



# Energy poverty and gender nexus – A case study analysis from Greece

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## ABBREVIATIONS

|      |  |
|------|--|
| DCEN | Energy Needs Coverage Degree             |
| EED  | Energy Efficiency Directive              |
| EEO  | Energy Efficiency Obligation Scheme      |
| EPOV | European Energy Poverty Observatory      |
| ERDF | European Regional Development Fund       |
| ESIF | European Structural and Investment Funds |
| EU   | European Union                           |
| GDP  | Gross Domestic Product                   |
| JTF  | Just Transition Fund                     |
| NECP | National Energy and Climate Plan         |
| RES  | Renewable Energy Sources                 |
| TJTP | Territorial Just Transition Plan         |

## EXECUTIVE SUMMARY

Energy poverty has become an increasingly pressing issue in Europe in recent years, affecting both genders, as gender and energy are interlinked. Measures and policies have been taken both at European level and for specific regions of Europe to mitigate the effects of energy poverty. The following research aims to address the relationship and the current situation between gender and energy poverty in Greece, specifically in the two coal regions of Western Macedonia and Megalopolis Arcadia. The research was divided into three stages: (1) a literature review was conducted in order to identify the relationship between gender and energy poverty both in Europe and in Greece and to identify the indicators to measure this relationship; (2) a quantitative analysis was conducted for the regions of Western Macedonia and Arcadia based on the selected indicators of measurement, and (3) an analysis of the existing policies and measures to address energy poverty in Greece, and research on whether and how much weight is given to gender aspects. The research found that there is a difference in the way how men face energy poverty compared to women in Greece: women are in a more vulnerable position. Policies to address energy poverty in Greece focus more on economic and technological means and less on social means, with little emphasis on gender. The study of energy poverty by gender in Greece and in the coal regions contributes to the understanding of this relationship, as well as to the identification of the most vulnerable gender to this phenomenon.

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## 1. INTRODUCTION

Energy is essential for socio-economic development and the energy needs of society are increasing over the years (Bergasse et al., 2013). Energy shortages can have serious consequences for human health and well-being (Tsagkaris Christos et al., 2023). On the other hand, poverty is a concept that is difficult to specify and measure. It can refer to a person who has less than a certain minimum, or it can refer to a person who has relatively less than something compared to someone else in a setting. The different approaches to defining poverty, or any other concept, lead to the identification of different factors and indicators that define the phenomenon. It is now widely acknowledged that energy poverty is an issue in many EU Member States, affecting approximately 42 million people across Europe and 104 million people cannot keep their homes comfortable during summer (European Economic and Social Committee, 2023). The phenomenon of energy poverty has intensified in recent years mainly due to the effects of the economic recession and has been studied by many scientists and experts. In the current conditions of economic recession, the phenomenon of energy poverty is becoming increasingly acute, especially among low- and middle-income households, affecting each person and gender differently. For this reason, it is crucial to conduct more in-depth research on how each gender experiences the phenomenon of energy poverty. Gender refers to the characteristics of women, men, that are socially constructed. This includes norms, behaviors and roles associated with being a woman, man, girl or boy, as well as relationships with each other (World Health Organization, 2023). Gender is directly related to energy since all humans have a need for energy supply. In terms of energy poverty, it is becoming recognized as a crucial problem in Europe and affects all citizens regardless of gender. It is a particularly critical social issue directly linked to the energy sector.

Furthermore, the importance of gender in the energy transition is increasingly recognized. Women and men have a different relationship with the energy sector, since they have different roles in the workplace, society, something that also shapes a gendered character towards the energy transition, and any change resulting from the energy transition will affect them differently (Lahiri-Dutt Kuntala, 2023). This is especially true in coal-intensive regions that are experiencing mine and power plant closures. Women in these areas tend to have less available time and less financial resources and, therefore, less agency and space to advance their interests and perspectives in the policy-making process (Lieu et al., 2020). Coal regions have a different distribution of jobs between the sexes that also results from socio-cultural background, generally showing a higher rate of unemployment for women compared to national averages as well as having a significant lack of quantitative and qualitative data on gender from studies reported on this topic (Walk et al., 2021). The just transition aspect offers little scientific basis, as much of the literature has focused primarily on economic impact analysis, with a focus on unemployment, as opposed to what the transition impacts on both genders separately (Walk et al., 2021).

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Energy poverty affects European countries differently, and it is more present in central, eastern, and southeastern Europe due to different political and economic circumstances, such as the higher homeownership rate in multi-family apartment buildings (MFABs) and the worse performing building stock (ComAct, 2021). The United Kingdom and Ireland were the first countries to become aware of the need to address and improve cold and inefficient homes, with Central, Eastern and Western European countries later becoming concerned about the problem of population access to energy, determinants, economic and social consequences. (Neacsu et al., 2020). Greece, located in south-eastern Europe, is one of the most affected countries in terms of energy poverty in Europe (ENPOR Dashboard, 2023). Thus, this study focuses on energy poverty in Greece and specifically two regions that are mostly affected by the transition to climate neutrality.

The general awareness and familiarity of Greek citizens about energy poverty is low. According to a survey by the Heinrich-Böll Stiftung, 19.7% of Greeks do not apprehend the term energy poverty, i.e. 1 in 5 citizens, 56.2% do not have an Energy Performance Certificate (EPC), and regarding available financial programs and incentives that could help to tackle energy poverty, 23.2% of Greeks claim that there are no such programs, while 19.7% do not know if there are any (Olga Drossou & Heinrich Böll Stiftung, 2020). This report will focus on how energy poverty and energy interlinked, and what are the specific challenges of energy poverty and gender aspects in coal regions in Greece, like Western Macedonia and Megalopolis in Arcadia. Western Macedonia is the region with the highest percentage of the index "energy expenditure is higher than 10% of income" in Greece (Tourkolias, 2022). To assess the trend for energy poverty in and how the two sexes are affected, the report runs an in-depth analysis of the current situation of energy poverty not only at European, but also at national level as well as it will be investigated if there is specific information for these specific regions in Greece. This is a major research challenge due to the lack of peripheral elements of energy poverty and gender in most cases. This report has the objective to contribute to close the knowledge gaps on the interlinkage between energy poverty and gender. The main research questions are: How are energy poverty and gender interlinked, based on current research? What indicators can be used to analyze the gender-specific impacts of energy poverty? To what extent are Greek women more affected by energy poverty than Greek men? How are energy poverty and gender addressed in current climate and energy policies in Greece? In order to answer the research questions, this report applies three methods: literature review, data analysis and policy analysis.

The study shows that there are many indicators, both social, economic and energy, to measure energy poverty, but regarding gender the available data are mainly limited to economic indicators. The risk of poverty in Greece, is in a greater extent in women (27.4%) than in men (25.2%), and energy poverty rates in the coal regions are higher than the overall average energy poverty rate in Greece. Unemployment among women in 2023 (14.4%), is higher than among men (8.2%) with the female unemployment



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doubling in the coal regions. Both regions exceed the average unemployment rate for women in the country in 2022 (16.3%). Western Macedonia, women experience unemployment to a greater extent (24.4%) than women in the Peloponnese (17.7%). In Western Macedonia, women experience unemployment to a greater extent (24.4%) than women in the Peloponnese (17.7%). Both regions exceed the average unemployment rate for women in the country in 2022 (16.3%).

## 2. BACKGROUND ON ENERGY POVERTY IN THE EU

### Defining energy poverty

Energy poverty is a multi-dimensional phenomena and different definitions exist across literature. Bouzarovski (2018) defines energy poverty as a situation which “occurs when a household is unable to secure a level and quality of domestic energy services – space cooling and heating, cooking, appliances, information technology – sufficient for its social and material needs”. More specifically, the poverty does not only refer to the difficulty of covering the energy needs of a household but as the wider inability to secure a socially and materially necessitated level of end-use energy in the home, exerting wider economic and political impacts (Bouzarovski, 2014).

Energy poverty at EU level is defined in the 2023 Regulation on the Social Climate Fund and revised Energy Efficiency Directive as “a household’s lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes” (Widuto Angieszka, 2023). Legislation that referred to the concept of energy poverty includes Directive (EU) 2019/944 on rules for the internal market in electricity (the “Electricity Directive”), which mentions the concepts of “vulnerable customers” and of “energy poverty”. In this legislation it is proposed that the calculation of the number of households in energy poverty can be determined by various criteria such as “low income, high expenditure of disposable income on energy and low energy efficiency” (Widuto Angieszka, 2023).

