

Energy poverty policies and measures in 5 EU countries: A comparative study

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ABSTRACT

Energy Poverty (EP) is the inability to attain a socially and materially necessitated level of domestic energy services. In the EU this occurs primarily due to low incomes, poor energy performance of buildings and high energy costs. The impacts of EP range from impaired social lives to unhealthy living conditions, with further consequences in the physical and mental health of energy poor individuals. Member states have been assigned by the EU with the responsibility of dealing with EP within their own territories. This is attainable mainly by creating effective policies, while also encouraging synergies among policies of different fields. However, scientific knowledge is gathered and action is taken on a national level only in a limited number of EU countries. For this reason, this paper aims to fill in the gap and capture snapshots from five EU countries (Cyprus, Spain, Portugal, Bulgaria and Lithuania) where EP has not been exhaustively examined. The study provides an overview of selected policies and measures directly or indirectly targeting EP alleviation and analyses their history and evolution at an EU level as well as at national level. It considers the different geographical dimensions, conditions and aspects (e.g. national or regional) where EP is encountered, in an attempt to identify any variances or similarities in the approaches adopted. Through this comparative study, strengths and weaknesses of national strategies are identified and analysed. Conclusively, based on this analysis, recommendations are made on how to utilise policy tools and provide the most efficient support to energy poor households in the corresponding countries.

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1. Introduction

The population of the European Union (EU) is in the midst of social, economic and energy imbalances [1]. Many countries have not yet recovered from the economic crisis of 2008 with consequences on living conditions of the inhabitants, a fact which has prompted national action plans and/or coordinated efforts at the EU level in the fight against energy poverty (EP) [2]. EP has been a research topic for approximately three decades, when Boardman first provided a definition for EP in the UK in 1991 [3]. Notably, it was then referred to as fuel poverty, and still the two terms are being used interchangeably, even in EU documents [4,5]. The UK

has been at the head of EP research, resulting in revised national definitions of EP and mechanisms to detect and address it, eventually leading to the Low Income High Costs (LIHC) indicator, which has been explored for adoption by other countries [6–8]. Due to EU obligations, several countries have provided definitions for EP and vulnerable consumers (albeit vague ones sometimes). However, the majority of knowledge on this topic originate in three countries – the UK, Ireland and France [9].

In general, EP is associated with low income, poor energy performance of buildings and increased energy prices, resulting in inadequate delivery of essential energy services in the home [10]. Health issues are often related to energy poor households, as well as social isolation of individuals, with further impacts on their mental health [11]. Despite the wide recognition of EP as a growing and urgent matter, there is no universal definition for it at the moment. This is mainly due to the fact that EP may be manifested in various ways and degrees, making it hard to measure and mon-

Country abbreviations: BG, Bulgaria; CY, Cyprus; ES, Spain; LT, Lithuania; PT, Portugal.

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itor universally [12]. The lack of a universal definition is often seen as a barrier to understand and address EP [5,13,14]. Nevertheless, it is not the lack of a universal definition of EP per se that is problematic, but rather the lack of a systematic, quantifiable way to measure and monitor EP across the EU member states (MSs). Of course, it has been argued that one (a common methodology) cannot exist without the other (the definition) [14].

For example, countries define vulnerable consumers based on various criteria and national standards, resulting in an array of different definitions that may or may not have similarities among them. Additionally, these definitions are not specific to *energy vulnerable consumers*, but rather include a wide array of population groups that are at risk [15,16]. Consequently, there is a range of methodologies used per national circumstance and the measurement of EP (which at the moment is based on the definitions of vulnerable consumers) may not be a true representation of the energy poor population. However, individual MSs are not at fault for this discrepancy, as they are following instructions stipulated in EU directives, discussed in a later section. The definitions for vulnerable consumers in the examined countries for this study are presented in Appendix A, Table A1. All of the investigated countries identify vulnerable consumers (who are beneficiaries of specific EP alleviating measures) through their social services systems. Bulgaria, Cyprus and Spain also base their definitions on individual characteristics of the consumers (e.g. age, health status) and specific circumstances (e.g. unemployment, large families etc.).

According to the existing literature currently available, there have been limited reviews of national essential policies and measures examining EP in Europe, especially in MSs that have been highly underrepresented in literature so far, like Cyprus and Lithuania. This study aims to fill in a research gap by capturing snapshots from five countries (Cyprus, Spain, Portugal, Bulgaria and Lithuania) where EP has not been exhaustively examined, but is a prominent impediment on the wellbeing of society. Some of these countries have more advanced research activities to showcase than others and the different levels of engagement for these five countries are deemed useful for this analysis. For example, Cyprus and Lithuania have little research activity to show, other than the EU-wide reviews that are not focused on detailed accounts of the available measures, as is the case in this investigation [9,13,17–19]. Spain has already passed the stage of non-existent literature and has accumulated significant research [20–25], whereas Bulgaria and Portugal have more national research to show than Cyprus and Lithuania [26–28], but less than Spain. Bulgaria also has the least degree of EP integration in the policy agenda (relative to the other MSs), which does not reflect the interest of the research community in the country. The five countries therefore represent different stages of research activity and government action in identifying and mitigating EP. These differences are used to identify best practices and gaps that need to be addressed in the countries where EP has not been studied or addressed sufficiently, or improvements for MSs that have more advanced EP action plans.

The section that follows outlines some main country characteristics that are of interest for this study, as well as a number of common proxy indicators describing EP in Europe. After that, the evolution of main policies in Europe considering EP, as well as additional measures taken through funded programmes to mitigate it are presented in Section 3, followed by a classification and analysis of the measures encountered in each MS in Section 4. For the discussion, a methodology is introduced which allows for a relative ranking of the EP-mitigating efforts of each country. This ranking approach provides insights for the best practices encountered in the presented case studies, as well as the MSs most in need for additional and/or more diverse measures.

2. Profiles and EP indicators for the examined countries

In this section, the profiles of each country with different socioeconomic profiles, climatic conditions and demographic characteristics are outlined, additionally with regards to the extent at which EP is observed within their respective territories and in comparison, to the EU average (EU28). This serves as a first indication of the extent of EP encountered in each of the case studies and key corresponding national circumstances. Table 1 provides country profiles in terms of their location in Europe, climate, demographics, residential energy consumption and Gini index (for 2016). The countries used as case studies for this investigation include mostly Mediterranean and Continental climates, with populations ranging from less than 1 million (Cyprus) to more than 46 million (Spain). The average final energy consumption in households in the EU is estimated to be 558 kg oil equivalent per capita, a value which is approximated only by Lithuania (at 502 kg oil equivalent); all other countries exhibit a significantly lower final energy consumption in the residential sector [29]. Moreover, the average Gini coefficient in the EU is 30.8%, with all participating countries having higher indices of income inequality [30].

The investigated countries therefore include a mixture of climatic, demographic and socioeconomic conditions and different scales. For this reason, the methodology of this section is based on well-established indicators widely used to estimate EP.

These are collected under surveys such as the European Union Statistics on Income and Living Conditions (EU-SILC) and Household Budget Survey (HBS), which are made available collectively through EPOV [32]. The indicators presented here are: Arrears on utility bills, Hidden EP (HEP), Inability to keep home adequately warm, High share of energy cost in income (2M), Home uncomfortably hot in summer and Presence of leak, damp or rot (Fig. 1). The first four indicators are described as primary indicators by EPOV, whereas the last two are secondary, meaning that they are relevant to EP but not direct indications of it. In the case of “Home uncomfortably hot in summer”, EPOV considers it to be a primary indicator but the low quality of currently available data renders it a secondary one. HEP refers to the share of population whose absolute energy expenditure is below half the national median and the 2M indicator presents the proportion of population whose share of energy expenditure in income is more than twice the national median share. Also, the indicators refer to data collected in 2016, with the exception of “Home uncomfortably hot in summer” (2012), the 2M indicator and HEP (both 2010).

