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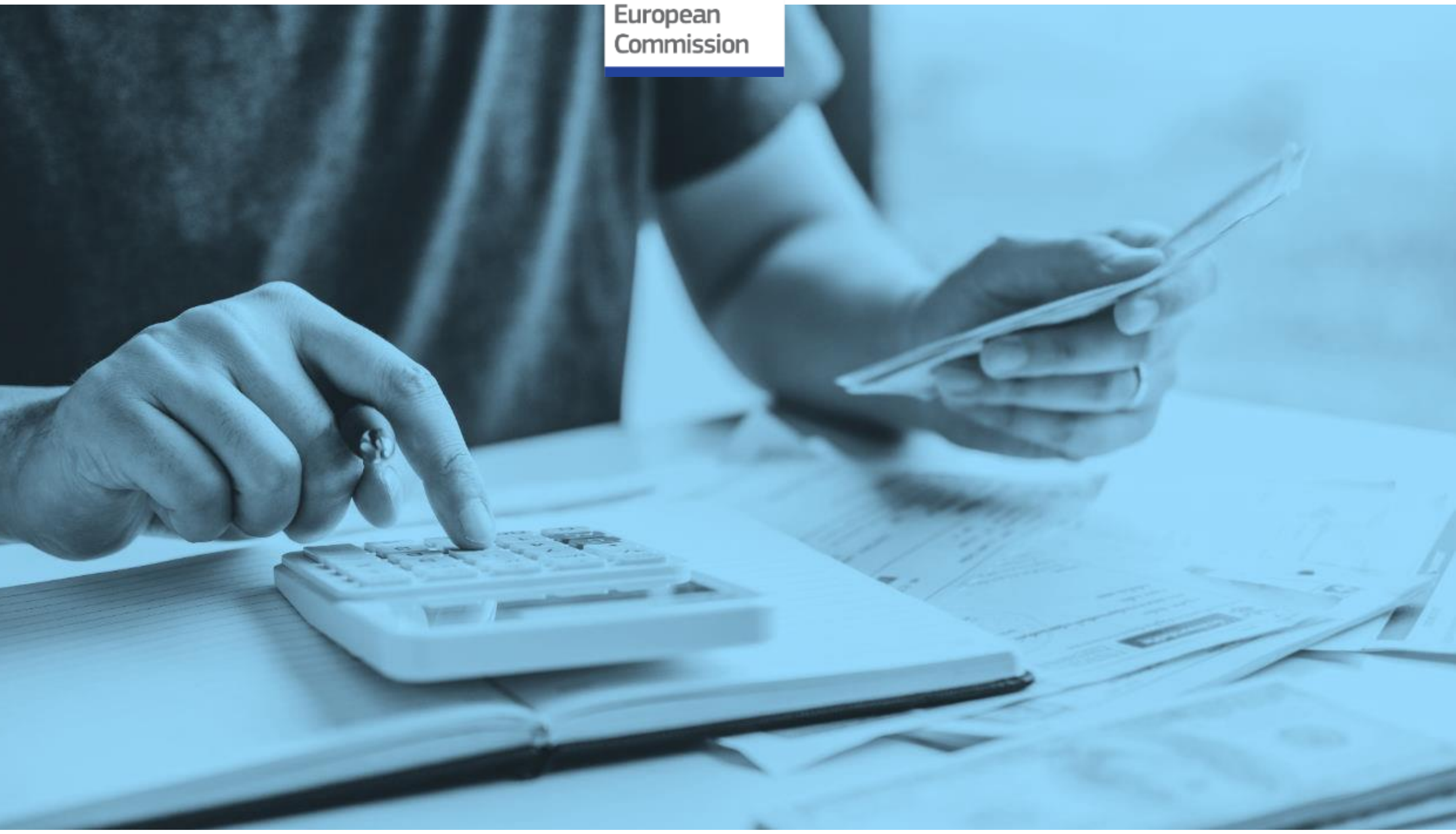

Energy Poverty

National Indicators

Insights for a more effective measuring

Energy Poverty Advisory Hub
October 2022

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Contents

Figures

Tables

Acronyms

BSO	EU Building stock Observatory
CoM	Covenant of Mayors for Climate and Energy in Europe
EP	Energy Poverty
EPAH	EU Energy Poverty Advisory Hub
EPOV	EU Energy Poverty Observatory
EU	European Union
EU-SILC	European Union Statistic on Income and Living Conditions
GEO	Geographical Entities
HBS	Household Budget Survey
JRC	Joint Research Center
NECPs	National Energy and Climate Plans
Pop.Liv.	Population Living

1 Introduction

The European Commission underlines energy poverty (EP) in the current policy strategies and legislative frameworks as a serious social problem that needs to be addressed with utmost urgency. Diagnosis is one of the key steps in addressing this issue in the Member-States, supporting the proper identification of the energy poor and monitoring vulnerability levels. To diagnose a potential situation of EP, it is necessary to measure it based on indicators that can reliably and effectively capture its different facets. A significant diversity of indicators and methods can be applied to study a complex and multidimensional problem such as energy poverty. The diagnosis process is inevitably shaped by the context, available data, and the indicators chosen to conduct the analysis as we have described in EPAH Handbooks: A Guide to Understanding and Addressing Energy Poverty.

The availability of data and selection of adequate indicators are becoming increasingly more relevant at European, national and local levels. In fact, in 2019, the European Commission mandated Member-States to assess energy poverty in their territory and estimate the size of the energy-poor population in the context of their National Energy and Climate Plans (NECPs). The Member-States are required to propose measures and policies to mitigate energy poverty if it is considered a severe social burden. The EU Energy Poverty Advisory Hub (EPAH) has been focused on exploring and gathering knowledge and practice around this topic at subnational and local scales. The project has already developed an ATLAS that compiles over 200 European initiatives and projects addressing energy poverty at the local scale in its different phases of diagnosis, planning, implementation, and impact assessment. A set of 24 inspirational cases covering a diverse range of initiatives and geographies was highlighted in the report "Tackling energy poverty through local actions – Inspiring cases from across Europe", aiming precisely to inspire local governments in their actions. The EPAH team has also produced the report “Bringing Energy Poverty Research into local practice - Exploring Subnational Scale Analysis”, a review of research articles focusing on local assessment and indicators of energy poverty in different geographical contexts, aiming to collect important learnings for local governments to set up and start their diagnosis tasks.

In parallel, the Covenant of Mayors for Climate and Energy in Europe (CoM) has launched the pillar on energy poverty, cementing the commitment of municipalities to tackle energy poverty to ensure a just transition. The CoM provides guidance and support to local authorities in their efforts to alleviate energy poverty, preferably in combination with existing climate action plans. Together with EPAH and the Joint Research Center (JRC), the CoM have proposed a framework based on a set of indicators, combining several macro-areas to analyse the incidence of energy poverty (CoM, 2022).

In this report, EPAH, turns its attention to macro indicators and how they can aid Member-States and other agency levels in their national strategies and policies, better understanding the problem and setting the scene for planning and implementation of energy poverty mitigation measures. Drawing on previous work conducted by the EU Energy Poverty Observatory (EPOV), a former EU initiative that ran from 2017 to 2020. The EPOV highlighted a set of indicators for analysing energy poverty, placing them in two categories: primary, if they were understood to directly depict energy poverty; and secondary, if they were meant to help characterize the circumstances that lead to a situation of vulnerability. These indicators were based mainly on Eurostat datasets and national Household Budget Surveys data, aiming to measure energy poverty in its multidimensionality across different national contexts (Thema and Vondung, 2020). This work on review, insights and updates of indicators by the EPAH team (2022) is also displayed in the revised online indicators’ dashboard depicted under the Observatory’s national energy poverty indicators section of the EPAH website.

2

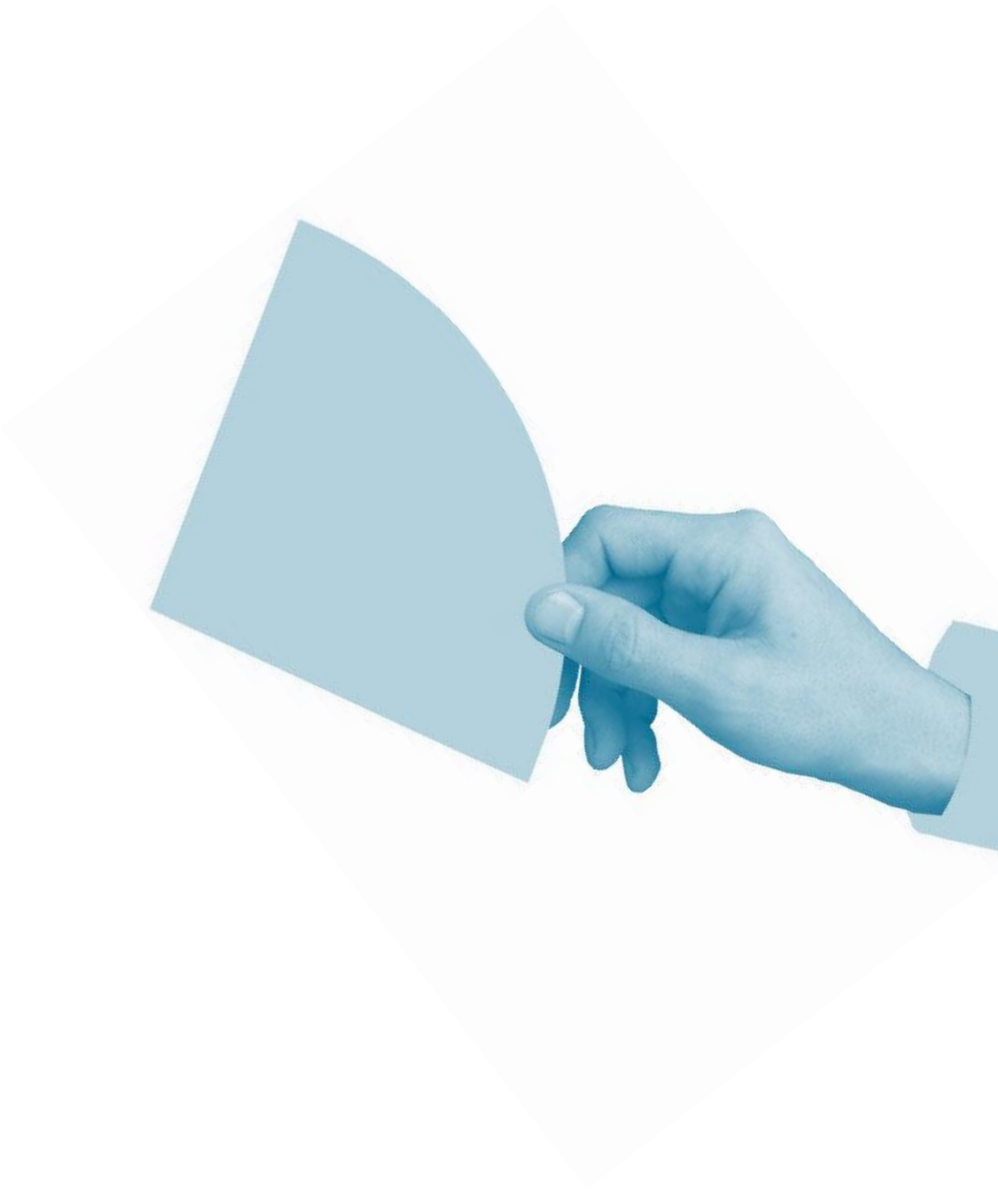
Contents and objectives

In this report, the EPAH team has conducted an extensive review and in-depth analysis of the existing energy poverty indicators derived from the past EPOV indicators database, supported by state-of-the-art scientific literature and energy poverty expertise. It reflects on the past, current, and future challenges of data and indicator availability, conducting an update when new data is available of the existing indicators, identifying advantages and shortcomings, mismatches, misleading interpretations, and inconsistencies.

Besides providing a deeper understanding of each indicator, his work also intends to provide a baseline for setting up the path for a future complete reformulation of the global set of commonly used energy poverty indicators bringing new perspectives and new indicators and data (coming in 2023), allowing a more comprehensive multidimensional analysis of energy poverty to support countries and regions for energy poverty assessment.

Notwithstanding the importance of decentralized data collection and assessment, EP diagnosis is a process that should be developed across multiple spatial scales to inform policymaking at different levels of governance and increase the impact of measures. It is identified the pressing need for an updated, consistent, and comprehensive set of national-level, publicly available EP indicators. These aim to support Member-States' central and local governments and organizations in devising effective overarching strategies, diagnosis, and mitigation programs to tackle this problem from both top-down and bottom-up perspectives. Overall, improving the understanding of energy poverty at the national level can also help to push for local work on it.

This report is organized into four main chapters, where besides the introduction and contents and objectives sections, the structure is the following. Chapter 3 describes the method employed to conduct the indicator appraisal and update. Changes in names, the indicators' organization, and/or data disaggregation is proposed. Chapter 4 individually explores each one of the existing indicators. The technical details, such as the identification code and the countries represented in the most recent data available, are presented. The limitations of the specific indicators in representing energy poverty are outlined, and a summary of updates and disclaimers is also shown for each indicator. We also included a sentence on the latest numbers to be used online for each indicator.



3 Methodology

3.1. Update and adaptation of the energy poverty indicators

During its duration, the EU Energy Poverty Observatory (EPOV) selected a set of consensual and expenditure-based indicators to measure energy poverty. Four primary indicators for energy poverty were identified. Two are based on self-reported experiences of limited access to energy services (based on EUSILC data), and the other two were calculated using household income and/or energy expenditure data (based on HBS data). Additionally, a set of 19 secondary indicators, organized as 24 individual indicators entries (Table 1), are extracted from different data sources, mainly the Eurostat website, SILC, and the Building Stock Observatory (BSO). As explained in the methodological guidebook from EPOV published in 2020, three main types of measurement are covered by the 28 indicators (Thomson et al., 2017):

- Expenditure-based – where examinations of the energy costs faced by households against absolute or relative thresholds provide a proxy for estimating the extent of domestic energy deprivation;
- Consensual approach – based on self-reported assessments of indoor housing conditions and the ability to attain specific basic necessities relative to the society in which a household resides;
- Direct measurement – where the level of energy services (such as heating) achieved in the home is compared to a set standard.

For this work, a thorough analysis of the EPOV energy poverty indicators have been carried out in conjunction with a comprehensive update of the indicators data, when possible. Firstly, all the indicators presented on the energy poverty observatory were extracted with the information on their definition, units of measurement, geographical entities (GEO) represented, table files, source type, and the corresponding link to the dataset source. Table 1 presents the complete list of the 28 EPOV indicators according to their definition and source. During this update process, it was identified that several indicators only presented data for a limited number of years and/or countries. For instance, the dwellings comfortably warm during wintertime indicator was last updated in 2012, and the household biomass prices indicator only presented values for two countries between 2005 and 2015.

Secondly, all the links to the indicators' sources, as presented in the past EPOV website, were identified, and information was tracked to the original datasets. The original dataset sources used by EPOV were the general EUROSTAT database, the EU-SILC (European Union Statistics on Income and Living Conditions), the BSO (EU Building Stock Observatory), and HBS (Household Budget Survey) (Table 1). An overall analysis of the EPOV indicators revealed that the indicators derived from the European BSO database are more frequently problematic, as it is not possible to update them. It was challenging to find and extract the data since the original links did not work anymore, and no details of the original data source are available on the BSO website. The most recent update for indicators from the BSO is from 2015. Furthermore, challenges were also encountered in accessing the most up-to-date data for some of the EU-SILC and HBS databases.

Regarding the EU-SILC, some indicators' links opened directly to the EUROSTAT-specific database and presented no problems, as is the case of the inability to keep the home adequately warm indicator. However, for some other EU-SILC indicators, for instance, Pop. Liv. dwellings comfortably warm during winter time, the link did not open directly, and it was not possible to locate the original dataset.

The HBS data is only used for two indicators: M/2 and 2M. The indicators only have data available for 2010 and 2015. Both indicators are currently not updated due to the need for HBS microdata to calculate these composite indicators.

On the other hand, indicator updates are more readily available via EUROSTAT and have more frequent updates. However, it should be noted that some indicators were also not updated at this time, as is the case, e.g., of the energy expenses by income quintile indicator since the most recent information provided by their database was already up to date on the EPOV's website.

Table 1 Energy Poverty indicators definition and source before EPAH's modifications (adapted from Thema and Vondung, 2020)

Indicator	Definition	Source
(1) Ability to keep home adequately warm	Share of population unable to keep warm, based on question "Can your household afford to keep its home adequately warm?	EU-SILC
(2) Arrears on utility bills	Share of population with arrears o utility bills, based on question "In the past twelve months, has the household been in arrears, i.e. has been unable to pay the utility bills (heating, electricity, gas, water, etc.) of the main dwelling on time due to financial difficulties?	EU-SILC
(3) Biomass prices	Average household prices per kWh generated from biomass	BSO
(4) Coal prices	Average household prices per kWh generated from coal	BSO
(5) District heating prices	Average household prices per kWh from district heating	BSO
(6) Dwelling comfortably cool in summer time	Share of population, based on question "Is the cooling system efficient enough to keep the dwelling cool?" and/or "Is the dwelling sufficiently insulated against the warm?"	EU-SILC
(7) Dwelling comfortably warm in winter time	Share of population, based on question "Is the heating system efficient enough to keep the dwelling warm?" and "Is the dwelling sufficiently insulated against the cold?"	EU-SILC
(8) Dwellings in densely populated areas	Share of dwellings located in densely populated areas (at least 500 inhabitants/km^2)	BSO
(9) Dwellings in intermediately populated areas	Share of dwellings located in intermediately populated areas (between 100 and 499 inhabitants/km^2)	BSO
(10) Dwellings with energy label A	Share of dwellings with an energy label A	BSO

(11) Equipped with air conditioning	Share of population living in a dwelling equipped with air conditioning facilities	EU-SILC
(12) Equipped with heating	Share of population living in a dwelling equipped with heating facilities	EU-SILC
(13) Excess winter mortality/deaths	Share of excess winter mortality/deaths	BSO
(14) Fuel oil prices	Average household prices per kWh generated from fuel oil	BSO
(15) High share of energy expenditure in income (M/2)	Absolute (equivalized) energy expenditure below half the national median	HBS
(16) Household electricity prices	Electricity prices for household consumers, band DC 2500-5000 kWh/year consumption, all taxes and levies included	EUROSTAT
(17) Household gas prices	Natural gas prices for household consumers, band 20- 200GJ consumption, all taxes and levies included	EUROSTAT
(18) Low absolute energy expenditure (2M)	Share of (equivalized) energy expenditure (compared to equivalized disposable income) above twice the national median	HBS
(19) Number of rooms per person by renters (20) Number of rooms per person by owners (21) Number of rooms per person by total	Average number of rooms per person in rented/owned/all dwellings	EU-SILC
(22) Poverty risk	People at risk of poverty or social exclusion (% of population)	EU-SILC
(23) Presence of leak, damp, rot	Share of population reporting leak damp or rot, based on response to the question "Do you have any of the following problems with your dwelling / accommodation? a leaking roof	EU-SILC

	damp walls/floors/foundation rot in window frames or floor	
(24) Energy expenses, income quintile 1 (25) Energy expenses, income quintile 2 (26) Energy expenses, income quintile 3 (27) Energy expenses, income quintile 4 (28) Energy expenses, income quintile 5	Consumption expenditure for electricity, gas and other fuels as a share of income for income quintile 1-5	EUROSTAT

The indicators' disaggregation presented by EPOV was conducted in different forms across indicators. For instance, the indicator number of rooms per person by ownership was considered as three independent indicators (number of rooms when occupants are renters, owners, or total), while the same happened to the expenses by income quintile (see Table 1).

Moreover, some indicators' names were not matching with the name they were identified within the original source data, potentially leading to some uncertainty regarding what they represented, as is the case with the Pop. Liv. dwelling equipped with air conditioning indicator. To present a uniform organization of the indicators' disaggregation, some indicators' names were now changed in the interest of clarity or to match the given name on EUROSTAT. Table 2 shows the current reorganization by the EPAH compared to what was previously available.

After revising the indicators' names and categorization, the number of indicators was reduced from 28 to 21. The designation of two indicators has been changed from "Poverty Risk" and from "presence of leak, damp and rot" to "at risk of poverty or social exclusion" and to "Pop. Liv. Welling with presence of leak, damp and rot", respectively.

The indicators "dwellings in populated areas", "energy expenses by income quintile", and "number of rooms per person by ownership" have been revised by EPAH and regrouped. This revision aims to aggregate the previous indicators, which have the same source and/or are calculated using the same method. The previous individual names have now been considered as disaggregation of the indicator's new name.

Additionally, to better understand some indicators' definitions/descriptions and units of measurement (e.g., if reported on population or households), we depict in Table 2, in bold blue, four indicators identified where the definition was inconsistent with the corresponding unit applied in the charts. For instance, the Dwellings with energy label A indicator is defined as the Share of dwellings with an energy label A. Still, the unit previously applied in the graphs was the share of the population. The correct unit to be considered in this and the other three indicators is the unit presented in the indicator's name (i.e., households or dwellings).

For the other five indicators, through EPOV's methodology book (Thema and Vondung, 2020), we were able to identify that the correct unit is indeed "share of the population", so the term Population Living (Pop. Liv.) has now been added to the name.

Two of the primary indicators, the "arrears on utility bills" and "inability to keep home adequately warm", presented four disaggregation categories: Income deciles, Tenure Type, Urbanization Density, and Dwelling Type. Due to the format of the original source data used by EPOV, it was not possible to update this disaggregation but only their national average values. However, the disaggregation of these two indicators has also now been adapted in line with the disaggregation process recently suggested by the Joint Research Centre (JRC), which will be explained in more detail in the next section.

After analysing the source, scale, period/update, and countries represented and accounting for the new indicator names and groupings, 9 of the original EPOV indicators were updated, corresponding now to 7 EPAH-reviewed indicators following the name change:

- Arrears on utility bills
- Inability to keep home adequately warm
- Household electricity prices
- Household gas prices
- Pop. Liv. dwelling with presence of leak, damp, rot
- At Poverty risk, or Social Exclusion
- Number of rooms per person by ownership status

To sum up, the **original 28 EPOV indicators have now been converted and reorganized into 21 indicators.** A total of 7 EPAH indicators have also been renamed to better align their definition and/or the indicator's original data source name. Some have been rearranged from 7 EPOV individual indicators to 3 EPAH newly renamed indicators. Finally, only 7 of the 21 revised EPAH indicators could be updated at this stage with more recent data due to the lack of access to original data sources for the remaining indicators or because new data on the indicators was not available from the sources since the last update made available by the EPOV. No indicators were added or removed at this stage.

Table 2 Energy poverty indicators' name, update, and units by EPOV and EPAH (bold- names revised; and - unit mismatches definition

	Indicator name by EPOV	Last Update from EPOV	Indicator name revised by EPAH	Timeline after update	Unit
Primary	Arrears on utility bills	2019	Arrears on utility bills	2004-2021	Population and Households (%)
	Low absolute energy expenditure (M/2)	2015	Low absolute energy expenditure (M/2)	2011-2015	Population (correct unit is **% households**)
	High share of energy expenditure in income (2M)	2015	High share of energy expenditure in income (2M)	2010-2015	Population (correct unit is **% households**)

	Inability to keep home adequately warm	2019	Inability to keep home adequately warm	2004-2021	Population and Households (%)
Secondary	Fuel oil prices	2015	Fuel oil prices	2005-2015	ct/kWh (correct unit is **€/kWh**)
	Biomass prices	2015	Biomass prices	2005-2015	ct/kWh (correct unit is **€/kWh**)
	Coal prices	2015	Coal prices	2004-2008 and 2014-2015	ct/kWh (correct unit is **€/kWh**)
	District heating prices	2015	District heating prices	2004-2015	ct/kWh (correct unit is **€/kWh**)
	Dwelling comfortably cool during summer time	2012	**Pop. Liv. dwelling comfortably cool during summer time**	2007-2012	Population (%)
	Dwelling comfortably warm during winter time	2012	**Pop. Liv. dwelling comfortably warm during winter time**	2007-2012	Population (%)
	Dwellings in densely populated areas	2014	**Dwellings in populated areas**	2004-2014	Population (correct unit is **% dwellings**)
	Dwellings in intermediately populated areas	2014			
	Dwellings with energy label A	2015	Dwellings with energy label A	2007-2015	Population (correct unit is **% dwellings**)
	Energy expenses, income quintile 1	2015	Energy expenses by income quintile	2005,2010 and 2015	Population (%)

	Energy expenses, income quintile 2	2015			
	Energy expenses, income quintile 3	2015			
	Energy expenses, income quintile 4	2015			
	Energy expenses, income quintile 5	2015			
	Equipped with air conditioning	2007	**Pop. Liv. dwelling equipped with air conditioning**	2007 and 2012	Population (%)
	Equipped with heating	2012	**Pop. Liv. dwelling equipped with heating**	2007	Population (%)
	Excess winter mortality/deaths	2014	Excess winter mortality/deaths	2005-2014	Population (%)
	Household electricity prices	2017	Household electricity prices	2007-2021	Population (%) (correct unit is **€/kWh**)
	Household gas prices	2017	Household natural gas prices	2007-2021	Population (%) (correct unit is **€/kWh**)
	Number of rooms per person, owners	2017	**Number of rooms per person by**	2004-2021	Number of rooms

	Number of rooms per person, renters	2017	**ownership status**		
	Number of rooms per person, total	2017			
	Poverty risk	2017	At risk of poverty or social exclusion	2004-2020	Population (%)
	Presence of leak, damp, rot	2016	**Pop. Liv. dwelling with presence of leak, damp and rot**	2003-2020	Population (%)

3.2. Data update with JRC disaggregation contribution

Since the original databases underwent some updates across the timeframe of the indicators, it was decided that all indicators and all years would be updated according to the most recently available data. The most recent data provided by EPOV was for 2019; after this EPAH's update, it is now from 2021 when information is available.

The indicators which required microdata for their disaggregation could not be updated directly from the EPOV's data source. For this reason, "arrears on utility bills" and the "inability to keep home adequately warm" national average data were updated from EUROSTAT (in population) covering the continuous period until 2020, and the disaggregated data update for 2019 was derived from the EU Joint Research Center (JRC) contribution.

For the most recent years (2019-onwards), we will follow the work developed by the Joint Research Center. The JRC recently published a report (Koukoufikis and Uihlein, 2022) that engages with ongoing work on situational awareness and indicators setting by summarising data deriving from EU surveys related to energy poverty, transport poverty, and living conditions. The report provides a series of visualisations of indicators or proxy indicators of energy poverty as it disaggregates the available datasets by sociodemographic, spatial, and built environment parameters.

In that report, the data from EU-SILC was analysed for the indicators of arrears on utility bills and the inability to keep the home adequately warm for 2019. The two indicators are used to monitor variations of households' energy poverty levels across income quintiles, Member States, and regions, controlling for tenures status, dwelling type, age, gender, and employment status, as well as population densities across the EU. The selected of analytical domains, took into account the EU common practices on indicators, the availability of complete datasets and their quality, the ability to compare across territories and social groups, and finally, the need for disaggregated data in specific thematic areas as identified by policy, civil society, and academic reviews. The JRC report is expected to be updated and enriched annually with new analytical domains and disaggregation levels. Since the EPAH team could not access the necessary microdata to update these indicators in their disaggregated form, the JRC values for 2019 (and potentially from 2020 onwards when available) will be used to update those indicators.

The JRC presented values both in household and population units. Having this in mind, after the EPAH's update of the dashboard, both indicators now present three national averages: National average extracted from EUROSTAT in the percentage of the population; the National average extracted from JRC contribution in the percentage of the population, and the National average extracted from JRC contribution in the rate of households.

The disaggregation of the indicators also required to be adapted for 2019 since the JRC's disaggregation was not the same as used previously by EPOV, as can be observed in Table 3. Moreover, data for "arrears on utility bills", reporting the number of times per year disaggregation, is a new category and is currently available only for 2019.

Table 3 EPOV/EPAH and JRC disaggregation for the primary indicators updated

Category	EPOV/ EPAH disaggregation	JRC disaggregation
Income	Income deciles	Income quintiles
Tenure type	Owner	Owner paying mortgage
		Outright owner
	Market rent	Tenant/subtenant paying rent at market rate
	Reduced/free rent, average	Accommodation is rented at a reduced rate
		Accommodation is provided free
Urbanisation Density		Average
		Densely populated
		Intermediate urbanisation
		Thinly populated
Dwelling type	Average	

		Detached house
		Semi-detached/terraced
	Apartment	Apartment/flat in a building with ≥10 dwellings
		Apartment/flat in a building with <10 dwellings
Number of times per year		Households with arrears on utility bills once per year
		Households with arrears on utility bills at least twice per year
		Combined

Another issue that has led to some changes in the indicators' dashboard is geography related. Due to Brexit, the European Union (EU) reduced from 28 to 27 countries in 2020. EUROSTAT has added the EU27 group, "European Union – 27 countries (from 2020)". The EPAH has followed the same geographic code used by EUROSTAT and has now integrated it. This code has also been added to the EPAH energy poverty indicators database. To maintain coherence with previous work and allow continuity of indicators analysis, the aggregated group of EU-28 countries (2013 - 2020) is still shown on the EPAH dashboard. Table 4 shows the data availability of the seven updated indicators for the more extensive set of 44 GEO considered now in EPAH, following the maximum GEO presented by EUROSTAT in its database for the indicators herein considered.

"Household electricity prices" is the indicator for which data is available for the largest number of countries. In contrast, the two primary indicators which have already available information for some countries for 2021 – "arrears on utility bills" and "inability to keep home adequately warm" - are those with the lowest number of countries available.

*Table 4 GEO represented after the EPAH's indicator update (**OK** - Represented; KO - not represented)*

Code	GEO	Total per country	Arrears on utility bills	Inability to keep home adequately warm	Household electricity prices	Household natural gas prices	Pop. Liv. Presence of leak, damp, rot	At Poverty risk or Social Exclusion	Number of rooms per person
	Last Update		2021				2020		2021
AL	Albania	2	KO	KO	KO	KO	**OK**	**OK**	KO
AT	Austria	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
BA	Bosnia and Herzegovina	2	KO	KO	**OK**	**OK**	KO	KO	KO
BE	Belgium	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
BG	Bulgaria	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
CH	Switzerland	2	KO	KO	KO	KO	**OK**	**OK**	KO
CY	Cyprus	6	**OK**	**OK**	**OK**	KO	**OK**	**OK**	**OK**
CZ	Czechia	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
DE	Germany	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
DK	Denmark	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
EE	Estonia	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
EL	Greece	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
ES	Spain	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**

EU 27	European Union 27 (from 2020)	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	KO
EU 28	European Union 28	0	KO	KO	KO	KO	KO	KO	KO
FI	Finland	6	**OK**	**OK**	**OK**	KO	**OK**	**OK**	**OK**
FR	France	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
GE	Georgia	2	KO	KO	**OK**	**OK**	KO	KO	KO
HR	Croatia	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
HU	Hungary	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
IE	Ireland	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
IS	Iceland	1	KO	KO	**OK**	KO	KO	KO	KO
IT	Italy	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
LI	Liechtenstein	2	KO	KO	**OK**	**OK**	KO	KO	KO
LT	Lithuania	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
LU	Luxembourg	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
LV	Latvia	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
MD	Moldova	2	KO	KO	**OK**	**OK**	KO	KO	KO

ME	Montenegro	3	KO	KO	**OK**	KO	**OK**	**OK**	KO
MK	North Macedonia	4	KO	KO	**OK**	**OK**	**OK**	**OK**	KO
MT	Malta	6	**OK**	**OK**	**OK**	KO	**OK**	**OK**	**OK**
NL	Netherlands	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
NO	Norway	3	KO	KO	**OK**	KO	**OK**	**OK**	KO
PL	Poland	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
PT	Portugal	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
RO	Romania	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
RS	Serbia	4	KO	KO	**OK**	**OK**	**OK**	**OK**	KO
SE	Sweden	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
SI	Slovenia	7	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**	**OK**
SK	Slovakia	5	KO	**OK**	**OK**	**OK**	**OK**	**OK**	KO
TR	Turkey	4	KO	KO	**OK**	**OK**	**OK**	**OK**	KO
UA	Ukraine	0	KO	KO	KO	KO	KO	KO	KO
UK	United Kingdom	0	KO	KO	KO	KO	KO	KO	KO
XK	Kosovo	1	KO	KO	**OK**	KO	KO	KO	KO
Total			27	29	40	33	36	36	26

3.3. Indicator Analysis

The migrated indicators from EPOV and now shown on the national Indicators section of the EPAH website, were analysed according **to four main topics:**

Current situation	the indicators' last data available and definition
Technical details	statistical information is described
Limits and application suggestions	strengths, shortcomings, and use cases of each indicator
Updates and disclaimers	core information analysis summary

4.2. Indicator Analysis is linked to the individual indicators leaflets available as a PDF for download on each indicator page of the EPAH Dashboard. Herein, these sections were designed in such a way that facilitates a comprehensive review of the details of the indicators.

In **4.1. Indicators 2 years variation**, the data points variation of the seven indicators updated at this stage was also analysed and compared for the last two years.

4 National Energy Poverty Indicators

After the current data update (i.e., October 2022) and indicators disaggregation, name, definition, and unit changes explained in the previous section, indicators are herein analysed under four topics.

First, in the current situation topic, the indicator is presented together with the latest version of the existing map and bar chart, displaying the results for the EU countries extracted from the new EPAH dashboard visuals. For the technical details, the following statistical information is described:

Identification code	statistical code used in the indicator source
Name	identification name used in the EPAH website
Timeline	years with available data
Countries	number of countries represented in the last update concerning the maximum 44 GEO list
Source	data source(s) the indicator uses
Technical details from EU-SILC	if existent, extraction of the technical details will be presented from the methodological guidelines of the EU-SILC variables (Eurostat, 2022).

The limits and application suggestions sections focus on the strengths and shortcomings of each indicator for representing energy poverty and describe how they can and should be used. It also analyses some application cases. Finally, in the updates and disclaimers section, a small summary of the core information from the indicator and the update conducted is presented together with a headline quote depicting the numbers referring to the indicator for the EU27.

4.1. Indicators 2 years variation

The analysis of the datapoints variation of the 7 updated indicators between 2019 and 2020; or 2020-2021 (when data is available) is displayed in Table 5 and in Table 6, we can observe the value changes for the number of rooms per person and ownership status. Most countries (#28) recorded similar values, which is expected as this indicator depends on the country's building stock with fewer annual variations.

It is possible to highlight the following findings:

Arrears on utility bills (2019-2021)

- 19 countries have decreased the percentage of the population in arrears from 2019 to 2021
- Romania (RO) was the country with the most significant decrease (-6.6 percentage points (pp))
- Portugal (PT) was the country with the most significant increase (1.8 pp)

Inability to keep home adequately warm (2019-2021)

- 17 countries have decreased the percentage of the population which was not able to keep their home adequately warm from 2019 to 2020
- Bulgaria (BG) was the country with the biggest decrease (-3.8 pp)
- Spain (ES) was the country with the largest increase (3.3 pp)

Household Electricity Prices[1] (2020-2021)

- Only 11 countries have decreased their household electricity prices from 2020 to 2021
- Moldova (MD) was the country with the biggest decrease (- 0.016 €/kWh)
- Norway (NO) was the country with the biggest increase (0.068 €/kWh)

Household Natural Gas Prices[2] (2020-2021)

- Only 11 countries have decreased their household gas prices from 2020 to 2021
- Lichtenstein (LI) was the country with the biggest decrease (- 0.0062 €/kWh)
- Sweden (SE) was the country with the biggest increase (0.0518 €/kWh)

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[1] The household electricity prices indicator represents the electricity prices for household consumers, band DC 2500-5000 kWh/yr consumption, all taxes and levies included.

[2] The household natural gas prices indicator represents the natural gas prices for household consumers, band 20-200GJ consumption, all taxes and levies included.

Pop. Liv. Dwellings with presence of leak, damp, and rot (2019-2020)

- 19 countries have decreased the percentage of the population in dwellings with presence of leak, damp, and rot from 2019 to 2020
- Albania (AL) was the country with the most significant decrease (-7.5 pp)
- Cyprus (CY) was the country with the most significant increase (8% pp)

At Risk of Poverty or Social Exclusion (2019-2020)

- 26 countries have decreased the percentage of the population at Risk of Poverty or Social Exclusion from 2019 to 2020
- Albania (AL) was the country with the most significant decrease (-2.8 pp)
- Germany (DE) was the country with the most significant increase (4.2 pp)

Number of rooms per person by ownership status (2019-2021)

- All three of the indicators' disaggregation values have mostly stayed the same from 2019 to 2021
- Spain (ES), Finland (FI), Hungary (HU), and Netherlands (NL) are the only countries that have increases in at least one of the ownership status and for the number of total rooms per person.

