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Review



A systematic review of the lived experiences of the energy vulnerable: Where are the research gaps?

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ABSTRACT

The transition to a low-carbon world, coupled with energy supply uncertainties, has heightened the urgency to better understand the experiences of vulnerable groups who lack affordable and adequate energy. Access to energy is crucial for their health, well-being, and social stability. However, there are significant knowledge gaps relating to the lived experiences of energy vulnerable groups that this paper directly addresses. There is a wide body of literature focusing on the quantification of, and policy response to, energy poverty alongside a fast-growing area of research on the lived experience of the energy vulnerable. This paper's systematic review of research on the lived experiences of the energy vulnerable reveals 46 peer-reviewed articles published between 2011 and 2021. Its review highlights diverse approaches to exploring energy vulnerability, the range of vulnerable groups investigated and different motivations for focusing on lived experiences. The results point to a number of key gaps in the literature in terms of definitions and terminologies, geographic coverage, gender, life stage (specifically children), ethnicity (ethnic minorities absent) and ability (people with disabilities are a further gap). It concludes that there is a need for more context-specific, mixed-methods and longitudinal studies in this area. Having identified gaps in the literature, it recommends how some of these can be addressed and reflects on how studies focused on the lived experience of energy poverty should advance.

1. Introduction

Access to energy is essential for maintaining good health and social well-being. However, vulnerable groups face unaffordable and insufficient energy to meet their daily needs, negatively impacting their well-being. With instability in energy supply and the need to achieve the United Nations Sustainable Development Goal 7 (UN SDG7) of ensuring universal energy access by 2030, there is a growing need to understand how people at risk of energy vulnerability experience and cope with energy poverty [1–3].

This paper examines research on the lived experiences of energy vulnerable populations, focusing on analysing existing studies. In it, we focus on exploring definitions and terminologies, the theoretical approaches and methods used, the groups examined and the geographical coverage where such research has taken place. We also examine the benefits of undertaking this kind of research. Secondly, this paper aims to advance the literature on energy vulnerability by highlighting existing research gaps and recommending how these can be addressed. This goal aims to inform further research efforts that can provide more robust evidence for shaping policy responses. To help us do this, we introduce our definition of energy vulnerability.

The paper is organised as follows. It starts with an exploration of the concepts of energy poverty and energy vulnerability, arguing for a focus on the different factors that make people vulnerable to energy poverty. The systematic literature review method used is presented in Section three. It is followed by a section that sets out the findings and addresses the paper's research questions. The discussion section scrutinises the implications of the findings and discusses the second aim of the paper.

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2. Energy poverty and energy vulnerability

Energy poverty, also known as fuel poverty, describes the inability of households to afford sufficient heating and energy for needs such as cooking, heating, and lighting. Energy poverty is a complex, multifaceted problem [4]. The three leading causes of energy poverty are low incomes, high energy prices and energy-inefficient buildings [5]. Other factors which compound its multifaceted nature include contextual factors such as geographical location, climate, dwelling type, available heating/cooling equipment, geopolitical factors affecting energy prices and personal factors, which include age, health status or household composition and other socio-economic elements [4]. Multiple definitions of energy poverty exist, and there is no one internationally recognised definition (we provide more information on definitions in Section 4.1.).

While energy poverty is a global issue, research on the subject is much more advanced in the Global North, such as the United Kingdom, Europe, Australia and, more recently, the United States and Canada [6,7]. In Europe, there have been a string of projects on energy poverty through the efforts of the Energy Poverty Advisory Hub (EPAH) in streamlining initiatives to end energy poverty in the region [8]. With the rise in global temperatures leading to hot summers, summer cooling is increasingly becoming a concern in cool temperate zones of the Global North, including much of Europe [9]. In other places, particularly in countries in the Global South, energy poverty is seen in the lack of access to electricity and advanced energy infrastructure [10,11].

Recent research on energy poverty has highlighted the importance of adopting the concept of energy vulnerability in conceptualizing its complexity [12]. Middlemiss & Gillard [12] outline six factors that shape energy vulnerability, including household income, energy efficiency of housing, energy prices and supply constraints, tenancy situation, and social relations, which can be instrumental in considering measures aimed at tackling energy poverty. Bouzarovski and Petrova describe energy poverty as static and energy vulnerability as dynamic, discussing the broader systemic causes of lack of access to energy as they change over time and space [13].

In this paper, energy vulnerability is the preferred term when exploring the lived experiences of energy poverty because it encompasses this dynamic and wider systemic approach. Energy vulnerability, a complex concept, refers to the exposure of households or communities to energy insecurity and energy poverty. People experiencing vulnerability to energy poverty often encounter challenges in affording or accessing the necessary energy resources that enable them to live a dignified life and meet their human capabilities [12,14]. The perception of what is understood to be necessary for a dignified life and for meeting human capabilities is culturally influenced and may vary based on geographical location, socio-demographic and political factors. For example, in Ireland, the Minimum Essential Standard of Living (MESL) [15] is a nationally recognised standard that *"allows an individual or household to live with dignity, meeting their physical, psychological and social needs at a minimum but acceptable level."* Based on focus groups and consensual budget standards methodology, the MESL data serves as the foundation for calculating the Irish Living Wage and serves as the primary source of data for determining the Reasonable Living Expenses by the Irish Insolvency Service of Ireland [16,17]. Amidst rising average incomes, there is a pressing need for more ambitious policy measures aimed at ensuring that the wealth generated translates into a reduction in energy poverty in the face of climate change impacts. Similar conditions apply in many other jurisdictions.

Thus, this paper defines energy vulnerability as "*the challenges that individuals and households encounter in accessing the energy needed for a dignified life and for meeting their human capabilities within their communities.*"

Energy vulnerabilities can exacerbate existing inequalities and disproportionately affect certain groups, such as women, children, and marginalised communities. Marginalised communities include those excluded from various aspects of socio-economic, educational, or cultural life. This includes, but is not limited to, groups excluded due to race, gender, age, sexual orientation, physical ability, language, and immigration status [18]. Similarly, vulnerability is not limited to specific groups like low-income households, the elderly, or people with disabilities. It can be because of other factors such as social circumstances, availability of infrastructure and political climate [4,19].

An energy vulnerability approach is helpful in broadening the scope of poverty to focus not only on the human and social angle but also on the structural factors that account for the different manifestations of limited access to energy at the domestic level [13]. Given the lack of a universally accepted definition of energy poverty, a vulnerability perspective becomes essential in providing a comprehensive understanding of the factors leading to energy poverty at the household level, within the household and across different regions. This allows a broadening of the scope and considers not just the immediate impacts but also the underlying systemic issues. This approach proves valuable for addressing the complexities associated with energy vulnerability, particularly in the current context of political pledges to decarbonise energy systems to achieve climate targets and global goals [20]. By incorporating a vulnerability perspective, we can further explore how people who already struggle to afford energy services can become entangled in circumstances that amplify their vulnerabilities, further increasing energy injustices. Energy poverty has been argued to be connected to the concept of justice: distributive justice, procedural justice and the justice of recognition [21]. These additional dimensions may not be fully captured by the conventional concept of energy poverty, which predominantly focuses on the proportion of household income spent on energy expenses, low household incomes, and inefficient building structures as its primary causal factors. We recognise that these definitions may not be meaningful to households, and they may not want to be referred to by this term; instead, they are concerned with how they will satisfy their energy needs and other demands.

