INTERREG NORTH-WEST EUROPE PROJECT SCEPA:SCALING UP THE ENERGY POVERTY APPROACH

DELIVERABLE D1.1.1: LITERATURE REVIEW

Karin Landsbergen, Erik Jansen, Koen Dortmans 2025

This research report was produced in collaboration and with the assistance of SCEPA (Scaling Up The Energy Poverty Approach)

Interreg
Co-funded by the European Union
North-West Europe
SCEPA

HAN_UNIVERSITY OF APPLIED SCIENCES

CONTENTS

FOREWORD

Energy poverty is a worldwide phenomenon and gets increasing attention in high-income countries. Despite the many different definitions of energy poverty, we adopt a definition that is commonly used in the European context in which energy poverty is understood as the inability to secure adequate levels of energy services such as space heating, cooling, lighting and information technology and is estimated to affect more than 50 million people in the European Union (EPOV, 2024). According to Eurostat, over 41 million people in the EU (9.3 % of the population) were unable to keep their home adequately warm in 2022. Moreover, almost 7 % of the EU population had arrears on their utility bills, and almost 15 % lived in dwellings with leak, damp or rot in 2020. In December 2016 the Clean Energy for All European Package (CEP) generated the EU Energy Poverty Observatory (EPOV), the predecessor of the Energy Poverty Advisory Hub. Aim was meeting the goals of the CEP by changing and integrating Energy Poverty in EU policies (Dobbins et al., 2019; Kyprianou et al., 2019). Together with ENGAGER (Varo et al., 2018), a research network funded by European Cooperation in Science and Technology (COST), information is gathered to address Energy Poverty as adequate as possible (Dobbins et al., 2019). The EU is committed to tackling energy poverty and protecting vulnerable consumers and the10-year national energy and climate plans (NECPs) outline how EU countries intend to meet the EU energy and climate targets for 2030. In this context local governments struggle to find the best approaches to apply locally in their specific contexts.

This literature review is part of the Interreg NWE project *Scaling up the Energy Poverty Approach* (SCEPA) that aims to assist these governments to develop a locally tailored energy poverty mitigation approach. Many definitions of energy poverty have been proposed making it difficult to define and compare outcomes of measures between EU-countries. However, there is broad consensus on the principal drivers of energy poverty, i.e. *low-income of households*, *high-energy prices* and *poor housing conditions*, sometimes extended with *high levels of energy consumption*. Energy poverty is most often typified as a multidimensional problem, with distinctions being made between political, technical, financial, economic and social dimensions. This review aims to shed light on the interventions and approaches that are reported on in the literature as a starting point and inspiration for building a joint action strategy for the SCEPA project partners that is state-of-the-art, practical and provides opportunities for mutual learning.


Energy Bill
Billing information
Service detail

1. INTRODUCTION

1.1 INTRODUCTION TO THE SCEPA PROJECT

In the Interreg NWE project SCEPA (Scaling up the Energy Poverty Approach), six municipalities and local governments in North-West Europe, a social organization and a knowledge institute[1] collaborate to learn from each other's energy poverty approaches. Energy poverty is a multifaceted phenomenon.

According to estimations a large number of people in Europe are exposed to conditions of energy poverty. Within the partner areas currently over 100.000 households suffer from energy poverty. In light of this problem scale local governments struggle to find fitting approaches to mitigate energy poverty and its causes (Mulder et al., 2023). SCEPA aims to contribute to a just and inclusive energy transition by better engaging more vulnerable households, and reducing energy poverty and alleviating the burdens that stem from it. Instead of reinventing already existing wheels, SCEPA gathers and enhances existing effective energy poverty approaches in order to be able to upscale initiatives. Stakeholders in the project share their best practices and learn from each other, jointly develop a flexible and integral intervention strategy and set up a jointly crafted toolbox to go with it. The jointly developed toolbox and strategy are enhanced as SCEPA progresses and partners share their experiences from their Local Action Plans (pilots for over 7500 households). The Toolbox and Strategy provides nuanced details of what works for specific target groups in specific dwelling areas in NWE. As a result, partners and stakeholders can develop their tailor-made approaches based on knowledge from best practices addressing local conditions. In this way the results of the project will benefit vulnerable households in the partner areas and public authorities and organizations beyond the SCEPA consortium that seek to scale up their energy poverty approach.

A lot has already been written with regard to, respectively, energy poverty as a phenomenon, its various definitions, ways of measuring, and incidence and manifestation in certain geographical areas or with certain groups within the general population, and about possible mitigation measures and approaches. We see emphasis in the literature shifting chronologically as summed up above, reflecting the development of the discourse from identification of to dealing with energy poverty. This reveals the worldwide growing acknowledgement of the importance of energy for dignified and valued human lives and the seriousness of limitations or inadequacies of energy access as well as the search for adequate strategies to mitigate these limitations and inadequacies in various settings and circumstances. This is reflected in energy being the topic of one of the UN's Sustainable Development Goals, i.e. SDG 7 "Affordable and clean energy: Ensure access to affordable, reliable, sustainable and modern energy for all (United Nations, 2015). Moreover, some authors even suggest energy to be at the core of the SDGs, as it is an essential resource for reaching all 17 goals (Neacsa et al., 2020). Apart from this, most recently attention has been geared towards developing adequate and effective strategies for mitigating energy poverty. As a result, more recent publications conceptualize broader frameworks for energy poverty. An important starting point for SCEPA (Scaling Up the Energy Poverty Approach) is that an action framework should be developed based on these latest notions such that it guides public actors and their partners in developing optimized and contextually valid approaches for energy poverty mitigation. Partners in the SCEPA project collaborate in developing, operationalizing and testing such an approach.

1 Municipality of Arnhem (NL), Municipality of Leeuwarden (NL), Municipality of Liège (BE), Southeast Energy Agency (IE), Agence Parisienne du Climat (FR), Westvlaamse Intercommunale (BE), HAN University of Applied Sciences (NL), ALDA (FR).

Therefore, in the SCEPA project a Joint Action Strategy (JAS) framework will be developed that guides project partners and other actors engaged in forming an energy poverty mitigation strategy to design a context specific action plan that is tailored to the local context and at the same time does right to the multidimensional nature of energy poverty. The primary aim of this literature review is to inform the development of the JAS with the state of the art of knowledge on effective energy poverty mitigation interventions, described in scientific literature as well as other publications (grey literature). Apart from this literature review, experiences from localized practices in the participating municipalities (embedded knowledge) serves as input for the development of the JAS. The integration of the various (explicit and implicit) information and knowledge sources is part of the whole SCEPA project. In this report (as delirable in the project proposal) we elaborate on the findings from the literature review.

1.2 LITERATURE REVIEW ON ENERGY POVERTY INTERVENTIONS

A broad search was performed in various literature databases. AI-algorithms were used to assist in the search strategy to efficiently narrow the wealth of available articles down to a focused and manageable set of documents that particularly pertained to energy poverty interventions and their effectiveness. The methodology followed is described in more detail below.

First, a systematic search was conducted in HANQuest, an integrated literature search tool from HAN University of Applied Sciences. HANQuest simultaneously enters literature search strings into multiple scientific databases such as: APA PsychInfo, Business Source Ultimate, JSTOR, ScienceDirect, SpringerLink and Wiley. Aim was to identify all articles between January 2000 and July 2023 to identify interventions to mitigate EP that are practiced within the European context. A sensitive search strategy was adopted using the following keywords and phrases: "Energy Poverty" + "Interventions", "Fuel Poverty" + "Interventions", "Energy Justice" + "Interventions", "Energy Vulnerability" + "Interventions", "Energy Inequality" + "Interventions", "Energy Poverty Programs", "Energy Poverty Practices". This initial search yielded 892 documents. After eliminating doubles, two reviewers screened the articles titles and abstract for inclusion in the analysis set. Inclusion criteria were: 1) the search keywords and phrases are in the title, abstract or keywords of the article, 2) articles that are published in a scientific

peer-reviewed journal in English, 3) key theses, books and reports on energy poverty. The criteria for exclusion entailed that we did not include 1) editorial letters, 2) conference proceedings, 3) studies that were not categorized as primary research, 4) studies not performed in or pertaining to the European situation. This yielded 245 articles that matched the inclusion criteria and were therefore deemed eligible for the objective of the search. Of these 245 articles we were able to retrieve full texts for 238 included documents.

To analyze these 238 articles an AI algorithm ChatLocal was used to perform a semantic search strategy to improve searching through the papers to obtain answers to the research questions. ChatLocal is a customized local text-mining tool that makes use of OpenAI algorithms. In order to do this, the body of literature was chunked: split into smaller pieces, each about 250 words long, but respecting the sentence boundaries. The OpenAI "text-embedding-ada-002" model was utilized to transform each chunk of text into an embedding, which are vectors with a dimensionality of 1536, and stored all these embeddings (with a link to the original paper and page) in a database. To obtain relevant papers, we took a set of research questions, and transformed each question into a similar embedding with the same model. After this, we were able to do a similarity search using cosine similarity with the embedding vectors, obtaining an ordered list of chunks that were closest to the question. The best matching documents (n=10) were then analyzed by hand by the researchers to retrieve the substantive information. One study (Chien et al., 2022) was deemed unfit for analysis: the text came across as incoherent rather than informative and parts of the article involved

mathematical reasoning with econometric formulae on energy consumption, whereas the conclusions stretched these findings to a brief mentioning of energy poverty; thus the paper was deemed irrelevant, and considered a false hit of the AI algorithms. The remaining nine articles were qualitatively sound and in fact mainly review articles, and therefore studied in detail. Furthermore, these nine articles referenced other literature that was retrieved in the process of drafting the text of this review. After carefully studying these 9 articles we identified gaps in the information on specific EP-vulnerable groups and EP-contexts and therefore identified 5 more articles as suggested by Chatlocal as relevant for these topics.

1.3 REPORTING THE LITERATURE REVIEW

To guide the literature search the research team drafted a number of guiding generative questions for weeding through the vast literature on energy poverty. The questions were articulated in such a way as to also optimize the text mining search of the Chatlocal application and were as follows:

1. What are proven interventions to reduce / alleviate energy poverty? Which interventions to reduce / alleviate energy poverty are effective?
2. In which contexts do interventions for energy poverty reduction work?
3. Which contextual factors are relevant for the success of interventions for reducing energy poverty?
4. For which specific target groups do interventions for energy poverty reduction work?
5. On which mechanisms are interventions for energy poverty reduction based?
6. Which indicators / (outcome) measures / outcomes can be used to measure the success of interventions for energy poverty reduction?
7. Which specific groups are vulnerable to energy poverty?
8. What are the characteristics of people at risk for energy poverty?
9. How can people at risk for energy poverty be identified / located?
10. How can target groups / hard-to-reach groups be engaged / involved in energy poverty programmes?
11. Which communication strategies can be used to involve target groups / hard-to-reach groups in energy poverty reduction?
12. What are the causes of energy poverty?
13. What are effective strategies / programmes to combat / reduce energy poverty?

In these questions we aimed to include several aspects that were already identified as being important to energy poverty. This was also inspired by the literature on evaluating complex interventions, particularly the realist evaluation approach as also recently applied in energy research (Fell et al., 2022; Middlemiss et al., 2023). This realist evaluation perspective builds on the notion that if evaluation of an intervention takes circumstances in the broadest sense into account this provides a much richer view on its effectiveness than mere indicator-based statistics alone. In order to do that one should also look at the specific characteristics of the target groups involved, the circumstances and contextual factors at play, and the actual mechanisms by which effectiveness is established.

As the list of questions above is relatively long, it was decided for the reporting to organize them in a more readable form. Therefore, in the following chapters the findings will be reported in terms of answers to a set of research questions consistent with the structure of the Joint Action Strategy for the SCEPA project. This structure is built around the realist evaluation rationale aspects and reads as follows: WHAT works FOR WHOM under WHAT CIRCUMSTANCES and TO WHAT OUTCOME?

