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What is Energy Poverty? A Concept Analysis

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Abstract

Defining concept of energy poverty plays crucial in problem-solving such as policy design. This paper discusses conceptual definition of energy poverty which provides a rich vocabulary representing functions together with clear definitions grounded from literature. This study synthesizes the concepts of energy poverty from 2012 to 2022 in two major databases which is Web of Science (WOS) and Scopus. There are 45 eligible articles were counted in this review. The variation in the concept of energy poverty reveals its dimensionality. Energy poverty can be considered as lack of income and monetary aspects, lack of basic needs and material assets, lack of capability and energy inefficient. However, when closely examined, these dimensions are seen to be conceptually interrelated and complementary rather than substitutable. The concept used to define energy poverty determined the methods employed to measure it. The definition of energy poverty provided in this concept analysis will facilitate proper interpretation of the meaning of energy poverty and standardization of tools used to measure and monitor energy poverty. Energy poverty eradication purports to positively affect the economic growth of nations and hence improve the well-being of the households.

Keywords: Energy Poverty, Definitions, Concepts, Review Paper, Energy Consumption

Introduction

The definition, concepts, and use of indicators for identifying energy poverty are varies across the countries, and therefore cover different target groups. The fact that energy poverty has an income, and an energy aspect means that tackling the problem requires complex interventions in different policy areas which have an impact on each other's. None of the implementing countries has actual definition of energy poverty, which makes it difficult to define the target groups of energy poverty (Mathen & Sadath, 2022). Energy poverty is widely recognized in the existed literature, and it has emerged as a severe issue. Energy carried a big responsible toward the progress of today's society. With the access to affordable electricity,

a school or hospital may incorporate modern technology such as computer, can assure the hygiene, water supply and access to clean cooking for household that may affect by indoor pollution. Indoor pollution is an essential issue when International Energy Agency (IEA, 2021) record those premature deaths in India is out of 800, 000 a year which caused by indoor pollution (Mathen & Sadath, 2022). Energy consumption has risen to become the dominant engine of economic growth, allowing millions of people to escape poverty. Due to its simple accessibility and unrestricted use, energy has also been recognized to have a role in associated environmental challenges (Ehsanullah et al., 2021).

Energy equips humans with necessary capabilities that allow them to meet their basic wants and live satisfactorily. However, Individuals who are unable to access needed energy services for a decent and healthy living are exhibiting signs of energy poverty and people's well-being is negatively affected by energy deprivation (Ssennono et al., 2021). For example, indoor pollution, health risk, lack of educational opportunities and poor environment. The multi-dimensional problem of energy poverty is influenced by a variety of factors, as well as their interactions and configurations in various situations. Demographic group identification is the biggest risk when addressing basic needs with income-based poverty indicators (Lan et al., 2022). Based on the existed literature, the most affected by the energy poverty is in rural and urban areas who struggling for income insufficient.

Energy poverty is a global issue, and The European Energy Poverty Observatory (EPOV) was established to help European Union member countries control and eliminate energy poverty. Policies and plans for the energy poverty are being developed at a rapid pace (Bienvenido-Huertas et al., 2022). This creation is a work adds benefit to the whole country included in Asia to eradicate the energy poverty. The literature (Laldjebaev & Hussain, 2021) on energy poverty has been thoroughly examined, addressing methodological and conceptual issues. The number of studies on the subject is increasing, and as of March 2020, the top five sites producing research on energy poverty are as follows included England (308 studies), United States (154), Spain (89), Australia (88) and Scot-land (62) (Laldjebaev & Hussain, 2021). Regardless of the increasing number of studies focusing on this issue, the discussion needs to continue to better understand about the energy poverty.

Poverty eradication and energy affordability has been unanimously endorsed by the international community as the overarching goal of development which stated in Sustainable Development Goal, SDG1 and SDG7 (UN, 2015). However, this target's meaning is obscured by the bewildering ambiguity with which the word energy poverty is defined, used, and measured by many different indicators proposed to measure and monitor energy poverty. They appear less agreement on what energy poverty is and how it can be measured. Different meanings of energy poverty and different ways to measuring energy poverty leads to different ways to tackle it. Therefore, this paper argue that energy poverty is a highly contested concept.

