.2025).

Deng, Y., Li, Z. & Quigley, J.M. (2012). Economic Returns to Energy-efficient Investments in the Housing Market: Evidence from Singapore. Regional Science and Urban Economics, 42(3), 506-515. https://dx.doi.org/10.1016/j.regsciurbeco.2011.04.004.

Eurostat. (2024). House price index – Annual data. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing_price_statistics_-_house_price_index (Accessed: 30.01.2025).

Fregonara, E., Rolando, D., Semeraro, P. & Vella, M. (2015). The Impact of Energy Performance Certificate Level on House Listing Prices: First Evidence From Italian Real Estate. Aestimum, 65(2), 143–163. https://dx.doi.org/10.13128/AESTIMUM-15459.

Fuerst, F. & Shimizu, C. (2016). Green Luxury Goods? The Economics of Eco-labels in the Japanese Housing Market. Journal of the Japanese and International Economies, 39, 108-122. https://dx.doi.org/10.1016/j.jjie.2016.01.003.

Fuerst, F. & Warren-Myers, G. (2018). Does Voluntary Disclosure Create a Green Lemon Problem? Energy-efficiency Ratings and House Prices. Energy Economics, 74, 1-12. https://dx.doi.org/10.1016/j.eneco.2018.04.041.

Fuerst, F., Oikarinen, E. & Harjunen, O. (2016). Green Signalling Effects in the Market for Energy-efficient Residential Buildings. Applied Energy, 180, 560-571. https://dx.doi.org/10.1016/j.apenergy.2016.07.076.

Fuerst, F., McAllister, P., Nanda, A. & Wyatt, P. (2015). Does Energy Efficiency Matter to Home-buyers? An Investigation of EPC Ratings and Transaction Prices in England. Energy Economics, 48, 145-156. https://dx.doi.org/10.1016/j.eneco.2014.12.012.

Gerassimenko, A., Defau, L. & De Moor, L. (2024). The Impact of Energy Certificates on Sales and Rental Prices: A Comparative Analysis. International Journal of Housing Markets and Analysis, 17(5), 1267-1281. https://dx.doi.org/10.1108/IJHMA-03-2023-0041.

Ghosh, A., McConnell, B. & Millán-Quijano, J. (2024). Do Homebuyers Value Energy Efficiency? Evidence from an Information Shock, Universidad de Navarra, Navarra, https:/dx./doi.org/10.2139/ssrn.4527854.

Glejser, H. (1969). A New Test for Heteroskedasticity. Journal of the American Statistical Association, 64(235), 315-323. https://dx.doi.org/10.1080/01621459.1969.10500976.

Godfrey, L.G. (1978). Testing Against General Autoregressive and Moving Average Error Models When the Regressors Include Lagged Dependent Variables. Econometrica, 46(6), 1293-1301. https://dx.doi.org/10.2307/1913829.

Heinzle, S.L., Boey Ying Yip, A. & Low Yu Xing, M. (2013). The Influence of Green Building Certification Schemes on Real Estate Investor Behaviour: Evidence from Singapore. Urban Studies, 50(10), 1970-1987. https://dx.doi.org/10.1177/0042098013477693.

Hui, Eddie C.M., Cheuk-kin Tse & Ka-hung Yu. 2017. 'The Effect of Beam Plus Certification on Property Price in Hong Kong'. International Journal of Strategic Property Management 21(4), 384–400. https://dx.doi.org/10.3846/1648715X.2017.1409290.

Hyland, M., Lyons, R.C. & Lyons, S. (2013). The Value of Domestic Building Energy Efficiency: Evidence from Ireland. Energy Economics, 40, 943-952. https://dx.doi.org/10.1016/j.eneco.2013.07.020.

Jarque, C.M. & Bera, A.K. (1980). Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals. Economics Letters, 6(3), 255-259. https://dx.doi.org/10.1016/0165-1765(80)90024-5.

Khazal, A. & Sønstebø, O.J. (2023). Energy Efficiency Premium Issues and Revealing the Pure Label Effect. The Energy Journal, 44(1), 33-54. https://dx.doi.org/10.5547/01956574.44.1.akha.