Thus, with the present report we aim to provide insight in the state of the art regarding the way energy poverty mitigation interventions and measures can be deployed in certain contexts by the central actors or coordinators of an energy poverty mitigation approach or policy.

This yields a clustering of the questions listed above as follows:

- What works: Q1, Q5, Q11, Q12 ,Q 13;
- For whom: Q4, Q7, Q8, Q9, Q10;
- Under what circumstances: Q2, Q3;
- To what outcome: Q6.

In the following chapters the findings are presented.

2. WHAT WORKS?

2.1 EXPLANATORY NOTES

The background to this question is to gain insight into types of interventions, measures, approaches, etc. that are reported in the literature. This may pertain to different levels, ranging from large-scale programmes to micro-level interventions within the household. Where possible the (supposed) mechanisms by which the intervention is operable are also described.

2.2 FINDINGS

In order to describe measures and their working mechanisms it is first important to have insight in what these measures should do. Many definitions on energy poverty but overall, in the literature there appears to be general consensus on three main components yielding energy poverty: 1. relative or absolute low income; 2. high energy costs (and thus a high energy bill for the household); 3. insufficient or inadequate insulation of the dwelling (Stevens et al., 2022). In reports discussing what works in energy poverty mitigation we often see a mix of measures focusing on these three components. In spite of this, there are also scholars from critical sociology that contest this component distinction as in their view it springs from a strict techno-instrumental framing of energy as a resource, whereas energy should better be treated as an integral part of everyday lived experiences, and that a very complex and wide-entangled nexus of variables ultimately may result in energy vulnerability or insufficient access to energy for leading a valued and dignified life (Butler, 2022). We will return to this discussion later. Below we discuss the findings from the literature search.

Dalia and colleagues (2020) state that energy poverty can be tackled in the EU by determined, continued, and multifaceted actions, focused on promoting responsible *behavior patterns* and discouraging environmentally harmful and wasteful *energy consumption* on the one hand and, at the same time, *reducing income inequalities* on energy consumption on the other. However, there is a lack of insight on specific behaviors and attitudes of energy poor households, and it is therefore necessary to investigate these in order to address the main behavioral barriers of energy vulnerable households and to develop well-shaped policies and measures targeting them. According to the authors this is particularly important as behavior and attitude are the most important factors why households do or do not take up initiatives designed to relieve their energy poverty. They argue for additional research to enhance energy poverty mitigation policies and measures by recognizing the non-economic rationales in the decision making of the households. This goes particularly for those policies and measures linked to behavioral change, which are currently not adequately addressed by climate change mitigation measures (Dalia et al., 2020).

Based on a study pertaining to the situation in Belgium, Bartiaux and colleagues (2019) provide nine recommendations that can contribute to diminishing the prevalence of energy poverty. Other policy measures or actions could be useful as well, but this selection was made on two grounds. First, what are the most recurrent and urgent demands observed in the field? Second, with the energy poor households in mind, what would contribute to alleviate their harsh situations? The nine recommendations can be related to one of the policy domains *energy policies* (federal and regional competences), *housing policy* (mainly regional) or *social integration* (interventions aiming to provide better social conditions) and are as follows:

Energy policy

1. *To set up or improve a system of minimal gas supply*
2. *To recognize the right to energy as a fundamental right*
3. *To expand the target group of the social tariff*
4. *To prevent abuse when selling energy by door-to-door or phone*

Housing policy

5. *To institute stronger legislation on rents*
6. *To incorporate insulation standards into the existing law on healthy housing*
7. *To shift the risk of a condemnation of a dwelling away from the tenant*

Social integration

8. *part A - To better coordinate Public Centers for Social Welfare/Action and NGOs; part B - To encourage the creation of "Energy Clusters"*
9. *To develop the capacity for action of people living in energy poverty*

The above recommendations are policy-based and do not in detail prescribe specific interventions or actions of which the effect could be measured. Nevertheless, a clear argumentation on each of the recommendations is provided in detail (Bartiaux et al., 2019). Although the study pertains to the Belgian situation, some recommendations can readily be translated to other contexts. However, this will depend greatly as to whether contextual circumstances are similar to those in Belgium.

Halkos and colleagues (2021) report that various actions suggested in the literature should help to address the issue. They consider *changes made to the living environments* and *high efficiency standards* in buildings key to the energy poverty mitigation process. Architects, designers, engineers, and building specialists should focus on the construction of energy-efficient buildings, such as energy passive houses. In addition, new technologies such as solar PV or smart technologies (such as smart grid technology, web-based geospatial information, intelligent communication technologies) could improve access to electricity and, at the same time, cleaner energy. On a wider level, the energy transition, i.e. substitution of energy sources by renewables, could potentially assist in tackling energy poverty because renewable energy sources are not only alternative solutions benefiting the ecological environment, but they can also be used to provide electricity in non-electrified regions and thus mitigate energy poverty there. Actions for tackling energy poverty should be promoted in a national, continental, and universal level through policies and legislations. For instance, European legislation recognizes energy poverty as a significant problem and promotes the development of national action plans, including social policies and energy efficiency improvements (Pye et al., 2017). In addition, financial schemes, such as funding for the implementation of innovative and energy efficient solutions in houses, for research and innovation on energy-related issues, for energy-saving and/or sustainable energy investments, for sustainable and affordable housing for vulnerable populations, have already been or could be developed by countries in order to address and mitigate energy poverty (Halkos et al., 2021).

Some examples of solutions for mitigating energy poverty at a micro-level are described by Neacsa and colleagues (2020). They describe several practices in Europe in countries such as Spain, Germany, Belgium and the UK of mitigating energy poverty by counseling vulnerable families who encounter difficulties in paying their utility bills. These practices are less costly than financial measures, involve volunteers and can be applied in local communities in European countries. Four projects aimed at reducing energy poverty and improving

household resilience to energy needs are listed below. Note that these projects involve varying sets of stakeholders, have varying financial implications and adhere to different implementation structures:

- The "No Home without Energy" Project (Spain)
  In Spain, about seven million people are affected by utility bill arrears and/or abnormal temperatures in their homes, affecting their wellbeing because of negative effects on health, children's education and personal savings. A non-governmental organization initiated this project to assist them in understanding the content of the bills and acting to reduce costs, while establishing a comfortable temperature inside their houses. The program's objectives are to make recommendations to people about adjusting the electricity supply contracts, to propose measures in order to increase the energy efficiency by thermal rehabilitation works on residential buildings or changing the consumption habits. The foundation's assistants, in case social worker, visited households drawing up a personalized energy diagnosis. The gathered data were utilized to develop an online platform making the advice and knowledge available for other households. From 2013 up to publication date over 4400 Spanish households were reached, resulting in savings of about 125 euro per household per year on average, and a total of about 550,000 euro per year.

- The Plymouth Energy Community Initiative (UK)
  In Plymouth, a social enterprise, The Plymouth Energy Community Initiative (PECI), was founded by over 1500 people, economic operators and non-profit organizations to render energy production, purchase and use more efficiently. PECI targets both natural persons and residents on the one hand and local authorities, public institutions and economic organizations on the other. The project offers advice regarding energy efficiency and cutting costs, but also provides an investment scheme for people to buy social shares with values between 50 and100,000 pounds to enhance public ownership on the project. Such a scheme gains them membership of the Plymouth Energy Community, eligibility to enter the organization's board and a 6% interest rate of the capital invested. The collected funds are invested in solar panels in public areas such as schools, public buildings and in community-led housing. This helps to reduce the respective energy consumption while extra revenues are transferred to Plymouth Energy Community, creating a social business model in which citizens benefit from renewable energy at reduced costs, investors collect interest, and means are generated for new sustainability projects.

- The Papillon Project (Belgium)
  Many households in energy poverty in the Flemish municipality of Westhoek own energy inefficient appliances that consume three to five times more than new ones but cannot afford to replace them. A company producing electric appliances teamed up with local authorities. In the project 100 households were offered to rent new appliances for a fee of seven euro per month, covering installation, maintenance and warranty for a period of 10 years. A social enterprise owned by the local authority pays the leasing fee once per year to the supplier of electric appliances who remains the legal owner. After expiration of the contract, the appliances are returned to the supplier for reuse or recycling. The project fits a broader circular economy strategy.

- The Program for the Reduction of Interruptions in Electricity Supply (Germany)
  In Germany 370,000 cases of disconnection from gas and power networks occurred in 2017 alone. To counter this, in the German state of North Rhine-Westfalia an integral program was set up with energy suppliers, local authorities, institutions of social protection, and NGOs implementing various activities such as offering advice to vulnerable consumers and providing legal representation in their relationship with energy suppliers and associated services, organizing debates, lobbying for domestic consumers, and public communications activities. By the date of publication of the paper, the program provided legal and technical advice to over 15,000 consumers, prevented disconnection for 80% of the households that benefited from advice and representation, succeeded to revoke over 60% of already operated disconnections, and increased public awareness about energy poverty (Neacsa et al., 2020).

The Energy Measures Horizon 2020 project, investigating tailored measures supporting energy vulnerable households (Breukers et al., 2021) provides an extended overview of types of policies and measures relevant to alleviate energy poverty supported by data from the EPOV (Energy Poverty Observatory). The report explicitly does not focus on evaluating actual quantitative and qualitative impact of these measures, but it assesses how national and subnational policy measures to mitigate energy poverty are intended or are expected to impact the resilience of energy poor households. The types of policies reported are:

- Financing energy performance improvements

Most common to counter energy poverty structurally is to financially support dwellers to fix improvements in the energy situation of households: building insulation; cooling system; energy storage; heating system; household appliances; renewable energy; transport.

- Disconnection protection

It is important to protect households against disconnection, particularly in colder months during wintertime. Disallowing disconnection completely during wintertime for households with certain physically more vulnerable individuals, such as disabled and pensioners, is most common.

- Energy audits

Providing tailored advice to vulnerable households on how to improve their specific situation based on home visits. This tends to be quite successful in reaching households, as often other social organizations, such as social workers or health professionals, are also involved.

- Reducing burden of energy bills

Providing financial assistance to reduce energy bills help households to reduce the burden of energy bills in the short-term either through *energy bill supports* (financial assistance or subsidies to pay energy costs) or *social tariffs* (lower energy tariffs for energy vulnerable households);

- Information and awareness

Measures providing advice, information or education to householders thereby indirectly supporting them to improve their situation.

- Social support

Providing general income support to vulnerable households.

Palma and colleagues (2022) show that increasing the energy efficiency of buildings can be achieved through so-called *passive* measures, such as improving the building envelope energy performance for reducing energy needs. Alternatively, *active* measures targeting energy consumption reduction can be applied such as the use of more efficient electric appliances and Heating, Ventilation, and Air- Conditioning (HVAC) equipment for reducing energy consumption. Both types of measures are highlighted and prioritised by the European Commission in the Energy Performance of Buildings Directive (EPBD) 2010/31/EU. The REPowerEU plan underlines the importance of energy efficiency for the EU's energy transition and independence, encouraging the roll-out of heat pumps for increasing energy savings and reducing gas consumption in buildings (European Commission, 2022b). Active measures in homes have been shown to be effective in ameliorating energy poverty (Boardman, 2013). The results from a case study in Portugal indicate that the increase in energy

efficiency in residential homes in Portugal reduces energy poverty levels when assessing vulnerability with a multidimensional approach for regional assessment (Gouveia & Palma, 2019).