Table 5 Comparison of the last updated 2 years for each indicator (Indicators: Arrears on utility bills; Inability to keep home adequately warm; Household Electricity Prices; Household Natural Gas Prices; Pop.Liv. dwellings with the presence of leak, damp and rot and at poverty risk or Social Exclusion) Note: household electricity and gas prices are presented in €/kWh)

Country Code	Arrears			Keep Warm			Electricity			Gas			Leak			Poverty		
	2020	2021	↑ or ↓	2020	2021	↑ or ↓	2020	2021	↑ or ↓	2020	2021	↑ or ↓	2019	2020	↑ or ↓	2019	2020	↑ or ↓
AL	24.6	N/A	N/A	35.8	N/A	N/A	0.092	N/A	N/A	N/A	N/A	N/A	29.5	22	↓	46.2	43.4	↓
AT	3.1	2.4	↓	1.5	1.7	↑	0.214	0.225	↑	0.065	0.067	↑	9.4	9.1	↓	16.9	17.5	↑
BA	N/A	N/A	N/A	N/A	N/A	N/A	0.089	0.087	↓	0.036	0.034	↓	N/A	N/A	N/A	N/A	N/A	N/A
BE	3.8	2.9	↓	4.1	3.5	↓	0.275	0.285	↑	0.050	0.057	↑	16.7	15.7	↓	19.5	18.9	↓
BG	22.2	19.2	↓	27.5	23.7	↓	0.099	0.106	↑	0.037	0.054	↑	11.6	11	↓	32.8	32.1	↓
CH	3.2	N/A	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.5	11.4	↑	18.8	18.1	↓
CY	9.2	9.1	↓	20.9	19.4	↓	0.192	0.214	↑	N/A	N/A	N/A	31.1	39.1	↑	22.3	21.3	↓
CZ	1.9	1.5	↓	2.2	2.2	Same	0.182	0.184	↑	0.057	0.056	↓	7.3	6.8	↓	12.5	11.9	↓
DE	3.3	3.7	↑	7.0	3.2	↓	0.303	0.321	↑	0.061	0.067	↑	12	12	Same	17.4	21.6	↑
DK	4.2	2.9	↓	3.0	2.8	↓	0.283	0.317	↑	0.075	0.107	↑	14.9	16.8	↑	16.3	15.9	↓
EE	5	4.1	↓	2.7	2.0	↓	0.126	0.163	↑	0.043	0.059	↑	13.8	10.2	↓	24.3	23.3	↓
EL	28.2	26.3	↓	17.1	17.5	↑	0.166	0.183	↑	0.05	0.073	↑	12.5	12.5	Same	30	28.8	↓
ES	9.6	9.5	↓	10.9	14.2	↑	0.227	0.257	↑	0.080	0.089	↑	14.7	19.7	↑	25.3	26.4	↑
EU27	6.5	6.4	↓	7.5	6.9	↓	0.213	0.229	↑	0.067	0.071	↑	12.7	14.8	↑	20.9	21.5	↑
EU28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.2	N/A	N/A	21.2	N/A	N/A
FI	7.1	5.8	↓	1.8	1.3	↓	0.176	0.180	↑	N/A	N/A	N/A	4.1	4.5	↑	15.6	16	↑
FR	5.5	7.1	↑	6.7	6.0	↓	0.193	0.198	↑	0.074	0.074	↑	11.5	17.9	↑	17.9	18.2	↑
GE	N/A	N/A	N/A	N/A	N/A	N/A	0.062	0.065	↑	0.013	0.013	↓	N/A	N/A	N/A	N/A	N/A	N/A

HR	13.6	15.2	↑	5.7	5.7	Same	0.130	0.130	↓	0.038	0.039	↑	10.2	9.4	↓	23.3	23.2	↓
HU	10.4	9.7	↓	4.2	5.4	↑	0.102	0.100	↓	0.031	0.031	↓	22.3	20.4	↓	18.9	17.8	↓
IE	7.9	7.5	↓	3.3	3.2	↓	0.252	0.277	↑	0.069	0.070	↑	12.5	16.6	↑	20.6	20	↓
IS	N/A	N/A	N/A	N/A	N/A	N/A	0.130	0.137	↑	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IT	6	6.5	↑	8.3	8.1	↓	0.219	0.231	↑	0.081	0.085	↑	14	19.6	↑	25.6	25.3	↓
LI	N/A	N/A	N/A	N/A	N/A	N/A	0.210	0.210	↓	0.078	0.072	↓	N/A	N/A	N/A	N/A	N/A	N/A
LT	6.3	5.5	↓	23.1	22.5	↓	0.137	0.141	↑	0.033	0.035	↑	14	10.9	↓	26.3	24.8	↓
LU	2.9	3.6	↑	3.6	2.5	↓	0.199	0.199	↑	0.039	0.054	↑	15.4	15.4	Same	20.6	20.9	↑
LV	8.3	5.8	↓	6.0	4.9	↓	0.143	0.165	↑	0.030	0.037	↑	19.3	17.5	↓	27.3	26	↓
MD	N/A	N/A	N/A	N/A	N/A	N/A	0.103	0.087	↓	0.028	0.036	↑	N/A	N/A	N/A	N/A	N/A	N/A
ME	31.5	N/A	N/A	13.2	N/A	N/A	0.099	0.098	↓	N/A	N/A	N/A	25.9	22.4	↓	30.5	30.9	↑
MK	29.9	N/A	N/A	23.8	N/A	N/A	0.081	0.084	↑	0.050	0.053	↑	13.9	13	↓	39.9	39.8	↓
MT	6.3	7.2	↑	7.2	7.8	↑	0.129	0.130	↑	N/A	N/A	N/A	7.6	6.1	↓	20.1	19	↓
NL	1.5	1.2	↓	2.4	2.4	Same	0.139	0.137	↓	0.100	0.103	↑	14.7	14.8	↑	16.5	16.1	↓
NO	2.8	N/A	N/A	0.8	N/A	N/A	0.134	0.202	↑	N/A	N/A	N/A	6.5	6.3	↓	16.1	15.9	↓
PL	4.7	5.2	↑	3.2	3.2	Same	0.149	0.156	↑	0.042	0.043	↑	10.8	6	↓	18.2	17.3	↓
PT	3.5	5.3	↑	17.5	16.4	↓	0.213	0.213	↑	0.078	0.077	↓	24.4	25.2	↑	21.6	19.8	↓
RO	13.9	7.3	↓	10.0	10.1	↑	0.145	0.157	↑	0.032	0.040	↑	9.4	10	↑	31.2	30.4	↓
RS	26.7	N/A	N/A	9.5	N/A	N/A	0.074	0.080	↑	0.034	0.034	↓	18	11.4	↓	31.7	29.8	↓
SE	2.4	2.2	↓	2.7	1.7	↓	0.177	0.236	↑	0.103	0.155	↑	7	7.1	↑	18.8	17.9	↓
SI	9.4	7.7	↓	2.8	1.7	↓	0.157	0.169	↑	0.057	0.057	↓	20.6	20.8	↑	14.4	15	↑
SK	5.2	N/A	N/A	5.7	5.8	↑	0.171	0.165	↓	0.047	0.042	↓	5.7	4.9	↓	16.4	14.8	↓

TR	22.8	N/A	N/A	20.3	N/A	N/A	0.091	0.081	↓	0.022	0.019	↓	36.9	34.7	↓	39.8	41.5	↑
UA	N/A	N/A	N/A	N/A	N/A	N/A	0.043	N/A	N/A	0.022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
UK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
XK	24.6	N/A	N/A	N/A	N/A	N/A	0.061	0.061	↓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

In Table 6, we can observe the value changes for the number of rooms per person and ownership status. Most countries (#28) recorded similar values, which is expected as this indicator depends on the country's building stock with fewer annual variations.

Table 6 Comparison of the last updated 2 years for each indicator (Indicator: Number of rooms per person by ownership status- owner, renters, Total)

Code	Rooms Owner			Rooms Renters			Rooms Total		
	2020	2021	↑ or ↓	2020	2021	↑ or ↓	2020	2021	↑ or ↓
AL	0.9	N/A	N/A	0.7	N/A	N/A	0.8	N/A	N/A
AT	1.8	1.8	Same	1.4	1.3	↓	1.6	1.6	Same
BA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BE	2.2	2.2	Same	1.8	1.9	↑	2.1	2.1	Same
BG	1.3	1.3	Same	0.8	0.8	Same	1.3	1.3	Same
CH	2.0	N/A	N/A	1.7	N/A	N/A	1.8	N/A	N/A
CY	2.0	2.0	Same	1.8	1.9	↑	2.0	2.0	Same
CZ	1.6	1.6	Same	1.2	1.2	Same	1.5	1.5	Same
DE	2.0	2.0	Same	1.5	1.5	Same	1.8	1.8	Same
DK	2.0	2.0	Same	1.8	1.8	Same	1.9	1.9	Same
EE	1.7	1.7	Same	1.4	1.4	Same	1.7	1.6	↓
EL	1.3	1.3	Same	1.1	1.1	Same	1.3	1.3	Same
ES	2.0	2.0	Same	1.5	1.6	↑	1.9	2.0	↑
EU27	1.7	N/A	N/A	1.5	N/A	N/A	1.6	N/A	N/A
EU28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FI	2.1	2.1	Same	1.6	1.6	Same	1.9	2.0	↑
FR	2.0	2.0	Same	1.4	1.5	↑	1.8	1.8	Same
GE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HR	1.2	1.2	Same	0.9	0.9	Same	1.2	1.2	Same
HU	1.6	1.6	Same	1.2	1.3	↑	1.5	1.6	↑
IE	2.3	2.3	Same	1.6	1.7	↑	2.1	2.1	Same

IS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IT	1.4	1.4	Same	1.2	1.2	Same	1.4	1.4	Same
LI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LT	1.6	1.6	Same	1.0	1.0	Same	1.6	1.6	Same
LU	2.2	2.2	Same	1.5	1.5	Same	2.0	2.0	Same
LV	1.2	1.2	Same	0.9	0.9	Same	1.2	1.2	Same
MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ME	0.9	N/A	N/A	0.7	N/A	N/A	0.9	N/A	N/A
MK	1.0	N/A	N/A	0.8	N/A	N/A	1.0	N/A	N/A
MT	2.3	2.3	Same	2.2	2.2	Same	2.3	2.3	Same
NL	1.9	2.0	↑	2.1	2.3	↑	2.0	2.1	↑
NO	2.1	N/A	N/A	1.7	N/A	N/A	2.0	N/A	N/A
PL	1.2	1.2	Same	0.9	0.9	Same	1.2	1.1	↓
PT	1.7	1.7	Same	1.5	1.5	Same	1.7	1.7	Same
RO	1.1	1.1	Same	0.8	0.9	↑	1.1	1.1	Same
RS	1.0	N/A	N/A	0.7	N/A	N/A	1.0	N/A	N/A
SE	1.9	1.9	Same	1.4	1.4	Same	1.8	1.8	Same
SI	1.6	1.6	Same	1.2	1.2	Same	1.6	1.6	Same
SK	1.2	N/A	N/A	0.8	N/A	N/A	1.2	N/A	N/A
TR	1.1	N/A	N/A	1.1	N/A	N/A	1.1	N/A	N/A
UA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
UK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
XK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Through this brief analysis, we observe that Albania presents the best improvement in terms of energy poverty indicators between 2019 and 2020. Germany, on the other hand, performs worse for two of the energy poverty indicators ("Inability to keep home adequately warm" and "At Risk of Poverty or Social Exclusion").

4.2. Indicator Analysis

The following section presents the critical analysis of the 21 indicators currently available on the EPAH website under the national energy poverty indicators section.

4.2.1 Arrears on utility bills

4.2.1.1 Current situation

The arrears on utility bills indicator represents the share of (sub-) population with arears on utility bills, based on the question "In the last twelve months, has the household been in arrears, i.e., has been unable to pay on time due to financial difficulties for utility bills (heating, electricity, gas, water, etc.) for the main dwelling?".

Figure 1 and Figure 2 present the last data (i.e., 2021) available for the indicator represented in the map and bar chart.

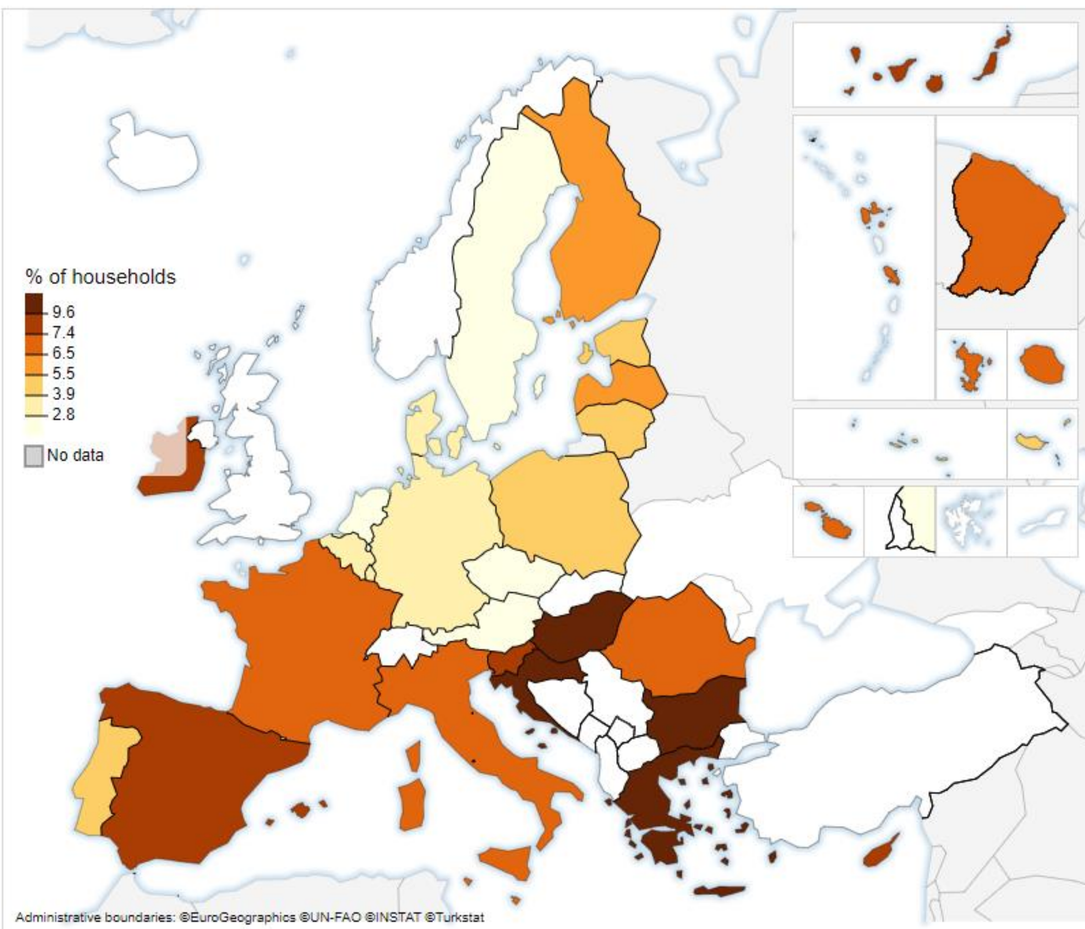

Figure 1 Map of the arrears on utility bills from 2021 (Source: EPAH, 2022a)

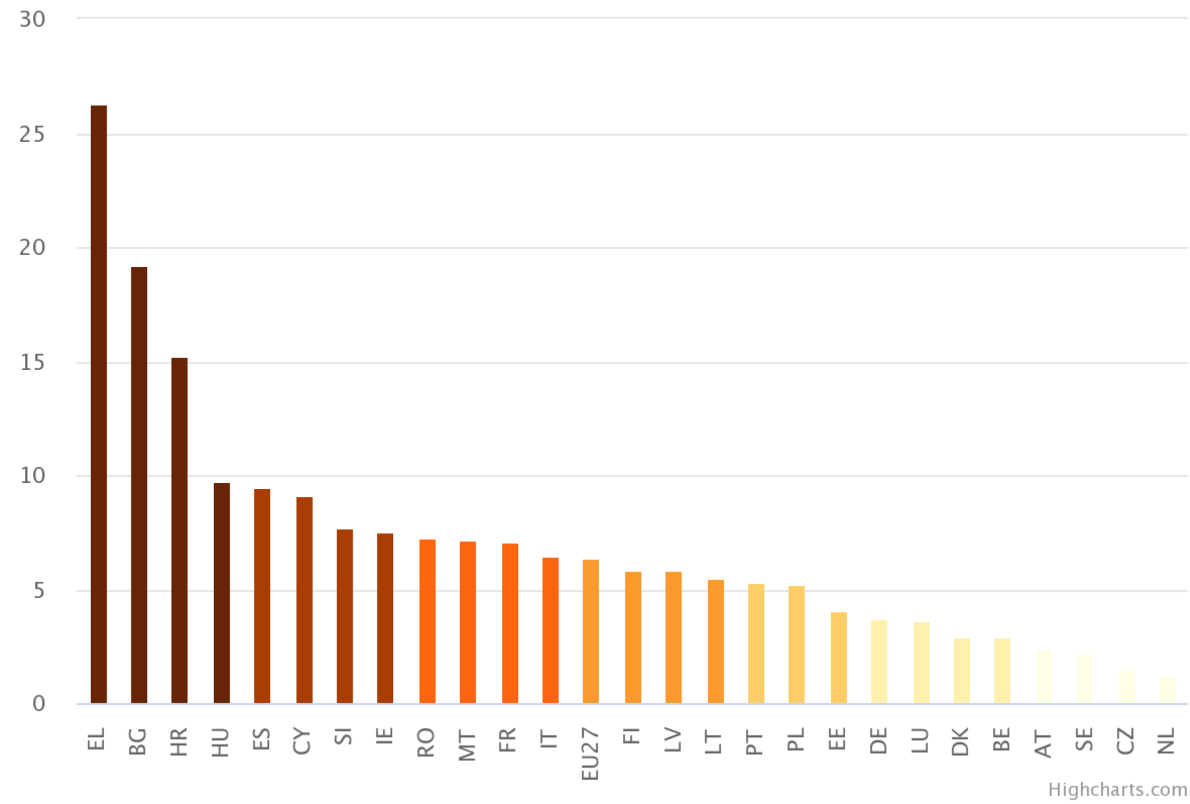

Figure 2 Arrears on utility bills (% of households) bar chart from 2021 (Source: EPAH, 2022a)

4.2.1.2 Technical Details

Table 7 presents the technical details for the arrears on the utility bills indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the current update in relation to the maximum 44 GEO list, and the data sources used.

Table 7 Arrears on utility bills technical details

Identification Code	Name	Timeline	# GEO	Source
ILC_MDES07	Arrears on utility bills	2004-2021	27/44	EU-SILC and JRC

The arrears on utility bills indicator country averages are directly extracted from the EUROSTAT (2022a) database. In the past EPOV version, this indicator was divided into four disaggregated groups: income deciles, tenure type, urbanization density, and dwelling type. The EPAH team was not able to continue this disaggregation under this update due to lack of access to the

EUROSTAT microdata but has worked with JRC to integrate their data into the update for the 2019 data (and onwards).

JRC presented different levels of disaggregation for this indicator in their last report with new or slightly modified options (Koukoufikis and Uihlein, 2022). After the JRC disaggregation update, the indicator is now presented for 2019 by share of population and share of households. The following options were now added and are available as new disaggregation:

- Tenure type
  - Accommodation is provided free
  - Owner paying mortgage
- Dwelling Type
  - Apartment or flat in a building with ten or more dwellings
  - Apartment or flat in a building with less than ten dwellings
- Number of times per year
  - Arrears on utility bills once per year
  - Arrears on utility bills at least twice per year
  - Combined

The national average values presented for “arrears on utility bills” only considers the total type of households and total income situation. However, EUROSTAT has the following disaggregation options for the indicator that could be used in future updates:

- Income situation in relation to the risk of poverty threshold
  - Total
  - Below 60% of median equivalized income
  - Above 60% of median equivalized income
- Type of household
  - Single person
  - One adult younger than 65 years
  - One adult 65 years or older
  - Single person with dependent children
  - Single female
  - Single male
  - Two adults
  - Two adults younger than 65 years
  - Two adults, at least one aged 65 years or over
  - Two adults with one dependent child

- Two adults with two dependent children
- Two adults with three or more dependent children
- Three or more adults
- Three or more adults with dependent children
- Households without dependent children
- Households with dependent children

The “arrears on utility bills” details as in EU-SILC can be observed in Figure 3. Note that in 2008, the EU-SILC HS020 indicator was replaced by HS021 and that the unit considered is household.

HS021: ARREARS ON UTILITY BILLS

Topic and detailed topic: Income, consumption and elements of wealth, including debts/ Arrears
Variable type: Annual
Unit: Household
Reference period: Last 12 months
Mode of collection: Household respondent
In use (period): Yes, since 2008
Series' differences: Yes, 2008 (replaces HS020 from 2008 onwards)

VALUES AND FORMAT

From 2008 onwards

1	Yes, once
2	Yes, twice or more
3	No

Before 2008

1	yes
2	no

FLAGS

1	Filled
-1	Missing
-2	Not applicable (no utility bills)

DESCRIPTION

This variable has replaced the variable HS020[35] from the 2008 operation onwards.

The variable records whether the household has been in arrears in the past 12 months, that is, unable to pay on time (as scheduled) utility bills (heating, electricity, gas, water, etc.) for the main dwelling. The question refers to financial difficulties, therefore, for example, if the household was unable to pay on time once/twice or more as result of lack of money, Only situations when household was unable to cover the costs due to financial difficulties should be recorded. If household was late with payment e.g. as forgot to pay the bill but had required amount of money, it should not be recorded..

Telephone bills should not be considered as utility bills in this item. However, sewage and rubbish bills are taken into account in this item.

If the household manages to pay through borrowing (from bank, relatives or friends), it is considered the same as if the household had managed to pay through its own resources.

If somebody from outside the household pays utility bill, flag -2 should be used[36].

The amount paid by other household should be recorded as a cost in HH070 but also as Regular interhousehold cash transfer received in HY080.

Suggested question:

In the past twelve months, has the household been in arrears, i.e. has been unable to pay the utility bills (e.g. heating, electricity, gas, water, waste disposal etc.) of the main dwelling on time due to financial difficulties?

Figure 3 Arrears on utility bills EU-SILC details (Source: EUROSTAT, 2022)

4.2.1.3 Limits and application suggestion

The arrears on utility bills indicator was considered by EPOV as a primary indicator, as it represents one possible dimension of energy poverty. It portrays the difficulty to pay for required energy services. However, this indicator does not depict the different types of energy needs. There are cases of underconsumption by households (Cong et al., 2022) that are not captured by this indicator, as these households may not have arrears due to their energy-limiting behaviour. Thus, it risks underestimating the proportion of the population in energy poverty. This discrepancy is well-illustrated, e.g., in the Portuguese and Lithuanian cases, where both countries present a low share of arrears but a high proportion of the population unable to keep the home adequately warm in winter. Some households adopt energy-limiting behaviours to guarantee that priority needs are met.

Example: An elderly person only turns on the oil heater at night and only in one room while sitting near it.

Alternatively, households can also engage in overconsumption compared to average, related to poor dwelling energy performance or higher energy needs due to special conditions (advanced age or disability, health condition) and not be captured with this indicator.

Example: A person with a disability that requires the maintenance of a temperature range throughout the day and the use of medical devices that need to be turned on 24 hours.

It also does not account for the costs associated with biomass use, which are generally omitted from energy costs statistics (Turai et al., 2021). From a more general perspective, a common problem with these consensual indicators, as highlighted by Thomson et al. (2017), is that they are framed as dichotomous variables. Respondents can only answer “yes” or “no”; hence this indicator does not capture the whole spectrum of experiences. A person can fail to pay their bills because of a lack of resources or because of neglect or forgetfulness. Rademaekers et al. (2016) state that one arrear can be caused by specific income shocks.

Example: *With the soaring energy prices and cold weather in a given month, the bill was higher than expected, and the household does not have enough money to cover it.*

Example: *The bill arrived, and since payment might not be automatic, the person forgot about it.*

On the other hand, it can also result from persistent or temporal indebtedness with the need for a follow-up question (Castaño-Rosa et al., 2019). It is important to understand whether debt is a coping strategy and whether it is a long- or short-term strategy. It would be helpful to ask the household why they have arrears. As it is, it is not possible to directly link the outcome to an inability. The Eurobarometer 72.1 (2009) and 74.1 (2010) surveys used a scale instead of a binary format, collecting additional information on the different levels of risk. In this format, the individual can provide an assessment of their vulnerability to non-payment of bills, helping to discern various levels of deprivation, despite the increasing subjectivity of the analysis. In its current form, compared to other consensual-based indicators, this indicator is the least subjective one, as paying bills is a less subjective variable to capture, than being adequately or comfortably warm or cool, thus being more suitable for cross-comparison in the EU.

It is also noteworthy that in instances where households have borrowed money for payments from the bank, relatives, or friends, this is not considered an inability to pay (Eurostat, 2022). This appears somewhat of an omission, as needing to borrow money still indicates an incapacity to meet payments at the given time. Furthermore, in cases of bank loans, it is likely that the household is incurring interest charges which may contribute to situations of vulnerability and result in an inability to pay further down the line when the repayments are due. This indicator interpretation can also be shadowed by national or local authorities' financial support for paying utility bills, such as social tariff support schemes. This means that a country/region with a strong social policy targeting vulnerable consumers potentially has low figures in this indicator, not representing their real levels of vulnerability. Complementing the analysis of this indicator with knowledge of the existence and coverage (number of persons) of such support schemes allows a more contextualized understanding of it.

Finally, the indicator bundles different bills (heating, electricity, gas, water), which can provide a skewed representation and overestimate energy poverty. At the same time, it would be beneficial to differentiate which bills are not being paid. Other basic needs, such as food and transport, should also be integrated into a comprehensive assessment to understand which are being prioritized and which are being limited. Rademaekers et al. (2016) make the same point, stating that because of this, the arrears in utility bills indicator is an indicator for general poverty, rather than for energy poverty, and “can be used only in a very indirect way for monitoring energy poverty”.

To avoid capturing a sporadic event, the indicator could be rephrased to depict a more persistent situation caused by a lack of resources. It could also be overlapped with an indicator portraying disproportionate expenditure, such as the 2M (see chapter High Share of energy expenditure in income (2M)), to detect people who have difficulty affording their energy bills consistently (Barrella and Romero (2022). To analyse the indicator in an assessment of energy behaviours would also provide vital information to identify who is in a situation of vulnerability. It is worth mentioning that as it deals indirectly with energy prices and income, this indicator considers the current social context of the region in analysis (Castaño-Rosa et al., 2019).

4.2.1.4 Updates and disclaimer

The summary of the updates that occurred on this indicator at this stage (October 2022) is:

- EU-SILC and JRC are the key data sources.
- Annual values available for 2004-2021 period.
- The disaggregation of the indicator has been updated for 2019 values.
- The indicator is now presented by the share of population and share of households in the 2019 case.

In 2021, **6.4%** of the European Union population presented **arrears on utility bills** (EUROSTAT, 2022a) corresponding to 29.9* millions of Europeans.

**considering that the European Union population in 2021 was 447.0 million, according to EUROSTAT (2022i)*

4.2.2 Inability to keep home adequately warm

4.2.2.1 Current situation

The inability to keep home adequately warm indicator represents the share of (sub-) population not able to keep their home adequately warm, based on the question "Can your household afford to keep its home adequately warm?".

Figure 4 and Figure 5 present the last data available (i.e., 2021) for the indicator represented in the map and bar chart.

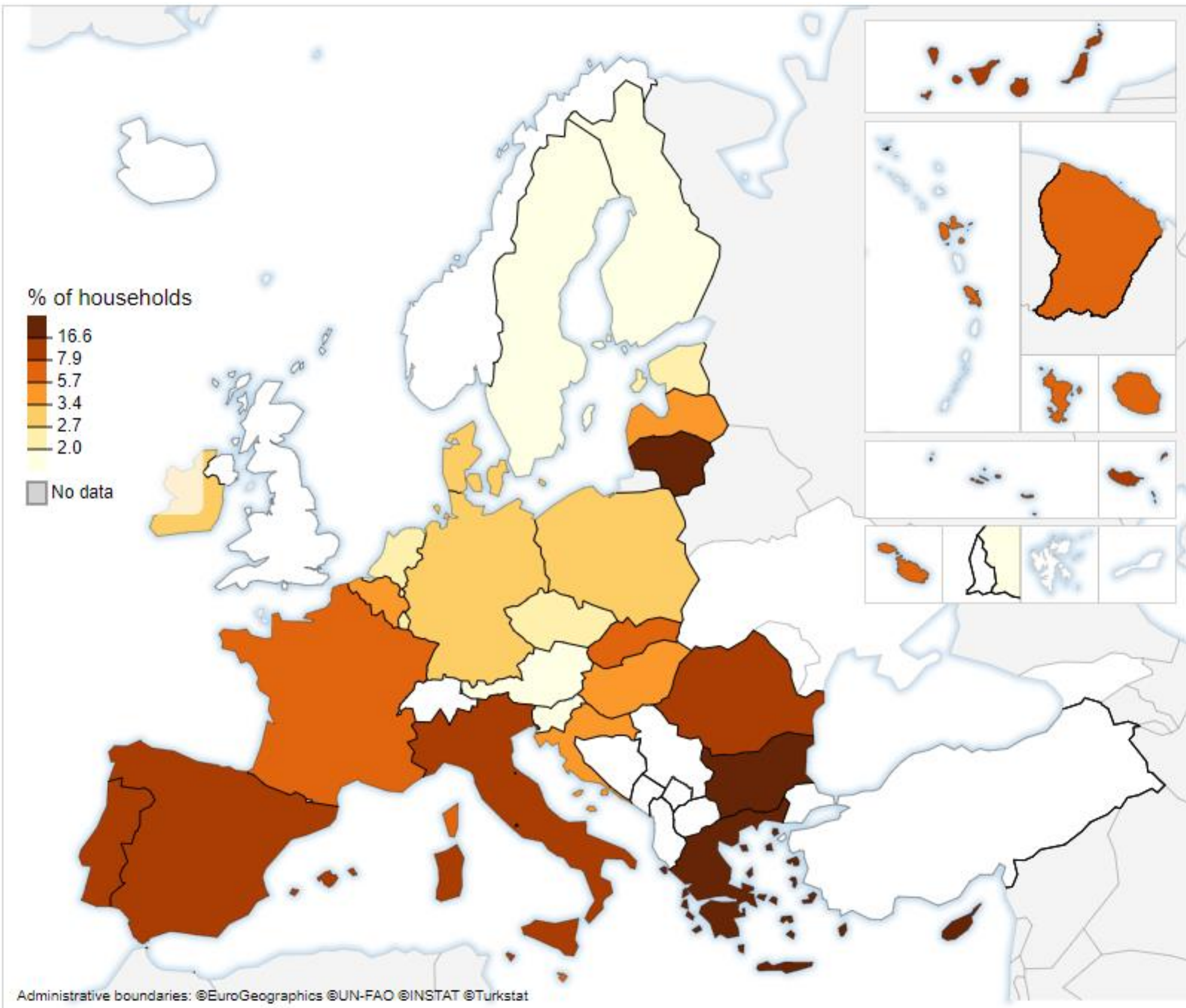

Figure 4 Map of Inability to keep home adequately warm indicator in 2021 (Source: EPAH, 2022a)

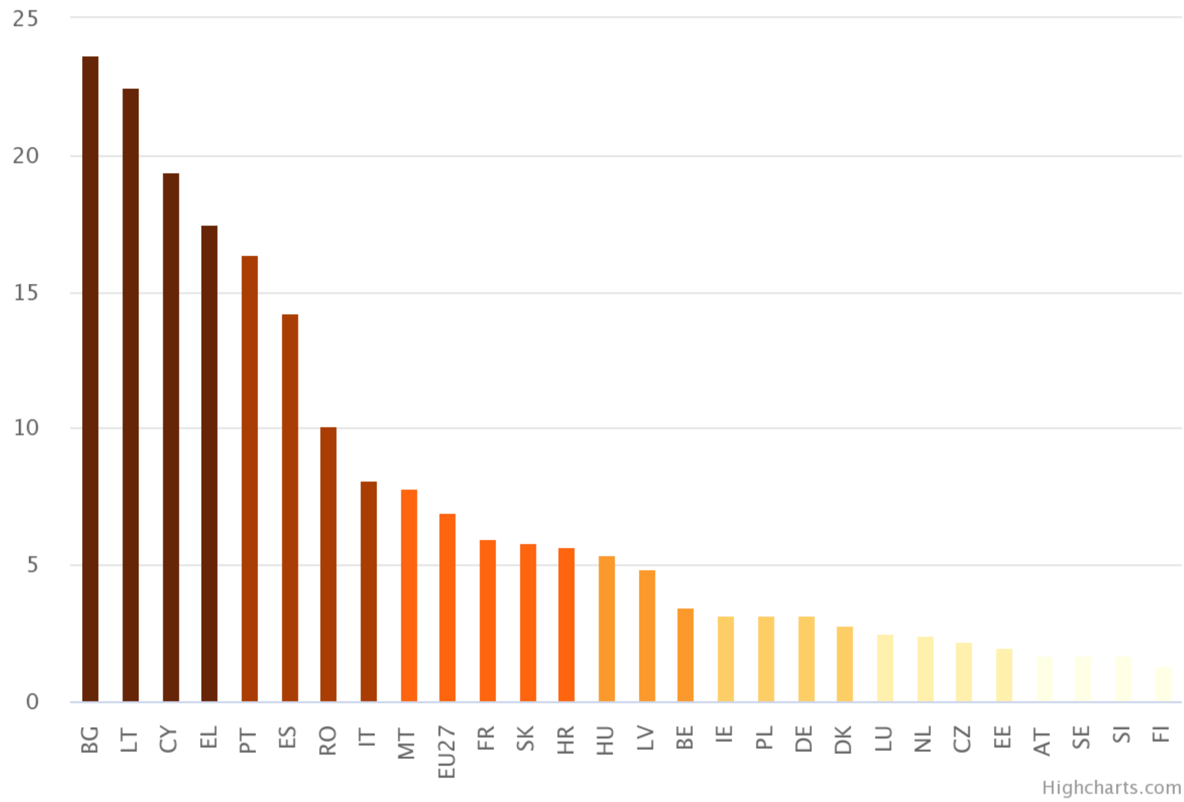

Figure 5 Inability to keep home adequately warm (% of households) bar chart from 2021 (Source: EPAH, 2022a)

4.2.2.2 Technical Details

Table 8 presents the technical details for the “inability to keep the home adequately warm” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the current update in relation to the maximum 44 GEO list, and the data sources used.

Table 8 Inability to keep home adequately warm technical details

Identification Code	Name	Timeline	# GEO	Source
ILC_MDES01	Inability to keep home adequately warm	2004-2021	29/44	EU-SILC and JRC

The “inability to keep the home adequately warm” indicator country averages are directly extracted from the Eurostat (2022b) database. In the past EPOV version, this indicator was divided into four disaggregation groups: income deciles, tenure type, urbanization density, and dwelling type. The EPAH team was not able to continue this disaggregation on the current update due to a lack of access to the EUROSTAT microdata but has worked with JRC to integrate their data into the update for the 2019 data.

JRC presented different levels of disaggregation for this indicator in their last report with new or slightly modified options (Koukoufikis and Uihlein, 2022). After the JRC disaggregation update, the indicator is now presented for 2019 in the share of population and share of households. The following options were also added as new disaggregation:

- Tenure type
  - Accommodation is provided free
  - Owner paying mortgage
- Dwelling Type
  - Apartment or flat in a building with ten or more dwellings
  - Apartment or flat in a building with less than ten dwellings

The EPOV value of “Inability to keep home adequately warm” only considered the total type of households and total income situation. However, EUROSTAT has the following disaggregation options for the indicator, that could be used:

- Income situation in relation to the risk of poverty threshold
  - Total
  - Below 60% of median equivalized income
  - Above 60% of median equivalized income
- Type of household
  - Single person
  - One adult younger than 65 years
  - One adult 65 years or older
  - Single person with dependent children
  - Single female
  - Single male
  - Two adults
  - Two adults younger than 65 years
  - Two adults, at least one aged 65 years or over
  - Two adults with one dependent child
  - Two adults with two dependent children
  - Two adults with three or more dependent children
  - Three or more adults
  - Three or more adults with dependent children
  - Households without dependent children
  - Households with dependent children

The “Inability to keep home adequately warm” EU-SILC details can be observed in Figure 6. Note that the indicator unit that is considered is household.

HH050: ABILITY TO KEEP HOME ADEQUATELY WARM

Topic and detailed topic: Living conditions, including material deprivation, housing, living environment, access to services / Material deprivation

Variable type: Annual

Unit: Household

Reference period: Current

Mode of collection: Household respondent

In use (period): Yes, since first year of EU-SILC data collection

Series' differences: No changes

VALUES AND FORMAT

1 Yes
2 No

FLAGS

1 Filled
-1 Missing

DESCRIPTION

This question is about affordability (ability to pay) to keep the home adequately warm, regardless of whether the household actually needs to keep it adequately warm.

Suggested question is:

Can your household afford to keep its home adequately warm?

Figure 6 Inability to keep home adequately warm technical details from EU-SILC (Source: EUROSTAT, 2022)

4.2.2.3 Limits and application suggestion

This indicator is also framed as a dichotomous variable, facing the same issues described previously for the “arrears on utility bills” indicator. Thomson and Snell (2017) defend the amendment of this indicator, framing the answers to the question in a “Likert type scale response format, to detect frequency of the problems.” The authors also suggest a follow-up variable, resulting from asking the respondents about why they cannot keep a comfortable temperature, providing options like the affordability of energy, the energy efficiency of the home, or a combination of factors. Technological limitations such as lack of equipment and ownership of central heating or heating in circuit that does not allow heating particular rooms without heating the whole dwelling should also be considered as follow-up options.

Example*: An elderly person living alone, without any working heating equipment, only using blankets to keep warm.*

It would be helpful to ask about the common thermostat temperature setting, if available, to understand potential cultural and social differences between countries. As the inability to keep the home adequately warm is an outcome of energy poverty, coupling it with other variables may bridge the gap between consequences and causes, providing a more comprehensive understanding of the problem. This is corroborated by Bouzarovski (2014), who states that combining data from this indicator with data from objective indicators, such as the share of the population with high housing burdens, the proportion living in poor quality dwellings, or energy bill arrear data, can give a more accurate representation of energy poverty levels. Castaño-Rosa et al. (2020) reinforce this point, highlighting the need to include new variables for discerning the cause of the problem. An objective measurement of energy expenditure could be an adequate indicator to complement the analysis. The same can be said for housing conditions and energy efficiency indicators, as poor energy performance of buildings is another major cause of energy poverty.

Thomson and Snell (2013) state that, in general, the EU-SILC was not designed to measure energy poverty, which is reflected in the sampling procedure, data anomalies, subjectivity of self-assessment and reporting, and the dichotomous nature of the indicators, not capturing the intensity of energy poverty. Regarding this indicator, the authors identify that beliefs on adequate warmth can differ across participants and countries, although they are assessed similarly. Tirado-Herrero (2017) corroborated the Thomson and Snell (2013) perspective, stating that the different household perceptions make assessing these indicators more challenging.

Example: *A person in Germany, used to central heating, might find a particular temperature to be too cold, while a person in Portugal might find it comfortable and acceptable, as it is used to colder inside temperatures.*

Poor households may have lower standards or adaptive preferences and may feel ashamed to report their inability to afford basic needs. Differing beliefs can be shaped by different social practices and energy beliefs, such as ventilation and cooling practices (DellaValle et al., 2018). Cultural differences may also partially justify different perceptions (Lowans et al., 2021). Perceptions can also vary across genders, and intra-household power dynamics may influence the achievement of adequate indoor temperatures. Hence individual responses per household are necessary to discern potential situations of vulnerability (Sintov et al, 2019).

***Example**: Two flatmates living in the same apartment with different social habits and standards of thermal comfort as a consequence.*

Moreover, the energy poor often have a "denial of reality" bias, or in other words, they deny being uncomfortable. As pointed out by Karpinska and Śmiech (2021), in some countries, the inability to keep home warm is more often reported in upper-income deciles households than in lower-income deciles. The authors state that there is little overlap between income poverty and the inability to keep the home adequately warm.

A comparable level of subjectivity applies to the concept or meaning of "being able" to have adequate warmth. It is relevant to mention that skewness can be magnified by translating the question to other languages (Barrella and Romero, 2022). Castaño-Rosa et al. (2019) praise the ability of the indicator to capture the perceived reality of households independently from income but underline its subjectivity as the major weakness. On another note, Rademaekers et al. (2016) affirm that the indicator is "too specific" because it only focuses on one energy service, space heating, a position also supported by Castaño-Rosa et al. (2019). Moreover, energy poverty is a complex issue that does not only occur during the winter and/or in colder countries, and this indicator does not represent the inability of the energy poor to cool their homes in hot seasons. While it is true that it only addresses one energy service, it is advantageous to use separate indicators to assess other energy services due to the significance of that indicator for the local context (e.g., heating as the main consumer of energy for northern European countries, cooling as a significant energy need for southern European countries).

4.2.2.4 Updates and disclaimer

The summary of the updates that occurred on this indicator at this stage (July 2022) is as follows:

- EU-SILC and JRC are the key data sources.
- 2004-2021 period of data available.
- The disaggregation of the indicator has been adapted for 2019 values.
- The indicator is presented by the share of population and share of households in the 2019 case.