These indicators are mostly consensual (household self-assessment) and so often described as subjective [10,19,33,34]. Two of the primary indicators are calculated based on HBS income and/or energy expenditures data (HEP and 2M). In some EU MSs (e.g. the UK), income/ expenditure-based indicators are used to assess EP in the country (e.g. LIHC indicator), an approach which is often viewed as more objective [34]. The strengths and weaknesses of the different methodologies in selecting EP indicators constitute a debate on its own and are out of the scope of this study. For this reason and since the only data currently available to produce a comparative study are sourced from the EU-SILC database and HBS, the abovementioned indicators are employed to assess EP and offer a general overview of the status quo in each of the examined MSs.

The case studies often have low-performing indicators compared to the EU average. For example, only Spain has a better performance than the EU28 in keeping homes adequately warm, with all the other countries showing significant thermal discomfort. Conversely, Spain is also the closest approximation to the European average when it comes to keeping homes cool in the summer; however, it is still higher than the EU28. Bulgaria has the worst performance for both of the abovementioned indicators, as

Table 1
Country profiles (Eurostat, 2016). Where appropriate, the EU average (EU 28) was included in the last column.

	Cyprus	Spain	Portugal	Bulgaria	Lithuania	EU28
Climate	Mediterranean (hot & dry summer, mild winter)	Mediterranean (hot & dry summer, mild winter), Oceanic (extensive rainfall) and Continental (hot and dry summer, cold winter)	Temperate Mediterranean (hot summer, wet winter)	Mediterranean (hot & dry summer) and Continental (warm summer, cold winter)	Temperate Continental (warm summer, cold winter)	–
Region	Southeast Europe	South Europe	Southwest Europe	Eastern Europe	Northern Europe	–
Population [31]	<1 million	46.44 million	10.34 million	7.15 million	2.89 million	–
Final energy consumption (households) [29]	383 kgoe/capita	324 kgoe/capita	254 kgoe/capita	316 kgoe/capita	502 kgoe/capita	558 kgoe/capita
GINI coefficient [30]	32.1%	34.5%	33.9%	37.7%	37.0%	30.8%

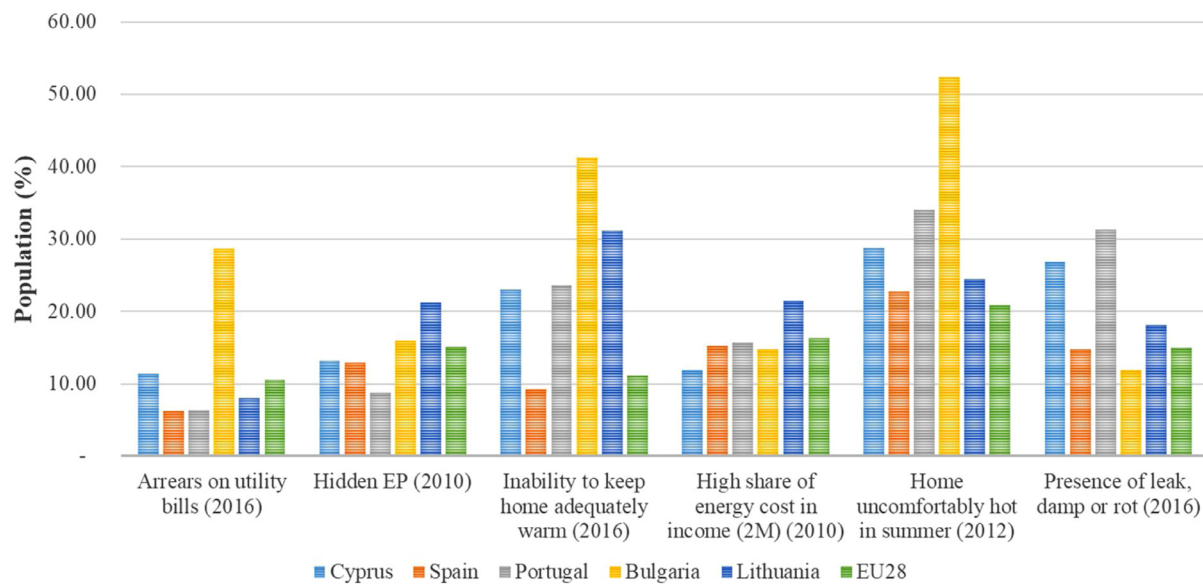


Fig. 1. Proxy indicators of EP, adapted from [32].

well as for “Arrears on utility bills”. Coupled by Cyprus, they are the only two countries with higher percentages of arrears on utility bills in relation to the EU28. For this specific indicator, Portugal seems to be performing better than most other countries, however this could be misleading, as large portions of the population rely on biomass burning for space heating and therefore not accounted for in energy bills [21].

Regarding the presence of leaks, damp or rot, Bulgaria has the lowest percentage of population living in such conditions. Together with Spain, they are the only two countries with lower indicators than the EU28. Lithuania is only slightly above average, whereas Cyprus and Portugal present the least adequate conditions, suggesting poor quality of construction and/or aging building stock. Of course, being a consensual indicator, these findings are open to discussion, since there are distinct deviations amongst the two Mediterranean countries. Lithuania is the only MS where energy expenditure (HEP) is significantly higher than the EU average. Correspondingly, Lithuania is the only MS where the 2M indicator is higher than the EU average. These can be further corroborated by the fact that Lithuania also has one of the highest Gini coefficients, indicating injustice in income distribution. Nevertheless, the HEP indicator is derived from 2010 data, which possibly cannot capture the full extent of the economic crisis in Europe (e.g. in Cyprus the

severe banking crisis occurred in 2013). For this reason and because of the consensual nature of some of these indicators, they should be viewed as indicia and not too literally.

3. Regulatory framework in the European Union (EU)

In response to the complex nature of EP, the EU continually develops policies based on multiple disciplines, either through directives or by providing funds so that action is taken at a national level for each MS. Due to the difficulties to identify EP consumers, “most research and action are ad hoc” and carried out nationally instead of EU-wide [9]. In spite of the lack of an EP-dedicated authoritative body and a structured EU-wide strategy, there has been increasing activity to address EP and protect vulnerable consumers. This section examines some of these activities, mainly focusing on significant EP-related policies.

3.1. Main policies in the European Union

Starting from Directives 2003/54/EC and 2003/55/EC regarding market regulation for natural gas and electricity, it was pointed out that actions needed to be taken to protect citizens against electricity disconnection and inability of payment of bills, according to na-

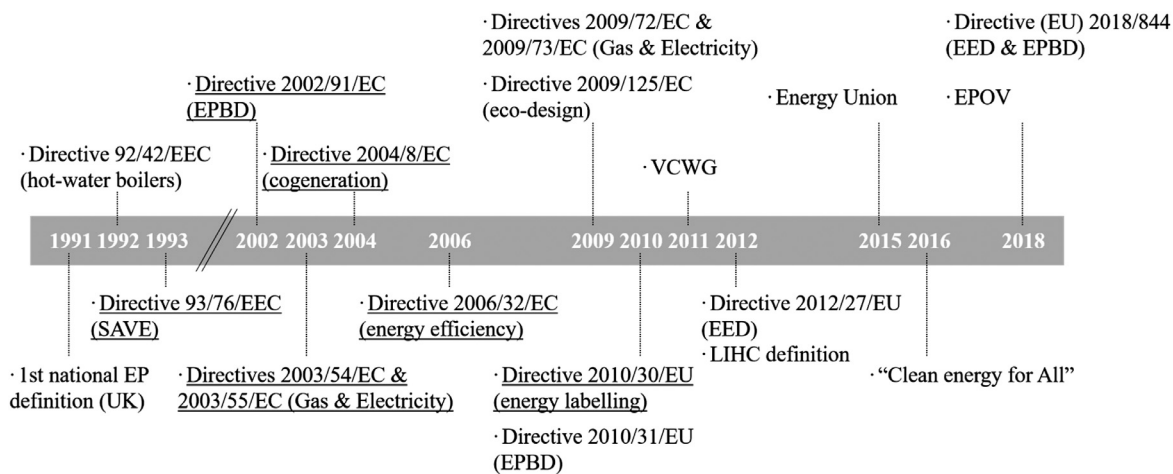


Fig. 2. Timeline of key junctures on the topic of EP (underlined policies are inactive at the time of submission according to EUR-Lex).

tional conditions [35,36]. The growing trends of EP were also highlighted in subsequent directives and initiatives (Third Energy Package, Vulnerable Consumer Working Group, Energy Union) [37–40]. While there was a considerable amount of time between the first directives and the subsequent revision (about 6 years), during the last decade many initiatives have included EP in the policy discussion. For instance, the European Economic and Social Committee culminated grounds for the creation of an observatory that coordinates the monitoring of vulnerability and energy poverty [41]. Additional actions include the “Clean Energy for All” report and ultimately the development of the Energy Poverty Observatory (EPOV), planning to offer a user-friendly and open-access resource on EP to support informed decision making at local, national and EU levels [42,43].