Definitions vary also across countries, as national socioeconomic conditions play a vital role in defining energy poverty. Some countries, like Greece, have no national definition for energy poverty.

## Status of energy poverty in the EU

Energy poverty is a growing social challenge in the EU, with some countries more affected and others less, resulting in detrimental effects on quality of life, in terms of health, economic well-being, housing, social cohesion, but also in political and economic matters (European Energy Network (EnR), 2019).

In 2022, 9.3% of the EU population were unable to keep their home adequately warm, approximately 7% of the EU population had arrears on their utility bills, and almost 15 % lived in dwellings with leak, damp, or rot in 2020 (Widuto Angieszka, 2023).

Energy poverty is a multidimensional phenomenon, and in many cases, has three underlying causes: 1) high energy expenditure in relation to the household budget, 2) low income and 3) low energy efficiency of buildings and appliances (European Commission, 2023). Energy poverty is linked to the difficulty of energy supply. Russia's war in Ukraine, together with rising energy prices, contributed to increasing energy poverty as Europe's consumers were forced to pay more for fuel, heating and electricity, making it harder to meet their energy needs. Another situation that contributed to energy poverty before the Russia-Ukraine war was the pandemic. During that period there was a rise in energy prices due in the post-pandemic economic recovery and increased energy demand, combined with the unusually low feeding due to the cold winter season, bad weather conditions resulting in less wind power and low levels of gas storage in Europe, according to the International Energy Agency (IEA). Analyzing by percentages, energy poverty, according to Eurostat (June 2023), declined in 2020 when energy poverty affected 8% of the population and 6.9% in 2021, but over the past few months the unprecedented surge in energy prices and the Russian invasion of Ukraine as mentioned before, have made it more difficult for even more people with an increase in the percentage to 9.3% in 2022.

Considering the gender differences, women are particularly at risk of energy poverty in Europe, as they typically have lower incomes, stay longer hours at home to care for children, and often manage energy resources differently than men (Clancy et al., 2017).

Greece is one of the countries most affected by energy poverty, facing many challenges. Factors that contributed to the creation and continuation of the phenomenon are serious economic challenges including a financial crisis that began in 2008. In 2013, Greece was ranked third among the EU28 Member States at risk of poverty or social exclusion (35.7% of the population) and first in the increase in poverty between 2009 and 2013 (Eurostat, 2015), as fuel prices rose significantly, with heating oil prices rising by up to 90.16%, average annual income contracted by 29.10% (Papada Lefkothea & Kaliampakos Dimitris, 2016). Since 2009, and within 6 years of the imposition of austerity policies, the country's Gross Domestic Product (GDP) has decreased by 25% (Papada Lefkothea & Kaliampakos Dimitris, 2016). These economic challenges lead to a crisis, to the increase in unemployment, since people in the workplace have lower and

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lower incomes, resulting in financial instability, making it difficult for some households to afford energy services. High levels of unemployment and social welfare challenges can contribute to energy poverty.

## Energy poverty impacts

According to Halkos George E. and Gkampoura Eleni-Christina's review about energy poverty in 2021, energy poverty in Europe has multifaceted impacts that affect individuals, and broader society. The impacts can be divided into:

- Social Impacts

Social impacts include areas such as employment since people cannot afford to move and work in some areas due to high energy costs, areas such as education since lack of access to reliable energy can deprive educational opportunities, with students in schools and universities, with students unable to study in places that are too cold or too hot, in places with inadequate lighting, resulting in poor performance. Still included in this area is gender and social cohesion, where low-income households, the elderly, low-income women and marginalised communities may be more vulnerable to the effects of energy poverty, creating a social divide. Finally, living conditions when poor insulation, old heating systems and reliance on fossil fuels for heating lead to high energy bills and therefore low levels of comfort, while also affecting health (E. Halkos George & Gkampoura Eleni-Christina, 2021).

- Economic Strain

Low income combined with high energy costs results in economic inequality in households. Energy poverty often forces individuals to cut back on basic needs such as health care, the provision of goods or services to save money to be able to live (E. Halkos George & Gkampoura Eleni-Christina, 2021).

- Environmental Impact

People experiencing energy poverty are likely to resort to using cheaper and more environmentally harmful energy sources, such as solid fuels. This contributes to their health, local pollution, and exacerbates global environmental issues (E. Halkos George & Gkampoura Eleni-Christina, 2021).

Tackling energy poverty in Europe requires a design that combines social, economic, and environmental policies. Targets and measures to improve the energy efficiency of housing, provide financial assistance to vulnerable households and promote renewable energy sources (European Commission, 2023a).

## Policies to reduce energy poverty

Nevertheless, in recent years, Europe has become aware and has included in its measures and regulations the chapter on gender inequality to eliminate energy poverty. The question is whether it has given due weight. European Green Deal is a strategic policy pathway at the European level that aims to "transform the EU into a just and prosperous society with a modern, resource-efficient and competitive economy, where there are no net greenhouse gas emissions in 2050 and economic growth is decoupled from resource use" (European Commission, 2021a) strategy includes a range of policy measures and regulations in many sectors, including the energy sector, transport, agriculture, and the circular economy. The Green Deal may focus primarily on addressing climate change and promoting environmental sustainability, but it also aims to address societal challenges, such as the important challenge of energy poverty (European Commission, 2021a).

The Green Deal is linked to the fight against energy poverty through (European Commission, 2021a).

- Energy efficiency measures

The Green Deal focuses on upgrading the energy efficiency of buildings, which contributes to both the environment and society. The various measures to upgrade the energy efficiency of buildings lead to reduced energy bills, helping to alleviate energy poverty.

- Development of renewable energy sources

The Green Deal promotes the exploitation of renewable energy sources through the transition to renewable energy technologies. In this way, the use of fossil fuels will be reduced, which pollute the environment and are more expensive to use than renewable energy sources. This transition will have a positive impact on energy poverty.

- Social justice and just transition

The Green Deal emphasizes the "just transition" with the goal of transitioning to a green and socially just economy. This transition includes supporting regions and communities in various regions in Europe that are facing economic challenges. The Green Deal aims to prevent or mitigate any negative impacts on vulnerable populations, including those at risk of energy poverty.

- Energy access and affordability

The Green Deal aims to provide immediate access to affordable, clean energy for Europeans. Policies under the Green Deal designed to ensure a just transition to a green economy have as their principle that no one is left behind, especially social groups facing energy poverty.

- Social Fund and financial instruments

The European Green Deal includes financial instruments like the Just Transition Fund (JTF) to support regions that are highly dependent on fossil fuels, such as rural areas in Europe. These financial instruments are also used to tackle energy poverty and be a bridge for the transition to clean forms of energy.

- Supporting vulnerable communities

The Green Deal supports vulnerable communities, and those facing energy poverty. With the aim of investing in the education sector and implementing social policies, we move forward to a sustainable economy.

The EU aims to alleviate energy poverty and has put in place relevant policies. Regarding plans at European level aimed at tackling energy poverty over the years, various policies have been developed (compare Table 1).

*Table 1: Policies in order to reduce energy poverty in EU*

|   |  |
|---|--|
| <p><b>Energy Efficiency Directive (EED)</b></p>               | <p>Measures to promote energy efficiency and reduce energy consumption. The revised March 2023 directive by the European Parliament and the European Council increases the energy efficiency target, going beyond the Commission's original "Fit for 55" proposal, making it binding on EU countries to ensure an additional 11.7% reduction in energy consumption by 2030, compared to the projections of the 2020 reference scenario (European Commission, 2023c).</p> |
| <p><b>Clean Energy Package for all Europeans</b></p>          | <p>Includes legislative proposals for Europe's clean energy transition by decarbonizing the EU's energy system in line with its targets European Green Deal. It deals with areas such as energy efficiency, renewables, and electricity market design, with governance regulation primarily concerned with making energy more affordable and sustainable for EU citizens (European Commission, 2019a).</p>   |
| <p><b>European Structural and Investment Funds (ESIF)</b></p> | <p>The European Union allocates funds through the EMFF to support Member States in achieving their energy and climate objectives, some of which relate to</p>  |

|  |   |
|--|---|
|  | reducing energy poverty (European Commission, 2014).  |
| European Energy Poverty Observatory (EPOV)     | It enhances understanding, facilitates knowledge sharing and supports the development of effective policies to tackle energy poverty (European Commission, 2016)  |
| 2030 National Energy and Climate Plans (NECPs) | Each EU Member State has an ESSF, which will outline national energy and climate targets and policies from 2021 to 2030. These plans shall include measures and policies to address energy poverty and enhance energy access for vulnerable populations (European Commission, 2019b).   |
| European Regional Development Fund (ERDF)      | The ERDF is one of the structural funds that can be used to finance public and private projects in all EU regions, which aim to improve energy efficiency and reduce energy poverty in various regions. This fund aims to reduce economic, social and territorial inequalities and supports investments through specific national or regional programs (European Commission, 2021). |

The European Commission recommended (October 20th, 2023) a set of measures to tackle the phenomenon of energy poverty. Some of the most important measures mentioned in the report are the following (European Commission, 2023b):

### **Fiscal/financial support measures**

#### 1. Support schemes for vulnerable households

Housing and energy unaffordability are addressed in the form of tax reductions, social tariffs, energy vouchers or heating allowances. Such schemes are important in times of crisis and needed in the absence of structural upgrades but do not provide the basis for structural improvements for the benefit of vulnerable households. Therefore, vulnerable households must give priority to improving their ways of living in terms of energy efficiency and renewable energy consumption.

