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Abstract

Energy poverty is an issue that considers several aspects acting together like households' income, energy costs, ability to keep the house warm, etc. This problem is gaining interest nowadays, especially due to the recent economic and geopolitical crises all over the World, Europe included. Different initiatives have been carried out so far to tackle energy poverty, but challenges that slow down the advancement of its evaluation in different countries remain. The European Public Health Alliance (EPHA) has provided in 2022 a common list of 21 indicators to assess the level of energy poverty in Europe. Nevertheless, there are still problems in its definition and measurement, especially in Western Balkans. In this research report, a complete overview of the energy poverty issue is provided, focusing mainly on two European countries (e.g., Italy and Sweden) and two Western Balkans (e.g., Albania and Bosnia and Herzegovina) that are partners of the GETA project. Starting from the definition of the 21 mostly used indicators of EPHA, some of them have been selected to measure and evaluate energy poverty in the previously mentioned Western Balkan countries according to both the characteristics and the available information coming from their remote and rural zones. Besides providing further details on energy poverty, the scope of this work is to build up the basis for the definition of the energy poverty tool and the GETA app to be developed during the project, providing reliable tools capable of assessing the energy poverty level in Albania and Bosnia and Herzegovina (BiH) properly, as well as a guideline on how addressing it as much as possible.

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1. Introduction

The awareness of institutions and individuals to different energy related contexts has driven many organizations in the European Union (EU) to describe future scenarios for 2030 and 2050. These scenarios have numerous similarities; for instance, Emissions Trading System (ETS) and non-ETS sectors could be reduced by 58-65% and 41-50% of their emissions in 2030, respectively. These predictions are followed by an overall reduction in fossil fuel consumption, such as a 70% reduction in coal usage and a nearly complete elimination from electricity generation systems. Furthermore, renewable energy could increase by a factor of 2 or 3 by 2030, and provide from 75 to 100% of the total electricity in Europe by 2050. Finally, the amount of power is expected to grow 2 to 3 times by 2050 through direct electrification, where 38% of the industry consumption would be electrified [1].

Renewable energies are a clear possibility for the elimination of fossil fuel consumption. The continuous development of renewable energy technologies allows the supply of electrical energy to remote regions with no grid connections. Furthermore, the development of energy storage systems is also a deterrent factor in fighting energy poverty as they can offer the possibility to store excess energy produced with estimated high efficiencies and supply energy when renewable energies are not available. Electrification is set to increase vigorously by 2050. The extension of the electrical grid is very important for the access of electricity to people in remote areas, improving individuals' quality of life and reducing the risk of energy poverty.

Despite significant progress in recent years in expanding energy access, over 750 million people in the World still lack electricity availability [2] and about 3 billion people rely on burning fossil fuels for some household activities like heating and cooking [3]. Indeed, energy poverty has an alarming impact on the most vulnerable citizens, particularly on ethnic minorities. Energy poverty is defined as the scarcity of any type of energy source, such as fossil fuels or renewable energy, to meet the basic needs of a house like heating, cooking, etc. This issue is present in many countries worldwide, and it has far-reached implications not only for individual and household life quality, but also for economic development, governmental aid, and environmental sustainability. According to the scientific literature, there are several indicators that have the purpose of addressing energy poverty. These indicators are measurable metrics used to track progress towards a specific objective. Regarding energy poverty, indicators help to identify strengths and weaknesses as well as initiatives aimed at reducing energy poverty and enhancing energy access. All the indicators recognised by the Energy Public Health Alliance (EPHA) were reported and some of them selected for tackling energy poverty issues in Western Balkans.

The aim of this research report is to provide a better understanding and context of energy poverty situation in some of the European nations (e.g., Italy and Sweden) and in Westerns Balkans, as well as identify effective strategies and actions to mitigate its effects and find a way out of addressing the negative effects of the energy poverty. Most of the potential indicators that are used for tackling energy poverty have been reported in this research report, and some of them have been selected to address the energy poverty issue in Western Balkans (e.g., Albania and Bosnia and Herzegovina (BiH)). The choice of using these indicators is due mainly to the ease of getting this information through questionnaires to locals, as well as the lack of proper equipment and

infrastructure capable of sending and acquiring data about the energy status of houses, respectively. The outcomes of this study will help in accessing energy services and promoting the energy transition in Europe and mainly in Western Balkans. It is worth noting that Western Balkans will undergo a wider analysis since the assessment of energy poverty in those places is the main goal of the GETA project.

The research report is structured as follows: Section 2 describes the energy poverty issue providing a definition and a global overview. Causes and concerns of energy poverty and the list of indicators to address it, which has been defined by European Public Health Alliance (EPHA), are reported. Section 3 deals with energy poverty in Europe focusing on Italy and Sweden. Section 4 is devoted to address the energy poverty issue in Western Balkans with a particular attention to Albania and BiH. Section 5 presents the list of indicators chosen among the ones recognized by EPHA together with the reasons behind their selection. These indicators are then used to evaluate energy poverty in Western Balkans and they will be used to develop both the energy poverty tool and the GETA app, which have the aim to provide guidelines on how to solve this issue in those zones. Finally, Section 6 reports the conclusions of the work.

2. Energy poverty

A broad overview of the energy poverty trend worldwide, starting from the past century till nowadays, is provided in Subsection 2.1. Subsection 2.2 focuses on the main general causes and concerns of energy poverty that affect the daily life of people in specific areas, mainly remote and rural ones that do not have a direct connection with national energy grids (e.g., electricity and natural gas). Subsection 2.3 reports the main energy poverty indicators from EPHA that have been standardized and used in other research works to evaluate the energy poverty level in the Eurozone. Some of these indicators will be then used to evaluate the energy status of the countries involved in the GETA project, particularly in Western Balkans.

2.1 Definition and overview of energy poverty

Energy poverty refers to people that have barely or no access to any kind of energy service [3]. In other words, energy poverty is related to people that cannot afford energy cost due to several reasons. Energy poverty can be manifest in several manners nowadays, and the main ones are listed below:

- Lack of electricity that leaves households and communities without the required power for lighting, cooking, refrigeration heating/cooling, and other needs;
- Pollutant energy sources dependence since energy-poor communities mostly rely on fossil fuels for satisfying their energy demand;
- Limited access to renewable sources and efficient technologies (e.g., efficient cook stoves, insulation, etc.) that can help to reduce energy consumption, costs, and dangerous environmental effects;

- Expensive bills in relation to household's incomes, driven by various factors such as economic instability and the financial circumstances of families, particularly their monthly incomes, have a significant impact on the inability to afford energy bills, ultimately resulting in financial insecurity.

Energy poverty is a big issue that affects low-income households, as well as the population living in rural areas that barely have access to energy sources. Starting from the last century, the electrification process involved cities and energy-intensive sectors. Important updates in the energy infrastructure and communication technologies have been performed so far, although some regions have had great advancements in energy production and infrastructure update and others have not. Indeed, there are still other nations that struggle to compensate for the high costs of energy evolution. In the late 1970s, an energy crisis occurred when different Western countries such as the United States, Western Europe, and Australia had energy shortages (e.g., lack of petroleum): this made the oil prices increase and showed that the energy system was vulnerable. Those events caused the energy poverty to worsen. Recently, energy poverty has gained the awareness and consciousness of the population. Several institutions, such as the International Energy Agency (IEA), have been constantly remarking on the importance of people having access to energy [4]. In this regard, the Sustainable Development Goal (SDG) 7 is an alliance created for achieving several objectives: one of these objectives established by the United Nations in 2015 states the guarantee of access to clean, secure, sustainable, affordable, and modern energy for everyone by 2030 [4]. These objectives are very likely to be obtained due to an energy transition and a necessary worldwide update of the energy infrastructure. The worldwide history of how the energy poverty issue has evolved shows the complexity to monitor and control energy-related technology, as well as economic and social factors. Moreover, it is interesting to highlight that energy poverty is not a single-factor issue since it varies depending on many factors. Both developed and developing nations experience energy poverty, with the latter showing higher evidence. It is interesting to have a panorama of energy poverty in different parts of the World (e.g., Africa, Asia, and Europe) and see how this issue evolved over the years.

Africa

Africa is currently facing financial difficulties, increasing risks of blackouts and rationing that strongly contribute to a sharp increase in energy poverty in this continent. With nearly one-fifth of the World's population, Africa accounts for less than 3% of the World's energy-related carbon dioxide (CO_2) emissions. As for other countries, Africans are experiencing negative effects of climate change, deeply worsening problems like water availability, reduced food production, increased frequency of extreme weather events, and lower economic growth [5]. Regarding the energy sector, countries representing more than 70% of the global CO_2 emissions have committed themselves to reaching net-zero emission targets by 2050 and, among them, there are 12 African countries. This target will be an ambitious plan to set up a new course for the global energy sector, which will attract investors and policymakers to contribute and invest in Africa. Access to affordable electricity requires bringing connections

to 600 million people in Africa (43% of the total population) [6]. This datum considerably affects the electrification speed rate to substantially face energy poverty, thus becoming a more challenging task for these nations. The African continent is also home to two of the most electricity-deficit nations in the World, namely Niger and the Republic of Congo; regarding the former, only 14.3% of the entire population has access to the electricity grid [7]. The steep increase of the population is another indicator that worsens the electricity inaccessibility among the African population. The poor electricity accessibility enlarges the high incidences of energy poverty across all continent. Furthermore, financial losses associated with the power sectors, poor energy infrastructure, lack of grid connectivity, lack of electricity affordability, and inefficient electrical systems in buildings are responsible for further lowering the electrification rate process. Considering all the issues previously mentioned, African nations need to adopt strategies that can speed up the electrification rate, especially working on a wiser use of energy. African resource-rich nations have traditionally relied on low-efficiency fuels for meeting their energy demand. As previously said, inefficient operational activities within the African power sectors contribute to significant distribution and transmission losses; indeed, the overall level of energy use efficiency in Africa is one of the lowest in the World.

Asia

More than 100 million people in Asia have no access to electricity; namely, 50% of them come from Indonesia, followed by Myanmar and the Philippines. Despite Brunei, Malaysia, Singapore, and Vietnam that have about 100% of the grid electrified, over 850 million people in Asia depend on biomass for their cooking basis [8]. The existence of energy poverty in many regions is primarily due to either people not being able to access energy services, or they are not able to afford them**.** On the other hand, improving the energy infrastructure and increasing the investment rates by promoting energy services [9] will make people exit energy poverty. Energy can be non-affordable due to low households' income, high energy prices, or high supply costs [10]**.** Because of this, there are three kinds of groups of people affected by the energy poverty issue: i) people with no energy access although they can afford it, ii) people with energy access although it is not affordable, and iii) people who neither have access, nor afford energy services. Nepal is a country that, despite having large resources of energy such as their big potential in hydropower, still faces energy poverty. A serious concern, which is gaining popularity throughout Asia, is the environmental impacts caused by energy poverty [11]. These factors include air pollution, an increase in the use of fossil fuels due to the discovery of new mines, and greenhouse gas emissions. In countries that may suffer from energy poverty, households without access to clean and modern energy sources will certainly heat their houses with traditional biomass fuels. Moreover, as South Asia has an increasing population growth, there is a greater demand for energy sources, therefore having a bigger reliance on fossil fuels as shown by Figure 1 (e.g., CO_2 emissions (kt) in South Asia from 1990 to 2020).

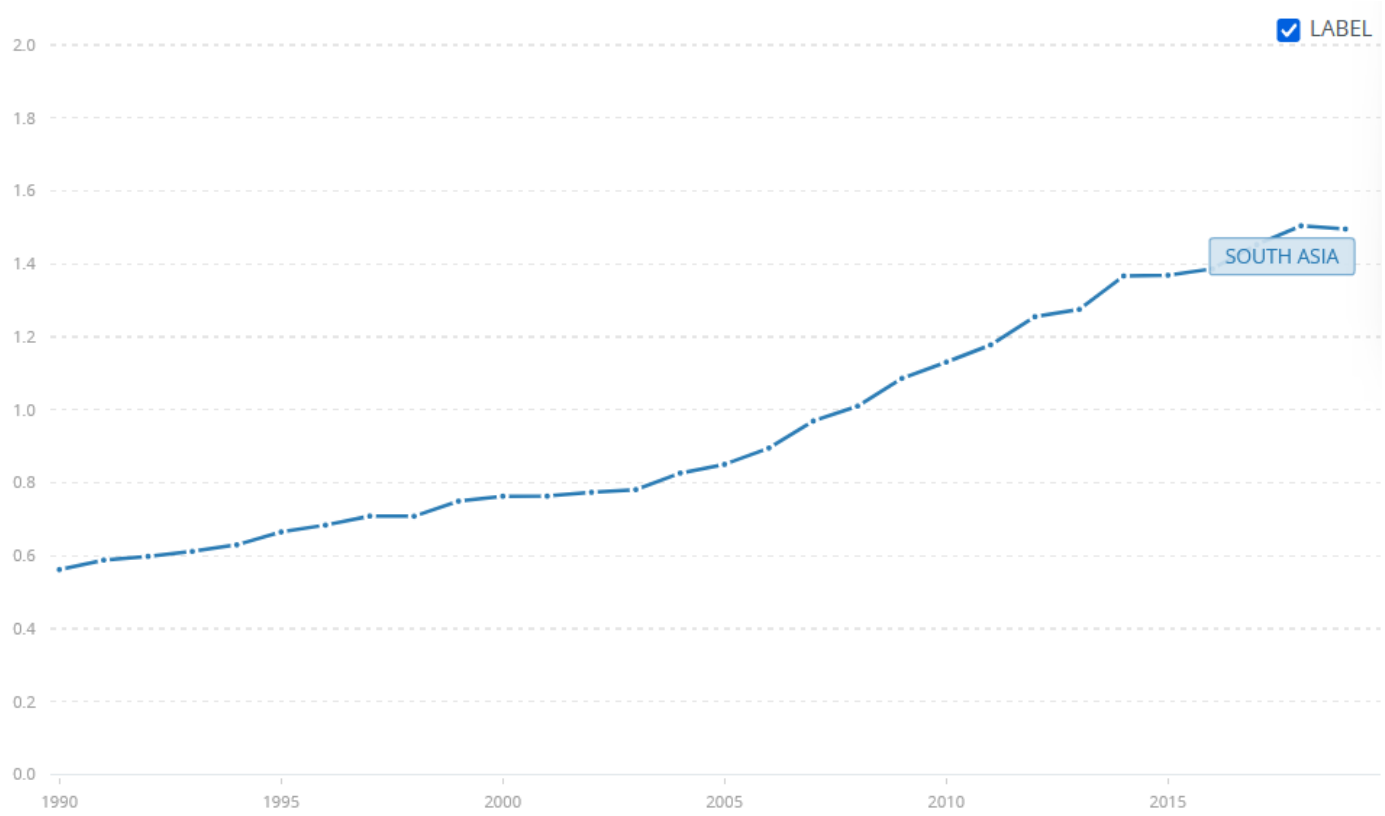


Figure 1: CO_2 emissions (kt) in South Asia from 1990 to 2020 [12]

Europe

In Europe there are nearly 34 million people affected by energy poverty [13]. Europe has already agreed on a common list of indicators to evaluate energy poverty in each country belonging to Europe: this means that the EU has adopted for obtaining data and measures is the Energy Poverty Observatory whose objectives are:

- Improve the dissemination of data among European countries;
- Provide a user-friendly and open source;
- Facilitate the diffusion of knowledge;
- Promote teamwork among member states;
- Provide technical assistance.

On the contrary, this action has not been taken yet in other countries worldwide. Indeed, Subsection 2.3 of this report provides a detailed explanation of the list of indicators commonly used so far for assessing energy poverty, as well as a common and standardised guideline for their practical application everywhere. The Energy Poverty Advisory Hub (EPAH) provided this common and standardised list of indicators. The widely varying information and estimations on energy poverty in the scientific literature makes devising and developing suitable policies

extremely difficult. EPAH has a two-fold goal: i) alleviate the energy poverty issue in Europe as much as possible and ii) push towards the energy transition and decarbonisation process. These objectives are in line with the current European policy that aims to replace fossil fuels with renewables while tackling the energy poverty issue [14]. Consequently, this process in Europe will lead to a considerable increase of electricity consumption since most of the involved sectors will be electricity-dependent, with the risk that some places will need to drastically adjust their energy consumption habits. This is not an easy task to perform since it requires strong changes of humans' behaviours in the energy management of their facilities, both from production and consumption sides. Most of the end-users in the future will be prosumers, meaning that they will be able to produce and consume energy locally and share the produced energy as well. In this part, it is interesting to get a very brief insight on the energy poverty situation in some European countries, which unfortunately are considered the most affected by this issue:

- Albania, whose situation will be treated in detail in Section 4, has a financial situation of households that is getting worse, leading to a great problem with energy sources according to a report done by the Inland Empire Health Plan (IEHP) in 2022. At least 37% of Albanians suffer from energy poverty, where the mean energy poverty of Europe was 6.9% in 2021 according to the European Commission. This result clearly shows the big difference between Albania and the average in Europe;
- Bulgaria has one of the highest rates of energy poverty in the EU according to the European Commission assessment. This is due to low earnings and a lack of access to modern energy services, mostly in low populated rural areas;
- Croatia has big issues with housing quality, which is the main deterrent factor that perfectly describes the energy poverty in this country. The poor quality is mainly due to bad insulation and old heating systems with low efficiency. This is shown by people in Croatia living in houses with damp walls, even without electricity connections [15]. Furthermore, energy costs have risen to such an extent that it has created a great disparity between households. There are high-efficiency homes that require a high initial investment, later reduced by a reduction in household expenses, however, there are also homes poorly constructed and may even lack basic needs such as water supply. These houses are usually illegally built [15]. The use of financial incentives and legislation modifications are one of the strategies used to attack these problems in Croatia [16];
- Cyprus has 20.9% of its population which is not able to keep homes adequately warm. One of the main issues concerning Cyprus institutions is the poor housing conditions in which some part of the population lives. Due to this, the government decided to produce housing schemes. Low-Cost Government Housing Scheme, Self-Help Housing on Government Land Scheme, Self-Help Housing on Private Land Scheme, and Purchase of a House/Apartment Scheme. The first three schemes are intended for low-income families and refugees, while the last one provides a subsidy to buy a house from the private sector;
- France has identified energy poverty though high energy prices and economic inequality. Electricity prices in February 2022 including taxes were 28.3c€/kWh, while, when compared to Spain (24.1c€/kWh), France´s electricity prices are higher [17]. Moreover, in 2021, France exhibited a considerable income inequality ratio of approximately 4.41, primarily driven by disparities between the elderly and adult

population [18]. In France, such as in other European countries, there are many support programs that help vulnerable households with financial support to combat energy poverty;

- Germany, compared to other countries such as Bulgaria, has a much lower energy poverty rate achieved, but energy efficient measures and social subsidies. One of the problems to deal with in Germany is the energy transition related to energy poverty. The transition is towards renewable sources: it is set that by 2030 half of the energy produced in Germany will be by renewable sources and coal use in energy production will be eliminated by 2038. Moreover, the most interesting fact about Germany is its denuclearization as it is set to be an accelerated phase-out of nuclear energy by 2022 [19];
- Greece is faced with the country's economic crisis that has contributed to high rates of energy poverty. One of the main problems is the increase in public debt that may lead to a bigger recession. Additionally, Greece's geographical location significantly influences the extent of energy poverty in the country. This can be attributed to the prolonged periods of hot weather experienced during the summer season, coupled with relatively mild winters characterised by higher temperatures compared to other European nations (see Figure 2);
- Today, about 4% of the population in Hungary, Ireland, and Belgium experience energy poverty. Hungary is one of the most affected country by this issue due mainly to the inability of keeping houses adequately warm. Wood is used for cooking or heating, but its price increased considerably so that people struggle to afford it [20]. In Ireland, people experiencing energy poverty spend more than 10% of their income on energy bills. Regarding Belgium, two of the main problems related to energy poverty are related to both the income and the poor-quality housing; in particular, 20% of the Walloon region faced with this issue in 2016 [22];
- Latvia and Slovakia both have a low percentage of energy poverty. However, Latvia has about 10.5% of its population with absolute low energy expenditure, registered in 2015, compared to 14.6% of the average EU [23]. On the other hand, Slovakia has future targets to reduce considerable its CO_2 emissions by 2030 and increase the awareness of renewable energy usage and production [24];
- Lithuania is also severely affected by energy poverty, and in the present days' energy prices are increasing. The Lithuanian National Energy Regulator (LNER) states that the average price to heat a house in Lithuania increased by 99% over a year, from 2021 to 2022, and even further there was a 181% increase in heating price from 2020 to 2022. In Lithuania, energy prices are not regulated by the government, and this could be an aggravating factor of their high costs since the government does not monitor or provide subsidies to heating providers (see Figure 3);
- Malta has a relatively low percentage of energy poverty compared to other European countries as shown in Figure 3. However, energy poverty is still an important issue in this country, and this is because the main cause of energy poverty in Malta is high energy costs, both electrical and from other energy sources. The electricity cost in Malta is 0.144 USD/kWh [25]. The possible reason for the high energy prices could be the inefficient energy infrastructure or the high costs of energy distribution. Due to the geographical position of Malta, it is more complicated for energy distribution. Malta has the third lowest final energy consumption, reinforcing the low energy efficiency in the electric distribution [26];

- Portugal is one of the European countries in which more than 15% of its population is unable to keep their home adequately warm in 2020 [27]. In the latest years, the evolution of energy poverty has remained constant and decreasing;
- Romania has a high percentage of energy poverty like Bulgaria, mainly in remote and rural areas. Many Romanian houses rely on solid fuels for satisfying their energy demand such as wood or coal for heating and cooking, which can be costly and hazardous to people´s health;
- Spain experiences energy poverty in the form of high energy costs as well as the seasonal high demand. These two factors can be combined into a single one. Due to difficult weather conditions such as heat waves in summer there will be a higher energy demand; for instance, more people using air conditioning. Due to the higher demand, the cost of energy consumption will be greater. Several measures are considered to reduce the effects of energy poverty and increase the offer of energy sources; for example, in the last year the Spanish government limited the usage of air conditioning or heating devices to save energy [28]. About 11% of the Spanish population is unable to keep their homes adequately warm [29]. A non-governmental business in Zaragoza (Spain) named ECODES is working hard to palliate the effects of energy poverty by investing in several initiatives such as *"Ni Un Hogar Sin Energía"* (Not a household without Energy). This initiative provides strategic assistance to the Spanish population by making people understand how their energy bills work or how to efficiently improve their housing [29].