Furthermore, the EU has provided directives that aim to reshape the construction sector in order to optimise energy efficiency of buildings and minimise their impact on climate change. The Energy Efficiency Directive (EED, 2012/27/EU) and the Energy Performance of Buildings Directive (EPBD, 2010/31/EU) are relevant to the efforts for EP mitigation because they can influence a prominent EP driver, i.e. the energy performance of buildings [44]. The EED now encompasses minimum performance and identifies that “the existing building stock represents the single biggest potential sector for energy savings” and therefore at the moment is the biggest drain of urban energy consumption [45]. As for the EPBD, it defines performance requirements for new buildings and ones that undergo major renovations [46]. Both directives therefore contribute in enhancing improvement of buildings and in encouraging various stakeholders to engage in deep renovations of the existing stock. Nevertheless, the refurbishment of the existing building stock has a long-term horizon, whereas EP is a current, imminent problem that affects millions of people [47]. What is more significant is that individuals living in energy poor conditions may not be homeowners and may therefore seem to be even more reluctant to invest in energy efficiency measures [48]. The revised EED, Directive (EU) 2018/844, attempts to address this issue, by encouraging MSs to apply minimum energy requirements for rental properties and suggesting stricter guidelines and a range of policies and national actions to target low-income housing with poor energy performance [49]. The various major junctures that have affected the evolution of research on EP are presented in Fig. 2. While the topic emerged largely in the scientific community in 1991, the first two decades were focused on the development of energy efficiency policies, specifications for building energy requirements and the regulation of the energy markets. EP emerged in the policy agenda sporadically at first and more frequently during the past decade.

In summary, so far EP has been approached indirectly on the EU level, with the incorporation of various provisions within directives dealing with alternative matters (e.g. energy efficiency in buildings and market regulation for gas and electricity). While synergies between policies are beneficial and encouraged, an authoritative body within the EU is needed to focus exclusively on EP. A first step was taken with the establishment of EPOV, a shared EU space that can provide the visibility and debate needed to encourage new policy frameworks. This development, along with the expressed interest of a range of countries suggests that a shift has begun towards forming policies across European MSs, to add EP in the policy agenda.

3.2. EU-funded projects

Besides the EU directives and strategies, EP is being tackled and studied through various independent projects and programmes. Usually these are EU-funded, which is an indirect way for the EU to promote local initiative. In addition, typically the projects foster internationally coordinated efforts to investigate the many faces and aspects of EP across Europe. All of the examined countries in this study are engaged with at least one EU-funded project. Indicatively, Spain is one of the countries that exhibits the most involvement in such projects. On the other hand, northern countries such as Sweden, Finland and Denmark have also participated in similar programmes, despite the low rates observed in EP-related indicators (e.g. ability to keep home warm) in their territories [13,50]. This indicates that the main variable to participate in these programs is not the EP situation of the country, but instead the emergence of non-profit organizations that are engaged with EU funded projects [11]. Due to the highly variable nature of these programmes and in order to avoid omission of initiatives with a significant impact, this study will not examine this perspective in more depth, but focus on state-coordinated efforts to mitigate EP.

4. National measures for the examined countries

The EU policies discussed above are transposed into national legislation for each MS, which gives rise to measures—either nationwide or regional ones. Four types of measures have been identified often adopted to tackle EP directly or indirectly (see Fig. 3): Consumer Protection, Financial Interventions, Energy savings measures, including energy efficiency and renewable energy sources (RES), and Information Provision [18]. Financial interventions give emphasis on short-term solutions based on payments distributed to vulnerable populations (often identified through the welfare national

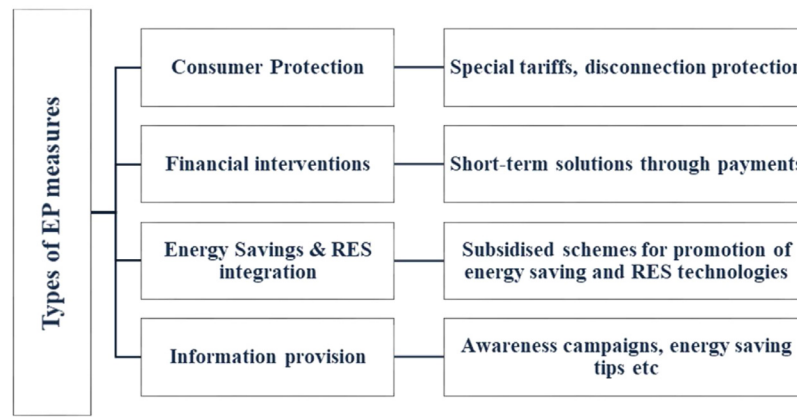


Fig. 3. Types of measures widely used in Europe to tackle EP.

services). Consumer protection measures operate on a similar way; that is, they do not offer a permanent solution but constitute a band aid to the problem of EP. These measures usually include special tariffs and protection from electricity disconnection. As for energy savings measures, these are often subsidised schemes that promote energy efficiency and use of renewable technologies in the household. The information provision type of EP measures, incorporate awareness campaigns and energy advice to inform the public about the effects of EP and ways to get out of it.

Selected national and regional measures for each of the case study countries of this study are presented in Appendix B, providing a representative depiction for each country regarding their overall efforts to mitigate EP. The measures are clustered according to the classification presented in Fig. 3 and each of the measures is provided with a timeline evident of their evolution. It should be pointed out that Spain operates in decentralised *modus operandi*. As a result, EP measures are distributed between three government levels (national, autonomous community and local). This situation means that EP measures may be established independently by one of the subnational governments, or they can be shared, generating a heterogeneous set of measures that varies across and within regions. For this reason, it was deemed appropriate to consider the region of Catalonia to examine the measures offered by Spain both at the national and regional levels, because of the region's innovative and holistic approaches.

4.1. Consumer protection policies

This category of measures is directly linked to the contents of Directives 2009/72/EC and 2009/73/EC, which advocate that vulnerable consumers should be protected by ensuring they are able to pay their energy bills and have continuous supply of energy in critical times. Most of the countries investigated have stipulated consumer protection measures in line to the above. These principally involve reduced energy rates and disconnection protection (Appendix B, Table B1). Bulgaria is the only country of the case studies that has not transposed the relative sections of these directives into national legislation, since no consumer protection measures are currently in effect. Moreover, in Portugal, national legislation exists solely for the special pricing of energy; therefore, the EU's proposition to protect vulnerable energy consumers from disconnection protection was not transposed. Instead, two measures to moderate the cost of energy are employed in Portugal (consumers that receive benefits for electricity and natural gas consumption are further supported by receiving the social tariff rate). In general, most countries provide consumer protection measures by identifying vulnerable consumers through the national welfare systems, with the only exception of Lithuania, where the reduced

value added tax rate on district heating and hot water is applied to all consumers.

Some of these measures have been in place as early as 2006 and have since been revised accordingly to include a more refined pool of vulnerable consumer groups (see Table B1 for the full evolution). This is not the case for Lithuania, where vulnerable consumers of electricity have been defined since 2012, but the official definition in the Law of Electricity only arrived in 2017. Vulnerable consumers are recognised as persons who need monetary assistance in accordance with the Law on Financial Social Assistance. This definition is only related with the electricity sector. However, the majority of the Lithuanian population is living in energy poor conditions due to very cold winters in Lithuania and high household expenses for heating (mainly district heating or conventional fuels). Furthermore, the reduced value added tax rate on district heating and hot water for households is applied to support district heating as an efficient centralized system for reducing air pollution in the cities and not to support low-income households. Consequently, Lithuanian measures on vulnerable consumers' protection are still inchoate and are in need of review. Measures in Cyprus, Spain and Portugal have been developing and are more mature, whereas Bulgarian consumer protection measures are currently non-existent. Noticeably, in Spain, legislation regarding disconnection protection is different on the national (only applies for severe medical situations) and regional levels (Catalonia has provided disconnection protection for vulnerable consumer groups).

