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Recognising summer energy poverty. Evidence from Southern Europe

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ABSTRACT
Summer energy poverty (SEP) is becoming a more concerning issue in southern European countries. This is due to the increasing intensity and frequency of heatwaves, which are particularly severe in urban areas. In this matter, scientific literature has grown on topics such as urban microclimate, passive urban cooling or assessing people's adaptability to high temperatures. However, there is still a gap between scientific knowledge and local policies when addressing energy poverty, particularly SEP. This paper aims to bridge this scientific and policy knowledge gap by gathering existing methodologies and approaches to SEP in the context of southern Europe. The methodology consists on a meta-study on the topic, involving analysis and synthesis of multiple and heterogeneous sources. A collaborative collection and revision of nearly two hundred references was conducted, focusing mainly on Spain, Italy, Greece and Bulgaria. Through a screening process, these references were examined and the main ideas, current debates, as well as limitations and boundaries in SEP knowledge were incorporated. Results show that, although authorities have developed local plans to tackle summer vulnerability and energy poverty, a cross-sectional vision is still needed to make operative the scientific advances. Therefore, this paper proposes instruments in the form of definitions, indicators, evaluation methodologies and their policy implications for identifying and addressing SEP in the context of the EU.

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1. Introduction

Several studies delve into the multidimensional nature of energy poverty (EP). From the first definitions and measurements focused on an expenditure-based approach (Boardman 1991), to the latter introduction of a consensual approach based on self-reported assessment (Healy and Clinch 2002), the appearance of new aspects to study and evaluate the phenomenon has continued to grow. The existence of vastly different elements that condition the definition of EP makes it difficult to establish a common global framework. At the EU level, the conglomerate of realities is very diverse (Castaño-Rosa et al. 2019); and even within each country, there are also many factors that condition its measurement and definition. Therefore, there is not a consensus at European level on a common definition. Recently, some drafts have been proposed: during EU Climate Fund Overhaul (Taylor 2022), the European Parliament established that EP was the situation which affects the lowest income deciles and whose energy needs were more than twice the national average; on the other hand, the European Commission, in its proposal for an Energy Efficiency

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Table 1. EP definitions and quantifications for EU countries.

No definition, not quantified
BG, HR, CZ, DK, EE, FI, DE, HU, LV, LT, LU, NL, PL, SK, SL
No definition, but quantified
CY, NO
Official definition and quantified
AT, BE, IE, IT, MT, RO, SP

Directive (European Parliament: TFEU/art194, 2021), proposes a broader definition, understanding that those households with problems of access to essential energy services would be suffering from EP.

This does not mean that some member states have not developed their own national EP definitions and/or quantified the phenomenon. Table 1 shows a list of those countries that have defined or quantified EP, according to the latest published results from the Energy Poverty Observatory (EPOV) (European Commission. Directorate General for Energy 2020):

This paper looks at the existing situation for four southern European countries, where Summer Energy Poverty (SEP) is expected to worsen due to the increased intensity and frequency of heat waves (Founda et al. 2019; Santamouris and Kolokotsa 2015). Thus, in order to assess the state of art in Southern EU, it follows an exhaustive examination of the literature in Spain, Italy, Greece and Bulgaria, that serve as case studies to provide more detailed perspectives and exemplify local realities of SEP (Palma and Gouveia 2022). The need to link local case studies with territorial and national assessments has been specifically pointed out in recent EP studies (Gouveia et al. 2019). This paper focuses on those aspects.

In relation to the definitions of EP developed by these case studies, Spain proposed in 2019 through the National Strategy against Energy Poverty a definition of the phenomenon as the "situation in which a household cannot meet its basic energy needs, due to insufficient income and that may be aggravated by having an energy inefficient dwelling" (Ministerio de Transportes Movilidad y Agenda Urbana 2018).

Bulgaria, instead of establishing a specific definition, focuses on households and their typology to define the phenomenon. In addition, it has three national indicators to measure it: number of households with restricted heating use; number of households unable to afford utility bills; and number of households unable to afford unplanned payments on utility bills.

Italy's definition of EP has not been revised since 2017. Energy poverty is defined as the difficulty in affording a minimum mix of energy goods and services. Energy poverty is also defined through special indicators based on international approaches, such as the "Low-Income High-Cost approach". They incorporate two innovations to this approach: first, this measurement is based on estimated energy consumption expenditure; and second, it includes hidden energy poverty as those with equivalent expenditure below the average or with no heating expenditure. Energy consumption is estimated based on technical information on the households' heating requirements and aggregated consumption data. These data are provided by RSE (*Ricerche sul Sistema Energetico*) and the Italian Household Budget Survey.

Lastly, in Greece, the phenomenon is measured through the ability of households to keep the dwelling at an adequate temperature in relation to the percentage of expenditure. However, there is no definition or quantification.

In this study, a total absence of official assessments for SEP was found. This is a relatively novel topic in the literature at the academic level (Bienvenido-Huertas, Sánchez-García, and Rubio-Bellido 2021), and it is considered even less in the development of policies and action plans. It is poorly represented at a European level (Thomson et al. 2019) and existing measures to improve comfort at high temperatures are very limited. In general terms, there is a lack of integration between scientific advances in understanding EP and public policy (Bouzarovski, Thomson, and

Cornelis 2021), and this might be holding back the inclusion of new dimensions. Moreover, SEP is more common in mid-to-low latitudes and is not yet identified as a problem in many higher latitudes, which increases the imbalance of knowledge and its definition in different regions (Sanchez-Guevara et al. 2019; Taylor et al. 2015; Morgan et al. 2017). Even so, climate change is contributing to the growing interest in SEP, as its incidence is very likely to correlate with public health risks due to the growing intensity and frequency of heatwaves, as well as urban climate phenomena such as urban heat islands (UHIs; Sanchez-Guevara et al. 2019).

Summer-specific conditions lack their own indicators in the assessment of EP (Bouzarovski and Thomson 2020). This paper strives to bridge the gap between policy and scientific knowledge on SEP by proposing its own instruments. To this end, 187 documents related to SEP have been analysed, broadening the search beyond academia and the existing papers in scientific journals. This paper juxtaposes academic literature with documents related to energy and health plans and policies, projects and examples of good practices, as well as public outreach through reports from research projects and third sector entities. The methodology, consisting of a guided-by-topics reading, enabled putting forward an instrumental proposal and evaluation of policy implications.

In this study, the means and methods of the collaborative collection and review of literature related to SEP are outlined in the first place (2). This section presents the main approaches found in the literature including methodologies for assessing and measuring energy poverty, urban and building types at the micro-climatic level, and health plans and policies. In line with the goal of this paper, the guidelines established for the analysis of the literature are discussed in this section. The analysis proposal (2.3) structures the results (3) as follows: indicators (3.1a), methodological innovation (3.1b), urban dimension (3.2) and public policies (3.3). Finally, the discussion (4) and conclusions (5) focus on the most relevant policy implications.

2. Means and methods

A meta-study of the topic was carried out, in order to collect and analyse systematically the specific topic of SEP. It initially required a collaborative search of the existing literature. It covered Europe and, most particularly, the Italian, Greek, Bulgarian and Spanish context. Several entities from these countries were asked to contribute to this collaborative search, both in English and the official national languages, in the context of the EU Funded Cooltorise Project.[1] This collaborative search considered different information resources, given the following guidelines:

- *Gathering methodologies to evaluate energy poverty in different countries.*
- *Setting general conditions of housing stock in summer, analysis of housing cooling loads by region and climate, and evaluation of the degree of air conditioning penetration.*
- *Verification of the existence of heat waves and/or health prevention plans by local and regional authorities responsible for them in each participant country.*

(Project Grant Agreement)

Considering that SEP is a novel topic, we did not want to encapsulate the search within any specific time period and/or sources, but rather foster heterogeneity in terms of type and origin of the information (2.1). Nevertheless, geographically, participants were specially committed to search for documents in their own regions and, more generally, in the context of Southern Europe (Figure 1). This process led to a considerable variety of data, as explained in the identification process. We generated a common database of 187 documents (Annex 1).

Next, a screening phase was initiated (2.2), examining and incorporating the main ideas, current debates, as well as limitations and boundaries in SEP related issues. Three different approaches were identified within the documents to develop a common framework for southern EU countries (Figure 2). After identifying the approaches and categorising the documents the analysis of the results was considered (2.3).

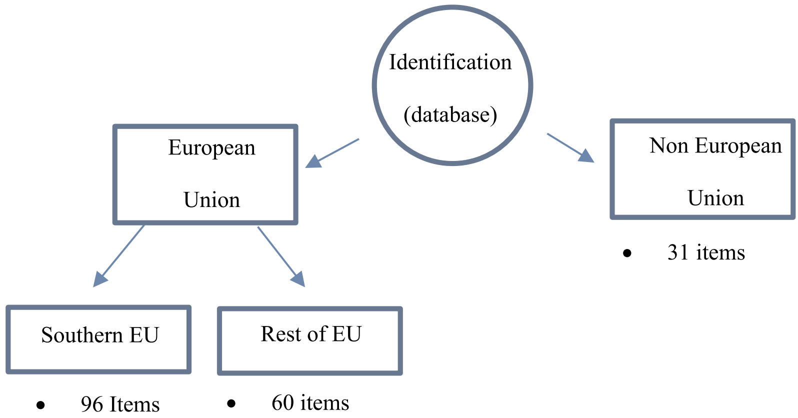

Figure 1. Documents geographical distribution.