#### 2. Structural measures

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They have long term impact (through investments into energy efficiency and renewable energy sources) and support the EU's objective of a fair energy transition but such measures should be prioritized along with complementary social measures.

### 3. Social Climate Fund

This Fund aims to provide funding to M.S. to support vulnerable households including households affected by energy poverty. To access funding, M.S. must submit their Social Climate Plans by June 2025 while building on the 2024 updates of their NECPs.

#### **Technical measures**

##### Smart meters

These devices allow consumers to monitor their actual energy usage throughout the day and can help in identifying people in energy poverty. This means that consumers can take control of their energy behaviour by adjusting the energy consumption to keep their costs in check. It is important for households affected by energy poverty, who often grapple with tighter financial constraints and are disproportionately impacted by fluctuations in energy prices.

#### **Regulatory/Policy measures**

##### Energy advisory networks or one-stop shops

These networks (Directive 2023/1791) give access to relevant information (e.g. energy consumption) and along with the proposals for energy performance of buildings can be an overall effective tool. This tool is tailored to satisfy individual needs of households with low income, vulnerable or affected by energy poverty and could also be provided through social care and healthcare workers.

## 3. METHODS AND CASE STUDY

### **Method**

This section describes the methodology used and presents the case studies for the investigation of energy poverty and gender in Greece.

Figure 1 presents an overview of the methodology, which consists of a literature review on the linkage between energy poverty and gender, statistical analysis of data on energy poverty and gender in Greece, and an analysis of policy documents in Greece, covering the Energy Poverty Alleviation Plan and the Territorial Just Transition plans to study the current link between energy poverty and gender.

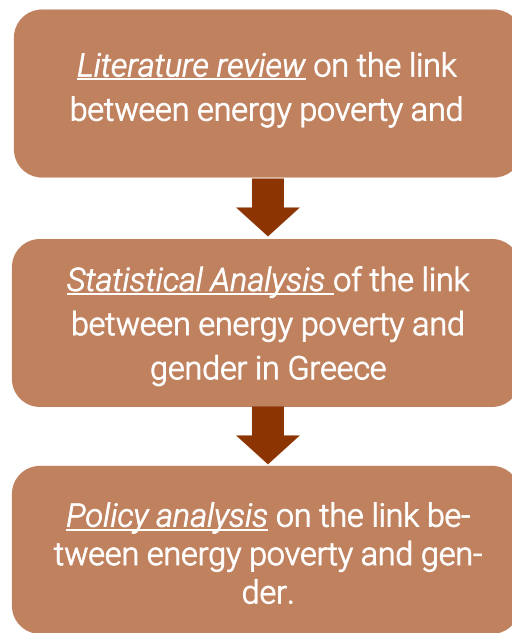


Figure 1: Methodology applied

### **Step 1: Literature review on the link between energy poverty and gender in Europe**

In the first stage, a literature review was carried out to identify the current research status and gaps on the interlinkage between energy poverty and gender in the literature, as well to identify key indicators used to measure energy poverty and gender. The search platform Google Scholar was used to find relevant academic papers and reviewed academic articles from the last two decades. First, the keywords “energy poverty” AND “gender” were used to identify cross-cutting literature from 2000-2023. The articles that appeared in the search concerned. The articles that appeared in the search were studies on measuring energy poverty both globally and in Europe, mainly for specific European cities. Despite the abundance of scientific articles in different geographical regions, only studies from Europe have been reviewed due to different geographical and cultural challenges. Among the studies that appeared, there were some that concerned energy poverty policies. The selection of suitable articles and studies was based on the following criteria: it was checked whether the research was about energy poverty measurement in general and preferably whether it focused on gender, and it was checked whether reference was made to poverty measurement indicators and what they are. In a second stage, specific literature from Greece was searched for. “Energy poverty and gender in Greece” with 168,000 results but not all the study results were mentioned about Greece, second keyword “Energy poverty Western Macedonia” with 44,500 results and “Energy poverty Megalopolis Arcadia” with 543 results. From Google Scholar, 6 studies included data that were useful to this review. Based on the research that has been done in Greece on energy poverty and at the same



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time on gender, the appropriate results of the research were collected and will be presented below. At the same time, the scientific platform for the review of scientific articles and research Science Direct was also used for the same purpose, that is, finding data and results from studies that have been applied to energy poverty in general and to gender. The research focused mainly on Greece and tried to find out if there are specific studies about the two regions in Greece. The keywords that applied were “Energy poverty Greece” with 5,555 results, “Energy poverty gender Greece” with 1,501 results, “Energy poverty gender Western Macedonia” with 127 results, of which 9 were selected to have their surveys analyzed.

## **Step 2: Statistical analysis of the link between energy poverty and gender in Greece**

The second research step involved the search for relevant statistical data from Greece on energy poverty indicators and gender that have been identified in the literature review. I used Eurostat, the ENPOR Dashboard and the Hellenic Statistical Authority in Greece as data basis. In October 2023, specific data requests to the Hellenic have been made to receive statistical data specifically for Western Macedonia and Peloponnese (Arcadia). The requests were for specific data/indicators to measure energy poverty and gender in Greece and in the specific regions. These requests concerned both demographic data, energy data, and economic data. Of those requested, some data was provided by the agency, however, data and measurements were not available for all of them. Mostly the metrics that have been done are at the national level and do not focus on regions and gender. Or if there are for the regions, there are not separately for women and men. However, for some indicators, disaggregated data were found both at national level and at regional level for both genders. These indicators were given more weight and priority in the statistical analysis. The dates of data for analysis focus mainly on data from the last decade, i.e. from 2015-2023 and for some indicators from 2018 onwards. For some indicators, however, data were only available up to 2015. The choice of the time interval was made to show the variability of the indicators over the years and to analyze the relationship of influence between the indicators.

## **Step 3: Policy analysis on the link between energy poverty and gender in Greece**

Third, a policy analysis of relevant climate and energy policy documents was performed to assess if the themes “energy poverty” and “gender” are addressed and if and how they have been linked in key policy measures. The following policy documents have been selected for the analysis.

- National Energy and Climate Plan (NECP) of Greece (HELLENIC REPUBLIC Ministry of the Environment and Energy, 2019)  
Updated version: (Hellenic REPUBLIC Ministry of Environment and Energy, 2023)
- Action Plan for Combating Energy Poverty (Action Plan for Combating Energy Poverty, 2021)

- Greece 2.0 National Recovery and Resilience Plan (Hellenic REPUBLIC Ministry of Environment and Energy, 2021)
- Territorial Just Transition Plans (TJTPs) of each region, Western Macedonia and Megalopolis
  - Western Macedonia: (Ministry of Environment and Energy, 2021)
  - Megalopolis: (Ministry of Environment and Energy, 2021b)
- Law 4513 Greece (PRESS OF THE GOVERNMENT OF THE HELLENIC REPUBLIC, 2018)
- Just Development Transition Programme supported from the ERDF (Investment for jobs and growth goal), ESF+, the Cohesion Fund, the JTF and the EMFAF - Article 21 (SFC2021 Programme Supported from the ERDF, 2021)

## Case study

High energy prices in Greece including electricity and heating costs are one of the main issues regarding energy poverty, as high energy prices disproportionately affect low-income households, such as those in Greece, leading to difficulties in meeting basic energy needs. The price per kilowatt hour for 2023 ranges between 0.16 - 0.216 euros per kilowatt hour (Public Power Corporation, 2023), when in 2013 the price was around 0.08 euros per kilowatt hour (Public Power Corporation, 2013)

Greece has always depended on fossil fuels, mainly oil and lignite. The main power plants are located in northern Greece in Central and Western Macedonia as well as in the Arcadia region (Figure 2). This dependence contributes to both environmental concerns and energy insecurity, especially if there are fluctuations in global fuel prices. The non-energy autonomy of Greece holds it back in dealing with energy poverty.