Analysis of the concept of energy poverty will help to close the gap between its varied definitions. This will provide a mutual understanding between the meaning of energy poverty and its measurement. Regardless of the different meanings of energy poverty, they tend to be a common goal which to reduce poverty and ensure access to affordable, reliable, sustainable, and modern energy for all. To reduce energy poverty, political commitment is needed and genuine facts in addressing energy poverty are needed. Analysts, economists, policy makers, politicians and practitioners need appropriate and dedicated measures of energy poverty to enable progress from rhetoric and general political statements to action and results on the ground. There are four sections make up this paper where the section one

is an introduction to the study and a suggested research question. The methods of data collecting, and analysis are described in section two of the paper. The third section focuses on the study's findings and discussion. Finally, section four concludes the article and makes recommendations for future research topics.

Methodology

This study aims to answer the question on what are the concepts of energy poverty that been discussed in the literature from 2012 to 2022. The research question provided our work with clarity, coherence, and direction so that we could determine what was pertinent to our issue. The next phases involved gathering, organizing, and analyzing our sources in accordance with the study question. Table 1 shows how this study been designed based on PICOC framework which determine the population, intervention, comparison, outcome, and context of study.

Table 1
Research scope based on the PICOC framework (Booth et al. 2016)

Concept	**Definition**	**Application**
Population	Research studies dealing with energy poverty	Scientific articles dealing with energy poverty.
Intervention	Existing approach applied to address the identified question	Identification of definitions of energy poverty.
Comparison	Approached to contrast the interventions used to measure energy poverty	Approach between the approaches applied to solve the main question.
Outcome	Achievements and gap of energy poverty definitions and concepts in the analyzed studies	Existing definitions and concepts used to define energy poverty.
Context	Characteristics of population analyzed	Trends, challenges, and gaps in the energy poverty research area, distribution of knowledge and information based on distinguished categories.

We framed clear inclusion and exclusion criteria to determine which studies to be reviewed. First, studies must possess the keyword(s) of “energy poverty” or “energy justice” or “fuel poverty” in the title. Second, to ensure the quality of the studies, we only considered peer-reviewed journal articles and excluded document types such as conference proceedings, book chapters, etc. Third, the original language of the articles must be English. Fourth, we considered articles published from 2012 to 2022. We searched literature from two dominant databases, namely the Scopus core collection and Web of Science (WOS). Based on the above-mentioned inclusion and exclusion criteria, we searched and selected data following the procedure as shown in Table 2. To attain maximum reliability of the data, all authors searched and evaluated literature from both databases separately using the same procedure. The results are highly similar, indicating that our data collection procedure is reliable. We discussed subtle differences and ultimately selected 45 articles in this review.

Table 2
Literature searching strategy in Scopus and WOS

Process	Criteria	Searching or selecting
1	Keywords (Initial search strings)	**Scopus:** TITLE (Energy poverty) OR TITLE ({Energy justice}) OR TITLE ({Fuel poverty}) **WOS:** Energy poverty (Title) OR "Energy justice" (Title) OR "Fuel poverty" (Title)
2	Document type	Articles
3	Language	English
4	Publication Date	From 2012 to 2022
5	Relevance (Round 1)	Assessing the relevance by reading the title and abstract and Selecting energy poverty studies
6	Relevance (Round 2)	Removing articles that are not available in full text or are broadly relevant

Result and Discussion

Quantitative Findings

The research patterns, which partially reflect the energy poverty trends, were examined by the year of publication, location of research, and theme of energy poverty. As illustrated in Figure 1, this analysis included 45 reviewed articles in total of the publication. Few publications were invented between 2012 and 2018. The number of pertinent papers published start climbed dramatically between 2018 and 2022. The highest number of articles is in 2021 which carries 22% and 25 number of articles. Instead of developed country and developing country, the paper survey cover countries/territories and categorized the income level from low income to high income. It is comprised from low income, lower middle income, upper middle income, and high income. Countries with low incomes include Rwanda and Uganda. Several countries/territories from Asia, Africa, and Latin America are represented for lower middle income: Sri Lanka, Africa, Nigeria, Cambodia, Ghana, Haiti, Honduras, Rwanda, Uganda, Pakistan, Nepal, Tajikistan, Zimbabwe, Kasaragod, and India. Upper middle income included China, Turkey, Bulgaria, Colombia, Dominican Republic, Guatemala, Mexico, Brazil, and Peru. While high income included Brunei, Japan, Italy, Poland, Belgium, Germany, Portugal, Spain, Lithuania, Cyprus, United Kingdom, United states, France, Queensland, Andalusia, Slovakia, Greece, and Czech Republic. Based on the reviewed paper, it has 45 countries/territories are counted. In Figure 2, low income, lower middle income, upper middle income, and high income are carried 4%, 33% 20% and 42% respectively. It demonstrates that the highest income groups are those counted in the paper reviewed.