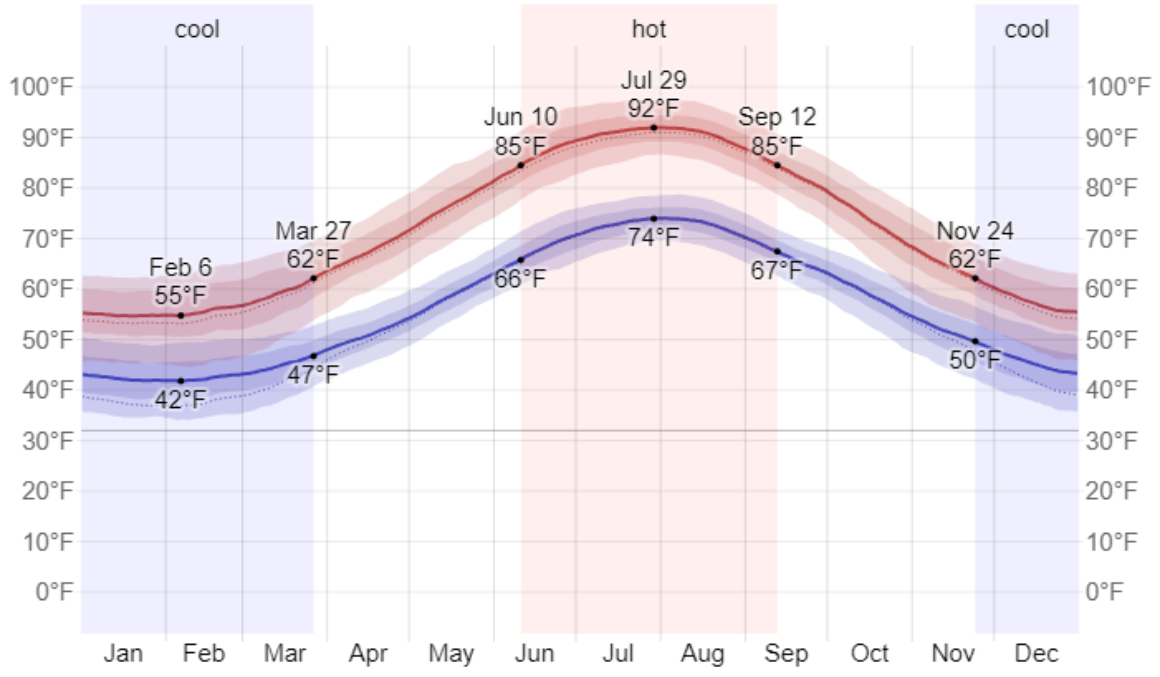


Figure 2. Average High and Low Temperature in Athens, Greece [30]

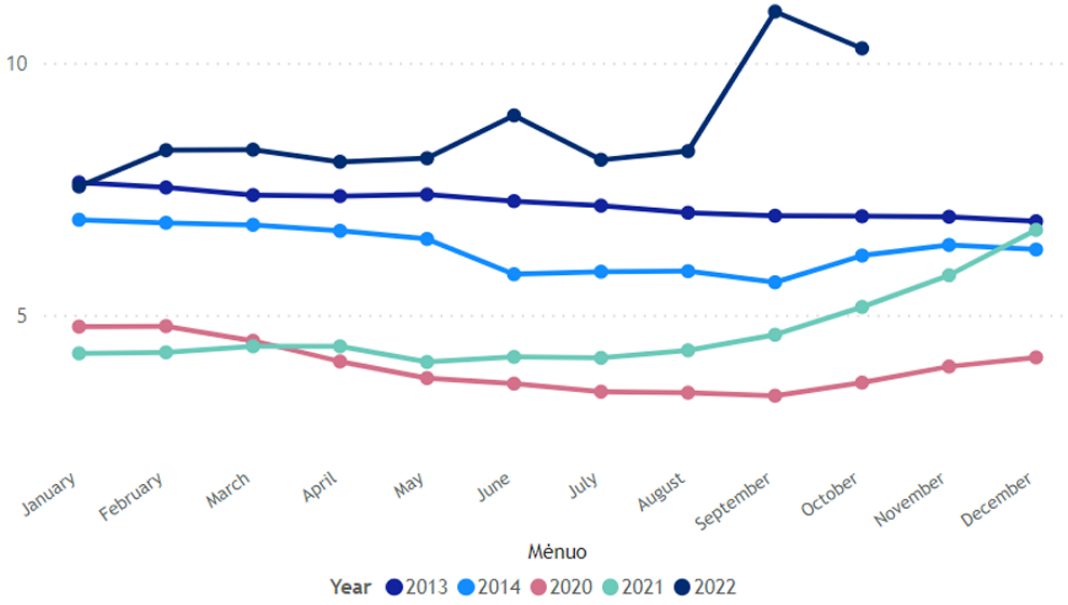


Figure 3. Average heating prices (c€/kWh) in Lithuania in different years [31]

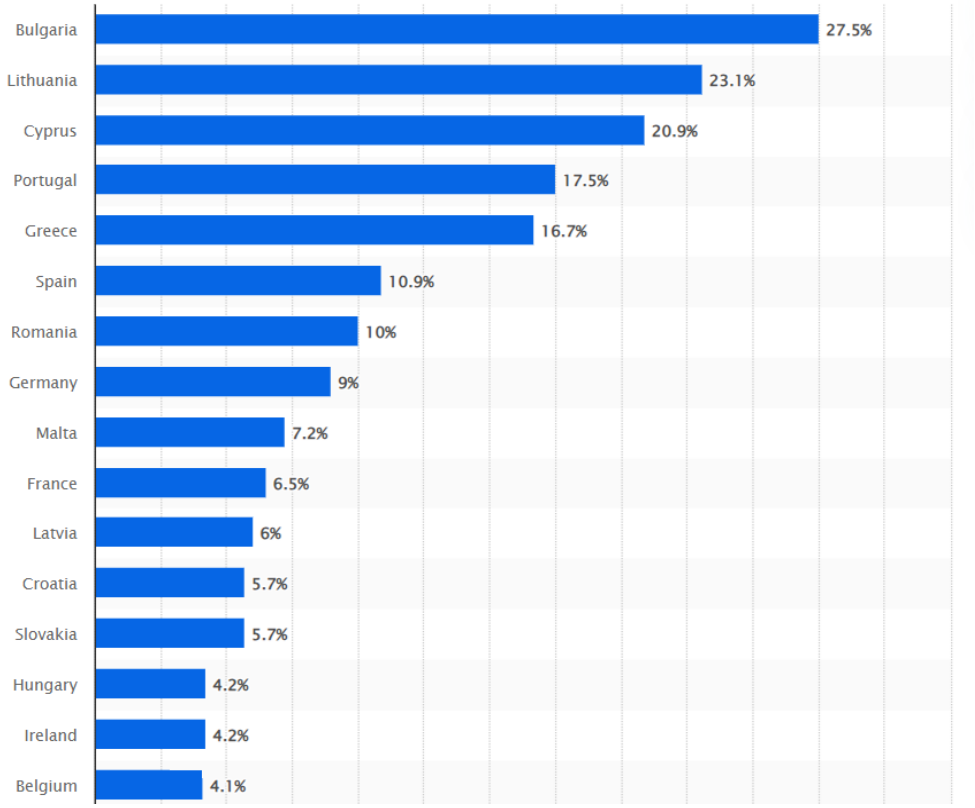


Figure 4. Share of households by countries unable to keep their home adequately warm in Europe 2020 [32]

2.2 Causes and concerns of energy poverty

Labelling energy poverty is a very complex issue that requires the help of governments and institutions to tackle and face its negative effects. Energy poverty is present worldwide in many ways; for instance, the increase of renewable sources capacity and their energy exploitation are the most important actions to be carried out since they are starting to be more affordable and being applied in rural areas. Nowadays, renewable sources can reach high power levels to sustain entire houses and big industries' energy demands. Governments also offer capital investments for their development to speed up this process. The causes of energy poverty come from different factors:

- Low household's income is one of the main causes of energy poverty, meaning that a household must spend a significant amount of money on energy bills. It leads to financially difficult situations and negative impacts on the overall life quality. Low household's income can be directly linked to the Gross Domestic Product (GDP);
- Lack of energy sources is another big issue widely present in some countries worldwide. This is due to the lack of energy infrastructure and heterogeneity in energy production;
- Lack of awareness in the population is also a cause of energy poverty as many households are unaware of how energy efficient their houses are and how reducing their energy bills. This reason makes it more difficult to mitigate energy poverty as some people have a bare idea of what this issue involves. Moreover, some citizens may also lack knowledge of the existence of certain renewable energies. The lack of information in rural areas also produces a lack of awareness as it makes it more difficult for the rural population to have energy efficient practices, as well as the ongoing updates in energy efficiency across the World;
- Seasonal variation makes some regions more vulnerable to energy poverty in certain seasons such as winter. Due to the high demand for heating resources, energy prices will increase. Furthermore, some individuals may run out of heating sources such as wood or coal, and not be able to keep their homes adequately warm;
- Climate change is an important cause of energy poverty because increasing temperatures and extreme weather events will increase the demand for warming or cooling systems, resulting in higher electricity or energy prices. In addition, extremely high-temperature conditions such as heatwaves or droughts will produce a water shortage in the future that will affect both humans' life in terms of survival and energy production (e.g., hydropower);
- Energy market dynamics affect the final energy prices, consumer, and manufacturer actions. Liberalisation and privatisation of the energy market can affect energy poverty in a country and sometimes it leads to energy oscillating prices, which makes it unaffordable for some energy consumers;
- High costs are a serious matter of energy poverty. Providing modern energy services in poor countries can be expensive, especially in rural areas. This makes it difficult for governments and private companies to invest in energy infrastructure resulting in a lack of access to modern energy services. In addition, poor countries that cannot produce energy independently must rely on other countries, so this dependence makes energy costs from other countries increase.

Demographic factors have a big role in energy poverty and, among them, there are two important ones to be considered: i) the location of the country and ii) the location of a specific place inside the country. Rural and urban zones may experience different types of energy conditions. Rural areas may have more limited access to energy sources or lack of electrical grid connections. Due to this, rural areas may face bigger problems such as electricity scarcity or higher energy costs than urban areas. Other countries may experience heavier extreme conditions during the year, especially in winter. Because of this, some individuals must pay higher energy prices to keep their houses warm during the year, so some households may not be able to afford this. The immediate impact of energy poverty is often indebtedness as people on low incomes are faced with bills they cannot meet. Not using energy is not really an option. Reducing consumption is often difficult because of housing and household circumstances. However, the main reason for debt is not so much bad financial management, but the impossibility of making ends meet with rising fuel prices and stagnant or reduced incomes, including social benefits. Increases in domestic energy prices have long been regarded as the crucial underpinning of energy poverty. High costs are a serious matter of energy poverty. Providing modern energy services in poor countries can be expensive. This makes it difficult for governments and private companies to invest in energy infrastructure, resulting in a lack of access to modern energy services. In addition, poor countries that cannot produce energy independently have to rely on other countries, so this dependence makes energy costs from other countries increase. Energy poverty is a closed cycle. A poor energy country has no access to energy sources so their energy demand is very high; therefore, if the country wants energy sources, they will buy them from another country. Due to the high energy demand, the cost at which the energy is sold is very high, so poor countries are not able to afford it. Not being able to afford energy sources or directly not having any kind of energy sources such as fossil fuels, or the capability of extracting them, makes the countries' society even poorer. In the worst cases, energy bills debt can result in cut offs and evictions. Households lose their right to fuel as energy companies cut off their supply for non-payment leading to untold hardship, increasing difficulties with their housing and risks of housing exclusion. An increasing number of studies demonstrate the severity of the impact of energy poverty on the health for different groups. Most often this is due to living in cold, bad housing. People on low incomes are often forced to cut back on heating because of cost, or to switch to less healthy forms. Poor construction compounds the problems: this result is not only deteriorating health and well-being, but significant indirect impacts. The rate of deaths in winter is strongly linked to the quality of the housing and capacity to heat it adequately. Energy poverty is found to impact first and hardest on the health of the most vulnerable like children, elderly people, and people with chronic conditions. It is not just physical health that is affected. People in energy poverty are particularly susceptible to mental health problems. Living in cold housing causes anxiety, can lead to social exclusion and isolation, can have a negative impact on self-esteem and the capacity to manage. When referring to the main consequences addressed by energy poverty, they can be split into direct and indirect effects on individuals within a society. A direct consequence of energy poverty is described as the instantaneous impact on the lack of energy sources. On the other hand, an indirect consequence is described as the impact of energy poverty produced by an intermediary factor. Direct and indirect consequences may include health, social, and economic impacts.

Direct consequences

- The economic impact is a clear direct consequence of energy poverty; for instance, countries that are rich in petrol have a big economy that in these years is being reduced due to the deployment of renewables. Furthermore, energy poverty can have bigger economic consequences on a national scale. For example, limited access to modern energy services can slow down economic development by making businesses operate inefficiently, or not being able to expand due to a lack of reliable energy sources;
- Environmental effects belong to the direct consequences of energy poverty.

Indirect consequences

- Educational problems are an indirect effect of energy poverty. Having access to the internet, for example, is a big factor that affects educational purposes; therefore, having no electricity or limited electricity in schools reduces the capability of students to go further in their learning. The education level is negatively correlated with energy poverty; this means that an increase in the education levels leads to a significant decrease in energy poverty;
- Social effects are also a big issue. Energy poverty can exuberate poverty by contributing to social inequalities. Due to this difference in society, households without access to electricity or modern energy services can be less able to access healthcare, education, and other basic services.

2.3 Energy poverty indicators

Energy poverty indicators are multidimensional measures that are used to describe the levels of energy poverty in each country or region. These indicators are usually directly related to the causes of energy poverty, so a cause of energy poverty can be directly an indicator used by any institution. There is a wide range of commonly used indicators around the World to assess the energy poverty issue. EPHA has proposed the following 21 ones, which can be divided in primary and secondary indicators [14].

Table 1: List of the 21 common energy poverty indicators proposed by EPHA [14]

Primary indicators
Arrears on utility bills
Low absolute energy expenditure
High share of energy expenditure in income
Inability to keep home adequately warm
Secondary indicators
Fuel oil prices
Biomass prices
Coal prices

District heating prices
Dwelling comfortably cold in summer time
Dwelling comfortably warm in winter time
Dwelling in densely populated areas
Dwelling in intermediately populated areas
Dwellings with energy label A
Equipped with air conditioning
Equipped with heating
Excess winter mortality/deaths
Household electricity prices
Household gas prices
Number of rooms per person by renters/owners/total
Presence of leak, damp, and rot
Energy expenses income quintile 1, 2, 3, 4, and 5

There are some boundary conditions in the energy poverty indicators, namely the different criteria used to define if an individual or household can be considered energy poor or not. The first boundary condition is commodity prices. Commodity prices affect the cost and reliability of energy sources, and they can have a significant impact on energy poverty. High commodity prices can exacerbate energy poverty in many cases, affecting the most vulnerable individual such as people with low income. On the other hand, commodity prices can help to promote renewable energy access and reduce energy poverty. For example, a decrease in the cost of renewable sources would make the energy market more competitive and reduce the high prices of fossil fuels. Dimensions are also an important boundary condition. There are many dimensions that depend on the number of indicators used to analyse energy poverty. For example, a two-dimension boundary condition would contain two indicators such as low household's income and house location. The number of indicators (dimensions) used to analyse energy poverty can be many: the more dimensions to describe energy poverty, the more specific the analysis. Energy poverty indicators are often used in combination with others, yet the previous indicators mentioned are globally known indicators. Despite these indicators, each place must have its own indicators. Furthermore, there are primary indicators and secondary indicators, which can vary significantly depending on the region of the analysis as countries have different priorities. Among the 21 indicators previously listed, there are four main ones:

1. Arrears on utility bills. Addressing utility bill arrears is an important strategy in preventing energy poverty. Governments can predict and prevent electrical or gas disconnections, therefore ensure that households continue to have access to energy services by providing financial support to people with unpaid bills;
2. Low absolute energy expenditure. This indicator can identify which families are most at risk of not being able to pay bills by searching and analysing the energy expenditure across different communities. If a given proportion of households in a country or region has low absolute energy expenditure, this will demonstrate that the cost of energy sources is very high. Politicians can use this indicator to create policies that address this issue such as helping with difficult financial situations or investing in importing a greater extent of energy resources;

3. A high share of energy expenditure in income. This indicator, as most of the others, is used to analyse the extent of energy poverty and find the vulnerable population to this problem. Governments develop targeted interventions to address energy poverty by analysing the percentage of household's income spent on electricity, gas, etc.;
4. Inability to keep homes adequately warm. This indicator reflects the capability of the households to have their basic needs. Not being able to keep their homes warm could mean two things: the first one is that their houses can be poorly insulated or they are unable to pay their bills. Both reasons are a direct factor of energy poverty; therefore, addressing this would convince individuals to update their homes with grants given by the government or act directly on the energy market and reduce energy prices.

Table 2. Overview of Secondary Indicators [33]

Type	Indicator	Description
ENERGY PRICES	Fuel oil prices	Average household prices per kWh generated from fuel oil
	Biomass prices	Average household prices per kWh generated from biomass
	Coal prices	Average household prices per kWh generated from coal
	Household electricity prices	Electricity prices for household consumers, band Direct Current (DC) 2500-5000 kWh/year consumption, all taxes and levies included
	District heating prices	Average household prices per kWh from district heating
	Household gas prices	Natural gas prices for household consumers, band 20,200 GJ consumption, all taxes and levies included
CONSENSUAL-BASED	Dwelling comfortably cold in summer time	Share of population, based on the questions "Is the cooling system efficient enough to keep the dwelling cool?" and/or "Is the dwelling sufficiently insulated against the warm?
	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?"

	Presence of leak, damp, and rot	Share of population with leak, damp, or rot in their dwelling, based on questions "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
EXPENDITURE-BASED	Energy expenses income quintile 1, 2, 3, 4, and 5	Consumption expenditure for electricity, gas, and other fuels as a share of income for income quintile 1-5
BUILDING STOCK FEATURES	Dwelling in densely populated areas	Share of dwellings located in densely populated areas (at least 500 inhabitants/km^2)
	Dwelling in intermediately populated areas	Share of dwellings located in intermediately populated areas (between 100 and 499 inhabitants/km^2)
	Dwellings with energy label A	Share of dwellings with an energy label A
	Equipped with air conditioning	Share of population living in a dwelling equipped with air conditioning facilities
	Equipped with heating	Share of population living in a dwelling equipped with heating facilities
	Number of rooms per person by renters/owners/total	Average number of rooms per person in rented/owned/all dwellings
POVERTY AND HEALTH RISKS	Excess winter mortality/deaths	Share of excess winter mortality/deaths

Besides being grouped, energy poverty indicators are also classified by categories as shown in Figure 5; however, the EU reviewed some metrics, which are classified depending on their approach (e.g., expenditure- or consensual-based) to measure and monitor the relevant aspects of the energy poverty measures.

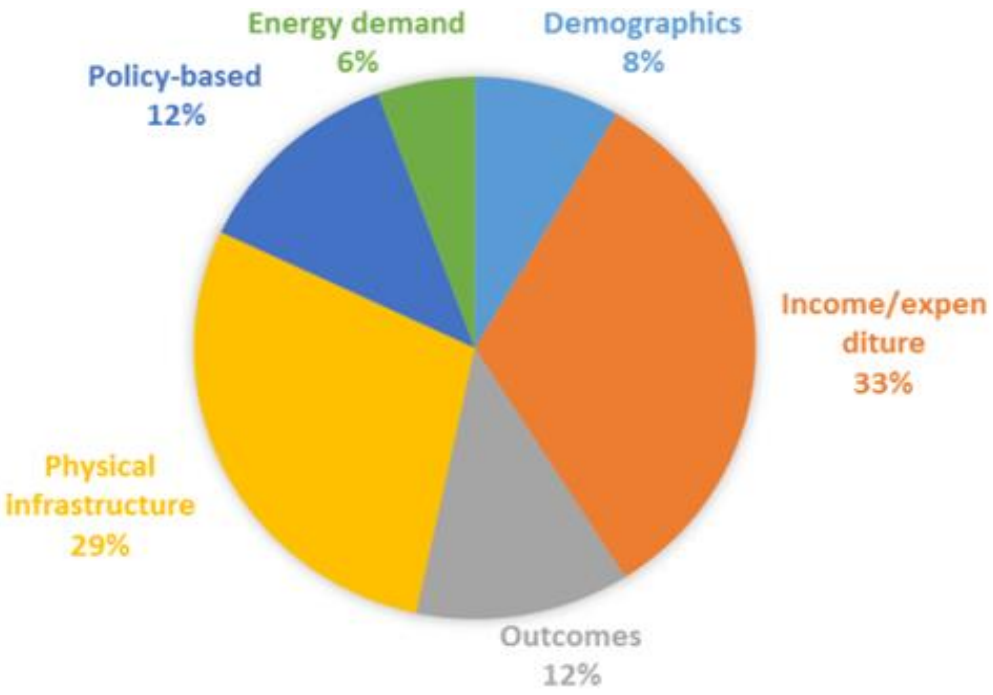


Figure 5. Energy poverty indicators classified by category [34]

Initiative	Energy poverty metrics	Approach
ONPE	• 10% energy cost ratio	Expenditure-based
	• Low Income High Costs (LIHC)	Expenditure-based
	• Survey data on lack of heating discomfort	Consensual-based
EU Fuel Poverty Network	• % of households unable to afford to keep their home adequately warm;	Consensual-based
	• % of households in arrears on utility bills	Consensual-based
	• % of households living in dwellings with a leaking roof, damp or rot.	Consensual -based
Insight_E Observatory	• % energy expenditures	Expenditure-based
	• share of energy cost in low income household revenue	Expenditure-based
UK Fuel Poverty Statistics Report	• LIHC	Expenditure-based
Belgian Energy Poverty Barometer	• **Measured Energy Poverty (MEP) extent**: households in the lower five deciles of equivalised incomes whose energy expenditures were higher than threshold • **MEP depth**: energy poverty gap (in €) *above* "acceptable" energy bill	Expenditure-based
	• **Hidden Energy Poverty (HEP) extent**: households whose energy bills are "abnormally low" • **HEP depth**: energy poverty gap (in €) *below* "acceptable" energy bill	Expenditure-based
	• **Perceived Energy Poverty (PEP)**: number of households that report having financial difficulties in heating their homes sufficiently	Consensual-based
Energie-Control Austria	• Households below established poverty "risk" threshold AND with above-average energy costs[13]	Expenditure-based
Report "Energy Poverty in Spain"	• MIS (Minimum income standard)	Expenditure-based

Figure 6. Key energy poverty metrics [34]

The expenditure-based approach focuses on the analysis of households' income and expenditure for paying energy bills; in this way, governments can assess how the problem can be approached. There is a threshold value

based on predetermined criteria for low-income households. Figure 7 shows how expenditure-based elements are sorted.

