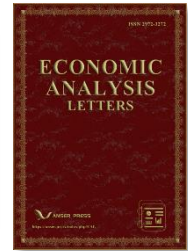




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## The effects of Energy Performance Certificates in energy poverty: A brief overview

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### ABSTRACT

Energy Performance Certificates are a key tool for achieving energy efficiency in the building sector. The existence of this type of legislation provides incentives for the energy renovation of buildings, increases energy-efficiency investments, and improves social welfare. At the same time, informational asymmetries are mitigated and energy consumption is reduced. However, the decarbonization of the building sector might influence regional energy poverty, especially because the rural energy poor are more vulnerable to energy price increases than their urban counterparts. Empirical research on rural-urban differences and the effects of Energy Performance Certificates is urgently needed, given the rising fuel prices and vulnerabilities of the energy market.

### KEYWORDS

Energy poverty; Energy performance certificates; Municipal vulnerability

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## 1. Introduction

Increasing energy efficiency is perceived as an essential step to dealing with the negative externalities associated with the energy sector and reducing greenhouse gas emissions. For this reason, ambitious energy efficiency targets are a priority for many countries (Fleckinger et al., 2019). The building sector is one of the largest consumers of total energy. In fact, buildings and buildings construction are responsible for more than 30% of total global final energy consumption and around 15% of global carbon dioxide (CO<sub>2</sub>) emissions. For European Union (EU), the values are even higher, with buildings being responsible for 40% of energy consumption and 36% of CO<sub>2</sub> emissions. Consequently, EU policy seeks to decarbonize the sector and foster the transition to a low-energy stock, since decreasing energy demand and improving the energy efficiency of the building sector leads to lower emissions in a cost-effective way (Camboni et al., 2021; IEA, 2021; Marmolejo-Duarte & Chen, 2022).

The EU's policy of renewing the building stock and creating the required conditions to scale up renovations and bring in the significant saving potential of the building sector is part of the European Green Deal. Moreover, EU policies such as the Clean Energy Package and the Energy Building Performance Directive promote measures to deal with energy poverty<sup>1</sup>. Reducing the risk of energy poverty by increasing the energy efficiency of the residential stock is crucial because it improves the living conditions of households and reduces emissions at the same time (Camboni et al., 2021; Fabbri & Gaspari, 2021; Gallego Sánchez-Torija et al., 2021).

Indeed, and as noted by Gallego Sánchez-Torija et al. (2021), a more energy-efficient building sector reduces energy dependence and increases purchasing power by lowering energy bills. Buildings, particularly the residential sector, are often deemed a cause or concurrent cause of falling into energy poverty. Energy bills depend on the energy cost within the energy market, the service systems, and on the building characteristics (e.g., shape, insulation, or construction period). The less income an individual has available the less she/he can cover the costs of energy and the more probably the decision to switch off the system to save money, which in turn increases the risk of living in uncomfortable and unhealthy conditions (Fabbri & Gaspari, 2021; Fleckinger et al., 2019; Roberts et al., 2015).

Energy performance certificates (EPCs), part of the Energy Building Performance Directive, are considered a key instrument for achieving energy efficiency in buildings, decreasing energy consumption, and providing more transparency on energy use in buildings. The energy certificate provides information about the dwellings' energy consumed (kWh/m<sup>2</sup>) and CO<sub>2</sub> emissions. This information is transmitted by means of a scale of letters that ranges from A, most efficient, to F, least efficient, and by a set of practical improvement recommendations (Gallego Sánchez-Torija et al., 2021). Its publication is compulsory in all advertisements for the sale or rental of buildings.

The aim of this type of legislation is to provide incentives for the energy renovation of buildings, increase energy-efficiency investments, and improve social welfare, by influencing the building market and informing actors in this sector about the energy performance of buildings. By providing potential buyers or tenants with information on a property's energy performance informational asymmetries are mitigated (Fleckinger et al., 2019; Gallego Sánchez-Torija et al., 2021; Pasichnyi et al., 2019).