Overall, the majority of MSs examined have provided adequate support to vulnerable consumers at this point. Furthermore, in three countries (Cyprus, Spain and Portugal) there have been revisions of the corresponding legislative measures. The revisions may not be identical among them; however, they suggest that authoritative bodies are able to re-adjust legislation as needed. The electricity and gas Directives of the EU state that MSs should take the necessary measures to protect vulnerable consumers towards "the payment of electricity bills, or more general measures taken in the social security system" and by prohibiting disconnection at critical times [37,38]. A common methodology pattern in the transposition of EU directives is detected in this line of measures across the majority of the investigated countries, although each MS has adapted the directives to their national circumstances [51,52].

4.2. Financial aids

This category only includes three measures, in three separate countries – Spain, Bulgaria and Lithuania (see Appendix B, Table B2). Despite the lack of consumer protection measures in Bulgaria, the state has been offering financial aid towards vulnerable consumer groups annually, since 2000. The Republic of Lithua-

nia has also been providing support to low income households by providing an aid for heating, cold and hot water costs, under various laws and legal acts, even during the Soviet Period. This measure has had revisions since then and is being regulated at the municipal level. However, up to now, it has not been harmonised to the Lithuanian definition of vulnerable consumers, but rather applies to the low-income population. As for the Spanish measure, local Social Services always have had a budget item intended for social emergencies. The criteria and implementation of this financial aid depend on local governments and have been reviewed since the economic crisis of 2008. For example, in Catalonia, the surge of individuals applying to benefit from this measure was addressed through legislation prohibiting electricity disconnection. Aside from the terms of the Directives mentioned in Section 4.1 of this study, it is also mentioned that vulnerable consumers should be protected by “providing social security benefits” to ensure continuous supply of electricity and gas. Some countries have opted to apply such measures to the regional level and only Bulgaria has offered state-wide support to vulnerable consumers.

Nevertheless, it is evident that all three countries have at least partially transposed the EU regulations into national legislation [51,52], although they may have done so through their existing measures and not by rethinking their EP-mitigating strategies.

4.3. Energy savings measures and RES integration

This category is the most heavily employed one, focusing on energy efficiency and promotion of RES and in some cases, with higher emphasis on vulnerable consumers. These measures are listed in Table B3 of Appendix B. Considering Cyprus, the available schemes include energy efficiency upgrades of households, as well as promotion of renewable technologies (mainly solar) with vulnerable consumers often receiving higher funding. Only one of the measures is offered and regulated at the municipal level in Cyprus (soft loans for solar photovoltaic (PV) installations). As for the progression of all the mentioned measures, they have been appraised and revised over the years, as seen in Table B3 (Appendix B). A general trend that can be observed is the increasingly available budgets, maximum grants and capacities allowed for RES installations, as well as expansion of the diversity in renewable technologies being promoted (e.g. biomass and biogas added in 2017, as well as decentralised RES installations). Similarly, in Spain, there is no energy efficiency policy dedicated to EP mitigation, but additional incentives are offered to the vulnerable population in some occasions. The offered programmes include energy efficiency and RES schemes, as well as building renovations. The national budgets of Spanish measures also follow an increasing trend over time, with biomass and geothermal energy being promoted in recent years. In the case of Spain, implementation and allocation of the national budgets are often under the authority of regional governments (a total of 19 autonomous communities), therefore the enactment of national schemes is uneven across the country. It can be concluded that Cyprus and Spain do not offer measures directly targeting the population in EP or at risk of it. Instead, support is provided indirectly, by means of higher subsidized amounts (assuming that vulnerable populations are able to provide the remainder of the investment).

As for the third southern European country, Portugal, the energy efficiency measures offered by the national regulatory authority and the state do not provide extra benefits to vulnerable consumers. Instead, Portuguese low-income homes may directly benefit through programmes promoting improvements in vulnerable households, disadvantaged communities and social neighbourhoods. Two of these measures targeting low-income households were first implemented in 2017, whereas the third measure has been implemented since 2007, with some revisions to incorporate

eligibility criteria. These schemes are nationally funded, but regulated on the regional, municipal and social neighbourhood levels. In general, Portugal has provided several different avenues for home improvements of vulnerable households on the national level, with municipalities being able to apportion their budgets to measures they wish to promote within their territories.

In Bulgaria, energy efficiency and RES measures are targeted to private individuals, corporations and the industry, without any additional benefits towards low-income households. Between 2006 and 2011 a total of 123 projects were carried out, whereas in the 5 years that followed, this number decreased (72), but the average amount of money allocated per project increased (see Table B3). This indicates an increased uptake in large projects that are not household oriented. Nonetheless, increasing budgets over the course of Bulgarian measures indicate an increased national interest to promote energy efficiency and use of RES.

In Lithuania, a renovation programme for multi-family buildings has been in place since 1996, offering low interest (soft) loans to households and a 100% subsidy for low-income families, for as long as . This measure is divided in three stages and mainly targets buildings constructed prior to 1993, indicating that emphasis is given to the older buildings in dire need for renovation. Additional measures promoting RES have achieved a significant increase in installed solar capacity and the notion of prosumers, urging the Lithuanian population and local authorities to utilise RES for self-consumption. The RES-promoting measures do not however include improved terms for vulnerable populations, but instead focus on increased RES uptake within the general population. The Republic of Lithuania therefore supports low-income households mainly via building renovations to improve energy efficiency but is lacking in the advancement of “clean” energy use in those households.

As for transposition of the EU Directives, it is stated within them that MSs should ensure support for energy efficiency improvements towards vulnerable consumers. Cyprus, Spain and Portugal have successfully transposed existing or new legislation for energy efficiency with specific additional benefits for low income population and vulnerable consumers. Lithuania has also transposed pre-existing legislation on energy efficiency, offering high level support towards vulnerable consumers at times. Bulgaria on the other hand, has not shown the same commitment in transposition of the directive recommendations for better support of vulnerable consumers [51,52].

4.4. Information provision

The topic of public awareness and information provision for improved energy performance of dwellings is the most under-represented, with only one measure currently being in place in Spain (see Table B4). Due to the decentralised nature of the country, it is up to local governments to develop similar initiatives, with national coordination regarding information provision lacking at the moment. This may be rooted in the fact that no directive exists stipulating the need to raise awareness for EP. The closest approximation may be found in the recent Directive (EU) 2018/844 for the energy performance of buildings, which states that “while outlining national actions that contribute to the alleviation of energy poverty in their renovation strategies, the Member States have the right to establish what they consider to be relevant actions.” [49].

As the allowance period for transposition of this Directive has only been initiated in mid-2018, it remains to be seen whether (any) MSs will consider information provision as one of the relevant actions of the national strategy to alleviate EP.

Table 2

Relative ranking of the examined countries regarding their efforts to mitigate EP through measures, definitions for EP and vulnerable consumers.

MS	EP definition	Energy vulnerable consumer	Consumer protection measures	Financial aids	Energy Savings	Information provision	Relative score
CY	X	X	X		XX		5
ES		XX	XX	X	XXX	X	9
PT		XX	X		XXXX		7
BG		X		X	X		3
LT		X	X	X	XX		5

Table 3

Differentiation between vulnerable consumer groups and the general population, within the measures offered by each country and extent of nationally regulated measures.