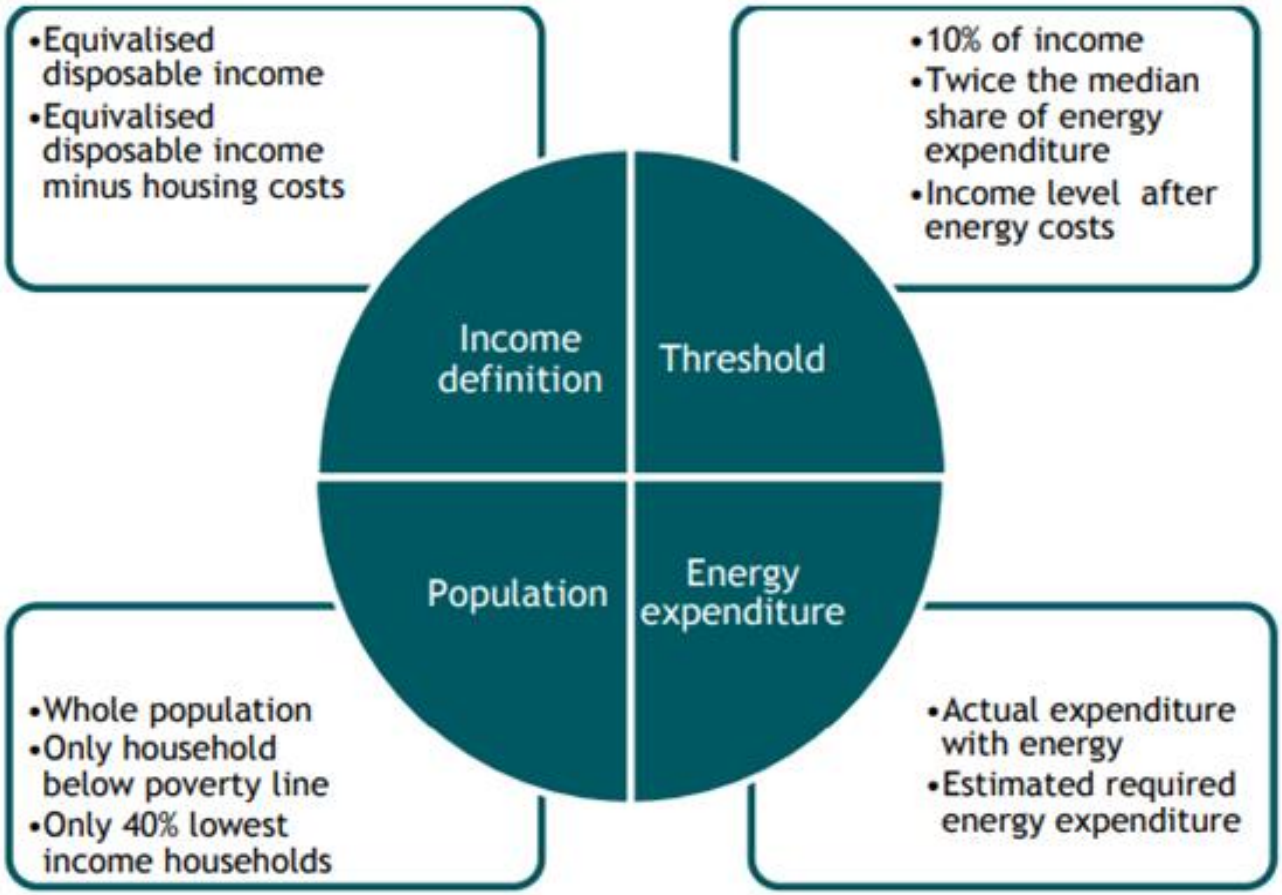


Figure 7. Summary of elements for the expenditure-based metric and possible choices [34]

The consensual approach is based on an individual's profile. The basis is to ask individuals if they are suffering from energy poverty or not. It aims to analyse the energy poverty issue by understanding it through a qualitative point of view in which households are directly involved in the analysis [34]. This process is usually done by survey-based approaches, which gives a clear image of how the population feel about their possible energy poverty situation. When selecting an indicator, there is the need to analyse the best suited one for the situation that is being dealt with. Several factors might affect an indicator (e.g., the objective of the indicator) as it can be used either for measuring or monitoring a particular aspect. Measuring through an indicator will give the objective data measurements, even though it is more interesting to analyse data with determination to conduct profitable actions by individuals and different institutions.

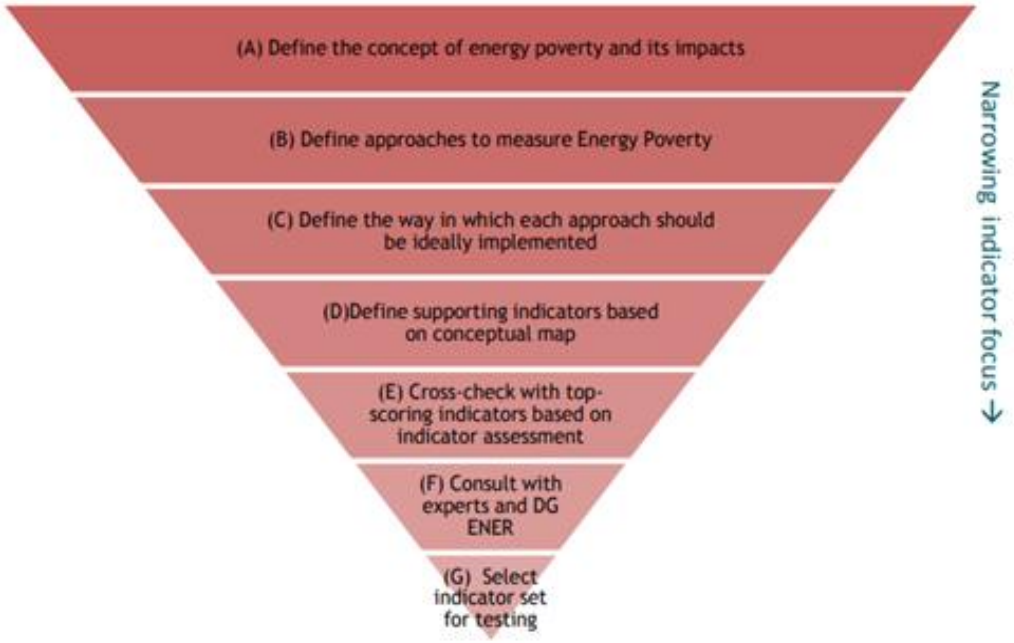


Figure 8. Process of selection of a suitable indicator for energy poverty [34]

Figure 8 shows the simple metrics when deciding to choose a suitable indicator for the situation that is being assessed. All in all, the metrics chosen to provide a comprehensive picture of energy poverty consider several aspects such as high energy costs or low energy expenditure. Finally, the important aspect of deciding on the indicator is clearly testing the indicator itself. By testing the indicator, both the reliability and the precision of data increase as the accuracy for real testing will be significantly higher; therefore, the indicator will be more trustworthy once scientists and researchers will be able to analyse all the obtained data.

3. Energy poverty in Europe

In Europe, despite having more developed and industrialised infrastructure, a significant number of residents still struggle with energy poverty. Approximately 36 million residents in the EU were unable to adequately heat their homes in 2020 [27]. This figure highlights the alarming prevalence of energy poverty in the region. COVID-19 has clearly aggravated the energy poverty in Europe. Lockdowns resulted in more time spent at home, increasing the demand for energy, and putting additional strain on already financially vulnerable households. Europe´s legislation acknowledges the severity of energy poverty and aims to address this issue through various measures such as promoting energy efficiency, providing financial assistance, and implementing social policies to support those affected by energy poverty. The complexity and versatility of energy poverty emphasises the urgent need for further research amongst the EU-member states to get the most effective actions in place.

3.1 Overview of the energy poverty in Europe

The Energy Efficiency Directive 2012/277EU stated that by 2020 there should be a 20% cut in energy consumption by increasing energy efficiency. The directive established the importance of energy consumption and efficiency focusing on vulnerable customers [35]. To do this, incentives have been provided to Small and Medium Enterprises (SMEs) that were being challenged by energy prices. On the other hand, to accomplish energy efficiency objectives in every region, nations must monitor efficiency levels of new energy generation capabilities and development of national heat and cooling plans as a foundation for efficient heating and cooling infrastructures, including waste-heat recovery. A present measure taken by Europe to counteract energy poverty is the National Energy and Climate Plans (NECPs). NECPs are strategies, developed and submitted by European states, that cover some important energy and climate aspects in their individual regions such as energy efficiency, greenhouse gas emission reduction, research and innovation, and renewable energies. To meet these objectives by 2030, the regulation declares that all the European countries must create a ten-year national energy plan. Part of these regulations mandates each country to submit its finished NECP documents before a specific deadline (December 2019). The Regulation on the Governance of the energy union and climate action (EU 2018/1999) introduces the NECPs for all member states. According to [36], this regulation set in 2018 has several goals to be met by 2030:

- Increase the cooperation between member states to achieve energy union objectives quickly;
- Jobs, economic growth, and social responsibility being encouraged by promoting an investment on energy and climate all over Europe;
- Compliance with better regulation's principles through integration, streamlining, as well as monitoring for EU countries' current energy and climate planning;
- Ensure a constant communication between Europe and its member states under the Paris agreement.

Furthermore, the European Commission has approved several strategies to help businesses and individuals across Europe like:

- The European Commission has authorised a Polish program to compensate high energy consuming businesses for increased power prices caused by expensive indirect emission costs;
- The European Commission has authorised 220 M€ to the Spanish subsidy to *"Cobra Instalaciones y Servicios, S.A."* for sustainable hydrogen generation. This action helps to accomplish the European hydrogen strategy and European Green Deal objectives while reducing the dependence on Russian energy sources and stimulating the energy sustainable energy transition;
- The European Commission has authorised 150 M€ to the Finnish capacity mechanism to ensure the security of Finland's power supply. The proposal will also help reduce CO_2 emissions in the electrical industry and even increase the rate of energy transition.

3.1.1 Results coming from the indicators in Europe

The present sub-subsection provides information on the main indicators of energy poverty, representing the percentage of the population with no disaggregation in each European country. Data come from the most recent updates from different years as some indicators have not been updated yet. These statistics were provided by the European energy poverty observatory, and there are many indicators that can be shown and focused on different countries according to [14]. Governments and stakeholders can develop more effective strategies to ensure access to energy services, reduce energy poverty, and expand economic opportunities by having a clear understanding of the results of the following energy poverty indicators. Figures 9-11 provide an overview of some indicators used by the EU to target energy poverty in its own countries.

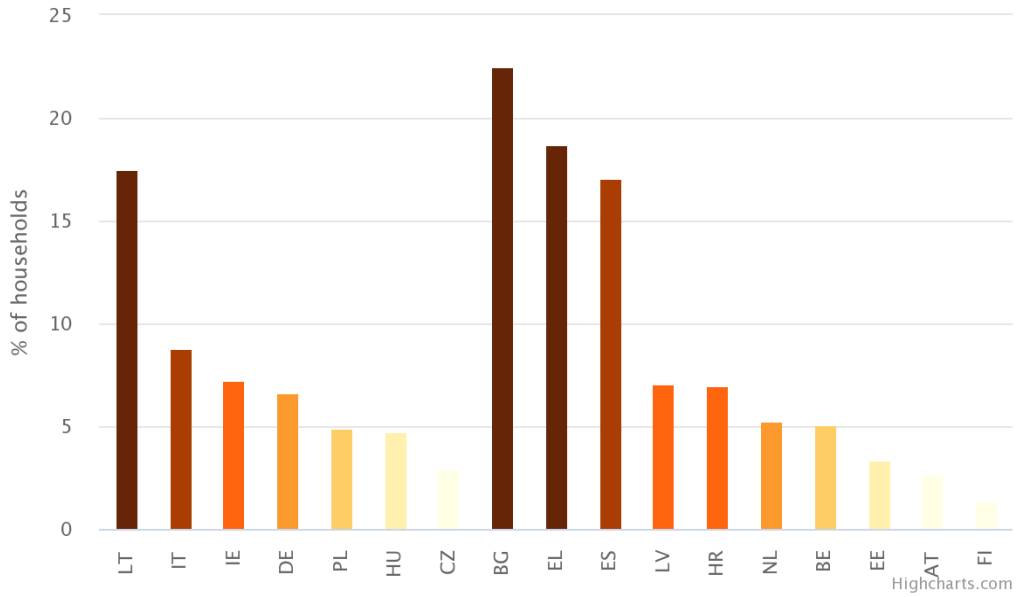


Figure 9. Bar chart of the percentage of households in EU unable to keep their home adequately warm in 2022 [37]

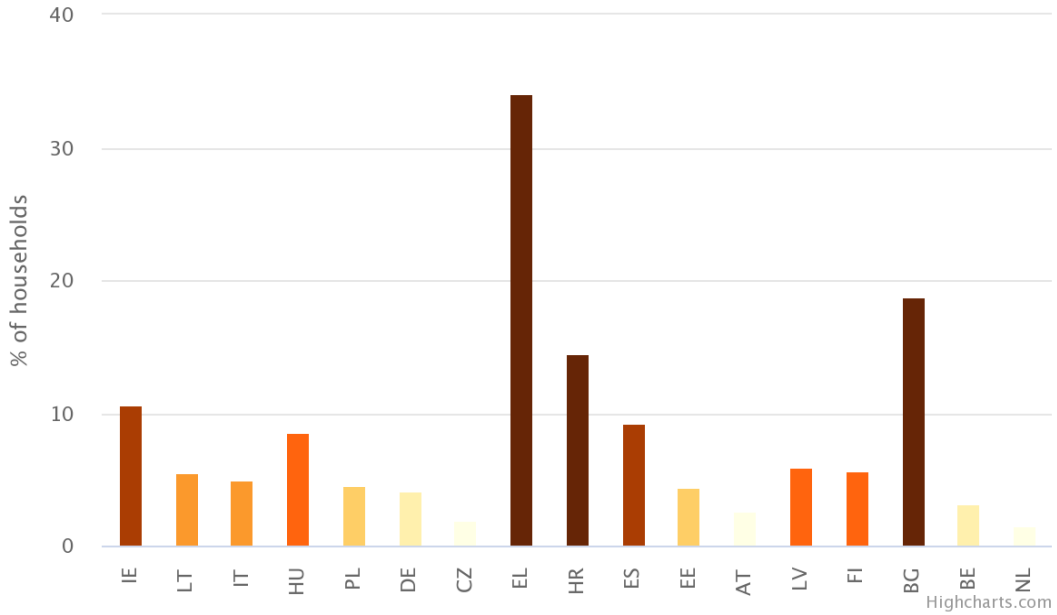


Figure 10. Bar chart of the percentage of households in EU with arrears on utility bills in 2022 [37]

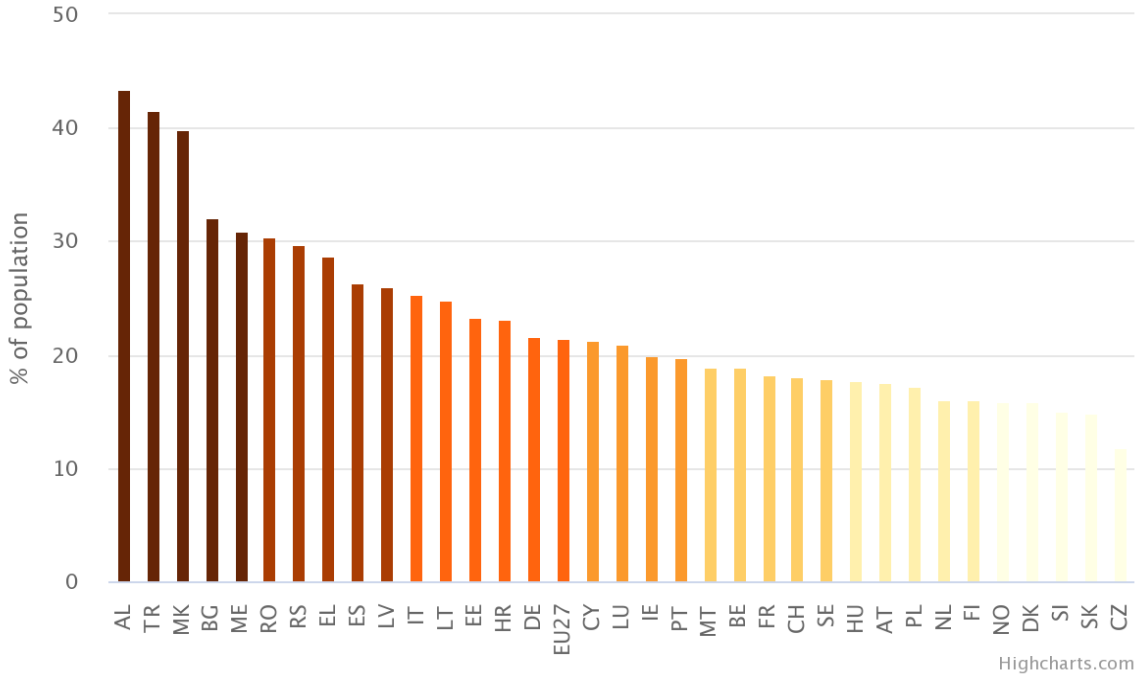


Figure 11. Bar chart of the percentage of households in EU at risk of poverty or social exclusion [37]

Figure 10 shows that arrears on utility bills are not used as an indicator in the EU: this is because this indicator might not always show the underlying issue of energy poverty. Furthermore, the dependence on arrears on utility bills depends on the region such as some countries being more flexible for payments or a variation of subsides

which help families deal with this problem. Figure 11 describes the At Risk of Poverty or Social Exclusion (AROP) indicator that is directly linked to energy poverty. However, this indicator assesses relative poverty as it compares individuals' income with the average income in a region. Moreover, the indicator can be combined with the arrears on utility bills and the inability to keep a house warm by institutions to address energy poverty with greater certainty. To target the evolution of energy poverty in Europe, the inability of households to keep their homes warm is one of the most important and used as there is very recent data and most of the EU countries use this indicator primarily for their energy poverty analysis. Furthermore, Figures 12 and 13 compare the evolution of this indicator in a 15-year time lapse to illustrate Europe's evolution, as well as the positive and negative effects certain regions have had after 15 years.