The concept of energy vulnerability is significant when considering policy, mainly due to the increasing necessity of safeguarding vulnerable consumers in energy markets. In the Global North and Global South, countries are making strides in this area, but much more needs to be done. Europe, for example, has a long history of policy initiatives to tackle issues of energy poverty and energy vulnerability [22–28], although in policy discourse, the term energy vulnerability is rarely used, with the preferred term being energy poverty. In the Global South, policy measures to address energy poverty often tie into access to energy, aligning with UN SDG7 [29].

The idea of lived experience is frequently employed to obtain insights and perspectives on social phenomena and is useful in the concept of energy vulnerability. Research on lived experience involves exploring how people view and interpret their social world. Studies have utilised this approach in various contexts, such as examining the experiences of households concerning the implementation of education policies [30], exploring the complexities of climate change [31], investigating transport systems [32], analysing social policy [33], examining divergent viewpoints on energy poverty [34] and assessing the efficacy of equitable and effective energy policy [35].

The current body of research on energy poverty primarily centres on its quantification and objectivity, with fast growing research in the area of its lived experience. The complexity of the lived experience of energy poverty cannot be adequately captured by quantitative research designs alone. Research on the lived experience of energy poverty, pioneered by Lucie Middlemiss and Ross Gillard [12] in their investigation into the lived experience of the energy vulnerable in the UK, is a relatively novel concept that is slowly gaining traction in the energy poverty literature. Since then, others have started gradually conducting this type of research as it delves deeper into the experiences and everyday practices of those unable to meet their energy needs. As will be seen in Section 4.2., variations to the term 'lived experience' including lived experience [12,23,36–38], lived experiences [39], experiences [40–42], practices

[43–45], behaviour patterns [46], coping [22,47–49], coping strategies [24,50–52], and choices [53] have more commonly been used in the literature when it comes to investigating the lived realities of those at risk of being vulnerable to energy poverty. In this paper, we use the terms 'lived experience' and 'lived experiences' interchangeably, aligning with the usage found in the literature.

3. Methodology

3.1. Systematic literature review method

The systematic review is informed by the processes used by Fink [54], McGookin et al. [55] and Siddaway et al. [56]. The steps followed include defining the scope of the study, the systematic literature search, assessing the quality of the papers and synthesising the literature.

3.2. Defining the scope of the study

Defining the scope of the study involved the consideration of several factors, including the formulation of research questions, the timeframe of the study, search terms, and selection criteria. These factors were carefully considered to ensure a comprehensive and thorough review of the relevant literature. In doing so, we put forward the following research questions to address the paper's aims:

- How is energy vulnerability defined, and what terminology describes its lived experiences?
- What methodologies, theories or models underpinned studies on the lived experience of the energy vulnerable?
- What methods are used to report on energy vulnerable experiences?
- How are research participants engaged?
- What groups and locations have been researched?
- What are the benefits of conducting research on the lived experiences of the energy vulnerable?

An initial scoping search was conducted in English from November 2021 to February 2022 to identify and consider other terms used to refer to detailing the lived experience of energy poverty. The scoping search was conducted by analysing articles which focused on capturing the lived experience of the energy vulnerable. It sought to refine the research questions, garner a better understanding of the potential breadth of the systemic review and identify the search terms to be used.

Based on the search, the following keywords were initially explored in the databases Web of Science, Scopus and EBSCO: fuel poverty, energy poverty, energy vulnerability, lived experience, experience, energy decisions, energy practices, fuel practices, fuel decisions, coping, practices and cold homes. The full list of terms and the results of the three databases are presented in Table 1. The final review excluded EBSCO as a database source because of the difficulty of exploring specific terms and the high frequency of duplicate results when the same strings were run on Web of Science and Scopus. We used the Boolean operators 'AND' and 'OR'. Boolean search operators are essential in systematic reviews because they help make the search process more efficient and effective, ensuring that all relevant articles are retrieved and considered.

This study employed a set of selection criteria to identify relevant papers for inclusion in the review. The criteria focused on the methodologies used, the research design, and the studies' findings. Specifically, the scoping review informed the criteria, which identified low-income, high-energy costs, and energy-inefficient buildings as the main causes of vulnerability related to energy. Additional criteria were developed to account for the relevance of the studies to the topic and their publication dates, which were restricted to the period between 2011 and 2021. This time frame was chosen because it marked a turning point in qualitative research on energy vulnerability when the term 'lived experience' was first introduced to this kind of work [12]. Thereafter, there has been an increasing number of studies on the lived experiences of energy vulnerability, as evidenced in this paper. Furthermore, the search was limited to peer-reviewed publications in English due to the authors' proficiency in English and easier access to English language publications. We acknowledge that focusing the study on the English language introduces limitations regarding representation and diversity of perspectives. As such, effort was made to ensure a wide geographical coverage to minimise this limitation. A summary of the inclusion and exclusion criteria is presented in Table 2.

Studies that focused on the extent, drivers, and implications of energy vulnerability without directly engaging with the lived experiences of the energy vulnerable were excluded. The same was also true for studies introducing concepts and theories or examining the efficiency of technology in homes, as they did not address participants' experiences about their thermal comfort. Overall, the rigorous selection criteria ensured that the studies included provided relevant and reliable insights into the lived experience of energy vulnerability.

Table 1
Results from scoping search in Web of Science, Scopus and EBSCO.