MS	Differentiation for vulnerable consumer groups (%)	Regulation on national level (%)
CY	67	83
ES	60	50
PT	63	75
BG	33	100
LT	43	86

5. Discussion

Based on the above, the efforts of each country to alleviate EP are analysed by also associating the respective vulnerable consumers' definitions. Table 2 shows a tally of each country's relative score – an arbitrary indication, in order to provide a relative ranking framework that aids in the identification of best practices and pitfalls (full details regarding the estimation of this relative score in Appendix C, Tables C1 and C2). Briefly, the lowest score for each criterion receives one point (one X), and each successively higher score receives an additional point. Due to the subjective nature of this ranking method, emphasis should be given to the lowest and highest scores, which are correspondingly indicative of the biggest potentials for improvement and best practices. The in-between scores indicate an adherence to the minimum requirements of the EU directives (definitions for vulnerable consumers, protection measures against disconnection and inability to pay bills), while also including undeveloped areas that can be improved.

In addition to the above relative ranking of the examined countries, the percentage of differentiation for vulnerable consumers is also evaluated and presented in Table 3 (details in Appendix C, Table C3). The higher the percentage, the more often the measures of that particular MS consider vulnerable consumers and/or provide improved terms based on socioeconomic criteria. For example, in Cyprus 6 out of the 10 measures are oriented towards vulnerable consumers, resulting in an approximate 67% of the measures mentioned here, differentiating between vulnerable consumers and the general population.

However, this percentage should not be regarded on its own as a representative effort to mitigate EP, since the definition of vulnerable consumers in some MSs is not relative to energy vulnerability, but poverty in general. To exemplify, the 67% of measures mentioning vulnerable consumers in Cyprus may not be as representative as the 60% mentioned in Spain, since Spain defines vulnerable consumers according to their eligibility for the electricity tariff and their contracted power. Rather, it should be interpreted as a proxy indicator in the same way as the tally is, i.e. to take a closer look at the lowest and highest rankings in search for strategies to use as examples for advancement. Another indicator is presented in Table 3, presenting the extent of nationally regulated measures offered by each MS. Lower percentages of national regulation indicate increasing regional/municipal action and thus more

decentralised approaches. For example, in Bulgaria all of the examined measures are nationally regulated, whereas in Spain approximately half of the measures are coordinated and monitored by the autonomous regional and local governments. At a first glance it seems that the amalgamation between a high ratio of measures directed at vulnerable consumer groups and the decentralised approach adopted by Spain may have a positive effect on EP indicators. Therefore, it can be suggested that countries that are highly dependent on nationwide regulation should endorse regional autonomy (e.g. Bulgaria, Lithuania and Cyprus). In addition, measures designed specifically for vulnerable consumer groups, or modified to accommodate them at a higher degree, are more effective in EP mitigation. However, this comes as no surprise, as a well-targeted measure is expected to deliver better results. For this reason, emphasis should be given to more accurate approaches for EP detection. Nevertheless, no conclusions can be generalised without careful consideration of national circumstances.

In general, Bulgaria is the country showing the least effort to mitigate EP, since the measures providing support to EP alleviation are minimal. Its national definition of vulnerable consumers refers to electricity consumers; however, no further details are provided regarding consumption limitations. Furthermore, only one of the three measures offered at the national level are directed to low-income households in Bulgaria, resulting in the lowest percentage of differentiation between the general population and vulnerable consumer groups. However, the main issue with Bulgaria is that there has been no sufficient transposition of the EP-related topics addressed by EU Directives 2009/72/EC and 2009/73/EC. This is apparent from the indicators presented in Fig. 1, since Bulgaria has the worst performance in half the indicators presented. Strangely enough, it also has the best performance in the indicator "Presence of leak, damp or rot", which reinforces the need for a closer look when analysing self-assessed indicators. Nonetheless, as more and more EU regulations and directives are including the need to address EP in their agenda, it is deemed urgent that Bulgaria starts transposing them instead of simply incorporating some existing legislative measures that may fit the EP agenda. Therefore, Bulgaria would benefit most by firstly transposing the Directives and thereafter implementing measures of all four categories, which are specifically designed for populations at risk of EP instead of the general population and the industry of the country. Moreover, a more accurate definition using contract limitations would render all relative measures more powerful towards EP mitigation. It should be noted that of all the discussed countries, Bulgaria has the highest Gini coefficient. This means that the "Arrears on utility bills" indicator may have to be dealt with through general poverty mitigating tools and not through the lens of EP.

Portugal, Cyprus and Lithuania are placed in the middle ranks, suggesting a moderate indirect effort in EP mitigation, with Portugal having a slightly higher ranking. Portugal and Cyprus have mainly Mediterranean climates and the examined measures focus on energy efficiency and harnessing the high solar potential that is offered due to their geographies. The portfolio of action for Portugal is the least diverse of these three countries, something which is believed to separate Portugal from the best performing country of this study – Spain. In the Portuguese case, measures are focusing

mainly on energy savings – an area in which this country seems to excel. Nevertheless, there has been evidence of low energy performance for 75% of the building stock in Portugal, indicating that although the measures exist, they may not in fact be effective towards delivering highly efficient infrastructure in the building sector [53]. The need for emphasis on household energy efficiency can also be traced back to the indicators, which offer corroborating evidence of low performance in keeping comfortable thermal environments and dealing with leaks, damp or rot (see Fig. 1). Of those measures, the Portuguese government has provided considerable support specifically to the country's vulnerable consumers, resulting in a high degree of differentiation between them and the general population, as well as a definition for *energy vulnerable consumers* with contract limitations instead of just at-risk consumers. This discernment augments the relevancy of all other measures, as it allows for increased precision in the targeted low-income population groups at risk of EP. Portugal would therefore most benefit not by deemphasizing on energy efficiency, but by incorporating more diverse actions across the categories of consumer protection measures, financial aids and information provision. For example, the Portuguese exhibit a relatively high share of energy cost in income (2M indicator), something which is already dealt with by the special tariff (see Table B1), but could also improve greatly by additional financial aids for certain periods of time.

Cyprus exhibits similar levels of involvement in the same measures as Portugal, with less energy savings measures and differentiation for vulnerable consumer groups. Vulnerable consumers in Cyprus are defined within the context of electricity users, since no natural gas grid exists in this country; however, there are no contract limitations or metric reference to accurately detect and monitor energy vulnerable consumers. The indicators studied suggest that household efficiency is a problematic issue in Cyprus and that there are significant arrears on utility bills. Therefore, although several energy efficiency measures are implemented in Cyprus, there is room for improvement. Firstly, it is suggested that Cyprus improves the existing definition of vulnerable consumers by introducing consumption limitations, and thereafter employing a range of measures across all categories, highlighting financial aids and energy efficiency and renewable technologies promoting prosumerism.

As for Lithuania, it shares the same ranking as Cyprus, due to its diverse portfolio of actions across the measures examined. It also provides a definition for vulnerable consumers centred on electricity users, but not related to the national heating laws, which is a main source of EP in Lithuania due to cold winters. The existence of the definition and the diverse portfolio of Lithuania are counteracted by the low percentage of differentiation between the general population and vulnerable consumers in the offered measures and the lack of technical specifications regarding energy vulnerable consumers. Moreover, by not being harmonized with the Law on Heat Sector, the definition excludes consumers who may be energy poor due to high costs related to heating. Hence, a contract limitations definition would enhance the effectiveness of all measures in Lithuania too. In this case and since the population is heavily relying on district heating, the definition should be inclusive of all energy users and harmonised with the heating legislation. Concerning the indicators in Fig. 1, Lithuania has the worst performance in the HEP and 2M indicators, suggesting that the income inequality pointed out by the Gini index (see Table 1) is contributing to enhanced EP in the country. This is already being addressed through the financial aid provided to households with low income (see Tables B2 and B3). Increasing the number of measures across all categories, especially the under-developed RES policies and enhancing their availability to the population affected by EP would further improve the country's EP alleviating efforts.