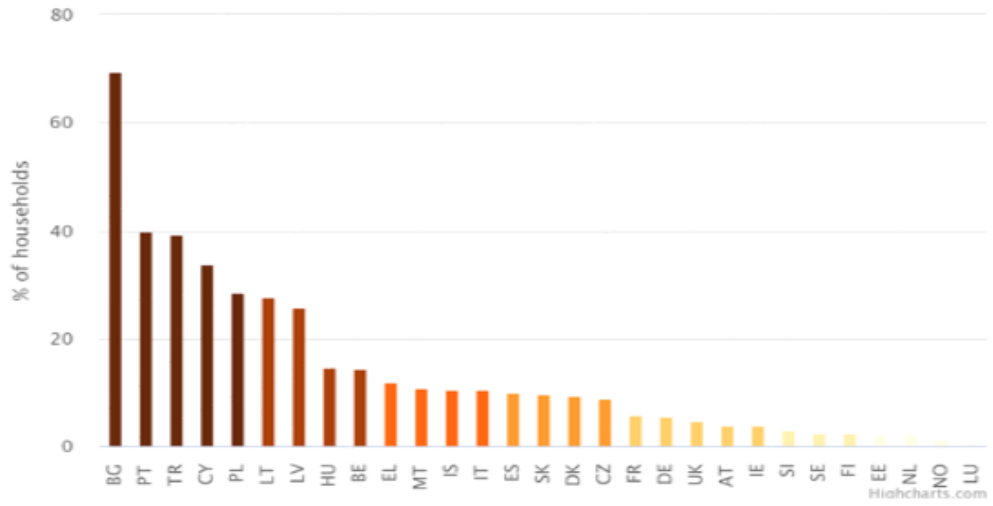


Figure 12. Percentage of households in European countries unable to keep their home adequately warm in 2006 [37]

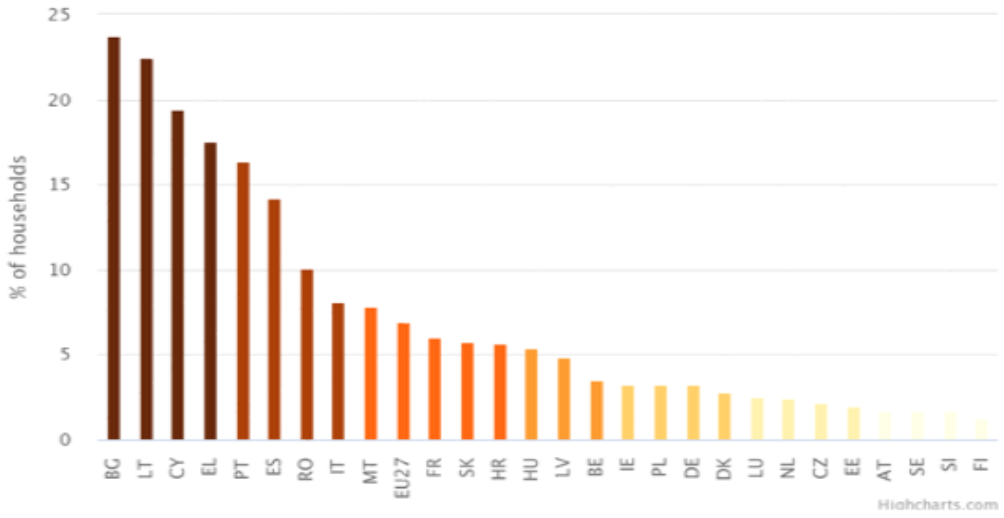


Figure 13. Percentage of households in European countries unable to keep their home adequately warm in 2021 [37]

Evidently, in a 15-year time lapse, most countries have experienced a decrease in the percentage of households unable to adequately keep their homes warm. Particularly, Bulgaria is an example of a country which has highly improved in 15 years, while their data compared to other countries are very high. The percentage of households unable to keep their home adequately warm in 2006 was 69.5%, and 15 years later decreased to 23.7%. On the other hand, countries with a very low percentage of this indicator, such as Finland with a 2.4% in 2006, have a main objective to maintain this percentage constant or decreasing while there is a population growth. In 2021, Finland had one of the smallest rates of energy poverty analysed with the indicator previously mentioned with a 1.3% of its population being unable to keep adequately warm their houses. Overall, EU countries have several differences such as economic conditions, energy poverty prevalence and policy responses which explain the big differences in the statistics shown before. These indicators were used in a 2020 EU Energy Poverty Observatory (EPOV) that showed that energy poverty, measured by arrears and the inability to keep warm, was especially prevalent in Eastern, Central, and Southern Europe with Bulgaria and Greece having the highest rates of energy poverty when focusing on these indicators [38].

3.2 Overview of the energy poverty in Italy

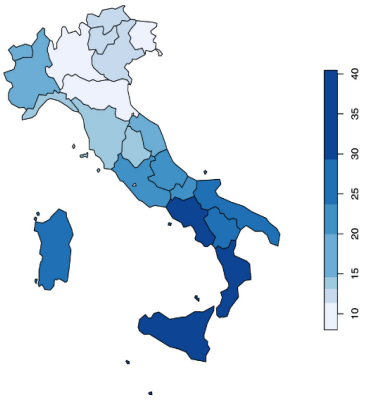
In the past twenty years, the Italian economy faced an important decreasing trend mainly due to the financial crisis of 2007-2008, which was marked by a lack of liquidity both at the level of banks and states and a shortage of corporate credit. Italy, as well as countries worldwide, intervened to not make their public debt deeply increase due to this crisis; however, governments' deficits have widened in many countries following a decline in the global gross domestic product of 2.2% in 2009 [39]. From that moment onward, poverty increased among Italian households. According to the Italian National Institute of Statistics (ISTAT), absolute poverty rose from 4% to 6.9% between 2009 and 2020. Consequently, energy poverty has been a growing concern for Italian governmental and non-governmental institutions. To face this problem, Italy introduced economic incentives for increasing energy efficiency interventions for households; however, there is no classification of the energy performance quality of the existing buildings at the national level. In this regard, the Building Fuel Poverty Index (BFP) was suggested by [40] that combines data from income and energy prices with Energy Performance Certificates (EPCs) through which the buildings that need direct action can be identified. So far, this analysis has been conducted considering only one region, thus not providing a complete overview of the Italian scenario. Regarding high-energy bills, some regions face different energy prices due to the availability/unavailability of specific energy sources as well as the location of power and thermal plants (e.g., fewer distribution losses through the grid). It is known that in Italy, but also in other countries, there are regional differences (e.g., geographical, meteorological variation, type of economy, social norms, and environmental behaviour). These differences also lead to the lack of adequate energy services between the North and South, even though an increase in energy cost has been recorded all over the entire nation. Indeed, the Italian Regulatory Authority for Energy, Networks, and Environment (ARERA) highlighted an increase of 50% in the fixed costs of energy bills that, in addition to the fluctuating cost of energy, has been reflected in high costs of energy bills. As a result, the energy poverty

trend in Italy is different from region to region, and it may face two diverse situations like i) the inability to afford higher energy bills [41, 42] or ii) lowering the energy consumption. The latter is known as hidden energy poverty, and it stands for lower energy consumption of an end-user than would be expected to do. This action is mainly done to limit financial stresses for end-users, and thus let them sustain other kinds of expenses for carrying on a proper life. However, the hidden energy poverty will not be treated in detail because it lies outside the topic of this research report, which is related to the provision of an overview of energy poverty worldwide and the selection of some indicators from the 21 released by EPHA to address energy poverty in Western Balkans.

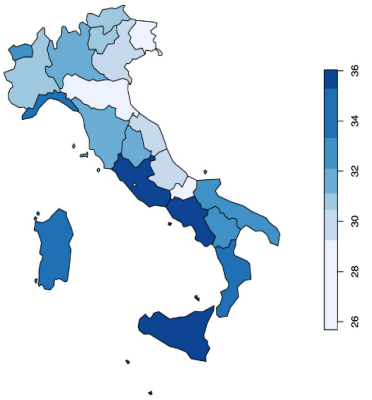
3.2.1 Results coming from the indicators in Italy

Some papers in the scientific literature tried to quantitatively provide information on the energy poverty status in Italy. Benedetti et al [43] used the so-called Laeken indicators that allow to compare inequalities between countries. In particular, they selected three different indicators: one poverty measure of income among AROP, two inequality measures of income within the Quintile Share Ratio (QSR - S80/S20), and the Gini coefficient. AROP stands for percentage of persons living in households where the equalised total disposable household's income is below the at-risk-of-poverty threshold. The AROP threshold is defined as 60% of median equalised disposable income of all households [44]. The Gini coefficient measures the income distribution across a population. It was developed by the Italian statistician Corrado Gini in 1912, and it is used to measure income and wealth distribution among a population. The coefficient ranges from 0 to 1: 0 represents the perfect equality and 1 represents the perfect inequality. Values greater than 1 are theoretically possible due to negative income or wealth [45]. QSR is the ratio of the overall income received by the 20% of the population with the highest income (the top quintile) to the one received by the 20% of the population with the lowest income (the bottom quintile). All incomes are compiled as equalised disposable incomes [46]. Finally, Benedetti et al [43] obtained the results of the indicators previously explained, whose numerical data were gotten from interviews of sampling units in Italy. Overall, 45,767 households sampled were considered. Results showed that regions with a high percentage of people at AROP level are the same that are experiencing higher inequalities as well; however, a greater level of heterogeneity has been displayed across all the Italian regions. Figure 14 identifies a clear trend among the regions in Italy, especially between the Northern and Southern regions. These results show how Northern regions have a low, but still important, percentage of poverty, and every indicator also shows how the Southern area is in increasing danger of poverty. Furthermore, to palliate this poverty distribution effect, national and regional institutions must consider this type of analysis for further energy poverty mitigation with different strategies such as financial support for regions with high risk of poverty, as well as increasing the amount of data analysis and collection to develop a reliable plan to monitor energy poverty and its negative effects. However, as energy poverty is a multifactorial dilemma, it is very difficult to assess with precision this problem by only analysing the income and wealth aspect. Considering the location of the Italian regions, Bardazzi et al. [47] stated that there is a relevant distinction among these Italian regions from both social and economic points of view. In particular, almost 1.7 million households lived in absolute poverty in 2019 with an incidence of 6.4% of the total. However, they reached the same results of [43] about the percentage heterogeneity of poor households across

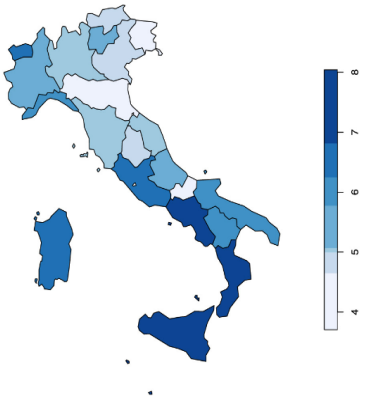
Italy with the highest value in the Southern regions (8.6% in 2019). The south and islands present an increasing trend of poor households (4.5%), while Central and Northern Italy have similar values that are increasing as well in the recent years 5.8%. Expenditures have a considerable impact on the households' economy. According to [46], the share of residential energy expenditure in total household expenditure in Italy was about 4.3% in 2015. The gap at the beginning of the century between Northern and Southern Italy in terms of total residential energy share had been reversed by 2018 due to the increase in temperature and rapid population ageing in Bardazzi et al. [47].



(b) AROP direct estimates. Italy.



(d) Gini coefficient direct estimates. Italy.



(f) QSR direct estimates. Italy.

Figure 14: Results coming from AROP, Gini, and QSR in Italy [43]

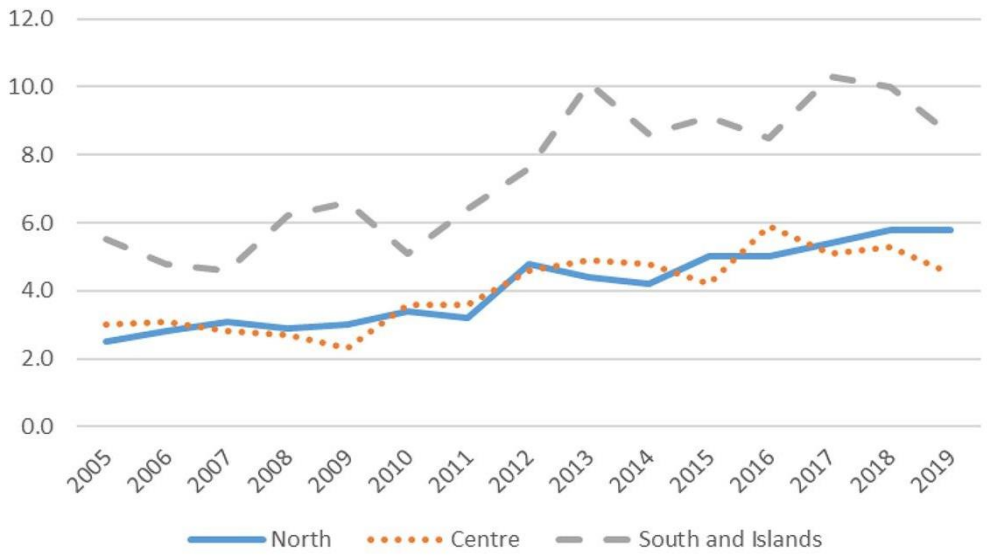


Figure 15. Poverty shares in Italy (%) [48]

3.3 Overview of the energy poverty in Sweden

Energy poverty is a relatively new concept in Sweden, where it has not been separated from other forms of poverty partly due to the country's strong social policy system with financial support, and a relatively well-insulated building stock. Households are also protected against energy supplies cut-off via legislation where social authorities are contacted. However, recent research suggests that Sweden may be vulnerable to energy poverty in the future due to geopolitical factors that could cause greater price variations. This could particularly affect households on low incomes, large families or single parents, and those living in older, poorly insulated buildings. Since low-income households are more likely to live in energy-inefficient buildings and may not have the resources to invest in energy-efficiency measures, it increases their vulnerability to energy poverty. Therefore, addressing energy poverty requires a combination of policy measures and social interventions that address the underlying causes of energy poverty and promote energy efficiency measures. Overall, the existing research on energy poverty in Sweden suggests that it is not a widespread issue. However, it is still a challenge for some households and should be addressed through a combination of policy measures and social interventions [49].

3.3.1 Results coming from the indicators in Sweden

Even though Sweden is one of the countries that stands out energy-wise from other countries, the vulnerability of certain groups of households due to high energy prices is addressed by using simple methods such as surveys and regression analysis of the results. According to a study done in 2022 on energy poverty in Sweden, around 2.3% of households in Sweden are unable to maintain their houses adequately warm, and 2.2% are estimated to

have arrears on utility bills [50]. On the other hand, these data do not determine that the low percentage of households suffering from energy poverty have difficulties when aiming to pay for their basic needs. In collaboration with the SOM institute in Gothenburg, researchers created several surveys for the Swedish population to collect data. The questions included in the surveys figured themes concerning high electricity and heating costs, household´s self-perceived flexibility capital as shown in Figure 16.

1. Do you perceive the cost of heating your home to significantly burden your finances during the winter months?					
No burden	Relatively small burden	Relatively large burden	Large burden	I have not reflected upon the costs	
2. Do you actively save in on energy for heating during the winter months to reduce your heating costs?					
Never	Rarely	Sometimes	Often	Always	I have not reflected upon the costs
3. Looking ahead, electricity prices are believed to vary more throughout the day than they currently do. What is your perception on the following claims regarding shifting energy demanding activities (such as washing, dishes, heating or charging of electric vehicles) to hours with lower electricity prices? a. It is possible for me to shift energy demanding activities b. I am happy to shift energy demanding activities to reduce my environmental impact c. I can easily pay extra to avoid shifting energy demanding activities					
Totally disagree	Slightly disagree	Slightly agree	Totally agree	I don't know	

Figure 16. Survey for Swedish population [51]

The survey methodology mainly focused on sending the survey to over 3000 Swedish populations with an age range from 16 to 85 years old. Furthermore, the percentage response of this population was about 50%. The representatives of the people who answered the survey are expressed in different aspects such as income and age as reported in Figure 17.

	Self-perceived ability to pay for heating costs				Self-perceived flexibility capital			
	Model 1		Model 2		Model 3		Model 4	
	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value	Coef.	p-Value
Intercept	−0.60	0.215	−1.1*	0.0395	−0.35	0.631	−0.72	0.363
September 2021	0		0		0		0	
October 2021	0.16	0.373	0.25	0.188	−0.067	0.756	−0.065	0.769
November 2021	−0.079	0.739	−0.038	0.877	**−0.47**	0.0826	**−0.48**	0.0889
December 2021	**−0.99***	0.0145	**−0.77**	0.0656	**1.5***	0.0294	**1.5***	0.0285
Electricity area 1–2	0		0		0		0	
Electricity area 3	−0.28	0.221	−0.24	0.306	0.14	0.615	0.16	0.565
Electricity area 4	−0.13	0.542	−0.10	0.642	−0.26	0.313	−0.094	0.717
Tenant-owned	0		0		0		0	
Rented	−0.24	0.546	0.040	0.920	0.55	0.227	0.47	0.321
Medium-sized city	0		0		0		0	
Sthlm/Gbg/Malmö city	0.013	0.968	−0.17	0.608	−0.25	0.527	−0.33	0.436
Small city	**−0.40**	0.0565	**−0.36**	0.0988	−0.25	0.315	−0.24	0.352
Rural area	**−0.45***	0.0307	**−0.42***	0.0490	−0.31	0.210	−0.39	0.121
One adult	0		0		0		0	
Two or more adults	**0.50***	0.0415	0.23	0.387	**0.91****	0.00106	**0.88****	0.00295
No children in household	0		0		0		0	
Children in household	0.11	0.593	0.074	0.719	**−0.49***	0.0350	**−0.39**	0.0972
Gainful employment	0		0		0		0	
Student	**1.9*****	0.000	**2.2*****	0.000	−0.67	0.165	−0.41	0.454
Unemployed/arbetsträning/sjuk-/aktivitetsersättning/annat	**−1.1***	0.0193	−0.77	0.110	**1.6***	0.0114	**1.6***	0.0132
Retired	0.23	0.265	**0.66****	0.00437	**0.78****	0.00401	**0.94****	0.00169
Woman	0		0		0		0	
Man	0.050	0.757	0.0069	0.967	**−0.84*****	0.000	**−0.86*****	0.000
Self-reported health status	**0.11***	0.0122	**0.10***	0.0181	−0.045	0.393	−0.043	0.410
No/rare saving of energy for heating	0		0		0		0	
Often/always saving energy for heating	**−1.7*****	0.000	**−1.7*****	0.000	**1.4***	0.0479	**1.4**	0.0528
Heating costs not perceived as burden					0		0	
Heating costs perceived as burden					**−0.64****	0.00419	**−0.68****	0.00314
Saving*Heating cost perceived as burden					**−1.7***	0.0228	**−1.6***	0.0335
Rare internet use (<half year)					0		0	
Monthly internet use					0.83	0.421	1.2	0.236
Weekly internet use					**1.9****	0.00171	**2.1****	0.00117
Daily internet use					**1.9*****	0.000	**2.3*****	0.000
Annual household income <300€			0				0	
Annual household income 300–800€			**0.51***	0.0480			−0.19	0.573
Annual household income >800€			**0.94****	0.00310			−0.054	0.892
N	759		739		643		616	
McFadden R^2	0.131		0.144		0.124		0.131	

Figure 17. Regression model that predicts how the population self-perceives if they can afford heating costs as well as their ability to have a flexible capital [51]

To understand the data shown in Figure 17, the difference between the analysed models is required. Model 1 is a statistical model that refers to the ability to pay for heating costs, not controlling the household's income, while model 2 also controls the household's income. Moreover, model 3 and model 4 follow the same principle, but for flexibility capital. Data show that there is no statistical proof of a difference between energy poverty indicators in the different electricity regions, while there is a big difference between rural and urbanised areas. This is shown in the data as small, medium, or large cities self-perceive themselves as abler to afford to heat their houses than people in rural areas. Furthermore, most of the connections between income and the ability to afford heating are noteworthy when controlling the income variable. In addition, for both model 1 and model 2, health status is not affected by the income variable as the p-value remains unchanged, 0.11 for model 1 and 0.1 for model 2. Because of this and the p-value being around 0.1, there is a clear statistical relation between health status and heating prices. Factors influencing the ability to pay heating costs extend beyond the income of individuals, and

this is manifested in the McFadden R^2 model that shows how controlling or not household's income does not significantly affect the model itself.

	Single-family housing (*n*=875)	Total sample (*n*=1645)
16–29y/o	8.9%	13.7%
30–49y/o	27.1%	26.8%
50–64y/o	30.9%	27.2%
65–85y/o	33.1%	32.3%
Total	100%	100%

	Single-family housing (n=875)	Total sample (n=1645)
<300,000 SEK	15.5%	22.9%
301,000–800,000 SEK	46.5%	42.1%
>800,000 SEK	32.5%	24.3%
NA	5.5%	10.7 %
Total	100%	100%

	Single-family housing (n=875)	Total sample (n=1645)
Single	13.3%	23.3%
In a relationship	4.8%	6.8%
Common law marriage	17.8%	15.5%
Married/registered partnership	60.8%	46.1%
Widow/widower	3.0%	4.0%
NA	0.3 %	4.3%
Total	100%	100%

Figure 18. Survey on representatives of segregation including age, income, and relation situation [51]

Figures 19, 20, and 21 provide a picture of the three indicators used to detect energy poverty in a country. Namely, Figures 19 and 20 show how the indicators of households unable to maintain their homes adequately warm and arrears on utility bills are very low; therefore, from this data it is difficult to notice any sign of energy poverty, while in Figure 21 there is a clear insight of energy poverty because of the high costs of electricity bills as well as their late sudden increase in 2020.