Western Macedonia and Arcadia face the consequences of many years of lignite activity, but also of the inactivity of previous years in a new, balanced and sustainable preparation model. Therefore, these two areas are also interesting research area on the subject of energy poverty.



*Figure 2: Western Macedonia and Arcadia*

It is interesting to observe the two specific areas on the map of Greece, because both Western Macedonia and Megalopolis in Arcadia represent different geographical areas with different meteorological data and energy needs. In fact, Western Macedonia district is characterized as the “energy heart” of Greece due to the presence of lignite electrical power production units, as the 2/3 of the country's only domestic fossil fuel reserves, lignite are located there. The country's mountain population has significantly higher energy costs and lower incomes, as a result people are more prone to energy poverty (Katsoulakos Nikolas M. & Kaliampakos Dimitris C., 2014). In general, both regions are highly dependent on lignite as both have lignite-fueled power plants. Also, the regions employ workers in industries related to lignite (Table 2). Energy poverty is a phenomenon that affects both regions, and although Greece has committed to phasing out coal by 2028, until jobs are found for the people employed in the plants that will close and lose their jobs, energy poverty will be an issue that will concern these societies.

*Table 2: Demographic, geographical characteristics and employment data for Western Macedonia and Arcadia (D2.1 (IEECP), Hellenic Statistical Authority, Territorial plan just and Development transition Megalopolis).*

|                                       | Western Macedonia | Arcadia       |
|---------------------------------------|-------------------|---------------|
| Area of the region (km <sup>2</sup> ) | 5,482             | 4,419         |
| Population (persons)                  | 254,595 (2021)    | 77,592 (2021) |
| Men                                   | 126,869 (2021)    | 39,571 (2021) |

|  |                |              |
|--|----------------|--------------|
| Women  | 127,726 (2021) | 38,021(2021) |
| Unemployment in the region                     | 26% (2020)     | 20% (2018)   |
| Direct employees in the coal sectors (persons) | 4,556 (2017)   | 1,113 (2020) |

It is important to note that in this work energy poverty in Greece will be studied and an attempt will be made to find data regarding energy poverty and the relationship that the two sexes have with it. The areas to be studied are:

- In general, the situation throughout Greece
- Western Macedonia
- Arcadia (Megalopolis)

## 4. RESULTS: ENERGY POVERTY AND GENDER NEXUS

### Literature review

#### Europe

This literature review present current research on measuring energy poverty and the interlinkage between energy poverty and gender will be mentioned, at European, and national level, as far as Greece is concerned.

Although there is an increasing literature that addresses energy poverty, studies on the relationship between gender and energy poverty in Europe have only been developed in the last two decades. The relationship between gender and poverty has been developed and studied in recent years, alongside issues of gender inequality in access to education, health care, work and representation in political decision-making. The main reason why there is no awareness about the gender dimension of poverty is because there is a lack of data and analysis that hides gender-related asymmetries. The issue was first addressed in the European context through the study "A gender perspective on energy access in the EU" by Clancy et al., 2017 which clearly highlighted the scarcity of available data and the general lack of awareness among policy makers, consultants, and researchers. The recently published report "Women, Gender Equality and the EU Energy Transition" by Clancy & Feenstra, 2019, highlights the main problem in developing countries: "The mistake is to equate [energy] availability with access [...] if [...] we take affordability into account, we see inequalities in access emerging." They also noted the lack of indicators for gender inequalities.

A recent study from Robinson Caitlin (2019) "Energy poverty and gender in England: A spatial perspective", sets out how an energy vulnerability framework can shed light on

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the relationship between gender and energy poverty and shows that gender vulnerabilities appear to increase energy poverty in England. The research reveals the spatial distributions of gender and energy poverty for the case of England. The aim is to better understand the relationship between gender and energy poverty and then to gender-sensitive measurement approaches. To create a complete picture of the situation, 13 indicators were taken into account, however, 9 were examined since there was data for them. Each indicator is analyzed to understand whether women are disproportionately represented compared to men. The 9 gender-specific indicators of vulnerability to energy poverty are age, disability and illness, single parent, part-time work, family or home care, unpaid care provision, English proficiency, full-time student, and retirement age and living alone. Through the derivation of gender-sensitive indicators of vulnerability, five dimensions are identified that increase the likelihood of women and other marginalized groups experiencing energy poverty: exclusion from a productive economy, unpaid caring or domestic care roles, vulnerability to negative impacts on physical and mental health, the lack of social protection throughout life, and to cope and help others to cope. The conclusion of the analysis recognizes how, in combination with other forms of social difference, gender inequality shapes vulnerability to energy poverty. The intersection of gender with age, ability and ethnicity creates varied and contradictory geographies of gendered vulnerability to energy poverty.

The study entitled "Does energy poverty matter for gender inequality? Global evidence" by Nguyen Canh Phuc & Su Thanh Dinh (2021) uncovers that the energy poverty reduction appears to increase gender equality in employment and that energy poverty reduction re-balances gender inequality in health explores the impact of reducing energy poverty on gender inequality, by using four specific dimensions namely employment, health, education, and socio-political-economic rights. Gender inequality in employment and pay is calculated with 11 indicators, while gender inequality in health, education and socio-political-economic rights is calculated with three indicators for each aspect. The effect of reducing energy poverty through five receptors (access to clean fuels and technologies, access to electricity for the total population, access to electricity for the rural population, access to electricity for the urban population and electricity consumption per capita) was examined, in four main aspects of gender inequality (inequality in employment and pay, inequality in health, inequality in education and inequality in socio-political-economic rights). Reducing energy poverty was found to rebalance gender inequality in health indicators. First, the results show the existence of gender inequality, particularly in education, health, and employment, while they do not appear to exist for gender inequality in socio-political-economic rights. Second, reductions in energy poverty generally appear to be associated with increased employment opportunities for women. In terms of employment, the reduction of energy poverty appears to enhance employment opportunities for women, especially in the industrial and service sectors. That is, reducing energy poverty generally promotes

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gender equality in employment. The study also shows that reducing energy poverty appears to rebalance gender inequality in health indicators. Interestingly, reducing energy poverty is confirmed as an important factor in improving women's educational equality and socio-economic rights.

The research of Petrova & Simcock (2021) "Gender and energy: domestic inequities reconsidered", shows that the everyday strategies adopted by households living in energy poverty are often gendered. The research was based on household interviews with a total of 66 households from three cities: Gdansk (25 households) in Poland, Prague (16 households) in the Czech Republic and Thessaloniki (25 households) in Greece, targeting the diversity of housing types, energy infrastructure and household demographics. The analysis identified two key gender themes that were evident in the interview: the gendered domestic practices of living in energy poverty and the emotional labor of living in energy poverty. In most mixed-sex households surveyed, it was found that women carried out most of the housework and caring duties. Among mixed-sex couples, it was usually the female partner who undertook "daily" changes to the routine to reduce energy consumption, such as changing the timing of their household chores, particularly in relation to household appliances. The percentage of men in energy efficiency improvements was not as great as that of women. Especially among Greek households, women provided care for children, dependent elderly parents, grandchildren, and neighbors. The value of such unpaid care provided by female neighbors was important in several households' struggles with energy poverty. Research findings suggest that women may experience the emotional effects of energy poverty more often than men. The way in which energy poverty is experienced in everyday life consists of and consists of the domestic relations of the sexes. Energy poverty is intertwined with broader patterns and processes of gender inequality, as well as with the potential to produce new forms of such inequality. The analysis highlighted two keyways in which gender is important in how energy poverty is negotiated. First in relation to the domestic practices undertaken to deal with energy poverty and secondly in terms of the emotional consequences of living with household energy deprivation.