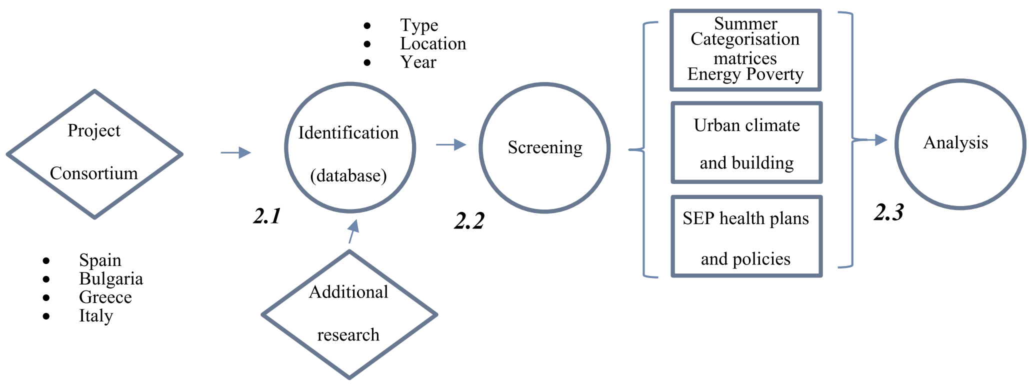

Figure 2. Flowchart of the evaluation process.

2.1. Identification

The first step was to compile a database of documents related to SEP. This is a topic that is still underdeveloped, underrepresented at European level (Thomson et al. 2019) and whose research is still in the early stages. However, the increase in the intensity and frequency of heatwaves has resulted in the proliferation of plans for prevention and mitigation of heat exposure. Therefore, the search was not limited to scientific publications, but included information published by the main actors dealing with the problem (Table 2). This determination made it possible to incorporate information that is not exclusively contained in the academic sphere, in order to include knowledge that is disseminated by other means and that shapes the level of engagement among agents regarding the phenomenon. The collaboration of the different entities in the participating countries favoured a greater diversity of documents as well as overcoming language barriers.

In order to standardise the collection and favour transversal readings, the collaborating entities were asked to provide three types of documents: 1. Health and energy plans, 2. Reports on energy poverty and 3. Methodologies for assessing the phenomenon. Additional research was conducted for those places and content with less representation, increasing the total number of sources added to the database to the final amount of 187. We also included research projects dealing with the phenomenon of EP at a European level in this second round. The projects we found were mainly related to vulnerable people suffering from heat stress, climate change in the city, financial

Table 2. Types of information.

Sources of information	Access to information	Example
Public agencies. Reports and plans	Official websites (ministries, town and city councils …)	(Council of Ministers of the republic of Bulgaria, 2022).
Public agencies. Legislation	Official gazettes. EC Official Journal	(European Commission, 2021).
Research projects	Published documents. Project websites	https://www.enpor.eu
European document bases	EPOV/EPAH repositories. Search by keywords	(Palma and Gouveia 2022)
Scientific papers	Scopus, WoS, Google Scholar. Search by keywords	(Sanchez-Guevara et al. 2019)
Third sector	Own websites	https://ecodes.org

education to tackle EP, identification of poor households, or tailor-made solutions to improve the housing conditions of people living under EP situations.

2.2. Screening

An initial review of the documents made it possible to assess the correct distribution of documents by country and by type of document requested. At the same time, three thematic paths were identified among the documents sampled. Each one contained a great diversity of studies, scales and results, but they are grouped according to approach, format and keywords (Table 3). The three approaches we identified were as follows:

Considering the objective and following an initial phase in which we identified the three approaches to the phenomenon, an analysis matrix was drawn up to facilitate the grouping of similar documents. Thus, the documents referring to each approach were analysed through a series of categories and a binary coding (yes/no) according to whether these categories were represented for each document.

A first categorisation exercise consisted of determining the geographical and temporal context of each document. On the one hand, we grouped together resources specifically located in the European Union (EU). Within these, a distinction was made between those from southern Europe (SE) and those from the rest of the EU (RE). We also identified those from outside the EU (Non-EU). Then, we conducted the same task for those resources specifically focused on summer conditions (SU) or those referring to the full year (YE). No documents tackling winter conditions exclusively were included.

A second categorisation exercise made it possible to disaggregate the resources according to three families of categories: type of document, methodology used in the document and the presence or absence of a specific approach. For document types, we differentiated: reports, guides, assessments, case studies and reviews. For methodology we differentiated: use of data, critical analysis of public policies, simulation and modelling, and qualitative research. For object of study or specific focus, we differentiated the following: gender approach, vulnerable population, building materials, Urban Heat Island and public health. This subdivision was reviewed and ratified by the contributors, in order to improve the cross-sectional study of the literature, as the consortium is integrated by heterogeneous entities (city council, academia, third sector, consultancies).

Table 3. Criteria guide for 1st filtering procedure.

Approach 1	Approach 2	Approach 3
Addresses energy poverty characterisation and/or social dimension of urban overheating, i.e. vulnerable population targeting.	Addresses urban thermal characterisation, building summer energy simulation or urban cooling needs and strategies.	Addresses overheating risks, action plans and/policies related to health and thermal stress.
Format: Scientific papers, public reports	Format: Scientific papers	Format: Public plans and policies
Keywords: Vulnerability, indicators, energy poverty, incomes, population, adaptability, comfort, summer	Keywords: Microclimate, urban, simulation, efficiency, modelling, Urban Heat Island, cooling strategy	Keywords: Health, public, policies, heatwaves, alerts, prevention.

Approach 1. Summer energy poverty methodologies.

Ref	CATEGORIES (1)					CATEGORIES (2)														
	Location			**Time period**		Type						**Method**				**Focus**				
	EU		Non EU	SU	YE	R	G	E	CS	RW	PR	D	P	S	Q	GN	VP	MP	UH	HN
	SE	RE																		
(1)		●		●		●														
(4)			●		●										●					
(10)			●	●					●											
(13)	●			●					●											
(14)			●	●					●						●					
(15)			●	●					●			●								
(16)	●			●					●										●	
(17)			●	●					●						●					
(18)			●	●								●								
(24)			●	●					●			●								
(32)			●	●			●					●			●					
(35)			●		●									●						
(37)			●	●										●					●	
(38)			●	●					●					●						
(42)			●	●				●							●					
(44)			●	●					●			●								
(45)				●										●					●	
(46)	●				●									●						
(55)	●				●				●					●						
(58)	●				●				●			●			●					
(71)	●			●		●		●					●							
(72)	●				●								●					●		
(74)	●				●			●												
(85)		●		●				●				●		●	●					
(96)		●			●					●										
(116)	●			●							●	●			●		●			
(118)		●			●						●						●			
(120)	●				●						●						●			
(121)	●				●						●						●	●		
(122)	●				●						●					●				
(123)		●			●						●	●								
(124)		●			●						●	●								
(126)		●			●						●									
(127)	●				●						●									
(128)		●			●						●									
(129)	●				●						●									
(130)	●				●						●									
(131)			●		●						●									
(133)		●			●						●									
(134)		●			●						●									
(135)	●				●						●									
(136)	●				●						●									
(140)	●			●					●			●								
(141)	●				●			●				●								
(150)	●				●	●			●											
(151)	●				●	●			●											
(152)			●		●				●								●			
(171)		●			●	●							●							
(180)		●			●	●					●									

CATEGORIES (2) R-repositories, G-guidelines, E-evaluations, CS-case studies, RW-reviews and PR projects; for methodologies D-data driven research, P-critical policy analysis, S-simulation and modelling and Q-qualitative research (questionnaires, interviews) were identified; and for specific focus categories GN-gender, VP-vulnerable population, MP-material performance assessments, UH-heat island analysis and monitoring and PH-public health approaches were identified.

Approach 2. Urban climate and building characterisation.

Item Number	CATEGORIES (1)					CATEGORIES (2)														
	Location			**Time period**		**Type**						**Method**				**Focus**				
	EU		Non EU	SU	YE	R	G	E	CS	RW	PR	D	P	S	Q	GN	VP	MP	UH	HN
	SE	RE																		
(5)			●		●		●													
(7)			●		●	●													●	
(19)			●	●										●				●		
(20)			●	●					●					●						
(22)			●	●									●							
(23)	●			●					●					●				●		
(25)			●	●					●					●						

(26)	●			●					●					●				●		
(27)			●		●									●						
(29)			●	●					●					●						
(33)			●	●				●												
(34)		●			●									●						
(36)	●			●					●											
(39)			●	●										●						
(40)	●			●					●					●						
(41)	●			●					●					●						
(48)			●	●										●						
(59)	●			●				●				●							●	
(60)	●			●				●											●	
(68)	●				●				●									●		
(69)	●				●				●			●	●							
(70)		●			●	●	●													
(75)		●			●		●													
(83)	●				●			●												
(117)		●			●						●	●								
(119)		●			●						●									
(125)	●				●						●									
(137)	●			●				●				●								
(138)	●			●				●				●								
(139)	●			●				●				●								
(142)	●				●			●				●								
(147)	●			●					●			●							●	
(148)			●	●					●			●							●	
(149)	●				●				●									●	●	
(187)	●				●			●				●							●	

Approach 3. Health and policies.

Item Number	CATEGORIES (1)					CATEGORIES (2)														
	Location			**Time period**		**Type**						**Method**				**Focus**				
	EU		Non EU	SU	YE	R	G	E	CS	R W	P R	D	P	S	Q	GN	VP	MP	UH	HN
	SE	RE																		
(2)	●				●															●
(3)		●		●		●														
(6)	●			●																
(9)		●			●					●									●	
(12)	●				●			●												
(21)			●	●											●					
(47)	●				●			●												
(49)		●		●				●												
(50)			●	●									●							
(52)	●				●				●						●					
(53)	●				●							●			●					
(56)	●				●								●							
(57)		●			●								●							
(62)	●				●		●													●
(64)	●			●			●					●	●						●	
(65)	●				●				●			●								
(66)	●			●			●						●		●					
(79)	●				●								●							
(80)	●			●									●							
(81)	●			●									●							
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(111)	●			●			●								●				●	
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(114)	●			●									●		●				●	
(115)	●			●			●								●				●	
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(154)		●		●		●											●			
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(156)		●			●	●							●							
(157)		●			●			●				●								
(158)	●				●	●							●							
(159)		●		●									●							
(160)	●			●				●				●							●	
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(184)		●			●	●							●							
(185)		●			●	●							●							
(186)		●			●	●							●							

Following the categorisation exercise, the documents were read by type of approach (A1, A2 and A3) and following similarities. The analysis was done according to a two-step process. Firstly, all the documents were read and the main themes were pointed-out as keywords. Secodly, an analysis script was developed according to such keywords and a logical structure. Therefore, the grouping of documents with common keywords served to develop the structure of the analysis (2.3). The analysis was elaborated following the script for each one of the three different approaches.