With respect to interventions specifically directed towards energy poverty related health problems, Middlemiss and colleagues conducted a review of 27 papers focusing on interventions involving substantial energy renovations on health (Middlemiss et al., 2023). A clear relation between energy poverty and health problems was established, which works in two directions: energy poverty can create health problems, such as respiratory conditions, cardiovascular disease, anxiety, depression and other mental health and social problems (Marmot Review Team, 2011), but health problems can also create special vulnerabilities for energy poverty such as when a certain in-house temperature is necessary to relieve muscular pains or because having a disability correlates with having a low income. The review yielded three main interventions in mitigating energy poverty-related health problems, in case: 1. *Improve insulation*: adding in roof, floor or wall insulation, or double glazing windows and reducing drafts; 2. *Improve heating systems*: replacing a boiler, adding central heating or installing a renewable energy source; 3. Both 1 and 2: improving both insulation and heating systems (Middlemiss et al., 2023). In brief, studies assume that substantial energy renovations will increase indoor temperature, reduce exposure to cold and reduce humidity in the home, all of which are known to have positive mental and physical health outcomes. Specifically, mental health improvements noted in these interventions include improvements to perceived quality of life and to overall wellbeing and emotional security. Physical health improvements include better general health, better respiratory health in children and improved health for those with existing conditions. It is also expected that increased indoor temperature, reduced exposure to cold and reduced humidity will have positive knock-on effects on financial and social life, leading to fewer financial difficulties and stress and improved family relations and social life. Interventions are expected to reduce financial stress with reduced costs of energy to the household. This leaves more money for the household to spend on other necessities such as food. In addition, both family life and people's sense of control are thought to be boosted by these kinds of interventions. With regard to family life, privacy is especially important for teenagers, whose intergenerational relationships are under pressure at this age. Interventions are expected to expand household living space in the winter resulting in better family relations. In sum, when the relation between energy poverty and health is considered, the complex nexus of relations between energy and broader wellbeing is evidently clear. Moreover, Middlemiss and colleagues recommend that interventions should take into account how people will respond to technical measures, that space and means to adapt are facilitated, that inclusive design is applied, and that delivery can be flexible and tailored (Marmot Review Team, 2011). This article thus shows how energy poverty is tightly connected with other issues such as health illustrating the importance of developing integral approaches and holistic views with respect to energy poverty mitigation, as is also advocated in Butler (2022).

Dalia and colleagues (2020) describe several studies that showed the intensity of energy renovation being linked with the age of households: willingness to engage in energy renovation is much lower for those over the age of 70 than that of the younger population. Retired homeowners face an additional hurdle with high heating and maintenance costs of under-occupied apartments since grown kids have left the country and do not have plans to return. The areas with the least energy-efficient building stock and the highest heat consumption levels often correlate with the incidence of elderly, retired, low-income and vulnerable households. This indicates that disadvantages of many kinds tend to cluster with energy poverty, suggesting that it is at least difficult to separate out energy poverty from general poverty (see also Butler, 2022). With respect to energy renovations another issue is linked with collective decision making in multi-apartment buildings as such processes become very complex when owners are mutually dependent or have diverse and sometimes conflicting interests due to age, education, awareness and income differences. This is a significant problem for policies and measures aiming to modernize and enhance energy efficiency multi-apartment buildings as current schemes often fail to solve such issues (Dalia et al., 2020).

One of the studies Dalia and colleagues refer to is from Portugal (Palma et al., 2022) in which a methodology is proposed to assess the impact of energy efficiency upgrades, in case the replacement of domestic space heating and cooling equipment, on regional energy poverty and carbon dioxide emissions. Results show significant reductions in energy poverty levels, especially when considering equipment replacement and profound change in the national equipment stock. The outcomes of this study, although specific to Portugal, emphasise the need for investigating heating and cooling systems replacement at a wider scale, as it can have a triple positive impact in simultaneously tackling the major challenges of energy poverty alleviation, decarbonization, and energy efficiency in other geographical contexts (Palma et al., 2022).

Kanellou and colleagues (2023) provide an extended overview of EP policies from the POWERPOOR project Approach in the following countries: Bulgaria, Croatia, Hungary, Greece, Estonia, Latvia, Portugal and Spain. They distinguish 4 stakeholder groups: 1. Sub-national governments; 2. National governments; 3. Civil Society and 4. Private sector. Based on the lessons learnt in each of the countries key policy recommendations are proposed to alleviate energy poverty per stakeholder group per country (Kanellou et al., 2023). Their main conclusion is that the need to empower citizens is prominent. The authors state that bottom-up approaches should be fostered, and local authorities should take up a central role in alleviating energy poverty. Local heroes can also play a crucial role in accelerating progress in these bottom-up approaches and training them to understand energy poverty and how to mitigate it is essential. One-stop shops providing information and guidance to energy poor within the local authorities can also be key. At the same time, energy poverty mitigation actions call for collaboration between the different stakeholder groups. Across the EU, there is considerable, untapped potential of leveraging joint energy initiatives to democratize energy; however, the notion is still not developed at a policy level, and these initiatives remain untrustworthy among the public, especially for the eight countries they studied (Kanellou et al.,2023).

Stevens and colleagues (2022) are currently performing a controlled trial, which is in progress at the time of writing of this review and involves an interdisciplinary approach to counter energy poverty and its effects on health and wellbeing. Their programme entitled WELLBASED aims to reduce energy poverty in six European cities: Valencia (Spain), Heerlen (the Netherlands), Leeds (UK), Edirne (Turkey), Obuda (Hungary) and Jelgava (Latvia). In both the intervention group (n=875) and the control group (n=875) data will be obtained at baseline, after 6, 12 and 18 months of both physical health related as well as mental health related conditions. At the same time energy related data like household expenditure on energy and energy consumption but also physical household data like temperature and humidity will be obtained. A social-ecological model will be used to get deep insight into the interactions between the individual, the community and the physical, social and political context. This model is characterized by fixed factors (such as age and gender), and by a set of modifiable factors (such as personal lifestyle, the physical and social environment). The first results of the study are yet to arrive, as announced in a protocol paper (Stevens et al., 2022). To our knowledge this will become the first experimental design to test causal effectiveness of energy poverty interventions.

To design appropriate policies and interventions the selection of indicators is crucial as energy poverty is a multifactor issue and very much dependent on context. However, the measurement of energy poverty is still a major challenge within the EU, because of shortcomings of databases and indicators. As stated above, different dimensions are related to indicators to define energy poverty, notably income, energy efficiency and energy consumption (Salomé Neto Bessa, 2021). According to Rademaekers et al. (2016) policy interventions in relation to the available indicators can be divided into four categories, i.e. 1) short term financial interventions, 2) consumer protection measures for vulnerable households, 3) long term energy efficiency measures and 4) enhancing consumer awareness.

2.3 CONCLUSION

In short, the review reveals that there is very little explicit information on the actual effectiveness of interventions on the most concrete level. Most of the investigated studies focus on discrete strategies or directives for energy poverty mitigation policies but fail to report on the actual effects of these in practice. This appears due in part to the complex nexus of variables involved: energy poverty is a complex issue, and its multidimensional nature makes it difficult to address it in isolation from the surrounding context. It is therefore important to stress that it appears insufficient to implement a singular intervention, but that multidimensional action is required, targeted at specific groups, contexts, areas or regions based on characteristics of the local setting and involving multiple stakeholders. Moreover, according to Halkos and colleagues (Halkos et al., 2021) policymakers should not focus on short-term solutions but on actions that help to effectively address the problem in the long run with an intervention mix covering the multiple dimensions in a strategy to mitigate energy poverty for a specific population or target group within specific circumstances. Whereas many interventions often focus on direct symptoms by relieving acute needs of target group households, this directs our attention to approaches that focus on structural solutions that support mitigating energy poverty over time. To this purpose good practices should be established in which such long-term strategies are implemented. In spite of the relative lack of information on effective measures, there are certain categories of measures that are indeed good candidates for such an intervention mix, making up basic ingredients for a good practice in energy poverty mitigation.

Based on the current review of the literature above we can draft the following preliminary list of the most common energy poverty interventions that we have come across. Note that the actual effectiveness of these interventions is still unclear, so the list is merely a first version of an overview to be elaborated on further and we do not as yet claim it is exhaustive:

1. Isolation and housing improvements (energy consumption attenuation);
2. Financial support to households (energy costs alleviation and subsidies for efficiency improvements);
3. Coaching of households (home visits, information provision and advice; similar to 4);
4. One stop-shops (awareness raising, information provision and advice; similar to 3);
5. Fixing brigades or similar (technical assistance in small housing measures);
6. Energy communities (empowerment, ownership and participatory processes);
7. Energy campaigns (awareness raising);
8. Energy inefficient appliance replacement (replacing households);
9. Disconnection protection (of householders, sometimes season-based);
10. General social support (general poverty).

In the SCEPA project we distinguish four domains of intervention, and this roughly matches with the above categories of interventions. These domains are:

- *Technical domain*
  Measures in this domain are primarily aimed at enhancing the *bad insulation of buildings* as a key aspect in the definition of energy poverty. The focus is on building insulation, applying cooling systems, energy storage, heating systems, installing household appliances, renewable energy, and transport. But also include energy audits wherein visits to vulnerable households provide direct advice on how to improve their specific situation. These measures tend to be successful especially when carried out together with social or health professionals. Technical measures aim at sustainable energy efficiency outcomes to reduce energy bills in the long-term.

- *Financial domain*
  Measures in this domain generally target the aspects of *high costs of energy* on the one hand, and of *absolute or relative low income* of target groups on the other in the definition of energy poverty. Focus is on energy bill supports -financial assistance and/or subsidies to pay energy costs, social tariffs but also the financing of technical measures. Nevertheless, financial measures often aim at reducing energy bills in the short-term, thus focusing on symptom alleviation. What is necessary is to connect with long-term structural poverty mitigation strategies as well.

- *Social domain*
  In this domain measures mainly target social or societal *causes of high energy costs* on the one hand and the *impacts of low income and energy poverty* on the other. Focus is on information, awareness and social support. Social measures generally aim at addressing underlying issues to enhance general income and to improve overall living situations of vulnerable households.
  However, social measures should target the aspects of wellbeing that energy services contribute to as well, such as mental health.

- *Governance domain*
  Measures in this domain target the systemic contexts of local energy practices, particularly concerning collaborating actors and decision-making. The focus is on national and/or local government subsidies and disconnection protection. Governance measures often aim at guaranteeing vulnerable households to be able to warm their homes, especially during wintertime, by stimulating networks of actors to facilitate this. However, analogously these measures should also aim at improving alignment and collaboration in terms of the long-term approaches that support structural change.

Before applying interventions, it seems logical to determine not only the measure domain it is targeting (technical, financial, social, governance) but also what the scope of the intervention will or should be. However, how the various interventions or measures that are available spread over the domains needs further scrutiny. As seen in the example of energy audits described above, it appears effective to address technical and social issues at the same time, which in some countries is referred to as so- called *coupling opportunities*. This may seem challenging, but the energy transition could improve the energy poverty situation and overall quality of life for their (vulnerable) citizens. Moreover, despite the relative absence of information on effectiveness of concrete interventions, this suggests a promising direction for developing integral approaches to crafting effective strategies in energy poverty mitigation.

One more note on the distinction of levels of actions: An energy poverty mitigation practice may entail multiple distinct measures. A specific measure can be implemented across various interventions. For example, a one-stop shop as an intervention may be set up to provide technical advice, as well as being an entry point to provide social support or assistance in understanding the utility bill or filling in the forms for financial support with covering energy costs. This one-stop shop may be an essential part of a local energy mitigation practice which may also contain other interventions such as a subsidy scheme, and energy coaches, which each tap into various energy poverty mitigation measures. In other words, it is important to disentangle what one is aiming for with what intervention or measure, how that is consistent with other interventions and policies at play. Such an integral view should be a decisive factor in determining a local strategy and local action plan.


Account Number
Enclose this coupon when mailing
Power may be turned off
Account Number
FINAL NOTICE for electric use at
records, your account is past due. This
or assist agency commitments made since the
To Avoid Power Turn Off and Extra Fees,
Amount
Must Be Paid By
August 27

3. FOR WHOM?

3.1 EXPLANATORY NOTES

The question for whom energy poverty measures are meant is highly tied up in the question which target populations are in energy poverty and at risk for becoming energy poor. As can be expected this may entail various kind of national factors, as systems may vary across countries in Europe, not just energy systems, but also economic systems, social institutions and laws and regulations, all leading to certain individuals and groups becoming energy poor within that specific context.