Search terms	Web of Science	Scopus	EBSCO	Total
Results for "fuel poverty" AND "practices"	55	52	73	180
Results for "fuel poverty" AND "lived experience"	26	11	3	40
Results for "fuel poverty" AND "experience"	69	54	83	206
Results for "fuel poverty" AND "coping"	20	11	5	36
Results for "energy poverty" AND "lived experience"	20	13	3	36
Results for "energy poverty" AND "experience"	63	86	84	233
Results for energy poverty AND practices	13	100	6	119
Results for energy poverty AND coping	2	14	0	16
Results for "cold homes" AND "coping"	6	4	2	12
Results for "cold homes" AND "practices"	2	12	11	25
Results for "cold homes" AND "experience"	8	9	5	22
Results for "energy poverty"	1301	1420	1014	3735
Results for "fuel poverty"	787	522	674	1983
Results for "energy vulnerability" AND "practices"	14	18	8	40
Results for "energy vulnerability" AND "lived experience"	13	7	0	20
Results for "energy vulnerability" AND "experience"	18	20	4	42
Total	2417	2353	1975	6745

3.3. Systematic literature search

The search strings were run through the databases for 2011–2021. This range was chosen because research on qualitative insights into energy vulnerability grew during this time, and there has been a growing interest in this research ever since [12]. The original search was done on 9 May 2022. Another search was conducted on 23 September 2022 with the search strings "energy vulnerability" AND "experience" and "energy vulnerability" AND "lived experience" and "energy vulnerability" AND "practices" as the term "energy vulnerability" is now commonly being used to refer to energy poverty. This was revealed upon close examination of the comprehensive list of papers obtained from the initial scoping search. Table 3 contains the final search terms used. In addition, a snowballing strategy, including: 'backwards snowballing', literature listed in bibliographies of papers identified through keyword searches; 'forward snowballing', literature that has cited the identified papers; and 'relationship snowballing', articles recommended by

Table 2
A summary of the inclusion and exclusion criteria for the scoping and systematic review.

Inclusion criteria	Exclusion criteria
Studies published from 1 January 2011 to 31 December 2021	Papers that did not directly investigate the lived experience of household energy usage. For instance, there was a study that analysed daily smart meter data to identify factors influencing energy consumption in two distinct groups. However, this particular study did not delve into the qualitative aspects of how households actually use energy.
Studies published in the English language	Editorials, conference papers, white papers, book chapters, review papers
Peer-reviewed original articles	
All household characteristics, including household income, type of dwelling, type of building, location, etc.	
There was active engagement to learn about the lived realities of participants to inform the research. As opposed to just gathering data	
All research designs, whether qualitative, quantitative or mixed methods	
All countries	
All gender[a] and population groups	

[a] In this context, the term "gender" pertains to the roles, behaviours, and identities that are socially constructed for women, men, and those who identify as gender-diverse. These constructs are shaped by historical and cultural influences, and they can differ across societies and evolve over time.

Table 3
Results from systematic search in Scopus and Web of Science.

Search strings	Raw search results from selected databases	Search results for further screening	Number of papers included in the final analysis
"Energy poverty" & "lived experience"	33	0	0
"Energy poverty" & "experience"	157	123	11
Energy poverty & practices	167	124	1
"Cold homes" & "experience"	17	15	1
"Cold homes" & "practices"	14	11	2
"Fuel poverty" & "experience"	123	53	15
"Fuel poverty" & "lived experience"	37	0	0
"Fuel poverty" & "coping"	32	18	5
"Fuel poverty" & "practices"	115	52	5
Snowballing technique			6
Total	695	396	46

bibliographic databases based on relevance scoring was used.

The databases used to carry out the systematic review included Scopus and Web of Science. These were chosen because they contain topics on social issues such as energy vulnerability. For Scopus, the search strings were run in the database's Title, Abs, and Keywords fields to obtain all relevant literature in English, resulting in 365 results. For Web of Science, 334 results were obtained after running the search strings in the TOPIC field, which represents the database's Title, Abs, and Keywords. The returned results using the search terms revealed academic papers from different disciplines and journals. After the search strings were run in the databases, the results were exported to Endnote. Duplicates were deleted using Endnote reference management software's automated duplication function. The results were then exported to Microsoft Excel using the Tab Delimited function for data extraction. In Excel, further sorting was carried out to delete another round of duplicates, as Endnote did not detect some articles in the duplication process, resulting in 299 duplicates removed in total.

The next step was to screen the remaining 396 studies by reading the titles and abstracts using the selection criteria and the research questions. In total, 227 studies were excluded based on blank abstracts, book chapters, conference articles, and other exclusion criteria, such as studies that did not particularly engage with the subject of lived experiences. This resulted in 164 articles that were then read in detail. For ease of accessibility and relevance of articles guided by the review's scope, some articles (5) could not be accessed in full-text, and the authors' institutional library did not have the required full-text versions. The breakdown of the entire review process is provided in the PRISMA[1] flow diagram in Fig. 1.

In Microsoft Excel, tabs were created based on the Critical Appraisal Skills Programme (CASP) [57] checklist for qualitative research. CASP, which began in the 1980s, was initially designed to raise awareness of the need for evidence in practice but has since shifted to emphasise the importance of systematic reviews in evidence-based practice.

The CASP tool is commonly used in the healthcare industry to systematically evaluate the reliability, applicability, methodological quality, and results of published articles. It provides clear questions for critically analysing published articles. Though the tool mainly focused on qualitative research, it was chosen due to the topic, which seeks to analyse information on lived realities, often the evidence base of qualitative work. However, this tool has been criticised for not providing guidance on how to respond to the list of questions on the checklist, which can lead to inconsistency in the assessment process [58].

3.4. Assessing the quality of the papers

Fink [54] argues that a good systematic review is one that carefully considers the methodological quality of the papers included and ensures the accuracy of the analysis. In most systematic reviews, this step is often ignored or, when added, not talked about in detail. This is due to the many limitations that have been identified with the use of study quality tools [54]. There is no standard tool for analysing papers included in a systematic review, nor is it a strict requirement to consider how papers are assessed when conducting such reviews. Thus, we used the CASP checklist for appraising qualitative studies. More information is provided in Section 3.3. The tool did not play a role in whether studies needed to be excluded but aided in analysing the papers and answering the research questions.

4. Researching lived experiences

This review finds 46 peer-reviewed articles published in English between 2011 and 2021 that explore the lived experiences of the energy vulnerable. The results are presented and discussed in this section. First, we discuss how energy/fuel poverty (terms commonly used in the papers reviewed) has been defined and the range of terminology referring to lived experiences used in our review sample. We present the different research designs and methods used to capture perspectives on the lived experiences of energy vulnerability, which groups have been researched and arguments made as to why this kind of research matters. The findings also indicate that research in this field has predominantly focused on the Global North.

[1] The PRISMA (Preferred Reporting Items of Systematic reviews and Meta-Analyses) flow diagram shows how many records were found, included, and excluded during the various stages of a systematic review.