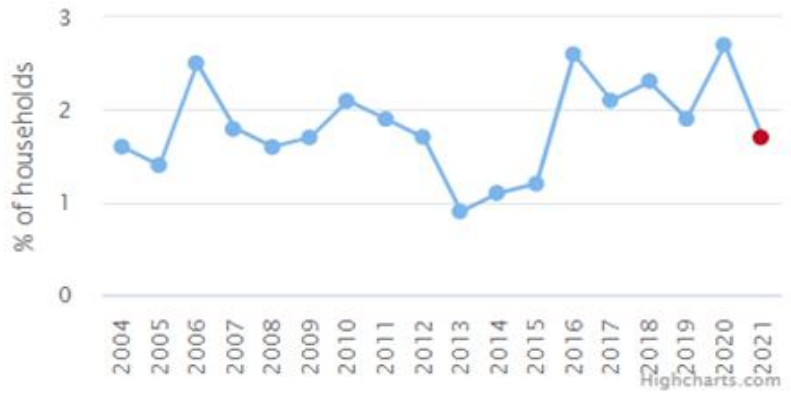


Figure 19. Percentage of households unable to keep their home adequately warm in Sweden [37]

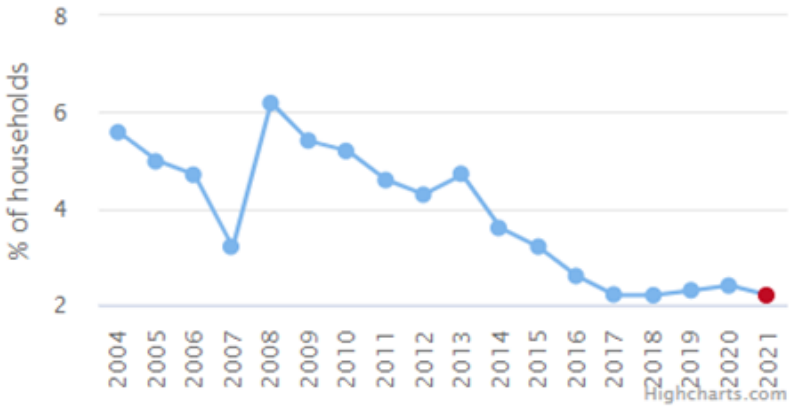


Figure 20. Percentage of households with arrears on utility bills in Sweden [37]

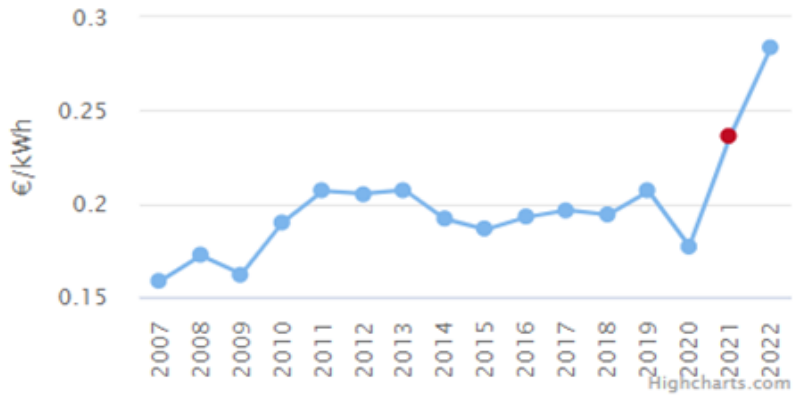


Figure 21. Household electricity prices in Sweden [37]

4. Energy poverty in Western Balkans

Western Balkans have slower economic growth compared to other countries in Europe and this can be due to different reasons. Having a slow economic growth means a slower development; therefore, bigger effects of energy poverty in these countries are expected. Some reports, such as the one by European Bank for Reconstruction and Development (EBRD) [52], show how lately most of the income of many households is spent on energy bills due to high energy costs as well as low income of individuals.

4.1 Overview of the energy poverty in Western Balkans

According to the Regional Corporation Council (RCC) latest reports and the United Nations Development Program (UNDP) articles, more than 16% of the population was suffering from energy poverty in 2008. Furthermore, in more recent years this issue has increased as more than 20% of the population cannot afford energy sources to meet their basic needs. These issues can be better seen in some countries than others in Western Balkans. Europe and Western Balkans have similar legislations focused on energy poverty:

- Western Balkans have several National Energy Efficiency Action Plans (NEEAPs) to deal with energy poverty. Each country in Western Balkans develops its own strategic plan as an obligation under the Energy Community Treaty (ECT), which is an international agreement to promote sustainable energy development. NEEAPs describe measures and goals for a better energy efficient environment, as well as including severe measures to fight energy poverty (e.g., help and provide individual households that are vulnerable to energy prices);
- Building standards and regulations are also a serious matter in Western Balkans. This is done to promote energy-efficient building design. These standards may include requirements for insulation, heating systems, and building energy performance certification that can help households, including those at risk of energy poverty, to reduce energy consumption and lower energy bills;
- Despite renewables having been widely used globally, Western Balkans began to promote them in the latest years. Renewable energy targets are represented as a percentage of the total energy consumed; therefore, the greater the percentage of renewable energy, the better it is. One of the most important targets is to increase their renewable energy capacity, which has been rising in the past years and now it is about 6% of the total electricity generation installed [53]. On the other hand, some countries in Europe (e.g., Spain) have more than 14% of their installed capacity covered by renewables. To move further, Western Balkans are promoting several renewable projects invested by governments and some private companies.

Nowadays, Western Balkans have a much bigger mind set focused on energy efficiency. For example, in December 2022 Western Balkans received an energy support package of 1 billion€ in grants, where 50% of this

is being used for immediate actions to balance energy prices for businesses and individuals [54]. The remaining 50% will be used for short- and medium-term measures, namely boosting the use of renewables and expanding the energy market. Energy poverty is very noticeable in Western Balkans mainly due to the low households' income, which is directly linked to the GDP of a country. Figure 22 shows the different GDPs in different countries in Western Balkans from 2010 to 2021 with an overall positive trend due to an economic growth over the past decade. From 2010 to 2014, there was a slow increase in GDP. Some countries like Montenegro and Kosovo had a significant fall in GDP during 2011 and 2012. However, from 2015 to 2016 Western Balkans experienced a stagnation in their economic growth. Western Balkans rebounded in 2016 till 2020 when COVID-19 pandemic occurred leading to a steep decrease in the economic growth. However, from 2010 to 2021 an overall resilience to economic and political adversities can be noticed. Low incomes make it difficult for households to maintain normal living conditions inside their homes. Keeping the house warm during winter and cool in summer becomes increasingly challenging when compared to inflation conditions, which is currently happening across Europe affecting fuel prices and wage inflation and making it unable to keep up.

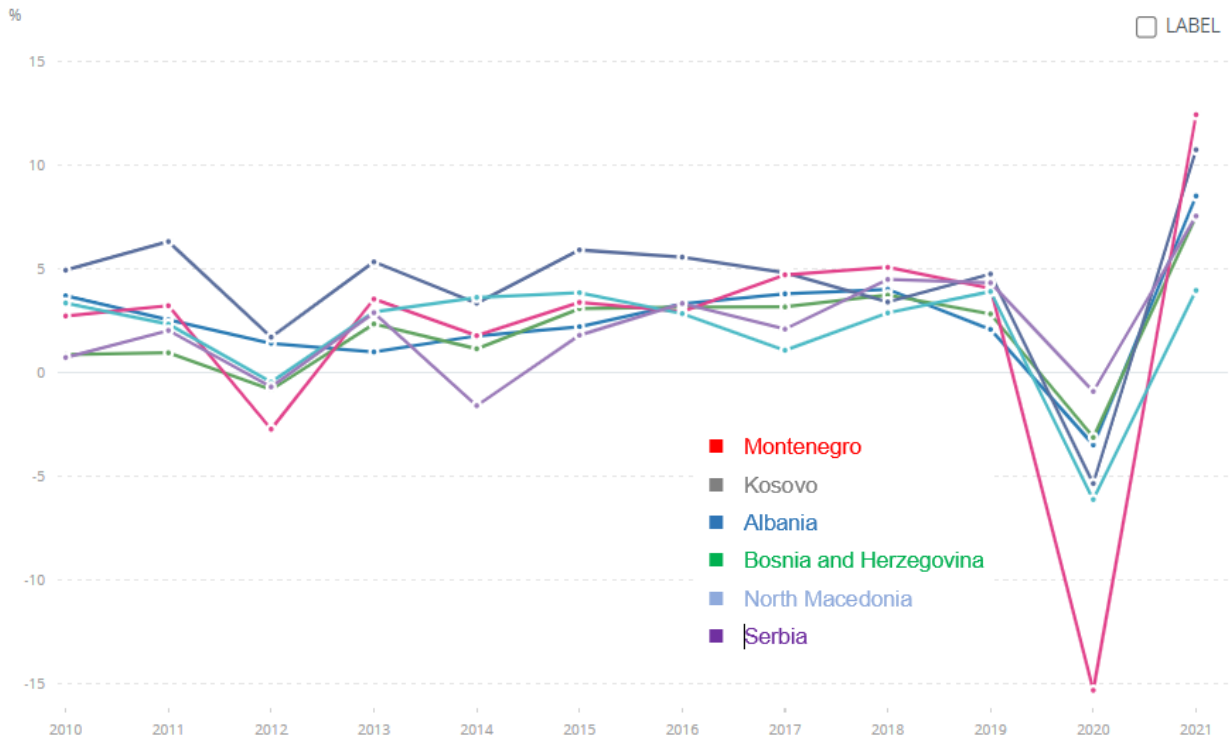


Figure 22. GDP growth (annual %) – Western Balkans [55]

Energy consumption trends show how people with a small amount of money tend more to face energy poverty as they may have larger families and live in poorly insulated houses or rely on inefficient heating and cooling devices. Despite efforts in improving the efficiency of houses, progress towards this objective has been slowed down with many individual homes still struggling to afford high prices to maintain living conditions. These challenges are more notable in winter in the northern countries due to high use of heating systems; furthermore,

to address these struggles even more investment must be done. For instance, people in Kosovo, which is one of the poorest countries in Western Balkans [56], lack the income to evolve renewables or upgradable sources for energy efficiency, most of the times due to governments lacking on providing financial support for this type of evolution. Figure 23 shows the evolution of the poverty rate in each individual country in Western Balkans. One of the slowest decreases in poverty rate are North Macedonia, Kosovo, and Montenegro. These three countries have the biggest energy intensity, which means they are the ones that consume the most energy. Many buildings and structures in North Macedonia are old and there is a strong need for their improvement. Albania is one of the countries that had the greatest decreases in energy poverty since 2017 as displayed in Figure 23, as well as the greatest increase in renewable energy consumption. Up to now, the main source of renewable energy in Albania is hydropower, which represents about 95% of the total generating capacity [57].

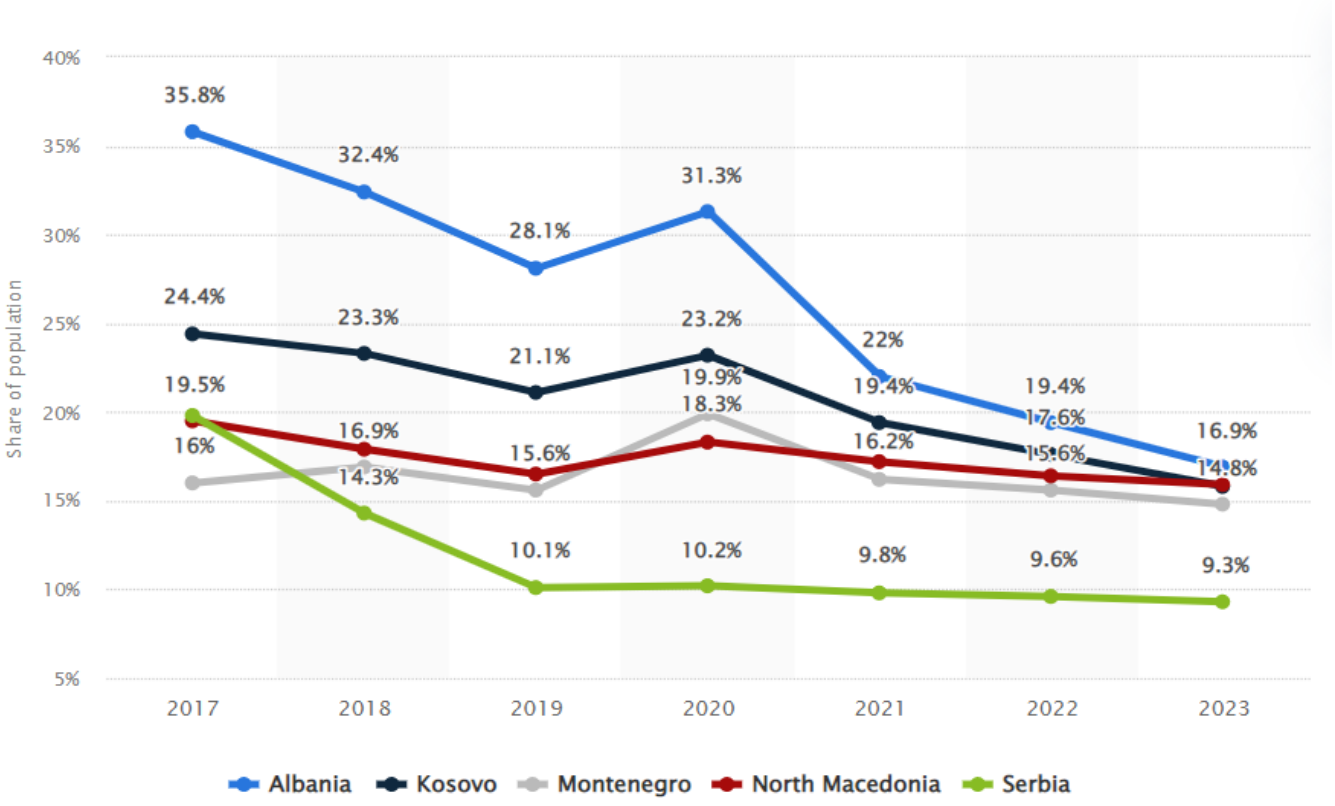


Figure 23. Poverty Rate as a percentage in Western Balkans [56]

Climate change is another concerning issue, specifically in Western Balkans as hydropower is one of the key sources; indeed, there are 8605 MW of installed capacity of hydropower plants [58]. If the power produced by hydropower is reduced, it will be replaced by fossil fuels due to their large availability, thus increasing the levels of greenhouse gases in the atmosphere. For instance, people in Kosovo, which is one of the poorest partially recognised countries in Western Balkans and in Europe [59], lack the income to evolve to renewables or upgradable sources for energy efficiency, most of the times due to governments lacking on providing financial

support for this type of evolution. Figure 23 also shows the evolution of the poverty rate in each individual country in Western Balkans. One of the slowest decreases in poverty rate are North Macedonia, Kosovo, and Montenegro. Western Balkan countries have 3 times higher energy intensity than the average in Europe, while these three countries have the biggest energy intensity that means they are the ones that mostly consume energy according to EBRD [60]. The study reinforced that many buildings and structures, for example in North Macedonia, are old and there is a need for improvement. Albania is one of the countries that had the greatest decrease in energy poverty since 2017, as well as the greatest increase in renewable energy consumption.

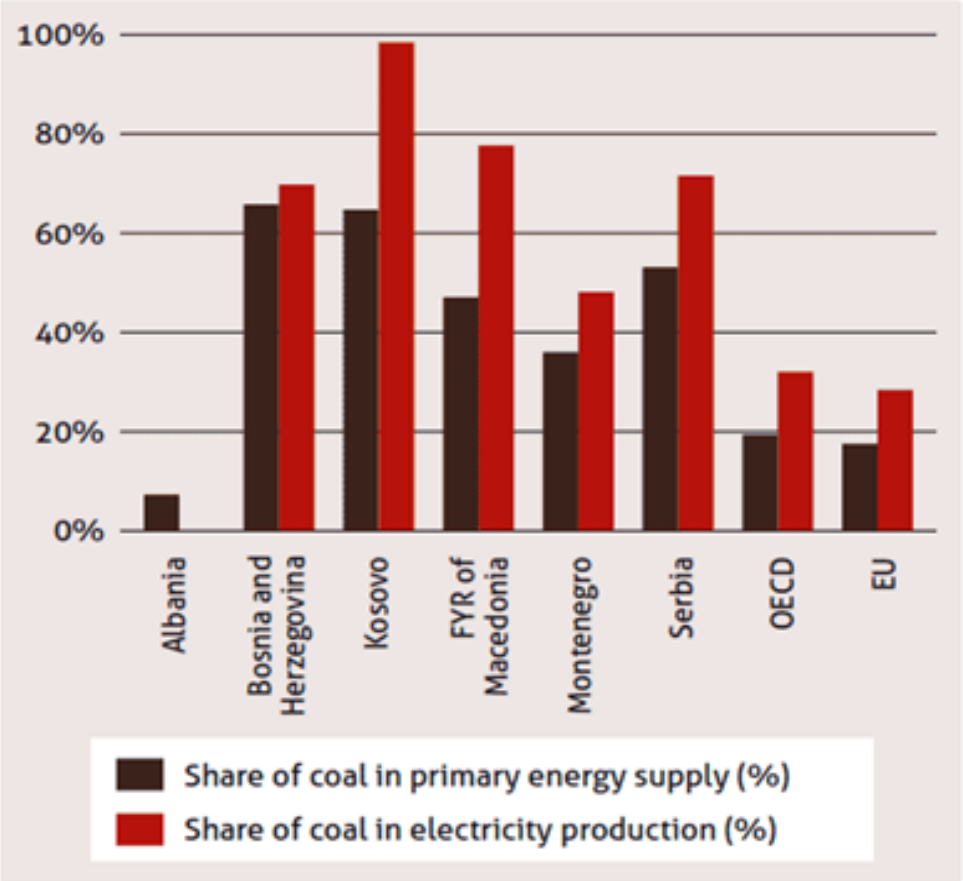


Figure 24. Coal in energy and electricity in the western Balkans, EU, and the OECD (2015) [61]

Lack of energy sources is a big deal in some regions of both Europe and Western Balkans. Statistics in Figure 24 shows that fossil fuels are the main sources of energy in Western Balkans because of the great abundance of coal reserves. In 2020, Western Balkans had 70% of coal in electrical production with the remaining 30% coming from renewable sources. Because of the lack of energy sources variety in Western Balkans, countries can be more vulnerable to any energy transition that leads to the raise of energy prices. Furthermore, consuming fossil fuels

entails environmental problems that affect economically some countries that are issued due to their high CO_2 emissions.

4.1.1 Results coming from the indicators in Western Balkans

Energy poverty in Western Balkans is a complex issue that requires a comprehensive understanding of various indicators and their implications. This sub-subsection aims to analyse the results obtained from different indicators used to assess the extent and impact of energy poverty in Western Balkans. By examining these indicators, insights into the current state of energy poverty and the identification of potential areas for improvement can be obtained. Findings from relevant studies and reports, incorporating specific statistical data and sources, are reported in the following.

1. Energy poverty rates in Western Balkans

According to the RCC and the UNDP, Western Balkans have experienced an increase in energy poverty over the past decade. In 2008, energy poverty affected over 16% of the population [62]. Subsequently, this figure has risen to more than 20% in recent years [63]. These statistics highlight the growing challenge of energy poverty in these regions.

2. National Energy Efficiency Action Plans (NEEAPs)

Western Balkans have recognized the significance of addressing energy poverty and have implemented NEEAPs as part of their commitment to the Energy Community Treaty (ECT). These plans serve as strategic frameworks to enhance energy efficiency and combat energy poverty. Each country develops its own NEEAP, outlining specific measures and goals. For instance, Albania's NEEAP focuses on improving energy efficiency in the residential sector by retrofitting buildings and promoting the use of energy-efficient appliances [64].

3. Building standards and regulations

Promoting energy-efficient building design is crucial for mitigating energy poverty in Western Balkans. Countries have been actively developing and enforcing building standards and regulations. These standards typically encompass insulation requirements, energy-efficient heating systems, and building energy performance certification. For instance, Serbia has implemented the energy efficiency law, which includes energy performance certification for buildings and encourages the use of renewables [65].

4. Renewable energy development

While Western Balkans have been slower in adopting renewable energy compared to some European countries, an important progress has been made in recent years. Currently, renewable energy represents approximately 6% of the total electricity generation installed in the region [63]. However, there is room for improvement. Countries like Serbia have set a target to achieve 27% of their final energy consumption from renewables by 2020 [66]. Additionally, investments in renewable energy projects, both by governments and private companies, are being made to accelerate the transition. For instance, Montenegro has developed wind farms with a total capacity of 308 MW [67].

5. Energy consumption trends and socioeconomic factors

Energy consumption trends reflect the challenges faced by low-income households in Western Balkans. Families with limited financial resources often reside in poorly insulated houses and rely on inefficient heating and cooling devices, leading to higher energy costs. These challenges are more pronounced in winter, particularly in northern countries with high heating system usage. To address these issues, financial support and investment are required. For example, the lack of financial support from the government often hinders individuals in Kosovo from adopting renewable energy or implementing energy efficiency measures [68].

6. Regional Disparities and Slow Progress

There are regional disparities in energy poverty and progress in addressing it within Western Balkans. Countries like North Macedonia, Kosovo, and Montenegro have the highest energy intensity, indicating significant energy consumption. These countries experience slower decreases in the poverty rate due to the need for improving energy efficiency in older buildings and structures. On the other hand, Albania has shown significant progress with substantial decreases in energy poverty since 2017 and a notable increase in renewable energy consumption [63].

7. Financial support and policy formulation

Financial support plays a crucial role in addressing energy poverty in Western Balkans. Governments need to allocate sufficient funds and develop effective mechanisms to provide financial assistance to vulnerable households. This support can enable them to invest in energy efficiency upgrades, renewable energy systems, and insulation improvements. Additionally, policies and regulations need to be formulated to incentivize energy-saving practices and promote the adoption of renewable energy sources.

8. Regional cooperation and international support

Regional cooperation and international support are vital for addressing energy poverty in Western Balkans. Collaborative efforts among countries can facilitate knowledge sharing, best practice exchange, and joint initiatives. The energy community, a regional initiative, serves as a platform for promoting cooperation and providing technical assistance. International organisations like the EBRD can contribute by providing financial support, technical expertise, and capacity building programs. Statistical data and findings from various sources highlight the challenges faced by the region and the efforts being made to address energy poverty. By implementing targeted measures such as NEEAPs, building standards, renewable energy development, and financial support, Western Balkans can make significant progress in reducing energy poverty, improving energy efficiency, and promoting sustainable and inclusive energy access. However, continued collaboration, regional cooperation, and international support are crucial to achieving these goals and ensuring a brighter energy future for the region. In this regard, current data and information show the energy situation in Western Balkans. Oil and electricity play a significant role in the energy mix of Western Balkans. Data for the total energy consumption have been estimated for a fixed number of countries in Western Balkans. As shown in Figure 25, oil and its products together with electricity and biomass dominate in most of Western Balkans [69].