2.3. Analysis

Following the paper's goal to assemble current scientific research related to SEP and policies that specifically address the problem, we divided the analysis into units. These units help to organise the research results and guide the discussion on their transfer to public plans and policies. The transfer instruments are delimited by (a) definitions and methodologies, (b) scales of action and (c) fields of action:

2.3.1. Analysis unit 1: how SEP is measured, definitions and methodologies

Within the issue of energy poverty in Europe, there has been a particular interest in the development of definitions and indicators for tackling the phenomenon (Castaño-Rosa et al. 2019). A first set of results discusses the relevance of existing definitions and indicators for summer conditions.

The need for data related to these new indicators was pointed out by the Energy Poverty Advisory Hub (Palma and Gouveia 2022). In the case of the SEP, there is a reiterated interest in incorporating qualitative methodologies that address the adaptability of the population (Thomson et al. 2019), as well as quantitative studies of summer conditions in the city (Sanchez-Guevara et al. 2019). Studies on new evaluation methodologies complete the first set of results.

2.3.2. Analysis unit 2: contextualising summer urban conditions, scales of action

The effects of built-up environments on heat experiences are particularly relevant for SEP, where mitigation actions are largely conducted in outdoor spaces (as climatic shelters or as attenuators of the UHI effect). Numerous studies have focused on the spatial performance of heat in the city.

The urban dimension, both as a built-up environment and as a microclimatic one, is considered as a second package to be analysed.

2.3.3. Analysis unit 3: how SEP is addressed in practice, areas of action

These innovative approaches must be adapted to the regulatory and legislative reality of each place, for which a specific section on public policy analysis is necessary, addressing the different scales of action that are more likely to incorporate both assessment methodologies and adaptation and mitigation policies.

3. Results

The results are grouped in three units. In this way, firstly, the boundaries for the definition and assessment of the phenomenon are presented, considering the debates and methodologies that are currently presented in the context of southern European countries. The spatial dimension of SEP is presented in the second set of results, where studies correlate the location of SEP and the intensity of the UHI and analyse passive cooling strategies. Finally, the review of SEP-related plans and policies shows the actions being implemented in the participating countries, as well as areas of improvement from the European to the national level.

3.1. Measuring and defining SEP

(a) Definitions and creation of indicators

At European level, there is no definition that specifically focuses on summer for EP, as most of them refer to the inability to pay energy bills in general and the indicators proposed for their assessment often focus exclusively on winter conditions.

An example of this is the EU Energy Poverty Observatory (2017-2020), now the EU Energy Poverty Observatory Hub, where the definition of energy poverty is associated with four primary indicators to measure the phenomenon (European Commission 2021), none of which includes specific measurements during the summer. It is necessary to delve into the set of nineteen secondary indicators to find references to the summer period.

From the consensual approach, we propose using the EU-SILC indicator “Dwelling comfortably cool during summertime”, derived from the answers to the questions “Is the cooling system efficient enough to keep the dwelling cool?” and/or “Is the dwelling sufficiently insulated against the heat?”. This indicator, however, does not belong to the common target variables of this survey, but is part of an ad-hoc module that includes secondary variables related to dwelling conditions, and gathered only for the year 2007 (MH070, (European Commission 2007)) and 2012 (HC070, (Ministerio de Transportes Movilidad y Agenda Urbana 2018; European Commission 2010)).

Similarly, but from an approach based on the availability of equipment, we propose using the indicator “Dwelling equipped with air conditioning facilities”, which is only available for the year 2007 (MH060, (European Commission 2007)), as it was not explicitly included in the 2012 ad-hoc module, but only as an “additional variable for national consideration” (European Commission 2010).

This proposal for indicators has been very relevant in a European context, as it has helped different countries to establish common measurement criteria (Castaño-Rosa et al. 2019). . For example, in Spain the indicators proposed by EPOV are integrated to characterise EP in its territory (Faiella et al. 2020).

This adoption of the indicators proposed by EPOV-EPAH is, however, limited to primary indicators. The secondary indicators proposed by EPOV-EPAH are generally ignored, which leads to the de facto exclusion of the summer perspective in the estimation of their impact. In fact, among the countries analysed, only in the case of Italy is the summer dimension included in its assessment of energy poverty (Faiella et al. 2020). It does so by generating a specific definition, understanding the problem as:

> "[…] the condition for those households who fall below the poverty line trying to satisfy a minimal requirement of energy to get the "minimal thermal comfort" during summertime."

(b) Qualitative Approaches and Adaptive Comfort

Within qualitative methodologies, studies are generally limited to the assessment of adaptive comfort, focusing almost exclusively on winter conditions and heating needs. Except for the case presented by Thomson et al. (2019), other qualitative and summer- oriented approaches are non-existent.

In the case of Greece, we found experiences that relate SEP to geographical and socio-economic conditions, which allows us to take into account specific population groups under situations of energy vulnerability (Papada et al. 2021).

The inclusion of gender studies applied to the characterisation of EP also provides added information on summer specific conditions. In the case of Madrid, in Spain, it has been possible to demonstrate through interviews that gender roles conditionate segregation in skills, broaden the difficulty to independently carry out maintenance of equipment by women. Not being able to repair or maintain the equipment is conditioned by the usage of awnings or air conditioning systems, as well as the consequences on sleep quality or the need to spend time outside the home to avoid thermal stress (Gayoso Heredia et al. 2022).

Some work focused on the study of the application of adaptive setpoint to reduce the risk in EP evaluations, and also enables a characterisation of SEP to be established. This characterisation is carried out through statistical studies of data that is derived from energy simulations and socio-economic databases, although it proves ineffective in detecting cases of hidden SEP (Bienvenido-Huertas, Sánchez-García, and Rubio-Bellido 2021).

3.2. Integrating the urban dimension in the definition and measurement of SEP

Considering urban climate and building characterisation, two approaches related to the assessment of SEP were identified. On the one hand, a large number of studies specialise in the analysis and quantification of passive cooling strategies in the city. These strategies can be very relevant from the point of view of SEP as low energy-demanding measures. On the other hand, a growing interest in urban energy simulation and its relation to the building is identified (Allegrini, Dorer, and Carmeliet 2012; Vallati, Mauri, and Colucci 2018). The relevance of this second approach is due to the fact that SEP situations are often associated with inefficient and low-quality buildings and urban environments with a higher incidence of UHI (Sanchez-Guevara et al. 2019).

Starting with this last point, experiences of UHI monitoring in the different participating cities have been identified (Vallati et al. 2018; Martin-Vide and Moreno-García 2020; Nuñez-Peiró et al. 2021; Rota, Gravante, and Zazzi 2019). We also found, at different points with higher intensity of the phenomenon, energy assessments that take into account the increase in local temperatures (Li et al. 2019). In this sense, some authors emphasise the need to incorporate UHI data into the building energy simulations for better climate contextualisation (Núñez-Peiró, Sánchez-Guevara Sánchez, and Neila González 2021; Salvati, Coch Roura, and Cecere 2017). Other authors emphasise adaptive comfort assessment methods as being more suitable for summer conditions, where the adaptability of users under heat-stress has a strong influence on indoor thermal performance . Finally, recent contributions point out the correlation of higher intensities of UHI with higher mortality rates associated with SEP (Sanchez-Guevara et al. 2019). The poor quality of town planning of these environments, the lack of green areas and the higher building density, as well as the lack of access to air conditioning are some of the reasons for this correlation between lower socio-economic areas and risks of heat stress (Vandentorren et al. 2006). Among the collated literature, we found UHI evaluations for Spain – in the case of Madrid (Núñez-Peiró, Sánchez-Guevara, and Neila González

2017) and Barcelona (Gerència d'Àrea d'Ecologia Urbana 2021; Martín-Vide et al. 2017), Italy – Parma (Rota, Gravante, and Zazzi 2019), Greece (Vardoulakis et al. 2013). Specific UHI studies for Bulgaria were not found.

These initial conditions can be counteracted by urban passive cooling actions, which are particularly necessary in areas with limited access to air-conditioning systems or limited energy use, both of which are related to SEP (Campaniço, Hollmuller, and Soares 2014). Advances in outdoor thermal comfort simulation facilitate the understanding of how urban features such as orientation, albedo and degree of permeability of surfaces, density of vegetation or thermal inertia of materials play an essential role in the passive cooling potentials of the builtscape (Tsoka et al. 2020; Hamdan and de Oliveira 2019). We also found direct measurements that analyse the above mentioned parameters, in the context of Madrid (Urrutia del Campo, Grijalba Aseguinolaza, and Hernández Aja 2020), and Thessaloniki (Tsoka, Leduc, and Rodler 2021). Urban cooling strategies, according to the information collected, are essential in counteracting the effects of overheating and improving the energy efficiency of buildings, which take advantage of reduced outdoor temperatures through natural ventilation at night. However, the implementation of passive cooling strategies on an urban scale is still limited, and the knowledge of their effects even more so (Trepci, Maghelal, and Azar 2021). No comprehensive experiences of urban retrofitting projects with a focus on temperature reduction have been identified within the documents provided by the consortium. Furthermore, we did not find either retrofitting or monitoring experiences that could evaluate the effects and contrast them with previous simulations.