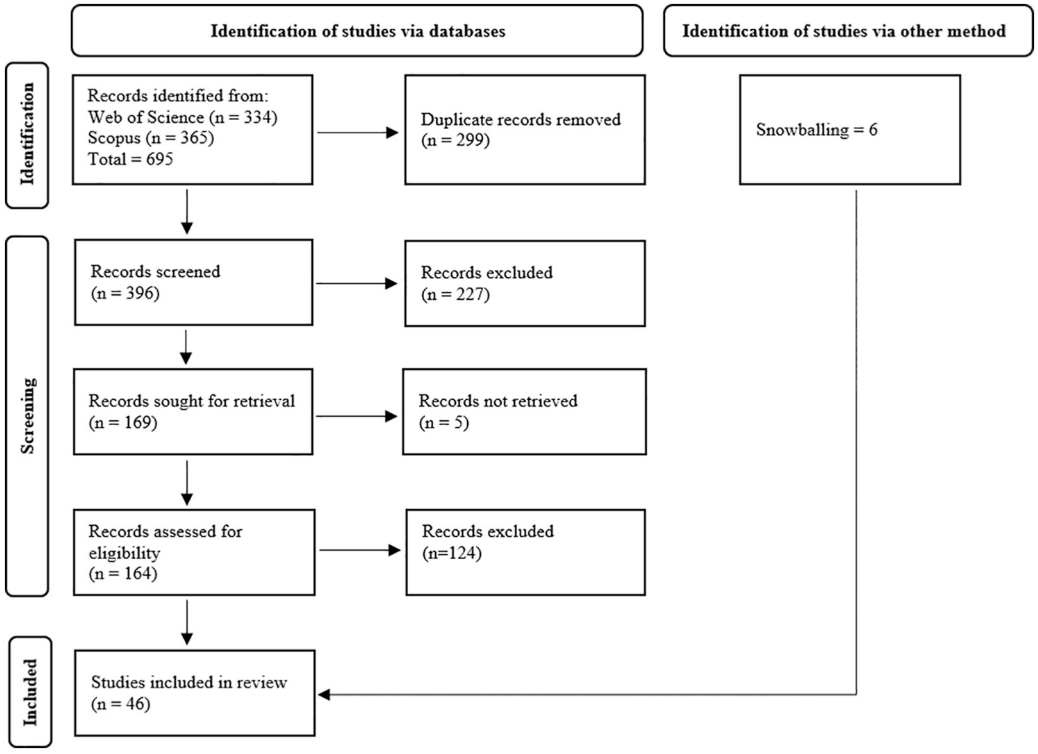


Fig. 1. PRISMA flow diagram for the systematic literature review process.

4.1. *Defining the problem*

There is no standard definition of fuel/energy poverty across the literature reviewed. While the majority of papers do not explicitly present their own definitions of fuel/energy poverty, they acknowledge this lack of consensus. Instead, these papers often rely on regional or country-specific sources to define the problem. However, some refer to the key definitions generally used in the field. Several papers make no mention of definitions at all. While fuel/energy poverty is typically used as synonyms, in some literature, these terms have different meanings.

The definitions of fuel/energy poverty presented in our review sample are primarily from the Global North, notably the UK and Europe. Fuel poverty[2] (as it is known in the UK) is a devolved policy area in the UK, and its definitions differ throughout England, Scotland, Wales and Northern Ireland. In England, the current policy definition indicates that a household is at risk of fuel poverty if they have low energy efficiency and low income, measured using the Low Income Low Energy Efficiency (LILEE) indicator [51]. Previously, Brenda Boardman's definition of a household spending more than 10 % of its income on heating was used [59–61]. In Scotland, Wales and Northern Ireland, the definition of fuel poverty is based on this 10 % threshold [39,60]. Here fuel/energy poverty is understood as a static condition based on a household's ability to adequately heat their home at an affordable cost.

Other studies within our reviewed literature that were focused on the Global North often adopted the definition provided by EPAH, where the term energy poverty is commonly used [46]. Most of these studies are geographically focused on Europe. The EPAH refers to energy poverty as a situation in which energy expenses constitute a significant portion of a household's income, hindering their ability to meet other financial obligations and recognises that there are vulnerability factors that lead to its complexity. Nonetheless, there is increased policy action to a drive towards a European definition in the region [14].

The studies that focused on countries in the Global South did not mention their definitions. Energy poverty (as it is known in the region) is linked to insufficient access to electricity and modern energy sources [42].

Energy poverty and energy vulnerability are generally associated with maintaining thermal comfort and accessing energy sources. However, energy sources provide multiple energy services needed for everyday life, including cooking and lighting [62]. The problem of energy poverty forces households and individuals to reduce their energy consumption, which can have adverse effects on their physical and mental well-being.

4.2. *Variations in lived experiences terminology*

Our analysis of studies on the lived experiences of energy vulnerability reveals a diverse range of terminology employed, often evident in the titles of the papers within our review sample. In addition, the terminology used is influenced by the academic disciplines, theoretical frameworks, and emerging themes from the studies. However, only a few studies explicitly justify the terminology chosen in their papers. Specifically, five studies utilise the term ‘lived experience’ [12,23,36–38], while one study used the term ‘lived experiences’ to analyse the importance of local connections in helping people navigate energy vulnerability [39]. Another five opt for ‘experience (s)’ [40–42,63,64]. ‘Behaviour patterns’ are employed by one study [46], and three studies use ‘practices’ to investigate student practices related to energy use, heating practices and self-disconnection of electricity meters and winter warmth practices among older people [43–45]. Additionally, four studies use ‘coping’ [22,47–49], while five used ‘coping strategies’ or ‘mechanisms’ [24,50–53]. One study used ‘strategies’ alone to explore older people's strategies for managing cold winters [25]. Furthermore, one study use the term ‘choices’ to the explore energy consumption choices of households [53].

[2] These are the definitions that appear in our review sample. Given that the duration of our review spans the years 2011–2021, some of these definitions may have changed. Current definitions can be found here: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/howfuelpovertyismeasuredintheuk/march2023.

4.3. Methodological, theoretical or models underpinning the lived experiences of the energy vulnerable

Twenty-nine (29) studies mentioned the methodologies, theories, or models used to guide their approach to capturing the lived experiences of the energy vulnerable. Qualitative research methodologies dominated in researching the lived experiences of the energy vulnerable, with case studies being the most common. Other qualitative research methodologies included phenomenology, ethnography, and grounded theory. Two studies were based on a phenomenological approach [23,63]. Three studies employed the use of ethnography in one way or the other [41,60,65]. Four studies were based on grounded theory [24,50,61,66].

In terms of theories and frameworks, the energy cultures framework was used in two papers [53,64]. The energy cultures framework is a concept used to understand the intricate social, cultural, and political influences that shape the patterns of energy consumption and attitudes towards energy. The framework attempts to identify the manner in which individuals interact with energy, how they perceive energy use, and what influences their behaviour. This framework places a strong emphasis on understanding how culture influences how people use energy. The capability-based approach, which focuses on the advantages of energy access over energy sources and services, was adopted by [67,68], while [69] introduced the concept of energy precarity. Petrova's [69] use of energy precarity explores energy access issues beyond households and links them to institutional and political influences that prompt specific social-demographic groups to act. Others include a sociological perspective [70,71], a theory of coping [22], a coping strategy framework [52] and a space of energy well-being framework [41]. Four studies use multi-frameworks in their work [38,64,72,73]. Yoon & Sauri [73] combined the use of the political ecology framework and the concept of co-production in showing how social movements can reveal the lived water-energy experiences of households in Spain and empower them to collectively deal with these challenges. Willand & Horne [38] adopt social practice theory and the capability framework to provide rich insights into the choices of households to pay their energy bills and their heating practices before and after renovations in their homes. The use of the different theories and frameworks helps to provide a greater appreciation of the multifaceted nature of energy poverty. Seventeen studies did not explicitly mention their research methodology or the use of a particular theory, model or framework.