Spain is distinctly different than the other countries, in that it is about 4 times more populated than Portugal and more than 40 times more populated than Cyprus (see Table 1). Since Spain is highly decentralised and taking into account the scalar difference, Catalonia (population of 7.4 million) was selected for a closer look in many occasions in this study. Spain has the most diverse portfolio of measures for tackling EP at the various governmental levels. It is the only country to provide measures for all categories – financial aids, consumer protection, energy savings and information provision. Due to its decentralized character and heterogeneity, most of the measures are not generalized in the entire Spanish territory. Therefore, they can be individually exhibited as good practices, but not as national good practices or a general trend in the country. As for the national definition for vulnerable consumers, Spain has ensured that the definition refers to consumers of electricity, and not vulnerable consumers in general, reinforcing its relevance (but again, at the same time excluding consumers of different energy sources, e.g. natural gas). In combination with contract limitations and the differentiation of three tiers of vulnerability, this definition is designed to describe to a representative degree the population at risk of EP in Spain. Nevertheless, it can be argued that the Spanish social tariff categories for vulnerable consumers are too focused on economic criteria. That can transform the social tariff in a complementary benefit to households with low income, instead of focusing on the EP population. The EP indicators presented in Fig. 1 illustrate that Spain has a better performance than the EU average in all areas, except the ability to keep the household comfortably cool in summer, where it is slightly above the EU28. The areas in which Spain has failed, is in providing an EP definition and nationally levelised measures to mitigate EP uniformly across the nation. Therefore, a national definition should be formally stipulated and some sort of uniformity should be kept across the various government levels, in order to allow for comparative approaches within Spain and in relation to other EU countries.

Besides the various initiatives observed in Catalonia, a noteworthy and innovative energy strategy has been introduced in 2018 in Barcelona, with the biggest local public energy supplier launching "Barcelona Energia" [54]. Barcelona Energia is estimated to provide energy generated by municipally-owned solar panels located at waste recovery plants by 2019. It demonstrates a holistic approach, harmonising with the local legislation regarding disconnection protection for vulnerable consumers, promoting prosumerism and engaging citizens in the production and management of the generated energy. In addition, it supports residents by providing valuable energy advice while also endorsing energy efficiency projects and a "smart energy culture". The Spanish approach to tackling EP is therefore on the one hand all-inclusive, carefully structured and well-aimed. On the other hand, the various elements comprising this holistic approach are implemented at different organisational levels. As a consequence, outcomes of actions and energy strategies cannot be observed at the national level in a homogeneous manner. Therefore, when examining EP on the national level in Spain, some regions that are not as engaged as others may be assessed overly optimistically, or prominent local initiatives may be underestimated. The EP indicators examined previously corroborate with the results of this study, however caution is advised in information interpretation. Ultimately, the higher ranking attributed to Spain may be a result of several local best practices that do not actually amount to nationally coordinated actions mitigating EP.

6. Conclusion

This study examines the evolution of policies and measures regarding EP for five MSs (Cyprus, Spain, Portugal, Bulgaria and Lithuania) that are under-studied in the existing literature, by

developing a relative ranking methodology to assess their EP-mitigating efforts. In general, the EU is showing increasing interest in creating a European-wide knowledge base dedicated to the topic of EP. All of the participating countries of this study have provided national definitions for vulnerable consumers, although only two MSs (Spain and Portugal) have formulated this definition relative to types of energy vulnerable consumers with specific contracted power limitations, and not simply populations at-risk. All of the examined countries have negative EP profiles at times, based on EU-wide indicators. Nevertheless, the country with the most promising profile in terms of engagement and mitigating EP is Spain. Conversely, the country with the least action towards supporting energy poor households is Bulgaria. The case of Bulgaria can be described as an oxymoron, since the issue is being recognised and discussed by the national scientific community, but very little action has been taken by the government. This is reflected in the observed indicators provided at the EU level by EPOV, as well as the measures and strategies examined in the present study. The Spanish national government and regional governing authorities are involved in a wide portfolio of actions in their efforts to alleviate EP and support the country's low-income population, covering all categories of measures that could be offered, whereas Bulgaria offers a very limited range of support to the country's vulnerable consumers. Attention is drawn on the fact that although not explicitly stipulated in EU directives, Spain has offered measures relating to public awareness, something which is lacking from the agendas of all other countries.

Relating to the transposition of EU legislative instruments, all of the case study countries have at least partially transposed sections of the legislation that refers to vulnerable consumers in relation to energy poverty (either through new national legislation or by transposing existing legislation). Moreover, it transpires that EU directives confound the terms “energy poverty” and “vulnerable consumers”, resulting in national definitions of EP that relate to vulnerable consumers, without requirements for energy consumption limitations or similar quantifiable energy metrics. A set of guidelines that relates EP to energy vulnerable consumers is advised, in order for MSs to act accordingly and develop more effective EP-mitigating measures. One possible limitation of this study is that it provides snapshots of each country, based on representative measures, resulting in the overlooking of independent projects and initiatives. Ultimately, best practices (such as the local initiative of Barcelona Energia to provide 100% locally generated green energy)

should be regarded as an example for replication by all MSs, since besides Bulgaria, Cyprus, Portugal and Lithuania also have obvious margins of improvement. With regards to localised actions, the results of this study suggest that a decentralised approach can be beneficiary to the mitigation of EP. Therefore, in addition to nation- and EU-wide strategies, local initiatives should be encouraged, to promote both the development of EP alleviating strategies, as well as practical support to low-income households. Ultimately, it is recommended that the investigated countries develop national strategies to accurately detect EP and effectively mitigate it, through tailor-made measures from a portfolio that covers different aspects of EP.

While EU directives mention EP and suggest guidelines for MSs to act upon, said guidelines are not specific to *energy vulnerable consumers*, but consumers at risk of poverty in general. This is a serious defect in the EU policy framework and it should not be overlooked, because it is relayed into national legislations and the development of misguided measures. For example, the measures discussed here largely relate to vulnerable consumer groups as defined in each national circumstance, low-income households and individuals at risk of poverty (not EP), as was suggested by EU regulations. Therefore, while the EU has been highlighting the urgency to mitigate EP, it has not provided adequate support. Individual MSs are to acknowledge EP and strive to support the populations living in it; however, they are not to take responsibility for lack of cohesive strategies, when the EU itself has been ambiguous on this matter.

Conflict of interest

None.

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Appendix A. Definitions for vulnerable consumers and EP

Table A1

Definitions of EP and vulnerable consumers in the examined countries. A: Individual characteristics, B: Specific circumstances, C: Social welfare system, D: Related to energy consumption with contract limitations.

Country	National EP definition	Vulnerable consumer definition	Vulnerable consumer criteria
CY	Yes*	Allowance beneficiaries of welfare stipends (based on Minimum Guaranteed Income or Public Aid), persons with physical disability, retired individuals with low incomes, blind individuals, families with three dependent children or more [15,55].	A,B,C
ES	No	There are three levels of vulnerable consumers, with different criteria and requisites but firstly, all vulnerable consumers of any kind must be beneficiaries of the Voluntary Price for Small Customer electricity tariff and a contracted power equivalent to or below 10 kW in their usual residence. The criteria involve low income individuals, pensioners, large families and assistance from national social services [16].	A,B,C, D
PT	No	Beneficiaries of social welfare with some contract limitations [56].	C, D
BG	No	Household customers in whose property, supplied with electricity, live persons who for reasons of old age, health or income are exposed to the risk of social exclusion in relation to the supply and consumption of electricity and who benefit from social assistance measures to ensure the necessary electricity supplies [57].	A, B, C
LT	No	Consumers of electricity, who are entitled to receive monetary social assistance in accordance with the Law on Financial Social Assistance to low-income residents and who have the right to use additional guarantees provided to vulnerable consumers in the manner prescribed in national legislation [58].	C

* “The situation of customers who may be in a difficult position because of their low income as indicated by their tax statements in conjunction with their professional status, marital status and specific health conditions and therefore, are unable to respond to the costs for the reasonable needs of the supply of electricity, as these costs represent a significant proportion of their disposable income.” [39].

Appendix B. Measures of the examined countries by type

Table B1

Consumer protection measures in the investigated countries.