3.3. SEP public policies

Several studies have pointed to the link between EP and people's health (Carrere 2021; Pan 2021; Zhang 2021), attributed to exposure to inadequate indoor temperatures, poor housing conditions, stress caused by the inability to cope with energy bills (Ballesteros-Arjona 2022) and, in particular, with these factors being aggravated by climate change (Vurro et al. 2022).

Exposure to high summer temperatures in the European climate context has prompted public administrations to develop plans and strategies to cope with the increasingly extreme summers and to take preventive actions (Ministerio de Sanidad 2021; Ministerio della Salute & Direzione Generale Prevenzione Sanitaria 2006). Similarly, the need to have warning systems, to deepen the knowledge of risk groups in relation to housing, institutional care, age, gender, social support networks and the protection of the most vulnerable people has been highlighted (Meusel et al. 2004).

With regard to the integration of EP in public policies, this is deployed in two main areas: on the one hand, those aimed at reducing the percentage of expenditure that households dedicate to energy and, on the other hand, those that seek to improve the energy efficiency of housing through renovations (Charlier 2021). These approaches are reflected in the range of schemes, regulations and directives adopted by the European Union. Among them, energy efficiency policies have been evaluated as more explicitly linked with EP drivers (Stojilovska et al. 2022).

The Third Energy Package of the European Union seeks to regulate the operations of domestic energy markets, considering vulnerable consumers and requiring that a formal definition of vulnerable consumers be established. In 2009/72/EC Directive, EP is recognised as a growing problem in member states, and they are required to draft national and/or other action plans to address the problem. The Clean Energy for All Europeans energy scheme is structured based on a package of regulations and directives, which establishes mechanisms to protect vulnerable consumers (UE 2019/944 Directive); mandatory assessment and monitoring of households in energy poverty in each of the member states (UE 2018/844 Directive, UE 2018/1999 Regulation); new energy efficiency and energy poverty reduction targets (UE 2018/2002 Directive). Likewise, the European Green Deal emphasises the renovation and rehabilitation of the building stock to tackle this problem. On the other hand, the European Energy Poverty Advisory Hub initiative stands out, which included among its objectives the eradication of EP and the acceleration of a fair energy transition for European local governments. This project was also part of the third pillar "Access to Energy" of the Covenant of Mayors for Climate and Energy Europe initiative,[2] under which the member administrations must implement action measures to tackle EP. Regarding SEP, the second report of the Energy Poverty Observatory project (Bouzarovski et al. 2019), at the conceptual level, considers the indicator measuring the inability to keep home cool as primary, however, inconsistency in the data available for its analysis has led to its classification as secondary.

No public policies targeting SEP were found for summer. The scientific literature has pointed out that cooling needs should be included in policies related to energy poverty (Thomson et al. 2019), as well as in the National Energy and Climate Plans (Bouzarovski et al. 2019). The Heating and Cooling Strategy[3] recognises that cooling is more important in warmer climates and its importance is increasing. It also recommends nature-based solutions, such as planting of vegetation on streets, and inclusion of shading elements to reduce the need for cooling in buildings.

Italy, in its National Integrated Plan for Energy and Climate of 2019, mentions subsidies to cover heating or cooling costs and, regarding the social gas voucher, a discount is made on the bill depending on the climate zone and type of use. Spain, for its part, in its National Strategy against Energy Poverty of 2019, points out, based on World Health Organization guidelines, that high indoor temperatures can lead to illnesses and increase mortality from cardiovascular causes. In its strategic line number five, it establishes criteria for protection against disconnection of energy services in extreme weather situations for both low and high temperatures. Spain also has, although only in three autonomous regions, financial aid for the replacement of domestic air conditioning equipment.

4. Discussion

4.1. Measuring and defining SEP

In relation to the two principal areas in which public policies undertake actions to tackle EP (reduction of the percentage of expenditure and rehabilitation), it is important to highlight the absence of data for secondary indicators that enable definition of both aspects for specific summer conditions. In this sense, data availability is limited to the 2007 and 2012 series and records do not exist for all countries. It is therefore difficult to design actions focused on alleviating SEP in an effective way and adapted to the real demand of households. The absence of public policies focused on SEP is closely related to the lack of data for its measurement and definition.

This limitation is sometimes overcome by building up self-made databases, usually through direct contact with households and pre-determined response surveys or interviews (Thomson, Bouzarovski, and Snell 2017). This case presents three indicators based on interview data: a first indicator that measures the risk of overheating inside the dwelling (by measuring surface area, orientation, building materials and possibility of shading or ventilation), adaptive capacity (based on household size, availability of climate shelters, number of incomes or ownership status of the dwelling) and sensitivity to health consequences of exposure to high temperatures (based on health status and age). Through these three indicators, it is possible to detect that cooling strategies, socio-economic status and ownership often influence the adoption of short- or long-term measures, as well as access to outdoor spaces for leisure, which allow people to be out of the dwelling during the hours of greatest exposure to heat extremes.

If one looks at the focus for measuring existing definitions and measurements of EP, there are only two types, that of the physical body and the dwelling. There are no definitions or indicators among the documents consulted that integrate urban environments and microclimatic conditions with SEP. This is something to consider for future research that seeks to characterise the phenomenon in the city.

4.2. Integrating the urban dimension in the definition and measurement of SEP

Based on the results of the review of documents that relate to the urban context and SEP, we found a number of limitations in proposing urban scale indicators for the assessment of the phenomenon.

Firstly, the lack of development of methodologies for analysing urban microclimate has been noted. However, the effects of its performance can be extremely relevant when analysing the socio-spatial distribution of SEP risks. The methodologies for assessing the UHI on an hourly-basis have room for improvement, incorporating technologies still to be tested that can overcome the high logistical and economic cost of carrying out direct measurements with a sufficient level of detail (Romero Rodríguez et al. 2020). This is one of the reasons why the analysis of the energy performance of buildings does not yet integrate real data from their immediate surroundings, in most cases (Nuñez-Peiró et al. 2017). Better data on the microclimatic dimension of the city would help to promote policies aimed at areas more exposed to overheating. Going further, promoting and implementing methodologies for detailed analysis of the UHI phenomenon would help to foster policies aimed at its mitigation, by identifying correlations between building and urban types with the highest temperature records.

The focus on passive urban cooling strategies is regarded as a central element for SEP, by encouraging adaptation to overheating events not based on air-conditioning systems and cost-associated measures that require energy demand. Case studies assessing the effect of such strategies have been found in different places. However, there is a general lack of studies of the built environment that could inform public policies and urban planning for the promotion of passive cooling strategies. There is also a complete lack of analysis of the city regarding climate shelter infrastructure potential. Some manuals promoted by institutions serve as design guidelines (United Nations Environment Programme 2021), and we also found this type of document in cities participating in the study, such as Madrid (Higueras García 2009) or Barcelona (Gerència d'Àrea d'Ecologia Urbana 2021), which are precisely the locations with the greatest achievements in terms of urban planning that incorporates passive cooling (Área de Gobierno de Desarrollo Urbano Sostenible 2018). However, the scarce level of implementation of these plans has not allowed us to assess their adequacy, and the lack of conclusive studies makes it difficult to replicate them in other locations. We have to look to other latitudes to find urban plans and on-going projects that are structured around the objective of reducing urban overheating by promoting urban cooling strategies (Ruefenacht and Acero 2017; Shi, Fonseca, and Schlueter 2017).

4.3. SEP public policies

In the review conducted for this paper, no documents or public policies addressing SEP were found in the context of Italy, Greece, Spain and Bulgaria. Commonly, most policies on EP are focused on winter conditions. Their focus, moreover, falls mainly on financial support for the payment of energy bills and renovation of buildings, lacking a broader and more comprehensive approach linked with SEP drivers.

Although specific measures for the summer season have been identified, such as financial assistance for some regions in Spain for the replacement of domestic air- conditioning equipment or protection against disconnection of energy services in extreme weather situations, formal recognition of SEP is absent. Furthermore, the relevance of providing solutions and guidelines that transfer scientific research into public plans and policies has been identified.

This transfer is only superficial, as noted in the second annual EPOV report (Economidou, M. et al. 2019), which points out the lack of attention to cooling needs in relation to EP and their under-representation in European energy policy. In addition to the two usual approaches to measuring EP, only in Italy has expenditure on Air-Condicioning systems started to be incorporated, mainly aimed at the renovation of refrigeration systems (Ministerio de Energía, Turismo y Agenda Digital 2017). The lack of verified data and commitment to evaluation methods that integrate summer hampers the implementation of specific plans and policies.

Some practices observed in public administrations that can serve as examples are the health plans for heat prevention (Ministerio della Salute and Direzione Generale Prevenzione Sanitaria 2019; Ministerio de Sanidad 2021). These plans include a heat wave alert system and protocols for health centres to contact vulnerable groups already identified based on their medical history and/or age. Urban initiatives such as the Urban Action Initiatives (*Energy Poverty Intelligence Unit*) are also conducted, with energy poverty as a central theme, in which not only vulnerable groups are identified and tailor-made solutions are established, but also interventions in public spaces are included, on the understanding that these are spaces that can affect the thermal comfort of nearby dwellings. In the social sphere, the protection of vulnerable consumers has been legislated to prevent them from being deprived of basic services due to outstanding energy bills (Ministerio de Energía, Turismo y Agenda Digital 2017). In the same vein, there is a proposal to quash past outstanding bills to avoid a progressive increase in interest rates. These good practices, contained in collated documents, point to areas and scales of action where to promote SEP mitigation plans and policies and where to incorporate, ultimately, the emerging body of knowledge on the nature of the phenomenon.

