Linking Housing Conditions and Energy Poverty

Subjects: Others

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Affordable and warm housing is a basic household living need, which is closely related to human health and well-being. Households are more likely to be exposed to energy poverty if they live in larger, older, poorly insulated houses, without basic energy service equipment, and in rental housing. The area of residence and energy installations are the main characteristics that distinguish energy poverty from non-energy poverty. The link between housing conditions and energy poverty is reinforced by the psychology and behavior of households, with those living in poor conditions tending to restrain their energy consumption, thus worsening their energy poverty situation.

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1. Introduction

Energy is a basic human need that is closely linked to human health and well-being. The United Nations Sustainable Development Goals (SDGs) incorporate energy targets, proposing the goal of ensuring access to affordable, reliable, sustainable and modern energy for all [1]. However, for a variety of reasons, many households are facing energy poverty through under-use and over-burdened energy. As reported, about 759 million people worldwide lack access to electricity in 2019. By the end of 2020, more than 25 million people in developing countries in Asia and Africa could lose the ability to afford a basic package of electricity services [2]. Additionally, the European Commission reports that more than 34 million people in the EU experience energy poverty to various degrees [3]. Addressing energy poverty is a global public policy challenge due to the complexity, diversity and invisibility of its manifestations, and the damage it can do to human well-being and physical and mental health.

The earliest research on energy poverty dates back to the 1980s, when Bradshaw and Hutton (1983) described it as the inability to obtain adequate warmth in the home and proposed three policies to alleviate energy poverty by increasing income to cover energy costs [4]. Subsequently, Boardman (1991) described energy-poor households from the perspective of energy expenditure as ‘disproportionate expenditure’, with households identified as energy-poor if they spent more than 10% of their income on access to energy services [5]. Since then, more research has been carried out on the definition [6][7][8], influencing factors [9][10] and consequences [11][12] of energy poverty.

As housing and energy are closely linked, the housing factor becomes an important perspective in examining energy poverty. Decent, warm, comfortable homes require basic energy services, including space heating and cooling, lighting, water heating, cooking and electricity [13]. On the one hand, the necessary energy needs of a household are highly correlated with the housing characteristics, such as the energy efficiency [14][15][16], building

envelope [17][18] and thermal insulation [19][20]. In general, inefficient energy systems [21] and insulation can increase the energy costs of a household to some extent. When households cannot afford high energy costs, they choose to reduce their energy consumption. When household energy consumption falls below the amount of energy required to maintain basic decent living conditions, energy poverty occurs. On the other hand, when housing costs account for a high share of household income, this affects the ability of households to pay their energy bills and households are forced to reduce their energy expenditure, resulting in a situation of the under-consumption of energy [22]. Furthermore, conversely, unfavorable housing conditions and poor housing quality are often associated with energy poverty, for example, energy-poor households may often experience damp houses and mold on the walls and floors [23].

In China, as urbanization continues, more and more residents are beginning to cluster in cities and some low-income households are facing housing affordability and energy affordability challenges. In urban areas, some older neighborhoods have poor energy infrastructure (e.g., electricity, gas and heating) and also suffer from inefficient buildings, increasing the risk of household energy poverty. In rural areas, a large number of houses are detached and poorly insulated, making it difficult for some households to maintain comfortable thermal conditions in their homes. At the same time, due to low income and poor basic energy facilities, some households have difficulty accessing modern energy services and rely heavily on inefficient traditional energy sources. Since housing and energy issues are related to the standard of living, health and well-being of occupants, both housing and energy poverty are pressing livelihood issues to be addressed.

2. Link between Housing Conditions and Energy Poverty

Initial research on energy poverty focused on the definition and measurement of energy poverty [5][6][7][8] and this has been extensively researched and debated [24][25][26]. Subsequent studies have broadened the scope of energy poverty research and started to focus on the drivers [9][10] and the consequences [11][12][27][28][29] of energy poverty. Due to the strong link between housing and energy, a number of studies have discussed the relationship between housing stock characteristics and energy poverty.