This article presents a brief overview of the literature assessing the effects of EPCs on energy poverty and presents pathways for future research. It is organized as follows. Section 2 presents the literature connecting energy efficiency, EPCs, and energy poverty. Section 3 provides policy implications and concludes.

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<sup>1</sup> Note that the terms *energy poverty*, *fuel poverty*, *energy deprivation*, *energy vulnerability*, and *energy precariousness* are often used interchangeably in the literature (Aristondo & Onaindia, 2018; Besagni & Borgarello, 2019; Camboni et al., 2021; Fabbri & Gaspari, 2021; Simoes et al., 2016). Accordingly, in our analysis, we use the term *energy poverty* following the definition provided by the European Observatory on Energy Poverty that "energy poverty occurs when a household suffers from a lack of adequate energy services in the home" (available at <https://www.energypoverty.eu/>).

## 2. Energy performance of buildings and Energy Poverty

The most significant energy user within the EU is the built environment, including homes, workplaces, schools, hospitals, and other public buildings. 85% of buildings in the EU were constructed before 2001, and the majority are not energy efficient. As a result, the EU's building stock accounts for a significant share of overall energy usage and up to 36% of CO<sub>2</sub> emissions. Thus, carrying out thermal modernization activities aimed at reducing energy consumption is one of the EU's priorities (Cichowicz & Jerominko, 2023).

The objective of the EU's Energy Performance of Buildings Directive, enacted in 2008, was to promote energy efficiency among owners and users. The EU is currently updating this directive with a key focus on increasing renovation rates and cutting energy consumption and greenhouse gas emissions. Some of these revisions include rules for zero-emission buildings, with all buildings operated by public authorities expected to be zero-emission from 2026 onwards and all other new buildings expected to be zero-emission from 2028 onwards. As for photovoltaic setups, solar technology installation will be mandatory in new buildings after 2028, and in significantly renovated ones after 2032. Additionally, from 2035 onwards, fossil fuel-based heating systems will be prohibited in new and renovated buildings. Following these initiatives will enable EU Member States to achieve the ambitious environmental targets contained in the FIT for 55 package<sup>2</sup>.

Given the relationship between the residential stock and the living conditions of its inhabitants, it is essential to assess the connection between the energy performance of buildings and key defining features of energy poverty, such as location, housing quality, and income, in order to properly design interventions within the urban fabric (Fabbri & Gaspari, 2021; Simoes et al., 2016).

Recent literature on energy poverty has assessed municipal vulnerability, some using information from EPCs. For instance, Sanchez-Guevara et al. (2019) assess summer energy poverty and overheating risk in London and Madrid. Yoon et al. (2019) explore the water-energy nexus in low-income households in the Metropolitan Area of Barcelona. Sánchez-Guevara et al. (2020) evaluate and quantify energy poverty in Madrid, at both city and district levels. Kelly et al. (2020) use information on EPCs to evaluate home-heating energy poverty risk in Ireland at small area levels. Fabbri & Gaspari (2021) map energy poverty in the municipality of Bologna using EPCs' information. Camboni et al. (2021) investigate the risk of energy poverty in small areas in the Italian province of Treviso, linking EPCs information with the socio-economic features of the families that most likely inhabit those buildings.

There is some evidence that the incidence of energy poverty in the EU varies across rural and urban dimensions (see, for instance, Cichowicz & Jerominko, 2023; Roberts et al., 2015; Thomson & Snell, 2013; Walker et al., 2013). In addition, Roberts et al., (2015) show that although there is a higher probability of energy poverty persistence in urban areas, the rural energy poor are more vulnerable to energy price increases relative to their urban counterparts. Therefore, more research focusing on rural-urban differences is urgent, especially in the current context of the energy crisis and rising fuel prices.