3.2 FINDINGS

There appears to be geographic diversity as to where energy poverty is most prominent and how it manifests. According to Halkos and colleagues (2021), the highest energy poverty levels in the EU states occur among Eastern and Southern European countries, while the lowest levels are found mainly in Scandinavian countries. Particularly Bulgaria, Cyprus, and Romania are the countries which showed the highest levels of fuel poverty based on the European Union Statistics on Income and Living Conditions indicators (EU-SILC). The EU-SILC project was established in 2003 to monitor poverty and social inclusion. Next to data on issues as income, poverty, social inclusion and living conditions, it provides data on the three main indicators to measure energy poverty, i.e. the *inability to keep the home adequately warm*, *arrears on utility bills* and *the presence of leak, damp and rot in the dwelling*.

Halkos and Gkampoura (2021) showed that the economic crisis worsened conditions of energy poverty in these countries but also elsewhere. It was found that energy poverty conditions were worsened during the time-period when the impacts of economic crisis were visible, and they found that the studied Balkan countries, particularly Bulgaria suffered from high levels of energy poverty during the years 2004–2019. The Energy Poverty Multidimensional Index (EPMI), developed by Bollino and Botti (2018), focuses on affordability and efficiency as two main dimensions of energy poverty, showed that central European and Mediterranean countries, such as Greece, Bulgaria, Cyprus, Hungary, Lithuania, Latvia, and Portugal had significant levels of energy poverty for the years 2012 and 2014. In contrast, in Scandinavian and northern countries, such as Denmark, Norway and Iceland, low levels of energy poverty were observed (Halkos et al., 2021), even though winters can be fierce. Thus, there appears to be a geographical divide in the occurrence of energy poverty levels across European countries (Dalia et al., 2020). This geographical divide also appears in a subnational sense, in that households in rural areas tend to be more prone to energy poverty than in the cities, since their homes are often in remote areas and in a less energy efficient state than in more urban areas.

Also, between various strata in the population there is diversity in who is affected by and therefore should be subject to energy poverty mitigation measures. Dalia and colleagues (2020) describe several studies in which scholars have defined various household variables that impact energy poverty: families with children, pensioners and disabled people have a greater chance at becoming energy vulnerable and energy poor. The most vulnerable households reside in low energy efficiency homes with poor inflexible heating systems without abilities to regulate heating or to switch to other forms of energy supply, mainly in eastern European and former communist countries such as Hungary, and Lithuania. Because adequate energy services are not available this deepens inequalities in housing situations. Also, tenants without regulated rents and owners with mortgages experience energy poverty because they deal with financial limitations for improving energy efficiency of their homes compared to the tenants having regulated rents or homeowners without mortgages that do not bear the burdens for these processes themselves (Breukers et al., 2021). In other words, financial burdens increase the risk of becoming energy poor because one is unable to improve the home (Straver et al., 2020). Moreover, people living in detached houses are more disposed to energy poverty than those living in multi-flat buildings because external walls in homes of the former are generally less energy efficient. Furthermore, people living in rural areas tend to have more struggles to heat their houses adequately, because they have restricted energy supply options and high deprivation rates in rural areas. Lacking supportive structures from governments or agencies may also be unhelpful in some countries (Breukers et al., 2021).

González-Pijuan and colleagues (2022) highlight the devastating effects of energy poverty on children during their childhood. They found physical impacts like poorer respiratory health as well as effects on psychological wellbeing. As for the latter, teenagers living in poor energy conditions are more likely to get involved in alcohol, drug abuse and violence. It can have an impact on their need for intimacy, difficulties assessing social technologies and having good relations with peers. If parents suffer from financial stress or depression, this will likely affect children's wellbeing. Moreover, living in an energy poor environment has a negative impact on educational development. Therefore, they state that policies should have a children-centered perspective rather than a family-centered perspective in which children are merely viewed as normal family members and not addressed in their specific characteristics. Authors conclude that it is necessary to get insight into the distinct behavior and needs of children and teenagers as an important element of sensitizing energy policies (González-Pijuan et al., 2022).

Why are people at risk for energy poverty? These are generally the households with the lowest incomes. According to Halkos and colleagues (2021) socioeconomic and environmental (macro-) factors, and (micro-level) household characteristics can also play a role in the occurrence of energy poverty. In the literature, the main factors that could increase the number of energy poor households in a country were traced (Halkos et al., 2021, p. 9). Specifically, a household's low income can be considered a key driver to energy poverty, since high energy costs, as a share of income, can lead to energy poverty. Thus, the availability or absence of means is an essential element in energy poverty. Further, income also correlates with other household characteristics, such as size, tenure, building quality, insulation, which can all influence the risk at energy poverty. Also, a household's location may affect energy poverty conditions: households in rural areas (based on EU studies) report higher levels of energy poverty. Available fuel sources and/or higher levels of poverty in rural areas might also explain this influence: particularly in eastern European countries rural households tend to still use solid fuels (coal and wood) as natural gas is more expensive. A household that is poorly insulated and has energy losses, uses older equipment and domestic appliances, has an inefficient heating system or has damage and leaks, is energy inefficient and is more likely to lead to energy poverty for its householders. Also, a higher room count within the house can impact a household's ability to keep adequately warm.

Awareness and insufficient information of energy issues with householders is also important, since a lack of access to necessary insight on how to improve energy related issues (e.g., how to switch energy suppliers, how to save energy, how to receive subsidies) could increase energy poverty levels in some households. This obviously induces an inequality gap, as these households are unable to benefit from support, whereas others can. Thus, households with insufficient access to adequate energy services are particularly at risk for energy poverty. However, what determines insufficient and adequate needs to be specified in the context. This will be further discussed in Chapter 4 in which we report on circumstances.

Current economic and political systems can play a key role in energy poverty: some former socialist states in the EU report higher levels of energy poverty, due to slow progress in the energy transition, state-owned energy enterprises, and inefficient heating systems and stocks in households (Halkos et al., 2021). Moreover, the structure of the energy market might affect the occurrence of energy poverty: liberalization and competition in energy market systems can influence products and tariffs of energy services. More generally, economic and political developments may affect a household's income and thereby have severe

consequences for the risk at energy poverty. Environmental conditions, such as climate and weather, may also impact energy poverty as they may affect energy demand for a dwelling's heating and cooling. Paradoxically, some studies show that Southern European countries face higher levels of energy poverty, despite their milder climate, due to inefficient housing and heating systems and economic recession. In addition, changes in climatic conditions (climate change) could lead to energy poverty, since they cause natural disasters, changes in energy needs and energy demand, and changes in energy service prices.

Regarding the engagement of people at risk for energy poverty, Middlemiss and colleagues (2023) report on a number of studies that deal with interventions regarding health-related energy poverty issues. Regarding the success of such interventions the define three key characteristics of the interventions in relation to the targeted groups, i.e. 1. *fidelity* defined as the extent in which the intervention was delivered as intended, 2. *adaptation,* defined as things that needed to be changed to make the intervention work and 3. *reach,* defined as whether the intended audience is reached by the intervention. While initially energy renovations often commence as a merely technical issue, further on in the process social characteristics of the households gain foreground and appear to play a very important role in how the intervention takes shape. In the realist (evaluation) approach literature it is a well-established insight that people have diverse needs, and will therefore react accordingly, instead of uniformly (Fell et al., 2022). Therefore, it is necessary for intervention programmes to be flexible so that (the implementation of) measures can be adapted to specific people, target groups and their needs. Middlemiss and colleagues thus argue that to facilitate this, it is helpful to involve inhabitants from the start, in both design and delivery aspects of the trajectory. Involving target groups could in fact qualify as a one-approach-fits-all solution for development of a local tailormade strategy, as it maximizes the utilization of implicit knowledge about local characteristics.

3.3 CONCLUSION

In sum, as regards the question for whom measures to mitigate energy poverty are targeting and are effective, this generally depends on those parts of the population with whom the principal drivers in the definition of energy poverty coincide: low income or large proportion of the income spent on energy, high energy costs and bad equipped housing, and possibly energy consumption as a separate variable. This may however differ with specific contextual variables. A particular highlight is on vulnerable groups such as people with various kinds of disabilities and pensioners, in the case of older people (Breukers et al., 2021). However, how specific vulnerabilities or disabilities lead to energy poverty or related issues seems to depend largely on the specific national systemic contexts and specific characteristics of the household and persons within the household, and the various kinds of more general support that are locally offered to these vulnerable households. To categorize which energy poverty mitigation measures are suited for whom this is complicating as people's or households' specific vulnerabilities will effectively depend on how their characteristics work out in an enhancing or supporting context from which their functioning cannot be viewed as independent. In other words, we cannot sift individual characteristics of target groups from their contexts. In the example of retired homeowners of whom the kids do not longer live in the same house, and must pay all living costs themselves, are thus confronted with high costs for heating and maintenance of the apartment (Weinsziehr et al., 2016), thus the prevalence of energy poverty depends on many factors. Because of this complication, a tailored approach in which the specific target groups are consulted and asked to bring in their context-specific insiders' perspective would enhance the fit of interventions. As such, it appears well-placed to develop a strategy in which specific target groups are involved in the design of strategy and interventions as to allow for a close alignment with their needs and flexible implementation in their contexts as also stated by Middlemiss and colleagues (2023). Although the latter study was focused on the interventions to improve health in contexts of energy poverty, it appears plausible to state that their recommendations hold for energy poverty interventions in general.

Another issue that is to be taken into account is brought forward by Butler (2022) and regards the entanglement of energy poverty in the broader context of general poverty. As becomes clear from the literature, it is often the case that a distinction is made between energy poverty on the one hand and general poverty on the other. Butler (2022, p. 129) points out that with energy poverty there appears to be a tendency to acknowledge that measures are warranted to support households and that it is legitimate for these target groups to accept that support. Contrastingly, apart from the fact that they fall under the umbrella of social and welfare policy in general, for households in general poverty there seems to be a tendency to view them as being responsible for their situation themselves. Based on Butler's study on energy poverty policy the distinction between energy and general poverty may therefore be viewed as artificial and in fact lead to worsening effects on health and social wellbeing of the groups targeted as also in their lives energy is an indispensable part of everyday life.

4. UNDER WHAT CIRCUMSTANCES?

4.1 EXPLANATORY NOTES

The background to this question is to explore the circumstances and contextual variables that affect the working of certain measures. In the previous chapter we already noted that target groups only become vulnerable because of the interaction between individual characteristics and their contextual settings.

Note that context is to be conceived broadly: it may refer to geographical or environmental aspects, but also to psychological or social variables associated with a specific target group. In this respect a division between environmental, social and personal factors may be useful as for instance applied in the capability approach to designate contextual variables (Robeyns, 2017). Furthermore, Breukers, Young and Adjini (2021) also refer to the subdivision between environmental, social and personal albeit in terms of the types of resources influencing energy poverty. Thus, in answering this question we aim to zoom in on both integral contexts and salient contextual variables.

4.2 FINDINGS

The literature search yields a variety of different contexts in which certain specific interventions work. Much empirical literature describes the context within which the data were gathered. However, a specific relation between what is to be considered context and energy poverty mitigation measures is unclear. What is more prominent is that certain contextual *factors* are determined that are linked to the effectiveness or feasibility of a specific measure. For instance, specific target populations for local approaches are mentioned, but reports do not specify large scale systematic relations between a measure or intervention being effective with a certain population in a certain setting. Or certain groups that are culturally used to having higher indoor temperatures could be targeted specifically with an awareness-raising campaign. It appears that measures are selected particularly based on certain features that are identified in the context and evaluated as fitting with a certain measure. This makes it more difficult to make general statements on how contextual circumstances determine what interventions to follow through, as this will need to be decided on locally. However, some of the literature does report on this more abstract level.