Pueyo & Maestre, (2019) add that women can benefit less from energy poverty alleviation, as they mainly work in smaller and less energetic enterprises. Also, possible connections between modern energy services and gender empowerment and he argues that energy poverty can affect gender roles and educational opportunities. Pachauri Shonali & Rao Narasimha D., (2013) mention that women spend more time and energy on unpaid care, domestic and agricultural work than men, forego opportunities to participate in income-generating or livelihood-enhancing activities and leisure activities that are detrimental to their health. Therefore, improving access to modern energy is seen as a potential means of improving well-being and mitigating these adverse effects. An explicit consideration of women in relation to energy poverty is important both for effecting a transition to improved energy services in these regions as well as to ensure women reap the benefits of programs and projects that aim to



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enhance access to modern energy carriers and technologies. Pachauri Shonali & Rao Narasimha D., suggest that more research is needed to build an understanding of the relationship between energy poverty and women's well-being. Reducing energy poverty can improve gender equality in employment. In terms of employment, women are usually responsible for home care activities such as cooking and childcare (Elissa Braunstein, 2019). Meanwhile, the tasks involved in managing traditional energy sources are widely seen as women's responsibility (Anver C. Sadatha & Rajesh H. Acharya, 2017). As a result, women have less time and opportunities to find wage employment. Reducing energy poverty contributes to improving gender equality in health. Regarding health, as mentioned in relation to employment, energy poverty has been documented to have a negative impact on health in general and has a greater impact on women and children (Kaygusuz K., 2011).

According to the study carried out in Spain (Oliveras Laura et al., 2020), entitled "The association of energy poverty with health, health care utilization and medication use in southern Europe" energy poverty is unevenly distributed along axes of inequality, such as gender or social class. Data from the Barcelona Health Survey were used to implement the research, by interviewing households of a representative sample of 3,519 people of which 53.3% were women. Based on the interview, energy poverty rates were estimated according to age, country of birth and social class. The indicators used were health status, use of health services and medicines and income. In Barcelona, 13.3% of women and 11.3% of men were found to be vulnerable to energy poverty. The most affected groups were people born in low- and middle-income countries, people from more disadvantaged social classes and women aged 65 and over. Therefore, from this research, the conclusion that emerges is that women prove to be more vulnerable to energy poverty with simultaneous sensitivity in terms of health.

Various other studies have been carried out in other regions as well as in Madrid "Feminization of energy poverty in the city of Madrid" by Sánchez-Guevara Sánchez Carmen et al., 2020 which aimed to assess the general situation of women's vulnerability to energy poverty and to identify gender inequalities in energy poverty. The research confirms the existence of a gender gap related to energy poverty in the city of Madrid. It focuses on three types of households (female breadwinner households, single-parent households and single-person households with women over 65) based on available statistics. The aim of this study was to characterize women's predisposition to energy poverty in the city of Madrid at both municipal and regional scales. First, women's energy poverty was addressed at the municipal level. At this stage, the incidence of energy poverty among women in the city was quantified and households were classified according to their relative position with respect to monetary and energy poverty thresholds. The main identification indicators were mainly income, and energy expenditure bills. The second part of the study attempted to identify the problem geographically in the 21 districts of Madrid. At this scale, a different data set was analyzed to identify women in the districts and overlap them with the determinants of

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energy poverty and its risk. For future research, the researchers recommend exploring other data sources that allow detailed analysis of all women, regardless of the household they belong to, and that the gender perspective should be considered in policies designed to alleviate energy poverty.

A recent study by Peretto et al., (2023), developed an impact matrix to assess energy poverty and other impact of just energy transition in different European regions. The selected study areas concerned coal areas in the countries of Greece (Western Macedonia), Poland, Spain, Bulgaria, Croatia and Romania. They used social, economic, demographic and environmental indicators to measure energy poverty, of which only one was considering the gender impact: Inability to keep the home adequately warm, arrears on utility bills, type of dwelling in cities or rural areas (i.e., population distribution by degree of urbanization), people living in households with very low work intensity, household electricity prices (last 5 years), household natural gas prices (last 5 years), unemployment rate (general), severe material and social deprivation rate (essentially an enforced lack of necessary and desirable items to lead an adequate life), risk of poverty and social exclusion rate, percentage of population under 30 emigrating, population density, energy intensity of GDP, share of energy from renewable sources, use of renewables for heating and cooling. The only indicator that refers to gender aspects was female unemployment rate. The study finds out that in terms of the social dimension, just transition is expected to have a positive impact on gender in the coal region of Bulgaria (Stara Zagora), which was confirmed by a negative trend in female unemployment in Southeast Bulgaria. On the other hand, Asturias's (Spanish) TJTP outlines several measures to support women in the sector, which can be seen as a measure to counter the stable level of female unemployment in the Spanish region. In terms of energy poverty, negative impacts were found in the region of Silesia (Poland), confirmed by the increasing number of households without adequate heating in Poland. Envisaged positive impacts of the TJTP in Western Macedonia, which were confirmed by a decrease in the risk of poverty and social exclusion rate in the region. For the region of Western Macedonia, which already has the highest unemployment rate, the transition will be more challenging.

Main indicators to measure energy poverty and gender across studies were usually always the employment index, then income and education and level of English, health services and disabilities, age and retirement age, unpaid care provision, single parenthood index, as well and energy expenditure bills (Robinson C., 2019, Phuc Nguyev C. et. al., 2021, Sánchez-Guevara Sánchez C. et. al., 2020). Using these indicators in the above surveys, an opinion was created on how much more women experience the effects of energy poverty than men.

### **Research in Greece**

The issue of energy poverty in Greece has been investigated mainly in recent years since this problem has increased after the economic crisis that Greece went through. The



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literature review found several studies that have been carried out to quantify energy poverty in Greece, however, without carrying out specific gender research.

A 2016 study by Papada Lefkothea & Kaliampiakos Dimitris (2016) entitled "Measuring energy poverty in Greece" showed that the combination of objective and subjective indicators best captures energy poverty. The aim of the research was to highlight the great vulnerability of Greek households to energy poverty, in a serious economic crisis. Despite this, gender-specific vulnerabilities were not considered. Applying primary research, the researchers recorded data on energy expenditure as well as subjective perceptions of housing conditions. Two different measurement methods (objective and subjective indicators) have been combined. The main indicators measuring energy poverty in the survey were, home heating comfort, arrears on utility bills, energy expenditure and income, housing condition such as leaky buildings and wet walls. The sample of 23 questions and interviews was evaluated in 400 Greek households in 13 regions of Greece, with 32% in the region of Attica, 17% in the region of Central Macedonia and with smaller percentages in the rest of the regions of the country. The results of the survey showed that 42% of respondents state that they do not feel thermal comfort in their home. 18.8% of respondents report delays in energy bills, which concern electricity bills and heating bills. 75% say they have had to cut back on other basic needs to meet their energy needs. Greek households spend on average around 14% of their income on energy. Using 10% of energy income as the energy poverty threshold, the result showed that 58% of households are energy poor. Among households below the poverty line, the energy poverty rate exceeds 90%.

Other relevant research investigated the quantification of energy poverty in regions of Greece, but without specific reference to the relationship between gender and energy poverty. However, the indicators taken into account to measure the phenomenon are interesting. The research carried out Ntaintasis E. et al. (2019) "Comparing different methodological approaches for measuring energy poverty: Evidence from a survey in the region of Attika, Greece" uses and comparatively evaluates objective, subjective and composite indicators for the measurement and analysis of energy poverty in the Attika Region. Objective indicators concern the percentage of household income that must be spent on fuel to maintain thermal comfort at home, and subjective indicators concern household assessments of the level of energy services available at home. The results of the analysis showed that the measurement of energy poverty based on classical objective and subjective indicators leads to divergent results, which have little relevance to each other. The use of composite indicators adapted to local conditions appears to be a suitable option for measuring energy poverty in a region, providing additional information on the intensity of energy poverty.

More recent research carried out by the researchers Lefkothea Papada and Dimitris Kaliampakos in 2020, entitled "Being forced to skimp on energy needs: A new look at energy poverty in Greece" delves into energy poverty in the populations of Greece and

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the mountainous regions of Greece, with the development of a new indicator, the "Energy Needs Coverage Degree " (DCEN), which is expressed as the "Actual/Required energy cost" ratio of a household, three important behavioural patterns are quantified: "energy compression needs", "energy needs satisfaction" and "energy waste". The results from the survey of 800 total households (400 in Northern Greece and 400 in the rest of Greece), showed that 45–51.5% of the two samples compress their energy needs, while 34.5–38% of them waste energy. The DCEN index introduces a different perspective on the phenomenon of energy poverty, emphasizing vital aspects of the problem that must be taken into account by policy makers.