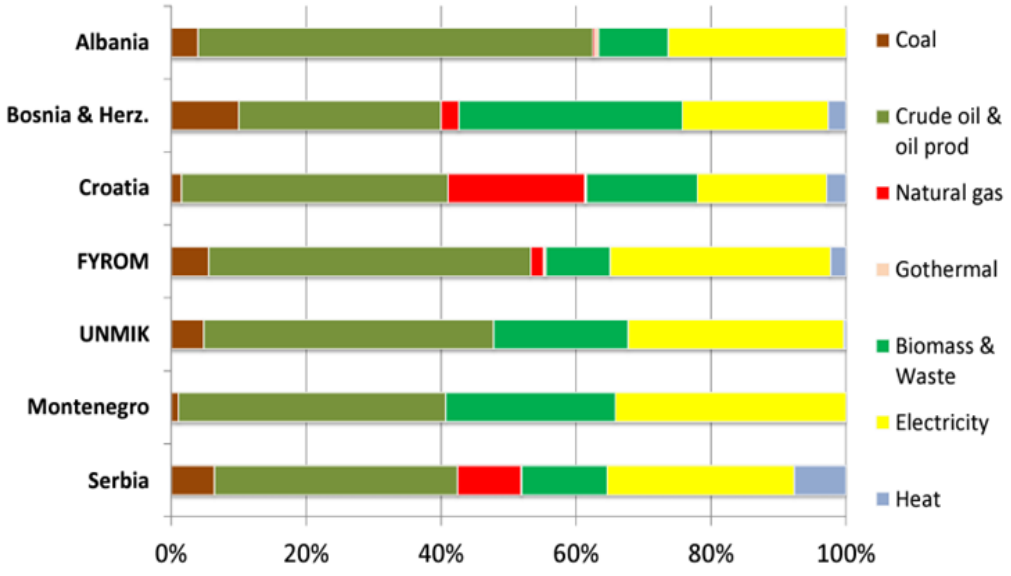


Figure 25. Total final energy consumption in Western Balkans [69]

Regarding the final energy consumption of the households in Western Balkans, data show that electricity is considered the main energy supplier for energy uses in Albania, Montenegro, and Serbia, whereas oil and its products are mostly used in BiH [69].

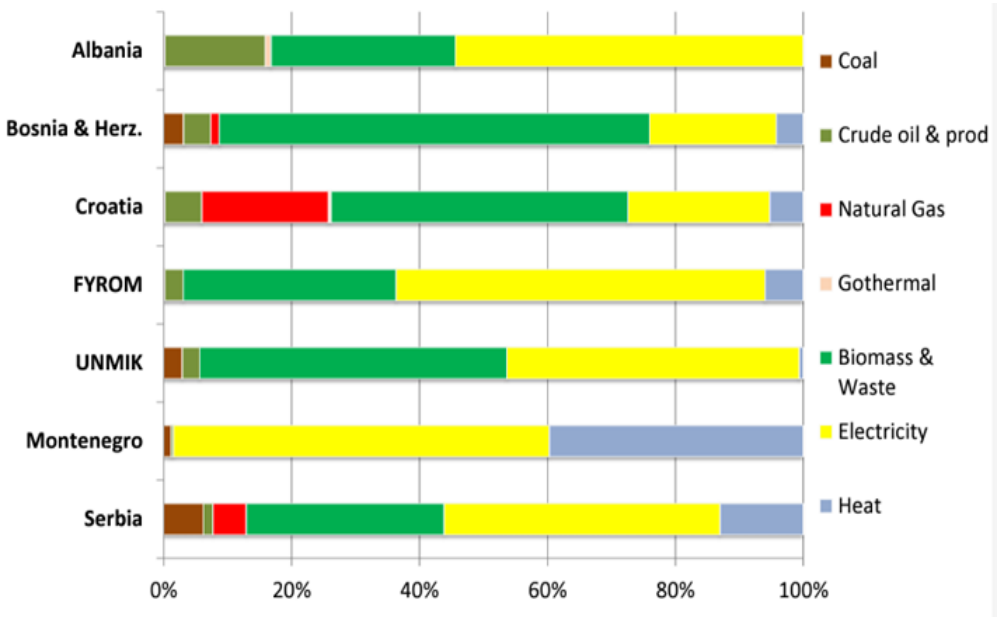


Figure 26. Households' final energy consumption in Western Balkans [69]

The average EU dependency on energy imports (53.4%) was higher than the relevant values for Western Balkans in 2014 (mainly oil and gas). Generally, Western Balkans are importers of electricity (Serbia is self-sufficient and BiH is an exporter) [69].

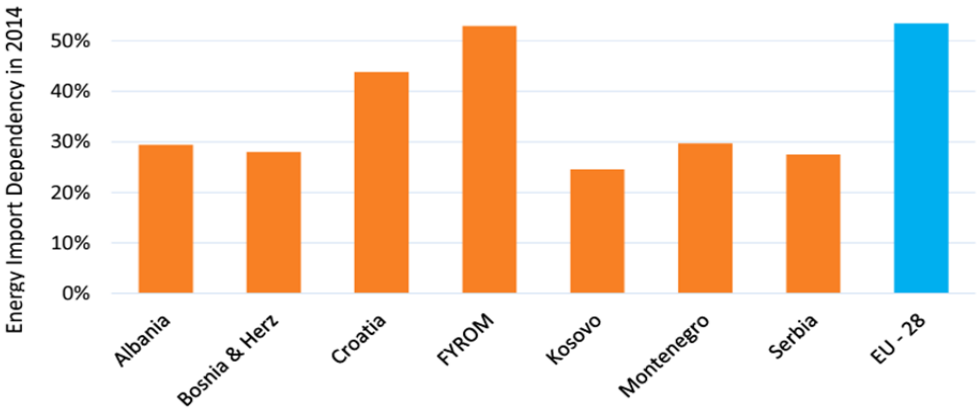


Figure 27. Security of energy supply - Import dependence in Western Balkans [69]

In 2013, the electricity consumption/capita in Western Balkans was about 60% of the EU-28. Households' electricity prices are carefully controlled and are much lower than those in EU28. Artificially low tariffs lead to a low level of customers' energy efficiency [69].

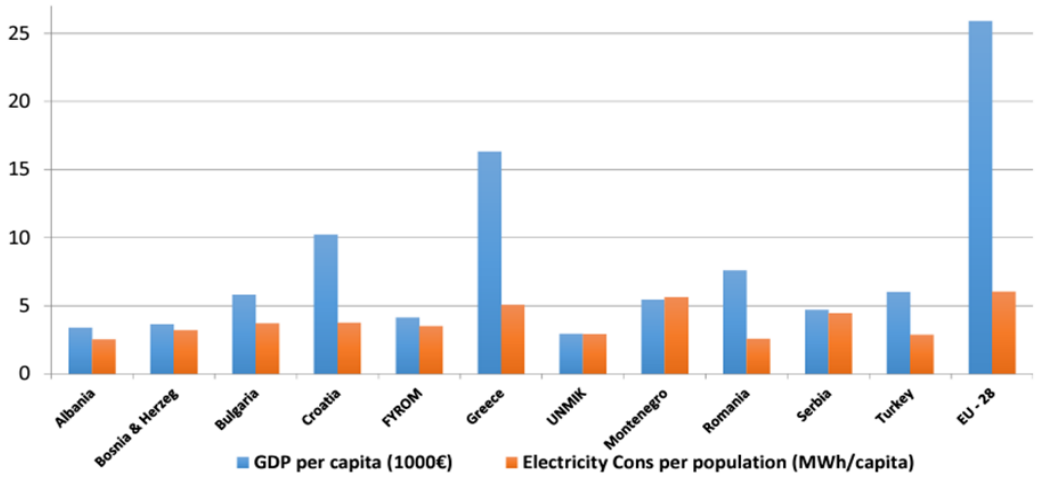


Figure 28. GDP and Electricity Consumption per capita in Western Balkans [69]

Rising energy prices are expected to weigh heavily on low-income households in Western Balkans, which spend a much higher share of their income on basic needs such as heating. At the country level, Western Balkans show a high degree of vulnerability to increases in the price of electricity imports. Albania and North Macedonia rely on imports for a significant share of their total electricity consumption (32% and 24% in 2019, respectively), which makes them particularly vulnerable to price shocks in the regional wholesale electricity markets. Kosovo faces a surge in demand in the winter due to the widespread use of inefficient electric heating that forces it to import significant amounts of electricity in the winter months, and exposes it to risks related to fluctuations in wholesale electricity prices. In Serbia from late 2021, adverse meteorological conditions and accidents at several thermal power plants have significantly reduced domestic coal production and generation output, pushing the country to import large amounts of electricity in late 2021 and early 2022. In 2019, Montenegro was a net importer of electricity (for 7% of its consumption), but recent data suggest that in 2021 domestic supply and demand nearly matched, so the country's level of vulnerability to increases in wholesale electricity prices remains relatively low [70]. Oil and oil products account for a share of the total energy supply ranging from 23% in BiH to 52% in Albania. Because of the low domestic production and limited refining capacity, Western Balkans rely on imports of oil and oil products for a large share of their consumption, which exposes them to risks related to price fluctuations. In addition, gasoline prices are already relatively high in the region, especially in Albania (about 1.8 €/l) and Montenegro (about 1.7 €/l) [70]. Residential consumers in Western Balkans have a limited ability to absorb higher energy prices. In 2019, North Macedonia had the highest share of households in Europe reporting that they cannot keep their home adequately warm (33.1%), Kosovo, Montenegro, and Serbia also rank among the top 10 countries [70]. The inability to keep their homes warm and the incidence of arrears and late payments of bills are more common among low-income households, suggesting that poor and vulnerable consumers often have more difficulty meeting their energy needs. For example, 48% of the lowest income decile households in Serbia and 65% in Montenegro have arrears in utility services, compared to only 8% and 17% in the top decile,

respectively. 43% of low-income households in Albania, 68% in Kosovo, and 68% in North Macedonia were in arrears on utility bills compared to 27%, 49%, and 34% on average in the country, respectively [70]. According to available household budget survey figures, the median household in Western Balkan spends between 7% and 10% of their total budget on energy. Share of household consumption expenditure on electricity, gas, and other fuels is considered high. In addition, when facing higher energy prices, households in Western Balkans (especially the low-income ones) often switch to cheaper energy sources such as firewood or waste, for heating [70].

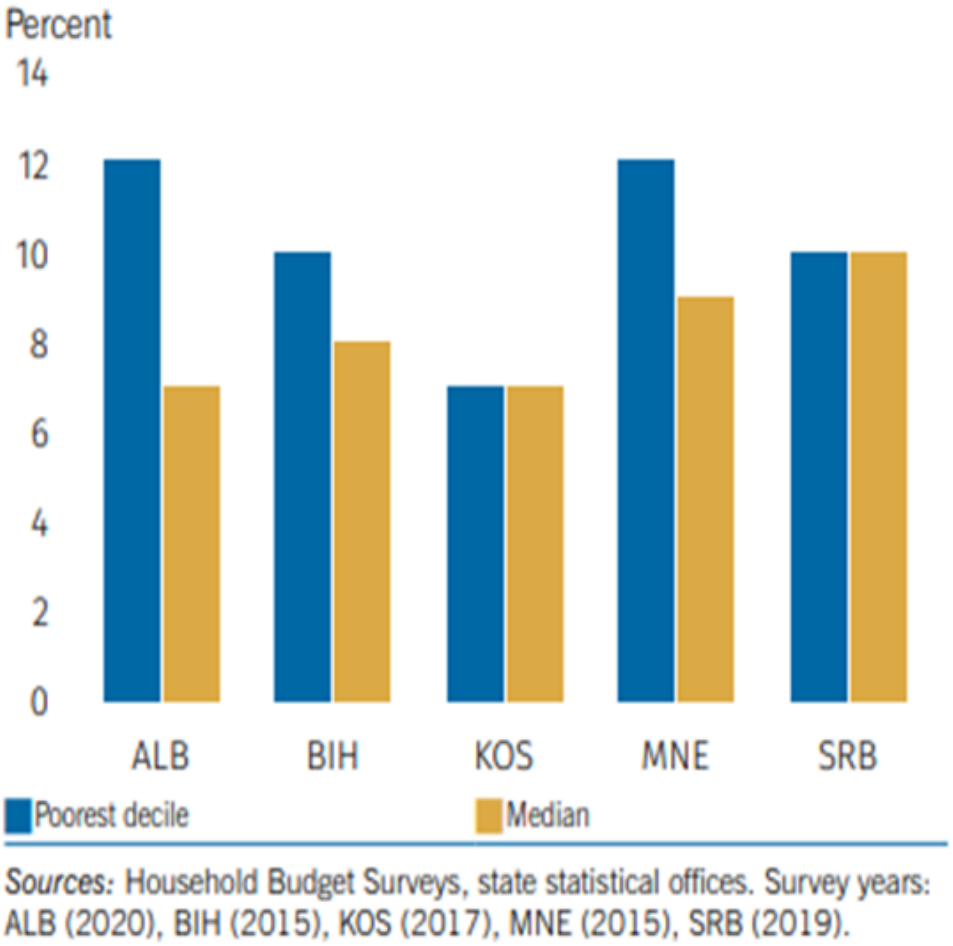


Figure 29. Share of household consumption expenditure on electricity, gas, and other fuels [70]

Electricity pricing is the key determinant in the overall financial condition of the Western Balkans' power sector. Tariffs in the region have long been below their cost-recovery levels. Overall, electricity prices for residential consumers are below prices for industrial consumers (except in BiH), which may imply a cross-subsidy from industrial to residential consumers, and they are also well below EU levels, although the costs are also expected to be lower due to differences in the generation mix and capital costs [71].

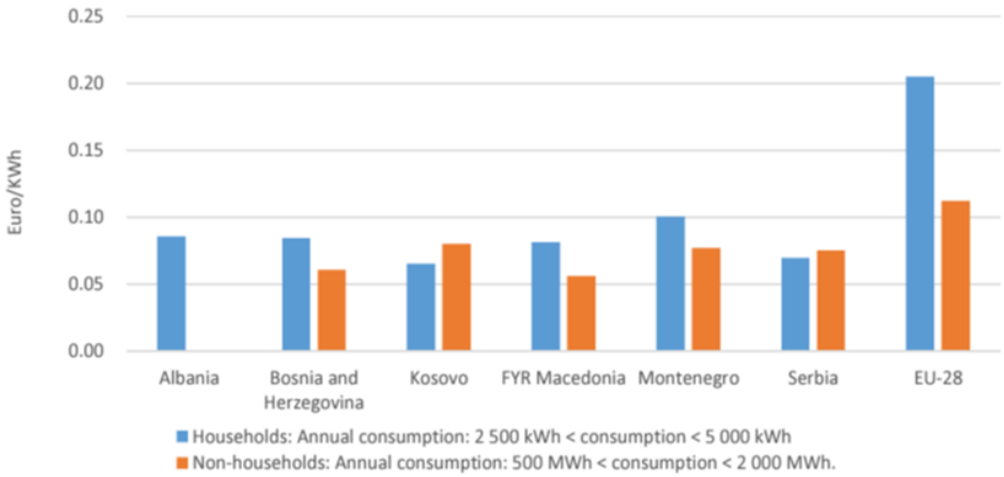


Figure 30. Electricity tariffs in Western Balkans countries, 2017 [71]

Affordability considerations are often cited as the key barrier to increasing tariffs to reach cost recovery. It is estimated that households in Western Balkans spend between 7–12% of their disposable income on energy. Electricity consumption constitutes the single largest source of energy expenditure (including central heating, coal, firewood, natural gas, and other) ranging from 6% of total expenditures in BiH and North Macedonia to 8% in Montenegro. When spending on energy exceeds a certain threshold, it is difficult for households to adjust and spending on other necessities is likely to be affected [71].

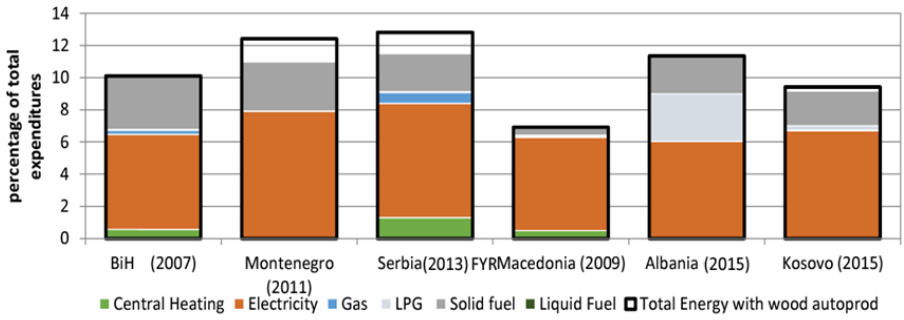


Figure 31. Energy expenditures as a share of total budgets by fuel use in Western Balkans [71]

While energy expenditures across Western Balkans are relatively high, they are regressive: the wealthier the households, the less they spend on energy and the more they rely on electricity for heating. Households rely mostly on firewood for heating in Western Balkans, particularly in rural areas, namely from 76% of rural households in Albania to about 100% in rural BiH and North Macedonia. Electricity remains the main source of heating for a significant proportion of urban households and the wealth pattern is strong: the wealthier the household, the more they rely on electricity, district heating, and gas (when available) to satisfy their heating

needs. The same pattern applies to energy expenditures in all countries, but in North Macedonia electricity expenditures as a share of total expenditures decrease with wealth. In BiH, the poorest spend up to 11% of their total expenditures on electricity only versus 3% for the wealthiest. In other countries, this share amounts to about 8 to 10% for the poorest versus about 5 to 7% for the wealthiest. Only in Albania, the electricity share stable across the population is about 6% of total expenditures [71].

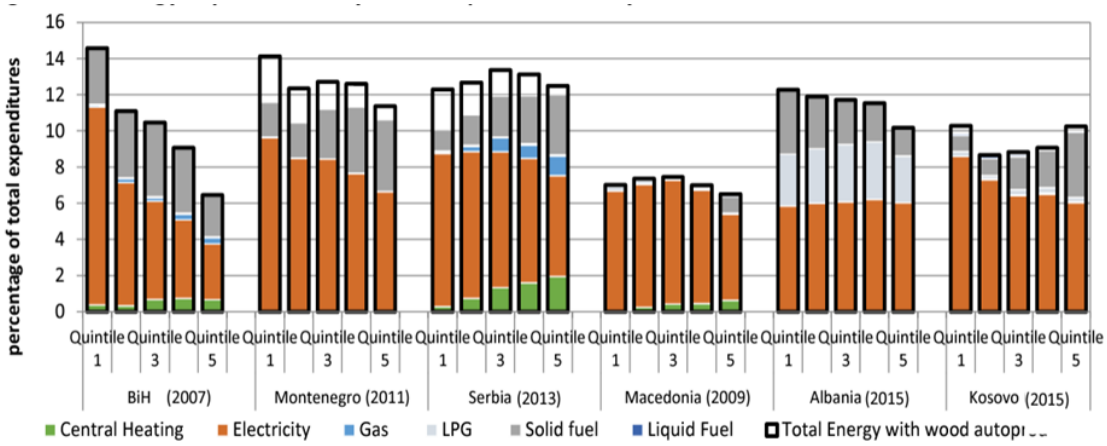


Figure 32. Energy expenditures by income quintiles and by fuel use in Western Balkans [71]

There is also evidence that, in addition to the households in the bottom quintile, other groups are also exposed to electricity tariff shocks. A recent World Bank cross-country assessment in Albania, Kosovo, and Serbia found that single elderly households also tend to be more at risk since they spend a large portion of income on electricity (7.7% in Albania, 6.9% in Kosovo, and 8.6% in Serbia). Their incidence in electricity poverty is 23% in Albania and Kosovo, and 32% in Serbia. In addition, in Albania people living in households that are recipients of unemployment benefits, households with children and a single parent or households with a female household head, also have a budget share of electricity expenditure that is above the national average. This is also the case for recipients of minimum pensions and households with a female household head in Serbia [71]. Almost two-thirds of annual heat demand in Western Balkans is met using firewood (42%) and electricity (21%), while other fuels account for the remaining 37%. Total annual heat demand in the region is estimated to be 6.4 Mtoe (74 TWh). The residential sector accounts for the largest share (70%) followed by commercial (20%) and public sector (10%). Firewood is commonly used in the residential sector, with a share ranging from 76% in BiH to 60% in Serbia. Only in Albania, electricity is the prevalent heating method. Electricity for heating is mostly used by households in urban areas (multifamily and stand-alone buildings) as the main heating source or to complement wood stoves in rural areas. The use of decentralised heating systems is widespread in the region. Approximately 88% of the 7.3 million buildings in Western Balkans use decentralised heating systems, small heat-only boilers, stoves and electric devices, whereas only 12% use district heating. Small heat only boilers are the most common

individual heating systems (47%), followed by electric appliances (21%) and stoves (19%). Stoves are used in more than half of stand-alone buildings [71].