In Halkos and colleagues (2021), for instance, an overview is provided for how energy poverty manifests in different parts of the world. In Europe the emphasis is on affordability of energy for and efficiency of energy use in homes, primarily but not exclusively pertaining to keeping warm or keeping cool. In Africa, however, the context is more on energy deprivations in general pertaining to the availability of energy and electricity for all kinds of everyday activities such as: cooking, lighting, household activities, entertainment and education and communication. In Latin America emphasis is on general access to energy services, but this seems heavily dependent on the varying stages of development of these services and (societal) infrastructures in the areas or countries under investigation. Finally, in Asia, energy poverty seems to manifest mainly in inadequate basic access to energy. Thus, although not all per se directly relevant information for the European context, it is feasible that the global differences in context between these regions can also inform the types of approaches and measures taken within the European context.

This brings attention to the fact that it is important to keep in mind that the demarcation of the definition of energy poverty one utilizes guides the approach that is selected, and thereby may have consequences for target groups that are being missed (Butler, 2022). For instance, if one addresses energy poverty in terms of energy consumption only, this may result in disregarding that a certain area or region is less well catered for in terms of energy infrastructure. Or that sufficient access to energy infrastructure with low electricity or gas consumption may miss the fact that people use solid fuels such as wood or coal to keep their homes warm, which is particularly the case in eastern European states. But also, that in certain of these states fuel poverty (pertaining to fuel for heating but also for cooking) is the core of the problem rather than the more general energy poverty. The literature generally takes these variables into account, but it cannot be enough emphasized that definitions matter and should always be scrutinized while working in practice. Thus, even though in Europe energy poverty will generally manifest as the inability to keep one's home adequately cool or warm within a reasonable range of resources and circumstances, it cannot be ruled out that other more specific manifestations turn up. A particular question for local policies should be acted upon accordingly: *to what extent can such and such effects be expected in this local setting and what exclusions of population segments may be the result of choosing this particular definition?* This all the more emphasizes the question "What is energy for?" to be taken seriously at all times and for all groups under all circumstances (Butler, 2022; Day et al., 2016; Simcock et al., 2016).

According to Neacsa and colleagues (2020) energy poverty is also related to geographic context and the development stage of each country. They argue that the factors contributing to energy poverty that they identify as central, i.e. low incomes, high energy prices and poor access to a suitable energy system have contextual components and that in both developed and developing countries, and both in cold and warm areas, these factors may induce energy poverty based on the local nexus of variables. Moreover, various kinds of (groups of) people experience energy poverty. For example, differences in needs of energy power may vary depending on the family composition where seniors use other appliances than children. But also, household members' health conditions may affect the need for warm homes, or whether they work from home or not. Moreover, interventions must address the household's specific characteristics and consider the corresponding context like urban or rural and evaluate this against an accepted view of whether this reflects what is to be considered consistent with the contextual circumstances for a valued and dignified life. Such wide-ranging potential contextual influences require an integral approach involving different kinds of organizations at many levels, e.g. local communities, NGOs, banks with adapted credit offers, public institutions for the legal framework, and at a macro level subsidy to enhance the availability of renewable energy. Neacsa and colleagues foresee a paradigm shift in which the concept of well-being energy, i.e. the degree of satisfaction of needs, as well as the efficiency of energy use become more central in policy and society. They suggest that it is difficult to apply a single model of energy poverty and fuel poverty to both developed urban and to rural contexts in developing countries, and therefore that to implement interventions successfully, they must be adapted to the very specific local situations in which they are applied (Neacsa et al., 2020). In other words, this underlines the central question: What is energy for with this target group in this particular context?

Breukers and colleagues (2021) go into detail on energy poverty policies in Belgium, Bulgaria, Ireland, the Netherlands, North-Macedonia, Poland and Scotland. They focused on the question of what resources are available to alleviate energy poverty and energy vulnerability. They found that with respect to personal resources, national policies in most countries mainly consider income and do not consider skills, awareness, competences and knowledge as relevant aspects to address as part of their national policy. However, complex bureaucratic systems and procedures in Bulgaria, Belgium, Poland, Ireland and the UK form serious barriers for energy poor households, which they suggest can be tackled by strengthening social resources. Concerning environmental resources, such as the energy efficiency of homes, heating systems and appliances, they see various complex mechanisms. For instance, some countries focus on social housing (e.g., The Netherlands and Belgium) making it easier to accommodate energy poor homeowners individually or via the private rental market. Particularly the lack of effective approaches to address the private rental market is signaled as problematic (such as in Ireland, Belgium and The Netherlands). Moreover, even when financial support for homeowners is available, it is not always recognized that the need to invest upfront with one's own financial means before subsidies can be obtained may form a significant barrier for energy vulnerable or energy

poor homeowners, as is particularly the case in Belgium, Poland and The Netherlands. In the Netherlands, some pilots currently focus on the financeability of energy efficiency improvements for this specific group. Likewise, in Belgium there are also a few sub-national initiatives attending to vulnerable homeowners. The second question addressed by Breukers et al (2021) on differences in the European countries was about the distributive impacts of policy. In all countries (except The Netherlands), some form of energy allowance or energy bill support is provided to decrease the direct cost of energy for vulnerable households. Eligibility criteria are in some instances, however, excluding vulnerable groups (e.g., Poland, Belgium and Bulgaria). Next to such support, in all countries the overall energy efficiency of residential buildings is being improved as part of national programmes. However, no particular priority is given to buildings where energy poor households live. And in addition, improving private rental housing stock, as well as supporting energy poor private homeowners, is a challenge that remains largely unaddressed – except for a few small subnational programmes and pilots (Belgium and The Netherlands). The overall conclusion by Breukers et al (2021) is that several countries are paying more attention to the specific needs of energy poor households and acknowledging by setting up more ambitious national policy frameworks to tackle energy poverty and acknowledging the role of sub- national policy and local public and private policy actors in making these frameworks successful. Moreover, in some countries (such as Ireland, the UK, Belgium and The Netherlands) it appears that bottom-up initiatives are to some extent driving the setting of a governance agenda (Breukers et al., 2021).

Middlemiss and colleagues (2023) focus more on psychological than on geographical contextual factors in their overview study on health effects of energy poverty mitigation measures. They investigate the awareness, priorities and expectations of receivers of the measures. i.e. energy poor households, that shape their responses to health-focused energy poverty interventions and evaluate whether this leads to beneficial or detrimental effects. Regarding awareness, they conclude that it is important for people to understand the relation between warm homes and health effects. Furthermore, if people spend their means on measures to keep their home warm this indeed yields positive health outcomes. Finally, if people choose to live in a warm home rather than in a cold home that has a positive influence on health as well. They also describe mechanisms that explain why people may not be willing to receive interventions. If householders do not understand the benefits of measures, if they fear getting in (more) financial problems, lose autonomy over their energy system, have previously had bad experiences or fear for stigma and therefore do not want to receive support, this may all impact people's willingness to participate and receive certain measures that could in principle benefit their energy-poverty related health status. Moreover, structural barriers like the tenancy type/agreement, or specific characteristics of the household itself may yield particular interventions unsuited for application.

In a study on the POWERPOOR approach Kanellou and colleagues (2023) state that despite the existence of many European energy poverty policies the actual implementation of measures with respect to building improvement faces many practical difficulties pertain to the physical environment. This notably pertains to, for example, the characteristics of the housing, characteristics of the region (i.e., social, economic, climatic), and the type of rental construction or ownership status. They also mention the particularly vulnerable position of certain citizens in Central and Eastern European countries in light of the poor thermal insulation of their houses, historical periods of low energy prices and the presence of an unsustainable energy supply mix, which they attribute partly to the region's history of centrally planned economies. However, Western and North-European countries face energy poverty as well but there it appears particularly prevalent in specific demographic groups (e.g. pensioners, single parent households) or the kind of dwellings which may or may not be sufficiently insulated (Kanellou et al., 2023).

Bartiaux and colleagues (2019) report on an overview study analyzing Belgian policies to mitigate energy poverty. The measures and recommendations they propose are geared very specifically towards the Belgian situation, and therefore provide a clear insight in how one could go about in translating general principles for a specific context. In their approach they apply general knowledge on energy poverty and energy poverty alleviation measures and evaluate whether and how this applies to Belgium and reversely how Belgian policies induce situations of energy poverty. They assert that, ultimately and at least in the Belgian situation, energy poverty is about *distribution*, not just of energy services as resources, but particularly of the actual capabilities for a valued and dignified life that these resources enable. In their view, this makes energy poverty essentially a political issue, that calls for strong policies (Bartiaux et al., 2019).

Other types of variation from contextual aspects with regard to energy poverty also play a role: Chandrashekeran and colleagues (2022) highlight rural-urban divides and seasonal differences, for instance with summer energy poverty pertaining to the inability of cooling down instead of heating. They present an overview of contextual factors contributing to energy poverty, among which: climate conditions, macroeconomic factors, national policies and the role of third sector actors and of social work within the system, gender issues and socio-demographic features (Chandrashekeran et al., 2022). As for climatic variation and the issue of summer energy poverty, Thomson and colleagues (2019) describe three factors that contribute to excessive indoor heat, i.e. risk of exposure, adaptive capacity and sensitivity. Feenstra (2021) shows that women and men are unequally affected by limited energy availability and that women tend to bear greater burdens from living in energy poor conditions.

Therefore, she advocates for a gender framework to be taken into account in addressing energy transition and energy poverty, for which she proposes a set of elements and criteria that can be used in policymaking for a just energy transition. By acknowledging gender differences, the inclusion of such a gender-sensitive component could form an upgrade of existing energy policies by responding properly to gender inequality in energy needs, use and access (Feenstra, 2021).

4.3 CONCLUSION

In an ideal but abstract sense the context describes the circumstances, conditions and environments in which an intervention takes place. It aims to capture the ways in which the more structural aspects of social phenomena shape an intervention's outcomes. For instance, what happens to people during an intervention can be affected by the social consequences of the demographic they belong to and how this affects their access to resources, their expectations and norms of how things should be done and what is and is not socially allowed, and how neatly the intervention fits with their existing roles and responsibilities (Fell et al., 2022). However, what is to be considered context and circumstance is very fluid: there is no broadly accepted definition of the demarcation of the contextual domain that should be included when focusing on energy poverty. Instead, within each policy unit in various countries and settings scope and definitions of relevant circumstances may vary. As such, the picture that arises from the literature shows differences in abstraction levels, i.e. macro/environmental, meso/social and micro/personal contextual factors. It appears that structural energy poverty mitigation requires transformative changes on all of these levels so that measures can settle and deliver in the long run. A distinction between environmental, social and personal factors in circumstances may be particularly useful, as it aligns with accounts of energy poverty that take the capability approach as a conceptual basis.