Kholodilin, K.A., Mense, A. & Michelsen, C. (2017). The Market Value of Energy Efficiency in Buildings and the Mode of Tenure. Urban Studies, 54(14), 3218-3238. https://dx.doi.org/10.1177/0042098016669464.

Koengkan, M. & Fuinhas, J.A. (2022). Heterogeneous Effect of "Eco-Friendly" Dwellings on Transaction Prices in Real Estate Market in Portugal. Energies, 15(18), 6762-6784. https://dx.doi.org/10.3390/en15186784.

Leskinen, N., Vimpari, J. & Junnila, S. (2020). A Review of the Impact of Green Building Certification on the Cash Flows and Values of Commercial Properties. Sustainability, 12(7), 2729-2741. https://dx.doi.org/10.3390/su12072729.

Lumley, T., Diehr, P., Emerson, S. & Chen, L. (2002). The Importance of the Normality Assumption in Large Public Health Data Sets. Annual Review of Public Health, 23, 151-169.

Marmolejo-Duarte, C. & Chen, A. (2019). The Uneven Price Impact of Energy Efficiency Ratings on Housing Segments: Implications for Public Policy and Private Markets. Sustainability, 11(2), 372-390.

McCord, M., Haran, M., Davis, P. & McCord, J. (2020). Energy Performance Certificates and House Prices: A Quantile Regression Approach. Journal of European Real Estate Research, 13(3), 409-434. https://dx.doi.org/10.1108/JERER-06-2020-0033.

Mesthrige, J.W. & Wan, S.M. (2013). Effect of Green Labelling on Residential Property Price: A Case Study in Hong Kong. Journal of Facilities Management, 11(1), 31-51. https://dx.doi.org/10.1108/14725961311301457.

Micelli, E., Giliberto, G., Righetto, E. & Tafuri, G. (2024). Urban Disparities in Energy Performance Premium Prices: Towards an Unjust Transition? Land, 13(2), 224-250. https://dx.doi.org/10.3390/land13020224.

Murphy, L. (2014). The Influence of the Energy Performance Certificate: The Dutch Case. Energy Policy, 67, 664-672. https://doi.org/10.1016/j.enpol.2013.11.054.

Olaussen, J. O., Oust, A., Solstad, J.T. & Kristiansen, L. (2019). Energy Performance Certificates-The Role of the Energy Price. Energies, 12(18), 3563-3582. https://dx.doi.org/10.3390/en12183563.

Ou, Y., Bailey, N., McArthur, D.P. & Zhao, Q. (2025). The Price Premium of Residential Energy Performance Certificates: A Scoping Review of the European Literature. Energy and Buildings, 332, 37-53. https://dx.doi.org/10.1016/j.enbuild.2025.115377.

Taltavull De La Paz, P., Perez-Sanchez, V., Mora-Garcia, R.T. & Perez-Sanchez, J.C. (2019). Green Premium Evidence from Climatic Areas: A Case in Southern Europe, Alicante (Spain). Sustainability, 11(3), 686-703. https://dx.doi.org/10.3390/su11030686.

Taruttis, L. & Weber, C. (2022). Estimating the Impact of Energy Efficiency on Housing Prices in Germany: Does Regional Disparity Matter? Energy Economics, 105, 50-57. https://dx.doi.org/10.1016/j.eneco.2021.105750.

Turley, M. & Sayce, S. (2015). Energy Performance Certificates in the Context of Sustainability and the Impact on Valuations. Journal of Property Investment & Finance, 33(5), 446-455. https://dx.doi.org/10.1108/JPIF-05-2015-0035.

Walls, M., Gerarden, T., Palmer, K. & Bak, X.F. (2017). Is Energy Efficiency Capitalized into Home Prices? Evidence from Three U.S. Cities. Journal of Environmental Economics and Management, 82, 104-124. https://dx.doi.org/10.1016/j.jeem.2016.11.006.

Warren-Myers, G., Judge, M. & Paladino, A. (2018). Sustainability Ratings in Residential Development: A Worthwhile Endeavour? International Journal of Building Pathology and Adaptation, 36(4), 353-372. https://dx.doi.org/10.1108/IJBPA-02-2018-0024.

Wilhelmsson, M. (2019). Energy Performance Certificates and its Capitalization in Housing Values in Sweden. Sustainability, 11(21), 6101-6122. https://dx.doi.org/10.3390/su11216101.