In 2021, **6.9%** of the European Union population presented **inability to keep home adequately warm** (EUROSTAT, 2022b) corresponding to 30.8* millions of Europeans.

**considering that the European Union population in 2021 was 447.0 million, according to* EUROSTAT (2022i)

4.2.3 High share of energy expenditure in income (2M)

4.2.3.1 Current situation

The 2M indicator represents the proportion of households whose share of energy expenditure in income is more than twice the national median.

Figure 7 and Figure 8 present the last data available (2015) for the indicator represented in a map and bar chart.

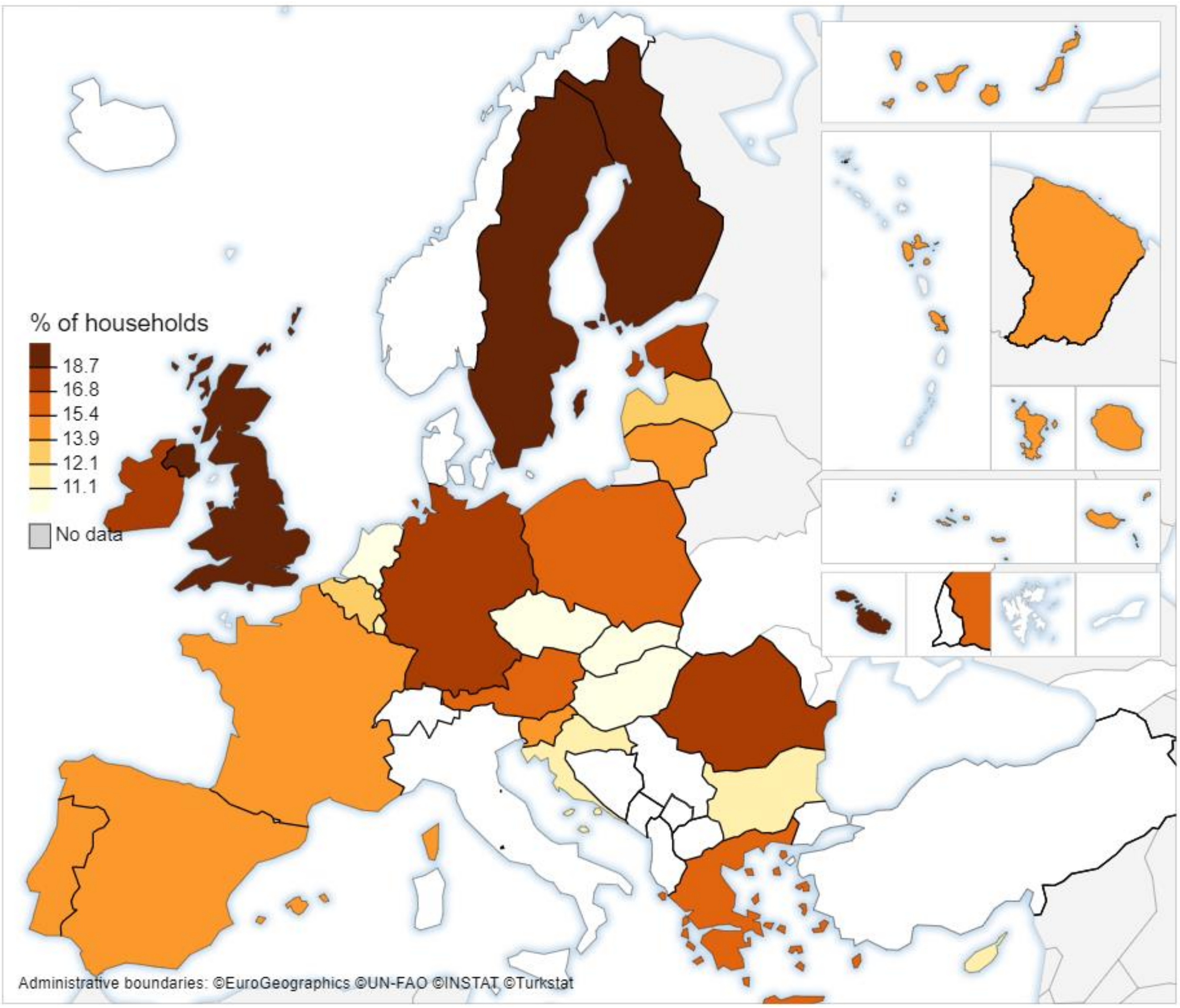

Figure 7 High Share of Energy Expenditure in income (2M) map from 2015 (Source: EPAH, 2022a)

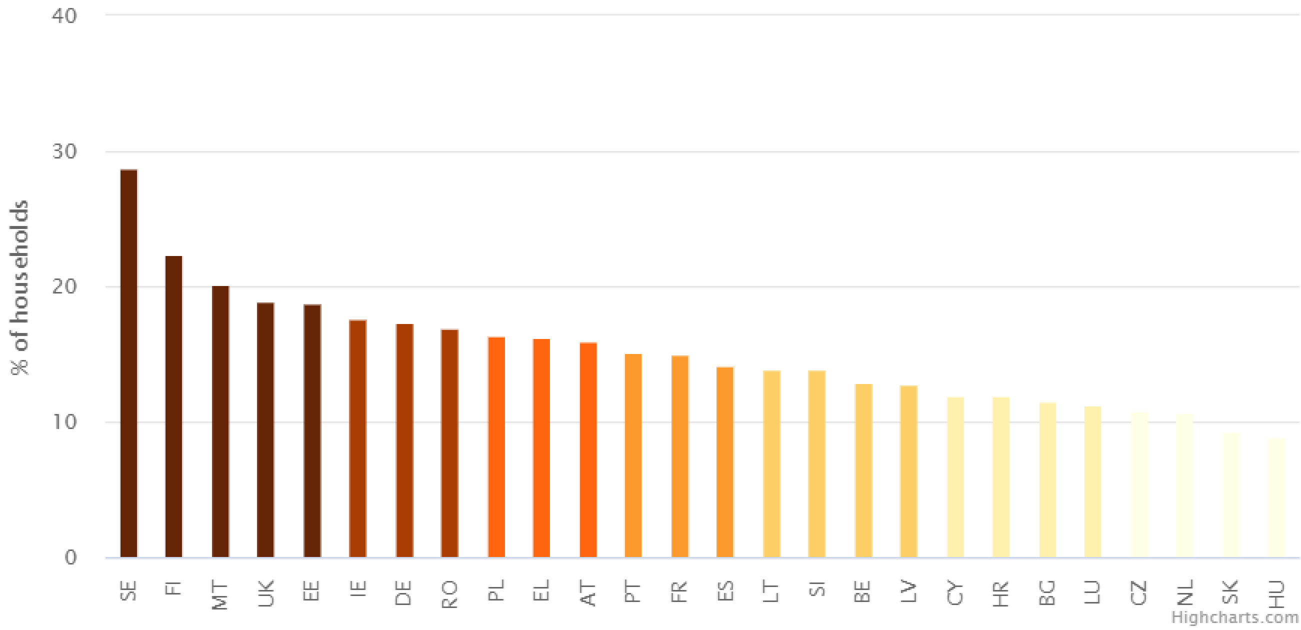

Figure 8 High Share of Energy Expenditure in income (2M, % of households) bar chart from 2015 (Source: EPAH, 2022a)

4.2.3.2 Technical Details

Table 9 presents the technical details for the "High Share of Energy Expenditure in income (2M)" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 9 High Share of Energy Expenditure in income (2M) technical details

Identification Code	Name	Timeline	# GEO	Source
None	High Share of Energy Expenditure in income (2M)	2010 and 2015	28/44	HBS

According to EPOV, the 2M indicator 2015 data was calculated with the HBS microdata and considering the following steps (Thema and Vondung, 2020):

1. Calculation of the share of (equivalized) energy expenditure in (equivalized) disposable income for each observation (household) in the dataset
2. Calculation of the (weighted) median value of this variable by country

3. Generation of a new variable that assigns households whose value on this variable is above twice the national median the value 1 (i.e., energy poor) and all others the value 0 (i.e., not energy poor)
4. Calculation of the share of households considered energy poor by country

4.2.3.3 Limits and application suggestion

This is a simple metric to identify households that have excessively high energy costs in relation to income. It does not represent the energy poor who are under-consuming or not consuming at all; therefore, it should be complemented with the M/2, depicting abnormally low expenditures. The 2M indicator is based on the concept of the UK's 10% threshold, but it does not set an absolute or fixed figure (Radamaekers et al., 2016). It also does not differentiate between different energy uses and the household's energy priorities. Consequently, it does not enable an analysis of the factors leading to energy-limiting behaviour or overconsumption.

Example*: Imagine two households with the same energy expenditure share, but one does not pay for housing expenses and has an energy-efficient home. Their vulnerability has different levels. One might be spending energy on basic services and the other for leisure activities.*

The 2M indicator uses a relative threshold, accounting for the varying economic and climatic conditions of each Member-State (Panão, 2021). The reference to a median value ensures a dynamic threshold that refers to the evolution of actual expenditures in the reference community, which can be regarded as an advantage. However, the fact that it is based on national incomes means that using it to compare data between Member-States can be problematic as international differences in costs of essentials such as food are not accounted for (Turai et al., 2021). There are arguments against the 2M as an appropriate threshold of energy poverty (Barrella and Romero, 2022).

Rademaekers et al. (2016) highlight the drawback of hiding certain energy-poor groups if the population's income and expenditure distribution change significantly. For instance, if the expenditure of the total population were to increase within the higher income groups, in particular, the number of households in energy poverty would decrease, which may be a misrepresentation of reality (Castaño-Rosa et al., 2019). One possible way to try to avoid this problem would be to compare with previous years' median values or with an average of medians.

This indicator can capture energy poverty instances in the highest income quintiles, which is not favourable. However, it happens only for a small percentage compared to other expenditure metrics, which can be considered an advantage. The definition of an absolute level of income above which households are not in energy poverty is something that the 2M indicator does not provide. Romero et al. (2018) argue that energy poverty is normative and of absolute limits and that the shift of the group's condition should not dictate whether a home is in energy poverty. Thus, the authors assert that relative measures should not be used to assess poverty but rather inequality. To face this problem, the indicator would need to be linked to an absolute "adequate level of energy services" (Barrella and Romero, 2022).

Example*: If overconsumption is a common practice within a population, using the median might hide the ones who only slightly overconsume and will not be identified as energy-poor.*

Moreover, the indicator focuses only on energy services, not accounting for the "heating or eating" effect, in which households choose between spending on energy or other basic needs. It also represents energy expenditure rather than thermal comfort requirements, which are not analogous (Castaño-Rosa et al., 2019). Heindl (2015) points out that using average and median values creates an arbitrary fuel poverty line and has shortcomings when analyzing households with differences in size, composition, and income.

Siksnelyte-Butkiene et al. (2021) affirm that the indicator is insufficient for a total energy poverty measurement as it does not reflect the social and environmental dimensions of the problem. The indicator also does not consider dwelling characteristics and energy efficiency (Castaño-Rosa et al., 2019).

Where income distributions are more equal, variance in energy expenditure translates to higher 2M shares. High variance in energy or income shares can occur due to structural differences in energy expenditure between household groups and in situations where energy is often, but not exclusively, included in rent.

In short, it can be a helpful indicator for identifying households that have excessively high energy expenditures. Still, it should be analysed with complementary indicators, namely income levels and energy efficiency of buildings, to separate the energy poor from the affluent households. This indicator does not capture energy underconsumption. Thus, it needs to be complemented with other indicator(s) that include households whose energy poverty condition is expressed by abnormally low energy consumption. Moreover, while providing important information, relative measures should not be the ultimate measure upon which decisions are made.

4.2.3.4 Updates and disclaimer

This indicator was not updated since it requires access to microdata to replicate the calculation done before, which EPAH was not able to access at this time.

The correct unit for this indicator is as presented in its definition (i.e., households).

In 2015, **14.6%** of the European Union households presented **high share of energy expenditure in income** (EPOV, 2020) corresponding to 32 001* thousands of Europeans' households.

**considering that the European Union number of households in 2015 was 219 186.3 thousands , according to EUROSTAT (2022f)*

4.2.4 Low absolute energy expenditure (M/2)

4.2.4.1 Current situation

The M/2 indicator represents the share of households whose absolute energy expenditure is below half the national median or, in other words, abnormally low.

Figure 9 and Figure 10 present the last data available for the indicator represented in a map and bar chart.

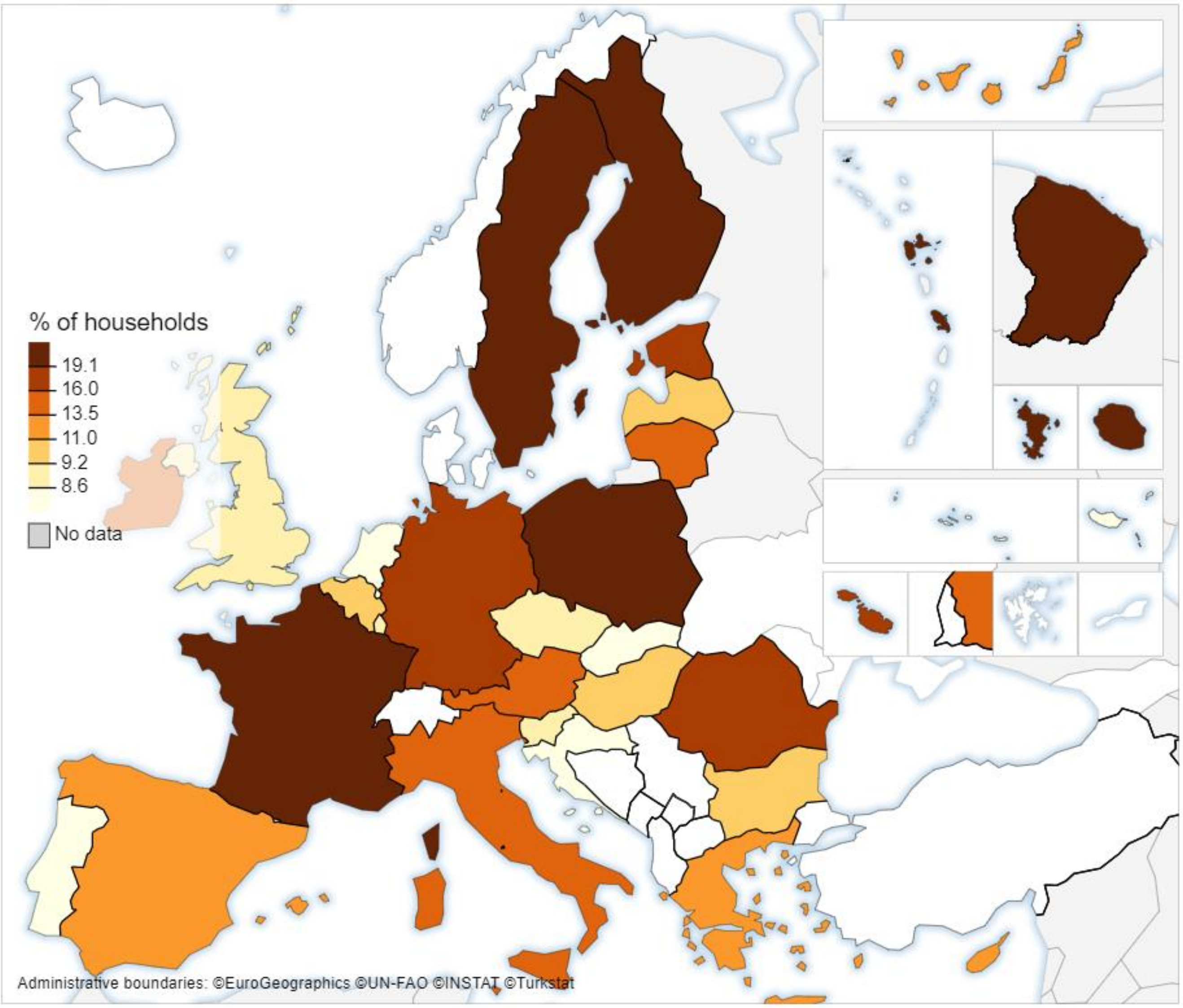

Figure 9 Low absolute energy expenditure (M/2) map from 2015 (Source: EPAH, 2022a)

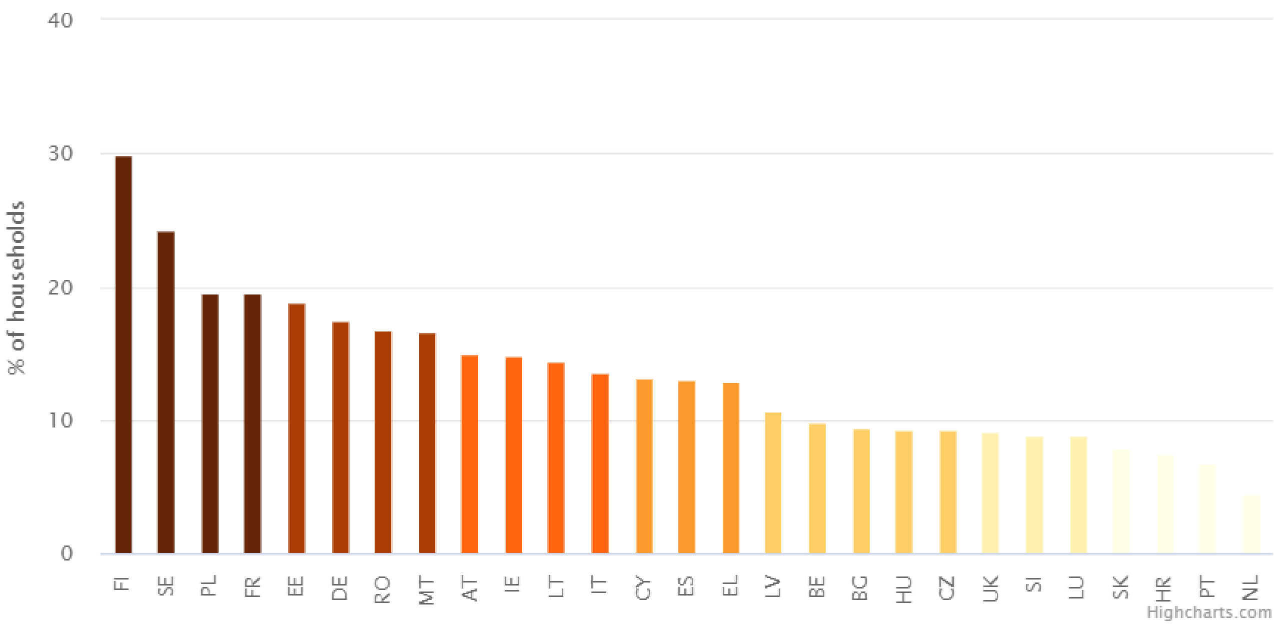

Figure 10 Low absolute energy expenditure (M/2, (% of households) bar chart from 2015 (Source: EPAH, 2022a)

4.2.4.2 Technical Details

Table 10 presents the technical details for the “Low absolute energy expenditure (M/2)” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 10 Low absolute energy expenditure (M/2) technical details

Identification Code	Name	Timeline	# GEO	Source
None	Low absolute energy expenditure (M/2)	2010 and 2015	28/44	HBS

According to EPOV, the M/2 indicator was calculated with the HBS microdata and considering the following steps (Thema and Vondung, 2020):

1. Calculation of the (weighted) median (equivalized) energy expenditure by country

2. Generation of a new variable that assigns households whose (equivalized) energy expenditure is below half the national median the value 1 (i.e., energy poor) and all others the value 0 (i.e., not energy poor)
3. Calculation of the share of households considered energy poor by country.

4.2.4.3 Limits and application suggestion

This indicator shares some of the advantages and drawbacks of the 2M indicator. It is a simple measure to calculate, representing an important aspect of energy poverty, energy expenditure, while capturing the economic and climatic context and reality of the respective Member-State or region, just like the 2M. It also does not take into account other dimensions, such as the dwellings' energy efficiency, local climate variability, or social features or conditions of households, solely focusing on the economic dimension. It also does not provide an absolute threshold of energy poverty, as households can move in or out of it depending on different circumstances. For example, factors like the effect of seasons on energy demand, unexpected energy bills, or changes in personal circumstances (unemployment, illness, etc.) can all impact vulnerability to energy poverty (Robinson et al., 2018).

The indicator is also subject to Romero et al.'s (2018) and Barrella et al. (2022) criticism of being a measure of inequality more than poverty. Contrarily to the “2M”, it captures households that have abnormally low energy consumption, potentially in “hidden energy poverty”(Rademaekers et al, 2016), excluding households with excessive consumption. These two indicators are, therefore, complementary and should be integrated into the same analysis. It can arguably have the disadvantage of capturing some high-income households whose expenditure is low due to a very efficient home and equipment, as described by Barrella et al. (2022). Thus it is advisable to complement this indicator with an income analysis, for instance, using an income threshold.

***Example**: Two households can have the same energy expenditure, but one is composed of only one person or a couple and inhabits a very efficient and smart home, and other can be composed of 5 people and live in a deteriorated home.*

This indicator is influenced by the underlying distribution of absolute energy expenses of the population. In contexts with high-income inequality, big disparities in expenditures, and a large percentage of low-income population, the median can be considerably low, and this could conceal a percentage of households restraining their consumption but who are not below half the median line. The same applies to countries with historically low energy consumption for space heating and cooling, even across the middle class, as the median, or half the median, might not be representative of an expenditure level that is enough to guarantee adequate levels of energy services. On the other hand, in a less likely context, a population with a large percentage of very high incomes and expenditures might drive up the median to a level that would result in the wrongful identification of non-deprived households as energy-poor. Therefore, this indicator can be more effective in contexts where income and expenditure inequality is lower and with fewer disparities, as the median expenditure value will be more representative of adequate domestic energy levels.

Recommendations for the use of this indicator are identical to the 2M, namely their complementary application and combining them with indicators such as income and energy efficiency of the dwelling to understand if the cause of the underconsumption is, in fact, deprivation or if it is just a consequence of good energy performance and efficiency of the dwelling, and/or a case of economic affluence. To combine it with an absolute threshold for energy expenditure could also help overcome the shortcoming of its relative nature (Barrella et al, 2022; Barrella and Romero, 2022). An absolute income threshold under which a household would be in energy poverty could also be advantageous for a clearer picture of the problem and for avoiding false positive cases.

4.2.4.4 Updates and disclaimer

This indicator was not updated since it requires access to microdata to replicate the calculation done before, which EPAH was not able to access at this time.

The correct unit for this indicator is as presented in its definition (i.e., households).

In 2015, **16.2%** of the European Union households presented **low absolute energy expenditure** corresponding to 35 508* thousands of Europeans' households.

**considering that the European Union households in 2015 was 219 186 thousands, according to EUROSTAT (2022f)*

4.2.5. Pop.Liv. dwelling with presence of leak, damp and rot

4.2.5.1 Current situation

The Pop. Liv. dwelling with presence of leak, damp, and rot indicator represents the share of the population with a leak, damp or rot in their dwelling, based on the question "Do you have any of the following problems with your dwelling/accommodation?

- a leaking roof
- damp walls/floors/foundation
- rot in window frames or floor

Figure 11 and Figure 12 present the last data available for the indicator represented in a map and bar chart.

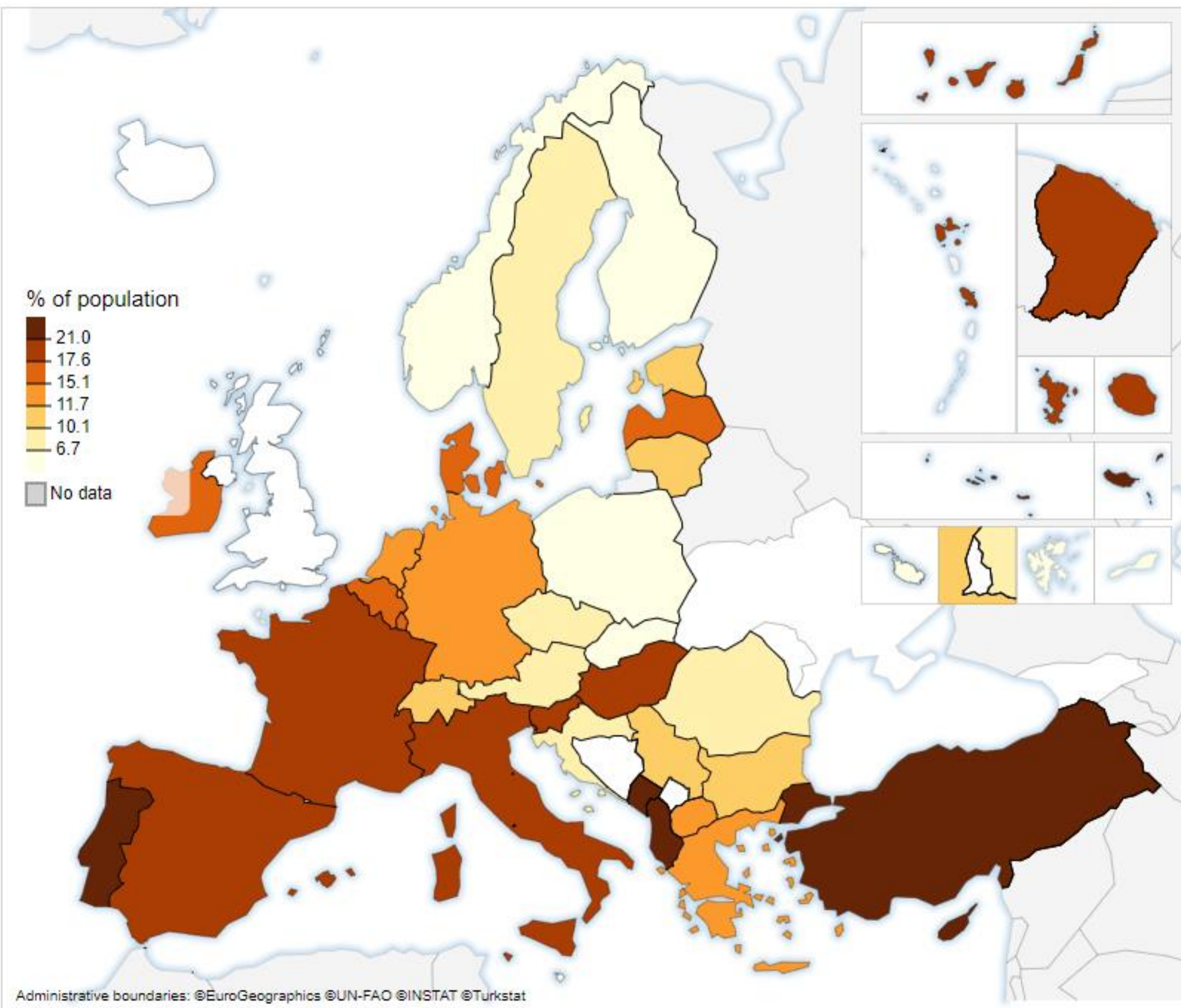

Figure 11 Map of Pop. Liv. dwelling with presence of leak, damp, rot indicator in 2020 (Source: EPAH, 2022a)

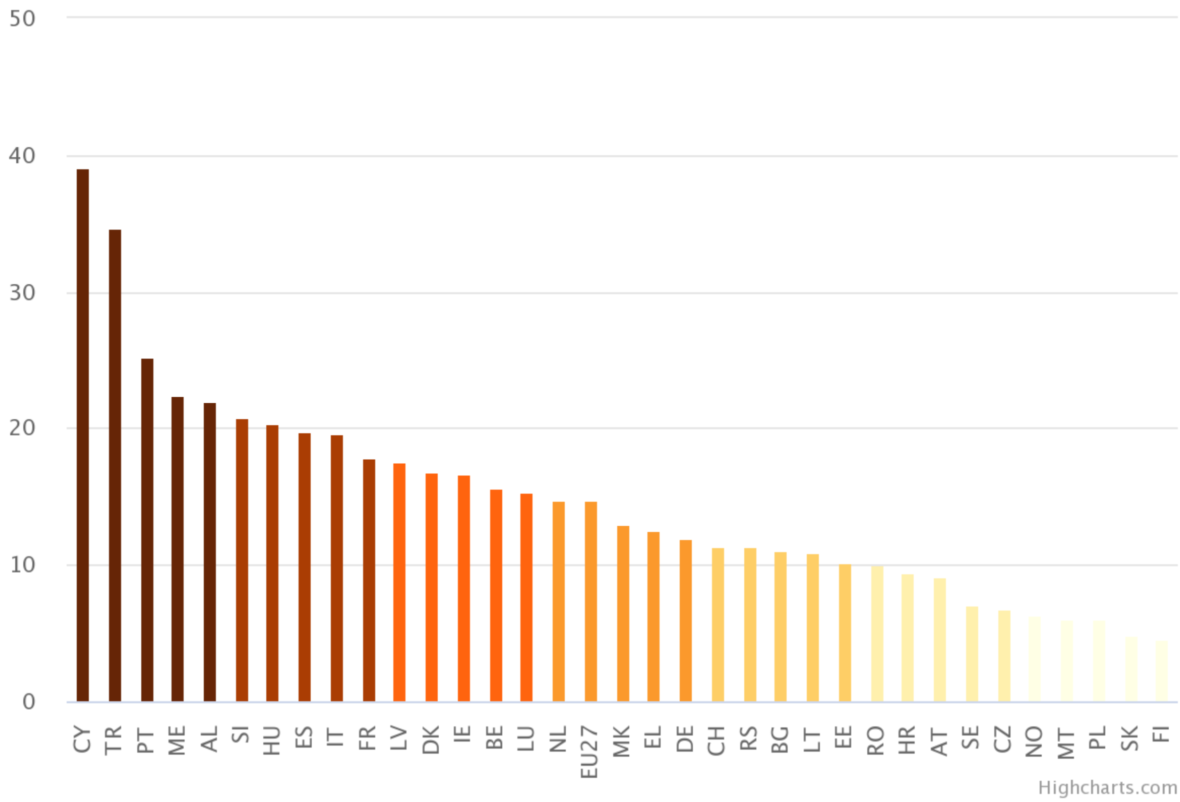

Figure 12 Pop. Liv. dwelling with presence of leak, damp, rot indicator (% of population) bar chart from 2020 (Source: EPAH, 2022a)

4.2.5.2 Technical Details

Table 11 presents the technical details for the Pop. Liv. dwelling with presence of leak, damp or rot indicator. The indicator data update was directly extracted from the EUROSTAT (2022c). The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 11 Pop. Liv. Dwelling with presence of leak, damp, rot technical details

Identification Code	Name	Timeline	# GEO	Source
ILC_MDHO01	Pop.Liv.Dwelling with presence of leak, damp, rot	2003-2020	35/44	EUROSTAT

The EPOV values of Pop. Liv. dwelling with presence of leak, damp or rot only depicted the percentage of the population considering the total number of households type, sex, age class and income situation in relation to the risk of poverty threshold. However, EUROSTAT has the following additional disaggregation options for the indicator:

- Age class
    - Total
    - Less than 18 years
    - From 18 to 64 years
    - 65 years or over
- Income situation in relation to the risk of poverty threshold
    - Total
    - Below 60% of median equivalized income
    - Above 60% of median equivalized income
- Sex
    - Total
    - Females
    - Males
- Type of household
    - Single person
    - One adult younger than 65 years
    - One adult 65 years or older
    - Single person with dependent children
    - Single female
    - Single male
    - Two adults
    - Two adults younger than 65 years
    - Two adults, at least one aged 65 years or over
    - Two adults with one dependent child
    - Two adults with two dependent children
    - Two adults with three or more dependent children
    - Three or more adults
    - Three or more adults with dependent children
    - Households without dependent children
    - Households with dependent children

4.2.5.3 Limits and application suggestion

The Pop. Liv. dwelling with presence of leak, dam, rot indicator is another consensual-based indicator collected in a dichotomous framing that shares some of the strengths and limitations of other self-reported indicators. Based on the household's perceived experiences, it will always have a degree of subjectivity, though substantially inferior to the "adequate warmth" indicator. It is simple to capture and provides a helpful descriptive report with a more objective character, even though it was also not tailored to capture energy poverty. As mentioned by Rademaekers et al. (2016), it measures energy efficiency more than it measures energy poverty; hence, it is insufficient to adequately grasp the issue. It provides an insight into the dwelling's state of conservation, which relates to the dwelling's energy performance, an essential factor in the occurrence of energy poverty. However, for a more robust insight into that specific cause, it would be advantageous to complement it with other indicators of buildings' energy efficiency or at least the year of construction as a proxy.

Thomson et al. (2017) indicate that the presence of damp walls or rotten windows is a sign of building deterioration, an unheated or ineffectively heated home, and increased difficulty of guaranteeing adequate warmth and cooling, as consumption would have to be higher due to the deterioration. Therefore, it can be argued that this indicator portrays a consequence of energy poverty in the dwelling, linked to a probable cause. However, it does not guarantee with certainty that energy poverty is the cause behind it. It can be a consequence of poor construction practices and humid indoor conditions and not necessarily be connected to an energy poverty situation.

When collecting data on this indicator, it would be beneficial to have a scale of severity (Likert), as situations may differ considerably, presenting different levels of urgency. Thomson et al. (2017) also defend this indicator's disaggregation between the various problems (mould, leaks, etc.). This could also be useful as it would provide a better idea of the specific problem and in which building element it occurs. Perhaps a quantification of the size and area of the deterioration could be a way of reducing subjectivity. Also, the magnitude of the deterioration is not captured by the nomenclature, as "rot" can have different levels of severity.

***Example**: Two households may claim they have rot in their windows while having very different levels of deterioration in their homes - one might have a slight sign of mould just appearing. In contrast, other could have a blackened and totally mouldy window frame.*

Castaño-Rosa et al. (2019) assert that this indicator should be supplemented with other indicators, portraying different energy poverty facets, such as the household's monetary situation, to increase its reliability as an energy poverty metric. An assessment of the individual's behaviour control and perceived agency would also be beneficial, as those experiencing poor housing conditions often feel they cannot change their condition and redefine their perception of these conditions, considering as "normal", instead of problematic

***Example**: While deteriorating elements are sign of a housing problem, one household may have the enough financial resources to solve it swiftly and may have not done yet because of lack of time or attention, whereas other maybe not have enough capital to fix it.*

Although it depicts an important cause of energy poverty, this indicator is one-dimensional and does not provide a comprehensive assessment of the issue if analysed individually, thus needing to be complemented with other indicators for a fuller picture of the problem.

4.2.5.4 Updates and disclaimer

The summary The summary of the updates done at this time is:

- 2003-2020 period of data available.
- The indicator has been renamed from "presence of leak, damp, rot" to "Pop. Liv. dwelling with presence of leak, damp or rot".

In 2020, **14.8%** of the European Union population was in **presence of leak, damp and rot** in their dwelling (EUROSTAT, 2022c), corresponding to 66.2* millions of Europeans.

**considering that the European Union population in 2020 was 447.7 million, according to EUROSTAT (2022i)*

4.2.6 Number of rooms per person by ownership status

4.2.6.1 Current situation

The "number of rooms per person by ownership status" indicator represents the average number of rooms per person by ownership status (rented/own property).

Figure 13 and Figure 14 present the last data available for the "number of rooms per person in owned dwellings" indicator represented in a map and bar chart.

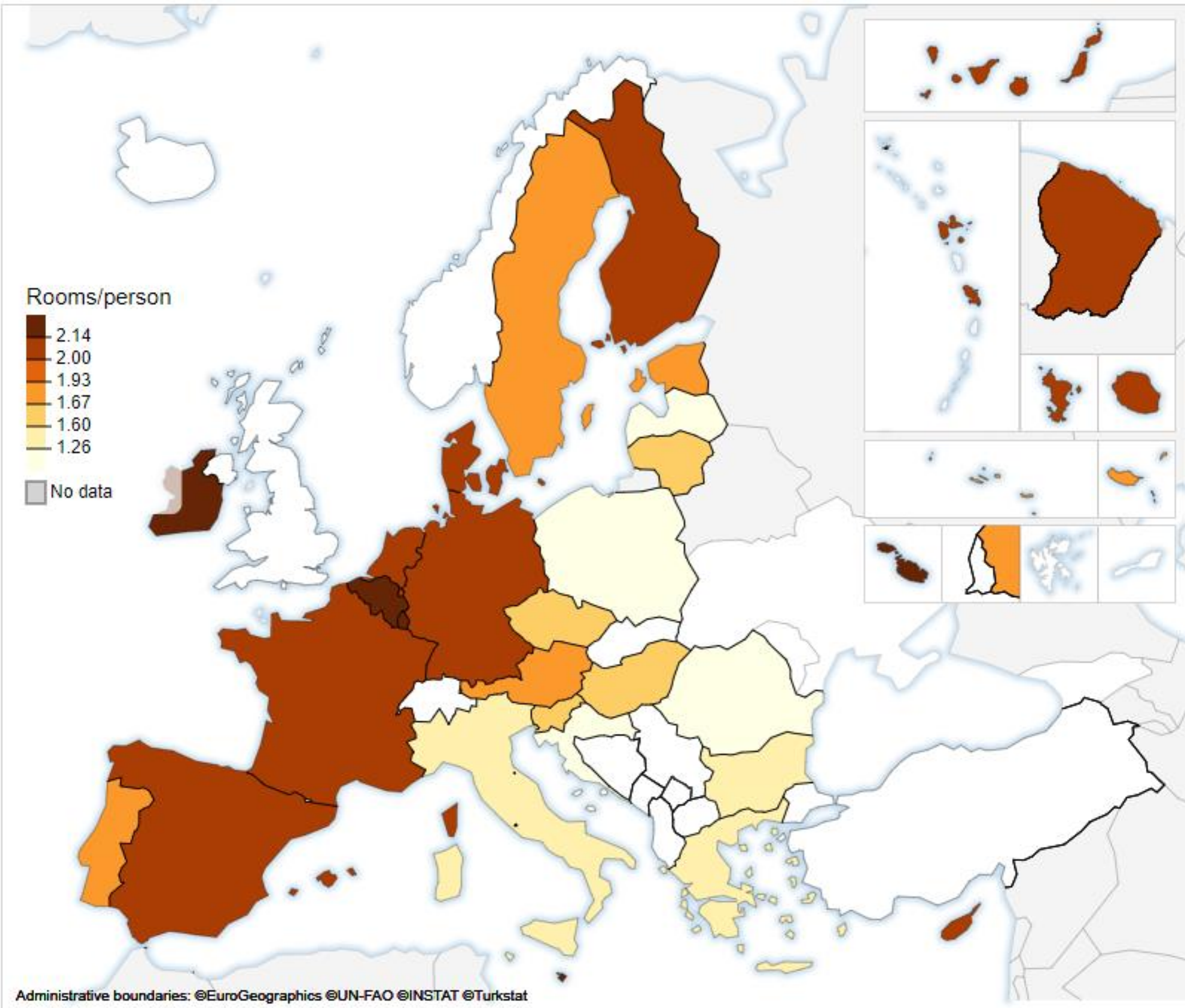

Figure 13 Map of the number of rooms per person in owned dwellings indicator in 2021 (Source: EPAH, 2022a)

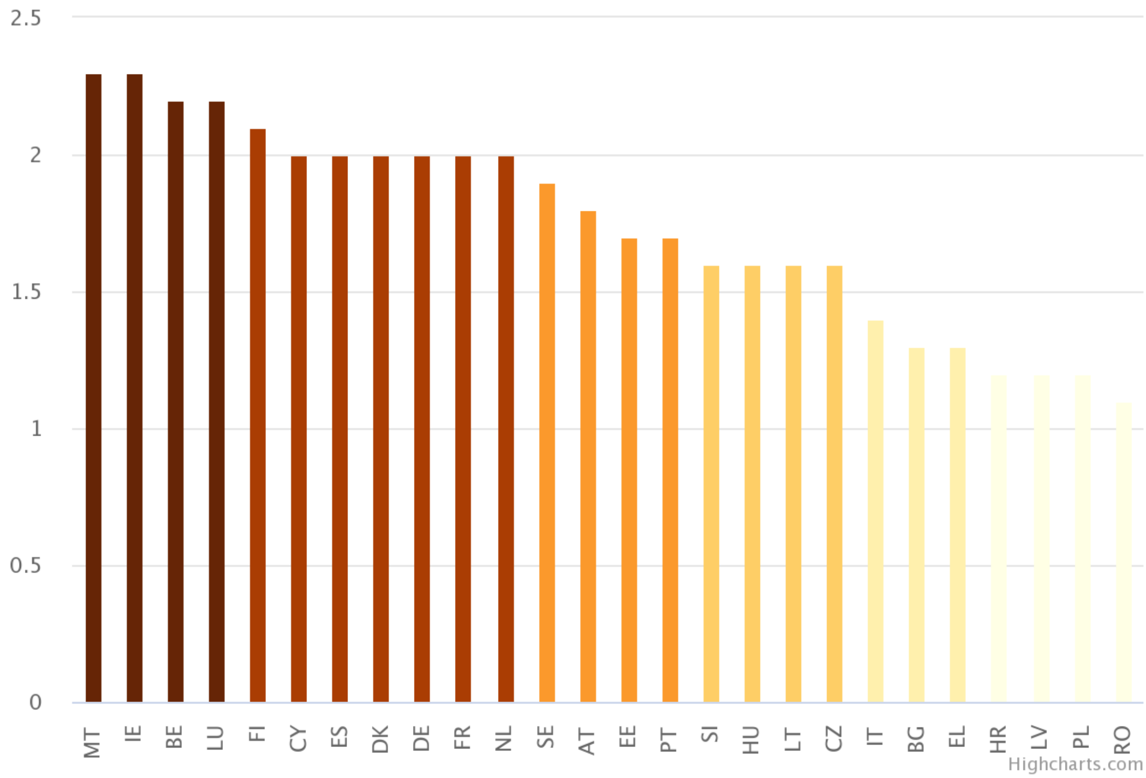

Figure 14 Number of rooms per person in owned dwellings indicator (rooms/person) bar chart from 2021 (Source: EPAH, 2022a)

Figure 15 and Figure 16 show the last data available for the "number of rooms per person in rented dwellings" indicator, are represented in a map and bar chart.