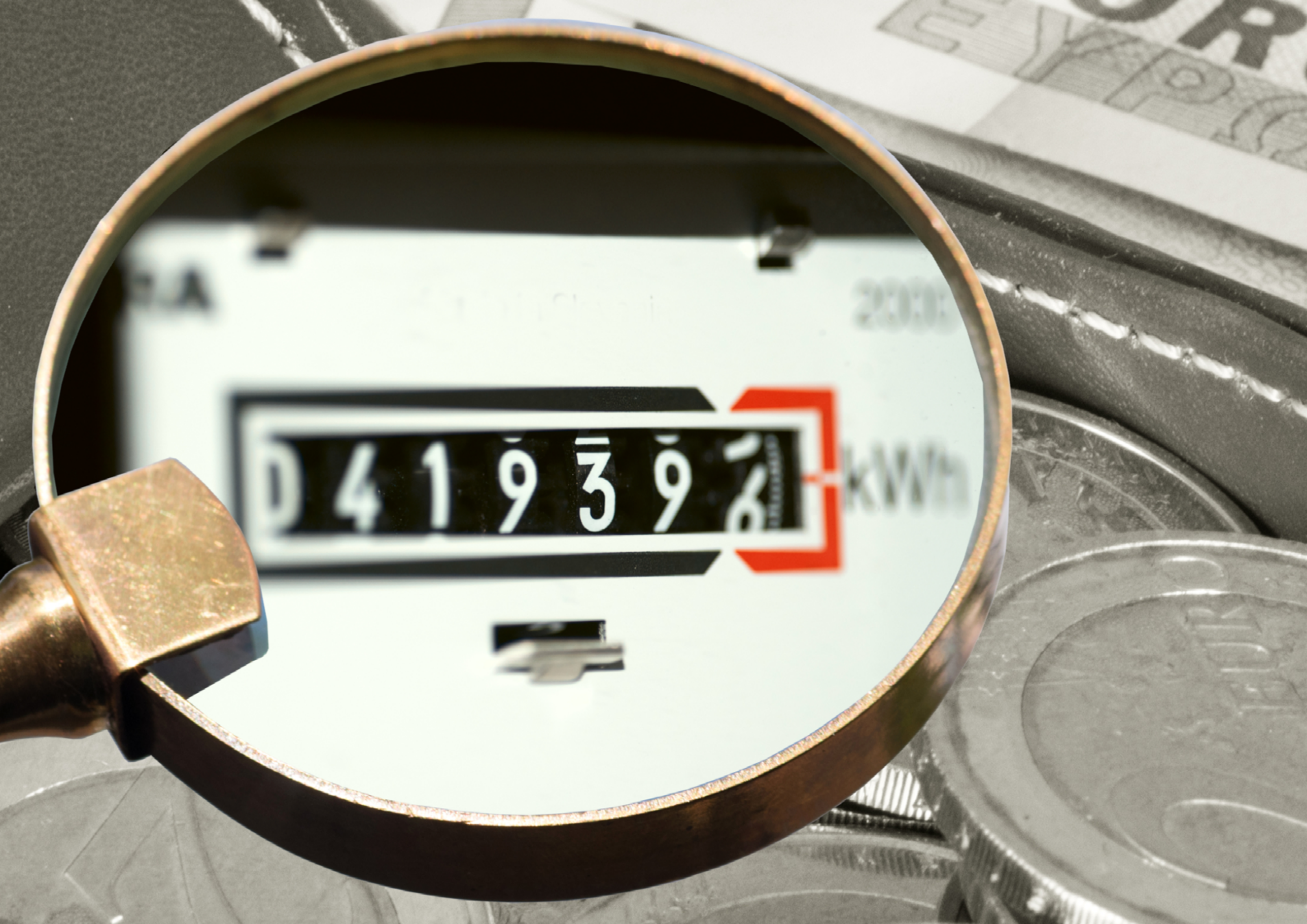
Firstly, *environmental* factors comprise geographical location, e.g. urban/rural/mountain area etc., infrastructural characteristics, wider policy (national, regional, local), the energy provision context and climatic aspects. For instance, it is important to acknowledge whether energy poverty pertains to heating homes

in winter or cooling homes in summer and match policies accordingly. Concerning such geographical differences Bouzarovski (2017) suggests that where a person lives may even be more important than from what socio-economic group this person stems. Although there are many policies aiming at mitigating energy poverty, there are still different barriers and challenges that hinder the real effects on vulnerable households (Kanellou et al., 2023). Implementation of EP-policies face barriers on both systemic level as well as on the level of individual households. A case can be made that energy poverty is a political issue rather than purely a distribution deficiency issue, and thus requires strong policies involving clear distributional choices (Bartiaux et al., 2019) which need to be prioritized in relation to the locally relevant environmental aspects. Considering that in SCEPA we focus on North- West Europe, such differences may only to a certain extent be relevant, but it may be that even their differences may play a role in for instance the energy sources that are used: nuclear energy sources may yield a completely different energy provision landscape than renewable weather-based sources such as solar, wind and water energy.

Secondly, *social* factors comprise the political situation, cultural norms and all forms of social systemic relations that affect energy poverty prevalence and policies. Some of these factors may be encountered in day-to-day practices of household members, in social circles such as the family, at work, in the neighbourhood, at the local football club. This pertains to interpersonal relationships and shapes the way we think, feel and act in everyday life. However, cultural norms may also affect the way in which energy poverty manifests and can be countered, for instance, when accepting support may feel to household members as "being weak" or having failed to live up to the image of being an autonomous self-sufficient citizen or when gendered or other inequalities affect the degree of social vulnerabilities of certain groups. Moreover, policies may also be based on pre-existing social assumptions which are not value-free, thereby narrowing the focus of energy poverty policies to what policymakers want to see rather than what is important to see from a broader perspective (Butler, 2022).

Thirdly, *personal* factors comprise individual characteristics tied to persons in the energy poor or energy vulnerable household such as demographic features, income and educational level, individual capacities, notably energy literacy and aspirations on living a valuable and dignified life. Albeit in the specific context of health focused energy poverty interventions, Middlemiss and colleagues (2023) describe people's awareness, priorities and expectations to shape their responses to energy poverty interventions and describe underlying mechanisms like understanding, fears, stigma and structural barriers why people do not receive interventions such as intended or best befitting. For example, if a person does not understand a technical measure, is afraid of getting (more) into debt or feels embarrassed to ask for help, this may hinder the willingness to be open to an intervention that in principle could help.

In closing, the following remark is important: studies disclosing insights into the circumstances under which interventions are effective seem to hinge on a particular definition of energy poverty. As Breukers et al. (2021) report in their study on energy measures across several member states, the definition chosen in a particular country or state demarcates the domain (target groups, contexts, etc.) for which interventions are operationalized and hence limit the view where effects of the interventions can be seen. Thus, the definition and demarcation of energy poverty will obviously guide the measures taken but thereby may inadvertently limit the scope of influence. This supports Butler's (2022) thesis that policy definitions of energy poverty and the socio-cultural climate from which they stem have a grave influence on how energy poverty is locally viewed, and consequently: what is occluded from sight, or what is targeted at all. This is particularly important, as the studies available, as reported in this review, indicate that there is quite a large environmental component in the causes and consequences of energy poverty. This emphasizes the need for building energy poverty mitigation strategies that cross sectoral divides in policy domains, as this not only opens up a broader view on circumstances and effects, but also acknowledges the complex and plural nature of the role of energy in people's lives in general and the energy poverty phenomenon in particular. In short, it is understandable and desirable to work from a clear definition of energy poverty that is valid locally, but this should not refrain one from keeping a broader view on possible unintended and indirect effects that relate to specific variations in the local circumstances and acting accordingly to foster the wellbeing and everyday capabilities for the households in case.


41939
kWh

5. TO WHAT OUTCOME?

5.1 EXPLANATORY NOTES

In terms of realist evaluation approaches, outcomes describe both the intended and unintended results of an intervention. They are what happens because of the intervention (whether positive or negative), and both direct and indirect effects are considered (Fell et al., 2022). Therefore, with respect to energy poverty mitigation interventions it is important to know what outcomes are desired and how they are measured in terms of outcome variables. Thus, in the literature we searched for indicators, measurements approaches, quantitative and qualitative measurements and results.

5.2 FINDINGS

As far as intended outcomes of energy poverty interventions is concerned this will depend to a large extent on some way of better performance on the same indicators as used to identify and measure the degree of energy poverty by. The main approaches that are proposed and followed in the literature concerning the measurement of energy poverty are the expenditure approach and the consensual approach (see e.g. Bouzarovski, 2017, p. 14). These approaches have been used to evaluate energy poverty in various countries, regions, and income levels. The choice of approach depends on how a particular researcher defines energy poverty. The *expenditure approach* takes into consideration the household's expenditure on energy, using an expenditure indicator, such as the household's energy expenses, its share on income. This indicator is often compared to a certain critical threshold, and it is assessed whether a household is energy poor or not, depending on whether the expenditure metric is above or below a certain threshold as defined. In the *consensual approach*, various, often subjective, measures and metrics are used that can capture the energy situation occurring in a household, such as thermal comfort and adequate warmth, energy affordability, dwelling efficiency. Such metrics can be used as proxies, and they can be combined and evaluated jointly, to identify whether a household is energy poor or not. The necessary data used in the consensual approach are collected via surveys, most notably the EU-SILC standardized survey; thus, self-report measures of how households perform regarding their energy conditions (Halkos et al., 2021). According to Dalia and colleagues (2020) the main approaches to outline energy poverty are systematized in the following way: 1) the amount of energy necessary to satisfy the necessary energy requirements for households such as heating, lighting, cooking and other indoor uses of energy; 2) the amount of expenditures spent on energy as a ratio or percentage of total households' expenditures; 3) the amount energy or the specific type of energy carriers that are in possession of households at the poverty line and 4) the level of income below which energy consumption and/or energy expenditures is not expected to change, indicating that the bare minimum energy consumption level is reached. To our disappointment our literature search did not yield concrete intervention studies that could show clear outcomes in terms of the above, although most studies reported on to describe expected intended effects from an analysis of policy (such as for instance Bartiaux et al., 2019; Breukers et al., 2021) and base their recommendations on these analytical evaluations. More robust evidence in terms of the direct effects of interventions requires effect studies based on experimental designs such as those recently set up by Stevens and colleagues (2022). Note what such studies report is heavily dependent on the type of indicator selected and in fact is not more informative than that it provides insight on performance on that indicator. Therefore, indicator-based studies are naturally limited by the scope of the definitions used.

However, concerning the unintended outcomes (just as with contextual variables) things start to get even more fuzzy. As the main drivers of energy poverty are considered low incomes, high energy prices, and low energy efficiency, it is important to emphasize that within this frame energy poverty is predominantly seen as a situation of material deprivation extending beyond income poverty. However, from our analysis in Chapter 4 we already learnt that the relative importance of the mentioned drivers varies between countries, household types and other contextual variables. Even in richer countries having low energy poverty rates, low-income households may experience energy poverty. In Finland, for example, having a high energy consumption per capita and a cool climate, the portion of low-income people that live in poor quality and low heat comfort homes and that have energy bill debts is twice higher than the country average for the EU. According to Bouzarovski et al. (2012), in Eastern European countries, the high level of energy poverty may be linked to inadequate investment in energy efficiency improvements and inadequate social support levels since the collapse of socialism, while in the UK and Ireland, the overlapping of low income and energy inefficient housing stock yields high rates of energy poverty, although these countries have quite mild climates. On the other hand, in Italy, energy poverty is related to low level of energy affordability due to high energy prices, and in Austria, energy poverty is attributed to energy-inefficient homes causing drastic energy bill increases with energy price increases. In other words, because of the strong dependence on contextual variables it seems feasible that the unintended outcomes of energy poverty interventions should be evaluated and interpreted adequately in terms of the local or regional situation in which the intervention or measure is implemented.