The research conducted from Boemi & Papadopoulos (2019) analyses the energy situation of households located in the coldest Greek region, Northern Greece and specifically in Central and Western Macedonia. The primary objective was to investigate household energy deprivation and analyse the correlation between residential energy behaviour and attitudes after eight consecutive years of economic recession. The main parameters were the average household size, their income and the thermal characteristics of the building. All information on the main characteristics that determine energy, environmental, economic, social and health indicators in households. Energy poverty was studied through three independent parameters: (a) inability to maintain adequate heating in homes, (b) late payment of the utility bill, and (c) inadequate living conditions.

The specific study by Boemi Sofia-Natalia et al. (2017), with the title "Residential Heating under Energy Poverty Conditions: A field study", was focused on Western Macedonia, and it analysed the energy situation of households by using as main parameters, the average household size, the income and the thermal characteristics of the building. Despite this, almost 32% of households face mould issues while 21% have indoor noise problems in their homes. Only 2% stated that they have health problems. Of the 2 people who reported health problems, they also reported having mould in their homes. Of the 241 households, 24% cannot pay their energy bills, and 1% cannot afford to pay them at all. Also, 2% of those can afford to heat their house only if the indoor temperature is 10oC and below that. The overall conclusion is that the region shows an inability to satisfy socially and materially the required levels of energy services.

Based on the current literature, researchers selected subjective and objective indicators to analyse energy poverty in Greece. Objective indicators concern the percentage of household income that must be spent on fuel to maintain thermal comfort at home, and subjective indicators concern household assessments of the level of energy services available at home. Indicators like home heating comfort, arrears on utility bills, energy expenditure and income, housing condition such as leaky buildings and wet walls are indicators used in the studies (Papada L. et. al., 2016, Boemi S. et. Al., 2019). Another indicator that was used is "Energy Needs Coverage Degree " (DCEN), which is expressed as the "Actual/Required energy cost" ratio of a household, three important behavioural

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patterns are quantified: "energy compression needs", "energy needs satisfaction" and "energy waste" (Papada L. et. al., 2020).

### **Selected indicators to measure energy poverty**

A selection of appropriate energy poverty indicators for measuring and monitoring is crucial for identifying energy-poor regions and population. Before analysing the results from the research that has been done on energy poverty and gender, it is important to review the existing types of indicators that have been used over the years in energy poverty studies and to understand the contexts in which they are used. Energy poverty presents variety in its indicators. The use and assessment of indicators for identifying energy poverty are different between countries. There is no single indicator that can be used to energy poverty assessment. In conclusion from the scientific studies and research that have been carried out studying energy poverty both in Europe and in Greece, various indicators have been taken into account to measure the phenomenon, such as home layout, living conditions, income, etc. These indicators are important because they help to measure and create a picture of the energy poverty situation of a region or a population group, but in a more general context. However, with regard to energy poverty and gender, indicators such as "unemployment by gender" are mainly examined. To enable a more in-depth analysis of energy poverty and gender, and to understand the relationship between them and how each gender is affected separately, more specific metrics need to be obtained.

Based on the current literature, the study selected 10 indicators to analyse energy poverty and gender in Greece. These concern indicators related to the dimensions and level of energy poverty and vulnerability indicators. For the indicators related to the level of energy poverty, an effort was made to find data regarding gender in indicators such as inability to keep the home adequately warm, arrears on utility bills, high share of energy expenditure in income, low absolute energy expenditure. For the vulnerability indicators, a search was made for gender-specific data regarding disposable household income, unemployment rate, risk of poverty and social exclusion rate, structure of the population and age dependency ratios, severe material and social deprivation, energy efficiency trends for households. Gender-specific data were found from the survey for most indicators. Specifically, for the vulnerability indicators, gender-related data were found that can draw a conclusion about the gender and energy poverty situation in Greece, while for the indicators related to the dimensions and level of energy poverty, no gender-related data were found separately in Greece, but only in general. Data for the energy efficiency trends for household's indicator was not found at all, therefore not included in the analysis.

Table 3: Indicators to measure energy poverty and energy poverty on gender.

| Indicator  |   |
|--|---|
| Indicators related to the dimensions and level of energy poverty | Inability to keep the home adequately warm  |
|  | Arrears on utility bills  |
|  | High share of energy expenditure in income  |
|  | Low absolute energy expenditure   |
| Vulnerability indicators   | Disposable household income   |
|  | Unemployment rate or Unemployment by gender   |
|  | Risk of poverty and social exclusion rate (reflecting both the risk of poverty but also intensity of economic activity) |
|  | Structure of the population and age dependency ratios (looking at the demographics)                                     |
|  | Severe material and social deprivation (forced lack of necessary and desirable items for an adequate life)              |
|  | Energy efficiency trends for households   |

## Quantitative analysis of the energy poverty – gender nexus in Greece

This section presents the results on key energy poverty indicators by gender (if gender-specific data were available). The indicators in Table 3 were used and investigated in relation to gender data provision in Greece and specifically for Western Macedonia and Arcadia. In order to find the data for the indicators, we turned to database platforms such as Hellenic Statistical Authority, ELSTAT, which provides data for Greece and specifically for the coal regions, EUROSTAT, where data was found at the national level as well as for the coal regions, and ENPOR Dashboard, n.d. In Table 4, it is shown in detail for which indicators gender data were found and for which they were not. The dark brown box represents the indicators that were not found in relation to gender but

only at the national or regional level. The light brown colour represents data found in relation to gender.

Table 4: Indicators to measure energy poverty and energy poverty on gender in Greece and in the two selected coal regions. Legend: in dark brown: no data for gender; in light brown: available data for gender.

|  | Indicator  | Gender  | Greece or Regional                        | Sources               |
|--|--|---|---|-----------------------|
| Indicators related to the dimensions and level of energy poverty | Inability to keep the home adequately warm   |   | Greece and NUTS1 (North and South Greece) | ENPOR Dashboard, 2021 |
|  | Arrears on utility bills   |   | Greece and NUTS1 (North and South Greece) | ENPOR Dashboard, 2021 |
|  | High share of energy expenditure in income   |   | Greece and NUTS1 (North and South Greece) | ENPOR Dashboard, 2015 |
|  | Low absolute energy expenditure  |   | Greece and NUTS1 (North and South Greece) | ENPOR Dashboard, 2015 |
| Vulnerability indicators   | Disposable household income  | Gender gap  | Greece (gender gap) Regional              | Eurostat              |
|  | Unemployment rate or Unemployment by gender  | Unemployment rate or Unemployment by gender         | Greece and Regional                       | ELSTAT, Eurostat      |
|  | Risk of poverty and social exclusion rate (reflecting both the risk of poverty but also intensity of | Risk of poverty and social exclusion rate by gender | Greece (gender) and Regional              | ELSTAT                |

|  |  |  |                             |                  |
|--|--|--|-----------------------------|------------------|
|  | economic activity)   |  |                             |                  |
|  | Structure of the population and age dependency ratios (looking at the demographics)                        |  |                             |                  |
|  | Severe material and social deprivation (forced lack of necessary and desirable items for an adequate life) |  | Regional                    | Eurostat         |
|  | Energy efficiency trends for households  |  | Greece (gender)<br>Regional | ELSTAT, Eurostat |

### Age structure of the population indicator

In Figure 4 and 5 concerning the age structure of the population in the regions of Western Macedonia and Peloponnese, it is observed that the population living in these regions ranges in age from 30-65+ years, with the main age group being in both cases that of 45-64 years. More specifically, of the total population of Peloponnese and Western Macedonia in 2020, approximately 86% are over 15 years of age. In addition, more than 55% of the population is estimated to be aged 45 and over, while it is worth noting the chronic decrease of the population aged 20-44. In other words, a change in the distribution of the population of the regions towards older ages is observed, resulting in the loss of part of its young and, by extension, more productive population.