5. Conclusions

The aim of this paper has been to recognise possible transfers between scientific knowledge on SEP and its practical application in the EU context, taking as a reference the cases of Bulgaria, Greece, Italy and Spain. To this end, a collaborative collection of documentation has been developed among similar entities from the four countries. The process of analysis of this documentation has allowed us to detect three different areas of information: SEP methodologies, urban/building characterisation and plans and policies related to SEP. In turn, needs have been detected in terms of the assessment of the phenomenon, and the scale and scope of action. These needs correspond to the proposed instruments to be fostered for the transfer of research to public policies, which are summarised below:

Regarding the definition and measurement of the phenomenon, we have identified the limitation of integrating a European perspective with a local one. The variability of situations can be resolved through specific indicators that are adapted to the situation in each country. However, at present, there is no primary indicator for summer conditions. It is particularly urgent to improve available data and to proceed to the design of suitable indicators to characterise SEP. Further work is needed on new indicators to measure the multiple factors involved in SEP.

This is linked to the need to incorporate methodological innovations that make it possible to identify SEP situations that cannot be quantified by traditional methods of assessing EP. Qualitative methods make it possible to capture people's lived experience and degree of adaptability to high temperatures and should be integrated to the measurements of the phenomenon. People's adaptability is reported in many documents as a determining factor in people's experiences of heat. Qualitative methods, moreover, should reach out to the collective experience in addition to individual indoor interviews.

In the context of current climate change, SEP and exposure to high temperatures are an issue addressed from a health perspective. However, there is a need to transcend the body scale and individual solutions to the building and urban scale. The reviewed documents point to the need to develop assessment methodologies that incorporate data on the hygrothermal performance of the city in summer. This requires indicators relating to urban heat and the adaptability of the population, in particular. Regarding this specific articulation between SEP and outdoor spaces, further research should be developed to obtain a better characterisation. The assessment of summer heat stress in specific urban environments is central to the implementation of effective urban policies and plans to address SEP. To better address summer heat experiences and their possible mitigation, a better understanding of cooling strategies and measures is needed. This requires collecting quantitative and qualitative data and a better consideration of local microclimatic differences.

These demands go hand in hand with the need to improve efforts in several policy areas. As far as public policies on EP are concerned, the European level is the best scope for action both for their definition and for the collection of indicators from each Member State. However, given the complexity in terms of the heterogeneity of data available in each country, the proposal for indicators to measure SEP should be approached from the national level, considering the methodologies used in every location. On the other hand, to address less explored dimensions of EP as a whole, such as its relationship with the urban microclimate, municipal public policies show a better fit for the deployment of analyses and interventions at the urban scale, as they usually command that level of action. In general terms, for a correct integration of scientific knowledge into political actions, a multi-scalar approach needs to be fostered, transcending health-related user scale concerns into social and urban spheres and implementing innovation in evaluation and action methods. This can only be possible through multi-level actions involving administrations.

Notes

1. COOLTORISE – *Raising summer energy poverty awareness to reduce cooling needs*, is a Coordination and Support Action financed by the European Commission under the H2020 Call *Mitigating household energy poverty* (H2020-LC-SC3-EC-2-2020).
2. https://pactodosalcaldes.gal/gl/pacto-0
3. https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en

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Data base

Ref	Title	Author(s)	Year	Location
1	Atlas of Initiatives of Energy Poverty in Europe. State-by-state Review	Directorate-General for Energy	2017	Spain, Austria, Belgium, Bulgaria, Croatia, Czechia, Estonia, Finland, North Macedonia, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Portugal, Romania, Slovenia
2	Plan Andaluz Temperaturas Excesivas 2020_0.pdf	Junta de Andalucía	2020	Spain
3	Heat waves: risks and responses	Koppe, Christina, Kovats, Sari, Jendritzky, Gerd & Menne, Bettina. World Health Organization. Regional Office for Europe.	2004	All EU countries
4	The good home dialogue	Centre for Ageing Better	2021	UK
5	Guidelines on recreational water quality	World Health Organization	2021	Global
6	Plan de actuación para prevenir los efectos de las olas de calor sobre la salud	Generalitat de Catalunya. Departament de Salut	2021	Spain
7	Inventory of energy efficiency technical measures for energy-poor households	Marin Petrovic. ComAct project	2021	Hungary, Bulgaria, Republic of North Macedonia, Lithuania and Ukraine
8			2021	EU

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Ref	Title	Author(s)	Year	Location
	Overview report on the energy poverty concept	Eszter Turai, Senta Schmatzberger, Rutger Broer. ComAct project		
9	Review of public policies and interventions to reduce energy poverty	Empar Soriano, Victoria Pellicer, Pilar Jordá and Aitana Muñoz . ComAct project	2021	EU
10	Cooling Degree Models and Future Energy Demand in the Residential Sector. A Seven-Country Case Study	Raúl Castaño-Rosa, Roberto Barrella, Carmen Sánchez-Guevara, Ricardo Barbosa, Ioanna Kyprianou, João Pedro Gouveia, Eleftheria Paschalidou, Nikolaos S. Thomaidis, Dusana Dokupilova, József Kádár Tareq, Abu Hamed and Pedro Palma	2021	Global
11	POBREZA, VULNERABILIDAD Y DESIGUALDAD ENERGETICA Nuevos enfoques de análisis. España 2006-2016	Asociación de Ciencias Ambientales	2016	Spain
12	Cuando la casa nos enferma. La vivienda como cuestión de salud pública	Thomas Ubrich	2018	Spain
13	Assessing population vulnerability towards summer energy poverty: Case studies of Madrid and London	Carmen Sanchez-Guevara, Miguel Núñez Peiró, Jonathon Taylor, Anna Mavrogianni, Javier Neila González	2019	Spain, UK
14	Dwelling performance and adaptive summer comfort in low-income Australian households	Trivess Moore, Ian Ridley, Yolande Strengers, Cecily Maller and Ralph Horne	2016	Australia
15	Fuel poverty in Summer: An empirical analysis using microdata for Japan	Tomohiro Tabata, Peii Tsai	2020	Japan
16	Exposure and Vulnerability Toward Summer Energy Poverty in the City of Madrid: A Gender Perspective	Miguel Núñez-Peiró, Carmen Sánchez-Guevara Sánchez,Ana Sanz-Fernández, Marta Gayoso-Heredia, J. Antonio López-Bueno, F. Javier Neila González, Cristina Linares, Julio Díaz and Gloria Gómez-Muñoz	2021	Madrid
17	Summertime thermal conditions and senior resident behaviors in public housing: A case study in Elizabeth, NJ, USA	Ioanna Tsoulou, Clinton J. Andrews, Ruikang Heb, Gediminas Mainelis, Jennifer Senick	2020	EEUU
18	An archetype-in-neighbourhood framework for modelling cooling energy demand of a city's housing stock	Choo Yoon Yi, Chengzhi Peng	2019	China
19	Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas	H. Akbaru, M. Pomerantz and H. Taha	2001	US
20	The urban heat island effect in a small Mediterranean city of high summer temperatures and cooling energy demands	E. Vardoulakis, D. Karamanis, A. Fotiadi, G. Mihalakakou	2013	Greece
21	Heatwaves, cooling and young children at home: Integrating energy and health objectives	Larissa Nicholls, Yolande Strengers	2018	Australia
22	Reducing outdoor air temperature, improving thermal comfort, and saving buildings' cooling energy demand in arid cities – Cool paving utilization	Amir Aboelata	2021	Cairo
23			2021	Tesalonica

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Ref	Title	Author(s)	Year	Location
	Tsoka, assessing the effects of urban street trees on building	Assessing the effects of urban street trees on building cooling energy needs: The role of foliage density and planting pattern		
24	Yi, correlating cooling energy use	Stella Tsoka, Thomas Leduc and Auline Rodler	2017	Seoul
25	Urban cooling primary energy reduction potential: System losses caused by microclimates	Forrest Meggers, Gideon Aschwanden, Eric Teitelbaum, Hongshan Guo, Laura Salazar and Marcel Bruelisauer	2016	New york
26	Influence of street canyon's microclimate on the energy demand for space cooling and heating of buildings	A. Vallatia, S. Grignaffini, M. Romagna, L. Mauri, C. Colucci	2016	rome
27	Machine learning for occupant-behavior-sensitive cooling energy consumption prediction in office buildings	Kadir Amasyali and Nora El-Gohary	2016	USA
28	User satisfaction adaptive behaviors for assessing energy efficient building indoor cooling and lighting environment	Ali Keyvanfar, Arezou Shafaghat, Muhd Zaimi Abd Majid, Hasanuddin Bin Lamit, Mohd Warid Hussin, Kherun Nita Binti Ali and Alshahri Dhafer Saad	2021	
29	Estimates of the impact of extreme heat events on cooling energy demand in Hong Kong	Tobi Eniolu Morakinyo, Chao Ren, Yuan Shi, Kevin Ka-Lun Lau, Hang-Wai Tong, Chun-Wing Choy and Edward Ng	2014	Hong Kong
30	Adaptive setpoint temperatures to reduce the risk of energy poverty? A local case study in Seville	David Bienvenido-Huertas, Daniel Sánchez-García, Carlos Rubio-Bellido	2021	Sevilla
31	Energy poverty analyzed considering the adaptive comfort of people living in social housing in the central-south of Chile	J.A. Porras-Salazara, S. Contreras-Espinozab, I. Cartesc, J. Piggot-Navarreted and. A. Pérez-Fargalloe	2020	Chile
32	Energy poverty and indoor cooling: An overlooked issue in Europe	Harriet Thomson, Neil Simcock, Stefan Bouzarovski, Saska Petrova	2019	Europe
33	Improving the SDG energy poverty targets: Residential cooling needs in the Global South	Alessio Mastruccia, Edward Byers, Shonali Pachauri, Narasimha D. Rao	2019	Global South
34	Influence of the urban microclimate in street canyons on the energy demand for space cooling and heating of buildings	Jonas Allegrinia, Viktor Dorer, Jan Carmeliet	2012	Basel
35	Energy flexibility for heating and cooling based on seasonal occupant thermal adaptation in mixed-mode residential buildings	Chenqiu Du, Baizhan Li, Wei Yu, Hong Liu, Runming Yao	2019	China
36	Assessment of the Portuguese building thermal code: Newly revised requirements for cooling energy needs used to prevent the overheating of buildings in the summer	Marta J.N. Oliveira Panão, Susana M.L. Camelo, Helder J.*P.* Gonçalves	2011	Portugal
37	Effect of gender difference on sleeping comfort and building energy utilization: Field study on test chamber with thermoelectric air-cooling system	Kashif Irshada, Salem Algarni, Basharat Jamil, Mohammad Tauheed Ahmad, Mohammad Arsalan Khan	2019	
38	The influence of sleeping habits on cooling energy use in residential sector in Hong Kong	YaniBaoTianqiLiuW.L.Lee	2018	Shanghai