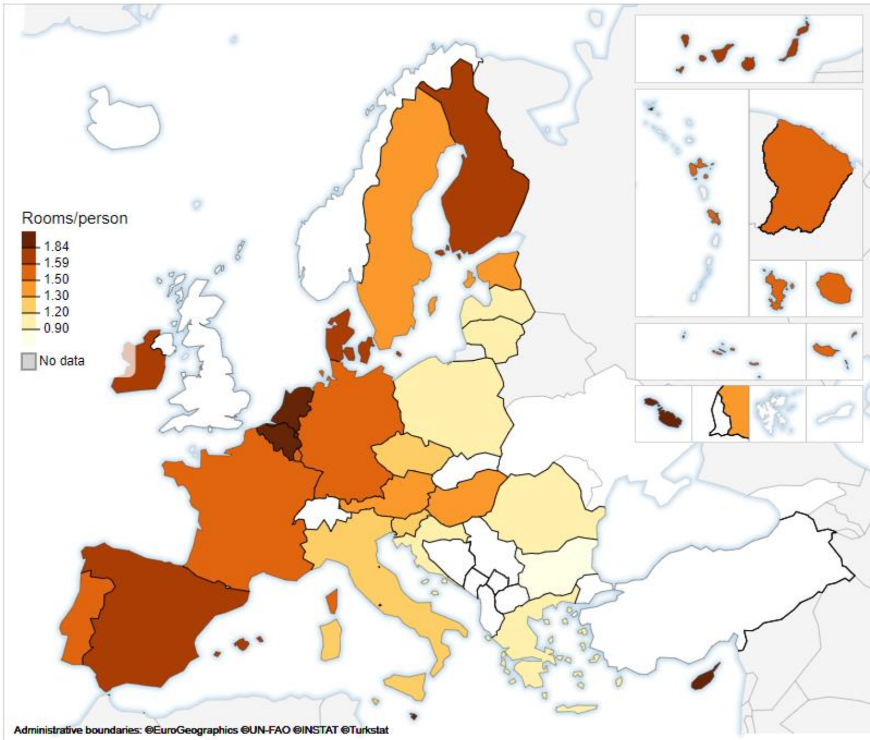

Figure 15 Map of the number of rooms per person in rented dwellings indicator in 2021 (Source: EPAH, 2022a)

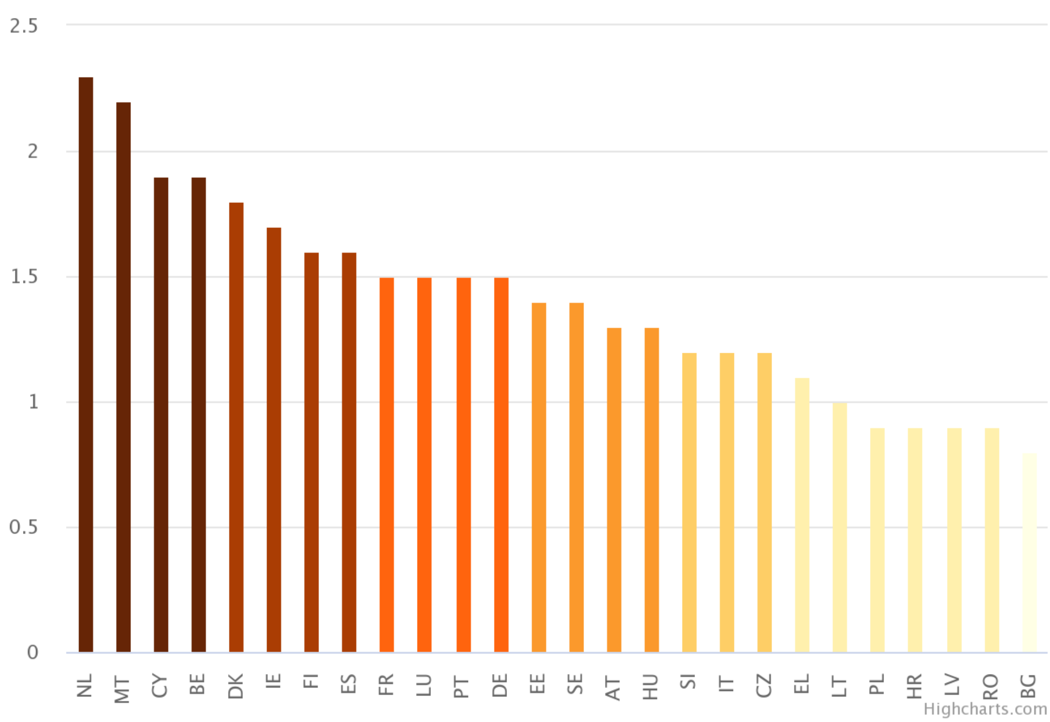

Figure 16 Number of rooms per person in rented dwellings indicator bar chart from 2021 (Source: EPAH, 2022a)

Figure 17 and Figure 18 present the last data available for the “number of rooms per person in all dwellings” indicator represented, respectively, in a map and bar chart.

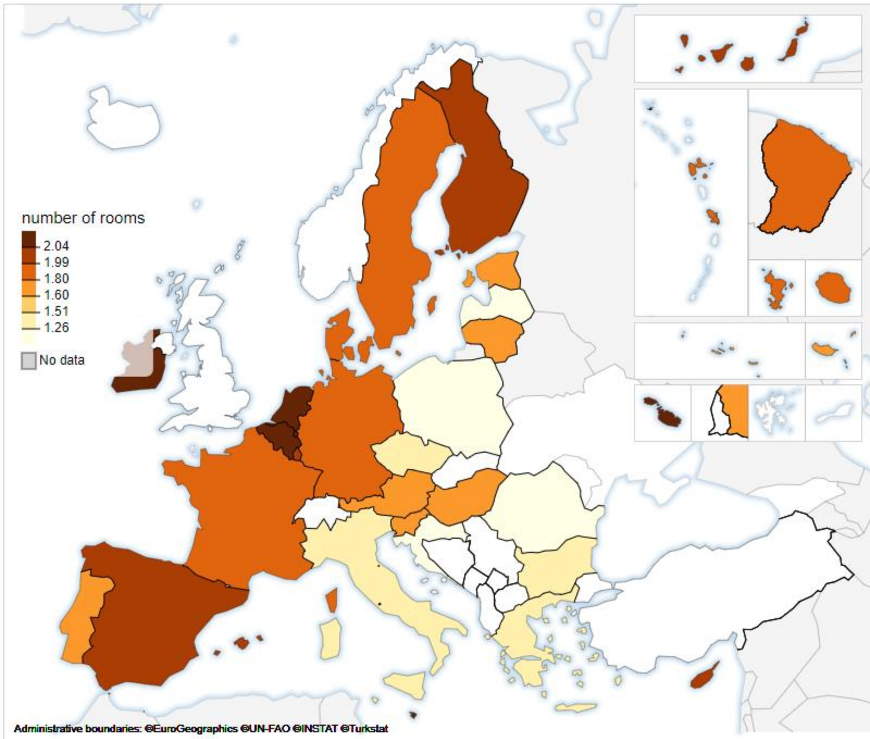

Figure 17 Map of the number of rooms per person in all dwellings indicator in 2021 (Source: EPAH, 2022a)

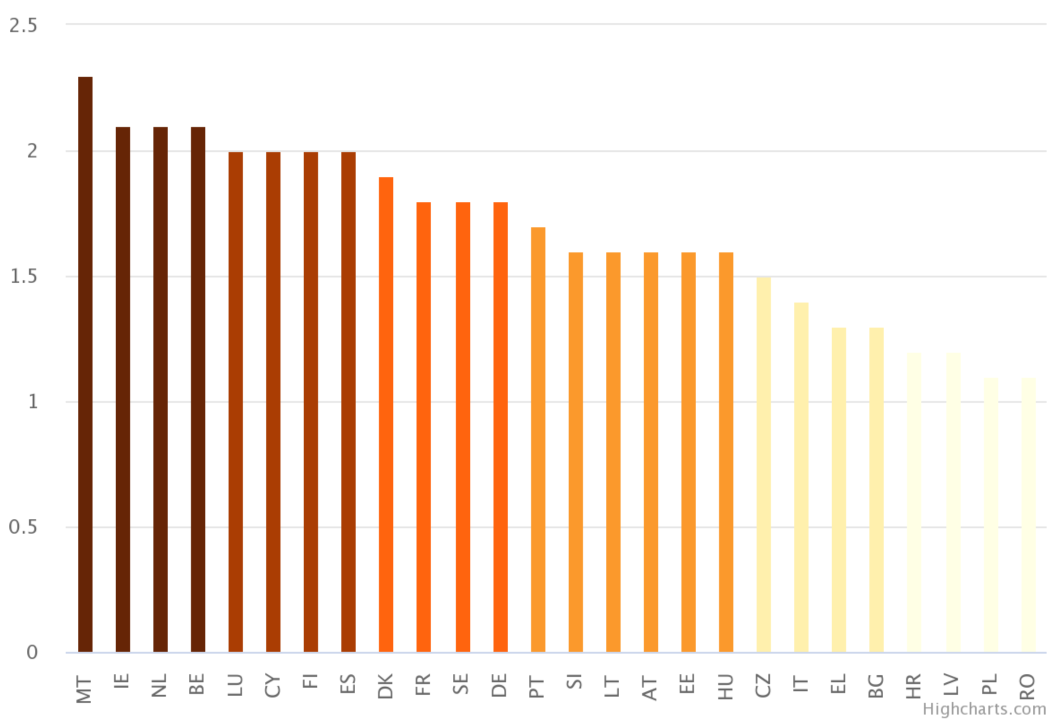

Figure 18 Number of rooms per person in all dwellings indicator bar chart from 2021 (Source: EPAH, 2022a)

4.2.6.2 Technical Details

Table 12 presents the technical details for the "number of rooms per person by ownership status" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

The indicator's data were updated with the data points directly extracted from EUROSTAT (2022d).

Table 12 Number of rooms per person by ownership status technical details

Identification Code	Name	Timeline	# GEO	Source
ILC_LVHO03	Number of rooms per person by ownership status	2003-2020	26/44	EUROSTAT

The "Number of rooms per person by ownership status" EU-SILC details can be observed in Figure 19.

HH030: NUMBER OF ROOMS AVAILABLE TO THE HOUSEHOLD

Topic and detailed topic: Living conditions, including material deprivation, housing, living environment, access to services / Main housing characteristics

Variable type: First wave/Annual

Unit: Household

Reference period: Current

Mode of collection: Household respondent or registers

In use (period): Yes, since first year of EU-SILC data collection

Series' differences: No changes

VALUES AND FORMAT

1–9.9	Number of rooms
10	10 or more rooms

FLAGS

1	Collected via survey/interview
2	Collected from administrative data
3	Imputed
4	Not possible to establish a source
-1	Missing

DESCRIPTION

Room: A room is defined as a space of a housing unit of at least four square meters such as bedrooms, dining rooms, living rooms and habitable cellars, attics, kitchens and other separated spaces used or intended for dwelling purposes with a height over two meters and accessible from inside the unit.

Kitchens are only excluded if the space is used only for cooking. A single room used as kitchen-cum-dining room is included as one room in the count of rooms.

The following space of a housing unit does not count as a room: bathroom, toilet, corridor, utility room, lobby and veranda.

A room used solely for business use is excluded, but is included if shared between private and business use.

If the dwelling is shared by more than one household and some rooms are shared with other households (within the same dwelling), the number of shared rooms should be divided by the number of households and the equal share should be added to each household. This variable can consequently be coded with one decimal. In the case of several households sharing a unique room, the variable is coded to '1' (zero is difficulty interpretable).

This variable is supposed to collect only the first wave households and to be reported annually.

In such cases that the household has moved from the previous address this information should also be collected even for the households in the new address.

Suggested question:

How many rooms does your household have altogether in your main residence that is excluding kitchen, bathrooms, toilets, corridors and lobby?

(A room is defined as a space of at least four square meter in a housing unit).

Figure 19 Number of rooms per person technical details from EU-SILC (Source: EUROSTAT, 2022)

4.2.6.3 Limits and application suggestion

The "number of rooms per person by ownership status indicator" is meant to be an indirect or alternative indicator to assess energy poverty, a proxy of dwelling size and type. Thomson and Snell (2013) describe this link based on the work of Hong et al. (2006). Number of rooms can also be linked to occupancy. Antepara et al. (2020) found a positive correlation between energy poverty, occupancy rate, and dwelling size. Larger dwellings and a higher number of occupants result in higher energy needs and, subsequently, increased energy needs, which may require higher consumption and expenses. This situation increases vulnerability to energy poverty risk, although high energy poverty levels are also frequently found in urban settings where dwelling size is smaller.

It is important to mention that the link between number of rooms and occupancy rate is not straightforward, as there are numerous instances of single-person households living in multiple-room dwellings, namely in one of the most vulnerable segments of the population, the elderly. It is arguably a better proxy of dwelling size than occupancy, as a higher number of rooms generally translates into a bigger dwelling.

***Example**: An overcrowded dwelling is more closely linked to a potential situation of energy poverty than a home with many rooms. Both are not enough to say if the household is in energy poverty.*

Therefore, it should be used with caution, preferably complemented with other indicators depicting occupancy and the energy efficiency of the dwelling, mainly if the goal is to portray vulnerability relative to the dwellings' high energy needs.

4.2.6.4 Updates and disclaimer

The summary of the updates that occurred at this stage is:

- 2003-2021 period of data available.
- The indicator is now part of the group of the former three EPOV indicators (Number of rooms per person, owners; Number of rooms per person, renters and Number of rooms per person, total).

In 2020, the European Union **average number of rooms per person by owner, tenant and total** ownership status was (EUROSTAT, 2022d), respectively, **1.7**, **1.5** and **1.6**.

4.2.7 At Poverty Risk or Social Exclusion

4.2.7.1 Current situation

The “at poverty risk or social exclusion” indicator represents the people at risk of poverty or social exclusion (% of the population).

Figure 20 and Figure 21 present the last data available for the indicator represented in a map and bar chart.

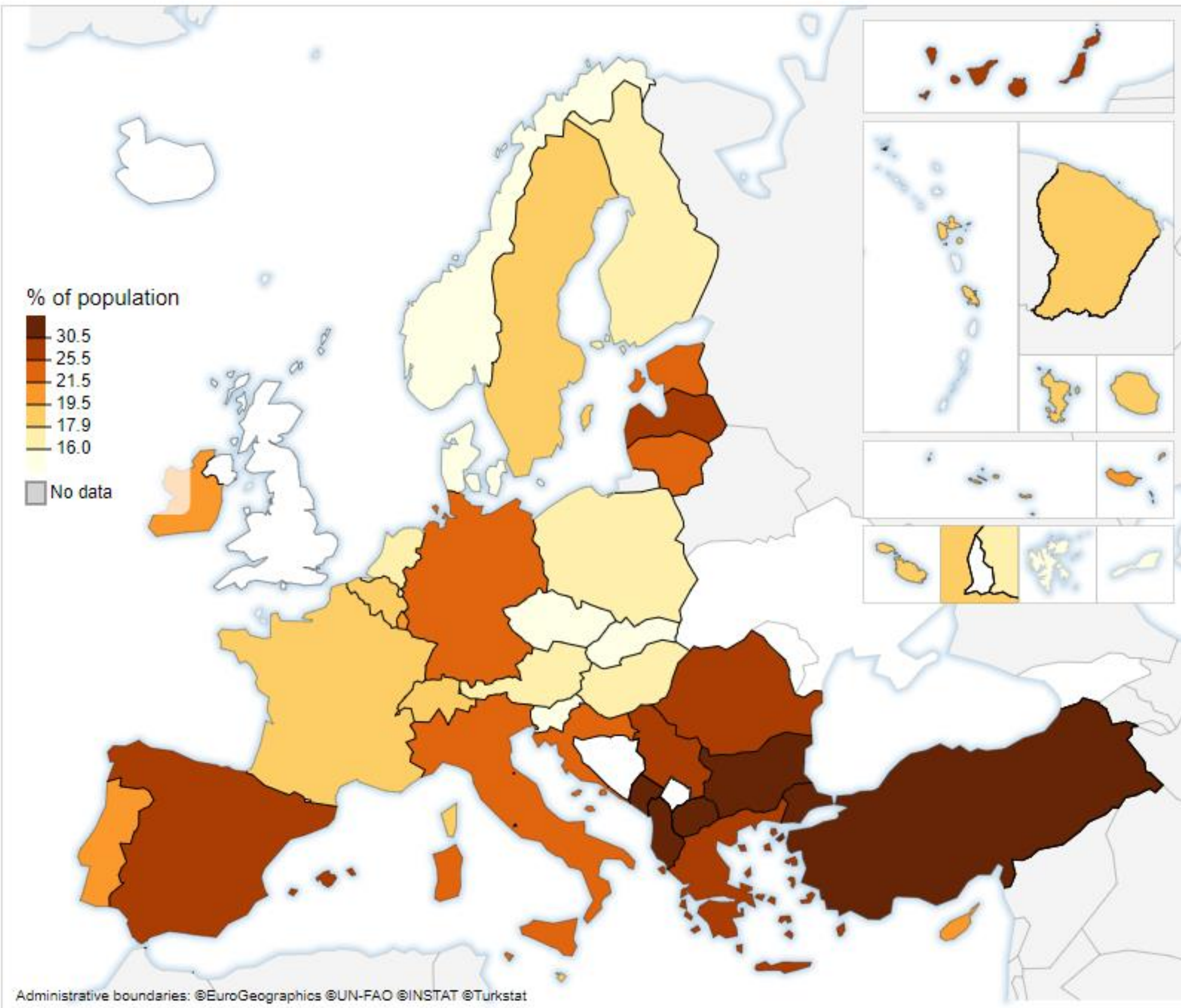

Figure 20 Map of At Poverty Risk or Social Exclusion indicator in 2020 (Source: EPAH, 2022a)

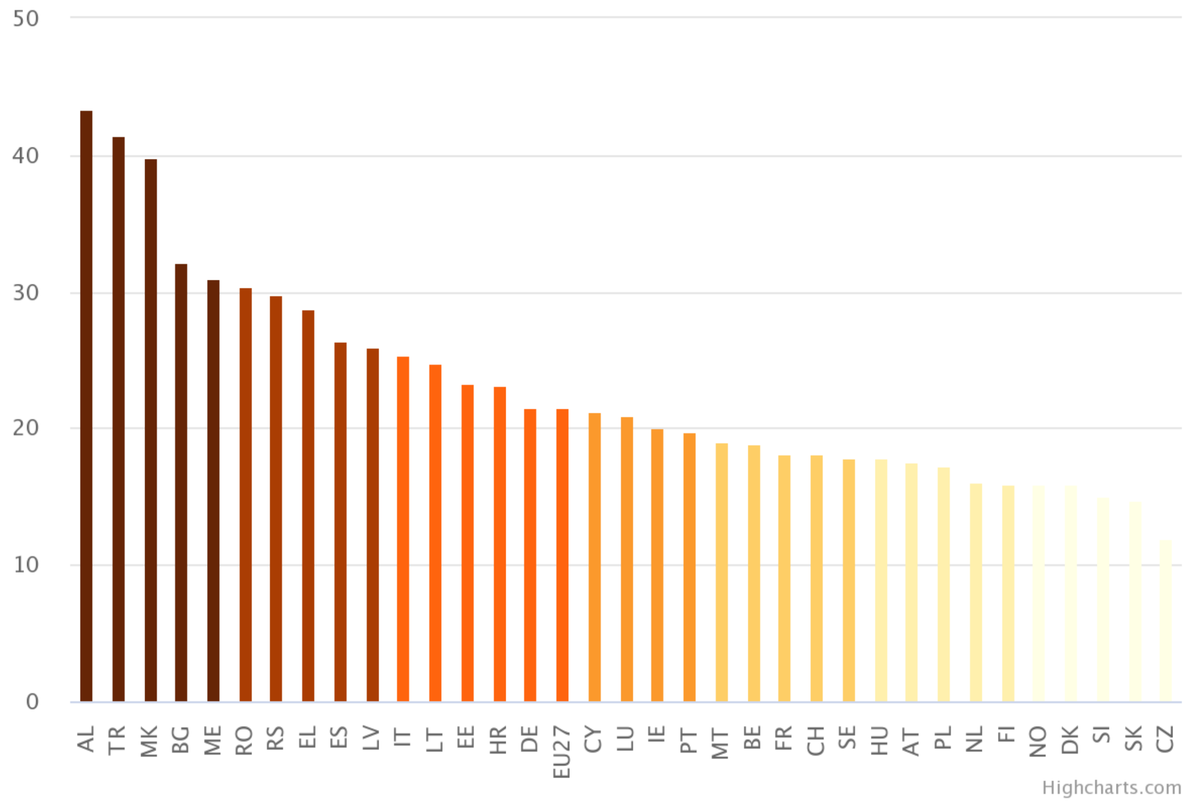

Figure 21 At Poverty Risk or Social Exclusion (% of population) indicator bar chart from 2020 (Source: EPAH, 2022a)

4.2.7.2 Technical Details

Table 13 presents the technical details for the "At Poverty Risk or Social Exclusion" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

The indicator's data were updated with the data points directly extracted from EUROSTAT (2022e).

Table 13 At Poverty Risk or Social Exclusion technical details

Identification Code	Name	Timeline	# GEO	Source
ILC_PEPS01	At poverty Risk or Social Exclusion	2003-2020	25/44	EUROSTAT

The EPOV’s Poverty Risk indicator only considered the percentage of the total for type, sex, and age class. However, EUROSTAT has the following disaggregation options for the indicator:

- Age class: 34 options
- Sex
    - Total
    - Females
    - Males
- Unit of Measure
    - Cumulative difference from 2008, in thousands
    - Thousand persons
    - Percentage

4.2.7.3 Limits and application suggestion

Those “At Poverty Risk or Social Exclusion” are persons with an equivalized disposable income below the risk-of-poverty threshold, which is set at 60% of the national median equivalized disposable income (after social transfers). This indicator corresponds to the sum of persons who are at risk of poverty or severely materially deprived or living in households with very low work intensity. Persons are only counted once, even if they are present in several sub-indicators. This is a relative measure characterized by the positives and negatives of this type of metric, as identified previously for other indicators. Income is undoubtedly a relevant indicator to assess energy poverty, having been used extensively for that purpose. The “At Poverty Risk or Social Exclusion” indicator, depicting monetarily deprived households, has been shown to be positively correlated with energy poverty levels (Maxim et al., 2016; Bouzarovski and Tirado Herrero, 2017). However, it can be argued that this indicator captures poverty in general, pertaining to the inability or difficulty in fulfilling all basic needs such as food, utilities, housing, and health costs. While most households in this situation are in energy poverty, there is evidence of population segments that are in energy poverty but are not in income poverty or deprivation regarding other basic needs (Phimister et al., 2015) this indicator does not capture these households. It also fails to capture the impact of national or local-level social policies focusing on energy services.

Example*: Energy poverty reduction policies can be impactful and effective in a region. Still, the share of the population at risk of poverty rises, as other causes might be causing it*

It would be advantageous to cross-examine the group of households identified through this indicator with energy expenditure and energy efficiency indicators to exclude cases where required energy consumption is, in fact, minimal, and despite the low income, there is no energy poverty. In some cases, households use local fuels, such as firewood, that are not reported in statistics. In this case, a joint analysis with the space heating equipment ownership or a survey on domestic fuel consumption could also provide relevant information for identifying and characterizing a potential situation of vulnerability. Cross-examination with impact assessments of energy-related social policies would be needed for using the indicator in an energy poverty diagnosis.

4.2.7.4 Updates and disclaimer

The summary of the updates that occurred at this stage is:

- 2003-2020 period of data available.
- The indicator's name has been changed from poverty risk to “At Poverty Risk or Social Exclusion” to clarify and match the EUROSTAT name that is its data source.

In 2020, **21.5%** of the European Union population was in **risk of poverty** (EUROSTAT, 2022e), corresponding to 96.2* millions of Europeans.

**considering that the European Union population in 2020 was 447.7 million, according to EUROSTAT (2022i*

4.2.8 Household Electricity Prices

4.2.3.1 Current situation

The household electricity prices indicator represents the electricity prices for household consumers, band DC 2500-5000 kWh/yr. consumption, all taxes, and levies included.

Figure 22 and Figure 23 present the last data available for the indicator represented in a map and bar chart.

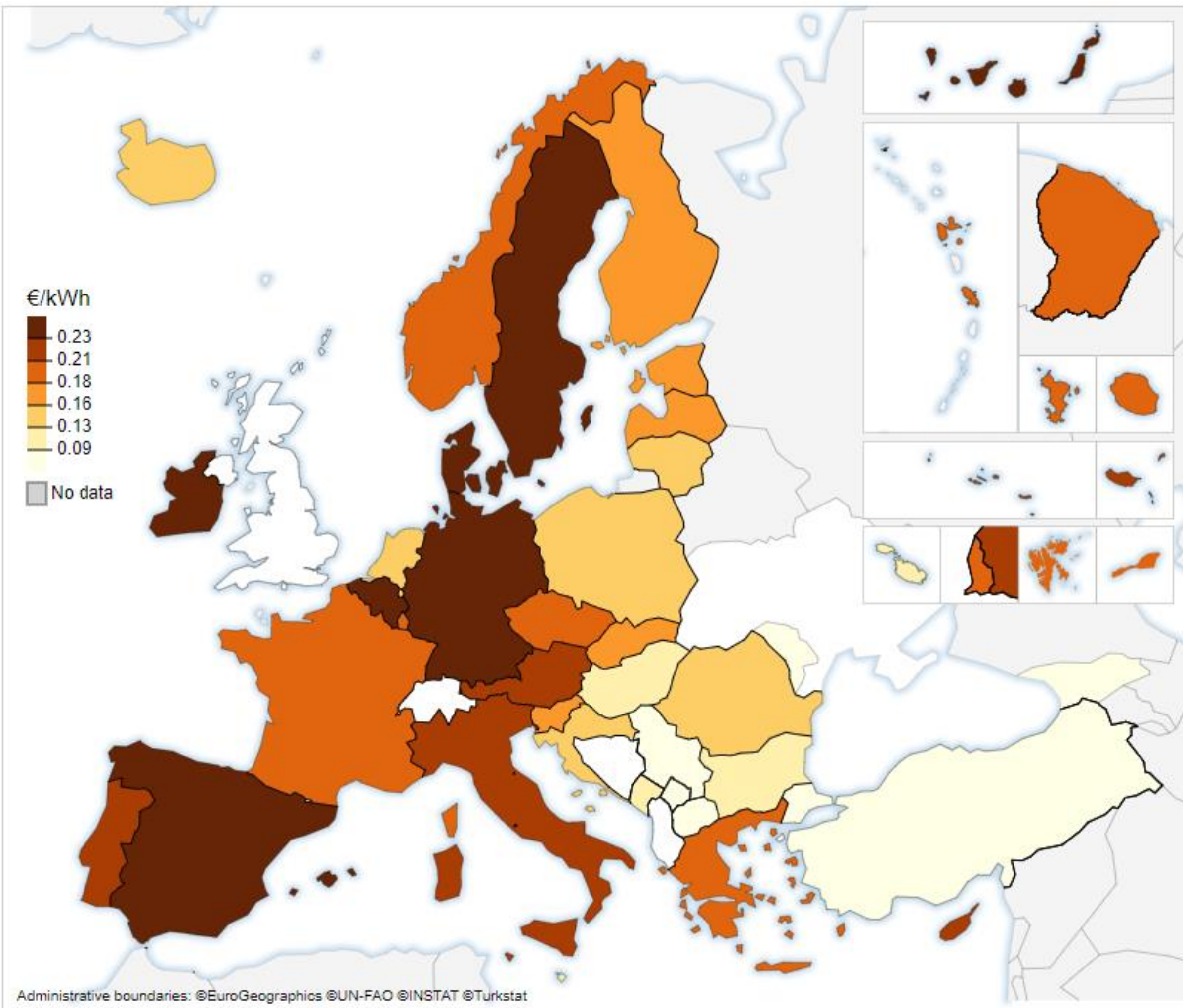

Figure 22 Map of Household electricity prices map in 2021 (Source: EPAH, 2022a)

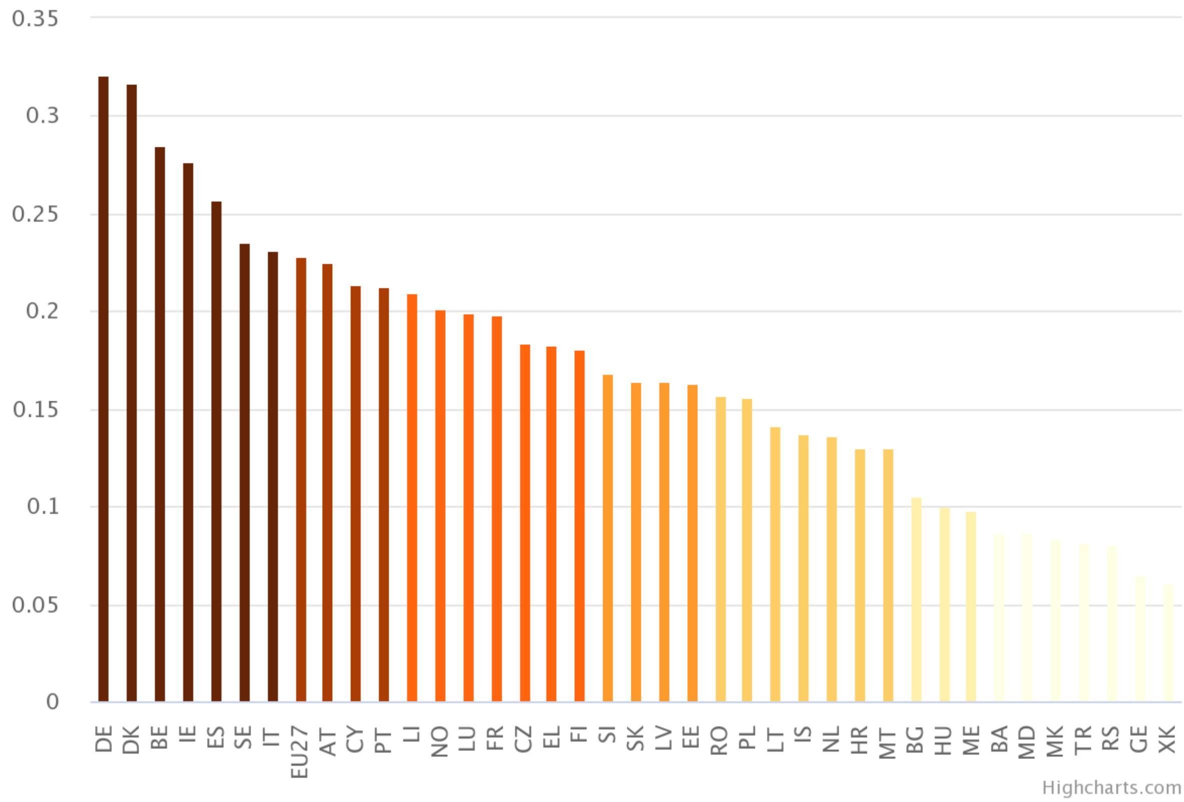

Figure 23 Household electricity prices (€/kWh) bar chart from 2021 (Source: EPAH, 2022a)

4.2.8.2 Technical Details

Table 14 presents the technical details for the household electricity prices indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

The indicator datapoints were updated with the average of bi-annual data extracted from EUROSTAT (2022f). Countries (i.e., GEO), which was missing one of the bi-annual values at the EUROSTAT database for one year, will have that year missing too, on the EPAH's database.

Table 14 Household electricity prices technical details

Identification Code	Name	Timeline	# GEO	Source
NRG_PC_204	Household electricity prices	2007-2021	39/44	EUROSTAT

Current national values for household electricity prices on the energy poverty indicators section of the EPAH website present values only considering the average of the biannual values for the band 2 500kWh < Consumption < 5 000kWh bands with all taxes and levies included for each country in euros. However, EUROSTAT has the following additional disaggregation options for the indicator:

- Biannual values
- Taxes:
  - Excluding taxes and levies
  - Excluding VAT and other recoverable taxes and levies
  - All taxes and levies included
- Currency
  - Euro
  - Purchasing Power Stand
  - National currency
- Bands
  - Consumption < 1 000 kWh
  - 1 000kWh < Consumption < 2 500kWh
  - 2 500kWh < Consumption < 5 000kWh
  - 5 000kWh < Consumption < 15 000kWh
  - Consumption > 15 000 kWh

4.2.8.3 Limits and application suggestion

Energy prices in general, and electricity prices in particular, are important indicators for energy poverty assessment, directly linked to one of the three major causes of this issue, the cost of energy. They are essential to calculate energy expenditure, a variable that has been extensively and historically used in energy poverty measurements. In the current context, with Europe facing soaring energy prices due to higher demand after the COVID-19 pandemic, and also due to the Ukraine war (EC, 2022), this kind of indicator has an increasingly important role in the study of energy poverty. Nevertheless, they cannot be used on their own to directly evaluate this problem at any scale or for the identification of energy-poor households. Energy prices constitute a single indicator that portrays only one dimension of the issue; hence they should be analysed together with other indicators to obtain a comprehensive overview of the problem. If considered in Purchasing Power Units (PPP) currency, this indicator can be compared based on purchasing power, providing an insight into households' higher or lower ability to afford electricity, hence serving as a relevant indirect indicator of energy poverty, supporting an approach that integrates a diverse set of indicators. Analysing in a monetary currency such as the euro enables a more direct comparison but provides no information on the relative affordability. For comparing the energy burden in different countries, prices should be considered with taxes, as taxation can differ significantly in each Member-State (Barrella and Romero, 2022).

Example: *A country might have nominal higher electricity prices than another, but if the cost of living regarding the other basic needs is considerably lower, as well as taxation, this might mean that overall vulnerability and energy poverty risk is also lower.*

Electricity is used to provide both space heating and cooling (and other energy services) at different degrees across regions and Member-States. The price shift can influence energy poverty in the winter and summer seasons. Hence, it should be considered in both contexts. It is essential for analysing summer energy poverty, as electricity is the only energy carrier used to provide space cooling.

Example: *In northern Europe countries, as summers get warmer due to climate change, high electricity prices might have an increasing impact on summer energy poverty.*

The share of electricity in total household energy use differs widely across member states, from 12% in Poland to 72% in Malta in 2020 (Eurostat, 2022), reflecting different energy consumption patterns, equipment ownership rates, building construction standards, and climate. Thus, this indicator should always be analysed together with data on the share of electricity for the different energy services, as well as the percentage of final energy consumption used to provide these energy services. Moreover, the indicator should be complemented with a more comprehensive analysis of energy prices, including energy carriers like natural gas and biomass. The importance of energy prices indicators is bound to vary across countries in future years due to efforts to push for the renewables-based electrification of energy consumption (EC, 2021) and to the impacts of climate change on energy demand for space heating and cooling (Castaño-Rosa et al., 2022).

***Example**: A household whose energy services are provided fully by electricity will be more vulnerable to a sudden increase in electricity prices than a household who has a varied mix of energy carriers to provide the basic energy services at home, if their socioeconomic characteristics are identical, hence needing more short-term support to face the situation.*

There is also an argument for analysing electricity prices with a broader range of indicators, including the "Inability to keep the home adequately warm" indicator, as Brucal and McCoy (2020) find that there is a link between higher electricity prices and a reduced capacity to maintain adequate warmth, this applies across both owner occupier and renter groups. Interestingly, these authors also find a connection between higher electricity prices and arrears on utility bills for low and medium-income homes but observe the opposite for higher-income homes. Thus, demonstrating the value of analysing this indicator in conjunction not only with energy price indicators but also with a broader range of expenditure measures, as well as consensual indicators, namely portraying thermal comfort perception in both seasons.

For a contextualized understanding of the electricity price or other fuel prices direct impact on energy poverty, it would be relevant also to link this indicator with data of the households' fuel/technology mixes at country, regional and local level, to better understand the variety and level of use of each end use and energy carrier.