In summary, this section has highlighted the definitions and terminology, methodologies, theories, or models of research on the lived experiences of energy vulnerability. While a majority of the studies examined mentioned the use of approaches, approximately 9 % combined more than one theory or framework.

4.4. Methods used to report on the lived experiences of the energy vulnerable

Out of the 46 studies analysed, eight papers relied on quantitative methods (close-ended surveys, indoor temperature monitoring with sensors, etc.), 17 used only one qualitative method, and 10 used a combination of different qualitative methods. Thus, 27 studies relied on qualitative research methods. Twelve used a mixed-methods approach, a combination of both quantitative and qualitative methods. Fig. 2 provides a summary of the research methods used in the articles reviewed.

In the studies reviewed, 19 studies administered surveys/questionnaires, either online, via post or one-on-one [22,38,42–44,46,47,49,50,64,70,73–79]. Surveys consisted of both closed and open-ended questions. Some surveys were administrated in-person or via telephone [52].

This piece of study revealed various qualitative methods used to gather experiences. The qualitative methods used were interviews, focus groups, participant observation, document analysis and field visits. Eleven studies used mixed qualitative methods: interviews and participant observation [52], interviews, desktop research and field visits [66], interviews, focus groups and workshops [40], interviews and focus groups [37], interviews and field visits [65], interviews and document analysis [25,41,45,81]. The majority of the studies conducted interviews, which were carried out using various formats: open, structured, and semi-structured. Several studies that used interviews mentioned that they also used an observation method. When the interviews were often conducted in the household, participants allowed researchers to observe some parts of the buildings and inside the house [47,82].

Twelve studies used mixed-method (combining qualitative and quantitative) approaches, including surveys, interviews, and secondary data analysis [49,70], surveys, participant observation and participatory action research [73], interviews and monitoring [47], surveys, interviews, and focus groups [80], interviews and surveys [12,22,50], surveys, interviews, and document analysis [47,68,79], and surveys, interviews and monitoring [38]. For most studies that used surveys in combination with other methods, the numerical data collected from surveys were often used to provide descriptive and socioeconomic characteristics to complement the data collected by other methods [12].

Regarding the number of data collection episodes employed, six studies [39,59,67,71,77,82] used a longitudinal approach in which energy vulnerability accounts were collected in more than one period. They help account for the complex and dynamic nature of energy vulnerability over time. Few articles evaluated the effectiveness of

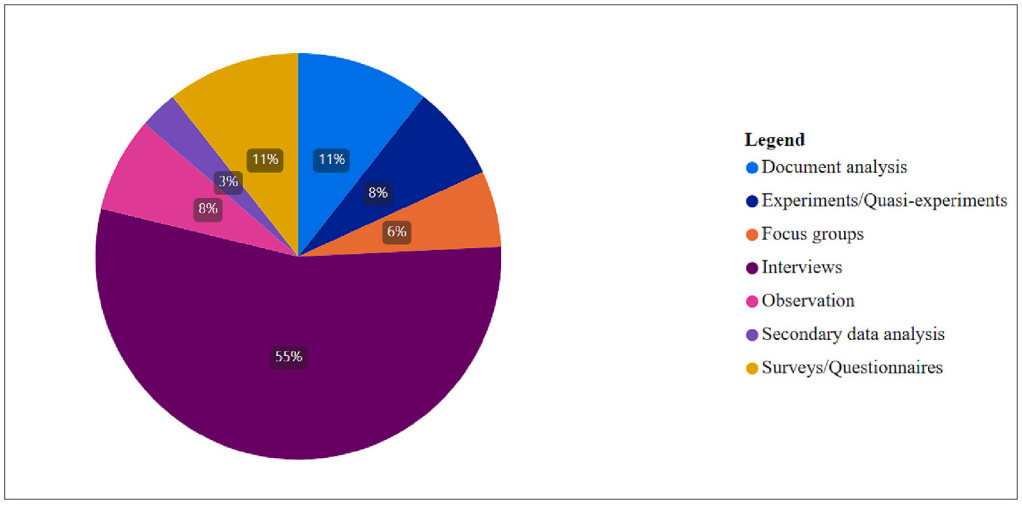


Fig. 2. A summary of the data collection methods and frequency of use in the articles reviewed.

measures implemented to address challenges in accessing energy services [39,59,67,71]. Such studies help discover whether policy interventions have achieved their goals and can uncover other benefits that should have been taken into account before implementing the measures. Grey et al. [59] conducted a study that demonstrated how an energy efficiency intervention aimed at improving physical health had additional positive effects on the participants' thermal comfort and social interactions. The intervention not only improved the health of the participants (which was the main objective of the project), but the investigation of their lived experiences revealed that this also allowed them to invite friends and family to their homes, thus improving their social relationships.

Surveys or questionnaires generally help collect socio-demographic data related to energy vulnerability, and qualitative methods provide in-depth information about such lived experiences. The mixed-method approach provided both numerical and descriptive data, and longitudinal studies accounted for the complex and dynamic nature of energy vulnerability over time. Fewer than 15 % of the articles in our analysis relied on longitudinal research designs, indicating a preference for cross-sectional studies as opposed to longitudinal studies.

4.5. How participants were engaged

Various ways were used to engage research participants. For example, through gatekeepers, housing associations, healthcare workers [12,39], personal contacts [65], sharing of leaflets [47], social media advertisements [39] and food banks [79]. One study employed community-based interviewers from energy vulnerable households [74]. This approach made it relatively easy to access research participants and led to an increased level of engagement in the community. Some studies employed the snowball sampling method, in which those who were initially contacted and asked to participate helped recruit additional interested participants for the research [63]. Interaction with participants occurred either at their homes or during organised meetings and workshops, whether related to the research or not. However, some studies did not specify the locations where participants were engaged. It was not always clear which participants were engaged: landlord, tenant or other household members. This lack of clarity assumes that those typically engaged were those present or available during the research or those who responded to the research request. A minority of studies involved intermediaries, and when they did, it was mainly to gather their perspective on the issue.

4.6. Groups and locations that have been explored

Individuals or households with income below the poverty line are at an increased risk of experiencing energy vulnerability, often set at the traditional expenditure-based 10 % of household income. This is a recurring finding consistently observed across the various studies. Although low income is a primary factor contributing to energy vulnerability, other factors, such as inefficient buildings and high energy costs, may also lead to this condition, potentially affecting individuals with moderate to high incomes as well [83]. Our findings reveal that research on the lived experiences of energy vulnerability has received significant attention in the Global North due to the prevalence of energy-inefficient homes and a record of policies targeted at addressing the issue. Analysis has been undertaken through various characteristics, such as household income, age, gender, household type, and household tenure.