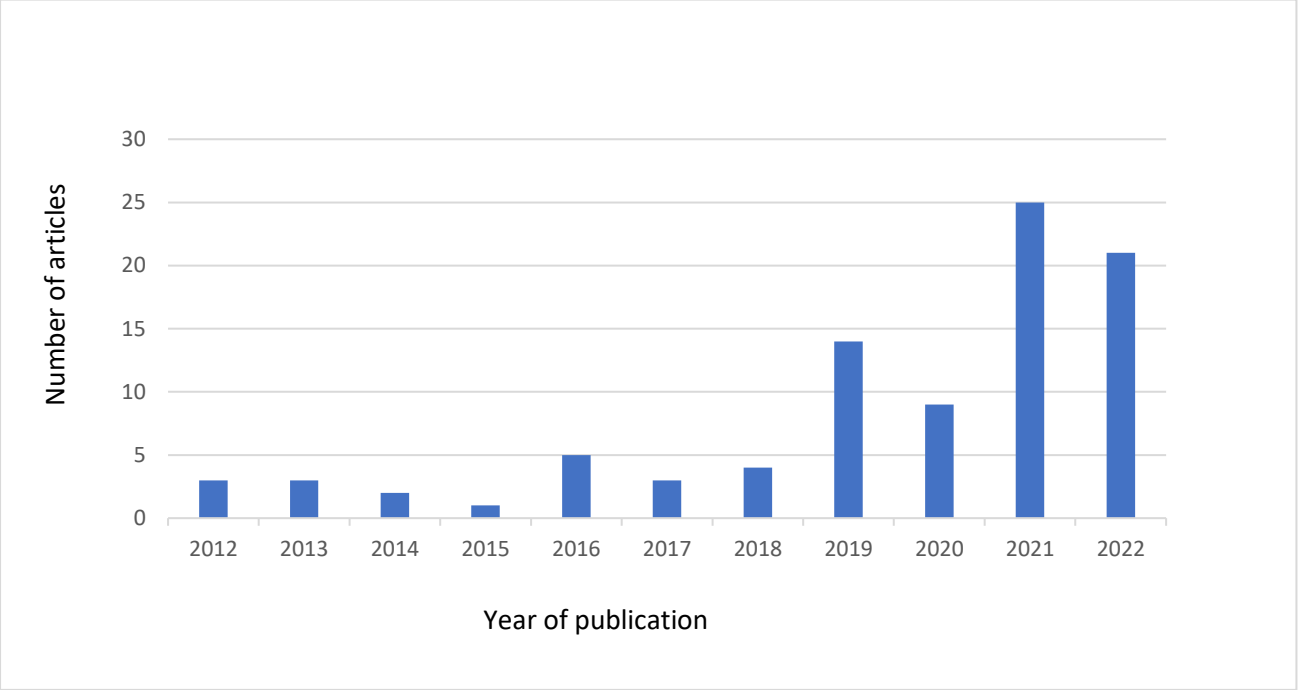

Figure 1: Articles reviewed by the year of publication.

We identified themes of concern to researchers by using a broad definition of energy poverty. The analysis focuses on the following themes: energy poverty (EP), fuel poverty (FP), energy justice (EJ), energy security (ES), and energy access (EA) were identified directly from the articles reviewed based on the study's focus topic or endogenous variables. Energy justice is defined similarly to energy poverty and fuel poverty. However, the relationship is that energy poverty can contribute to the effort to achieve energy justice.