The energy efficiency of housing is considered as an important influence on energy poverty. Hills [6] identifies fuel prices, low income and energy efficiency as the three main drivers of energy poverty. The energy performance of a building affects a household's energy demand and is a contributor to energy poverty [30]. In general, households whose dwellings are less energy efficient are at greater risk of exposure to energy poverty and are likely to face more severe energy poverty [14][15][16][31][32]. A study carried out in the UK suggests that wealthier middle-income households may fall into energy poverty as a result of living in relatively inefficient homes [33]. Housing energy efficiency is highly correlated with indoor thermal conditions, with low-energy performance dwellings generally having lower indoor temperatures [20][34]. A study of energy poverty in low-income households showed that residential energy efficiency can cause large differences in heating costs and increase the energy burden of inefficient households [35].

Housing insulation is an important component of residential energy efficiency. There is a significant relationship between housing insulation and energy poverty [17][18]. The installation of double glazing and insulated roofs indicate a more insulated home. Studies have shown that improving housing insulation is effective in improving the indoor environment of homes, reducing condensation, mold and dampness problems [36], as well as improving the thermal comfort of homes [19][20].

Another condition associated with residential energy efficiency is the age of the dwelling. Older homes are often associated with conditions such as poor insulation and outdated energy systems [10], which together lead to energy poverty in households. Older dwellings tend to have higher heat loss [20] and poorer thermal regulation [9]. Households may be at higher energy risk if they live in older homes [9][18][23][30][37][38]. Furthermore, in terms of energy costs, households may pay higher energy bills for normal energy use because of their older homes [33], resulting in high energy costs as a proportion of income.

In addition to the energy efficiency attributes of housing, the other physical attributes (size and type) of housing may also be correlated with energy poverty. The link between house size and energy poverty may be based on energy bills [39][40], with larger homes being colder than smaller ones [20] and households being burdened with heavier energy costs in order to keep rooms warm, increasing the risk of household energy vulnerability exposure [10][33]. However, some studies have also reported the opposite result, with households living in small spaces being more vulnerable to energy instability [21][41], while households with larger homes are less vulnerable to energy poverty [42]. In addition, some studies have discussed the characteristics of house types of energy-poor households, and it is found that households living in detached, semi-detached dwellings are more likely to be exposed to energy poverty [37][43][44], which may be associated with higher levels of heat loss [45]. Additionally, the area of residence may also influence energy poverty [46][47].

Energy-poor households can also be affected by the energy system and energy installations in their homes. The installation of a heating system in a home can be effective in improving the indoor environment, enhancing the comfort of the home and alleviating energy poverty [18][36]. Efficient heating systems can reduce household energy costs and reduce the risk of energy poverty in households [18][21][48]. In addition, the household's energy equipment and type of energy source are also important factors influencing energy poverty [9][33].

In terms of the economic attributes of housing, housing tenure is regarded as a driver of energy poverty [10][47]. It has been shown that energy-poor households are predominantly renters [9][41], and living in rented housing increases the risk of energy poverty compared to owner-occupied dwellings [21][37][48][49]. One possible explanation is that rented housing suffers from low energy inefficiency. There are insufficient incentives for landlords to retrofit their homes for energy efficiency, while tenants have limited rights and insufficient incentives [50] to implement effective energy efficiency improvements and retrofitting measures in their homes. Rental housing therefore has more serious energy efficiency problems [51]. On the other hand, renting is a manifestation of lower household income [52] and, in order to limit expenditure, choosing low-cost housing is a necessity, which may result in more energy consumption due to the poor thermal performance of the housing [53]. Low income and high energy consumption therefore make renting households more vulnerable to energy poverty. Furthermore, from an income

distribution perspective, when housing costs account for a large proportion of household income, households are constrained in the amount of money they can spend on energy consumption and therefore fall into energy instability [42].

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