MS	Measure	Source	Aim	Geographic scale
CY	Special tariff [59]	Government	Reduced cost of electricity for specific groups of vulnerable consumers.	National, same everywhere
Timeline	- 2006: Limited groups of vulnerable consumers. - 2013, 2015 and 2016: Revised criteria to include more groups of vulnerable consumers.			
CY	Electricity disconnection protection [55]	Government	Protection for all categories of vulnerable consumers from disconnection in critical times.	National, same everywhere
Timeline	- 2015: Initially applied to all vulnerable consumer, revised in 2015 to only apply to vulnerable consumers with serious medical conditions.			
ES	Social tariff for electricity [60]	National Government	Discount on the electricity bill for vulnerable households and protection of severely vulnerable households from disconnection.	National, same everywhere
Timeline	- 2009: The measure freezes the electricity tariff at the time of the measure approval (2009) that was a remarkable discount, due to the important price increase in the following years. - 2012: 25% discount for specific consumers not mainly determined by income criteria. - 2017: 40% discount for vulnerable households, and prohibits the disconnection in severe vulnerable households when other administrations (regional or local) cover the remaining 50% of the bills.			
ES	Prohibition of disconnection for medical reasons [60]	National Government	Law on the Electric Sector (Law 24/2013) establishes the prohibition of disconnection for consumers with severe health problems.	National, same everywhere
Timeline	- 2013: National law, only for household consumers that require electricity powered life support equipment.			
ES	Precautionary principle in disconnection situations [60]	Regional Government	Prohibition of disconnection of electricity, gas and water supply for vulnerable households as certified by local social services in accordance with the precautionary principle.	Regional, Autonomous Community of Catalonia
Timeline	- 2015: Local law promoted through a citizen initiative by social movements and civil society organisations.			
PT	Social Tariff [61]	Government	Reduced cost of electricity and natural gas for specific groups of vulnerable consumers.	National, same everywhere
Timeline	- 2010: Vulnerable consumers, with a contracted power equal to or below 4,6KVA. - 2011: Vulnerable consumers, with contracts with annual consumption equal to or below 500m ³ . - 2014: Electricity consumers with contracted power equal or below 6,9KVA, more categories and criteria. 2016: Both previous laws were revised to consider an automatic identification of vulnerable consumers through the social welfare system instead of by request of the consumers and with revised income criteria.			
PT	Extraordinary Social Support [61]	Government	Reduced electricity and natural gas bill for specific groups of vulnerable consumers.	National, same everywhere
Timeline	- 2011: Applied to all electricity and natural gas consumers already benefiting of the social tariff. - 2014: Revised criteria to be coherent with the changes to the social tariff law.			
LT	Reduced VAT on district heating and hot water [62]	Government	Reduced VAT rate (9% instead of standard 21%) on district heating and hot water for households.	National, same everywhere
Timeline	- 2001: Reduced VAT rate (at 9%), temporary measure (extended annually). - 2017: Between June–September the VAT rate went back to 21%, but in October it was once again reduced to 9% and became a permanent measure.			
LT	Electricity disconnection protection [63]	Government	Protection of vulnerable consumers from electricity disconnection in critical times.	National, same everywhere
Timeline	- 2012: Recognition of vulnerable electricity consumer, permanent measure. - 2017: Definition of vulnerable electricity consumer, permanent measure.			

Table B2

Measures in the form of financial aids in the investigated countries.

MS	Measure	Source	Aim	Geographic scale
ES	Energy cost financial aid [60]	Local governments	Emergency financial support to households, used for energy expenses in case of disconnection risk.	Local. Depending on municipality
Timeline	- Local governments offer parts of their budgets through local social services. - Since the economic crisis in 2008 the demand increased dramatically and is now offered only in severe social exclusion situations.			
BG	Targeted aid for the new heating season [64]	Government	Financial aid for heating for five months (from 1 November to 31 March) for specific groups of vulnerable consumer. Aid differs for different vulnerable groups.	National, same everywhere
Timeline	- 2000 - 2008: Limited groups of vulnerable consumers. - Since 2009 and ongoing: revised criteria to include more groups of vulnerable consumers.			
LT	Compensations on heating, cold and hot water costs [65]	Municipality	Compensations on heating, cold and hot water costs for households with low income.	Administration on municipality level
Timeline	- 2012: Mixed model of funding: 55 municipalities from state budget, 5 municipalities from own budget. - 2015: All funding from municipality budget. - 2017: Funding if heating costs exceed 10% of income (before it was 20% of income).			

Table B3
Energy savings measures in the investigated countries.

MS	Measure	Source	Aim	Geographic scale
CY	Saving Energy – Upgrading of Households [66]	Government/EU	Energy upgrades and use of RES in households - enhanced grant (75% instead of 50%) for vulnerable consumers.	National, same everywhere
Timeline	- 2014: Max grant €10.000 for apartments and €15.000 for houses. - 2018: Max grant €20.000 for apartments and €25.000 for houses.			
CY	Installation or replacement of solar water heating [67]	Government	Financial assistance (€175 / €350, depending on type of investment) for the installation or replacement of solar water heating systems.	National, same everywhere
Timeline	- 2015: Only available for replacement, not initial installation. Annual budget: €200.000. - 2017: Initial installation or replacement. Annual budget: €600.000.			
CY	Solar energy for all / Energy production from RES for own use [68]	Government	Promotion of solar energy (“Solar energy for all”), and with the 2017 revision also biomass/ biogas for own use. Vulnerable consumers receive additional funds.	National, same everywhere
Timeline	- 2014: Net metering for houses/ local authority buildings and own production PV systems for commercial and industrial units. Max capacity of 20MW. - 2015: Max capacity increased to 40MW. - 2016: Autonomous PV systems also included. Max capacity increased to at least 63MW. - 2017: Net metering for houses and non-domestic consumers & own production PV, Biomass/Biogas systems for commercial and industrial units & Autonomous PV systems (at least 63MW).			
CY	Soft loans for Photovoltaics [69]	Municipality	Loans with favourable terms for the installation of PV systems on homes. Cooperative Bank and the regional Chamber of Commerce and Industry also involved.	Regional
Timeline	- 1 million euros for loans with favourable terms for PV installations in the Aradippou municipality.			
ES	Programme for the promotion of building renovations [60]	National government/ Autonomous Communities	Financial assistance to households for energy efficiency works.	National, same everywhere
Timeline	- 2013–2017: National budget was c. €888 million combined with partial regional investment. Amount of subsidy determined based on socioeconomic criteria. - 2018–2021: National budget will be c. €1.4 billion combined with partial regional investment. Specific groups of individuals (e.g. large or single-parent families) at risk have priority.			
ES	Renewable energy self-consumption financial support [70]	National government/ Autonomous Communities	Build or improve RES self-consumption systems. Social housing or small municipalities can receive better economics aids.	Regional – more benefits in rural areas
Timeline	- Autonomous communities use parts of their budgets to create schemes on a local basis, e.g. in Catalonia, subsidies for energy storage systems with batteries associated to PV self-consumption installations.			
ES	Regional energy efficiency programmes [71]	National government/ Autonomous Communities	Spanish regions provide financial assistance for energy efficiency renovations and renewable energy.	National, but not the same everywhere.
Timeline	- 2017: Initiation of schemes promoting energy efficiency, e.g. in Catalonia, subsidies to improve accessibility and knowledge of the state of residential buildings managed by the regional Housing Agency.			
ES	Housing renovation grants [72]	Local Governments	Improvements in the housing conditions, including targets to increase energy efficiency levels to protect households against EP.	Local (Barcelona)
Timeline	- 2017: Final approval for “Barcelona Right to Housing Plan 2016–2025”, with a budget of app. €3 billion.			
ES	Programmes PAREER [73]	National government, Institute for the Diversification and Saving of Energy	Energy efficiency improvements and switch of conventional energy sources with biomass/ geothermal energy. Additional funds may be provided based on social criteria.	National, same everywhere
Timeline	- 2015–2017: Budget for 1st call €126,5 million, budget for 2nd call €78 million.			
PT	Electrical Energy Consumption Efficiency [74]	Regulatory Authority for Energy Services	Improve the efficiency of electricity consumption, through actions taken by several agents in the different energy sectors.	National, same everywhere
Timeline	- 2007–2012: 156 measures (24 on the residential sector) with a budget of €50.3 million. - 2013–2018: 145 measures (16 on the residential sector) with a budget of €40 million.			
PT	Energy Efficiency Fund - Energy Efficiency in Buildings [75]	Government	Energy efficiency measures such as windows, heating and hot water systems replacement and wall and roof insulation, for residential dwellings and service buildings.	National, same everywhere
Timeline	- 2012: Budget of €2 million, only for window replacement and solar thermal systems installation. - 2015: Budget of €1 million, for external and roof insulation. - 2016: Budget of €1.1 million, for solar hot water systems, windows, wall insulation, pavements and roofs. - 2018: Budget of €1.5 million, for measures of solar hot water system rated A; replacement of existing water heating systems by new A+ ones; replacement of windows, insulation in internal and external walls, roofs and indoor and outdoor pavements.			