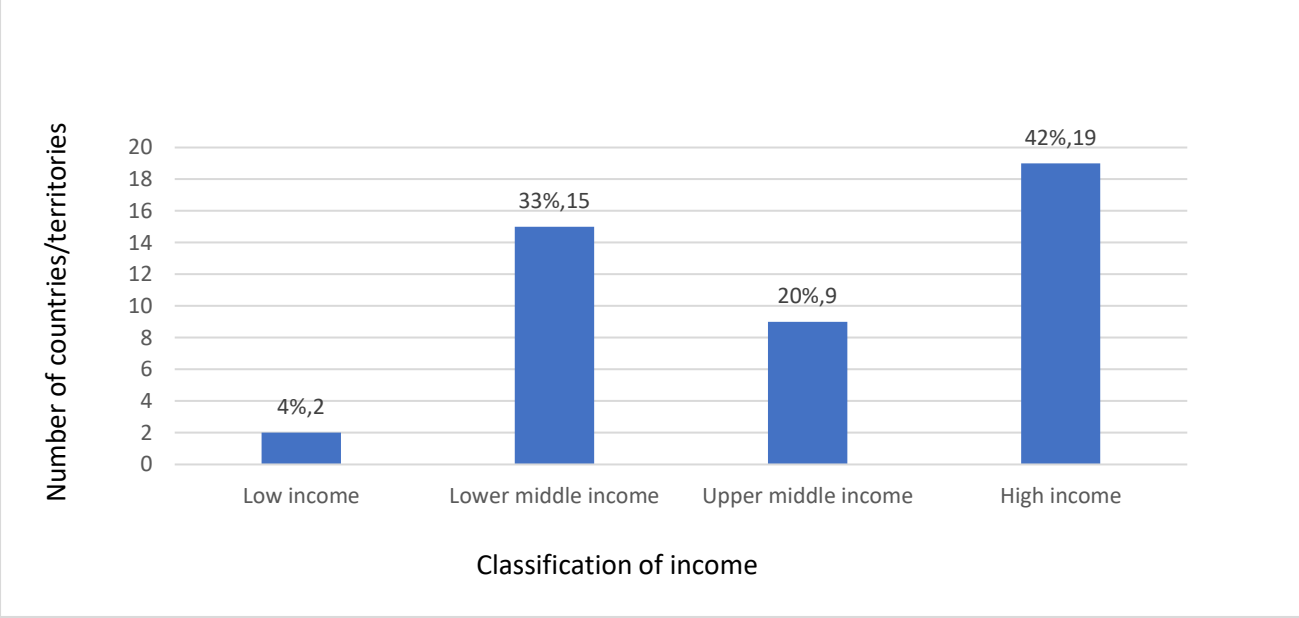

Figure 2: Articles reviewed by income classification.

Energy Poverty Concepts

The definition of energy poverty is various, and it could be depending on the situation of the country. Energy poverty is characterized in a variety of ways depends on the context and the

country and it is difficult to define even though this poverty affected a large of number of people around the world (Mendoza et al., 2019). For instance, in developing country, it addresses issues such as households' lack of access to energy services such as electricity, the use of outmoded technologies, or the use of harmful or inefficient fuels for cooking, heating, and lighting in their homes (e.g., burning firewood and other traditional biomass for cooking and heating) (Maxim et al., 2016). Since there isn't a single, widely agreed-upon definition of energy poverty, we have just condensed the term considering the articles we have read. First, energy poverty can be divided into two categories: affordability and accessibility. Accessibility is the issue with clean and modern energy, whereas affordability is referring to appropriate and sufficient energy. In developing countries, accessibility is by far the biggest issue, and developed countries are also concerned about affordability (Bonatz et al., 2019). Lack of access to modern energy services, which is mostly a problem in developing nations (Li et al., 2014).

The concepts of energy justice, energy vulnerability, and fuel poverty are frequently encountered in the literature in the context of developing countries (Dagoumas & Kitsios, 2014). Universal access to energy resources remains a challenge in many developing countries, electricity may not be readily available to most of the people, resulting in reliance on solid fuels, which not only pollute the environment but also pose a health risk (Siksnelyte-Butkiene et al., 2021). Developing countries are typically affected by energy poverty yet the economic downturn has impacted some developed countries and prompting concerns about energy poverty (Dagoumas & Kitsios, 2014).

Based on Table 3, there are various theme has been used by the researcher. The theme is divided into three parts called energy poverty, fuel poverty and energy justice. To differentiate between energy poverty and fuel poverty, fuel poverty usually used for European country or cold climate country because it included the cooling and warm as the indicators. While energy justice is ensuring everyone can afford the energy. Besides, the definition of energy poverty is based on the country whether it is a developed country or developing country. Energy poverty in developing countries is primarily a problem of adequate access to clean energy and modern energy, whereas energy in developed countries is rather an issue of affordability and energy efficiency.