4.2.8.4 Updates and disclaimer

The values were obtained by calculating the average of the bi-annual data on EUROSTAT, and if one semester is missing, the annual average will also be missing.

In 2021, the average **household electricity price** for the European Union was 0.229 €/kWh (EUROSTAT, 2022f). The price has continuously grown in the last 14 years.

4.2.9 Household Natural Gas Prices

4.2.9.1 Current situation

The household natural gas prices indicator represents the natural gas prices for household consumers, band 20-200GJ consumption, all taxes and levies included.

Figure 24 and Figure 25 presents the last data available for the indicator in a bar chart.

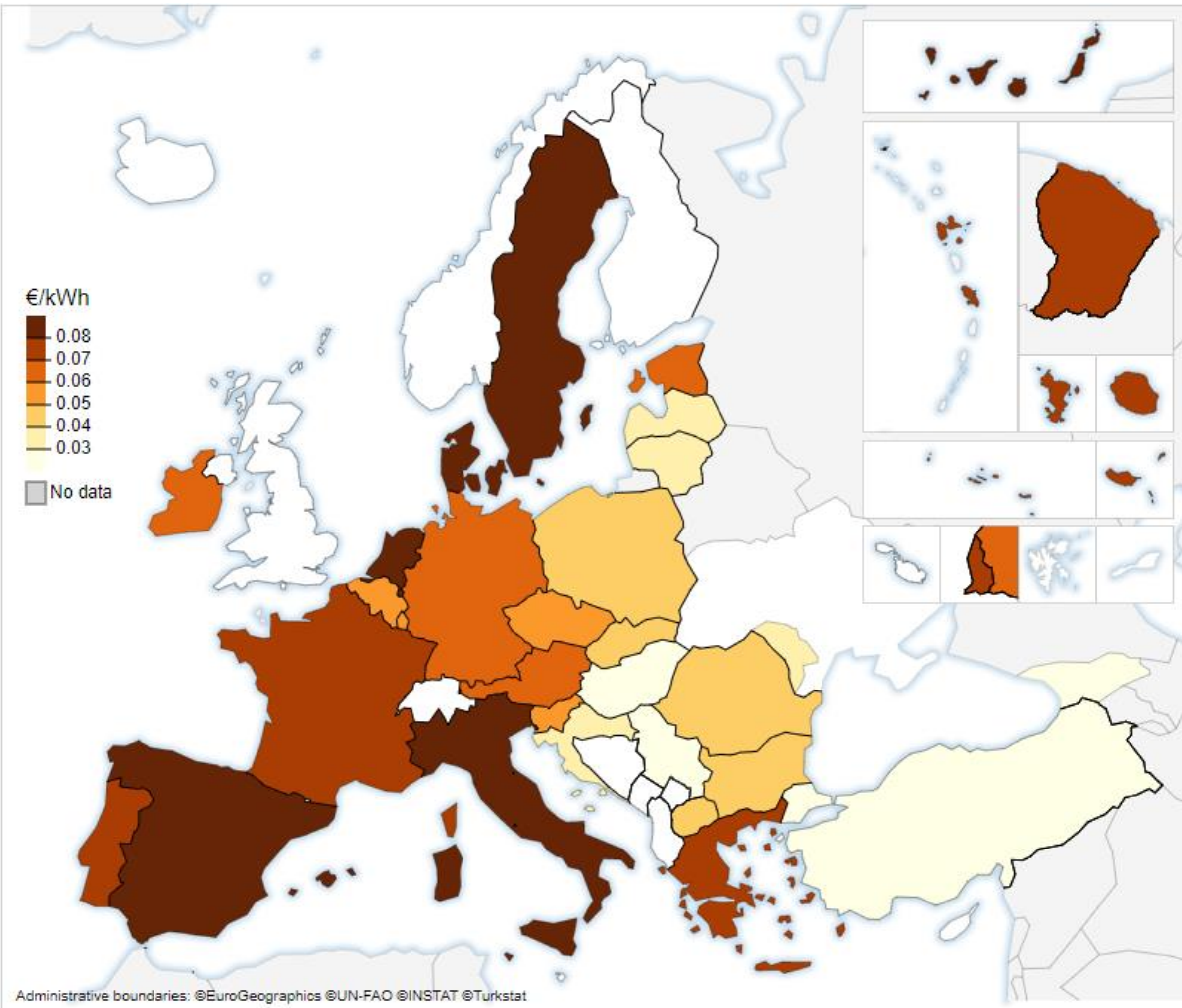

Figure 24 Map of Household natural gas prices map in 2021 (Source: EPAH, 2022a)

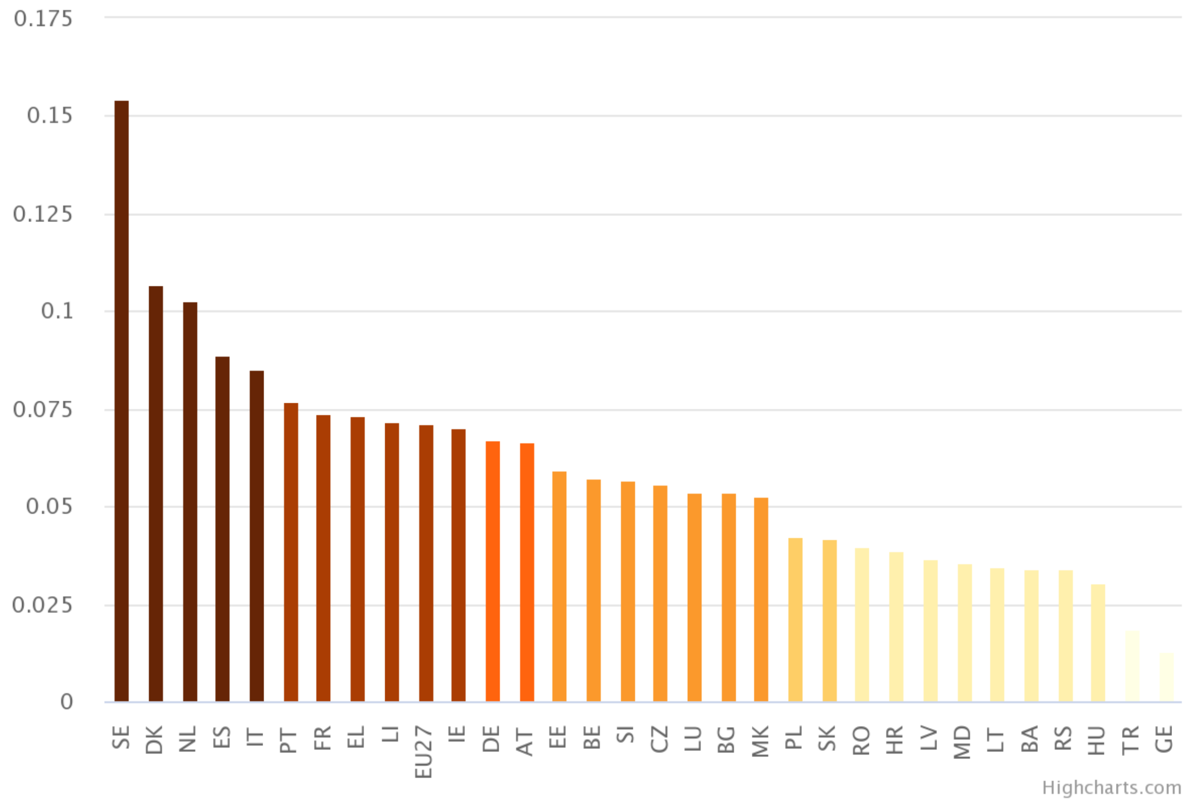

Figure 25 Household natural gas prices (€/kWh) bar chart from 2021 (Source: EPAH, 2022a)

4.2.9.2 Technical Details

Table 15 presents the technical details for the “Household natural gas prices” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

The indicator’s data were updated with the average of bi-annual data points extracted from EUROSTAT (2022g). Countries (i.e., GEO), which was missing one of the bi-annual values at the EUROSTAT database for one year, will also have that year missing on the EPAH’s database.

Table 15 Household natural gas prices technical details

Identification Code	Name	Timeline	# GEO	Source
NRG_PC_202	Household natural gas prices	2007-2021	32/44	EUROSTAT

The household gas prices indicator is the average of the EUROSTAT biannual data. If the value for one semester is missing, that country's annual average will also be missing.

Current national values for household gas prices on the energy poverty indicator's section of the EPAH website only consider the average of the biannual values for the band 20 GJ < Consumption < 200 GJ band with all taxes and levies included for each country in euros and kilowatt-hour. However, EUROSTAT provides the following disaggregation parameters:

- Biannual values
- Taxes:
    - Excluding taxes and levies
    - Excluding VAT and other recoverable taxes and levies
    - All taxes and levies included
- Currency
    - Euro
    - Purchasing Power Stand
    - National currency
- Bands
    - Consumption < 20 GJ
    - 20 GJ < Consumption < 200 GJ
    - Consumption > 200 GJ

4.2.9.3 Limits and application suggestion

Energy prices, in general, are gas prices, in particular, are important indicators for energy poverty assessment, directly linked to one of the three major causes of this issue, the cost of energy. They are essential to calculate energy expenditure, which is a variable that has been extensively and historically used in energy poverty measurements. In the current context, with Europe facing soaring energy prices due to higher demand after the COVID-19 pandemic and also due to the Ukraine war (EC, 2022), this kind of indicator has an increasingly important role in the study of energy poverty.

Nevertheless, it cannot be used on its own to directly evaluate this problem at any scale or for the identification of energy-poor households. It constitutes a single indicator that portrays only one dimension of the issue; hence, it should be analysed together with other indicators to obtain a comprehensive overview of the problem. If considered in Purchasing Power Units (PPP) currency, this indicator can be compared based on purchasing power, providing an insight into households' higher or lower ability to afford electricity, hence serving as a relevant indirect indicator of energy poverty, supporting an approach that integrates a diverse set of indicators. Analysing in a monetary currency such as the euro enables a more direct comparison but provides no information on the relative affordability. For comparing the energy burden in different countries, prices should be considered with taxes, as taxation can differ significantly in each Member-State (Barrella and Romero, 2022).

Example*: Natural gas prices can be higher in specific countries, but the social programs and bill support should be considered when analysing energy poverty, as they can significantly mitigate the energy burden for families*

For a contextualized understanding of the natural gas prices or other fuel prices' direct impact on energy poverty, it would be relevant also to link this indicator with data of the households' fuel/technology mixes at country, regional and local levels, to better understand the variety and level of use of each end use and energy carrier.

Naturally, as households in different geographies use different energy carriers, the indicator has increased importance in Member-States or regions where heat or hot water is obtained in a significant part through the combustion of gas. It is only relevant to study winter energy poverty, as gas is not used for providing space cooling.

4.2.9.4 Updates and disclaimer

The "Households natural gas prices" are the new name for the former EPOV households gas prices indicator. The values were obtained by the average of the bi-annual data on EUROSTAT, and if one semester is missing, the annual average will be missing too.

In 2021, the **household natural gas price** for the European Union was 0.071 €/kWh (EUROSTAT, 2022g). Georgia is the country with the lowest price in 2021, 0.013 €/kWh, and Sweden the highest, 0.155 €/kWh, of the 32 countries where data is available.

4.2.10 Biomass prices

4.2.10.1 Current situation

The “biomass prices” indicator represents the average household prices per kWh generated from biomass, used in fireplaces, boilers, stoves, etc., at the household level.

Figure 26 and Figure 27 present the last data available for the indicator represented in a map and bar chart.

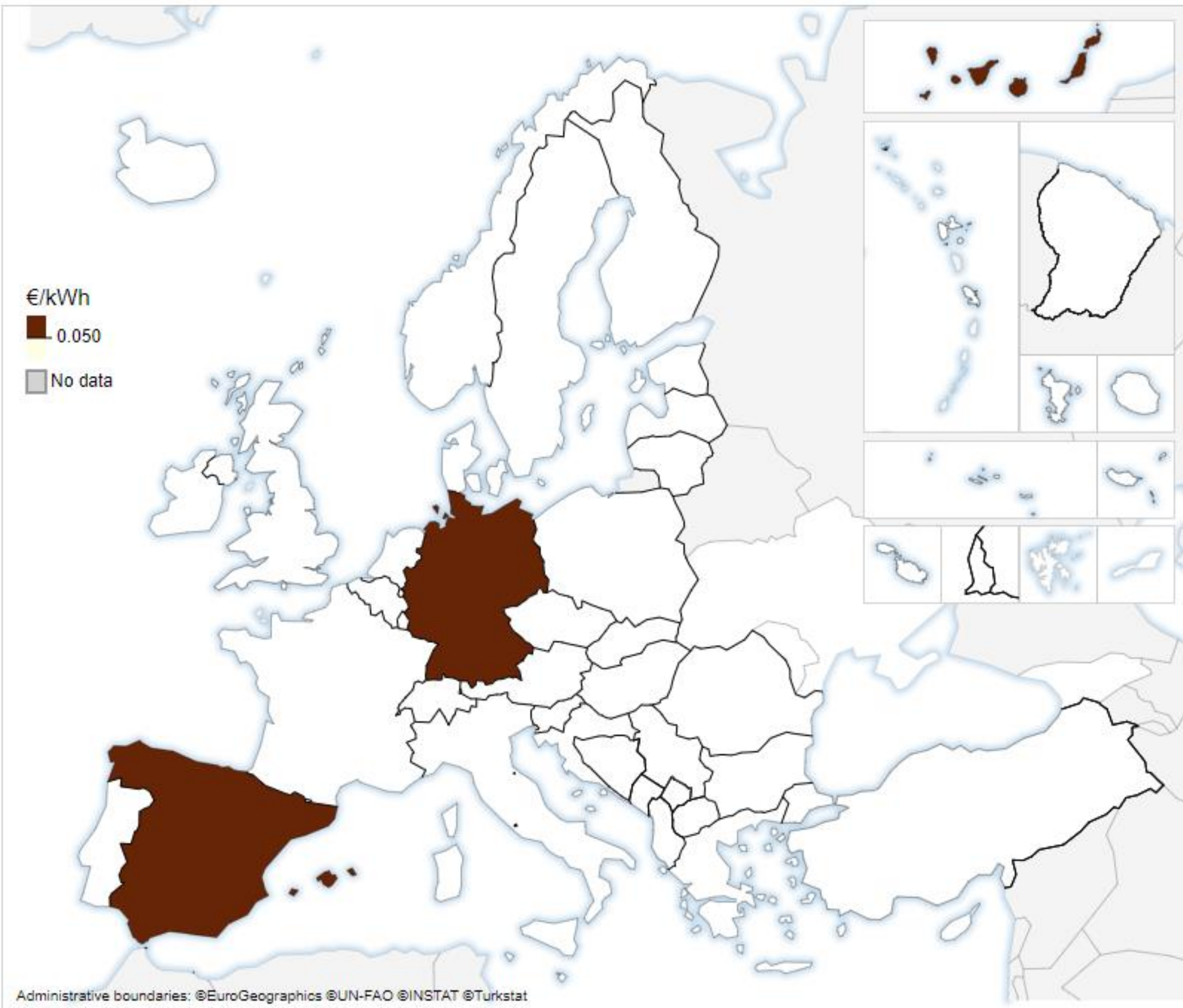

Figure 26 Map of Biomass prices indicator in 2015 (Source: EPAH, 2022a)

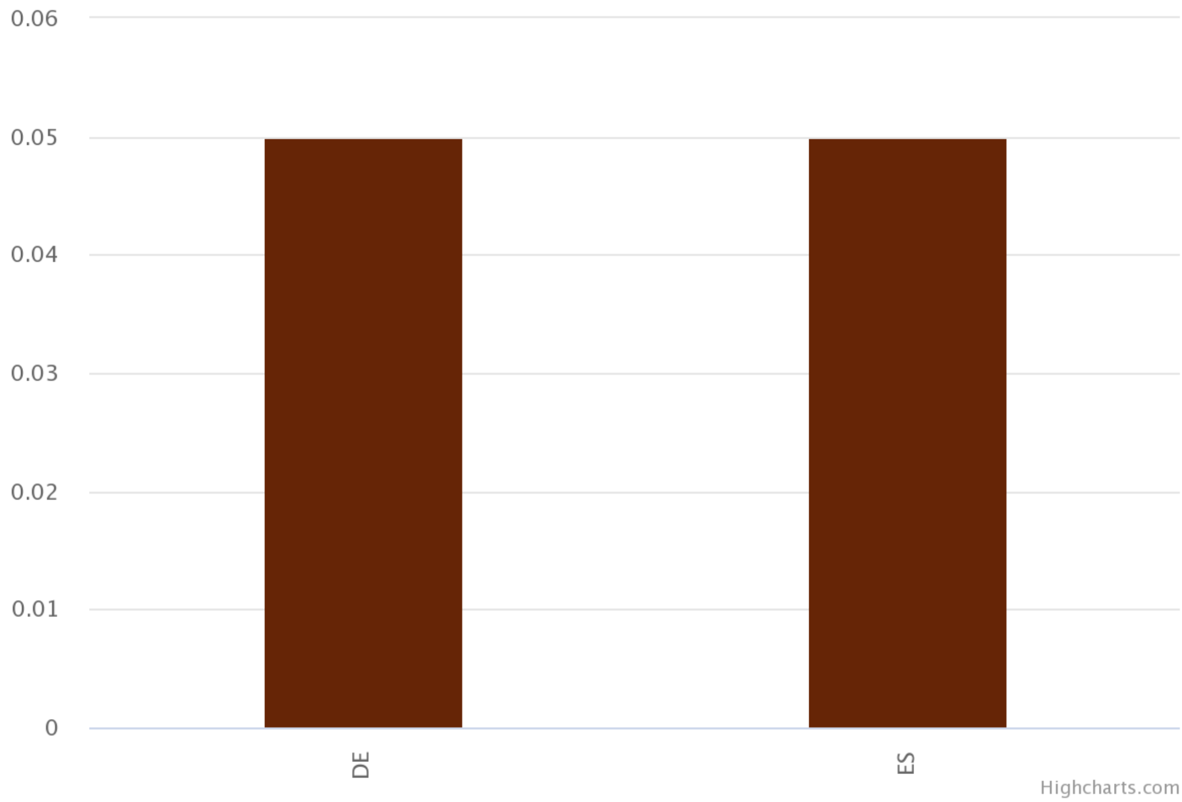

Figure 27 Biomass prices indicator (€/kWh) bar chart from 2015 (Source: EPAH, 2022a)

4.2.10.2 Technical Details

Table 16presents the technical details for the “biomass prices” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

Table 16 Biomass prices technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Biomass prices	2005-2015	2/44	BSO

4.2.10.3 Limits and application suggestion

Energy prices, in general, are important indicators for energy poverty assessment, directly linked to one of the three major causes of this issue, the cost of energy. They are essential to calculate energy expenditure, which is a variable that has been extensively and historically used in energy poverty measurements. Nevertheless, it cannot be used on its own to directly evaluate this problem at any scale or for the identification of energy-poor households. It constitutes a single indicator that portrays only one dimension of the issue; hence it should be analysed together with other indicators to obtain a comprehensive overview of the problem. If considered in Purchasing Power Units (PPP) currency, this indicator can be compared based on purchasing power, providing an insight into households' higher or lower ability to afford electricity, hence serving as a relevant indirect indicator of energy poverty, supporting an approach that integrates a diverse set of indicators. Analysing in a monetary currency such as the euro enables a more direct comparison but provides no information on relative affordability. For comparing the energy burden in different countries, prices should be considered with taxes, as taxation can differ significantly in each Member-State (Barrella and Romero, 2022). Regarding biomass, the quality of the product and the share of freely or illegally sourced products can significantly impact energy poverty levels, especially in rural regions, and therefore should be considered in diagnosis assessment. However, finding data on these two factors is often very challenging.

Example: *A family living in the countryside in a small property with very little registered energy consumption might have large quantities of wood for free at disposal for heating water and space, keeping them away from energy poverty.*

For a contextualized understanding of the biomass prices' or other fuel prices' direct impact on energy poverty, it would be relevant also to link this indicator with data of the households' fuel/technology mixes at country, regional and local level, to better understand the variety and level of use of each end use and energy carrier.

4.2.10.4 Updates and disclaimer

The Biomass prices only present values until 2015 and for very few countries. This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU-level dataset.

4.2.11 Fuel Oil prices

4.2.11.1 Current situation

The "fuel oil prices" indicator represents the average household prices per kWh generated from fuel oil used at the household level in boilers or other space heating, cooking, and water heating equipment.

Figure 28 and Figure 29 present the last data available for the indicator represented in maps and bar chart.

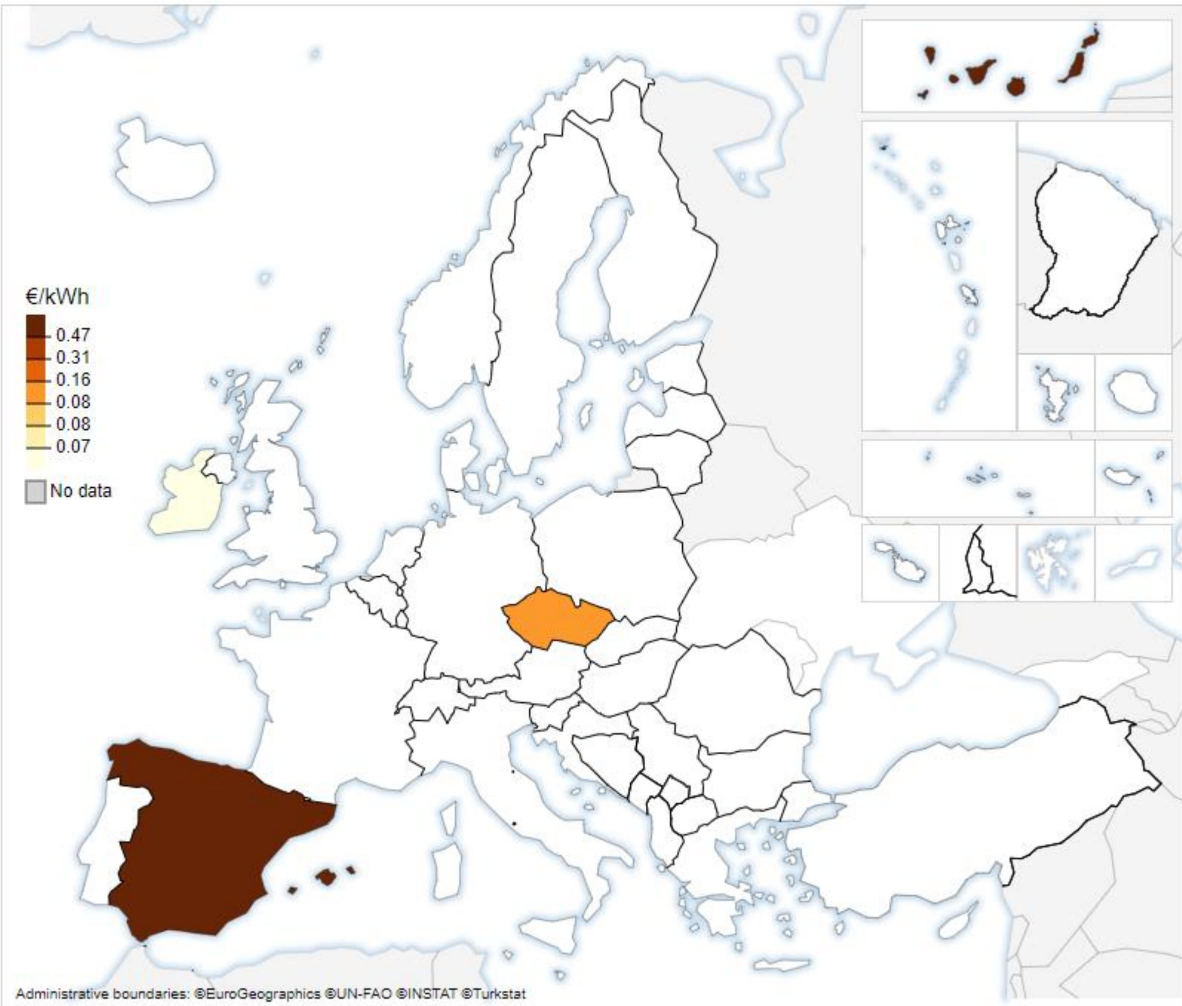

Figure 28 Map of Fuel Oil prices indicator in 2015 (Source: EPAH, 2022a)

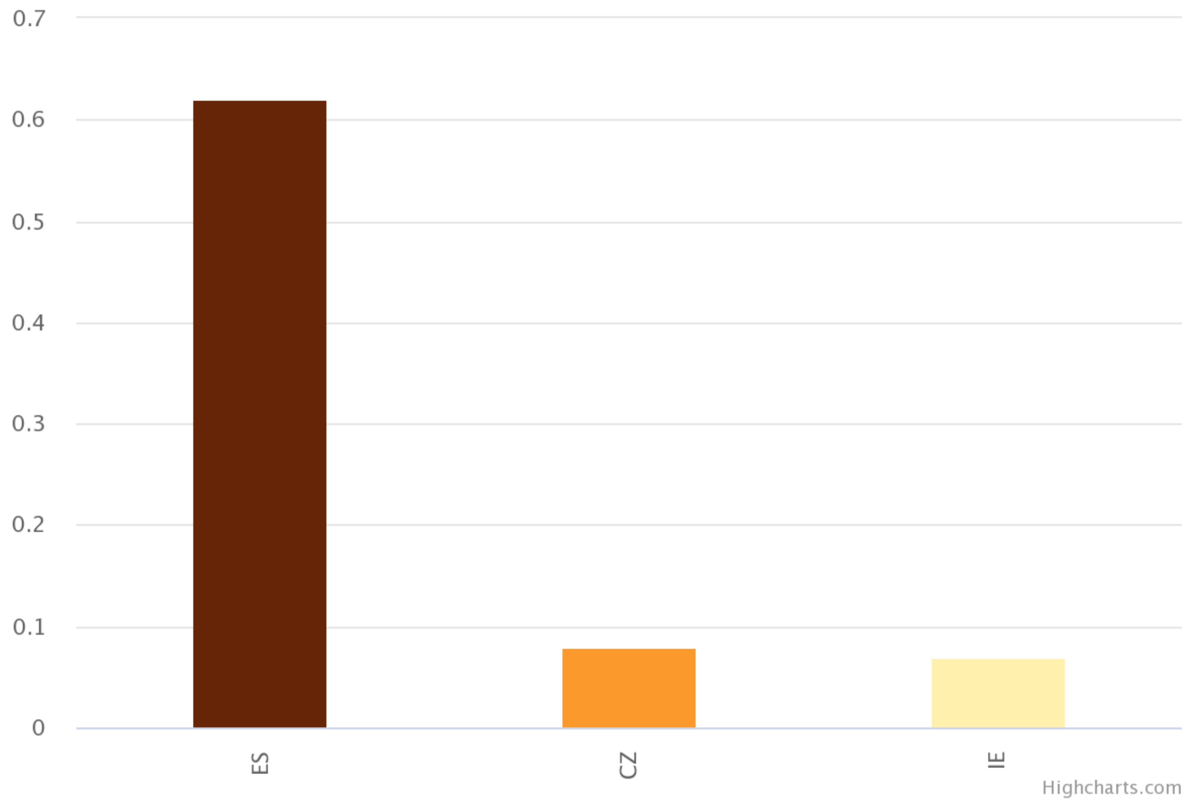

Figure 29 Fuel Oil prices indicator (€/kWh) bar chart from 2015 (Source: EPAH, 2022a)

4.2.11.2 Technical Details

Table 17 presents the technical details for the fuel oil prices indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, and the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

Table 17 Fuel oil prices technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Fuel Oil prices	2005-2015	2/44	BSO

4.2.11.3 Limits and application suggestion

Energy prices, in general, are important indicators for energy poverty assessment, directly linked to one of the three major causes of this issue, the cost of energy. They are essential to calculate energy expenditure, which is a variable that has been extensively and historically used in energy poverty measurements. Nevertheless, it cannot be used on its own to directly evaluate this problem at any scale or for the identification of energy-poor households. It constitutes a single indicator that portrays only one dimension of the issue; hence it should be analysed together with other indicators to obtain a comprehensive overview of the problem. If considered in Purchasing Power Units (PPP) currency, this indicator can be compared based on purchasing power, providing an insight into households' higher or lower ability to afford electricity, hence serving as a relevant indirect indicator of energy poverty, supporting an approach that integrates a diverse set of indicators. Analysing in a monetary currency such as the euro enables a more direct comparison but provides no information on the relative affordability. For comparing the energy burden in different countries, prices should be considered with taxes, as taxation can differ significantly in each Member-State (Barrella and Romero, 2022).

For a contextualized understanding of the fuel oil prices or other fuel prices' direct impact on energy poverty, it would be relevant also to link this indicator with data of the households' fuel/technology mixes at country, regional and local level, to better understand the variety and level of use of each end use and energy carrier.

4.2.11.4 Updates and disclaimer

The oil prices present values only until 2015 and for very few countries. This indicator was not updated at this stage due to a lack of access to the indicator's original source, and since we were not able to find it elsewhere at the moment from an EU level dataset.

4.2.12 Coal prices

4.2.12.1 Current situation

The “coal prices” indicator represents average household prices per kWh generated from coal used at the household level in boilers, stoves, etc.

Figure 30 and Figure 31 present the last data available for the indicator represented in maps and bar chart.

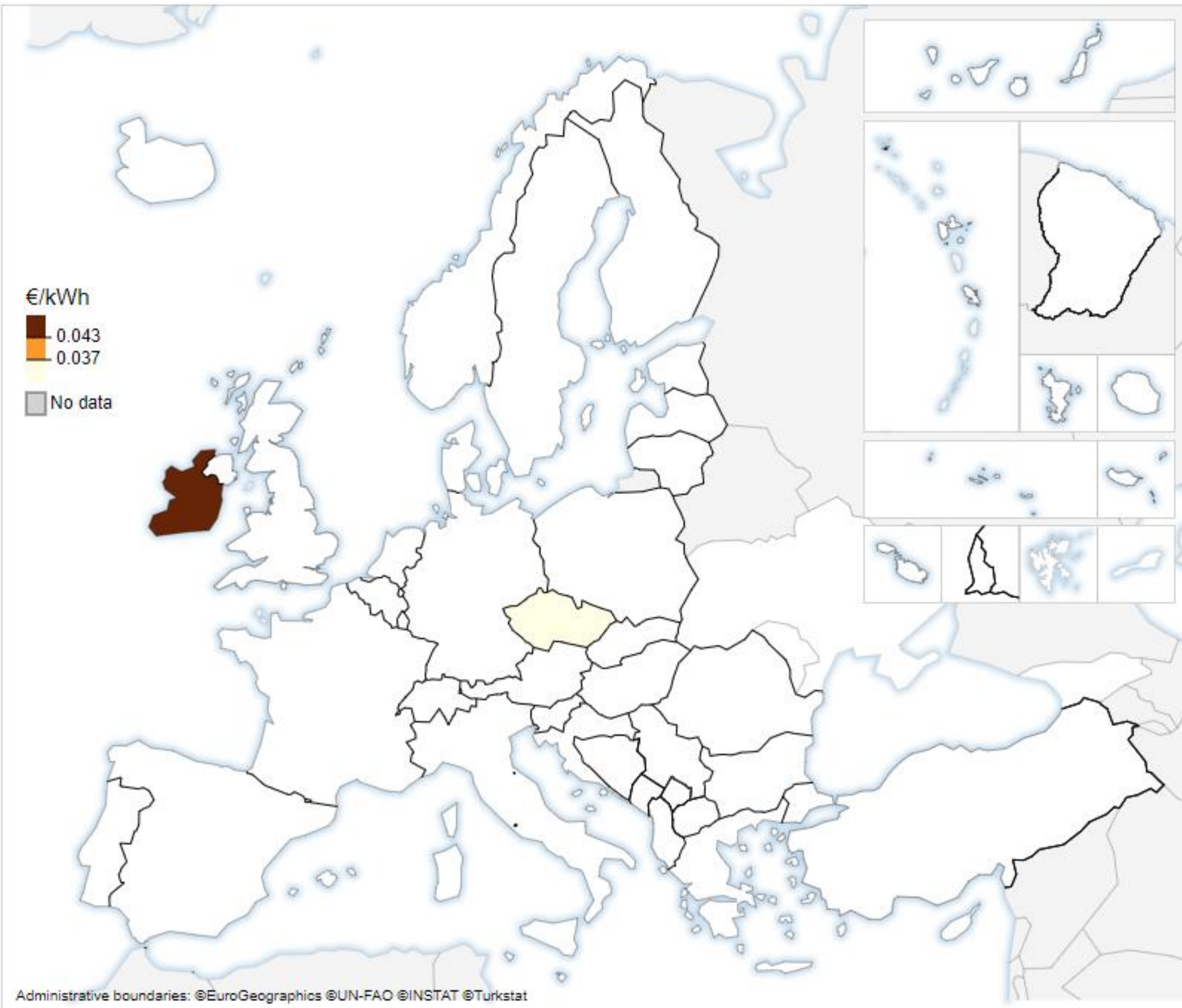

Figure 30 Map of Coal prices indicator in 2015 (Source: EPAH, 2022a)

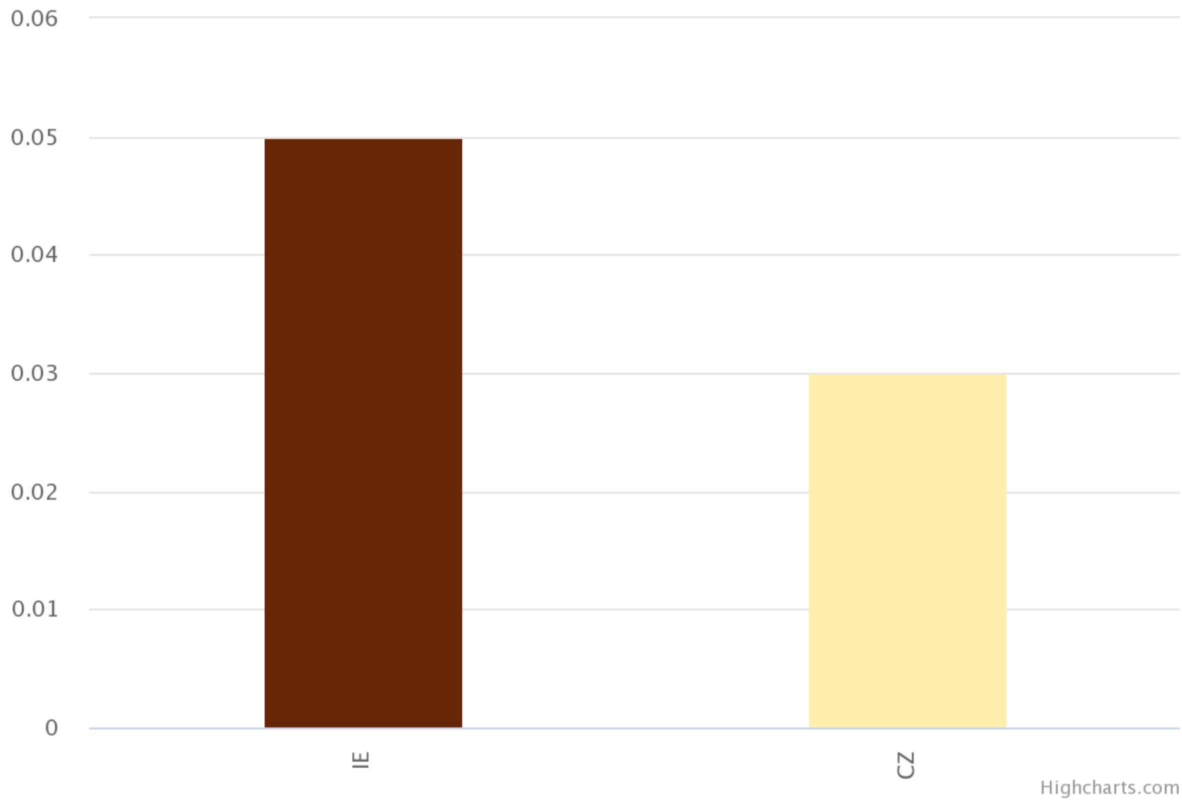

Figure 31 Coal prices indicator (€/kWh) bar chart from 2015 (Source: EPAH, 2022a)

4.2.12.2 Technical Details

Table 18 presents the technical details for the coal prices indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, and the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

Table 18 Coal prices technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Coal prices	2004-2008 and 2014-2015	2/44	BSO

4.2.12.3 Limits and application suggestion

Energy prices, in general, are important indicators for energy poverty assessment, directly linked to one of the three major causes of this issue, the cost of energy. They are essential to calculate energy expenditure, which is a variable that has been extensively and historically used in energy poverty measurements. Nevertheless, it cannot be used on its own to directly evaluate this problem at any scale or for the identification of energy-poor households. It constitutes a single indicator that portrays only one dimension of the issue; hence it should be analysed together with other indicators to obtain a comprehensive overview of the problem. If considered in Purchasing Power Units (PPP) currency, this indicator can be compared based on purchasing power, providing an insight into households' higher or lower ability to afford electricity, hence serving as a relevant indirect indicator of energy poverty, supporting an approach that integrates a diverse set of indicators. Analysing prices in a monetary currency such as the euro enables a more direct comparison but does not provide any information on the relative affordability. For comparing the energy burden in different countries, prices should be considered with taxes, as taxation can differ significantly in each Member-State (Barrella and Romero, 2022).

For a contextualized understanding of the coal prices' or other fuel prices' direct impact on energy poverty, it would be relevant also to link this indicator with data of the households' fuel/technology mixes at country, regional and local level, to better understand the variety and level of use of each end use and energy carrier.

4.2.12.4 Updates and disclaimer

The "Coal prices" only present values only until 2015 and for very few countries. This indicator was not updated at this stage due to a lack of access to the indicator's original source, and since we were not able to find it elsewhere at the moment from an EU level dataset.

4.2.13 District Heating prices

4.2.13.1 Current situation

The "coal prices" indicator represents average household prices per kWh generated from coal used at the household level in boilers, stoves, etc.

Figure 32 and Figure 33 present the last data available for the indicator represented in maps and bar chart.