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Ref	Title	Author(s)	Year	Location
39	Space cooling energy usage prediction based on utility data for residential buildings using machine learning methods	Yanxiao Feng, Qiuhua Duan, Xi Chen, Sai Santos hYakkali and Julian Wang	2021	USA
40	Analysing natural ventilation to reduce the cooling energy consumption and the fuel poverty of social dwellings in coastal zones	David Bienvenido-Huertas, Daniel Sánchez-García and Carlos Rubio-Bellido	2020	Cadiz
41	Assessing energy savings in cooling demand of buildings using passive cooling systems based on ventilation	Hugo Campaniço, Pierre Hollmuller and Pedro M. M. Soares	2014	Genova
42	Behavioural, physical and socio-economic factors in household cooling energy consumption	Geun Young Yun, Koen Steemers	2011	USA
43	Thermal comfort and cooling strategies in the Brazilian Amazon. An assessment of the concept of fuel poverty in tropical climates.	Antonella Mazzone	2020	Brasil
44	Temperature shocks and energy poverty: Findings from Vietnam	Simon Feeny, Trong-Anh Trinh and Anna Zhu	2021	vietnam
45	Typical energy-related behaviors and gender difference for cooling energy consumption	Jiayuan Wang, Jiaolan Zhu, Zhikun Ding, Patrick X.W. Zou, Jie Li	2019	China
46	Estimating the influence of occupant behavior on building heating and cooling energy in one simulation run	Isabella Gaetani, Pieter-Jan Hoes, Jan L.M. Hensen	2018	Delft
47	Objective vs. subjective fuel poverty and self-assessed health	Manuel Llorca, Ana Rodriguez-Alvarez and Tooraj Jamas	2020	España
48	Urban mitigation and building adaptation to minimize the future cooling energy needs	Samira Garshasbi, Shamila Haddad, Riccardo Paolini, Mattheos Santamouris, Georgios Papangelis, Aggeliki Dandou, Georgia Methymaki, Panagiotis Portalakis, Maria Tombrou	2020	Sydney
49	Heat and health in the WHO European Region: updated evidence for effective prevention	WHO Regional Office for Europe	2021	EU
50	Heat Waves and Cold Spells: An Analysis of Policy Response and Perceptions of Vulnerable Populations in the UK	Johanna Wolf, W Neil Adger, Irene Lorenzoni	2010	UK
51	EPAH Report: Tackling energy poverty through local actions – Inspiring cases from across Europe	European Commision. Directorate-General for Energy	2021	EU
52	The Association of Energy Poverty with Health and Wellbeing in Children in a Mediterranean City	Laura Oliveras, Carme Borrell, Irene González-Pijuan, Mercè Gotsens, María José López, Laia Palència, Lucía Artazcoz and Marc Marí-Dell'Olmo	2021	Barcelona
53	The association of energy poverty with health, health care utilisation and medication use in southern Europe	LauraOliveras, Lucia Artazcoz, Carme Borrell, Laia Palència, María José López, Mercè Gotsens, Andrés Peralta, Marc Marí-Dell'Olmo	2020	EU
54	Improving Energy Poverty Measurement in Southern European Regions through Equivalization of Modeled Energy Costs	Iñigo Antepara, Lefkothea Papada, João Pedro Gouveia, Nikolas Katsoulakos and Dimitris Kaliampakos	2020	EU
55	Applying the mixed-mode with an adaptive approach to reduce the		2021	Spain

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Ref	Title	Author(s)	Year	Location
	energy poverty in social dwellings: the case of Spain	David Bienvenido-Huertas, Daniel Sánchez-García and Carlos Rubio-Bellido		
56	Linking Energy Poverty with Thermal Building Regulations and Energy Efficiency Policies in Portugal	Ana Mafalda Matos, João M.*P*.Q. Delgado and Ana Sofia Guimarães	2022	Portugal
57	Energy poverty policies and measures in 5 EU countries: a comparative study	Kyprianou, I.; Serghides, D. K.; Varo, A.; Gouveia, J. *P*.; Kopeva, D.; Murauskaite, L.	2019	EU
58	Energy poverty in Portugal: Combining vulnerability mapping with household interviews	Ana Horta, João Pedro Gouveia, Luísa Schmidt, João Carlos Sousa, Pedro Palma and Sofia Simões	2019	Portugal
59	L'illa de calor a l'àrea metropolitana	Javier Martín-Vide, Victor M. Artola, M. José Cordobilla, M. Carmen Moreno Grup de Climatologia – Universitat de Barcelona Marc Montlleó Barcelona Regional. Direcció de Serveis Ambientals de l'AMB	2015	Spain – Barcelona – AMB
60	Pla Clima, Efecte Illa de Calor	Ajuntament de Barcelona	2018	Spain – Barcelona – Barcelona
61	Indicadors municipals de pobresa energètica a la ciutat de Barcelona	Sergio Tirado Herrero, RMIT Europe	2018	Spain – Barcelona – Barcelona
62	Pla de Barris	Ajuntament de Barcelona	2021	Spain – Barcelona – Barcelona
63	La vulnerabilitat urbana a Barcelona: persistència, concentració i complexitat	Fernando Antón-Alonso, Sergio Porcel, Irene Cruz, Francesc Coll Pujol	2020	Spain – Barcelona – AMB
64	Pla d'actuació per prevenir els efectes de les onades de calor sobre la salut (POCS)	Agència de Salut Pública de Catalunya (ASPCAT)	2021	Spain – Catalunya
65	Pla pel Dret a l'Habitatge de Barcelona 2016-2025	Àrea de Drets Socials, Justícia Global, Feminismes i LGTBI. Ajuntament de Barcelona	2016	Spain – Barcelona – Barcelona
66	Temperatura i mortalitat a Barcelona (TEMOB)	Agència de Salut Pública. Consorci Sanitari de Barcelona	2021	Spain – Barcelona – Barcelona
67	What mitigation measures affecting vulnerable citizens should be adopted at National level before the household sector goes to the fully liberalized energy market in Bulgaria	Petar Kisiov – Energy Agency expert – Plovdiv	2020	Bulgaria, Plovdiv
68	RES Sytems for vulnerable groups	Energy Agency of Plovdiv. Powery project	2021	Bulgaria, Plovdiv
69	Energy poverty and renewable energies – state of the art in Bulgaria	Energy Agency of Plovdiv. Powery project	2021	Bulgaria, Plovdiv
70	_Energy poverty good practices	Agencia Andaluza de la Energía	2021	EU level
71	Present status of energy poverty in 8 pilot EU countries of Powerpoor project	Anamari Majdandžić, Daniel Rodik, Matija Eppert	2021	Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Portugal and Spain
72	POWERPOOR Certification Scheme	George Konstantopoulos (NTUA), Chris Stefanatos (NTUA), Eleni Kanellou (NTUA)	2021	Bulgaria
73	Technical measures for EE in energy poor households	Marin Petrovic (ENOVA)	2021	Bulgaria
74	Overview report on the energy poverty concept	Eszter Turai (MRI), Senta Schmatzberger (BPIE), Rutger Broer (BPIE)	2021	EU level
75	Educational materials for energy advisors	Marin Petrovic (ENOVA)	2021	EU level
76		CONSEJERÍA DE POLÍTICAS SOCIALES Y FAMILIA Dirección General de Servicios	2016	Madrid