In this review, 26 studies focused on low-income households as their primary population of interest. However, few of these studies also took into account vulnerable subgroups such as people with disabilities, women and children when analysing their experiences [65,67]. The remaining 20 studies examined experiences of energy vulnerability among specific age groups, gender, types of households, or housing tenures (see *Fig.* 3 for the breakdown). Of these, 17 studies investigated experiences among older people, young people, students, children and gender. Day and Hitchings [25] reveal that older women strategically choose certain clothes and avoid specific fashion styles to navigate age-related stigma, even though their thermal needs may change with age. Most of the reviewed studies reported that many of their research participants were women, as they were more willing to talk about their experiences and were often more involved with household energy practices than men [23,47,64,75,79]. This suggests that more research is needed to uncover energy vulnerability dynamics within homes based on gender, which may reveal insights into how different genders cope

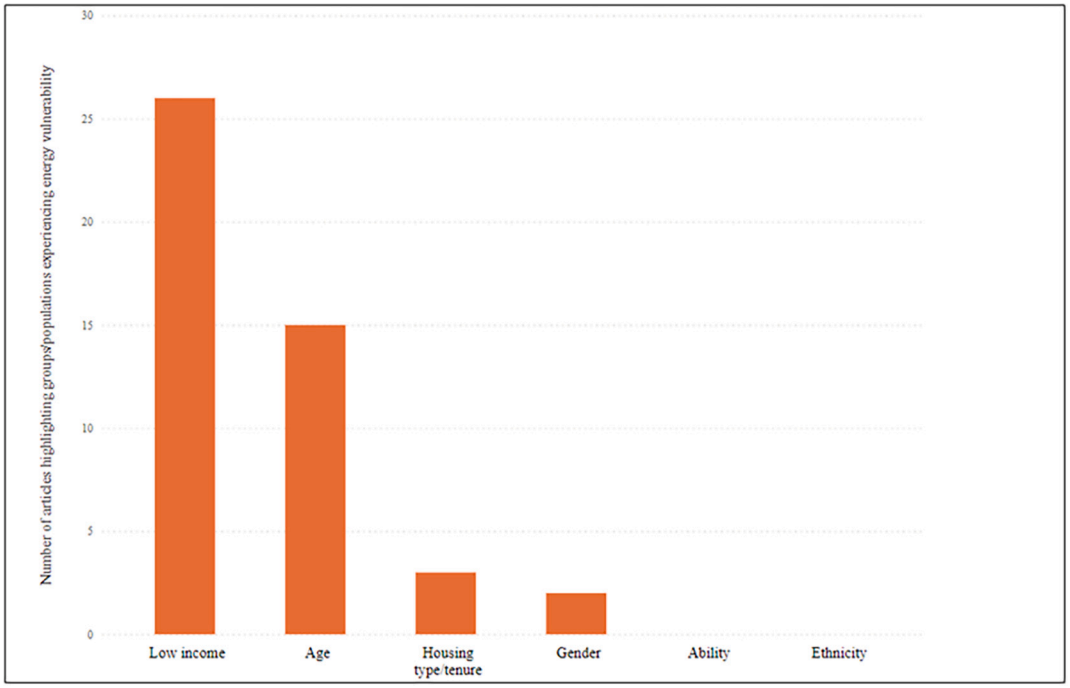


Fig. 3. Number of articles per group/population experiencing energy vulnerability.

with their energy demands across the life cycle [72]. The remaining three studies looked at housing tenure or type, with two explicitly investigating social housing and one examining energy vulnerability in multiple occupancy homes [41,41,75].

The primary reason for the imprecise targeting of specific groups can be attributed to the difficulties associated with researching the lived experience of the energy vulnerable and the need to ensure that no group of individuals is inadvertently excluded. In addition, individuals at risk of energy vulnerability may be disinclined to self-identify as such or may not recognise their vulnerability, emphasising the significance of including a broad demographic in such investigations and building early relationships with research participants.

Climate, socio-political, infrastructure, and access to energy infrastructures present different levels of energy vulnerability that shape energy vulnerability experiences [10,83,84]. The geographical landscape of documented energy vulnerable experiences (see Fig. 4 for details) has taken place in 21 countries, with one country from the Global South [42]. More studies have been done in the Global North in the UK (24), followed by Australia and Spain (3). Two studies have taken place in New Zealand, while two have been conducted in Greece, Hong Kong, and Ireland. A single study was recorded to have been conducted in 14 countries.

On the whole, most of the studies focused primarily on households based on income levels. In contrast, others were more specific in investigating experiences among other vulnerable groups, such as older people and students. Many studies reported that women were more involved in household energy practices than men. The studies also examined experiences of energy vulnerability among household types or housing tenures.

4.7. Benefits of looking into the lived experiences of the energy vulnerable

The examination of lived experiences of energy vulnerability reveals the need to go beyond income and expenditure-based indicators, which may fail to fully identify energy vulnerable households and may overlook broader factors that drive and shape energy vulnerability [9,24,38,61]. These factors can lead to hidden energy vulnerability, where energy vulnerability benchmarks do not fully capture the energy expenditures of vulnerable households due to their habits of peculiar consumption, which requires the need to embrace a broader and all-inclusive framework. Using a multidimensional framework to understand the dynamics among vulnerability factors, impacts, and responses within energy-poor households, Yip et al. [66] note that households in hot climates like Hong Kong are exposed to multiple vulnerability factors and respond in various ways to cope with these challenges. This is also seen in colder climates [12].

Second, qualitative evidence of energy experiences is crucial in the role it plays in revealing aspects of people's lives that quantitative data alone cannot capture. In a recent study involving 15 households members, interviews conducted prior to a renovation project revealed that residents' thermal comfort did not align with direct temperature readings [81]. This finding supports the notion that household members' temperature needs may vary based on factors such as health conditions, disability, age, and gender, which cannot be captured solely by technical solutions such as temperature sensors. Furthermore, the Swedish study highlighted how inadequate recognition of tenants' thermal needs and experiences by a housing company resulted in suboptimal indoor temperatures and negatively impacted residents. This underscores the increasing prevalence of misrecognition (including invisibility) of energy vulnerability in policy contexts and the implications for policy contexts, which can perpetuate energy vulnerability [85]. Therefore, the inclusion of qualitative evidence is vital in complementing quantitative data to provide a more comprehensive understanding of energy experiences and inform effective policy interventions.