Thus, apart from the apparent lack of studies into clear and robust effects of energy poverty interventions, it seems wise to adopt an approach that adequately helps to gain insight in the local outcomes. For such an approach a broader perspective on energy poverty is needed than a too narrow focus on material deprivation alone, that in fact allows for the integral evaluation of enhancement of the valued and dignified lives that people aspire to live and in which energy plays an integral role (Butler, 2022). In other words, an evaluation aligned with the more general question of: what is energy for?
Chandrashekeran and colleagues (2022) therefore advocate an *energy vulnerability* approach over an energy poverty approach to address the issue. They argue that energy vulnerability implies a time- dependent situation in which circumstances can change whereas a narrow energy poverty approach that hinges on static parameters (such as categorizing demographic strata based on socio-economic variables alone) does not reflect the dynamics and complexities of the energy poverty phenomenon well enough. In a vulnerability approach it is acknowledged that households that are currently not in energy poverty can find themselves in a situation of energy poverty when situations change (Chandrashekeran et al., 2022), which happened to quite a lot of households in some countries considering the huge impact of rising fossil energy prices during the first year of the Ukraine conflict. Thus, a vulnerability approach better captures the potential risk at energy poverty.
In line with this, Bouzarovski and Petrova (2015) list six key factors that contribute to energy vulnerability: access, affordability, flexibility, energy efficiency, needs and practices. These factors, that may interact, form a set of conditions to determine whether a household will or will not be able to require the socially and materially minimum level of energy services and is thus at risk for becoming energy poor or not (Bouzarovski & Petrova, 2015).
Furthermore, notably Day and colleagues (2016), Walker (2014) and Butler (2022), among others, argue for a perspective on energy poverty based on the Capability Approach. This approach developed by Amartya Sen (2001) and developed further by many others (see for instance Nussbaum, 2011; Robeyns, 2017) starts from the assertion that human wellbeing depends on the freedom that people have to live valuable and dignified lives. Thus, wellbeing manifests in the actual realistic opportunities they are provided with in their everyday lives and the capacities they have to redeem those opportunities; these are labeled capabilities. Considering that today's everyday practices of citizens in North-West Europe are very energy-dependent (Butler, 2022), the natural question to ask in terms of outcomes of energy poverty interventions would thus be: *To what extent are people's everyday capabilities actually enhanced as compared to a situation in absence of the intervention?* Note that the answer to such a question might stretch further than the narrow topic of energy poverty variables: it spreads across all life domains that make up such valued and dignified lives in general.

5.3 CONCLUSION

Based on our literature review, only a few studies provide insight into the effectiveness of energy poverty interventions. Whereas such interventions may yield enhancement in terms of the indicators found, what seems missing is a practical integral perspective to evaluate the broader outcomes of energy poverty measures. Studies on mere technical measures for buildings and larger groups of people may be precise and concrete and yield results on the performance indicators proposed, but generally fall short in capturing the complex and localized nature of energy poverty as a multidimensional phenomenon. Furthermore, concrete but all too narrow definitions of energy poverty may hide the unintended effects of interventions from plain sight. However, these unintended effects may not always be beneficial for the broader wellbeing of household members. Therefore, to evaluate outcomes properly, it appears best to apply an integral approach such as energy vulnerability or the capability approach to energy poverty wherever possible.

To really gain insight in the complex outcomes of energy poverty interventions it appears wise to also include the target groups themselves in the evaluation procedure. Doing so would recognize them as being persons with relevant knowledge, which is consistent with one of the principles advocated in the energy justice literature, the principle of recognition justice (Sovacool et al., 2021). Furthermore, it would also be consistent with the principles of the realist approach to implementing and evaluating complex interventions (Fell et al., 2022). In evaluating the outcomes of energy poverty interventions, the question that should be central would then be stated somewhat in the following direction: To what extent does the intervention or intervention package enhance the everyday capabilities of the targeted groups in this local setting based on the collective views of the relevant actors?

6. CONCLUSION

6.1 DISCUSSION OF THE FINDINGS

In the previous chapters we discussed the literature on energy poverty interventions in terms of what works for whom under what circumstances and to what outcome. This yielded a picture of this particular section of the energy poverty literature showing the complexity and multidimensionality of the phenomenon in full view. The total body of literature on energy poverty is much larger, stretching across all geographical areas of the world and from conceptual papers on phenomenology via definitions and measurement of energy poverty to interventions and approaches. However, although even our current focus yielded conceptual grasp on the issues and discussions on energy poverty, unfortunately, the yield in terms of specific information on the effectiveness of interventions is rather limited. The main part of this part of the energy poverty literature reviewed indeed discusses outcomes, but only on a rather abstract level aimed towards policy makers and falls short in providing concrete evidence in terms of what interventions are actually proven or plausibly effective in practice. At the same time, it may have been overoptimistic to expect such unambiguous evidence, given the complexity of both the issue and many interventions reported in the literature. However, currently a controlled trial is being conducted that may provide clearer insight into the causality of interventions under scrutiny (Stevens et al., 2022). Studies of such or other types delving more into causal mechanisms of interventions and their outcomes are needed. In case experimental designs are unsuited (for ethical or methodological reasons), performing realist evaluation studies can provide insights needed to rightly inform practice (Fell et al., 2022). Nevertheless, despite the somewhat disappointing yield of our literature review, we can indeed learn from the insights gained from the literature review. To that purpose we will first sum up our main insights, and then formulate recommendations for the practice of energy poverty mitigation approaches based on these insights.

Firstly, it remains a question what should be viewed as an intervention, a measure or an approach. In the literature these concepts are often used interchangeably or with different meanings across papers, and this does not help gaining integral insight on what has been done in a specific context, who was targeted and what outcome was the result. Moreover, various authors note that some interventions or measures are specifically geared to alleviating the direct burdens of energy poverty or symptoms of energy vulnerability, such as financial support for energy poor households in winter to cover the costs of heating, while other interventions or measures are more directed towards implementing structural solutions, such as implementing collaborative networks of energy suppliers, service companies, local governments and civil society actors to prevent households to fall to energy poverty and enhance their general living conditions (see for instance Breukers et al., 2021). Therefore, it is important to discuss and define as clearly as possible what the intervention or measure entails, which households or persons it targets and what mechanism it aims to influence or mitigate. The literature might help to provide suitable conceptual frameworks for this.

Secondly, the literature clearly points to the complex nature of the phenomenon of energy poverty, and consequently the nexus of relations with contextual variables at play (Bouzarovski, 2017; Butler, 2022). The exact manifestation of energy poverty or vulnerability will depend greatly on contextual circumstances which may be of a local nature, for instance in the existence of micro-practices in the lives of household members in communities and neighborhoods, along a meso-level of collaborating organizations in the provision of energy sources and services, up to the level of macro-level policymaking or cultural norms in countries or states. Thus, it is important to be aware of the fact that reducing this complexity to a single aggregate statistic will necessarily miss out on many relevant and potentially insightful relations and may even have worsening effects. This may for instance be the case if energy poverty is viewed as a phenomenon separate from general poverty, which may induce a cleavage between energy versus social policies leading to inequal treatment of households across situations dependent on whether their situation is categorized as one or the other (Butler, 2022, p. 126). The literature suggests that the most adequate way to gain grip on this complexity and recognize the contextual influences at play locally appears to be to implement a responsive evaluation procedure that includes the perspective of local stakeholders as informants.

Thirdly, and related, this advocates for the implementation of an interdisciplinary and multiprofessional approach, and preferably even a transdisciplinary approach in which members from the target groups in energy poverty interventions are also involved to ensure a good fit with the receivers of intervention measures (Middlemiss et al., 2023). This could yield the local collective insight that will guide policy and practice decisions to be matched to local specifications and needs of the target groups. Obviously, this would require a locally fitting genuine participatory and collaborative strategy to be designed and implemented. This is not an easy task, but the literature suggests this as a promising direction.

Fourthly, the literature suggests that developing adequate policy for mitigating energy poverty should not only focus on energy issues but rather be approached as a socio-technical systems issue, in the sense that it requires action on multiple levels of governance across different sectors in the entire setup of social and material relations is taken into account (Kanellou et al., 2023). This calls for an integral approach that also considers other disciplines' perspectives. This calls for an inclusion of social science and humanities approaches as a counterweight against a too technical approach of the energy transition in general, and of energy poverty in particular (Foulds & Robison, 2018). The consequence of the conceptualization of energy poverty as a systems issue is that it opens a perspective in which various policy domains need to be seen as interrelated, the most obvious being that energy policies and anti-poverty measures should be aligned or at least coordinated. This does not go without saying, as generally these policy fields are separated silos within organizations or departments of governments.

Thus, one should start from the question what energy is eventually for, which brings up a focus on energy services and energy security, i.e. the ability of a society to provide for the long-term needs of its citizens (Bouzarovski, 2017). It must be emphasized that NGOs and local actors facilitating bottom-up participation (Middlemiss, et al. 2023; Pye, et al., 2017) are necessary to render interventions more effective, because they enhance the customized fit between target groups' and households' needs and specific circumstances, than when a more top-down directed program is implemented that capitalizes on large-scale but standardized measures.

Finally, our literature review points clearly in the direction of one particular conceptual approach that is promising as a vehicle for developing effective energy poverty mitigation approaches: the Capability Approach as originally developed by Sen and adopted and enhanced by many others (Nussbaum, 2011; Robeyns, 2017; Sen, 2001). The more recent and most influential literature advocates the application of a capability approach to energy poverty as a promising route for energy poverty mitigation interventions (see among others Butler, 2022; Day et al., 2016; Walker, 2014) and particularly a combination with a sociological approach that focuses on everyday social practices seems most promising (Royston et al., 2018; Shove et al., 2012; Shove & Walker, 2010). The advantages of a capability approach to energy poverty are that it firmly places the question "what is energy for in everyday life?" centre stage. Furthermore, it provides an integral framework for the evaluation whether energy-dependent practices in the daily lives of persons from energy vulnerable households are compromised and whether interventions actually help to restore, support or enhance these daily lives to above a threshold level of what can be considered valuable and dignified.

One more remark should be made on the complexity of energy poverty and its consequent risks in terms of mitigation approaches. In a study examining how energy policies and structures of governance affect energy poverty, Butler (2022, p. 126) claims that if energy poverty is merely seen as an issue of predefined indicators

and classifications to identify energy poverty and apply measures accordingly, underlying issues like overall poverty and injustice will not be addressed properly. This may lead to worsening effects on the incidence of poverty in general as energy poverty may then be viewed as an issue that can be mitigated whereas general poverty due to its less concrete causes may be neglected or left aside as too complex. Moreover, Butler states that most literature and measures with regard to energy poverty deal with the domestic context only, whereas energy use goes far beyond that. Thus, she asserts that a Capability Approach is absolutely necessary to gain profound insight into the lived experiences of people and as a guiding integral framework for policies. One, perhaps unexpected, example she provides is that in current societies ICT demands a lot of energy and ICT-applications are often needed to gain access to systems and resources such as applying for financial benefits when living in energy poor conditions. Therefore, if a person cannot afford a mobile phone or laptop, this will have a double negative effect on the poor energy condition in which he or she already lives. Such 'double deprivations will only become properly visible if the insiders' perspectives of persons are studied. A similar example goes for the energy use with respect to mobility which gains people access to necessary resources and may easily be overlooked as well. To this purpose, Royston and colleagues (2018) introduced the term 'invisible energy poverty' as the negative effects of insufficient access to energy dependent services or resources manifest only in indirect ways (Royston et al., 2018).

In short energy poverty mitigation policies should go beyond a single emphasis on technical measures such as building efficiency but instead focus on the broader topic of human capabilities, quality of life, precarity and lived experiences (Day et al., 2016; Middlemiss & Gillard, 2015; Petrova, 2017; Simcock et al., 2016). Thus, the challenge for all stakeholders in an energy poverty mitigation strategy is to see energy poverty as a result of a dynamic and complex system of variables and to address it from a lived experience capabilities-based perspective (Butler, 2022).

