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RECEIVED 07 May 2023

ACCEPTED 14 June 2023

PUBLISHED 19 September 2023

CITATION

Belaid F, Sanin M-E and Lazaric N (2023),
Editorial: Energy efficiency and residential
energy consumption: current challenges,
policies, and emerging trends.
Front. Energy Res. 11:1218527.
doi: 10.3389/fenrg.2023.1218527

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Editorial: Energy efficiency and residential energy consumption: current challenges, policies, and emerging trends

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KEYWORDS

energy efficiency, residential energy consumption, energy policy, building renovation, energy modeling, energy poverty

Editorial on the Research Topic

Energy efficiency and residential energy consumption: current challenges, policies, and emerging trends

Buildings are large consumers of energy worldwide. According to the International Energy Agency, buildings account for approximately 28% of global energy use and 32% of energy-related greenhouse gas emissions. More specifically, the residential sector accounts for a significant share of the overall energy demand for buildings, ranging from 50% to 70% depending on the country (Krarti et al., 2020; Krarti et al., 2020; Belaïd et al., 2020; Belaïd et al., 2022; Belaïd and Massié, 2022). This makes the building sector, particularly the residential sector, crucial for reducing GHG emissions and achieving a low-carbon future (Economidou et al., 2020; Belaïd et al., 2021). Furthermore, the energy consumption of buildings is a complex phenomenon that is influenced by multiple interrelated factors, including building characteristics, household characteristics and behaviors, and other contextual factors such as climate conditions (Kendel et al., 2017; Belaïd and Joumni, 2020; Fanghella and Della Valle, 2021; Lazaric and Toumi, 2022).

By increasing the energy efficiency of buildings, we can make a significant impact in several areas. First and foremost, it can help reduce greenhouse gas emissions and mitigate the worst impacts of climate change. This is crucial for ensuring a sustainable future for generations to come. Additionally, improving the energy efficiency of buildings can have significant economic benefits by reducing energy bills. Thus, improving the energy efficiency of buildings can help alleviate financial strain and create more equitable communities, particularly for low-income households who may be more vulnerable to high energy costs. Energy-efficient buildings can also have positive impacts on occupant health and well-being. By improving indoor air quality, reducing noise levels, and ensuring comfortable temperatures, we can create healthier and more productive living and working environments. Furthermore, increasing the energy efficiency of buildings can create new job opportunities in industries such as construction, engineering, and energy management and help build more resilient and secure communities.

This Research Topic's purpose is to put together high-quality research on energy efficiency and residential energy consumption as well as provide insights into factors

that affect energy efficiency adoption and highlight effective policy strategies to overcome the energy efficiency paradox (Aldubyan and Krarti, 2022; Bakaloglou and Belaïd, 2022; Belaïd, 2023).

In this Research Topic, the main barriers to adopting new, more efficient technologies inside the household are meticulously assessed, considering economic, behavioral, and psychological aspects. Economic research usually considers consumer preferences, budget constraint problems, and rational behavior. But recent research developments in this area have shown that behavioral aspects matter considerably when households decide to invest in new, more efficient appliances. The most neglected determinant is, without any doubt, the psychological one, which is thoroughly reviewed herein. In particular, while the perspectives taken by economics and behavioral science enable to capture the individual dimension of energy efficiency as a problem of personal choice, the collective and social aspect of energy efficiency is the missing link in the energy efficiency policy. Such a complete assessment allows us to understand the critical barriers regarding energy efficiency policy effectiveness. It further makes a case for interdisciplinary reviews to design energy policy better to address energy efficiency and poverty simultaneously.

Energy efficiency is regarded as the low-hanging fruit solution to two different problems. Firstly, it fosters emissions reductions due to sober energy consumption. In the particular case of electricity, this is true during peak consumption, when fossil fuels are used for electricity generation. Secondly, sober consumption increases energy affordability for households, reducing household expenditure on energy which, in turn, decreases the number of families concerned with energy poverty (Della Valle, 2019; Belaïd, 2022a; Belaïd, 2022b; Belaïd and Flambard, 2023). In this Research Topic, we look into these considerations in detail, which have been largely neglected, mainly due to a lack of clear operative definitions. In this Research Topic, we learn about the link between energy poverty, poor housing quality, and housing size in several locations in Spain (Taltavull de La Paz). Identifying this link allows us to classify households according to these categories, showing that many energy-poor households are not poor in the traditional definition, which suggests specific policies must be implemented to tackle the energy poverty dimension. Moreover, it clearly states how house quality and building retrofitting are important ways to achieve meaningful results in increasing energy efficiency.

The findings regarding the previous contributions show that, even if energy efficiency among households is an important objective, many barriers stand in the way of a rational minimization of energy expenditures (Della Valle and Bertoldi). This is not the case for firms. They are rational profit-maximizing entities, and therefore, as long as energy efficiency comes with significant cost reductions (also regarding the avoidance of CO₂-related costs), we should observe an increasing flow of investments in energy efficiency.

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Contributions in this Research Topic show that increasing investments in energy efficiency is consistent with the mitigation of carbon emissions. This is studied in different regions of Northern China (Wang et al.). The main findings suggest that in some regions like Liaoning, the flow of investments in energy efficiency is a major driving force in reducing carbon emissions, but less so in some other regions like Inner Mongolia, where emissions are dominated by their coal-based energy consumption industry.

Finally, technical barriers to more efficient energy usage cannot be neglected. An important aspect regarding this is grid efficiency and the fact that to achieve energy sobriety, we need to implement efficient technologies that minimize investment efforts. Part of this depends on the application of the proper technological standards. In this Research Topic, we host a contribution tackling this aspect of energy efficiency for the integration of electric vehicles into the electricity grid. The contribution models the optimal amount of EV converters needed to optimize efficiency in the electricity grid (Saravanakumar).

All in all, this Research Topic reviews the challenges, strategies, and lessons learned in recent years regarding the role played by energy efficiency implementation in addressing critical energy and environmental issues. To this end, it provides an overview of the many facets of the energy transition, including domestic energy consumption, existing building renovation dynamics, behavioral change, fuel poverty, and energy efficiency deployment both in households and in the industrial sector.

Author contributions

FB, M-ES, and NL wrote the first draft of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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