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Ref	Title	Author(s)	Year	Location
	Estrategia de Inclusión Social de la Comunidad de Madrid_2016-2021	Sociales e Integración Social. Comunidad de Madrid		
77	Dos años de estrategia contra la pobreza energética_2021	Cecilia Foronda, Charo Romero y Javier Tobías (ECODES)	2021	Spain
78	Identificación, localización y caracterización de la vulnerabilidad energética a nivel de sección censal en el municipio de Barcelona	Lise Desvallées	2021	Barcelona
79	Estrategia Nacional contra la pobreza energética 2019-2024	Ministerio para la Transición Ecológica. Gobierno de España	2019	Spain
80	Vigilancia y Control efectos olas de calor	Ayuntamiento de Madrid	2016	Madrid
81	Variables Meteorológicas y salud	Ayuntamiento de Madrid	2006	Madrid
82	PMnlan Nacional de Actuaciones preventivas de los efectos del esceso de temperaturas sobre la salud	Ministerio de Sanidad	2021	Spain
83	PROYECTO SECH-SPAHOUSEC Análisis del consumo energético del sector residencial en España	IDAE – Secretaría General Departamento de Planificación y Estudios	2011	Spain
84	What are the effects of energy poverty and interventions to ameliorate it on people's health and well-being?	Virginia Ballesteros-Arjona, Laura Oliveras, Julia Bolívar Muñoz, Antonio Olry de Labry Lima, Juli Carrere, Eva Martín Ruiz, Andrés Peralta, Andrés Cabrera León, Inmaculada Mateo, Rodríguez, Antonio Daponte-Codina, Marc Marí-Dell'Olmo	2022	Worldwide
85	Energy poverty and indoor cooling: An overlooked issue in Europe	Harriet Thomson, Neil Simcock, Stefan Bouzarovski, Saska Petrova	2019	Europe
86	Evaluación de un programa para reducir la pobreza energética en Barcelona: "Energía, la justa"	Juli Carrere Balcells	2021	Spain
87	European Energy Poverty: Agenda Co-Creation and Knowledge Innovation (ENGAGER 2017-2021)	ENGAGER 2017-2021	2017	Greece
88	Report on the Status Quo of Energy Poverty and its Mitigation in the EU	Institute of Communication & Computer Systems. Social Watt	2020	EU
89	Energy Poverty in Greece Policy developments and recommendations to tackle the phenomenon	Alice Corovessi, Sophia-Natalia Boemi, Theocharis Tsoutsos	2020	Greece
90	Assessment of heating and cooling related chapters of the national energy and climate plans (NECPs)	Toleikyte, A., Carlsson, J.	2021	EU-Greece
91	Comparing different methodological approaches for measuring energy poverty: Evidence from a survey in the region of Attika, Greece	Ntaintasis, E., Mirasgedis, C., Tourkolias, C.	2019	Greece
92	Measuring energy poverty in Greece	Papada, L., Kaliampakos, D.	2016	Greece
93	Reforms and investments to combat energy poverty	Antonis Marinos	2019	Greece
94	Energy poverty and indoor cooling: An overlooked issue in Europe	Thomson, H., Simcock, N., Bouzarovski, S., Petrova, S.	2019	EU
95			2010	Italy

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Ref	Title	Author(s)	Year	Location
	Surveillance of Summer Mortality and Preparedness to Reduce the Health Impact of Heat Waves in Italy	Michelozzi, *P*., de'Donato, F.K., Bargagli, A.M., D'Ippoliti, D., De Sario, M., Marino, C., Schifano, *P*., Cappai, G., Leone, M., Kirchmayer, U., Ventura, M., di Gennaro, M., Leonardi, M., Oleari, F., De Martino, A., Perucci, C.A.		
96	Energy poverty indicators: A critical review of methods	Sergio Tirado Herrero	2017	EU
97	A multi-sourced data based framework for assisting utilities identify energy poor households: a case-study in Greece	Evangelos Spiliotis, Apostolos Arsenopoulos, Eleni Kanellou, John Psarras, Panagiotis Kontogiorgos	2020	GREECE
98	An assessment of Energy Poverty in Greece_A comparative study regarding the phenomenon in Greece	Dimitris Panagopoulos	2019	GREECE
99	Energy poverty and energy efficiency improvements: A longitudinal approach of the Hellenic households	Sofia-NataliaBoemi, Agis M.Papadopoulos	2019	Greece
100	Report on replicable best practice national and European measures	ASSIST Project	2018	Europe
101	Report on national and European measures addressing vulnerable consumers and energy poverty	ASSIST Project	2018	Europe
102	Report on vulnerable consumers and energy poverty	ASSIST Project	2018	Europe
103	Integrated National Energy and Climate Plan	Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Infrastructure and Transport	2019	Italy
104	National Energy Strategy	Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea	2017	Italy
105	Mapping fuel poverty risk at the municipal level. A small-scale analysis of Italian Energy Performance Certificate, census and survey data.	Camboni, R., Corsini, A., Miniaci, R., Valbonesi, *P*.	2021	Italy
106	Energy poverty. How can you fight it, if you can't measure it?	Osservatorio Italiano sulla Povertà Energetica	2021	Italy
107	Annual report on energy poverty	Osservatorio Italiano sulla Povertà Energetica	2020	Italy
108	health Ministry heat wave alarm system	Ministero della Salute. Italia	2021	Italy
109	Health Institute (ISS) info page	Instituto Superiore di Sanitá	2018	Italy
110	Red Cross info Campaign	Croce Rossa Italiana	2021	Italy
111	LINEE GUIDA PER PREPARARE PIANI DI SORVEGLIANZA E RISPOSTA VERSO GLI EFFETTI SULLA SALUTE DI ONDATE DI CALORE ANOMALO	Direzione Generale Prevenzione Sanitaria, Ministero della Salute	2006	Italy
112	National health Plan	Ministero della Salute. Italia	2005	Italy
113	Lazio Regional Heat Plan	Dipartimento di Epidemiologia del Servizio Sanitario Regionale del Lazio (DEP)	2021	Italy
114	Emilia Romagna Heat Plan –: Linee regionali di intervento per mitigare l'impatto di eventuali ondate di calore – estate 2021,	Sanità e Politiche Sociali, Regione Emilia-Romagna	2021	Italy

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Ref	Title	Author(s)	Year	Location
	in applicazione della DGR 584/ 2013.			
115	Parma – Heat plan	Comune di Parma	2021	Italy
116	EmCliC	CICERO, NILU, University of Warsaw, Uniwesytet im. Adama Mickiewicza w Poznaniu	2021-2023	Warsaw-Madrid
117	Climate-fit	Vlaamse Instelling Voor Technologisch Onderzoek N.V., IMMO 14 Genossenschaft, GISAT S.R.O., Katholieke Universiteit Leuven, Fundación privada Instituto de salud global Barcelona, Joanneum research Forschungsgesellschaft MBH, T6 Ecosystems SRL, ARCTIK SRL, Stad Antwerpen, Bickecityguide Apps GMBH, Soprintendenza Speciale per il Colosseo Il Museo Nazionale Romano e l´area Archeologica di Roma, INES Energieplanung GMBH, IURS, Agencia de Salu Publica de Barcelona, Meteotest AG, Pronoo AG	2017-2019	EU
118	ComAct	Habitat for Humanity, Vartotojy aljansas, BPIE, IWO, EnEffect, Metropolitan Research Institute Budapest, ENOVA, Odessa Housing Union Association	2021-2023	EU
119	DOOR	Climate Action Network Europe, Connect4Climate, ECOS, ZELENI Forum, Hrvatska Mreza, Sustainable Energy for All	2019-2021	Zagreb
120	EFFyPE	ISADORA DUNCAN	2011	Spain
121	ELIHMED	IVE (Spain), AViTeM (France), OMAU (Spain), CSTB (France), Conseil régional du Languedoc-Roussillon (France), CEA (Cyprus), GERES, MIEMA (Malta), Municipality of Genova (Italy), ISNOVA (Italy), LAORE Sardegna (Italy), CRES (Greece), IJS (Sweeden), CPMR (France), 13 Habitat (France), Municipality of Frattamaggiore (Italy)	2011-2014	Cyprus
122	EmpowerMed	DOOR, Enginyeria, FOCUS, GERES, IREC, Milieu Kontakt Albania, SOGESCA, UAB, WECF	2019-2023	EU
123	ENPOR	IEECP, Austrain Energy Agency, Kane Cres, Climate Alliance, Tartu Regional Energy Agency, ENEA, DOOR, The University of Manchester, UIPI, Hogeschool, Utrecht, Wuppertal Institut, TEES Lab	2020	EU
124	Enpover	Deutsche Umwelthilfe, Energiaklub	2019-2021	EU
125	LifeNadapta	Gobierno de Navarra, GAN-NIK, INTIA, NASUVINSA, NILSA, Universidad Pública de Navarra	2017-2025	Navarra
126	Lightness	R2M solution Spain, AXPO, CiviESCo, ENER2CROWD, ENEA, SOFENA, DUNEWORKS BV, Unión Renovables, Unión de Cooperativas de Personas Consumidoras y Usuarias de Energías Renovables, I. Leco, IES, IREC, Albedo Energie	2021-2023	EU
127	Ni Un Hogar Sin Energía	ECODES	2013	Spain
128	PowerPoor	ICLEI, Coopérnico, SOGENA, European Crowfunding Network, DOOR,	2020-2022	EU

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Ref	Title	Author(s)	Year	Location
		INTRASOFT, GOIENER, Housing Europe, Eesti Korteriühistute Liit, Sustainable City, EnergiaKlub, EPU NTUA, INZEB, ZREA		
129	Powert	Andalusian Energy Agency, Andalusian Regional Government (AEA)	2019-2023	EU
130	RADAR	SOCAIRE	2018-2020	Madrid
131	REACH	FOCUS Association for Sustainable Development (Slovenia), DOOR (Croatia), Energy agency of Plovdiv (Bulgaria), Macedonian Centre for Energy Efficiency	2014-2017	Eu
132	Replace	Austrian energy agency, Black Sea Energy Research Centre, Energy Institute Hrvoje Pozar, ENOVA, Ente público Regional de la Energía de Castilla y León, ESCAN, EWO, JSI, REGEA, SDEWES, WIP renewable energies	2019-2022	EU
133	SocialWatt	NEW edp, Naturgy, PPC, CEZ, HEP ESCO, GREN, EVISO, ICCS, IEECP, RAP, E7, ISPE	2020-2022	EU
134	STEP	ADE, BEUC, Българска национална асоциация "Активни потребители" (BNAAC), Citizens Advice (Coventry, Reading & Manchester), Cyprus Consumers Association (CCA), DECO, dTest, Federacja Konsumentów (FK), Latvijas Patērētāju interešu aizstāvības asociācija (LPIAA), Lietuvos vartotojų organizacijų aljansas (LVOA), Spoločnosť ochrany spotrebiteľov (S.O.S.)	2019-2021	EU
135	Voluntariado Energético	FUNDACIÓN NATURGY	2022	Spain
136	Wellbased	LAS NAVES, Valencia Clima i Energia, INCLIVA, Senior Europa S.L. (KVC), Erasmus MC University Medical Center Rotterdam, Municipality of Edirne, DemirEnerji, University of Leeds, TNO innovation for life, Energy Cities, Ente Ospedaliero Ospedali Galliera, Zero Discrimination Association, MTUK, Óbuda-Békásmegyer Municipality, ASIDEES, City of Skopje, JPOIC, Municipality of Heerlen, Leeds City Council,	2021-2025	EU
137	Assessing Heat Waves over Greece Using the Excess Heat Factor (EHF), January 2019	Tolika, K.	2019	Greece
138	A database of high-impact weather events in Greece: a descriptive impact analysis for the period 2001–2011, March 2013	Papagiannaki, K., Lagouvardos, K., Kotroni, V.	2013	Greece
139	Response of Urban Heat Stress to Heat Waves in Athens (1960–2017), August 2019	Katavoutas, G., Founda, D.	2019	Greece
140	Energy Poverty during the Era of Economic Crisis in the Island of Crete, Greece, June 2020	Vourdoubas, J., Plokamakis, G., Gigandidou, A.	2020	Greece
141	Fighting Energy Poverty Using User-Driven Approaches in Mountainous Greece: Lessons	Papada, L., Balaskas, A., Katsoulakos, N., Damigos, D., Kaliampakos, D.	2021	Greece