Based on the definitions of energy poverty in the literature, which can be split into several categories.

Lack of income and monetary aspect

The monetary approach to the identification of energy poverty is the most used. Energy poverty is identified with the shortfall in consumption or income from some poverty line. Fabbri (2015) refer energy poor as the relationship between annual family energy costs and annual family income. If this ratio is more than 10%, the family is in a condition of energy poverty. Additionally, Sy and Mokaddem (2022) said the energy poverty also focuses on the lack of sufficient income to achieve the minimum temperature thresholds in cold climate countries.

Lack of basic needs and material assets

The material/physical aspects of energy poverty are well known. Absence of physical opportunity to connect or acquire energy remain the core concerns in developing countries.

For poor countries, getting modern and clean energy can be a daily struggle. Mendoza et al (2019) said, a household must have at least the equivalent of 50% of the weighted seven indicators to be considered energy poor when the sum of its deprivations surpasses a certain level which is access to modern cooking fuel, access to fresh air, access to household convenience like refrigerator, recreation, communication, and space cooling.

Lack of capability; the capability approach focuses on indicators of freedom to live a valued life instead of a monetary life. Energy poor is seen as failure to achieve certain basic capabilities that is the ability to satisfy adequately certain crucially important functioning. Bartiaux et al (2018) said households not enough to encompass all the qualities deemed essential for leading a respectable life. Capability within the context of energy consumption and energy services may refer to a basic capability as being a good health, including to keep adequately warm or cool, and being able to acquire and cook nutritious meals, which would require energy services of heating, cooling, and cooking.

Energy inefficient; A home is energy inefficient if it lacks adequate investment. The occupants, therefore, they must buy expensive warmth and other energy services. They need to pay more to keep warm than people in home where there has been a higher level of investment in energy efficiency measures.

Table 3
Summary of Energy Poverty Definition

Author/s & Year	Country	Definition
(Siksnelyte-Butkiene et al., 2021)	Multiple countries	The concept of energy poverty is analysed based on two dimensions: (i) absence of physical opportunity to connect/acquire energy. (ii) inability to consume modern energy for various reasons.
(Malla, 2013)	Nepal	Lack of clean, affordable, and reliable energy service (basic energy)
(Bonatz et al., 2019)	China & Germany	In developing countries is primarily a problem of adequate access to clean and modern energy while in developed countries is rather an issue of affordability and energy efficiency
(Ahmed & Gasparatos, 2020)	Ghana	When a household cannot ensure the wide availability of modern energy and cannot capitalize the characteristic of individual local contexts and industrial crop intervention.
(Mendoza et al., 2019)	Philippines	A household must have at least the equivalent of 50% of the weighted seven indicators to be considered energy poor when the sum of its

		deprivations surpasses a certain level. (Access to modern cooking fuel, access to fresh air, access to household convenience like refrigerator, recreation, communication and space cooling)
(Jayasinghe et al., 2021)	Sri Lanka	The absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally energy services to support economic and human development" as it incorporates a number of interesting elements and nuances.
(Dagoumas & Kitsios, 2014)	Greece	The economic crisis and the inequalities among different economic quintiles have raised the issue of energy poverty, namely the lack of access to modern energy services
(Thema & Vondung, 2020)	EU	Inability to access and afford sufficient levels of energy services to fulfil basic needs.
(Igawa & Managi, 2022)	Many countries	Inability to access an adequate level of energy services in the home.
(Sy & Mokaddem, 2022)	Many countries	The concept of energy poverty addresses the issues of availability, affordability, acceptability, reliability, quality, and adequacy of energy
(Awan et al., 2022)	Pakistan	There are no widely accepted ways to establish the threshold of energy poverty because conditions differ from region to region and there is no clear definition of what constitutes energy poverty. As a result, researchers frequently use a variety of indicators when building energy poverty metrics.
(Khundi-Mkomba et al., 2021)	Rwanda	It seems to lag in terms of access to clean fuels and technologies for cooking.
(Maxim et al., 2016)	EU	A situation in which a household lacks a socially and materially necessitated level of energy services in the home.
(Aguilar et al., 2019)	Spain	Understood as the problem of affordability of domestic energy consumption and covering all energy sources (electricity, natural gas, liquefied petroleum gas, oil, coal, district heating and other solid fuels)