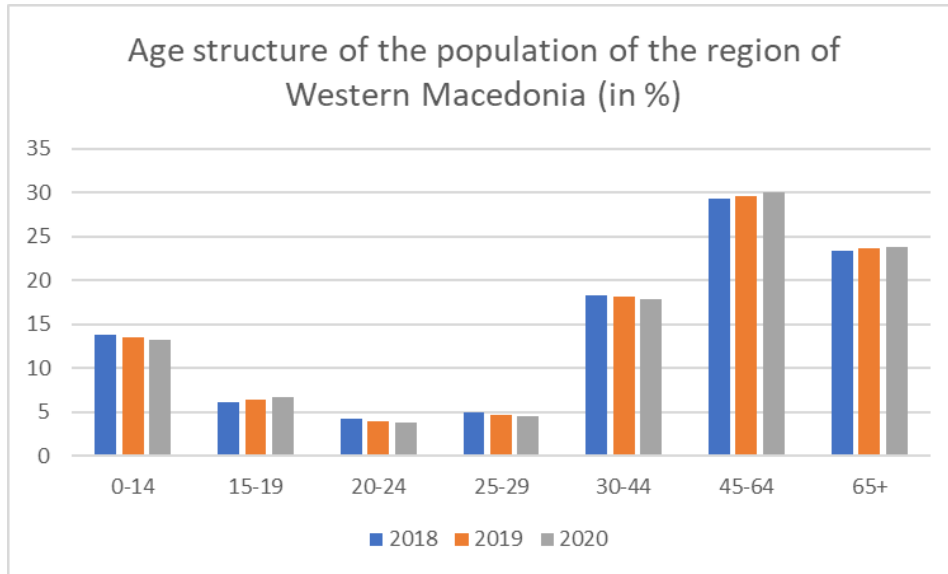


Figure 3: Rate (%) of age structure of the population in Western Macedonia (TJTP Western Macedonia, Hellenic Statistical Authority).

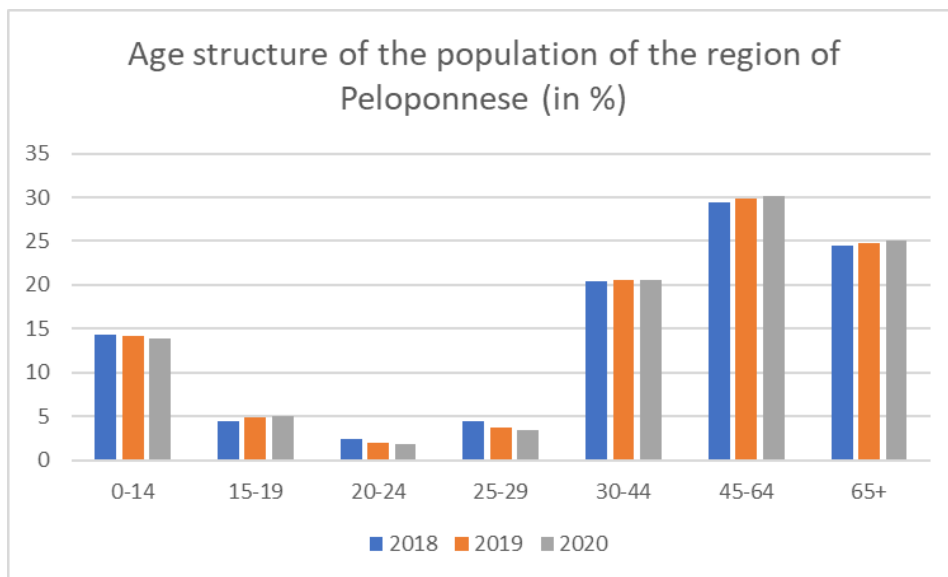


Figure 4: Rate (%) of age structure of the population in Peloponnese (TJTP Megalopolis, Hellenic Statistical Authority).

Comparing the data from the average age of women and men for the regions of interest (Figure 6), namely Western Macedonia and the Peloponnese (where for the Peloponnese specific data for Arcadia and gender were found), it is observed that women living in these regions are older than men, for all years of recording, as well as it is observed that over the years there is an increase in the age of residence in the regions for both genders. Therefore, women than men especially in the Peloponnese are older. Nevertheless, these ages are characterized as productive ages (employment sector).

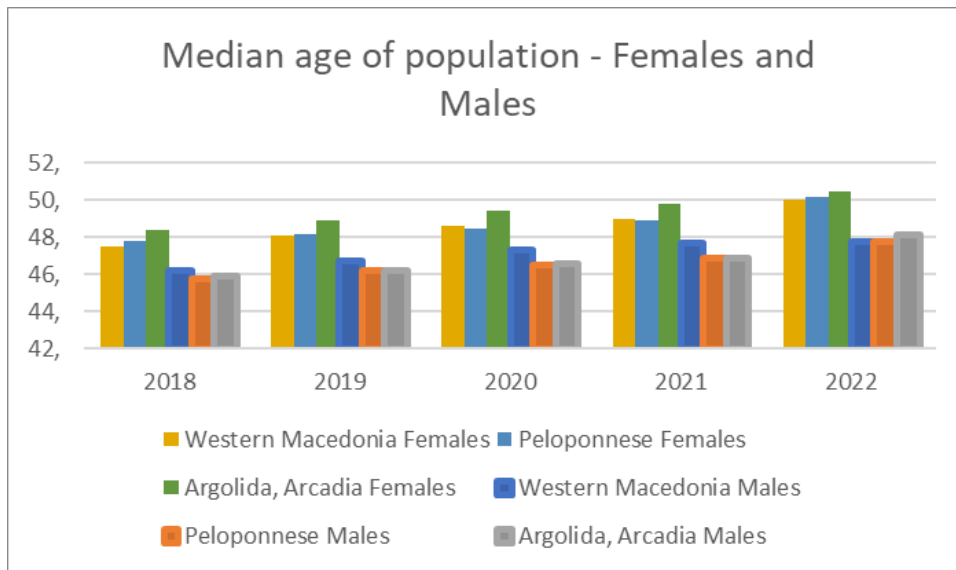


Figure 5: Median age of population by gender in Western Macedonia and Peloponnese (Eurostat).

### Unemployment indicator

Unemployment levels in Greece have been on a downward trend in recent years after the exit from the economic crisis. In the case of Greece, a small increase is observed during the pandemic period (2020), but the recovery of employment is felt over the years. In particular, despite the gradual reduction of unemployment in recent years, in relation to both sexes, it is observed that women have higher rates of unemployment than men (about 5% more difference). In Figure 7, it is observed that male unemployment in 2022 was 9.3% falling to 8.2% in 2023, while the female unemployment rate in 2022 was 16.3%, in 2023 it dropped to 14.4%. The decrease in unemployment for both sexes in 2023 was the same, however, comparatively, women in Greece experience unemployment to a greater extent. It is noticed that the countries that have the biggest gap between gender employment, face energy poverty the most.

In the EU, the employment gap between women and men was 10.8% points in 2021, meaning that the proportion of working-age men in employment exceeded that of women by 10.8 percentage points. In September 2023 according to Eurostat, the unemployment rate for women in EU was up to 6.3%, when the unemployment for men was 5.7%. So, it seems that there is an employment gap between men and women, in some countries less and in others more. As the employment gap between men and women widens, inequalities widen, and women become more prone to energy poverty.



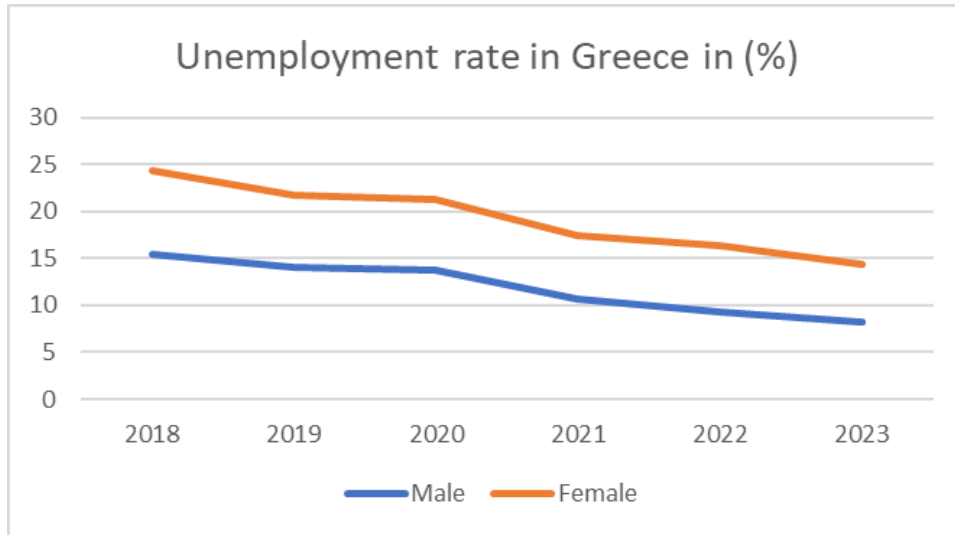


Figure 6: Unemployment rate (%) by gender, Greece, August 2018 – 2023 (Hellenic Statistical Authority).