Such investigations can provide valuable information on the impacts of lack of access to reliable and affordable energy on various aspects of life, such as physical and mental health, social relationships, dignity, self-esteem, finances, and education [22–26,60,68]. By examining the experiences of energy vulnerable individuals and communities, researchers and policymakers can gain a deeper understanding of the

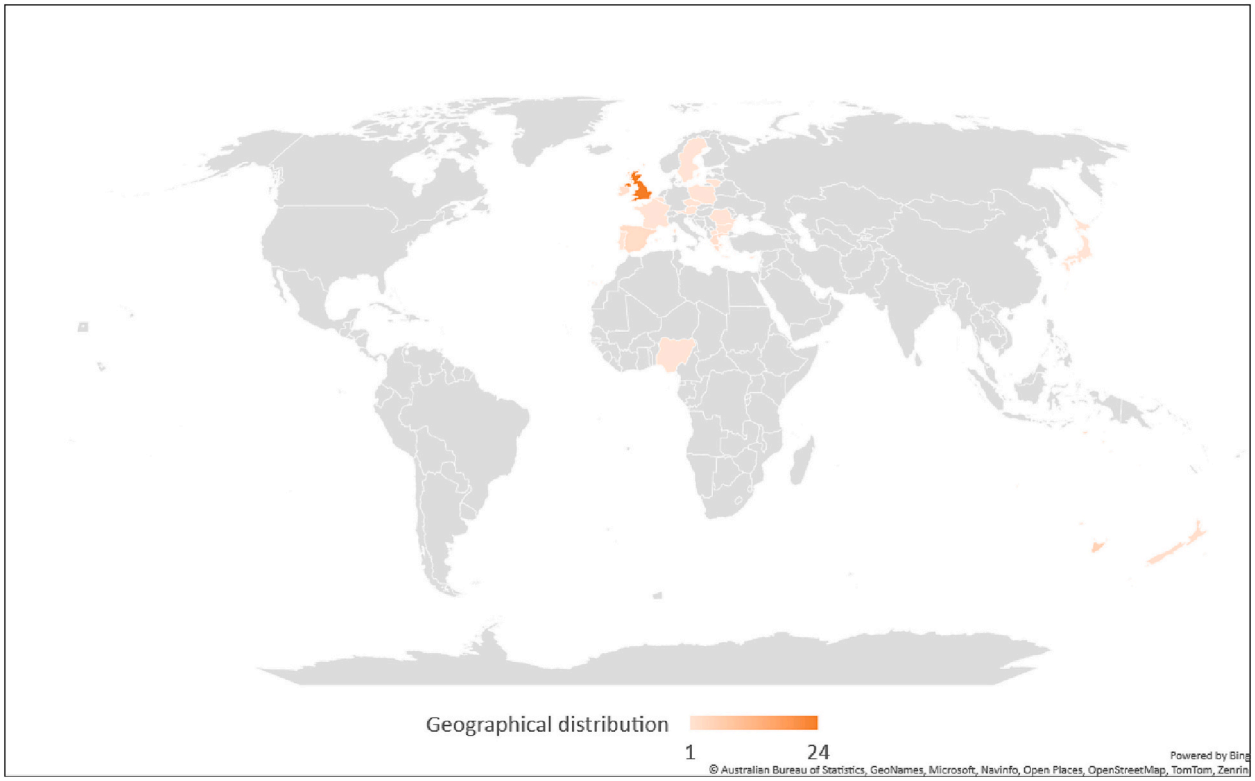


Fig. 4. The geographical distribution of research on the lived experiences of the energy vulnerable in the review sample.

challenges and needs of these populations. This knowledge can then inform the development of targeted policies and interventions aimed at reducing the negative impacts of energy vulnerability. For example, Eludoyin & Lemaire [42] highlight that in Nigerian energy vulnerable households, the priority is to sustain and develop their livelihoods, the use of modern energy services being less concerning than basic needs such as food and accommodation. In light of this, affordable living costs may play a crucial role in promoting the adoption of modern energy infrastructure, particularly in the context of meeting global targets such as UN SDG7, which aims to ensure access to affordable, reliable, sustainable, and modern energy by 2030.

Finally, the importance of lived experiences in revealing household coping strategies to address energy vulnerability is widely recognised in the literature [22–25,45,48,50,52,53,61,77,80]. These strategies can range from wearing extra layers of clothes and having hot food to turning on the oven or occupying one room and can shed light not only on household adaptations, but also on how these coping mechanisms extend beyond the home. A supportive social network can greatly aid energy vulnerable individuals in accessing their desired energy needs, as demonstrated in studies like Middlemiss et al. [68] and Ambrosio-Albala et al. [70], who specifically analysed the British energy retail market. They found that some energy vulnerable households lack the necessary skills and resources to actively participate in the market or switch suppliers, often due to loyalty. Only with the help of friends are they able to identify their options and access grants or subsidies. Another study also shows that public spaces like the library and buses also go a long way in helping to adapt to energy vulnerability [51].

Conducting research on the lived experience of energy vulnerability is crucial to unveil hidden energy vulnerabilities and complement quantitative data. It leads to a more comprehensive understanding of energy-related experiences and their significance in addressing the issue effectively. Through such research, the effects of energy vulnerabilities on various aspects like physical and mental health, social relationships and finances become evident. Additionally, it sheds light on the diverse coping strategies adopted by energy vulnerable individuals. Collectively, these insights play a vital role in informing effective policy interventions aimed at addressing energy poverty and its multifaceted impacts.

5. Advancing the literature on energy vulnerability

Our analysis revealed the different terminology used in describing the lived experiences of energy vulnerability. Unfortunately, few papers explained their choice of these terms. Nevertheless, while this does not compromise the richness of the research data on the lived experiences of energy vulnerability, researchers need to explain and justify their terminology.

We now turn to discuss the second aim of this paper, which is to advance the literature on energy vulnerability by highlighting the research gaps discovered in this systematic review. We aim to inform further research efforts that can provide more substantial evidence for shaping policy responses.

Firstly, while it is understandable that the primary focus is on low-income households, the narrow focus on income is problematic. Income is a key factor driving energy vulnerability, but other circumstances can also play a key role. We suggest a need for research into the lived experiences of energy vulnerability to be fully cognisant of all the factors that lead to vulnerability. Rotmann et al. describe vulnerability as *"not limited to specific groups like low-income households. It is also a "function of other life circumstances (e.g., being older, disabled, having young children) and a function of, e.g., a complex intersection of life circumstances, social circumstances, availability of infrastructure, market (de-) regulation and the political climate."* [19: 45].

Secondly, Petrova and Simcock [72] argue that energy poverty and vulnerability research in the Global North tends to treat the household as a singular entity. Consequently, this approach fails to consider how the roles of individual household members shape vulnerability and the day-to-day lived experiences of energy vulnerability. We argue that a focus on energy vulnerability can help address the problem of treating the household as a single unit and identify the different factors that lead to vulnerability. Thinking more broadly about people's lived experiences of energy vulnerability includes a broader range of vulnerability factors at the household monolithic and also individual levels (within the household).