(Rao et al., 2022)	N11: Egypt, Bangladesh, Iran, Indonesia, India, Pakistan, Nigeria, Philippines, South Korea, Vietnam, and Turkey	Experience significant barriers in having access to energy; do not have access to basic electricity, monetary limitation, increasing number of households.
(Gupta et al., 2020)	India	Have limited access towards energy and prevalence of energy poverty.
(Day et al., 2016)	-	Lack access to sufficient, affordable, and high-quality energy to meet survival and development.
(Li et al., 2014)	-	Lack of access to modern energy services which mostly occurs in developing countries.
(Dong et al., 2022)	China	Refers to such conditions as a lack of sufficient, affordable, efficient, and high-quality energy services to support local development.
(Castaño-Rosa & Okushima, 2021)	Japan	Inability to fulfil adequate levels of domestic energy services.
(Kahouli & Okushima, 2021)	France and Japan	Whether a home is in energy poverty is determined by determining whether the household truly fulfils "a socially and materially necessary level of domestic energy services". In other words, it establishes an energy poverty line by defining a particular amount of home energy service usage and then classifying households whose domestic energy service use falls below this level as energy poor.
(Middlemiss, 2022)	Global north	Have insufficient access to energy services (light, heat, warmth, and cooling) to live a decent life.
(Okushima, 2019)	Japan	This study employs previous paper definition which it considers households in the lowest 30% income group as (dimensionally) poor.

(Nathan & Hari, 2020)	Urban India	**A transitional energy-poor:** one who lives in a home that relies primarily on modern fuels for lighting and cooking but yet utilises inefficient fuels occasionally. **Moderate energy-poor**: A home without modern fuels as its primary source of energy for either lighting or cooking, but not both, is said to be moderately energy-poor. **Extreme energy-poor**: A person who lives in a home without access to modern fuels as its main source of energy for both lighting and cooking is extremely energy-poor.
(Faiella & Lavecchia, 2019)	Italy	Affordability: energy poor families must divert a big chunk of their budget to satisfy their energy needs or they are constrained and they cannot afford to buy the desired amount of these services.
(Fabbri, 2015)	Italy	This paper considers Fuel Poverty as the relationship between annual family energy bills, and annual family income, if this ratio is more than 10%, the family is in a condition of Fuel Poverty
(Sy & Mokaddem, 2022)	Many countries	The concept of fuel poverty focuses on the lack of sufficient income to achieve the minimum temperature thresholds in cold climate countries.
(Charlier & Legendre, 2021)	Industrialized countries	Depending on the country, the amount spent on cooling, the indoor temperature, damp walls, the lack of central heating, and rotten window frames can all vary by nation. Considered as a monetary poverty issue (monetary poverty)
(Li et al., 2014)	-	Focuses on the issues of affordability
(Bartiaux et al., 2018)	Belgium	not enough to encompass all the qualities deemed essential for leading a respectable life.
(Goldthau & Sovacool, 2012)	Many countries	Supplying billions of people in developing nations with affordable power
(Jenkins et al., 2020)	Many countries	As a global energy system with equitable distribution of the costs and benefits of energy

		services, as well as with representative and unbiased energy decision-making,

Conclusion

The paper presents a conceptual view which focus on concepts of energy poverty and their trends. This research set out to review the literature on the topic from 2012 to 2022. The quantitative findings have presented the current research concepts of energy poverty, which partly reflects the trends in the energy poverty study. The paper notes that the concepts are often confused, as in arguments that energy equality is impossible because everyone is different. Four important inter-related bases of energy poverty are considered as lack of income and monetary aspects, lack of basic needs and material assets, lack of capability and energy inefficient. This original paper is of value in correcting some misconceptions and improving understanding of energy poverty concepts as a subject. Energy poverty is clearly an important issue requiring much more intention in policy discussion than has been the case to date. Rather than conflicting with an energy poverty reduction focus with attainment of the SDGs, this is likely to be important for the successful attainment of these. Conventional techniques for defining energy poverty remain useful and valuable, but it is important to broaden concepts of energy poverty beyond those typically considered in discussion on this issue. This includes developing a more multidimensional perspective on energy poverty, but also other aspects such as considering energy poverty at different levels of society and different time horizons. It is important to enrich our understanding the process behind energy poverty and changes in energy poverty, and to bring this to the forefront of policy debate.

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