(continued on next page)

Table B3 (continued)

MS	Measure	Source	Aim	Geographic scale
PT	Electricity generation from RES for self-consumption [61]	Government	Electricity generation, for own use in the location associated with the respective producing unit, with or without connection to the grid supported on RES.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2002: Power to be delivered to the grid could not exceed 150 KW; and own consumption or the supply to third parties would be at least 50% of the electricity generated. - 2014: Electricity generated by PV systems should be used mostly for the households' own benefit, with systems until 1500 W avoiding the payment of taxes. 			
PT	Improved Comfort in Vulnerable Households [76]	Municipal	Improvement of the housing comfort of vulnerable households.	Mainland Portugal, especially in inland areas with more elderly people.
Timeline	<ul style="list-style-type: none"> - 2007: Improvements are identified at the building level and at the equipment level. - 2014: Eligibility criteria introduced and different measures according to regions. 			
PT	Integrated Action Plans for Disadvantaged Communities (PAICD) & Energy efficiency (EE) measures [77]	Government	Physical, social and economic regeneration of social neighbourhoods (designated territories of disadvantaged communities). Also, interventions in buildings to improve energy efficiency and use of RES.	Social neighbourhoods within municipalities
Timeline	<ul style="list-style-type: none"> - 2017: Rehabilitation of 17 social neighbourhoods (10 PAICD applications and 7 EE applications) and a total of 1632 households. Combined budget of over €16 million through interventions in the building's shell, common areas and networks of water and electricity (PAICD). For the EE applications, beneficiaries are municipal bodies that own or operate social housing, with a non-refundable support rate of up to 85%, except in the Lisbon region where this figure drops to 50% due to the rules for the distribution of funds. 			
PT	Instrument for the Urban Rehabilitation and Revitalization (IFRRU 2020) [77]	Government	Financial products with favourable terms, designed to support urban rehabilitation and energy efficiency, with emphasis on social housing.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2015–2023: Budget of €252 billion from which €106 billion are from EU funds. Intended for the complete rehabilitation of buildings of 30 years of age or more, abandoned spaces and industrial units, and also for interventions in private fractions inserted in social housing buildings. 			
BG	Energy efficiency and RES fund [78]	Government/EU	Financial products (loans, cessions and guarantees) to municipalities, corporate clients and private individuals towards energy efficiency investments.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2006–2011: 123 projects with a total budget of €19 million (av. €154,500/project). - 2012–2017: 72 projects with a total budget of €13 million (av. €180,600/project). 			
BG	Introduction of energy saving technologies in industry [79]	Government/EU	Subsidies for energy audits in small and medium-sized enterprises; introduction of energy saving technologies and RES in industry.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2007–2013: Total budget of €1.16 billion. - 2014–2020: Total budget of €1.39 billion. 			
LT	Promotion of RES [80]	Government	Installation of RES in residential sector (Special Programme for Climate Change funds).	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2011: Modernisation programme: promotion of RES for residential buildings. - 2012: All buildings must be constructed prior to 1993. - 2013: For residential RES installations, energy produced must be for self-consumption. - 2014–2016: Introduction of grant limits (up to 30% of investment). - 2017: Subsidy up to 25%. 			
LT	Multifamily Buildings Renovation Programme (Special Programme for Climate Change) [81]	Government/EU	Soft loans (fixed 3% interest rate) to promote energy efficiency and use of RES in multifamily buildings: grant (up to 100%) for vulnerable consumers (already receiving financial aid) and partial VAT exemptions.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 1996–2004: World Bank project for modernisation, budget of 70 million LT (state funds). - 2005–2010: Multi-apartment Buildings Renovation Programme, budget of 325 million LT. Only for buildings constructed prior to 1993. Low-income families receive a 100% subsidy. - 2010–2020: Multi-apartment Buildings Renovation Programme through JESSICA, budget of €227 million. Only for buildings constructed prior to 1993. 			
LT	Feed-in tariff for Photovoltaics [82]	Government	Solar power plants, decentralized electricity generation.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2011: Installed capacity of solar PV is 0 MW. - 2012: Feed-in tariff for solar PV up to 30 KW was 0.42€/KWh (three times higher than electricity price). - 2013: Feed-in tariff for solar PV up to 10 KW decreased to 0.16 EUR€/KWh, feed-in tariff only for surplus electricity. Quota of 70 MW Solar PV was reached. 			
LT	Energy production from RES for own use [83]	Government	Solar PV, Wind, and Biomass installations for own production.	National, same everywhere
Timeline	<ul style="list-style-type: none"> - 2015: Definition of prosumer, promotion of prosumers' PV up to 10 KW, except public and local authority buildings up to 50 KW. - 2017: Prosumers' PV, wind, and biomass up to 10KW (natural persons) and up to 100 KW (legal persons). - 2018: Since May four types of net metering for prosumers (natural and legal persons) of PV, wind, and biomass installations. 			

Table B4
Information provision measures in the investigated countries.

MS	Measure	Source	Aim	Geographic scale
ES	Energy advice points [84]	Local Governments	Offer advice to the households in energy service issues, such as how to improve their energy efficiency, check if the energy contract is the best for their needs or how they can protect their energy rights in case of disconnection risk.	Local. Depending on municipalities.
<i>Timeline</i> - The first Energy Advice Points were in Barcelona, and were opened in 2017.				

Appendix C. Estimation of relative score

The information collected here is translated into an indicative score for each MS, in order to provide a relative ranking framework. Table C1 presents the criteria for the ranking. The first two criteria are yes/no fields, with each country scoring the same amount when “yes” is indicated (one point).

The rest of the criteria indicate the share of measures for each MS relative to the total number of measures presented. For example, Cyprus, Portugal and Lithuania each have a share of 2 consumer protection measures out of the 9 presented in Table 1 (i.e. overall 6 out of 9), and Spain has the remaining 3 measures (for a total of 9).

The lowest score for each criterion receives one point, and the next higher score receives an additional point. Thus, Table C1 is translated into Table C2, resulting in a total relative score (last column) which is used to rank each MS.

In addition, the differentiation between the general population and vulnerable consumer groups and the percentages of measures regulated on the national level are estimated by dividing the corresponding value over the total number of measures offered per country (not per type) and presented in Table C3. For example, 5 of the 6 Cypriot measures are regulated on a national level, and 4 of them discriminate between low-income households and the rest of the population. For this estimation, the definition of EP and energy vulnerable consumers is not considered.

Table C1
Criteria and proportion of each MS participation in total number of measures per category.

MS	EP definition	Energy vulnerable consumer	Consumer protection measures	Financial aids	Energy savings	Information provision
CY	Yes	Yes	2/9	–	4/21	–
ES	–	Yes, contract limitations	3/9	1/3	5/21	1/1
PT	–	Yes, contract limitations	2/9	–	6/21	–
BG	–	Yes	–	1/3	2/21	–
LT	–	Yes	2/9	1/3	4/21	–

Table C2
Ranking for each of the considered criteria.

MS	EP definition	Energy vulnerable consumer	Consumer protection measures	Financial aids	Energy savings	Information provision	Relative score
CY	X	X	X		XX		5
ES		XX	XX	X	XXX	X	9
PT		XX	X		XXXX		7
BG		X		X	X		3
LT		X	X	X	XX		5

Table C3
Percentages of national regulation and distinction for vulnerable consumers.

MS	Differentiation for vulnerable consumer groups	Differentiation for vulnerable consumer groups (%)	Regulation on national level	Regulation on national level (%)
CY	4/6	67%	5/6	83%
ES	6/10	60%	5/10	50%
PT	5/8	63%	6/8	75%
BG	1/3	33%	3/3	100%
LT	3/7	43%	6/7	86%

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