Table 1 presents a compilation of articles centered around the effects of the energy performance of buildings. It is worth noting that the prevalence of studies post-2019 is justifiable, considering the enactment of the EU Energy Building Performance Directive in 2018. Additionally, it is interesting to observe how the geographic focus of these studies has shifted over time, transitioning from broader supranational and national scales to more localized city and municipality scales. This evolution underscores the need for policy frameworks that account for differences at the municipal level, particularly acknowledging the diverse impacts such initiatives can exert on rural and urban regions. Furthermore, articles focused on Asian countries or regions, as well as studies on methods to award EPCs' are beginning to emerge.

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<sup>2</sup> <https://www.europarl.europa.eu/news/en/press-room/20230206IPR72112/energy-performance-of-buildings-climate-neutrality-by-2050>

**Table 1.** List of the analyzed papers focused on energy efficiency certification ordered by year of publication.

Year	Authors	Journal	Geographical Scope
2012	Bull <i>et al.</i>	Energy and Buildings	Europe
2013	Walker <i>et al.</i>	Energy Policy	Northern Ireland
2013	Thomson & Snell	Energy Policy	European Union
2015	Roberts <i>et al.</i>	Energy Policy	United Kingdom
2016	Simoes <i>et al.</i>	Energy Procedia	Portugal
2018	Aristondo & Onaindia	Energy	Spain
2019	Fleckinger <i>et al.</i>	Energy Economics	European Union
2019	Pasichnyi <i>et al.</i>	Energy Policy	Sweden
2019	Besagni & Borgarello	Energy Research and Social Science	Italy
2019	Sanchez-Guevara <i>et al.</i>	Energy and Buildings	Madrid & London
2019	Yoon <i>et al.</i>	Energy and Buildings	Barcelona
2020	Vaquero	Energy Reports	Portugal
2020	Sanchez-Guevara <i>et al.</i>	Energy Policy	Madrid
2020	Kelly <i>et al.</i>	Energy Policy	Ireland
2021	Fabbri and Gaspari	Energy and Buildings	Bologna
2021	Camboni <i>et al.</i>	Energy Policy	Italian
2021	Sánchez-Torija <i>et al.</i>	Energy Research and Social Science	Spain
2022	Ji <i>et al.</i>	Energy and Buildings	South Korea
2023	Cichowicz & Jerominko	Energy	Poland

### 3. Conclusions

The building sector is a significant global consumer of energy. Consequently, enhancing energy efficiency is seen as a crucial step in curbing greenhouse gas emissions and addressing the adverse effects of fossil fuel energy usage. Accordingly, the EU's strategy to revitalize the building stock and establish the necessary foundations for expanding renovations and unlocking substantial savings within the building industry aligns with the goals of the European Green Deal. Actions to address energy poverty are also being advocated with initiatives like the Clean Energy Package and the Energy Building Performance Directive. The objective is clear, diminish the likelihood of energy poverty by supporting and augmenting the energy efficiency of residential properties. Implementing such measures will simultaneously enhance household living conditions and reduce emissions.

Additionally, political sensitivity towards the adverse welfare impacts of energy poverty is growing. Understanding how the decarbonization of the building sector might influence regional energy poverty is urgent due to its welfare implications and given the difference in policy measures depending on how energy poverty varies in different regions. As noted by Walker *et al.* (2013), area-based methodologies allow for targeting energy poverty policies more accurately and equitably. Indeed, in recent years, research on this topic has evolved from broader supranational and national scales to more localized city and municipality scales.

One-size-fits-all policies are not a good approach when tackling environmental and poverty issues. The same policy mechanisms may have different effects in rural and urban areas and extra attention needs to be paid to rural areas in periods of hiking energy inflation since rural households are the most vulnerable in such periods. Accordingly, monitoring the dynamics of energy poverty is important for ensuring that policy targets are effective and reach those most in need (Roberts *et al.*, 2015).

Finally, additional research concerning the impacts of EPCs at the municipal level and in different countries is also needed. Supporting the efficiency of the building stock will lead to reduced energy consumption and greater transparency in energy usage within buildings, representing a mutually beneficial solution for reducing poverty and emissions.

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## Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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