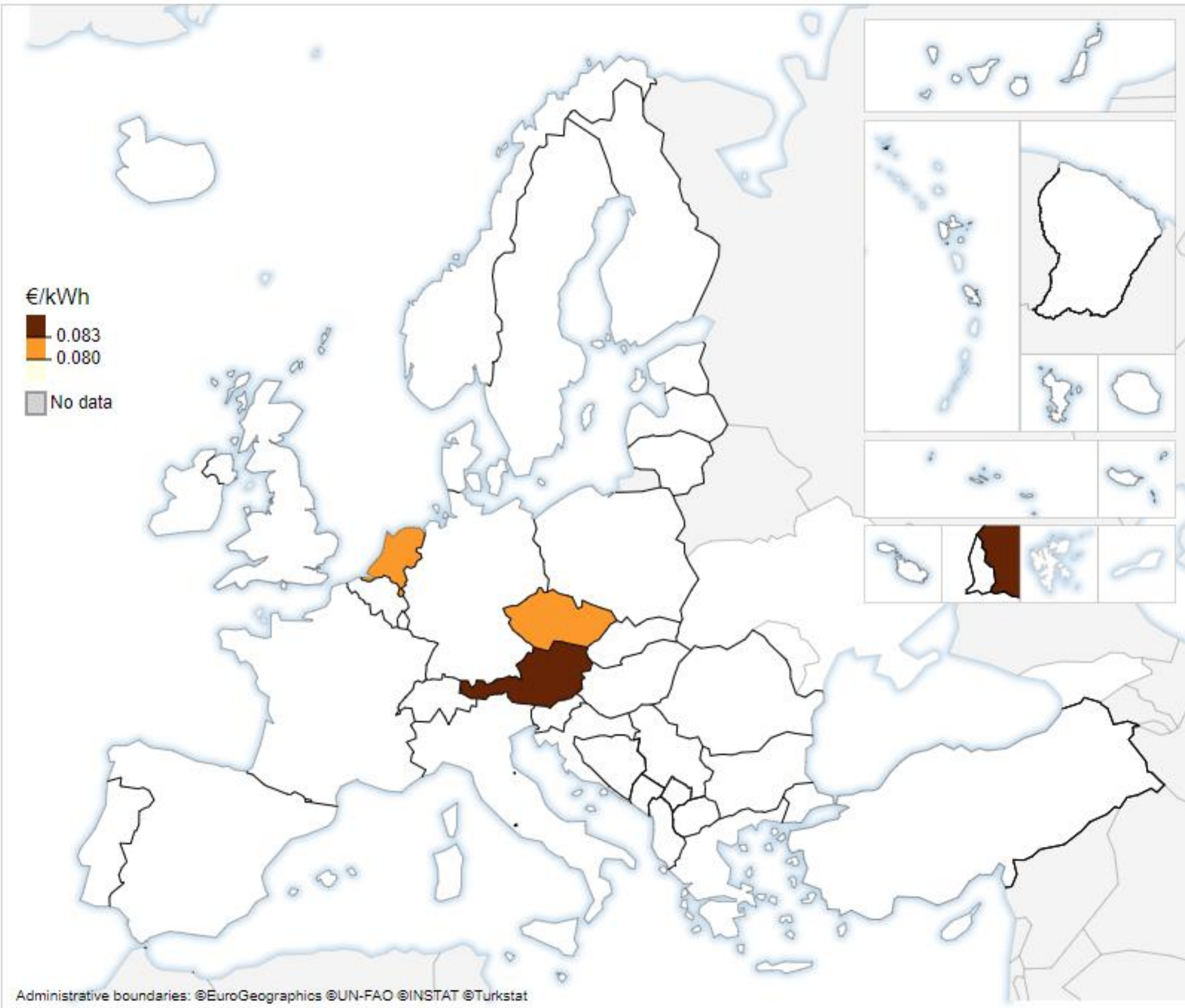

Figure 32 Map of District heating prices indicator in 2015 (Source: EPAH, 2022a)

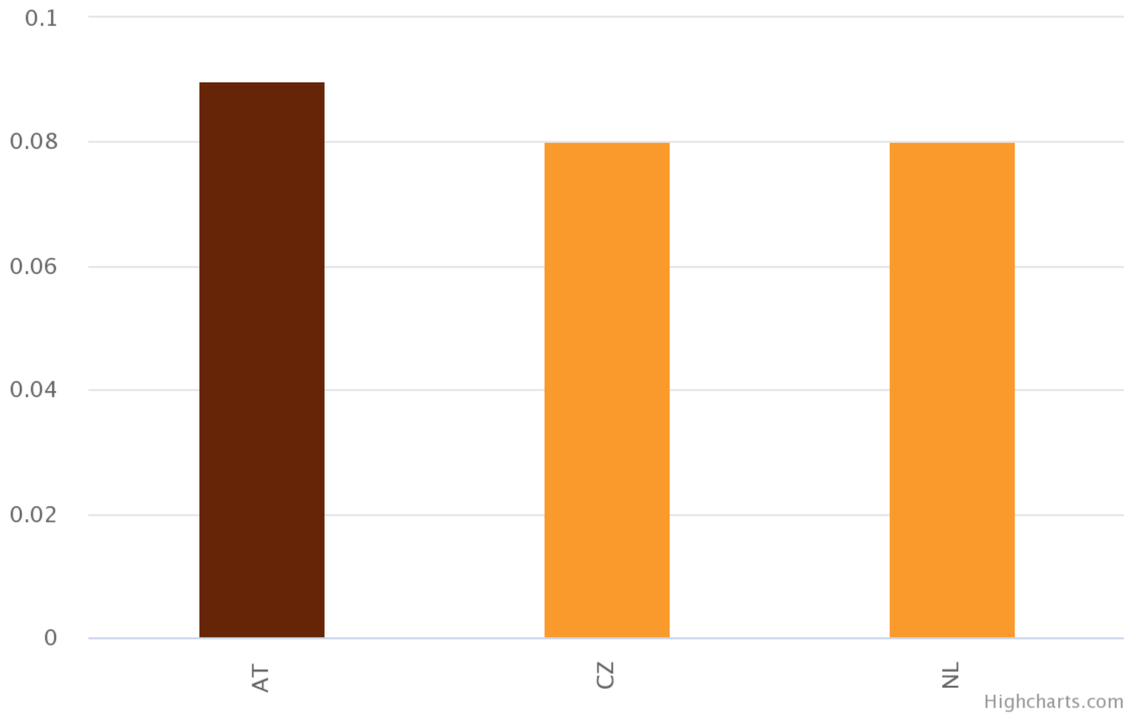

Figure 33 District heating prices indicator (€/kWh) bar chart from 2015 (Source: EPAH, 2022a)

4.2.13.2 Technical Details

Table 19 presents the technical details for the "district heating prices" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data source used.

Table 19 District heating prices technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	District heating prices	2004-2015	3/44	BSO

4.2.13.3 Limits and application suggestion

The considerations for this indicator are analogous to the ones for electricity and natural gas. Energy prices per carrier assume a different level of importance in energy poverty assessments, depending on how relevant and widespread the use of the energy carrier in the Member-State is for providing domestic energy services. For example, district heating is a significant heating source for homes in Denmark over 60%, whereas, in Portugal, it is virtually non-existent (Ramboll, 2020). Natural gas is the most common final energy source in domestic consumption in the Netherlands (67.9%), whereas in Malta, most consumption is in the form of electricity (72.0%) in 2020 (Eurostat, 2022h). The difficulty of changing from district heating to other heating modes should also be considered.

Example*: In Eastern European countries, switching from a district heating system to another form of heating is costly, and there are significant administrative and technical barriers, so energy-poor households with inefficient or expensive systems face more challenges in changing their condition.*

As previously mentioned for electricity and natural gas prices indicators, energy prices in isolation do not provide enough information to characterize energy poverty in a Member-State or region and assess the population's vulnerability. For that purpose, the affordability of energy expenditures, socioeconomic characteristics of the population, climate, energy carrier mix, and buildings' energy performance must be considered in the evaluation.

4.2.13.4 Updates and disclaimer

The district heating prices only present values until 2015 and for very few countries. This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU level dataset.

4.2.14 Energy Expenses by income quintile

4.2.14.1 Current situation

The "energy expenses by income quintile" indicator represent the consumption expenditure for electricity, gas, and other fuels as a share of income for income quintiles.

Figure 34 and Figure 35 present the last data available for the "energy expenses and income quintile 1" indicator represented, respectively, in a map and bar chart.

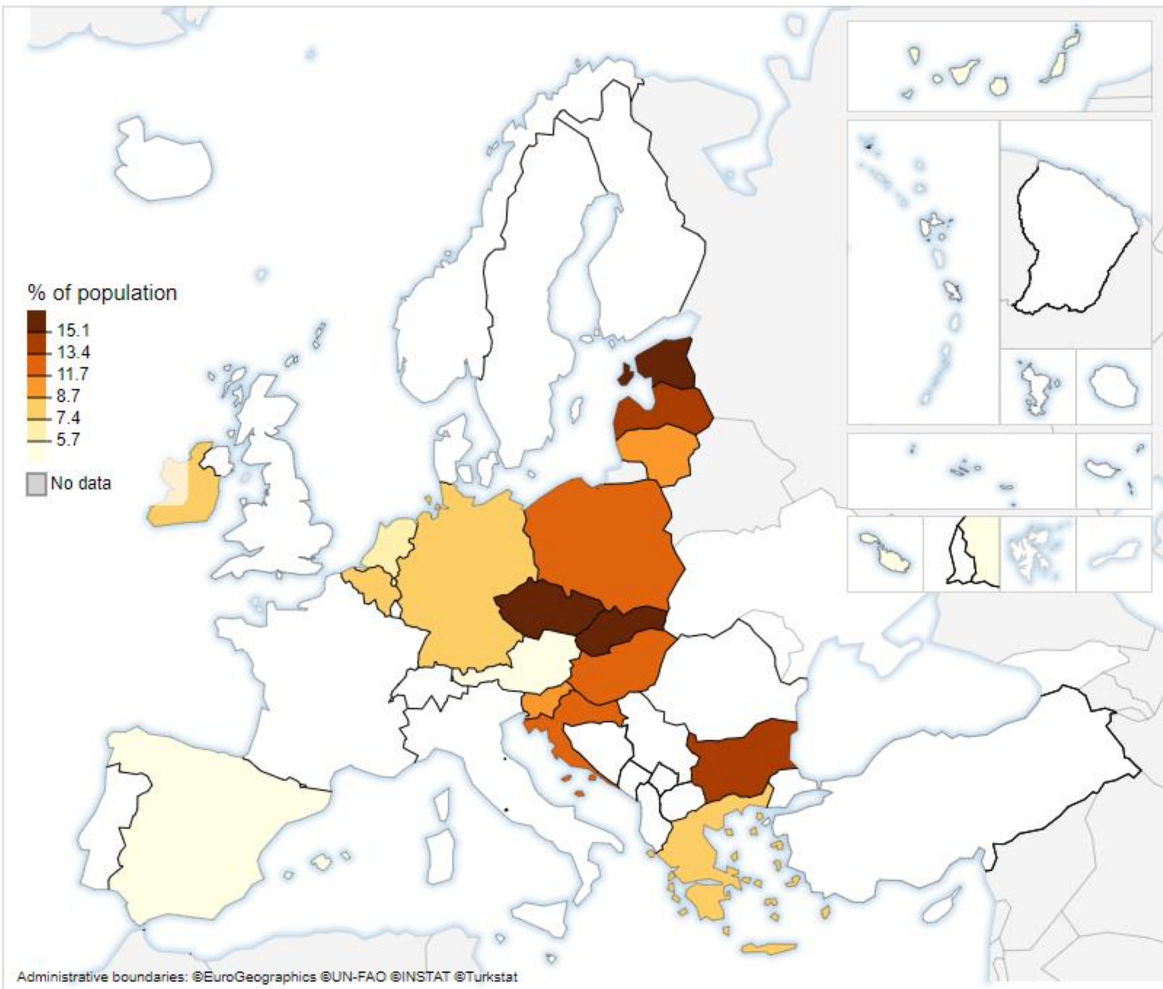

Figure 34 Map of Energy expenses, income quintile 1 indicator in 2015 (Source: EPAH, 2022a)

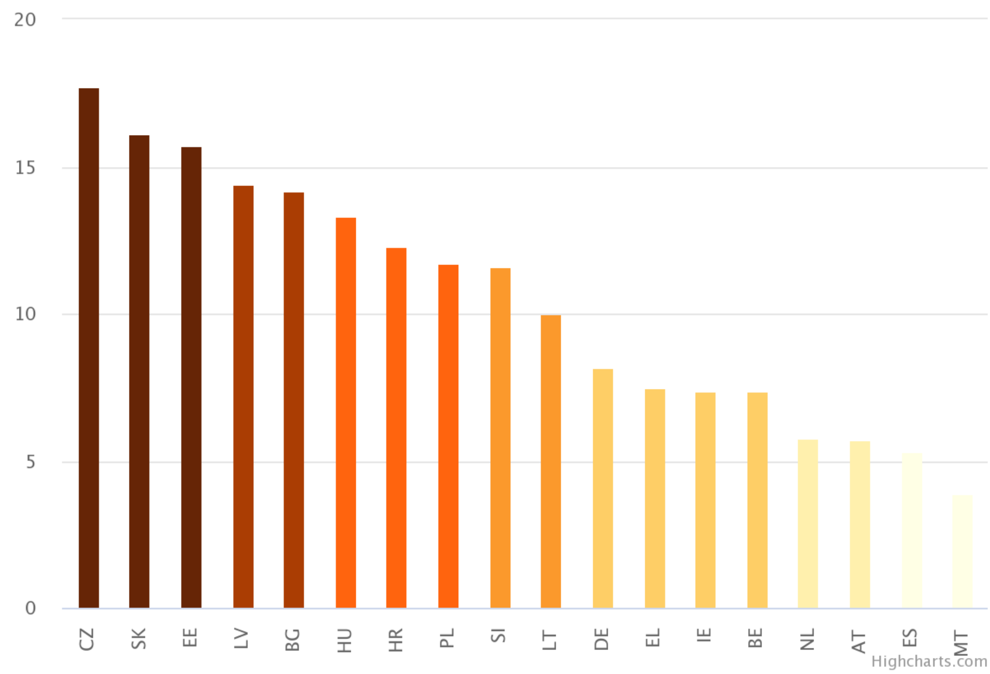

Figure 35 Energy expenses, income quintile 1 indicator bar chart from 2015 (Source: EPAH, 2022a)

Figure 36 and Figure 37 present the last data available for the "energy expenses and income quintile 2" indicator represented, respectively, in maps and bar chart.

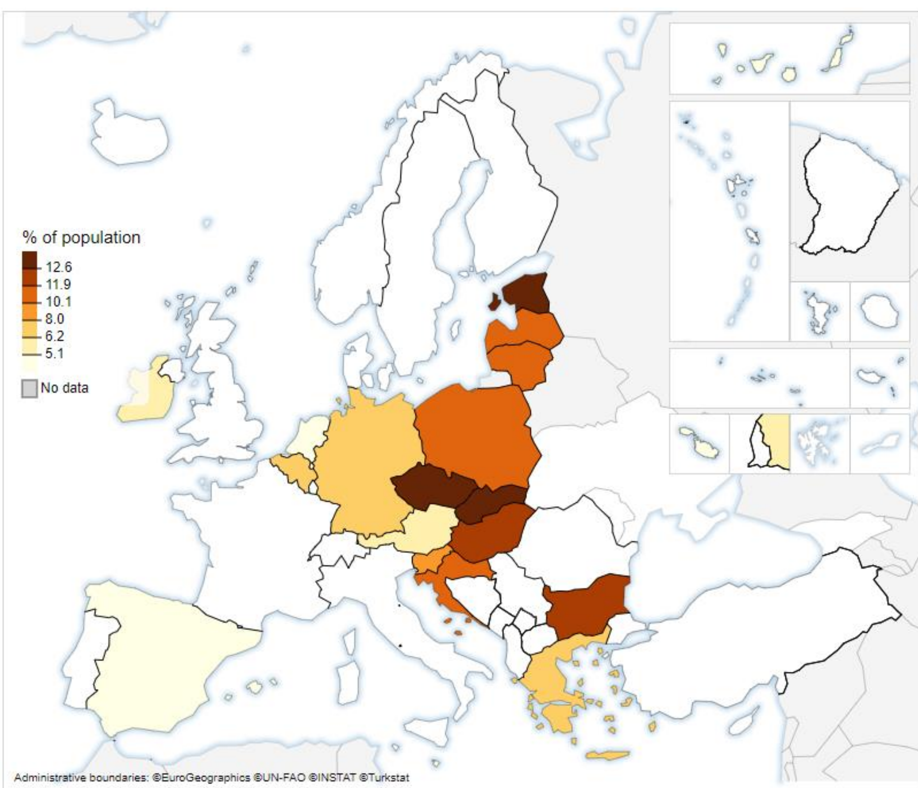

Figure 36 Map of Energy expenses, income quintile 2 indicator in 2015 (Source: EPAH, 2022a)

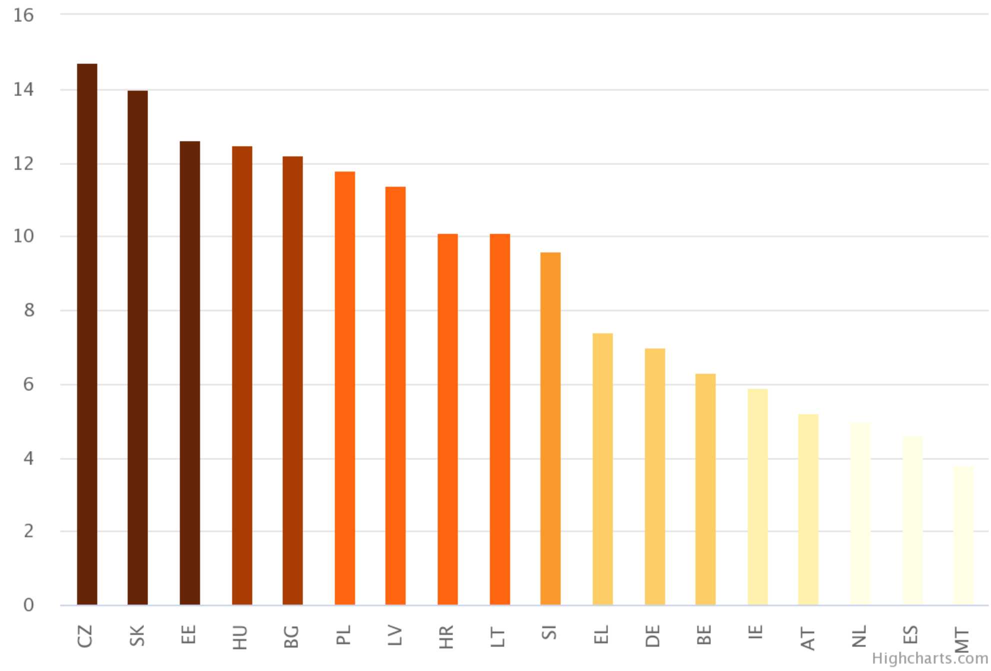

Figure 37 Energy expenses, income quintile 2 indicator bar chart from 2015 (Source: EPAH, 2022a)

Figure 38 and Figure 39 present the last data available for the “energy expenses, income quintile 3” indicator represented, respectively, in a map and bar chart.

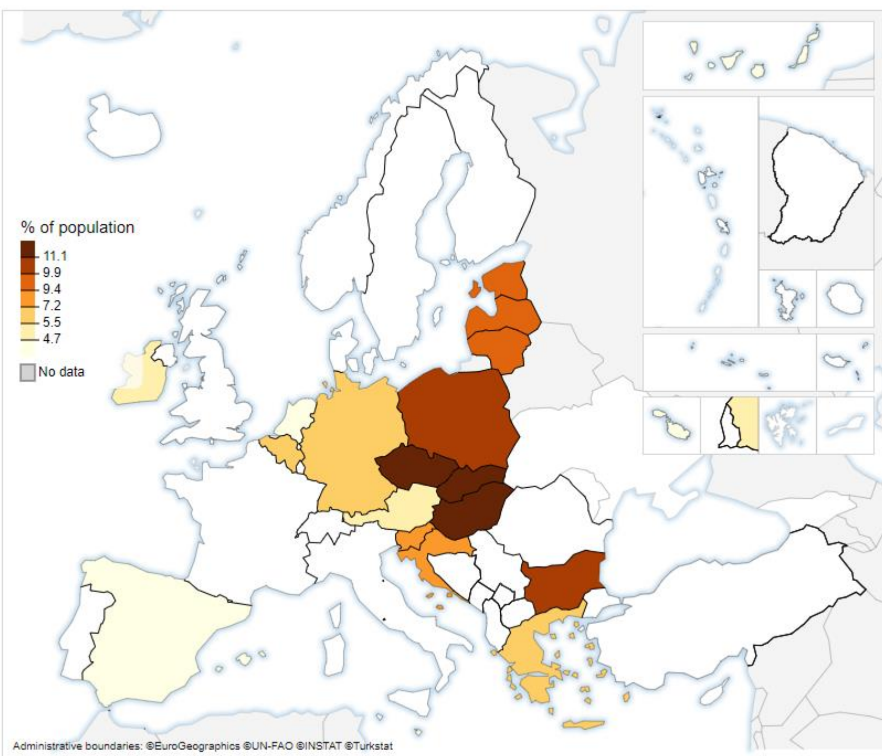

Figure 38 Map of Energy expenses, income quintile 3 indicator in 2015 (Source: EPAH, 2022a)

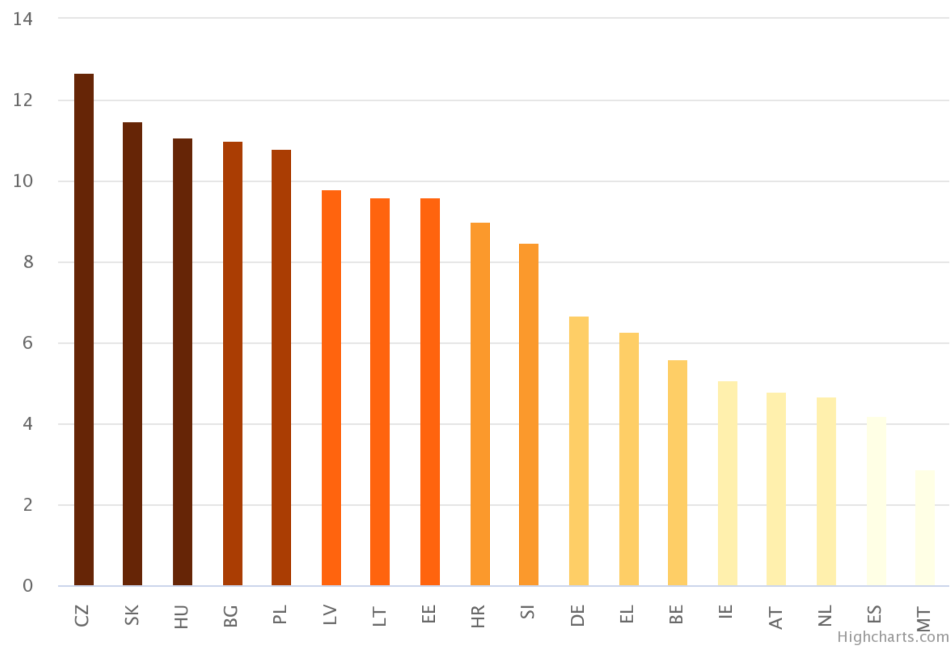

Figure 39 Energy expenses, income quintile 3 indicator bar chart from 2015 (Source: EPAH, 2022a)

Figure 40 and Figure 41 present the last data available for the "energy expenses, income quintile 4" indicator represented, respectively, in maps and bar chart.

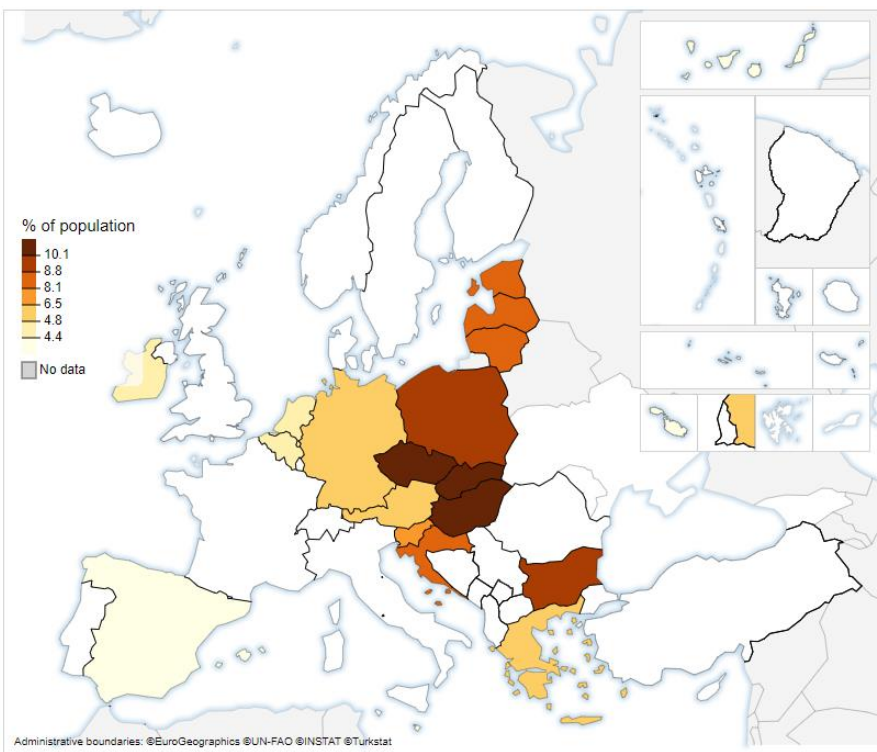

Figure 40 Map of Energy expenses, income quintile 4 indicator in 2015 (Source: EPAH, 2022a)

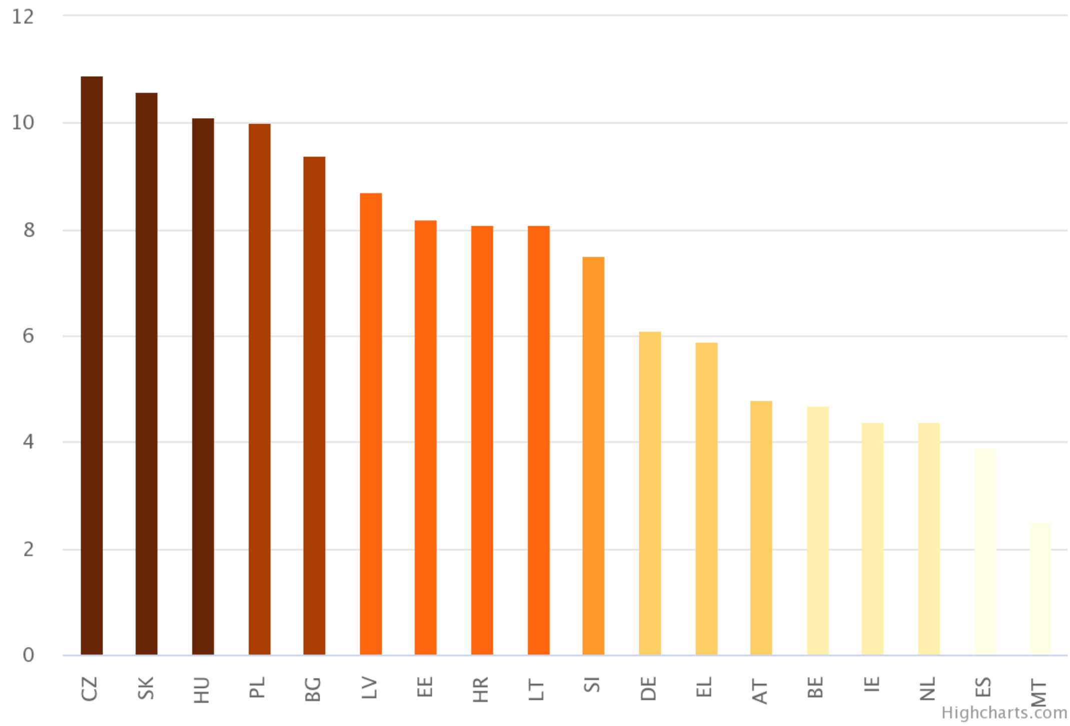

Figure 41 Energy expenses, income quintile 4 indicator bar chart from 2015 (Source: EPAH, 2022a)

Figure 42 and Figure 43 present the last data available for the "energy expenses, income quintile 5" indicator represented, respectively, in a map and bar chart.

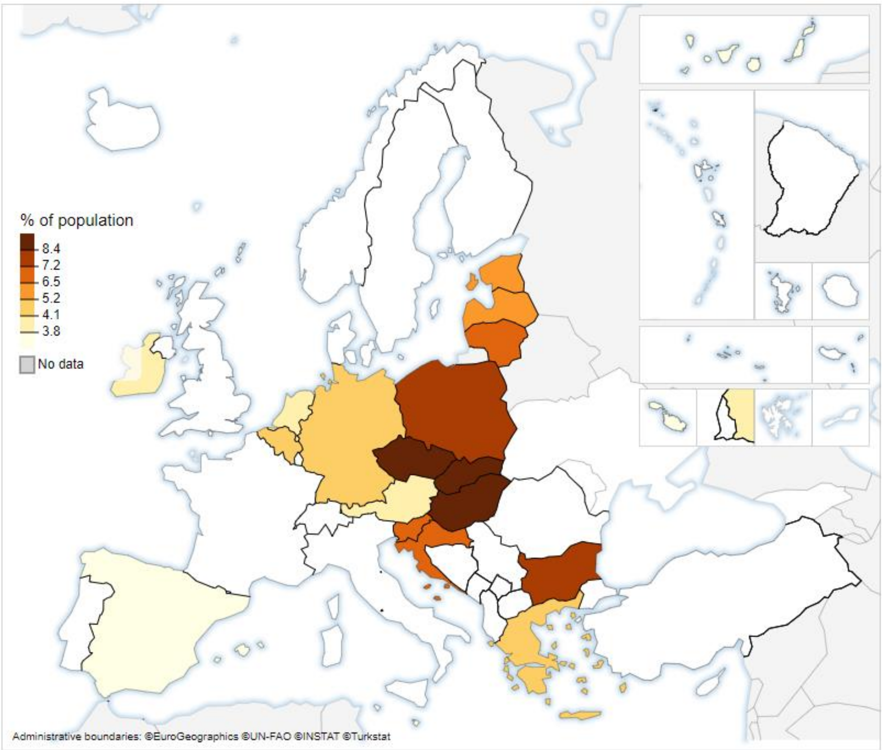

Figure 42 Map of Energy expenses, income quintile 5 indicator in 2015 (Source: EPAH, 2022a)

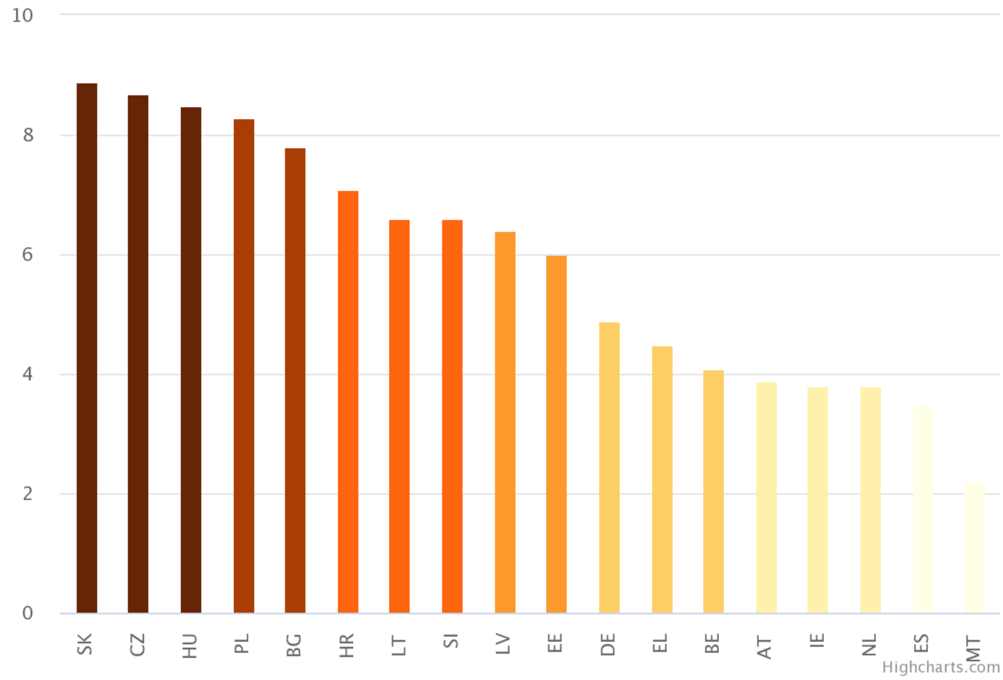

Figure 43 Energy expenses, income quintile 5 indicator bar chart from 2015 (Source: EPAH, 2022a)

4.2.14.2 Technical Details

Table 20 presents the technical details for the energy expenses by income quintile indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 20 Energy expenses by income quintile technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Energy Expenses by income quintile	2005, 2010 and 2015	18/44	SILC

4.2.14.3 Limits and application suggestion

This indicator is based on a variable that has been extensively applied in energy poverty assessments and subjected to considerable research and analysis. It is the basis of several of the most used energy poverty indicators, such as the 10% (Boardman, 1991), 2M, M/2, Low Income High Costs (Hills, 2011) and the Minimum Income Standard (Moore, 2009). It depicts the economic dimension of energy poverty with arguable effectiveness, providing information on the financial burden of households related to the energy services in their homes, which means addressing energy poverty through its most direct outcome. As it deals with total energy expenses, when it comes to low-income households, it indirectly includes the poverty premium, which is the set of conditions that make poor households pay more for basic needs such as energy (Davies et al., 2016).

***Example**: Poor households do not switch energy provider often due to, e.g., lack of knowledge, not benefiting from potential better tariffs in the market.*

Contrary to the 2M and M/2 indicators, it considers the distribution per income quintile. This analysis based on income is beneficial because income is a determining factor of energy consumption, opening the door to a more nuanced interpretation of energy expense values, despite only focusing on the economic aspect of the problem. Since it does not use a threshold or any other form of comparison, it can be challenging to discern if expenditures are excessively high or abnormally low. On the other hand, while it can be beneficial to account for the context of the population, the indicator is not limited to a comparison with median or average values, which can often be misrepresentative, leading to a decreased accuracy in energy poverty evaluation.

This indicator enables the identification of different household profiles with varying levels of vulnerability, such as low-income households with high energy expenses (high vulnerability) and high-income households with low energy expenses (no vulnerability). It can also give insight into collective behaviours of energy consumption between socioeconomic classes and cultural explanations (e.g., environmental awareness) for the expense fluctuations. The main criticism that can be made of the indicator is that it does not provide information on the level of energy consumption that determines the expenses or the energy uses.

***Example**: Two households might have the same share of energy expenses but consuming different levels of energy, resulting in varying levels of energy services provision.*

Cross-referencing it with energy consumption values and corresponding determining factors (dwellings energy performance, heating system ownership, consumption patterns, type of energy carrier, and respective prices), assessing nominal expenses, and even analysing it in comparison to different types of thresholds for understanding the context, would enable a more comprehensive understanding of the reasons behind abnormally low or excessively high expenses.

4.2.14.4 Updates and disclaimer

The summary of the updates that occurred is:

The indicator is now in the group of the former five EPOV indicators (Energy expenses, income quintile 1; Energy expenses, income quintile 2; Energy expenses, income quintile 3; Energy expenses, income quintile 4 and Energy expenses, income quintile 5).

This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU level dataset.

4.2.15 Dwellings with energy label A

4.2.15.1 Current situation

The "dwellings with energy label A" indicator represents the share of dwellings with an energy label A.

Figure 44 and Figure 45 present the last data available for the indicator represented in a map and bar chart.