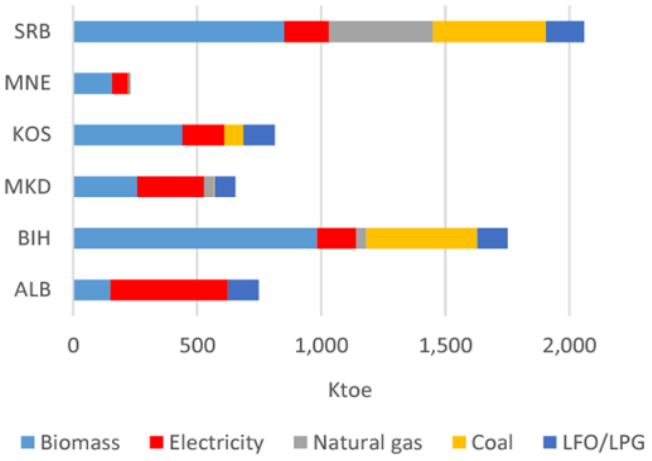


Figure 33. Heat demand by Fuel in Western Balkans [71]

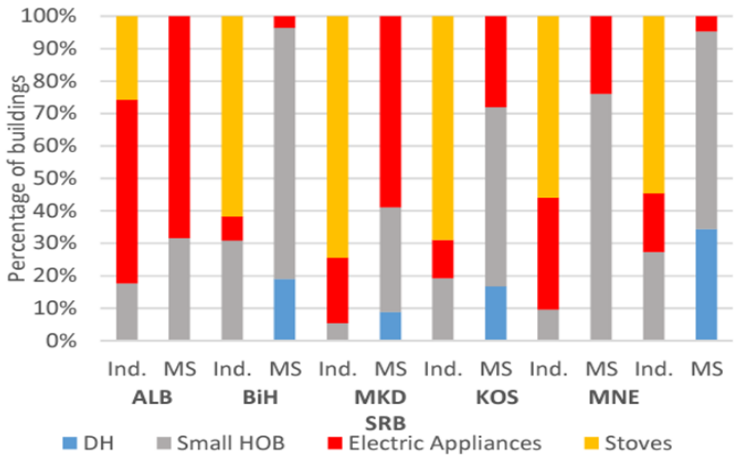


Figure 34. Heating systems by type of buildings in Western Balkans [71]

The overall efficiency and quality of decentralised heating services is low and results in the high indoor emissions. Despite the fact that they are widely used for heating and cooking, firewood stoves are inefficient and produce high levels of smoke and indoor pollution. Stoves are produced domestically in BiH, North Macedonia, and Serbia; generally, do not comply with EU certification standards. The widespread use of firewood, which is harvested in the months preceding winter with little or no drying, also results in the loss of 40 to 50% of the energy content [71].

4.2 Overview of the energy poverty in Albania

Albania's 2018-2030 energy strategy is the core strategic document for the sector. It aims to align the energy market with EU rules and directives through the main principles of affordability, reliability, and sustainability. According to the energy strategy, energy poverty is not yet clearly defined and systematically monitored and there are no specific policies in place designed to alleviate energy poverty [72]. The current legislative framework in Albania addresses the issue of vulnerable consumers who are entitled to support a disability, health, and income status, although it still fails to capture the broader aspects of energy poverty. The actual definition of vulnerable consumers has been adopted in Government Decision No. 8 from 2015. The primary legislation (the Power Sector Act and the Natural Gas Sector Act) provides criteria for consideration when defining vulnerable consumers and procedures for those who qualify as gaining vulnerable customers status. The defined criteria are as follows [73]:

- Customers with low income;
- Connection to the single-phase grid with a maximum power of about 16 Ampere;
- Maximum level of energy consumption per person;
- Direct support from the state budget.

The key stakeholders in the institutional framework in Albania concerning vulnerable consumers include:

- The Ministry of Infrastructure and Energy that is responsible for the implementation of energy policy and consequently for managing issues related to vulnerable consumers;
- The Ministry Responsible for Social Affairs that is responsible for providing support to low-income households for energy consumption costs;
- The Albanian Energy Regulatory Authority (ERE) that is responsible for undertaking measures ensuring that customers benefit from internal market operation promoting competition and customer protection;
- The Agency for Energy Efficiency (AEE) that is responsible for improving and promoting energy efficiency by undertaking a series of activities such as setting minimum requirements for energy performance in buildings, professional training on energy efficiency, issuing certificates to energy auditors, and energy managers;
- Energy provision in Albania is not stable and, according to the International Monetary Fund (IMF), in 2016 there were on average about 97 hours of power interruption, or on average 43 interruptions per customer that was the highest in Western Balkans region.

Albania's national distribution operator, after a failed privatisation, accumulated significant debts with major risks to its budget. Technical losses on the electricity grid reached nearly 46% in 2013, while revenue collection rates declined. In this context, electricity losses in the distribution system for 2020 reached the value of 21.48%,

marking a slight decrease in the level of losses compared to the value of 21.79% in 2019 [74]. Figure 35 shows the annual losses in the distribution system until 2020 in Albania. Eventually, the company was returned to the public sector in 2013, and the recovery of the electricity sector became a top priority. However, this priority relates primarily to minimising loses, increasing performance, and strengthening the electricity operator with arguably insufficient attention to vulnerable groups and the barriers that they may face in accessing the service.

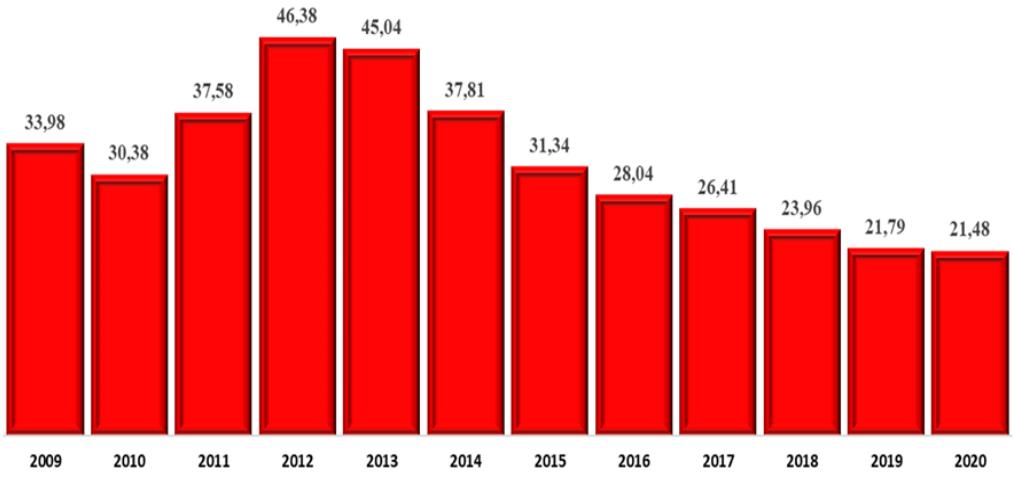


Figure 35. Annual losses in the Distribution System 2009-2020 [74]

Currently, Albania's residential sector is the largest consumers of electricity. According to the Albanian ERE, before the 1990s household consumption accounted for only 8-10% of total electricity, while the share of the industry was greater. For a large part of the first two decades of the country's "transition", household consumption of electricity showed a steadily increasing trend, which later slowed down and almost stagnated after 2006. This was caused by the rise of energy prices, the introduction of a variety of alternative energy sources for families such as natural gas, and the development of new industries and services [75]. Albanian households pay 11.4 ALL/kWh (0.09 €/kWh) for their electricity [76], being the second most expensive rate in the Western Balkans. Electricity prices in Albania for household consumers inclusive of all taxes and levies were 93 €/MWh in the second half of 2019 [73]. On a purchasing power basis, Albania's electricity prices rank 14th cheapest out of 35 European countries [74]. However, due to low-income levels, Albanian households dedicate a considerable part of their budget to utility bills. Indeed, the 2018 expenditure patterns of Albanian households show that "housing, water, electricity, gas, and other fuels" absorb about 10.5%, second only to "food and non-alcoholic beverages" at 44% [74]. Levels of energy consumption provide a more accurate picture of the qualitative aspects of access to energy. Households headed by an unemployed person typically have lower energy consumption, namely 81% of that where the head of household is employed. The average energy consumption is drastically lower among those families where the head of household has no primary education. The share of electricity costs in the overall consumption of families, where the head of the household is either unemployed or has a low

educational attainment, is twice the national average [74]. Based on the data from the energy balance, Albanian households use primarily three energy sources: electricity, biomass, and Liquefied Petroleum Gas (LPG) [73].

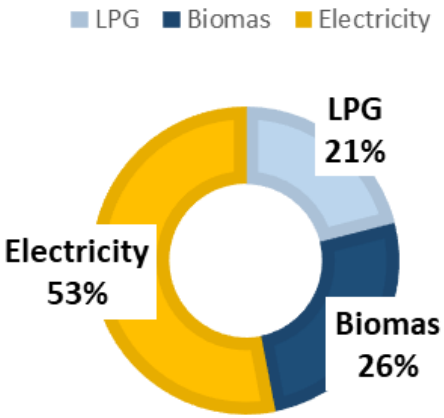


Figure 36. Structure of Energy Consumption in Albania [73]

There are a few national data sources that systematically capture the degree of energy poverty in Albania. Apart from the household budget surveys, which shed some limited light on the cost of utilities for Albanian families, the latest set of data that offers some additional insights is that derived from the 2011 census. Data from these sources show that electric heaters and electricity are more used by non-poor households, as they are more expensive heating options. Electric heaters are used by 14.3% of poor households compared to 19.0% of non-poor households, and electricity for heating is used by 19.5% of poor households versus 28.0% of non-poor households [75]. Only 3.2% of private households have central heating (e.g., building or dwelling heating), while 4.4% have a fireplace. Even where central heating systems exist, there is a lack of metering and controls for adjusting temperature levels. In rural households, wood is mostly used (85%). Leaving aside the issue of heating, an outright subsidy up to 210 kWh per month threshold would cost up to 2394 ALL (19.70 €) per household per month, which is nearly twice as much as the existing benefits of 1288 ALL (10.42 €). Total housing building stock in Albania has a surface of 84,927,085 m^2. According to the Census data from 2011, the average surface of dwelling is 117.58 m^2. Most of the housing stock surface was built between 1991 and 2011 (56%), but only buildings built after the year 2000 (35%) are considered to be energy efficient. Only 35% of living areas are heated in buildings on the coast, and about 70% in buildings in the mountains. Overall, 50% of households cannot afford heat services for the entire household area. On the other hand, there is also the coverage dimension. Beneficiaries would need to be paying customers, and this would mean that they would not only have a stable dwelling, but also an installed metre. Although there is no solid data available, these requirements are considered as barriers to rural and remote communities. Data show that households that are receiving social assistance are vulnerable in terms of their access to energy. In 54,000 social assistance beneficiaries, only 20,112 have access to the energy compensation scheme, while 10,646 are considered problematic since households are

in arrears and therefore they are not qualified to receive the current level of cash benefit. Indeed, such a finding is reinforced by the Soros Foundation in 2020 that states that 62% of beneficiaries of social assistance do not have access to the compensation scheme [77]. The scheme has coverage and efficiency problems that extend to other groups such as people living in rural areas, or women who have been subject to domestic violence. Energy prices and payment collection are both issues that affect many low-income households. These already have low consumption levels and so they can only afford higher electricity bills by reallocating expenditure from other areas. It is also important to note that, at this point, Albanian customers do not have the freedom to switch suppliers as the electricity market remains closed to competition under a regulated contract between state-owned generation and supply companies. Financial mechanisms are in place for the protection of several social categories. Currently, there are two layers of support:

1. A compensation scheme has been in place since 2006 in the form of a cash benefit of 640 ALL (5.20 €) for all those recognised as customers that reach the threshold of 200 kWh of monthly energy consumption;
2. The second measure was adopted in 2015 to provide compensation to vulnerable households due to the scrapping of the two-tier pricing structure that had been in place since 2008.

Until 2014, a lower tariff of 7.70 ALL/kWh (0.06 €/kWh) was applied to consumptions up to 300 kWh per month. Above this level, the tariff increased to 13.50 ALL/kWh (0.11 €/kWh): this was an energy consumption control mechanism to encourage the use of alternative sources for heating. However, as its implementation turned out to be problematic and led to extensive losses and abuse, it was abolished at the start of 2015 in favour of a single unified price of 9.50 ALL/kWh (11.40 ALL/kWh including VAT) equal to 0.08 €/kWh. To protect the same social categories as above, the government approved an additional cash benefit compensation of 648 ALL (5.30 €) per month. With the application of both measures, the total cash benefits were equal to 1288 ALL (10.42 €) per month. These are the only energy measures in the country, providing support to 213,000 persons. The cost to the state budget amounts to 1.76 billion ALL (14.5 M€) per year [75].

4.2.1 Results coming from the indicators in Albania

Expenditures on energy

Figure 37 shows the average share of expenditure on housing, water, electricity, gas, and other fuels in 2019. Regarding the first quintile of 18%, a decline trend has been down to 7% in the fifth quantile has been obtained. The average share of expenditure in the population is 10.1%. Since data include expenditures on water and housing, it can be assumed that energy-related expenditures are slightly lower.

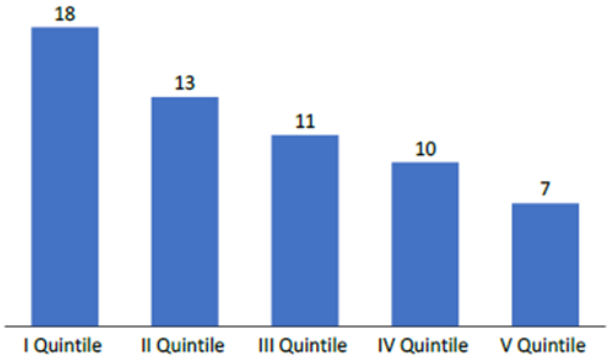


Figure 37. Share of average expenditure on housing, water, electricity, gas, and other fuels by quintile in 2019 [73]

Data are ordered according to total equalised disposable income. Four cut-point values of income (so-called quintile cut-off points) are identified, dividing the survey population into five groups equally represented by 20% of each person: (1) first quintile group of equalised income, (2) second quintile group of equalised income, (3) third quintile group of equalised income, (4) fourth quintile group of equalised income, and (5) fifth quintile group of equalised income. The first quintile group represents 20% of the population with the lowest income, and the fifth quintile group represents 20% of the population with the highest income.

1. Arrears on utility bills

Data on arrears on utility bills are based on the year 2019 [73]. Data are provided for the following types of households. The percentage of households in arrears on utility bills is shown in Figure 38 for households with an income below 60% of the median equalised income, and captures the most vulnerable households. The highest proportion of households below 60% of the median equalized income in arrears on utility bills are those occupied by a single person with dependent children: 47% of such households in 2019 had arrears on utility bills.

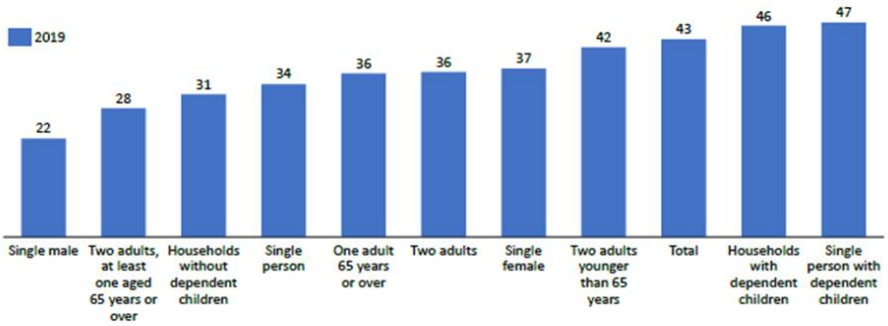


Figure 38. Share of households below 60% of the median equalised income in Albania in arrears on utility bills in 2019 [73]

2. Inability to keep home adequately warm

Data on the inability to keep households adequately warm are based on the year 2019 [73]. Data are provided for the following types of households. Data on the inability to keep a household warm are shown in Figure 39 for those households with an income below 60% of the median equalised income and captures the most vulnerable households. Figure 39 also shows that households with single females face the greatest difficulties in keeping their homes warm: 71% of single female households in 2019 were unable to keep their homes warm. Similarly, slightly lower values are observed for a single person with dependent children and a household with one adult of 65 years or over. These results point to the conclusion that probably single parent, single retired, and single-person households face the greatest difficulties in keeping their homes warm. Overall, 54% of households with income below 60% of the median equalised income had difficulties in keeping their homes warm in 2019.

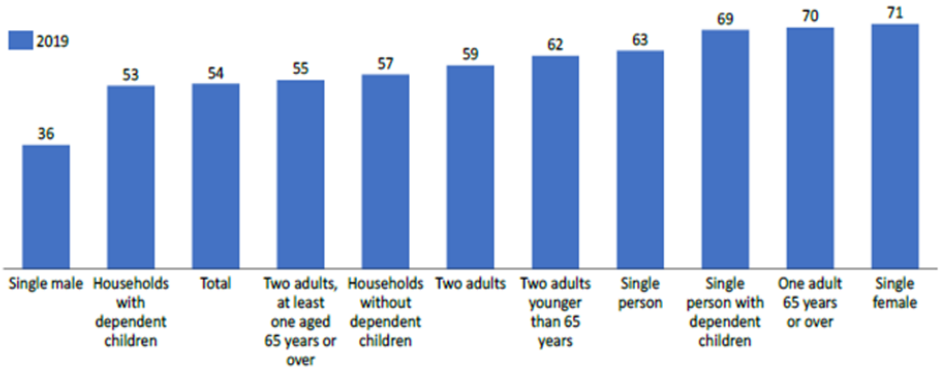


Figure 39. Share of households below 60% of the median equalised income in Albania unable to keep homes adequately warm in 2019 [73]

3. Condensation, leaking roof, rot in windows or doors

Data on condensation, leaking roof, rot in windows or doors are based on the year 2019 [73]. Data are provided for the following types of households. Data on condensation, leaking roofs, rot in windows and doors are shown in Figure 40 for households with an income below 60% of the median equalised income and captures the most vulnerable households. Figure 40 also shows that households with a single person and dependent children are the most affected: 47% of such households in 2019 meet the criteria.

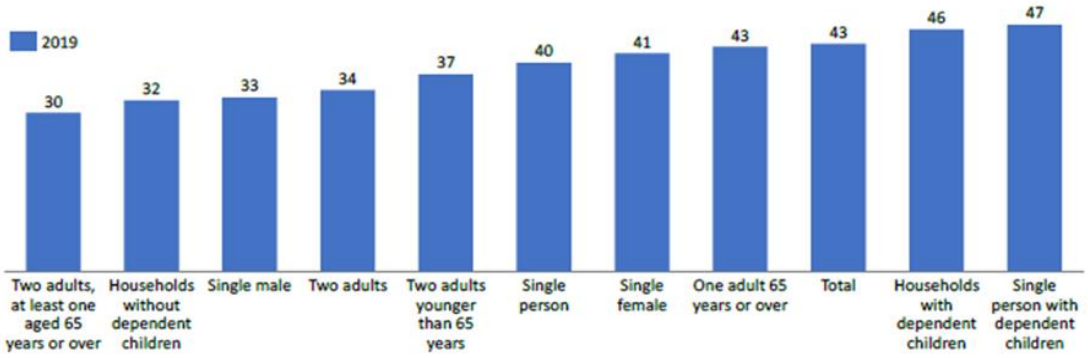


Figure 40. Share of households below 60% of the median equalised income in Albania suffering from condensation, leaking roof, rot in windows or doors in 2019 [73]

The 2014 Household Budget Survey (HBS) data show that, on average, a household spent 3089 ALL (25.10 €) monthly, or 4% of its total budget, on energy consumption (see Table 3). On average, electricity accounted for half of total household spending on utilities and it was similar in value to spending on health, education, or clothing. The budget proportion allocated to electrical energy was twice as high for those households living below the relative poverty threshold. On average, for a household living under the relative poverty threshold, monthly spending on electricity amounted to 2088 ALL (17 €), or around 9% of total spending (see Table 3) [75].

Table 3. Average monthly expenditure on electrical energy by households in relative poverty; Albania (2014) [75]

	Poor households	Non-poor households	Total
Energy: average total spending	ALL 2088 (17 €)	ALL 3342 (27 €)	ALL 3089 (25.10 €)
Average total consumption spending	ALL 23,721 (193 €)	ALL 80,967 (658 €)	ALL 69,442 (565 €)
Energy spending as proportion of total spending	9%	4%	4%

An assessment of energy poverty from Eden Centre took place in 2017 in five cities in Albania located in different geographical areas and with different population typologies [75]. Results showed that 90% of interviewees used electricity for water heating, 65% for heating purposes, and 37% used for cooking.

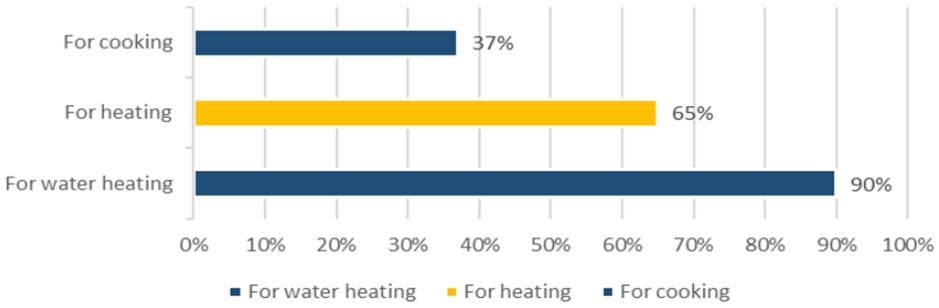


Figure 41. Electricity utilisation structure; Albania (2017) [75]

Respondents' monthly income varied from 10,000 AL (82 €) to over 50,000 ALL (410 €). Table 4 shows the average monthly cost of electricity, as well as the share of incomes it represented [75]

Table 4. Monthly spending on electricity by income range; Albania (2017) [75]

Average monthly household's income	Average monthly electricity costs	Share of income constituted by electrical costs
Under 10,000 ALL (82€)	3607 ALL (30 €)	At least 36%
10,000-25,000 ALL (82-205€)	3411 ALL (28 €)	19.5%
25,000-35,000 ALL (205-287€)	3830 ALL (31.5 €)	13%
35,000-50,000 ALL (287-410€)	4332 ALL (36 €)	10%
Over 50,000 ALL (410€)	5868 ALL (48 €)	No more than 12%

The findings show considerable disparities in terms of the share of electricity costs at different income levels: 62% of the households in the sample admitted they had difficulties in paying their electricity bill, and 72% said that they consumed less energy than they needed, especially during the winter season. Indeed, a qualitative study in 2009 conducted by the ERE provides some information on the structure of the energy expenditure of Albanian households. The study argues that a household of four people requires at least 210 kWh per month of energy consumption without taking into account heating [75].