6.2 RECOMMENDATIONS

The complex and multidimensional nature of the energy poverty phenomenon requires an integral and versatile but conceptually consistent strategy to match. This could center around the questions: 1) What is energy for in the everyday lives of people? 2) How are target groups affected by energy poverty in their everyday lives? and 3) What should be done to mitigate those effects in the short-term and in a structural sense? Working through these questions and acting accordingly from all relevant policy angles could provide an integral approach to energy poverty mitigation. Thus, based on the insights from this literature review we make the following recommendations:

1. *Consider energy poverty as a multifaceted problem that as such needs to be addressed in an interdisciplinary approach in which technical, financial and social professionals are involved.*

2. *Enable the participation and collaboration of local target group members: this unlocks the experiential perspective and can either be done by involving them directly, or by proxy of local NGOs or social work organizations that already work with these target groups.*

3. *Consider a capability approach to get a deeper insight into what energy is for and why people use energy and based on that generate action perspectives for interventions. A good starting point could be formed by the lived experiences of people from energy poor households or those at risk for it.*

4. *Focus on long-term mitigation by addressing structural factors, apart from immediate ad-hoc measures for alleviation of symptoms.*

5. *Take context and circumstances into account in an integral way and take care not to overlook relevant but unintended and invisible mechanisms.*

6. *Evaluate the chosen strategy with a realist approach involving as many local stakeholders as possible. This will enrich the collective insight and enhance the match with local target groups, and thereby increase the chances of a successful implementation.*

7. *Work towards a repertoire of potential interventions to form and possibly adapt integral strategies. Determine as precisely as possible the ends and means of the strategy and interventions. This should at least entail a) long term strategy development to induce transition and practice change in the structural and systemic aspects of energy poverty; b) a toolbox of concrete and if needed immediate alleviation measures.*

ACKNOWLEDGEMENTS

Authors would like to thank Thomas Pelgrim for his support and assistance with the literature search and Diana Senden for her support in retrieving all corresponding full texts. We also thank Raoul Grouls for setting up an AI algorithm ChatLocal that was used to perform the text-mining analysis and his willingness to support us with all related questions.

This literature review report was produced as part of the SCEPA project funded by the EU Interreg North-West Europe programme.

REFERENCES

Bartiaux, F., Baudaux, A., Vandeschrick, C., Heymans, E., Oosterlynck, S., Delbeke, B., Lahaye, W., Fournier, F., Sibeni, & Day, R. (2019). *Generation and Gender ENergy DEprivation: Realities and Social policies [2GENDERS]*. BRAIN-BE.

Boardman, B. (2013). Fixing fuel poverty: Challenges and solutions. *Fixing Fuel Poverty: Challenges and Solutions*, 1-244. https://doi.org/10.4324/9781849774482

Bollino, C. A., & Botti, F. (2018). *Energy Poverty in Europe: A Multidimensional Approach* (SSRN Scholarly Paper 3100120). https://papers.ssrn.com/abstract=3100120

Bouzarovski, S. (2017). *Energy Poverty: (Dis)Assembling Europe's Infrastructural Divide*. Springer Nature. https://doi.org/10.1007/978-3-319-69299-9

Bouzarovski, S., & Petrova, S. (2015). A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science*, *10*, 31-40. https://doi.org/10.1016/j.erss.2015.06.007

Bouzarovski, S., Petrova, S., & Sarlamanov, R. (2012). Energy poverty policies in the EU: A critical perspective. *Energy Policy*, *49*, 76-82. https://doi.org/10.1016/j.enpol.2012.01.033

Breukers, S., Young, J., & Ajdini, O. (2021). *Review of EU and national policy affecting energy vulnerabilities in the participating countries*. Zenodo.

Butler, C. (2022). *Energy Poverty, Practice, and Policy*. Springer International Publishing. https://doi.org/10.1007/978-3-030-99432-7

Chandrashekeran, S., Noka, V., & Bouzarovski, S. (2022). Energy Poverty: Measurement and Governance in Europe and Lessons for Australia. In *Australian Economic Review* (Vol. 55, Nummer 4, p. 491).

Chien, F., Hsu, C.-C., Zhang, Y., Tran, T. D., & Li, L. (2022). Assessing the impact of green fiscal policies and energy poverty on energy efficiency. In *Environmental Science & Pollution Research* (EBSCOhost; Vol. 29, Nummer 3, pp. 4363-4374).

Dalia, S., Vidas, L., Tomas, B., Grigorios, L. K., & Josef, A. (2020). Climate Change Mitigation Policies Targeting Households and Addressing Energy Poverty in European Union. In *Energies* (Vol. 13, Nummer 3389, pp. 3389-3389).

Day, R., Walker, G., & Simcock, N. (2016). Conceptualising energy use and energy poverty using a capabilities framework. *Energy Policy*, *93*, 255-264. https://doi.org/10.1016/j.enpol.2016.03.019

Dobbins, A., Fuso Nerini, F., Deane, P., & Pye, S. (2019). Strengthening the EU response to energy poverty. *Nature Energy*, *4*(1), 2-5. https://doi.org/10.1038/s41560-018-0316-8

Feenstra, M. (2021). *Gender just energy policy*. University of Twente.

Fell, M. J., Roelich, K., & Middlemiss, L. (2022). Realist approaches in energy research to support faster and fairer climate action. *Nature Energy*, *7*(10), 916-922. https://doi.org/10.1038/s41560- 022-01093-8

Foulds, C., & Robison, R. (Red.). (2018). *Advancing Energy Policy: Lessons on the integration of Social Sciences and Humanities*. Springer International Publishing. https://doi.org/10.1007/978-3-319- 99097-2

González-Pijuan, I., Ambrose, A., Middlemiss, L., Tirado-Herrero, D. S., & Tatham, D. C. (2022). Overcoming energy poverty in childhood from a policy perspective. *Unpublished Draft*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4252663

Gouveia, J. P., & Palma, P. (2019). Harvesting big data from residential building energy performance certificates: Retrofitting and climate change mitigation insights at a regional scale. *Environmental Research Letters*, *14*(9), Article 9.

Halkos, G. E., Gkampoura, E.-C., & Katsaprakakis, D. (2021). Coping with Energy Poverty: Measurements, Drivers, Impacts, and Solutions. In *Energies (19961073)* (Vol. 14, Nummer 10, pp. 2807-2807).

Kanellou, E., Hinsch, A., Vorkapić, V., Torres, A.-D., Konstantopoulos, G., Matsagkos, N., & Doukas, H. (2023). Lessons Learnt and Policy Implications from Implementing the POWERPOOR Approach to Alleviate Energy Poverty. In *Sustainability (2071-1050)* (Vol. 15, Nummer 11, p.

8854).

Kyprianou, I., Serghides, D. K., Varo, A., Gouveia, J. P., Kopeva, D., & Murauskaite, L. (2019). Energy poverty policies and measures in 5 EU countries: A comparative study. In *Energy and Buildings* (Vol. 196, pp. 46-60). https://doi.org/10.1016/j.enbuild.2019.05.003

Marmot Review Team. (2011). *The Health Impacts of Cold Homes and Fuel Poverty*. Institute of Health Equity. https://www.instituteofhealthequity.org/resources-reports/the-health-impacts-of-cold- homes-and-fuel-poverty

Middlemiss, L., & Gillard, R. (2015). Fuel poverty from the bottom-up: Characterising household energy vulnerability through the lived experience of the fuel poor. *Energy Research & Social Science*, *6*, 146-154.

Middlemiss, L., Stevens, M., Ambrosio-Albalá, P., Pellicer-Sifres, V., & van Grieken, A. (2023). How do interventions for energy poverty and health work? In *Energy Policy* (Vol. 180).

Mulder, P., Batenburg, A., & Della Longa, F. (2023). *Energiearmoede in Nederland 2022: Een actuele inschatting op nationaal en lokaal niveau*. TNO. https://publications.tno.nl/publication/34640439/KjLV5U/TNO-2023-energiearmoede.pdf

Neacsa, A., Panait, M., Muresan, J. D., & Voica, M. C. (2020). Energy Poverty in European Union: Assessment Difficulties, Effects on the Quality of Life, Mitigation Measures. Some Evidences from Romania. In *Sustainability (2071-1050)* (Vol. 12, Nummer 10, p. 4036).

Nussbaum, M. (2011). *Creating capabilities: The human development approach.* Harvard University Press.

Palma, P., Pedro Gouveia, J., Mahoney, K., & Bessa, S. (2022). It starts at home: Space heating and cooling efficiency for energy poverty and carbon emissions reduction in Portugal. In *People, Place & Policy Online* **(Vol. 16, Nummer 1, pp. 13-32).**

Petrova, S. (2017). Encountering energy precarity: Geographies of fuel poverty among young adults in the UK. *Transactions of the Institute of British Geographers*, *43***(1), 17-30. https://doi.org/10.1111/tran.12196**

Pye, S., Dobbins, A., Baffert, C., Brajković, J., Deane, P., & De Miglio, R. (2017). Energy Poverty Across the EU. In *Europe's Energy Transition—Insights for Policy Making* **(pp. 261-280). Elsevier. https://doi.org/10.1016/B978-0-12-809806-6.00030-4**

Rademaekers, K., Yearwood, J., Ferreira, A., Pye, S. T., Hamilton, I., Agnolucci, P., Grover, D., Karásek, J., & Anisimova, N. (2016). Selecting Indicators to Measure Energy Poverty. In *European Commission: Energy: Brussels.* **[Report]. European Commission: Energy. https://energy.ec.europa.eu/selecting-indicators-measure-energy-poverty_en**

Robeyns, I. (2017). *Wellbeing, freedom and social justice: The capability approach re-examined***. Open Book Publishers.**

Royston, S., Selby, J., & Shove, E. (2018). Invisible energy policies: A new agenda for energy demand reduction. *Energy Policy*, *123*, **127-135. https://doi.org/10.1016/j.enpol.2018.08.052**

Salomé Neto Bessa, S. (2021). *A Framework for Policy Mix Analysis: Portuguese Case Study on Energy Poverty***. University of Porto.**

Sen, A. (2001). *Development as freedom***. Oxford Paperbacks.**

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes***. SAGE Publications.**

Shove, E., & Walker, G. (2010). Governing transitions in the sustainability of everyday life. *Research Policy*, *39***(4), 471-476. https://doi.org/10.1016/j.respol.2010.01.019**

Simcock, N., Walker, G., & Day, R. (2016). Fuel poverty in the UK: Beyond heating? *People Place and Policy Online*, *10***. https://doi.org/10.3351/ppp.0010.0001.0003**

Sovacool, B. K., Hess, D. J., & Cantoni, R. (2021). Energy transitions from the cradle to the grave: A meta-theoretical framework integrating responsible innovation, social practices, and energy justice. In *Energy Research & Social Science* **(Vol. 75).**

Stevens, M., Raat, H., Ferrando, M., Vallina, B., Lucas, R., Middlemiss, L., Rédon, J., Rocher, E., & van Grieken, A. (2022). A comprehensive urban programme to reduce energy poverty and its effects on health and wellbeing of citizens in six European countries: Study protocol of a controlled trial. *BMC Public Health*, *22*, **1578. https://doi.org/10.1186/s12889-022-13968-2**

Straver, K., Mulder, P., Middlemiss, L., Hesselman, M., Feenstra, M., & Tirado Herrera, S. (2020). *Energiearmoede en de energietransitie: Energiearmoede beter meten, monitoren en bestrijden***. TNO. https://www.tno.nl/nl/over-tno/nieuws/2020/11/energiearmoede-en-de-energietransitie/**

Thomson, H., Simcock, N., Bouzarovski, S., & Petrova, S. (2019). Energy poverty and indoor cooling: An overlooked issue in Europe. *Energy and Buildings*, *196*, **21-29. https://doi.org/10.1016/j.enbuild.2019.05.014**

United Nations. (2015). *THE 17 GOALS | Sustainable Development***. https://sdgs.un.org/goals**

Varo, A., Horta, A., Gaydarova, E., Schneller, A., Martín-Consuegra, F., & Jiglau, G. (2018). *European Energy Poverty: Agenda Co-Creation and Knowledge Innovation (ENGAGER 2017-2021) Case study: Innovation and energy poverty policies***. University of Manchester.**

Walker, G. (2014). Beyond individual responsibility: Social practice, capabilities and the right to environmentally sustainable ways of living. In Y. Strengers & C. Maller (Red.), *Social practices, intervention and sustainability: Beyond behaviour change***. Routledge.**

Weinsziehr, T., Grossmann, K., Gröger, M., & Bruckner, T. (2016). Building retrofit in shrinking and ageing cities: A case-based investigation. *Building Research & Information*, *45*, **1-15. https://doi.org/10.1080/09613218.2016.1152833**

OPEN UP NEW HORIZONS.

HAN_UNIVERSITY OF APPLIED SCIENCES