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Ref	Title	Author(s)	Year	Location
	Learnt from a Living Lab, March 2021			
142	Residential Heating under Energy Poverty Conditions: A field study, 2017	Boemi, A., Panaras, G., Papadopoulos, A.M.	2017	Greece
143	Energy Efficiency trends and policies in Greece, March 2021	ODYSEE-MURE	2021	Greece
144	Energy efficiency promotion in Greece in light of risk: Evaluating policies as portfolio assets, December 2018	Forouli, A., Gkonis, N., Nikas, A., Siskos, E., Doukas, H., Tourkolias, C.	2018	Greece
145	COUNTRY REPORT ON THE ENERGY EFFICIENCY SERVICES MARKET AND QUALITY, February 2018	QualitEE Project	2018	Greece
146	Urban Imperviousness Effects on Summer Surface Temperatures Nearby Residential Buildings in Different Urban Zones of Parma	Morabito, M., Crisci, A., Georgiadis, T., Orlandini, S., Munafò, Congedo, L., Rota, *P.*, Zazzi, M.	2017	Italy
147	Actualizacion de la isla de calor urbana de Madrid	Núñez Peiró, N., Sánchez-Guevara Sánchez, C., Neila González, F.J.	2017	Spain
148	BeatingTheHeat	United Nations Environment Programme	2021	Worldwide
149	Geographical inequalities in energy poverty in a Mediterranean city: Using small-area Bayesian spatial models	Marí-Dell´Olmo, Oliveras, L., Vergara-Hernández, C., Artazcoz, L., Borrell, C., Gotsens, M., Palència, L., López, M.J., Martinez-Beneito, M.A.	2022	Barcelona
150	Identificación, localización y caracterización de la vulnerabilidad energética a nivel de sección censal en el municipio de Barcelona vulnerabilidad energética a nivel de sección censal en el municipio de Barcelona_2021	Descallées, L.	2021	Barcelona
151	Climate change impact on energy poverty and energy effiency in the public housing building stock of Bari, Italy	Vurro, G., Santamaria, V., Chiarantoni, C., Fiorito, F.	2022	Italy
152	Household multidimensional energy poverty and its impacts on physical and mental health.	Zhang, Z., Shu, H., Yi, H., Wang, X.	2021	China
153	Health, well-being and energy poverty in Europe: A comparative study of 32 European countries.	Thomson, H., Snell, C., Bouzarovski, S.	2017	EU
154	Report on excess mortality in Europe during summer 2003 (EU Community Action Programme for Public Health, Grant Agreement 2005114)	Robine, J., Cheung, S.L., Le Roy, S., Van Oyen, H., Herrmann, F.R.	2007	EU
155	Energy poverty and vulnerable consumers in the energy sector across the EU: Analysis of policies and measures	Pye, S., Dobbins, A., Baffert, C., Brajkovic, J., Miglio, R., Deane, *P.*	2015	EU
156	Energy poverty and public health: Global evidence.	Pan, L., Biru, A., Lettu, S.	2021	Worldwide
157	Gas Supply Act. Official Gazette of the Republic of Slovenia, No 204/21	Republic of Slovenia	2021	Slovenia
158	La povertá energetica in Italia. Secondo rapporto dell'Osservatorio Italiano sulla Povertá Energetica (OIPE)	Osservatorio Italia sulla Povertá Energetica	2020	Italy

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Ref	Title	Author(s)	Year	Location
159	Public Health responses to extreme weather and climate events – A brief summary of the WHO meeting on this topic in Bratislava on 9-10 February 2004	Meusel, D., Menne, B., Kirch, W., Bertollini, R.	2004	EU
160	Valoración del impacto de la ola de calor del verano de 2003 sobre la mortalidad.	Martínez, F., Simón-Soria, F., López-Abente, G.	2004	Spain
161	Politics, problematisation, and policy: A comparative analysis of energy poverty in England, Irland and France.	Kerr, N., Gillard, R., Middlemiss, L.	2019	England, Irleand, Framce
162	Member state reports on energy poverty 2019	European Commision, Directorate-General for Energy	2020	EU
163	Impact of extreme temperatures on public health	Díaz Jiménez, J., Linares Gil, C., García Herrera, R.	2005	Spain
164	Policies and measures	European Commision. Energy Poverty Observatory	-	EU
165	Comunicación de la Comisión. El Pacto Verde Europeo.	European Commision	2019	EU
166	Energía limpia para todos los europeos	European Commision. Directorate-General for Energy	2019	EU
167	Comunicación de la Comisión al Parlamento Europeo, al Consejo, al Comité Económico y Social Europeo y al Comité de las Regiones. Estrategia de la UE relativa a la calefacción y la refrigeración	European Commision	2016	EU
168	Fuel poverty in industrialized countries: Definition, measures and policy implications a review.	Charlier, D., Legendre, B.	2021	EU
169	Energy poverty, its intensity and health in vulnerable populations in a Southern European city	Carrerem, J., Peralta, A., Oliveras, L., López, M.J., Marí-Dell'Omo, M., Benach, J., Novoa, A.M.	2021	Spain
170	Transforming energy poverty policies in the European Union: Second Annual Report of the European Union Energy Poverty Observatory	Bouzarovski, S., Thomson, H., Cornelis, M., Rogulj, I., Campuzano, M., Goermaere, S.	2019	EU
171	Confronting energy poverty in Europe: A research and policy agenda.	Bouzarovski, S., Thomson, H., Conerlis, M.	2021	EU
172	Reglamento 2018/1999	Parlamento Europeo y Consejo de la Unión Europea	2018	EU
173	Dictamen del Comité Económico y Social Europeo sobre *La comunicación de la Comisión al Parlamento Europeo, al Consejo, Al Comité Económico y Social Europeo y al Comité de las Regiones – Estrategia de la UE relativa a la calefacción y la refrigeración*	Comité Económico y Social Europeo	2017	EU
174	Estrategia de la UE relativa a la calefacción y la refrigeración	European Commision	2016	EU
175	Directive 2009/72/EC	European Commision	2009	EU
176	Directiva 2012/27/UE	European Commision	2012	EU
177	Conferencia sobre la pobreza energética en la encrucijada entre el pilar verde europeo de derechos sociales y el Pacto Verde Europeo	European Commision	2021	EU

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Ref	Title	Author(s)	Year	Location
178	Estado de la Unión de la Energía 2021: las energías renovables superan a los combustibles fósiles y pasan a ser la principal fuente de energía de la UE	European Commision	2021	EU
179	Decisión (UE) 2022/589 de la Comisión por la que se establecen la composición y las disposiciones operativas para la creación del Grupo de Coordinación de la Comisión sobre Pobreza Energética y Consumidores Vulnerables	European Commision	2022	EU
180	Fighting energy poverty: achievements and lessons of project REACH	Živčić, L., Robić, S., Kisyov, *P*., Tkalec, T., Ilievski, Ž.	2017	South-East Europe
181	Piano Nazionale Integrato per l'energia e il clima	Ministerio dello Sviluppo Economico, Ministerio dell'Ambiente e della Tutela del Territorio e del Mare, Ministerio delle Infrastrutture e dei Transporti	2019	Italy
182	Plan Nacional Integrado de Energía y Clima 2021-2030	Ministerio para la Transición Ecológica y el Reto Demográfico	2021	Spain
183	Pobreza energética en Europa. Un análisis comparativo. ¿Qué hacen los países europeos para afrontar la pobreza energética?	Costa-Campi, M.T., Jové-Llopis, E., Trujillo-Baute, E.	2020	EU
184	D 5.4 Renewable Energies prosumership Policy Recommendations	SCORE project, grant agreement N° 78496	2021	Czech Republic, Germany, Italy, Bulgaria, Poland
185	Status of energy poverty and policies to address it in CEE/SEE countries	Heeman, J., Faassen, E., Rogulj, I., Pizzini, G., Anagnostopoulos, F., Oikonomou, V., Gallerand, A., Oprea, M., Bouzarovski, S.	2022	Bulgaria, Czechia, Greece, Hungary, Italy, Poland, Portugal, Romania, Slovakia, Spain
186	Tackling energy poverty: learning from the experience in 10 European countries	Bosseboeuf, D., Bouzarovski, S., Broc, J.S., Oikonomou, V., Mistré, M., Rousselot, M.	2021	Belgium, Bulgaria, France, Germany, Greece, Italy, Poland, Romania, Spain, UK
187	Urban-scale air temperature estimation: development of an empirical model based on mobile transects	Romero Rodríguez, L., Sánchez Ramos, J., Molina Félix, J.L., Álvarez Domínguez, S.	2020	Spain