4.3 Overview of the energy poverty in Bosnia and Herzegovina (BiH)

Energy poverty in Bosnia and Herzegovina (BiH) affects mostly households that are still heavily reliant on non-renewable energy sources such as wood, coal, and gas. The IEA defines energy poverty as the lack of access to affordable, reliable, and sustainable energy services for basic needs such as cooking, heating, and lighting [78]. Energy poverty is the result of very low incomes of household members, living in energy-inefficient buildings that have significant energy needs because of the condition of the envelope, the age of the building, and the inability to use the appropriate type of energy or energy due to technical, legal, or economic barriers [79]. The consequences of living in an energy-poor household are impaired health because of the exposure to cold air, mould, or condensation that can negatively affect health and increase the mortality of the population, especially during periods of extreme temperatures. In addition to the negative consequences, living in energy-poor households also leads to negative consequences on mental health and limits educational and economic opportunities. Also, the use of the cheapest energy sources results in increased air pollution. According to the data on the BiH housing fund, the categories of buildings (e.g., individual and collective) built in the period before 2014 is characterised as energy inefficient, with energy classes on average from C to G. Heat transfer coefficients of the envelope elements generally do not meet the conditions prescribed by regulations. The total number of buildings that use room stoves for the heating system is 64%, with a very low level of efficiency that results in increased energy consumption and significant energy costs. The average efficiency of thermomechanical heating systems of individual buildings built in the period before 2014 is 56.7%, while for collective housing buildings it is an average of 69%. As a result, 30% of the total useful area of the building is not heated at all. Also, in buildings used by people in a state of social need, significantly higher CO_2 emissions are present than in buildings used by other categories of the population. The energy mix for the year 2020 shows that less than 8% of the final energy for heating was delivered from the district heating system, and the percentage of buildings connected to the district heating system is very small. When a comparison of the materials cost that are installed in buildings during the implementation of energy rehabilitation measures for the population of BiH and EU countries [80] is made, as presented in Figure 42, costs of implementing the measures are uniform. Therefore, the financial burden for the implementation of energy rehabilitation measures for BiH citizens and EU citizens does not differ significantly. Data refers to the period 2019-2020 related to the category of individual buildings. When GDP and the specific cost of investment in energy efficiency measures is expressed, on average the inhabitants of BiH

have up to 4 times fewer financial opportunities for implementing energy efficiency measures compared to residents in EU countries.

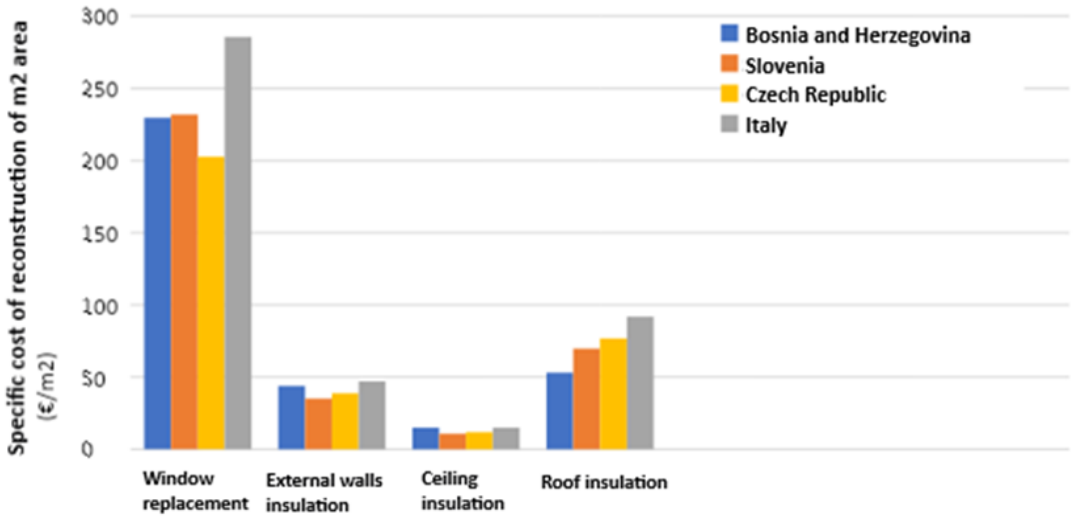


Figure 42. Specific costs of energy rehabilitation per unit area of envelope elements (year 2020) [80]

In BiH, energy poverty is a particular concern in rural areas where access to energy is limited and where people are more vulnerable due to their low-income levels and the high cost of energy. According to the Energy Community Secretariat (ECS), around 45% of the rural population in BiH is affected by energy poverty [79]. The lack of access to modern and efficient energy services leads to health problems, environmental degradation, and economic losses. According to the BiH Agency for Statistics, nearly 17.7% of the population lives in absolute poverty, while 34.8% live in relative poverty [81]. In 2019, the poverty rate in BiH was 9.2%; however, poverty is more relevant in rural areas than in urban ones, with a poverty rate of 12.6% in rural areas compared to 6.7% in urban areas [81]. These data indicate that poverty is a more significant issue in rural areas of BiH. The poverty rate is even higher among vulnerable groups such as elderly people, women, and children. The lack of access to modern and efficient energy services is a significant factor contributing to poverty in rural areas. Most households rely on non-renewable energy sources, and the energy consumption is inefficient due to outdated technologies and poor insulation. As a result, energy bills are high, and households spend a significant portion of their income on energy. Studies conducted in the energy community region, which includes BiH, highlight several key factors exacerbating energy poverty [68]. These factors include inadequate regulatory frameworks, lack of investment in energy efficiency, and low consumer awareness. Improving these aspects is crucial for addressing energy poverty effectively [79]. Investing in energy efficiency measures and renewable energy sources can play a vital role in alleviating energy poverty in BiH. Such investments not only contribute to poverty reduction but also create employment opportunities and stimulate economic growth [82]. To tackle energy poverty and promote inclusive growth, BiH recognizes the need for integrated policies that address the

multidimensional nature of poverty. These policies aim to enhance energy efficiency, promote renewable energy sources, and improve access to modern and efficient energy services [83]. By adopting sustainable and green recovery strategies, BiH can mitigate impacts of energy poverty while advancing its socio-economic development goals. This approach requires collaboration among government agencies, international organisations, and other stakeholders to ensure the successful implementation of energy-efficient and renewable energy projects. Furthermore, it is essential to learn from successful practices and experiences in addressing energy poverty in similar contexts. The implementation of energy efficiency retrofits has been identified as a promising approach. Research conducted in the EU and through projects like the REELIH Project in Armenia, BiH, and North Macedonia has shown that energy efficiency retrofits can contribute significantly to energy poverty alleviation [84]. These retrofits involve upgrading buildings with energy-efficient materials and technologies, improving insulation, and optimising energy consumption. By implementing such measures, households can reduce their energy bills, alleviate the burden of high energy costs, and improve their overall living conditions. Efforts to address energy poverty in BiH are also supported by international organisations such as the UNDP and the EBRD. The UNDP conducts assessments of development results in BiH to evaluate progress and identify areas for improvement [85]. The EBRD's BiH Country Strategy 2022-2027 provides a roadmap for sustainable development and includes measures to enhance energy efficiency and promote renewable energy sources [86]. Additionally, an in-depth review of energy efficiency policies and programs conducted by the ECS highlights the importance of robust regulatory frameworks and targeted support for energy efficiency initiatives in BiH [87]. These findings underline the need for strengthening policy frameworks, increasing investments, and raising awareness among consumers and stakeholders to overcome energy poverty effectively. Although BiH is not a member of the EU, it is a signatory to the Energy Community Treaty [88]. As a result, the country is required to align its energy policies with EU standards and directives. The European Commission's Energy Performance of Buildings Directive (EPBD) is one such directive that aims to improve energy efficiency in buildings, including reducing energy poverty [85]. The EPBD sets minimum energy performance requirements for new and existing buildings, encourages the use of energy-efficient materials and technologies, and promotes the implementation of energy-efficient building standards. Addressing energy poverty in BiH requires a comprehensive approach that combines policy interventions, investments in energy efficiency measures and renewable energy sources, and targeted support for vulnerable groups. By implementing sustainable and green recovery strategies, the country can improve access to affordable and reliable energy services, reduce energy costs, alleviate poverty, and contribute to its overall socio-economic development goals.

4.3.1 Results coming from the indicators in Bosnia and Herzegovina (BiH)

BiH, like other Western Balkan countries, currently lacks a clear definition of energy poverty. While the country's Federation's Law on Electrical Energy acknowledges the need for a program to protect vulnerable energy consumers, there is no specific statistical data collection, criteria, or monitoring system in place to address energy poverty. However, a survey conducted by the Centre for Ecology and Energy in 2018 in Zenica-Doboj Canton sheds light on the challenges faced by households. The survey revealed that 38% of households reported issues

with damp walls, 28% faced problems with draughts and energy conservation, and 42% can afford only to heat one or two rooms rather than the entire house or flat. Additionally, 18% of households struggled with electricity and heating bills [89]. These findings highlight the urgent need for action to tackle energy poverty in the country. While addressing energy poverty should be a priority alongside overall poverty alleviation, leaders of BiH seem preoccupied with personal and political pursuits, hindering the development of policies that could benefit the most vulnerable members of society. In 2015, the national poverty rate in the country stood at 16.9%, gradually declining from 17.7% in 2004 [90]. The national poverty rate indicates the percentage of the population living below the national poverty line, and these estimates are derived from household surveys weighted by population subgroups. In addition to the aforementioned information, it is worth noting that BiH's GINI index, a measure of income inequality, stood at 33% in 2011, slightly lower than the 33.1% recorded in 2007 [91]. Unfortunately, there is a lack of updated data available regarding the country's GINI index. Income inequality is an important factor to consider when addressing energy poverty, as it can further exacerbate disparities in accessing and affording essential energy services. BiH has taken several steps to mitigate energy poverty in rural areas. One of the key initiatives is the implementation of the NREAP in the period from 2010 to 2020 [92], which aims to increase the share of renewable energy sources in the country's energy mix to 40% by 2020. The plan includes a number of measures to promote the use of renewable energy sources such as incentives for the production and consumption of electricity from renewable sources as well as measures to promote energy efficiency. Another important initiative is the establishment of the Energy Efficiency Fund (EEF) of BiH [93], which was established in 2008 with the aim of promoting energy efficiency and renewable energy sources. The fund provides financial support for the implementation of energy efficiency and renewable energy projects including grants, soft loans, and guarantees. The EEF has also developed several programs aimed at improving energy efficiency in households and small businesses such as the "Warm Home" program, which provides financial support for the installation of energy-efficient heating systems and insulation in households. Furthermore, the Government of BiH has signed several international agreements and initiatives aimed at promoting renewable energy and energy efficiency [91]. These include the Southeast Europe Energy Community (SEEC), the Regional Energy Efficiency Program (REEP), and the European Energy Community (EEC), which all aim to promote the development of renewable energy and energy efficiency in the region. The challenges of energy poverty in rural areas of BiH are complex, but there are several solutions that have been successfully implemented in other countries that could be adapted and applied in the Bosnian context. These solutions include policy interventions, financial mechanisms, and technology innovations: further details are provided hereinafter.

1. Policy interventions

Policy interventions can play a significant role in addressing energy poverty in rural areas. The following policy options can be considered:

- Development of a national energy poverty strategy: a national energy poverty strategy should be developed to tackle the root causes of energy poverty, including poor quality housing and low incomes.

The strategy should involve a combination of measures including the provision of energy-efficient technologies, financial incentives, and social support to improve the living conditions of rural households;

- Introduction of minimum energy efficiency standards: minimum energy efficiency standards for new buildings can be introduced, which would help to reduce energy consumption and energy bills in the long term. This can be supported by public awareness campaigns to promote the benefits of energy-efficient technologies and practices;
- Increase access to renewable energy sources: the promotion of renewable energy sources such as solar, wind, and hydropower can be an effective way to provide affordable and sustainable energy to rural households. This can be supported by government subsidies, incentives, and tax breaks for renewable energy projects.

2. Financial mechanisms

The implementation of financial mechanisms can help to address the issue of affordability for low-income households. The following financial mechanisms can be considered:

- Introduction of energy-efficient mortgages: energy-efficient mortgages can incentivize homeowners to invest in energy-efficient upgrades to their homes by providing lower interest rates and longer repayment terms. This can be supported by a national program to promote the uptake of energy-efficient mortgages;
- Creation of a national energy fund: A national energy fund can be established to provide grants and loans to low-income households to improve their energy efficiency and access to renewable energy sources. This can be funded by a range of sources including government budgets, carbon tax revenues, and private sector contributions.

3. Technology innovations

Technological innovations can provide affordable and sustainable energy solutions to rural households. The following technological innovations can be considered:

- Development of community-based micro grids: community-based micro grids, which are small-scale power grids, which can operate independently of the main power grid, can be developed to provide reliable and affordable energy to rural communities. This can be supported by government grants and subsidies;
- Use of smart metres and energy management systems: the use of smart metres and energy management systems can help households to manage their energy consumption and reduce their energy bills. This can be supported by government incentives and education programs to promote the uptake of smart metres and energy management systems.

Based on the collection and analysis of secondary evidence and good practices, some of the solutions to overcome the barriers in energy poverty in rural areas of BiH are:

1. Introduction of energy-efficient building standards: BiH should introduce energy-efficient building standards that require new buildings to be nearly zero-energy buildings by 2025. Standards should also apply to existing buildings, which must undergo energy renovations to improve their efficiency;
2. Targeted support for vulnerable groups: BiH should implement targeted support measures for vulnerable groups such as low-income households, elderly people, and people with disabilities. Support measures should include subsidies for energy bills, energy-efficient appliances, and home renovations.
3. Use of renewable energy sources: BiH should invest in renewable energy sources such as wind, solar, and hydropower. The investment should be supported by regulatory frameworks that provide incentives for renewable energy and penalise non-renewable energy sources.

Energy poverty in rural areas of BiH is a complex problem that requires a multifaceted approach. Policy interventions, financial mechanisms, and technology innovations can all play a role in addressing energy poverty in rural areas. The successful implementation of these solutions requires strong political will, effective coordination between government agencies, and the involvement of local communities and civil society organisations.

5. Energy Poverty Indicators used in the GETA project

As discussed in detail in Section 2, the list of indicators is important to evaluate and address the energy poverty level worldwide. In this regard, EPHA has provided a list of 21 common indicators to pursue this task in the EU [14]. Based on the indicators listed in Table 1, the following ones (10 out of 21) have been selected. In particular, these indicators are proposed through specific questions, and the answers to each question is numerically evaluated (e.g., a score is assigned) to provide a global picture of the energy status of households that have participated in the proposed questionnaire.

1. Arrears on utility bills

Arrears on utility bills indicator represents the share of (sub) population with arrears on utility bills based on the question: **In the last twelve months, has the households been in arrears, e.g., has been unable to pay on time due to financial difficulties for utility bills (heating, electricity, gas, water, etc.) for the main dwelling?**

	Due time	**1 month later**	**2 months later**	**More than 2 months**
How long does it take to pay electricity bills?				

2. Percentage of persons or households spending up to a certain percentage of their income on energy services.

This indicator evaluates the share of households' expenses in paying energy (e.g., electricity, natural gas, etc.), which provides an overview of the energy situation in a country and, namely, in a particular location within the country. To evaluate this indicator, the following question is asked: **How much of your income goes for electricity?**

	10%	**20-30%**	**More than 30%**
How much of your income goes for electricity?			

3. Inability of keep home adequately warm

The inability to keep homes adequately warm indicates 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?**

	Very unsatisfied	**Unsatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
What is your opinion regarding the level of energy efficiency of your building?					
What is your opinion regarding the level of energy efficiency of your devices?					
What is your opinion regarding the quality of your windows and doors?					
What is your opinion regarding the quality of the roof and walls?					

4. Dwelling comfortably cold in summer time

Due to climate change, the EU is currently facing a considerable increase in temperatures, mainly in the summer. High temperatures can lead to some diseases (and sometimes deaths) for households, especially for elderly people if it is not tackled properly (e.g., use of fan, air conditioning, etc.). To evaluate this indicator, the following question is asked: **What is your opinion regarding the level of comfort in summer time?**

	Very unsatisfied	**Unsatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
What is your opinion regarding the level of comfort in summer time?					

5. Dwelling comfortably warm in winter time

In some countries of the EU (especially in Northern Europe), the winter season can be particularly strong in terms of temperatures and bad weather. Like the summer period, also the winter one can lead to some diseases (and sometimes deaths) for households, especially for elderly people if it is not tackled properly (e.g., use of a proper heating system). To evaluate this indicator, the following question is asked: **What is your opinion regarding the level of comfort in winter time?**

	Very unsatisfied	**Unsatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
What is your opinion regarding the level of comfort in winter time?					

6. Equipped with air conditioning

The use of the air conditioning is one solution to tackle hot temperatures in the summer as already discussed about the indicator #4. However, this system might not be always affordable for households due to economic or technical (e.g., status and years of the buildings) reasons. To evaluate this indicator, the following question is asked: **What is your opinion regarding the level of air conditioning?**

	Very unsatisfied	**Unsatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
What is your opinion regarding the level of air conditioning?					

7. Equipped with heating

The use of a heating system is the only solution to tackle cold temperatures in the winter as already discussed about the indicator #5. There are several heating systems that use a determined heat source (generally fossil fuels like natural gas), and others that use electricity (e.g., heat pumps). However, the choice of using one technology rather than the other is due to i) availability of the primary sources ii) connection of the building to the national energy grids, and iii) lack of renewables exploitation locally. This system might not be always affordable for households due to the previous reasons. To evaluate this indicator, the following question is asked: **What is your opinion regarding the level of heating?**

	Very unsatisfied	**Unsatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**
What is your opinion regarding the level of heating?					

8. Household electricity prices

Electricity prices vary depending on the energy situation of a country (e.g., availability or lack of particular primary sources). The more a country is self-sufficient from the energy point of view, the lower the energy prices for households. However, this is not always true because another important aspect to consider is the development of the energy infrastructure and its ability to reach the highest number of end-users. In some places, this is not possible mainly due to the morphological characteristics of the country so that local people have to buy and use their own energy generator to produce electricity. Generally, fossil fuels are used and their costs increase due to the difficulty of reaching those places. To evaluate this indicator, the following question is asked: **What is the level of electricity price for your home?**

	Unaffordable	**Neutral**	**Affordable**
What is the level of electricity price for your home?			

9. Number of rooms per person by renters/owners/total

The *"Number of rooms per person by ownership status"* indicator represents the average number of rooms per person by ownership status (rented/own property). This indicator embeds different implications for energy poverty for several reasons, and two of them are: i) the higher people density, the lower the thermal discomfort felt in the summer/winter periods (on an equal building status) and ii) the higher people density, the higher the energy expenses and vice versa. To evaluate this indicator, the following questions are asked: **How many people are in your home? How many rooms do you have in your home?**

	2	**2-5**	**More than 5**
How many people are in your home?			

	2	**2-5**	**More than 5**
How many rooms do you have in your home?			

10. Presence of leak, damp, and rot

The general conditions and years of a building strongly affect its structural integrity as well as its internal thermal conditions. There could be the presence of leak, damp, and rot that can lead to uncomfortable and unhealthy living conditions to households, thus worsening their lifestyle. To evaluate this indicator, the following question is asked: **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**
Do you have any of the following problems with your dwelling/accommodation?			

The choice of the previously reported 10 indicators has been done according to the ease of getting these types of information by performing onsite questionnaires to people, especially in Western Balkans, living in those areas where energy poverty is more evident (e.g., remote and rural areas). Indeed, the information coming from the missing 11 indicators is hard to get due to the absence of a proper data infrastructure and equipment, thus onsite visits are not enough to obtain and analyse them. The selected 10 energy poverty indicators will be then used to evaluate energy poverty in Western Balkans in the GETA project via the development of the energy poverty tool and the GETA app.

6. Conclusions

This work, which has been developed during the GETA project, wants to give further insights on energy poverty in some of the European nations (e.g., Italy and Sweden) and in Westerns Balkans (e.g., Albania and Bosnia and Herzegovina (BiH)). In particular, a general overview of this issue has been provided as well as the common list of 21 indicators reported by EPHA. Only a few of them will be used for tackling energy poverty in Western Balkans (e.g., Albania and BiH) by organising on-site activities with questionnaires to address and evaluate energy poverty consequences, mainly in remote and rural zones where there is no connection with national energy networks.

A detailed focus on the current situation of energy poverty in the countries involved in the GETA project has been proposed, showing its evolution over the years and highlighting the most affecting aspects of energy poverty on the population. In Europe, a significant number of residents still struggle with energy poverty, highlighting the alarming prevalence of energy poverty in the region. Europe´s legislation acknowledges the severity of energy poverty and aims to address this issue through various measures, such as promoting energy efficiency, providing financial assistance, and implementing social policies to support those affected by energy poverty. The complexity and versatility of energy poverty emphasises the urgent need for further research amongst the EU-member states, to get the most effective actions in place. Western Balkans have slower economic growth compared to other countries in Europe and this can be due to different reasons. Having a slow economic growth means a slower development; therefore, bigger effects of energy poverty in these countries are expected. Some reports showed how lately most of the income of many households is spent on energy bills due to high energy costs as well as low income of individuals.

Results of this study will help GETA project partners to assess energy poverty and promote the energy transition in Europe, mainly in Western Balkans, by fighting against this issue. Of course, this is a first step before moving further to the development of an energy poverty tool capable of providing a numerical assessment to energy poverty, and guidelines to tackle it via the GETA app that will be developed during the GETA project as well.

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