Thirdly, studies focused on lived experiences tend to explore other factors that lead to energy vulnerability. Some of these factors include age, gender and housing type or tenure. Few studies have used longitudinal research methods, which can help here, by tracking changes in specific household demographics or individual factors of interest over time and identifying circumstances that influence these changes. A longitudinal research approach can help assess the success or failure of energy efficiency interventions and changing household and individual circumstances, such as the introduction of new family members, declining health or change in employment status.

Fourthly, more research is needed to ensure other vulnerable groups, including children, ethnic minorities, race and people with disabilities and geographic regions, particularly in the Global South, are not forgotten, or 'left behind.' Advancing the research body on energy vulnerability calls for broadening the geographical focus of where such studies have currently taken place. This analysis has identified a significant discrepancy in research pertaining to the lived experiences of energy vulnerability, with a predominant emphasis on the Global North. Nevertheless, there is a burgeoning trend of increasing attention towards Global South countries, particularly those in Africa. Such a trend helps provide evidence for policy efforts. To this end, approaches and methods used in exploring lived experiences in countries in the Global North identified can be applied to other geographical landscapes. However, it is crucial to consider the different vulnerability factors at play, as the patterns and manifestations of this phenomenon are often strongly influenced by geography and political conditions [84].

Fifthly, the lived experiences of energy vulnerability can uncover aspects of people's lives that cannot be measured quantitatively and can shed light on the impacts of energy vulnerability as well as unique ways that people cope with it. Such experiences also vary across culture, gender, race, education, employment and socio-economic background. Only one paper, the first-ever, examined the experience of energy vulnerability from a gender perspective [72]. They identified how energy vulnerability is differentiated along gender lines in exploring through in-depth interviews in Central, Eastern and Southern Europe. Although the initial objective of data collection was to investigate the causes and consequences of energy vulnerability in these regions, their findings revealed gendered household practices and the emotional labour of being energy vulnerable. It is clear from this study that different genders may experience vulnerability in different ways, which may be comparable when experiences of energy vulnerability are looked at through the social lens of a range of vulnerability factors. Incorporating the perspectives and experiences of energy vulnerable populations can help ensure that energy policies and programs are inclusive and equitable and consider the needs and priorities of all members of society.

In addition, researchers should establish in the early stages of their study how they will reach out to their target research groups. In engaging participants to know their lived experiences, many studies used gatekeepers. A wide range of theories and models from diverse disciplines are being used to understand energy vulnerability, underscoring the complexity of the issue and the need for a multidisciplinary approach [86]. Research on the lived experiences of those who are energy vulnerable can adopt one or more methodologies and frameworks to study the problem. Qualitative research methods, such as interviews, have been widely used to study lived experiences of energy vulnerability. Researchers should remember to contextualize their methods within theoretical and philosophical frameworks [87].

Finally, this paper shows that lived experiences can also provide

valuable insights into potential solutions that policy makers and energy providers may not have considered or have misrecognised. By listening to the perspectives of these populations, innovative approaches can be identified to address energy vulnerability and promote energy access. It also helps empower these populations by giving them a voice and ensuring their perspectives are heard. This can help build trust and collaboration between energy providers and energy vulnerable populations and lead to more effective and sustainable energy solutions.

Furthermore, it is essential to address the limitation of this study, which focused exclusively on peer-reviewed articles published in English, thereby omitting conference proceedings, reports, and publications in other languages. Notably, energy vulnerability is often documented by Non-Governmental Organizations and various groups, with their outputs commonly featured in reports. Additionally, it is crucial to acknowledge that the problem of energy vulnerability is consistently referred to using alternative terms, some of which may not have been encompassed within the scope of our paper.

6. Conclusion

Energy vulnerability research spans different approaches and is the culmination of various discipline areas with varying methods of analysis [86]. Across this diverse literature, a consistent message is the importance of building an understanding of the lived experiences of energy vulnerability into policy and action to address energy poverty and its consequences.

This article has systematically reviewed how research has been conducted on the lived experiences of the energy vulnerable, presenting an extensive exploration of the strategies and approaches in the field. While there is an increasing uptake in expanding the evidence base of energy poverty to include its lived experiences rather than relying on traditional quantitative methods alone, this paper lays out a clear path to make it easier for more lived experience research in energy poverty studies. We believe that as more data on the lived experiences emerges, it will expand the evidence (to include lived experiences), feeding into policy responses. This information will shed light on effective strategies, highlight inefficacies, and provide further grounds for integrating these insights into policies addressing energy poverty.

The key findings of this study have revealed several noteworthy trends in the field of energy vulnerability research. There seems to be no single definition of energy poverty; instead, regional, country-specific sources or key definitions in the field are widely used to describe the problem. Due to the lack of a recognised definition, it is unclear which vulnerable groups are usually the subject of lived experiences studies. Addressing this gap can be achieved by adopting the definition of energy vulnerability put forth in this paper which emphasises the need for full awareness of all the factors that contribute to vulnerability at and within the household level. Research and policy should be receptive to incorporating a vulnerability approach, which would be advantageous in successfully tackling energy poverty.

Our findings reveal the definite need to look beyond income alone as an indicator of vulnerability and consider a broader spectrum of factors that can contribute to it. A significant majority of the studies (more than half) clearly mention their chosen research methodology, emphasising the importance of transparent and well-defined approaches.

Furthermore, the focus on exploring the lived experience has been through qualitative methods (albeit some papers have also reported the collection of quantitative data, e.g. socio-demographic information). We have demonstrated that although mixed-method approaches in the examination of lived experiences have gained considerable attention, there exists a scarcity of studies employing longitudinal research methodologies. There is a need for more longitudinal studies, mainly to account for the complex and dynamic nature of energy vulnerability over the course of time and to assess the effectiveness of intervention policies, for instance. A mixed-method approach is also needed, as combining both methods yields rich insights.

Additional study is also required to consider other at-risk populations, such as individuals and households based on gender, minors, ethnic minorities, race and persons with disabilities with such research. Conducting such research demands an intersectional approach that considers the overlapping impacts of various factors [88].

Finally, the research identified a need for further research, particularly in the Global South and warmer climates. Although the dynamics of energy vulnerability in hotter climates align more with access to modern energy services, the underlying factors and impacts of energy poverty remain the same in colder and hotter climates.

Governments around the world are increasingly introducing policies to reduce their greenhouse gas emissions. As such, further research is critical to ensure that lived experiences are factored into policy development to avoid exacerbating existing vulnerabilities and generating new ones.

CRediT authorship contribution statement

Claudia Hihetah: Writing – original draft, Writing – review & editing, Formal analysis, Data curation, Conceptualization. **Brian Ó Gallachóir:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Visualization. **Clodagh Harris:** Writing – review & editing, Supervision, Resources. **Niall P. Dunphy:** Writing – review & editing, Supervision, Resources, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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