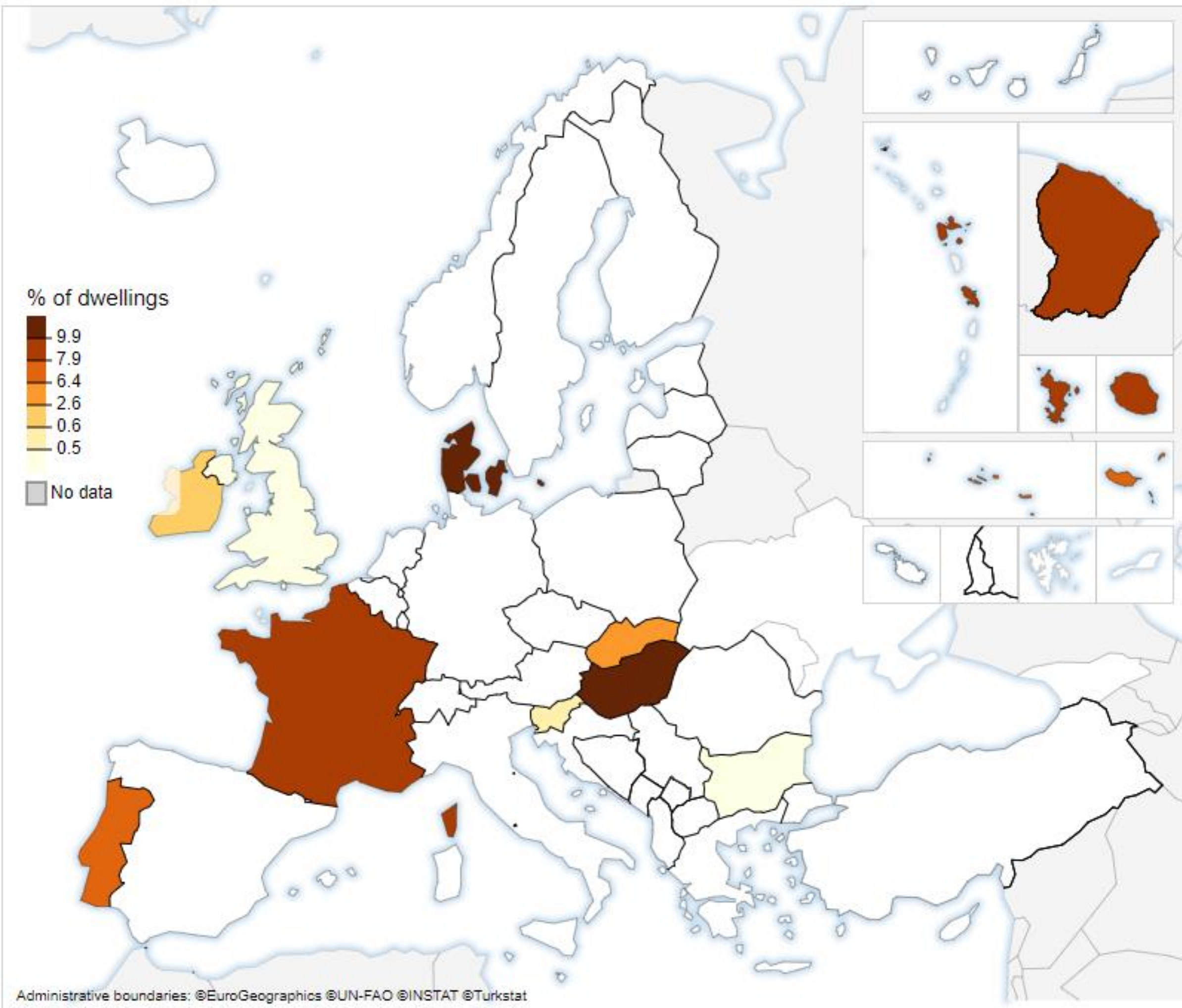

Figure 44 Map of Dwellings with an energy label A indicator in 2015 (Source: EPAH, 2022a)

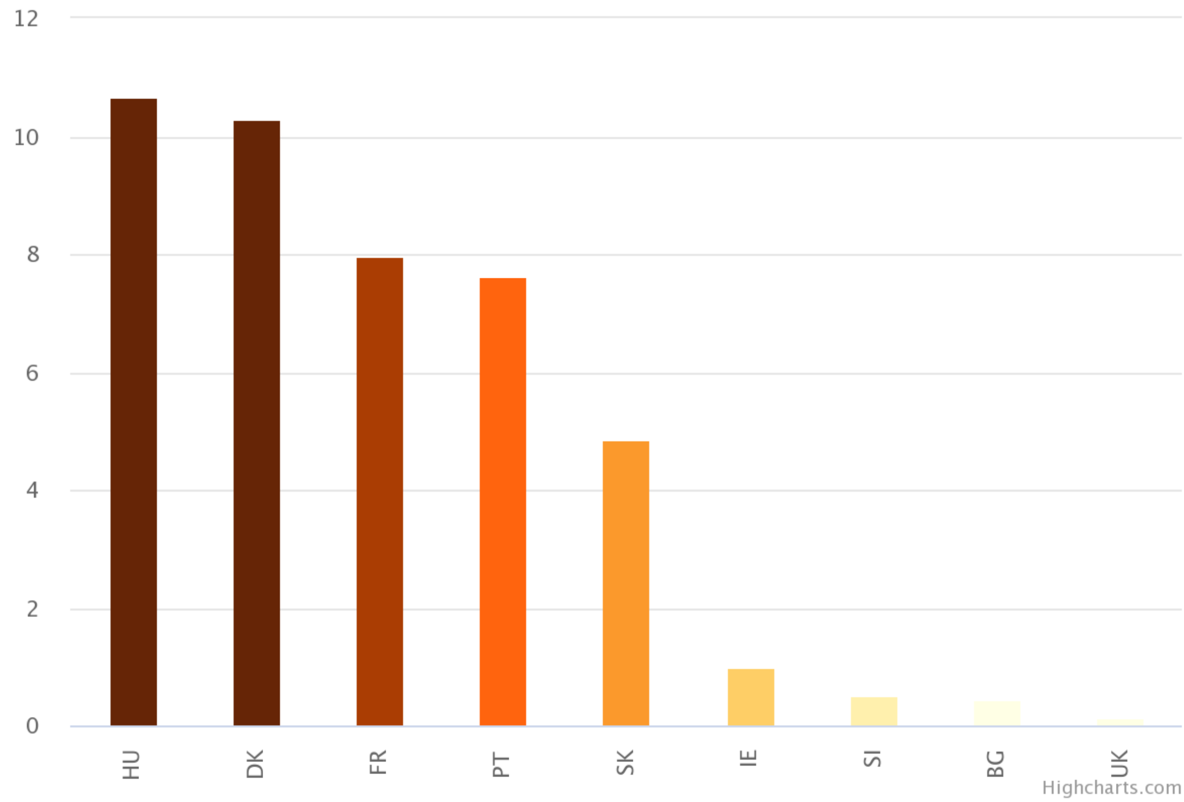

Figure 45 Dwellings with an energy label A indicator bar chart from 2015 (Source: EPAH, 2022a)

4.2.15.2 Technical Details

Table 21 presents the technical details for the "dwellings with the energy label A" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 21 Dwellings with energy label A technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Dwellings with energy label A	2007-2015	9/44	BSO

4.2.15.3 Limits and application suggestion

Dwelling stock energy efficiency is one of the three leading causes of energy poverty, and thus its analysis is integral in efforts to understand and assess energy poverty. Energy labels or certificates are a proxy of a dwelling's energy efficiency and have been used in several studies in the literature (e.g. Gouveia and Palma, 2019; Camboni et al., 2021; Fabbri and Gaspari, 2021; Palma et al., 2022). Being the only indicator that directly focuses on this dimension, it is of significant relevance for national and local-level assessments. The energy label indicator includes an appraisal of dwellings' energy performance related to the building fabric thermal performance and dwelling systems' efficiency. While it provides a complete picture of the energy requirements of the dwelling, the division of this indicator into two separate indicators, or alternatively having two complementary indicators providing information on these aspects separately, would enable the distinction of potential issues regarding the provision of different energy services more precisely and the corresponding design of solutions. In fact, two C-label dwellings might need very different interventions to realize a label upgrade.

Moreover, the indicator only focuses on energy label A, highlighting the percentage of the dwelling stock with very good energy performance, which provides a picture of the current state of the building stock but is incomplete since it does not represent the remaining stock. It can favour countries and regions with late urbanisation or in-migration, leading to higher rates of newer and more efficient buildings. It would be valuable for this indicator to be expanded to show every label and the respective share of the dwelling stock. A building with a C label has a substantially different performance than one with an A or E label, requiring a different level of retrofit work, so it is paramount to have a complete indicator that portrays the dwelling stock more comprehensively. Moreover, the energy label depends on the building envelope but also on the equipment, which means two dwellings labelled C can have very distinct energy performance of the building envelope or quality and efficiency of the equipment.

Example*: One dwelling might achieve its energy class C because of heat pump installation, while other might achieve it because of wall insulation and window replacement.*

It should also be noted that the energy label of a dwelling does not provide enough information to assert whether its occupants are in energy poverty or not. Authors have unveiled situations where energy consumption does not cover the basic energy needs (Calì et al, 2016), and deprivation can often be the cause of this underconsumption, as shown by Barrella et al. (2022). On the other hand, there can also be cases of overconsumption, resulting from strong preferences for comfort (Bakaloglou and Charlier, 2021) or higher unnegotiable family members’ energy needs (Ivanova and Middlemiss, 2021).

Example*: A household might live in an A label dwelling and not have enough resources to guarantee the small energy consumption needed, while other might live in a dwelling rated D and not have trouble keeping the home at a comfortable temperature.*

Although helpful for representing the building dimension, in the context of an energy poverty dimension, this indicator should be integrated as part of a multidimensional assessment that also focuses on the economic and social dimensions. One-dimensional dwelling performance-based approaches can produce unbalanced estimates, estimating all poorly rated dwellings as energy poor and all highly rated dwellings as not in energy poverty, which would be an oversimplification of this complex problem.

4.2.15.4 Updates and disclaimer

The “dwellings with energy label A” only present values only until 2015 and for very few countries This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU level dataset. The correct unit for this indicator is as presented in its definition (i.e., dwellings).

4.2.16 Dwellings in populated areas

4.2.16.1 Current situation

The “dwellings in populated areas” indicator is disaggregated into two indicators which represent:

- Dwellings in intermediately populated areas: share of dwellings located in intermediately populated areas (between 100 and 499 inhabitants/km^2).
- Dwellings in densely populated areas: Share of dwellings located in densely populated areas (at least 500 inhabitants/km^2)

Figure 46 and Figure 47 present the last data available for the “dwellings in intermediately populated areas” indicator represented, respectively, in a map and bar chart.

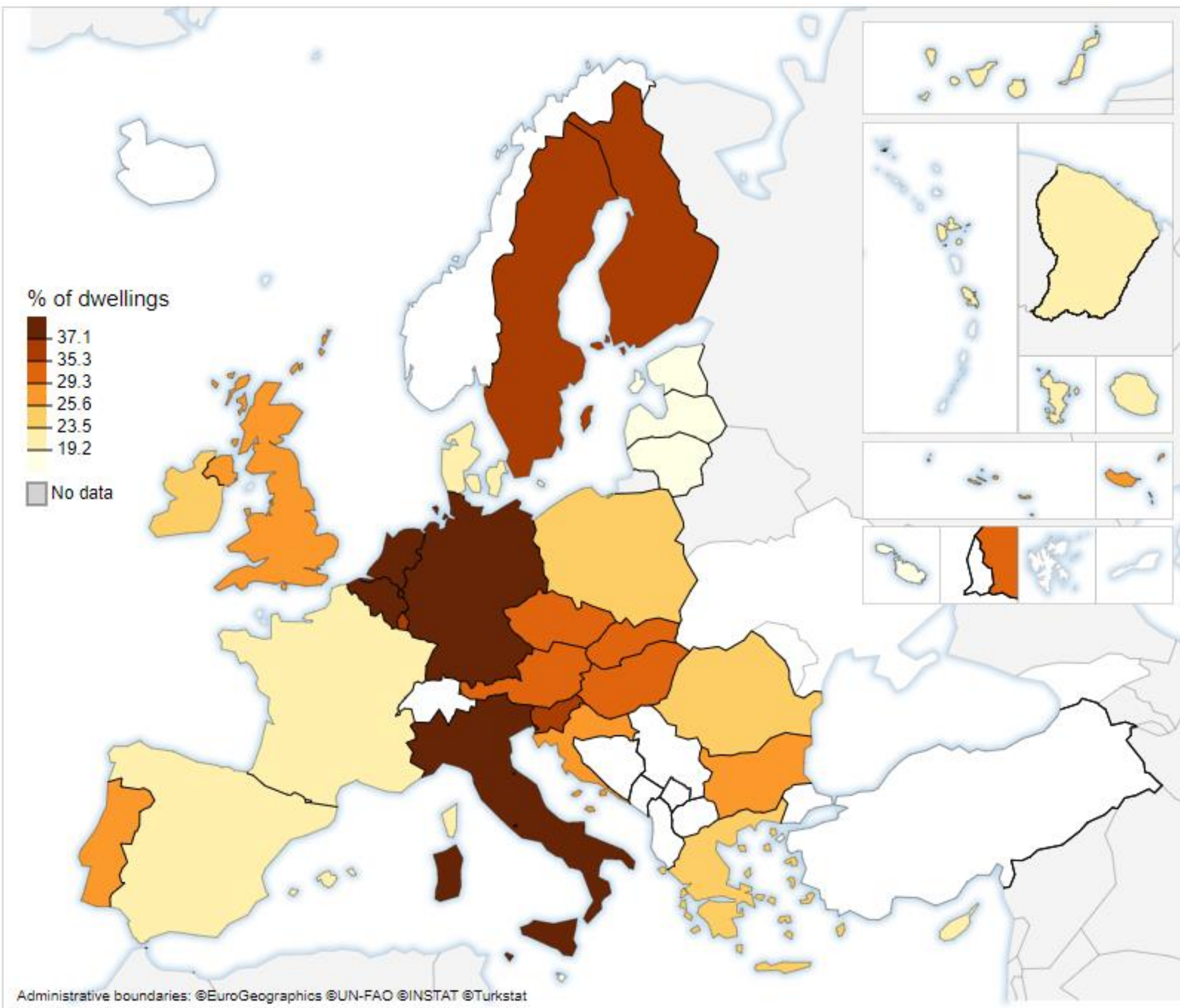

Figure 46 Map of Dwellings located in intermediately populated areas indicator in 2014 (Source: EPAH, 2022a)

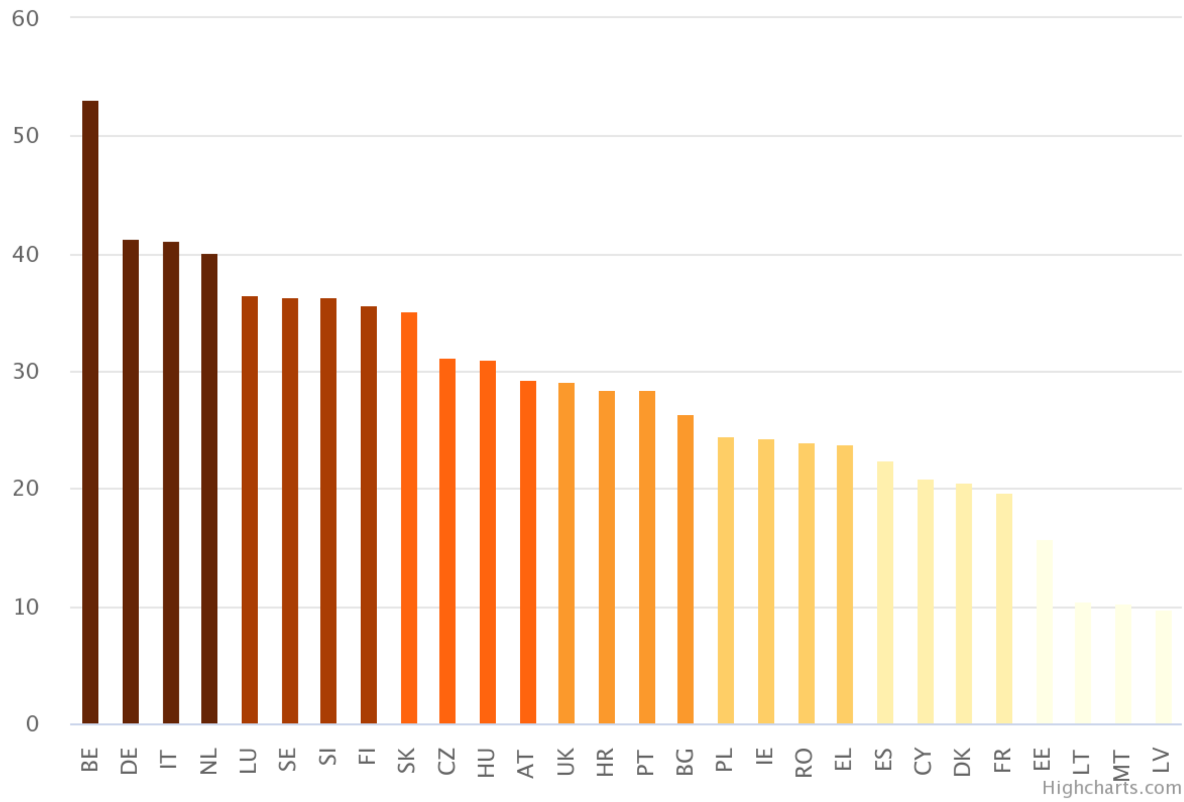

Figure 47 Dwellings located in intermediately populated areas indicator bar chart from 2014 (Source: EPAH, 2022a)

Figure 48 and Figure 49 present the last data available for the “dwellings in densely populated areas” indicator represented, respectively, in a map and bar chart.

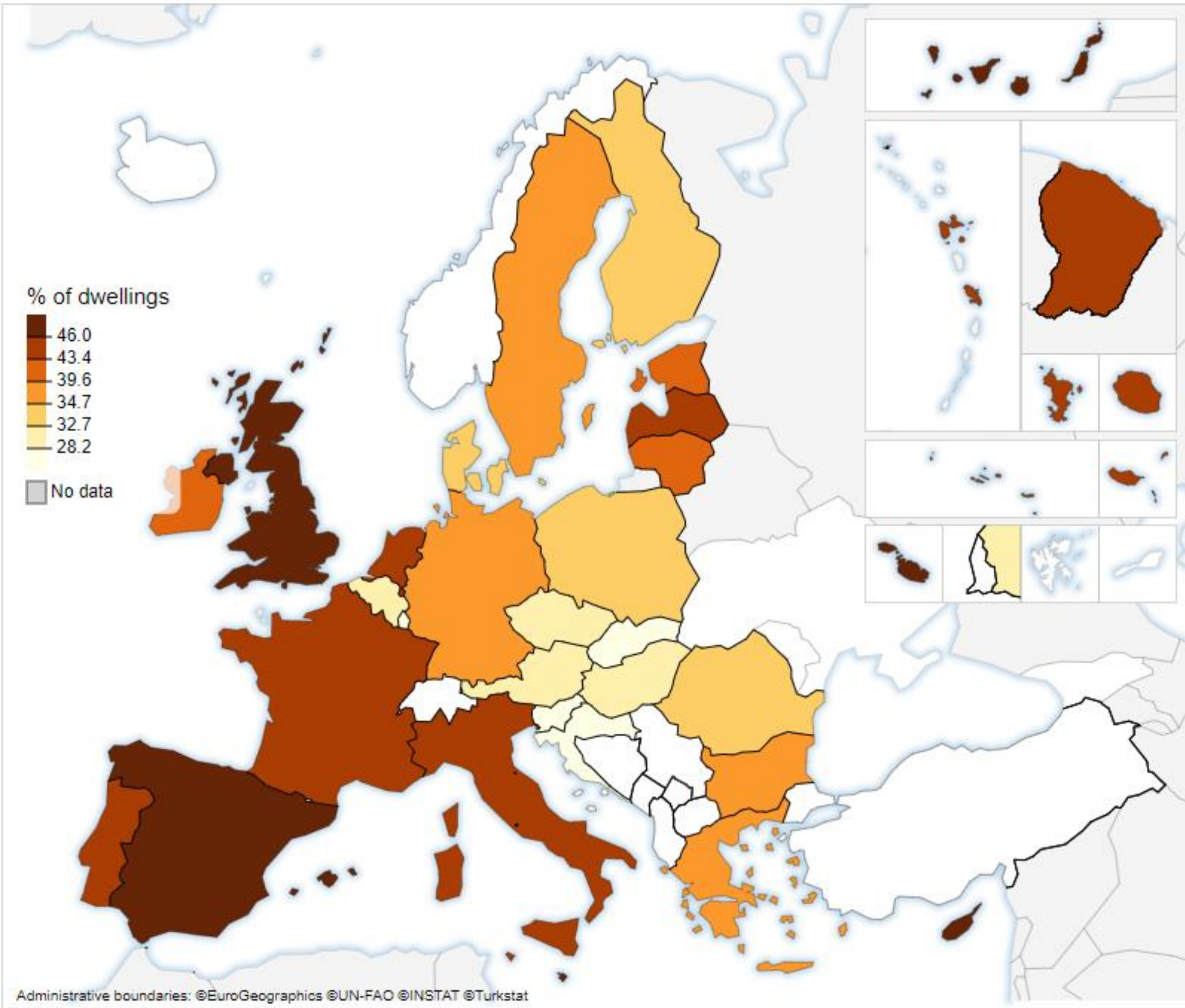

Figure 48 Map of Dwellings located in densely populated areas indicator in 2014 (Source: EPAH, 2022a)

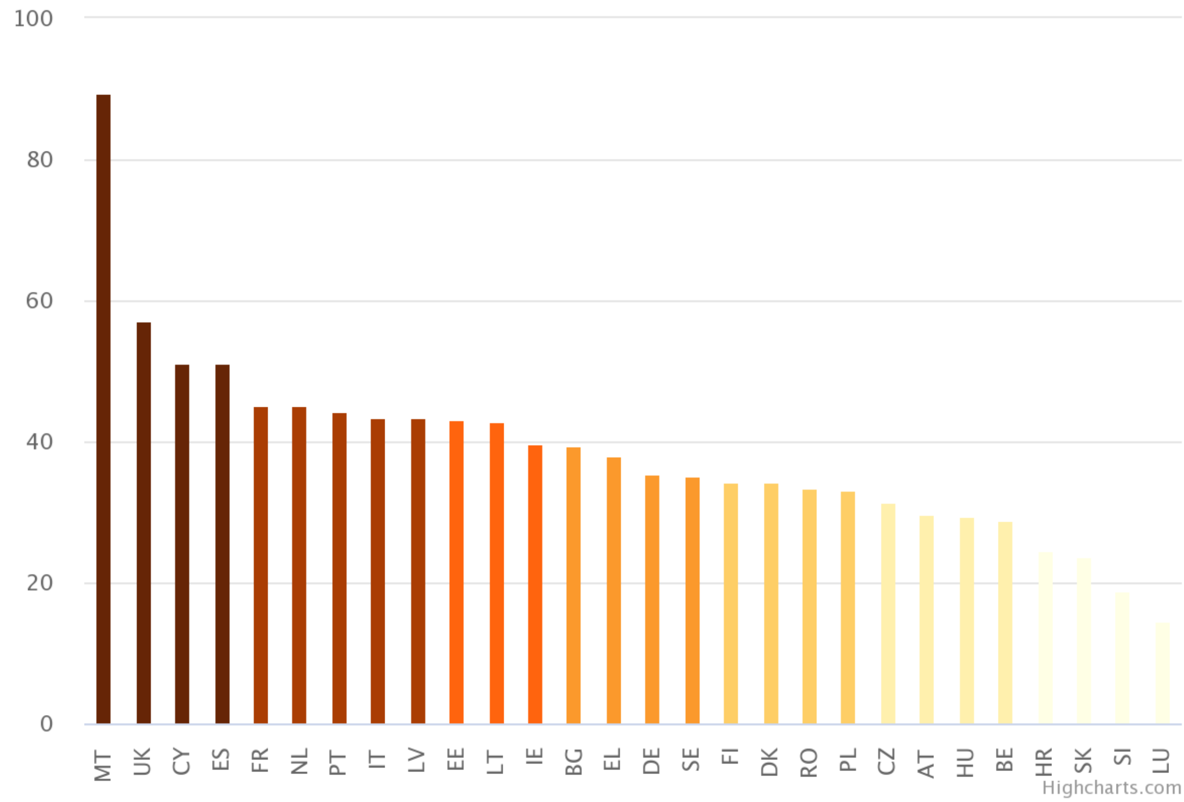

Figure 49 Dwellings located in densely populated areas indicator bar chart from 2014 (Source: EPAH, 2022a)

4.2.16.2 Technical details

Table 22 presents the technical details for the dwellings in populated areas indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 22 Dwellings in populated areas technical details

Identification Code	Name	Timeline	# GEO	Source
Not found	Dwellings in populated areas	2007-2014	29/44	BSO

The "dwellings in populated areas" EU-SILC details can be observed in Figure 50 Note that in 2021 modalities were changed, indicating that we may be able to access the data in the future.

DB100: DEGREE OF URBANISATION

Topic and detailed topic: Technical items/Localisation
Variable type: Core variable/ Annual
Unit: Household
Reference period: Current
Mode of collection: Derived
In use (period): Yes, since the first year of EU-SILC data collection
Series' differences: Yes (2012 and 2021 modalities were changed)

VALUES AND FORMAT

From 2021 onwards

1	Cities
2	Towns and suburbs
3	Rural areas

Before 2021

1.	Densely-populated area
2.	Intermediate area
3.	Thinly-populated area

FLAGS

1	Filled
-1	Missing (allowed only from wave 2 onwards)

DESCRIPTION

This variable reports on the degree of urbanisation in the area where the usual residence of the person or the household is located.

From 2021 onwards the modalities were changed according to the standardised social variables.

This variable must be filled in for every household in wave 1. From wave 2 onwards, a missing value (flag -1) is allowed in exceptional cases (like moving house).

From 2021 onwards the variable classifies LAU2 into three types of area:

1. *'Cities'* - densely-populated areas where at least 50% of the population live in an urban centre.
2. *'Towns and suburbs'* - intermediate density areas where at least 50% of the population live in urban clusters, but which are not 'cities'.
3. *'Rural areas'* - thinly populated areas where more than 50% of the population live in rural grid cells.

This classification is based on a combination of criteria of geographical contiguity and minimum population threshold applied to 1 km^2 population grid cells.

Figure 50 Dwellings in populated areas technical details from EU-SILC (Source: EUROSTAT, 2022)

4.2.16.3 Limits and application suggestion

When analysed independently, this indicator is too generic to provide relevant insights into energy poverty. Population density is related to territorial typology, i.e., rural or urban, and research shows that energy poverty occurs in both typologies, though manifestations may differ according to particular socioeconomic and infrastructural features (e.g. Thomson and Snell, 2013; Karpinska et al., 2021; Simcock et al, 2021). Nevertheless, it is not possible to make inferences about energy poverty solely based on population density; it is necessary to introduce indicators that capture the problem's different dimensions (economic, social, climatic, and infrastructural). Cross-examining population density with the dimensions mentioned above is necessary to identify and distinguish other profiles and situations of vulnerability across regions. A suggestion for simplifying this indicator is an assessment of dwellings in both urban and rural areas, uniformized across the Member-States.

4.2.16.4 Updates and disclaimer

The “dwellings in populated areas” are now a group of two former EPOV indicators (dwellings in intermediately populated areas and dwellings in densely populated areas). This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU level dataset.

Although it is defined as the share of dwellings, the unit presented in the existing version of the dashboard is the share of the population. The EPAH team has clarified that the correct unit is as presented in its definition (i.e., dwellings).

4.2.17 Excess winter mortality/death

4.2.17.1 Current situation

The “excess winter mortality/death” indicator represents the share of excess winter mortality/deaths.

Figure 51 and Figure 52 present the last data available for the indicator represented in a map and bar chart.

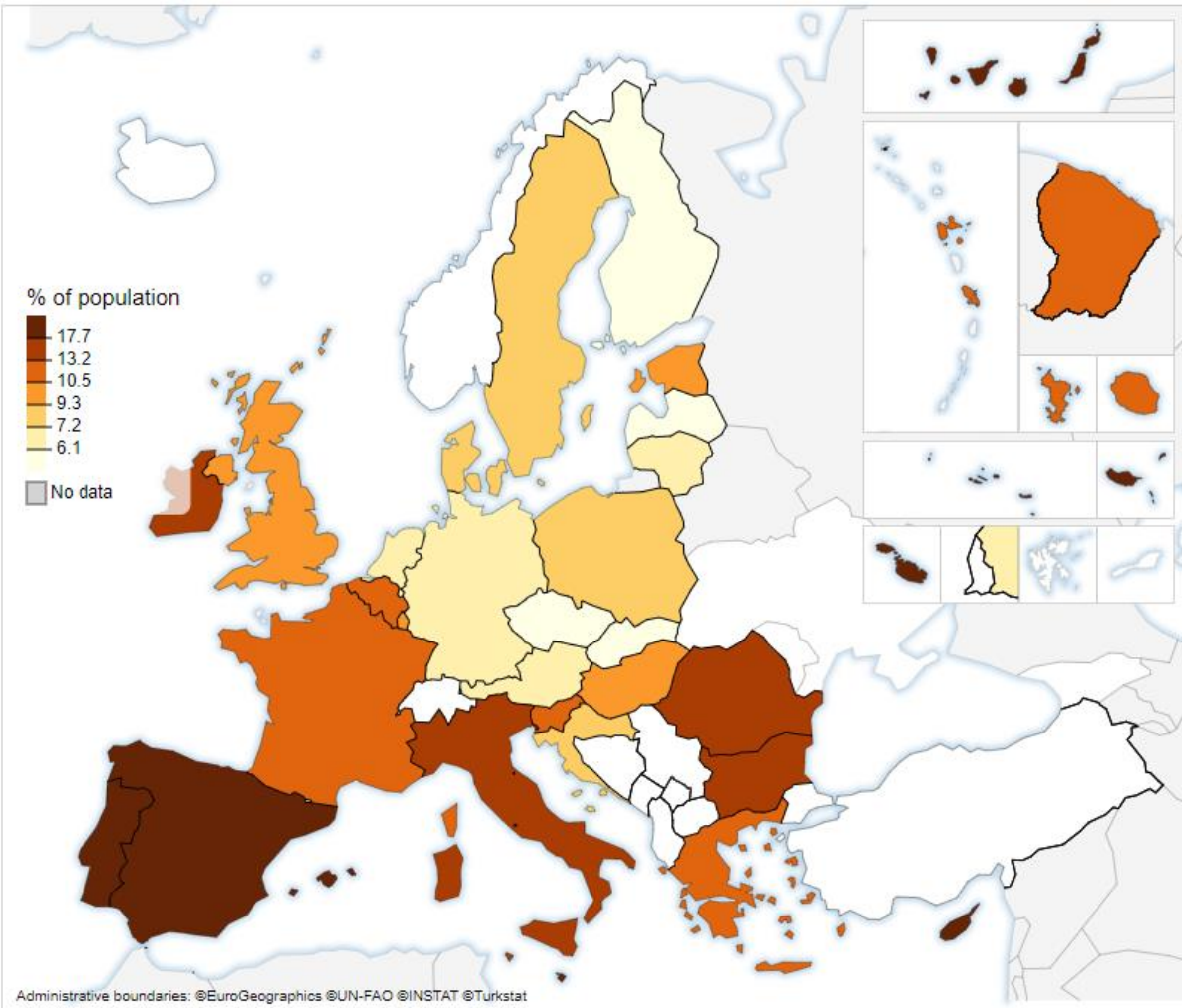

Figure 51 Map of Excess winter mortality/death indicator in 2014 (Source: EPAH, 2022a)

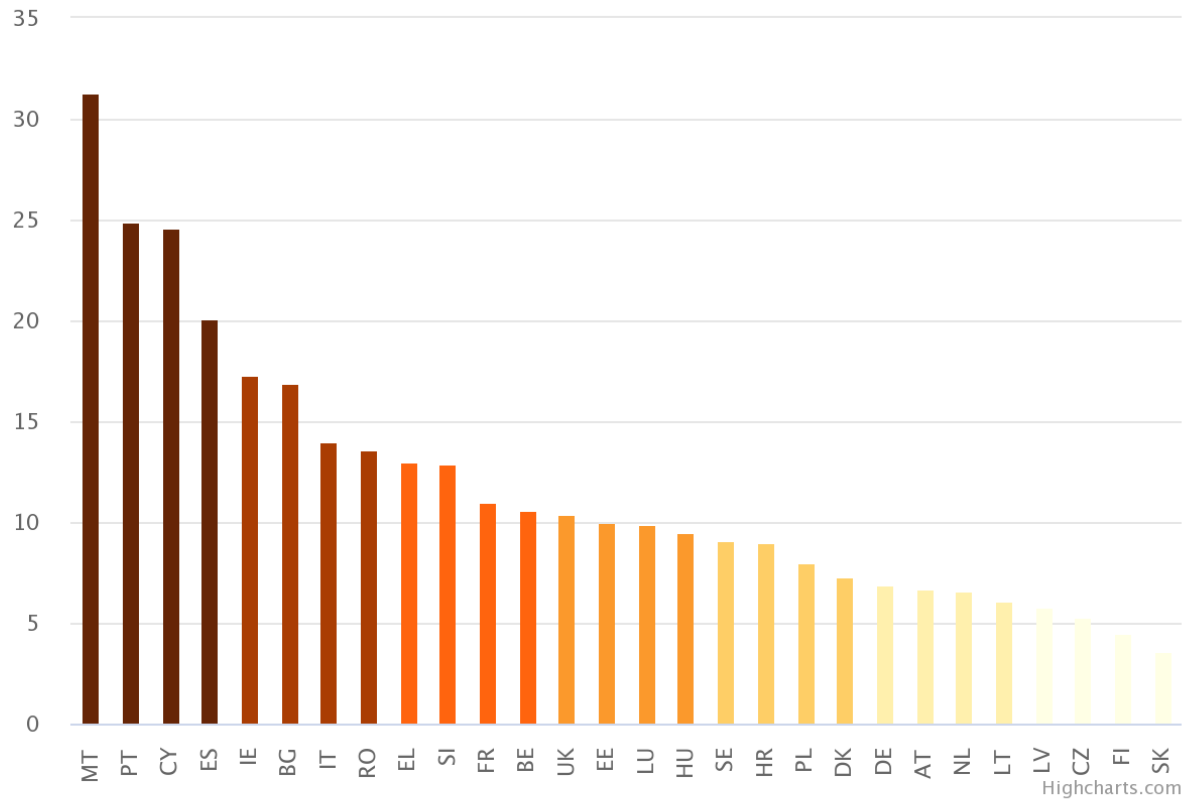

Figure 52 Excess winter mortality/deaths indicator bar chart from 2014 (Source: EPAH, 2022a)

4.2.17.2 Technical Details

Table 23 presents the technical details for the “excess winter mortality/death” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 23 Excess winter mortality/deaths technical details

Identification Code	Name	Timeline	# GEO	Source
NONE	Excess winter mortality/death	2005-2014	28/44	BSO

4.2.17.3 Limits and application suggestion

Excess winter mortality represents a potential consequence of winter energy poverty; therefore, it is a suitable indicator to be included in energy poverty assessments. Rudge and Gilchrist (2005) highlight that energy poverty risk is a predictor of excess winter morbidity based on an estimated significant statistical relationship. There are also important established links between cold homes and higher rates of excess winter mortality, as well as a series of other diseases, such as cardiovascular and respiratory conditions, and impacts on mental health (Marmot et al., 2020). Recalde et al. (2019) also found that excess winter mortality in the EU is higher in countries with the most significant structural energy poverty issues. These findings coincide with an observed trend of higher rates of excess winter deaths in countries with higher average winter temperatures but with recognized problems in terms of poor building quality, including many Mediterranean countries (Healy, 2003; Fowler et al., 2014).

Despite the possible correlation, excess mortality is a phenomenon with several potential causes that should be considered. The connection between energy poverty risk and excess mortality should not be inferred lightly, as the influence of other extraneous variables should also be estimated when analysing the correlation between these two variables. Other factors or phenomena not depicted in these indicators may also influence excess mortality, such as a virus outbreak, lack of medical assistance, or other diseases unrelated to cold weather.

***Example**: On a very cold winter, excessive mortality might be high, but other causes, such as floods or impact of significant viruses or diseases, as seen with COVID-19, can be at play.*

The COVID-19 pandemic is an example of an event that significantly impacted the reported numbers of this indicator. It is advisable to cross-analyse this indicator with others related to building energy efficiency, energy expenditure, income levels, population density, material deprivation, or access to medical services, as they would enable the ruling out of some possible misrepresentations. Selection bias should also be considered, as it is possible that vulnerable people have poor medical assistance according to all these factors.

A comprehensive analysis of the problem should integrate indicators that depict not only consequences but also the causes of the problem to establish a causal relationship between factors, which could reveal energy poverty as the connecting node. It should also be highlighted that this indicator only represents excess mortality in the winter. There are reports of excess summer mortality related to the inability of people to face heat waves, as mentioned by Sanchez-Guevara et al. (2019). Thus, an indicator representing excess mortality in this season is also necessary for a more comprehensive analysis of the effects of yearly energy poverty.

4.2.17.4 Updates and disclaimer

This indicator was not updated at this stage due to a lack of access to the indicator's original source, and we were not able to find it elsewhere at the moment from an EU level dataset.

4.2.18 Pop. Liv. Dwelling Comfortably warm in winter time

4.2.18.1 Current situation

The "Pop. Liv. dwellings comfortably warm in winter time" indicator represents the share of the population, based on the question "Is the heating system efficient enough to keep the dwelling warm?" and "Is the dwelling sufficiently insulated against the cold?".

Figure 53 and Figure 54 present the last data available for the indicator represented in a map and bar chart.

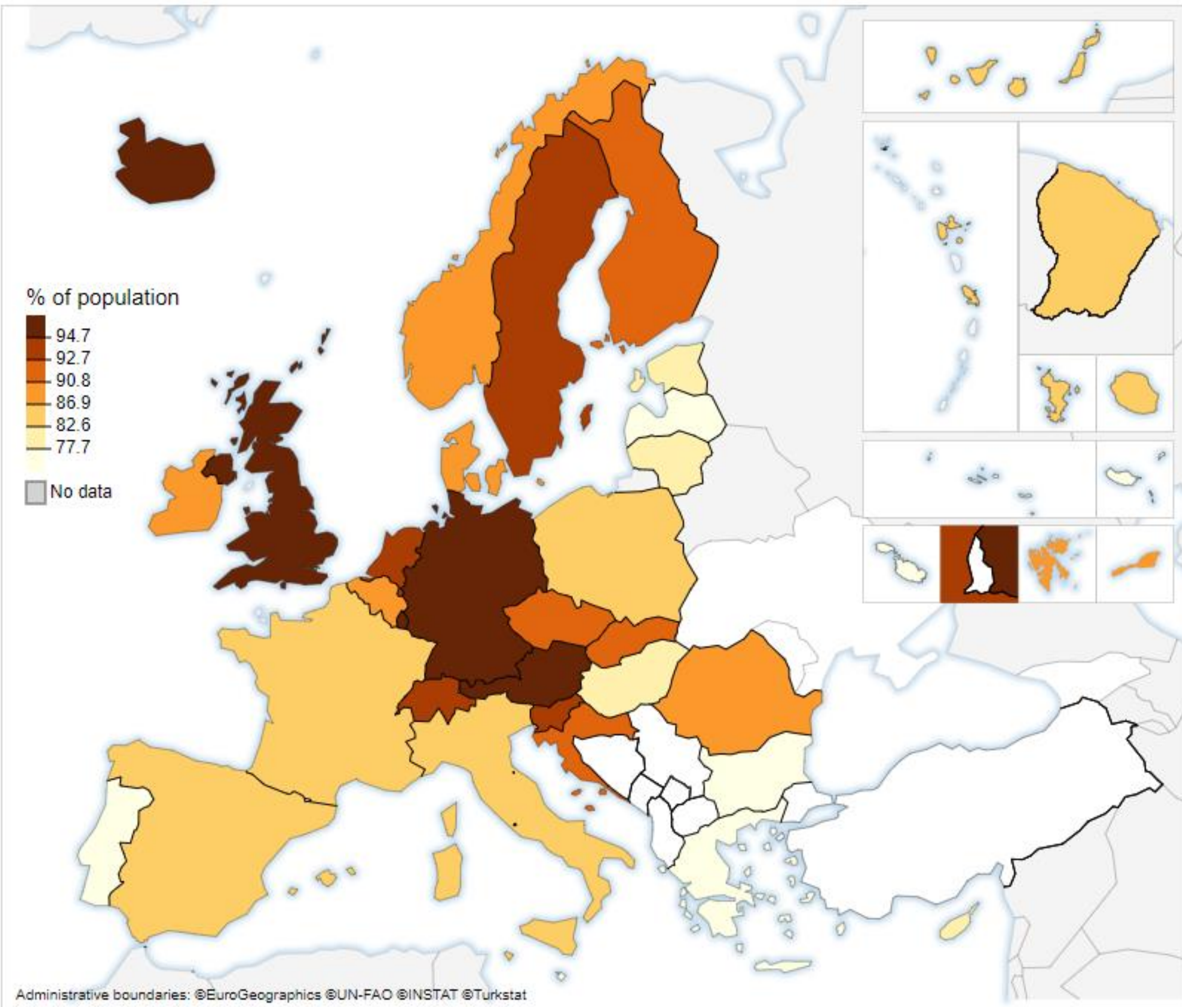

Figure 53 Map of Pop. Liv. dwellings comfortably warm during winter time indicator in 2012 (Source: EPAH, 2022a)

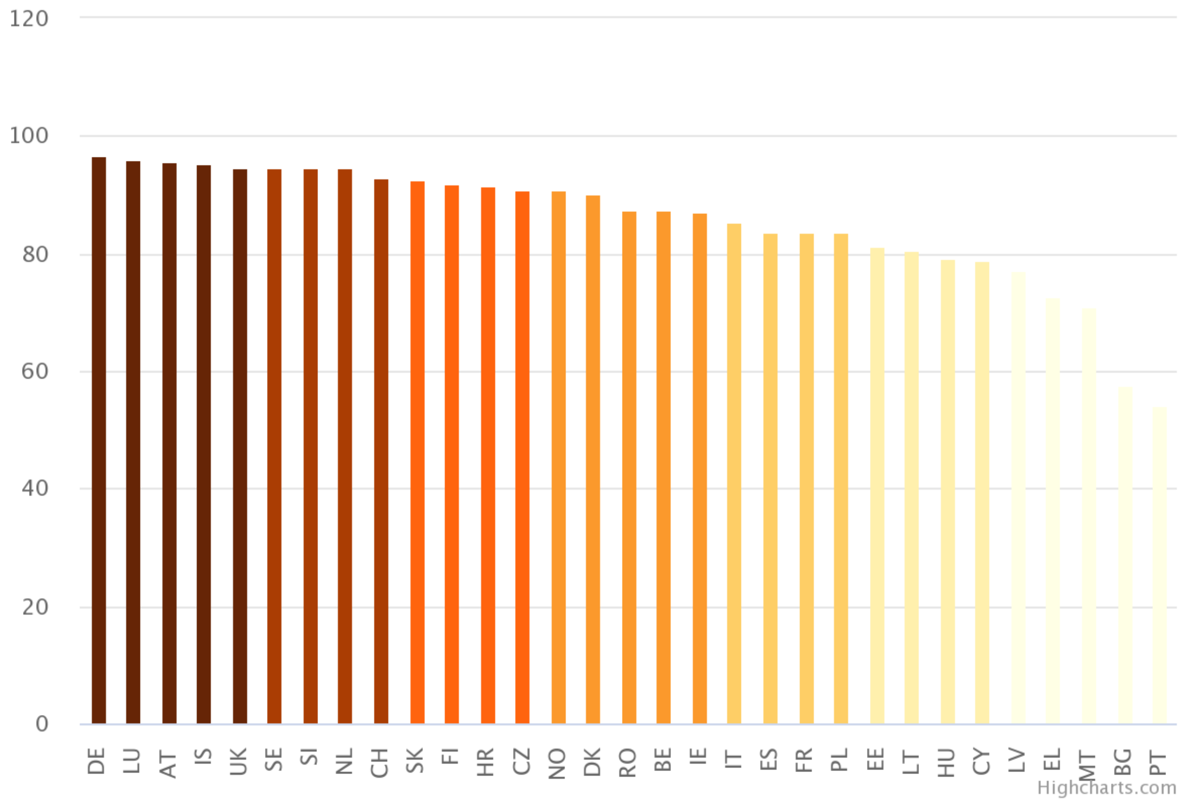

Figure 54 Pop. Liv. dwellings comfortably warm during winter time indicator bar chart from 2012 (Source: EPAH, 2022a)

4.2.18.2 Technical Details

Table 24 presents the technical details for the “Pop. Liv. dwellings comfortably warm during winter time” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 24 Pop. Liv. dwellings comfortably warm during winter time technical details

Identification Code	Name	Timeline	# GEO	Source
Not found	Pop.Liv. dwelling comfortably warm during winter time	2007 and 2012	32/44	SILC

The “Pop. Liv. dwellings comfortably warm during winter time” EU-SILC details are shown in Figure 55. Note that in 2023 the indicator is presented as “in use,” which may indicate new data for future updates. Moreover, this indicator is an ad hoc subject, meaning that the themes are of particular interest for users at a specific point in time but that are not included in the regular datasets.

HC060 INABILITY TO KEEP THE DWELLING COMFORTABLY WARM DURING WINTER

Topic and detailed topic: New policy needs module / Households energy efficiency
Variable type: ad-hoc module
Unit: Household
Reference period: Usual
Mode of collection: Household respondent
In use (period): Yes, 2007, 2012, 2023
Series' differences: Yes, Identifier (MH050 in 2007)

VALUES AND FORMAT

1	Yes
2	No

FLAGS

1	Filled
-1	Missing
-7	Not applicable (Not collected according to the implementation of the "multiannual rolling planning")

DESCRIPTION

This variable informs if the household is able to keep the dwelling comfortably warm during winter, taking into account the insulation of the dwelling and the heating system in place.

The purpose for this variable is to cover the following concerns: "Is the heating system used enough to keep the dwelling warm?" and/or "Is the dwelling sufficiently insulated against the cold?". Interviewers should take into account these two questions even though they were not explicitly documented in the questionnaire.

This variable does not measure whether the household has financial resources to keep the dwelling comfortably warm during winter. Therefore, it should not be confused with the variable HH050 "Ability to keep home adequately warm", which refers to the financial resources of the household and for which the concern could be expressed as: "Does the household have sufficient financial resources to keep its dwelling sufficiently warm during winter time?" It also does not measure if the household is able to keep the dwelling comfortably warm during extreme weather situations, e.g. extreme cold spells.

Suggested question:

HC060_Q1: Is your household able to keep the dwelling comfortably warm during winter, taking into account the insulation of the dwelling and the heating system you have in place? ? Please do not consider whether the household has financial resources to keep the dwelling comfortably warm during winter.

1. *Yes*
2. *No*

Figure 55 Pop. Liv. dwellings comfortably warm during winter time technical details from EU-SILC (Source: EUROSTAT, 2022)

4.2.18.3 Limits and application suggestion

This indicator is similar to the indicator "inability to maintain an adequate temperature in the winter" as both are connected to the thermal experience inside the dwelling. However, a clear distinction should be pointed out: this indicator focuses directly and solely on the indoor temperature and whether the respondent considers it comfortable. At the same time, the former depicts the ability of the household to guarantee this condition, and not if the state is indeed guaranteed. Using the inability indicator, it is not possible to gain precise insights into the household's thermal comfort, as "inability" can signify varying levels of comfort or no comfort at all. This intermittence is evident in the term "maintain." The "comfortably warm" indicator implies a more permanent condition, though it does not provide any insight into the ability to adapt. This difference in practical terms may seem irrelevant but can result in other replies to the question from households and a different distribution of values at the national level. Question formulation is a crucial step for adequately capturing the aimed phenomena. There is no complete overlap in the answers to the two questions, which is an argument in favour of collecting data for the two as complementary indicators.

It would also be valuable to have a Likert scale for this indicator, with different frequency levels such as “always,” “frequently,” and “sometimes,” to clearly understand if thermal comfort is maintained throughout the winter or only at specific periods. It would be beneficial to analyse the indicator with objective expenditure and direct temperature measurements (Barrella and Romero, 2022).

Being a subjective indicator, the self-reporting of thermal comfort is influenced by all the aforementioned factors for consensual-based indicators, such as gender, age, socioeconomic situation, culture, and social practices, which justify various possible results.

> ***Example**: Two persons sharing the same home might have different perceptions of thermal comfort.*

However, it can play a relevant part in energy poverty diagnosis, as living in uncomfortably cold temperatures increases the likelihood of reporting poor health by 1.7 times compared to persons without being exposed to poor housing conditions (John et al., 2018). Overall, housing that is difficult or expensive to heat contributes to significant health problems, increasing the burden of non-communicable diseases (WHO, 2018). Improvements to indoor temperature may affect the psychosocial pathway by improving household occupants' perception of their homes and reinforcing social interaction with family and friends based on the increasing use of their houses (Poortinga et al., 2018).

4.2.18.4 Updates and disclaimer

The “Pop. Liv. Dwellings comfortably warm in winter time” is the new name for the former EPOV dwellings comfortably warm in winter time indicator. Data for this indicator was not updated due to lack of updates since 2012. However, according to EUROSTAT (2022), this indicator is expected to be updated in 2023.

In 2012, **85.8%** of the European Union population was **comfortably warm in winter time** (EPOV, 2020), corresponding to 377.9* millions of Europeans.

**considering that the European Union population in 2012 was 440.55 million, according to STATISTA (2022)*

4.2.19 Pop. Liv. Dwelling comfortably cool in the summer time

4.2.19.1 Current situation

The “Pop. Liv. dwellings comfortably cool in the summer time” indicator represents the share of the population, based on the question “Is the cooling system efficient enough to keep the dwelling cool?” and/or “Is the dwelling sufficiently insulated against the warm?”.

Figure 56 and Figure 57 present the last data available for the “Pop. Liv. dwellings comfortably cool in the summer time” indicator represented, respectively, in a map and bar chart.

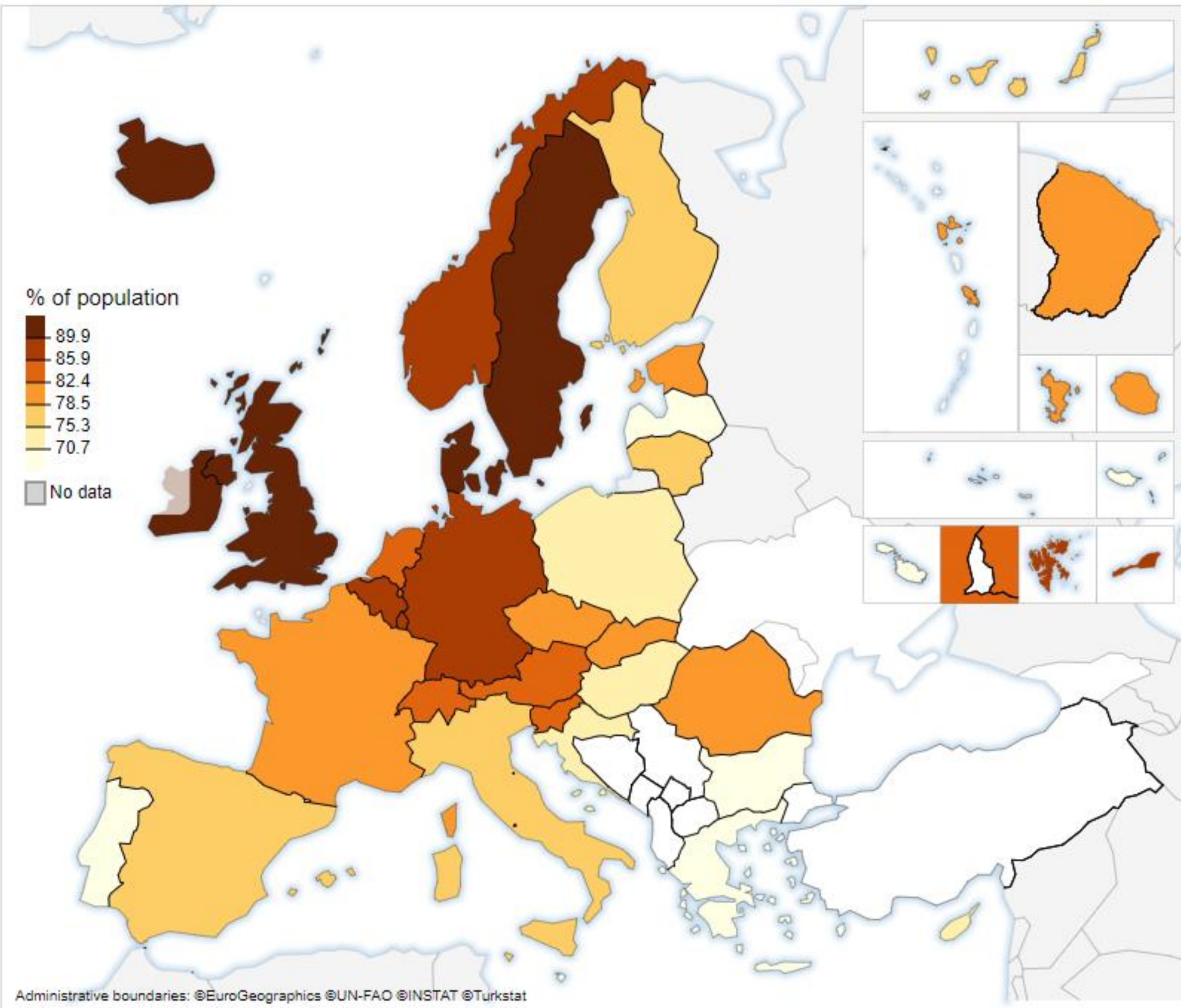

Figure 56 Map of Pop. Liv. dwellings comfortably cool during summer time indicator in 2012 (Source: EPAH, 2022a)

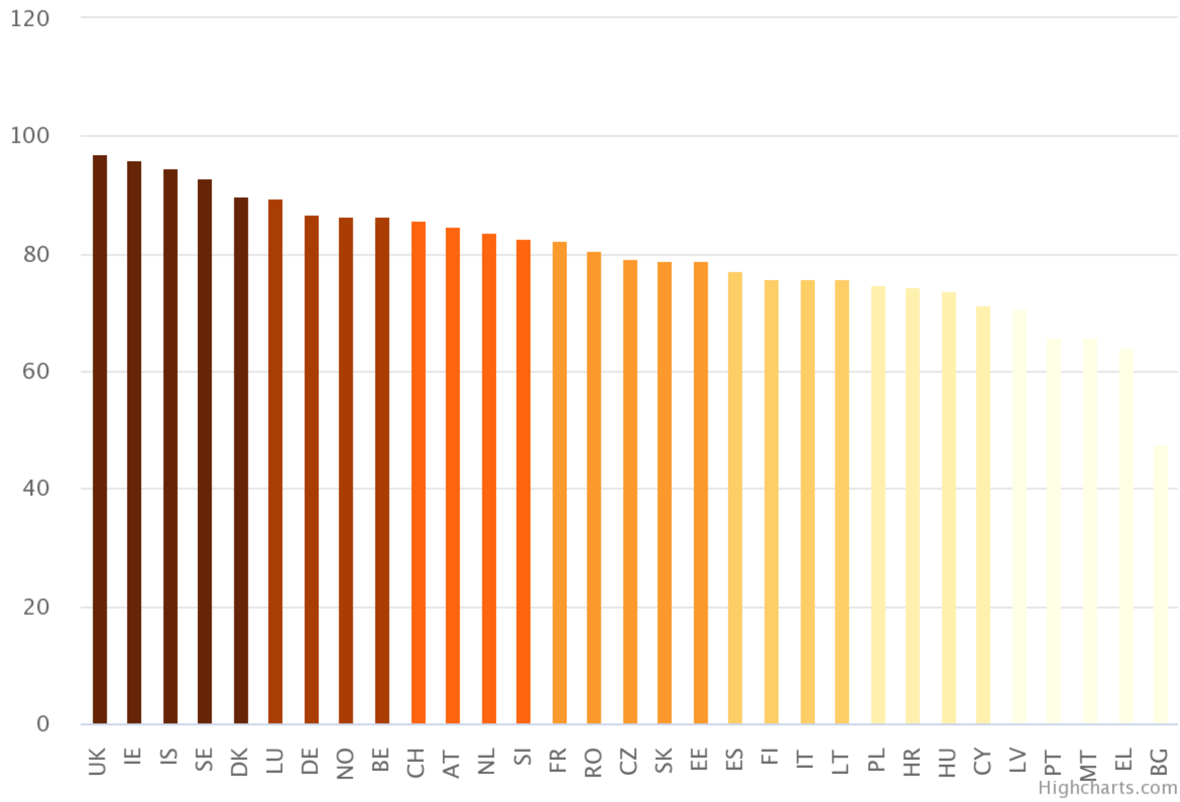

Figure 57 Pop. Liv. dwellings comfortably cool during summer time indicator bar chart from 2012 (Source: EPAH, 2022a)

4.2.19.2 Technical Details

Table 25 presents the technical details for the Pop. Liv. dwellings comfortably cool during summer time indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 25 Pop. Liv. dwellings comfortably cool during summer time technical details.

Identification Code	Name	Timeline	# GEO	Source
Not found	Pop.Liv. dwelling comfortably cool during summer time	2007 and 2012	32/44	SILC

The "Pop. Liv. dwellings comfortably warm during summer time" EU-SILC details can be observed in Figure 58 Note that in 2023 the indicator is presented as "in use," which may indicate new data for future updates. Moreover, this indicator is an ad hoc subject, meaning that the themes are of particular interest for users at a specific point in time but that are not included in the regular datasets.

HC070: INABILITY TO KEEP THE DWELLING COMFORTABLY COOL DURING SUMMER (OPTIONAL)

Topic and detailed topic: New policy needs module / Households energy efficiency
Variable type: ad-hoc module
Unit: Household
Reference period: Usual
Mode of collection: Household respondent
In use (period): Yes, 2007, 2012, 2023
Series' differences: Yes, Identifier (MH070 in 2007, HC070 in 2012)

VALUES AND FORMAT

1	Yes
2	No

FLAGS

1	Filled
-1	Missing
-7	Not applicable (Not collected according to the implementation of the "multiannual rolling planning")
-8	Not applicable (variable not collected)

DESCRIPTION

This variable informs if the household is able to keep the dwelling comfortably cool during the summer, taking into account the insulation of the dwelling and the cooling system in place. The purpose for this variable is to cover the following concerns: "Is the cooling system efficient enough to keep the dwelling cool?" and/or "Is the dwelling sufficiently insulated against the warm?"

This variable does not measure if the household:

– has financial resources to keep the dwelling comfortably cool during summer; or

is able to keep the dwelling comfortably cool during extreme weather situations, e.g. extreme heat waves.

Suggested questions:

HC070_Q1: Is your household able to keep the dwelling comfortably cool during the summer, taking into account the insulation of the dwelling and the cooling system you have in place? Please do not consider whether the household has financial resources to keep the dwelling comfortably cool during summer.

1. *Yes*
2. *No*

Figure 58 Pop. Liv. dwellings comfortably cool during summer time technical details from EU-SILC (Source: EUROSTAT, 2022)

4.2.19.3 Limits and application suggestion

The same considerations regarding the previous indicator apply to this "Pop. Liv. dwellings comfortably cool during summer time indicator." It should be noted that summer energy poverty is an increasing concern in the EU and is still an overlooked issue (Thomson et al., 2017).

***Example**: A person might feel comfortably cool in the summertime in their home, but that does not mean that they are able to maintain a comfortable temperature in case of a heatwave.*

Experiencing overheating increases the likelihood of reporting poor health by 1.3 times when compared to persons without being exposed to poor housing conditions (John et al., 2018). Excessively high indoor temperatures can cause heat-related illnesses and increase cardiovascular mortality. Improvements to indoor temperature may affect the psychosocial pathway by improving household occupants' perception of their homes and reinforcing social interaction with family and friends based on the increasing use of their houses. Poortinga et al. (2018) have reported evidence that improvements to indoor temperatures were associated with the use of more rooms in the house, enabling frequent visits from relatives and friends.

Therefore, there is a need to resume data collection on a regular basis to inform this indicator. Furthermore, to maintain consistency, data for an indicator representing the inability to maintain the dwelling adequately cool in the summer should also be collected to enable a more detailed and precise assessment of this problem in the summer season. Both indicators could arguably be considered primary and integrated into the EU-SILC. This indicator, combined with knowledge of the ownership of cooling systems, is essential for a comprehensive understanding of summer energy poverty vulnerabilities.

4.2.19.4 Updates and disclaimer

The “Pop. Liv. dwellings comfortably cool in summer time” is the new name for the former EPOV dwellings comfortably cool in summertime indicator. Data for this indicator was not updated due to the lack of data collected since 2012. However, according to EUROSTAT (2022), this indicator is expected to be updated in 2023.

In 2012, **79.1%** of the European Union population was **comfortably cool in summer time** (EPOV, 2020), corresponding to 348.4* millions of Europeans.

**considering that the European Union population in 2012 was 440.55 million, according to STATISTA (2022)*

4.2.20 Pop. Liv. Dwelling equipped with heating facilities

4.2.20.1 Current situation

The “Pop. Liv. Dwelling equipped with heating facilities” indicator represents the share of the population living in a dwelling equipped with space heating equipment.

Figure 59 and Figure 60 present the last data available for the “Pop. Liv. Dwelling equipped with heating facilities” indicator represented in a map and bar chart.

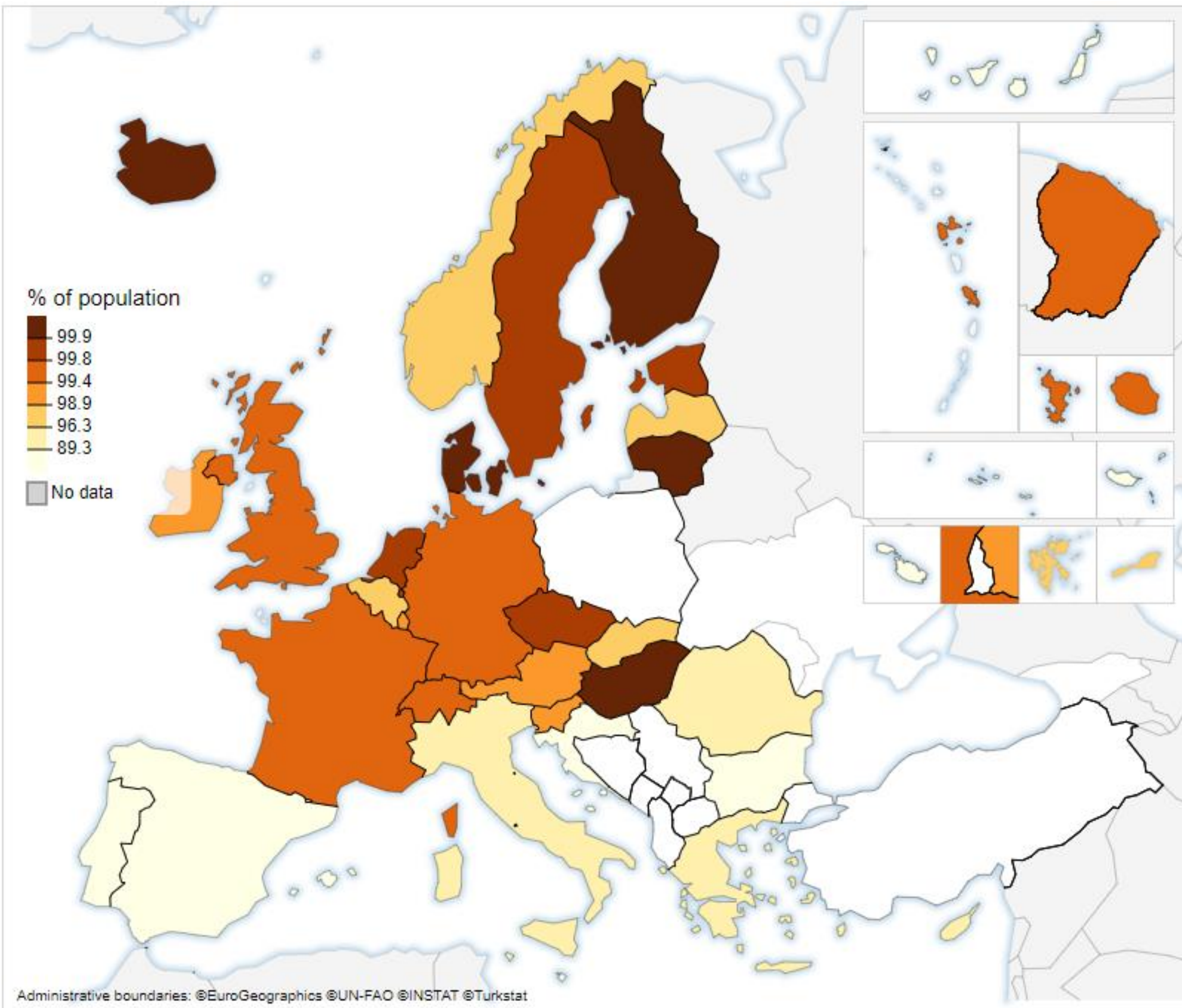

Figure 59 Map of Pop. Liv. dwelling equipped with heating indicator in 2012 (Source: EPAH, 2022a)

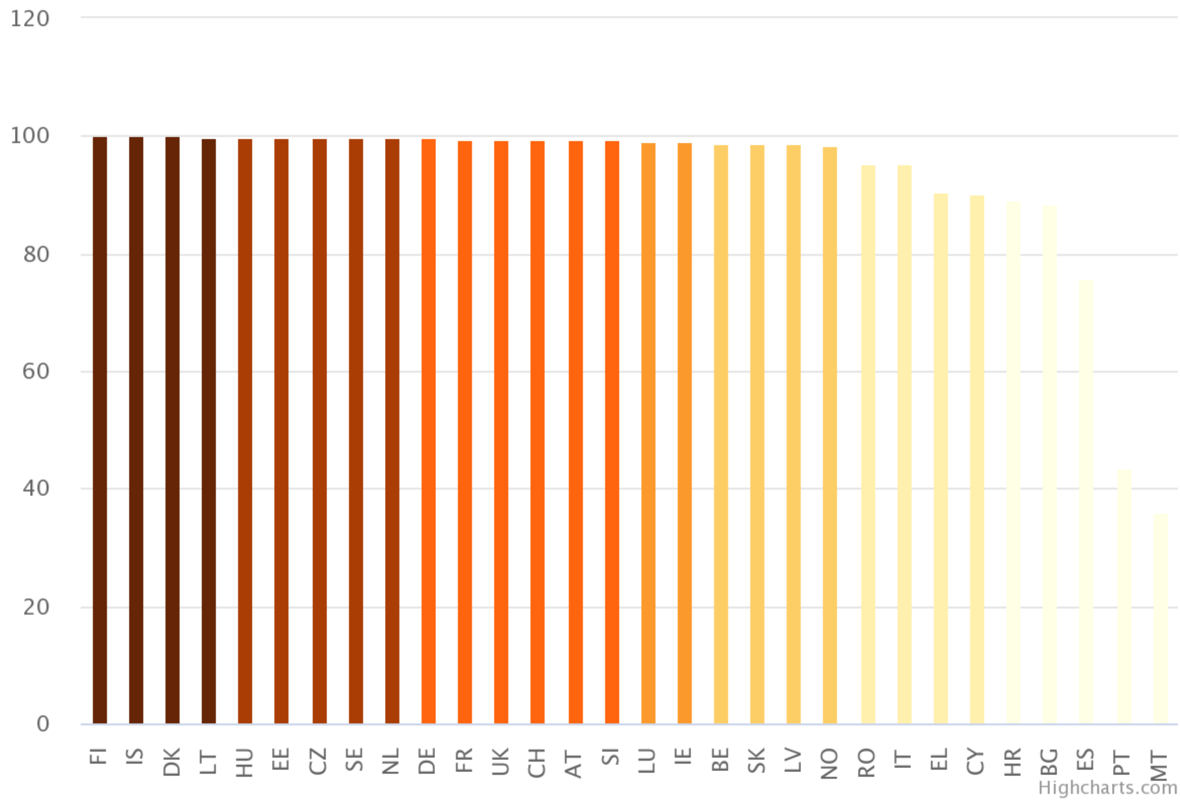

Figure 60 Pop. Liv. dwelling equipped with heating indicator bar chart from 2012 (Source: EPAH, 2022a)

4.2.20.2 Technical Details

Table 26 presents the technical details for the “Pop. Liv. dwelling equipped with heating facilities” indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator’s section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

Table 26 Pop. Liv. dwelling equipped with heating facilities technical details

Identification Code	Name	Timeline	# GEO	Source
Not found	Pop.Liv. dwelling equipped with heating facilities	2007 and 2012	31/44	SILC

4.2.20.3 Limits and application suggestion

Pop. Liv. dwelling equipped with heating indicator can be an important indicator for energy poverty diagnosis but does not represent the ability to consume energy and cope with thermal discomfort. While owning a space heating system can be a sign of increased adaptive capacity of a household and less vulnerability, this indicator does not differentiate between different heating systems. This is key as the type of system can significantly influence the ability to achieve thermal comfort.

***Example**: Using a heat pump compared to a fireplace means that the household is using a more efficient heating system. This is not sufficient information to understand their energy poverty status, as a household using the heat pump might be paying high electricity prices and restricting their consumption. At the same time, other might get very cheap fuelwood from neighbours and use it with restrictions.*

The energy efficiency and safety of the equipment and availability and price of the fuel are factors that vary according to the type of system and that impact vulnerability to energy poverty. This indicator provides an excessively simplistic portrayal of the equipment used by a household, not offering enough consequential information regarding their situation, especially considering that in most EU Member-States, most households own space heating systems. Knowing the ownership rate of equipment disaggregated by the type of equipment/energy carrier used would be more beneficial. Just like for the indicator equipped with air conditioning (next section), the fact that a household owns equipment does not necessarily mean that they use it (Gouveia et al, 2018). Thus, the cross-analysis of this indicator with data on space heating patterns, including duration, schedule, and proportion of space heated, as well as the type of energy carrier and equipment age and efficiency (Barrella and Romero, 2022), would potentially provide helpful information. Joint analysis with energy consumption levels and indicators representing the dwelling's size, energy performance, and efficiency could yield sounder conclusions on the capacity of the equipment to provide adequate warmth. Additionally, including energy costs, expenditure, and income in the analysis would enable the investigation of the financial resources necessary to achieve the level of warmth reached. Not differentiating the type of heating system also makes estimating required energy consumption in households more challenging, preventing a potential comparison between required and real energy levels, which can be a valuable energy poverty indicator.

4.2.20.4 Updates and disclaimer

The “Pop. Liv. dwelling equipped with heating” is the new name for the former EPOV’s households equipped with heating indicator. Data for this indicator was not updated due to lack of data collected since 2012 at EU level.

In 2012, **93.6%** of the European Union population lived in a dwelling **equipped with heating** (EPOV, 2020), corresponding to 412.3* millions of Europeans.

**considering that the European Union population in 2012 was 440.55 million, according to STATISTA (2022)*

4.2.21 Pop. Liv. Dwelling equipped with Air conditioning

4.2.21.1 Current situation

The “Pop. Liv. dwelling equipped with air conditioning” indicator represents the share of the population living in a dwelling equipped with air conditioning equipment.

Figure 61 and Figure 62 present the last data available for the indicator represented in a map and bar chart.

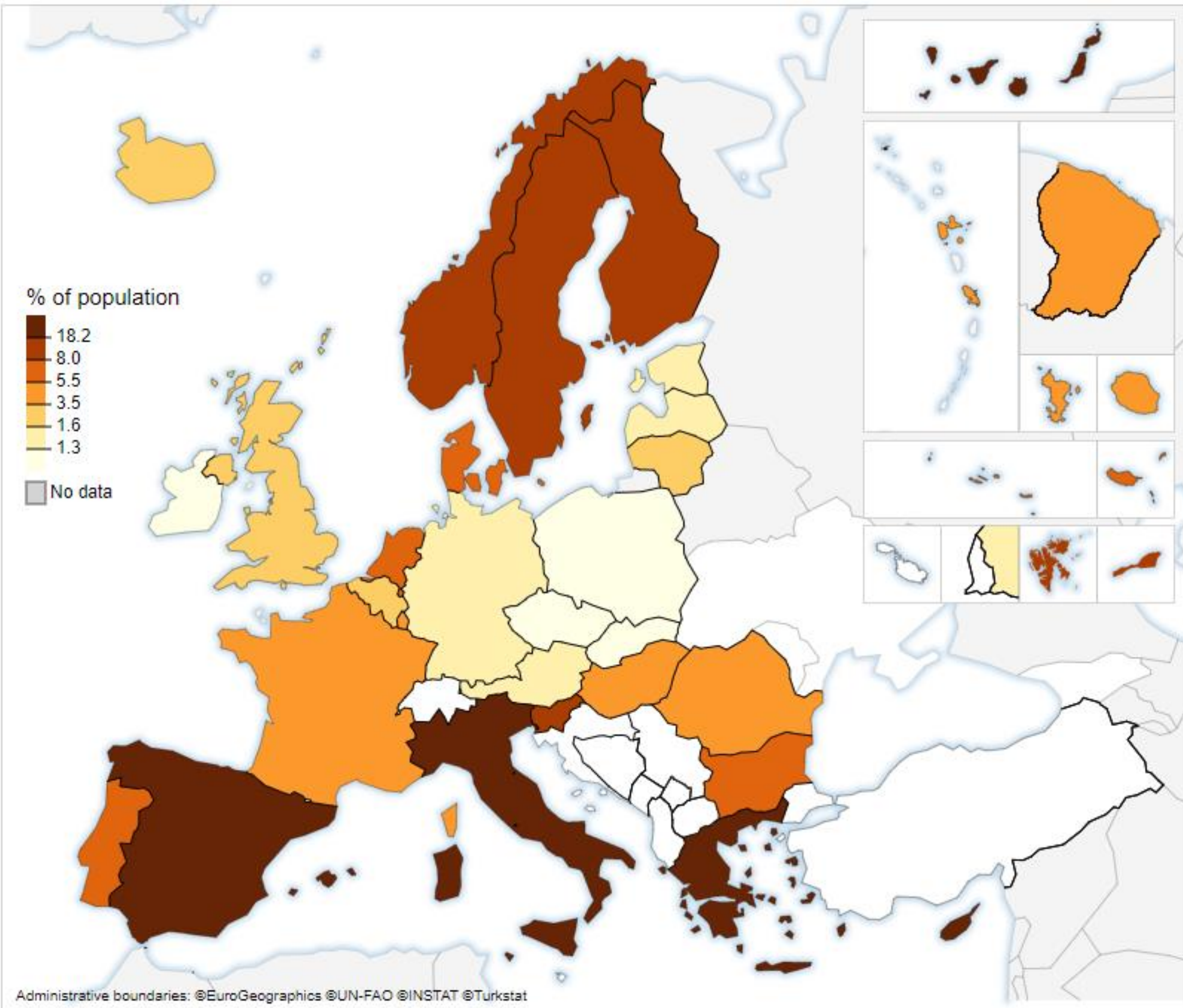

Figure 61 Map of Pop. Liv. dwelling equipped with air conditioning indicator in 2007 (Source: EPAH, 2022a)

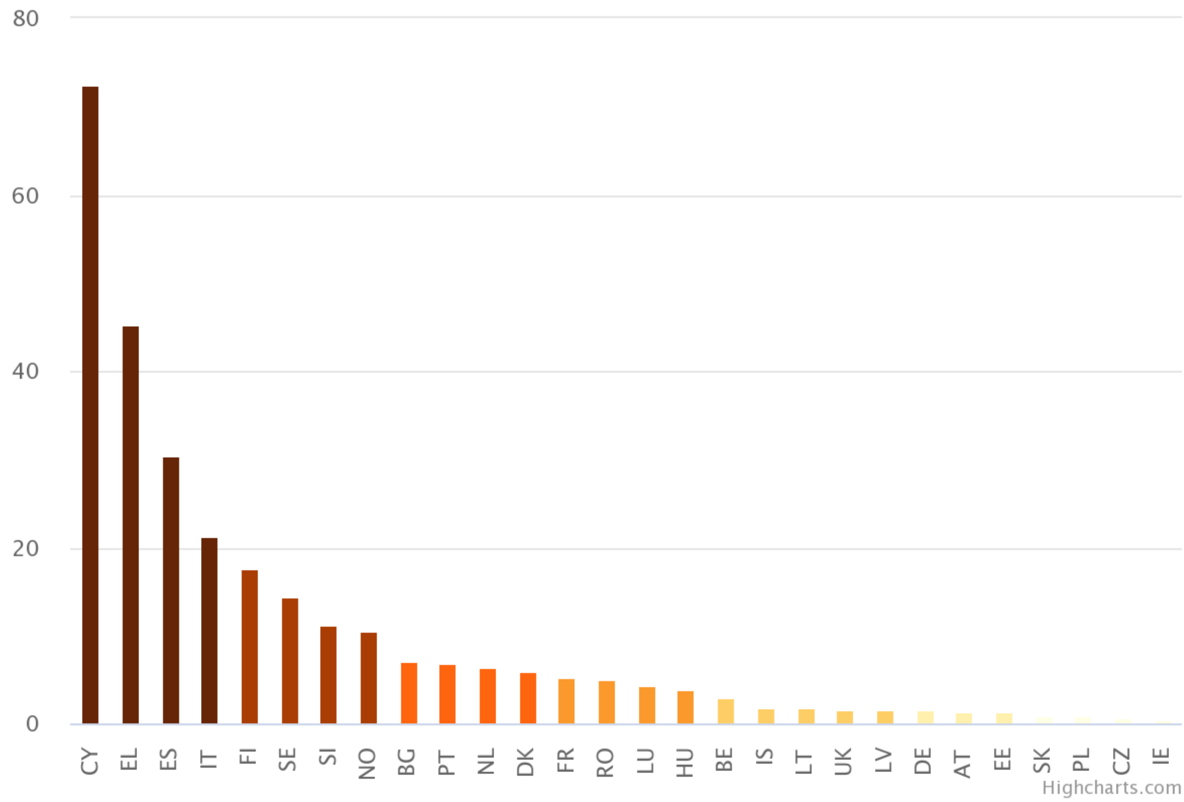

Figure 62 Pop. Liv. Dwelling equipped with air conditioning indicator bar chart from 2007 (Source: EPAH, 2022a)

4.2.21.2 Technical Details

Table 27 presents the technical details for the "Pop. Liv. dwelling equipped with air conditioning" indicator. The information presented is the statistical code used in the indicator source, the identification name used on the energy poverty national indicator's section of EPAH website, the timeline period with available data, the number of countries represented in the last update in relation to the maximum 44 GEO list, and the data sources used.

The air conditioning facilities are systems for controlling, especially lowering, the temperature and humidity of an enclosed space. These are systems that keep air cool and dry. Simple fans are not considered as air conditioning systems.

Table 27 Pop. Liv. dwelling equipped with air conditioning technical details

Identification Code	Name	Timeline	# GEO	Source
Not found	Pop.Liv. dwelling equipped with air conditioning	2007	29/44	SILC

4.2.18.3 Limits and application suggestion

The ownership of air conditioners is an indicator that can be used to assess the ability of households to cope with cold or hot temperatures by consuming energy for space heating and cooling. Nevertheless, it is not the only indicator determining that ability, as financial means and building construction characteristics are as important as having adequate equipment. A household can own the equipment but not have the means to use it (Gouveia et al., 2019), especially if living in an insufficiently insulated dwelling. Despite their high cost, air conditioners (heat pumps) can be one of the most energy-efficient heating and cooling systems, especially in warmer climates, potentially providing warmth or cooling at lower prices. This could lead to the assertion that the ownership of this equipment is an indicator of a greater ability to face thermal discomfort and move out of energy poverty. Nevertheless, significant increases in electricity consumption have been reported when households own air conditioners, exacerbated by the rising importance of cooling as a basic need due to climate change, which results in households spending a larger share of income on energy costs (Randazzo et al., 2020). This shift in energy demand and the difficulty in purchasing these efficiency systems might create inequality and increased vulnerability in low-income households. It can be argued that this indicator is relatively more informative for evaluating summer energy poverty, as space cooling is entirely provided by electricity and air conditioners. In contrast, space heating can be sourced from different energy carriers and heating systems.

***Example**: Owning an air conditioner is not a synonym for not being in energy poverty. A household might use other equipment for heating and live in a region with mild summers where natural ventilation is enough.*

Nevertheless, for both seasons, this indicator should be analysed with data on space cooling and heating habits, space heating and cooling energy needs and energy consumption, and expenditure data, as the ownership rate indicator is insufficient for predicting a household's vulnerability to energy poverty. Social practices such as ventilation are also important factors to be considered, as they are often considered more acceptable than air conditioning. It should be noted that ownership rates can be used for estimating dwelling energy needs and consumption requirements, a standard indicator used in energy poverty assessment. Data on dwelling fabric characteristics and climatization habits are also required in these approaches.

4.2.18.4 Updates and disclaimer

The "Pop. Liv. dwelling equipped with air conditioning" is the new name for the former EPOV households equipped with air conditioning indicator. Data for this indicator was not updated due to lack of data collected since 2012 at EU level.

In 2007, **10.1%** of the European Union population lived in a dwelling **equipped with air conditioning** (EPOV, 2020), corresponding to 49.7* millions of Europeans.

**considering that the European Union population in 2007 was 493 million, according to EUROSTAT (2022i)*

5

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