Regarding the two lignite regions of Greece (Western Macedonia and Peloponnese, Arcadia) unemployment levels are noticeable in both sexes. Unemployment levels on average for both women and men have fluctuated with a slight decrease in recent years or at stable levels. In more detail in Figure 8, for Western Macedonia compared to 2018, there has been a significant decrease in unemployment for both sexes. However, unemployment levels among women remain high, and with a much smaller decline compared to the downward trend of unemployment among men. To make the difference in reduction even more impressive, in 2021 unemployment for men was recorded at 16.4% with a decrease to 12.7 in 2022, while for women in 2021 the rate rose to 24.1% with a very small increase in 2022 to 24.4%. It is therefore observed that the unemployment rate among women is much higher, not only in relation to men in the region, but also in relation to the average levels of unemployment among women in Greece (16.3% in 2022). In the Peloponnese, the same phenomenon is found with women facing unemployment to a greater extent than men, with unemployment fluctuating at stable levels in recent years. Men in the last two years have rates of 8.3% and 8.4% (2022), while women with double the unemployment rate, 18.3% and 17.7% (2022). While men fluctuate in the average unemployment levels of the country's male population, women in the Peloponnese exceed the average rate of female unemployment. Comparing the unemployment rates in the two regions of Western Macedonia and the Peloponnese, it is observed that female unemployment in Western Macedonia has the highest percentages, with female unemployment in the Peloponnese coming in second, followed by male unemployment.

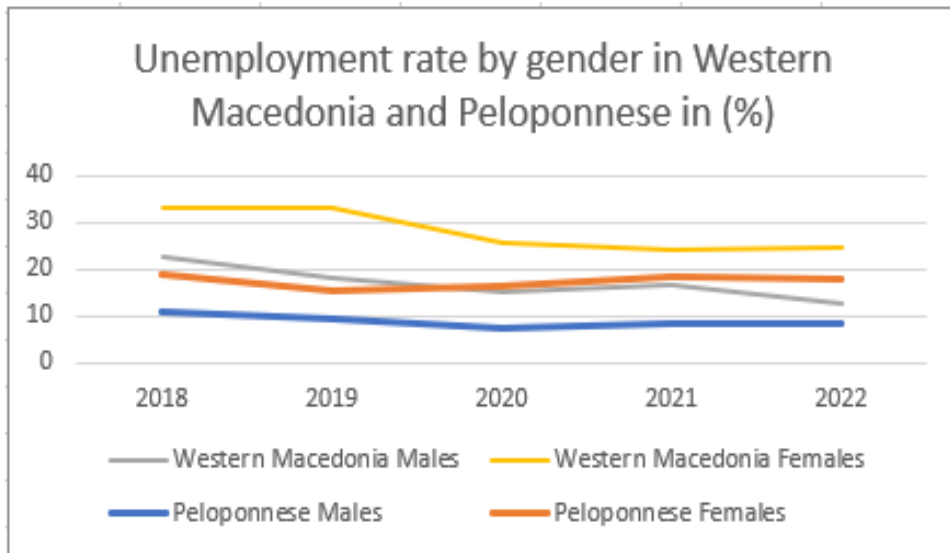


Figure 7: Unemployment rate by gender in Western Macedonia and Peloponnese (Eurostat)

### Risk of poverty or social exclusion indicator

In terms of the risk of poverty and social exclusion, Greece (26% in 2022) is one of the first countries in Europe, along with Romania, Bulgaria, and Spain. (Hellenic Statistical Authority) The high rate of social exclusion is interrelated with the still existing high rates of unemployment in the country. Regarding the two sexes in Greece in Figure 9, for women in 2022 the rate of risk of poverty and exclusion reached 27.4%, higher than that of men with 25.2%. It is therefore also observed in this index that the female percentage prevails over the male, a fact expected since unemployment among women is also higher than that of men.

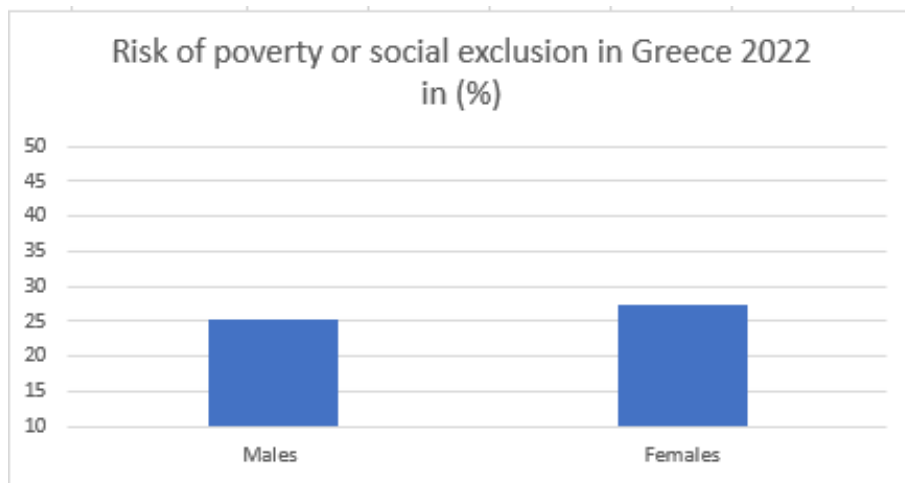


Figure 8: Rate (%) of the risk of poverty or social exclusion in Greece in 2022 (Hellenic Statistical Authority).

In a more in-depth look, in Figure 10, one can notice that in addition to the conclusion that women experience a greater percentage of the risk of poverty and social exclusion, the age group that is most affected is that of 18-64 years (28.8%). This affects the female population more, but it is also noticeable among men of the corresponding age

group (26.9%). Moreover, this age group is the group in which the sector of employment is composed, so this relationship is interconnected.

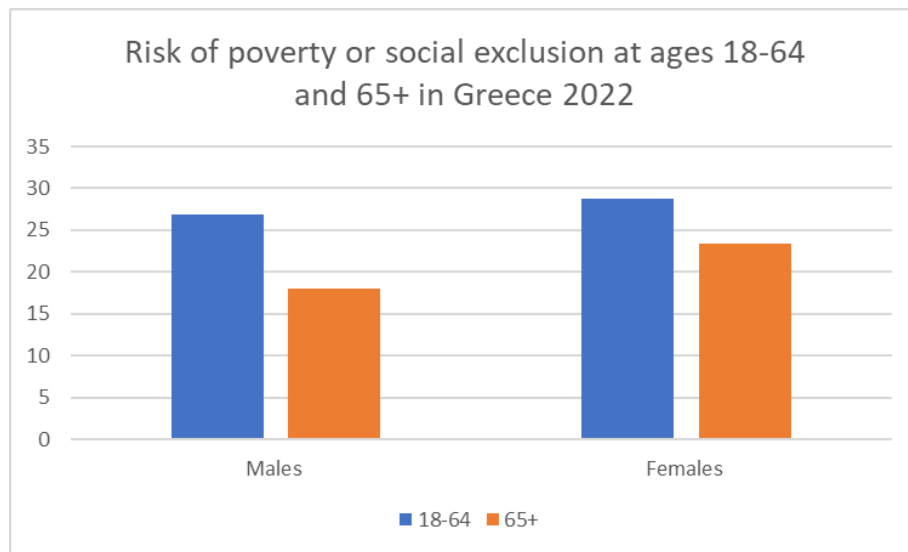


Figure 9: Rate (%) of the risk of poverty or social exclusion ages (18-64 and 65+) in Greece in 2022 (Hellenic Statistical Authority).

In five (5) Regions (Crete, Attica, South Aegean, Epirus and Thessaly) poverty risk rates are lower than that of the entire country, while in the remaining Regions (Ionian Islands, North Aegean, Peloponnese, Western Macedonia, Central Greece, Central Macedonia and Eastern Macedonia and Thrace) the corresponding percentages are higher (Figure 11). It is generally observed on average that from central Greece and towards the north, the rate of poverty and exclusion is higher than the southern part of the country. Also, the study areas concerned, i.e. Western Macedonia and Peloponnese, belong to the regions with the highest poverty risk rates with 25.4% for Western Macedonia and 23.4% for Peloponnese respectively, rates that have not changed much from 2018 to 2022 (Figure 12).

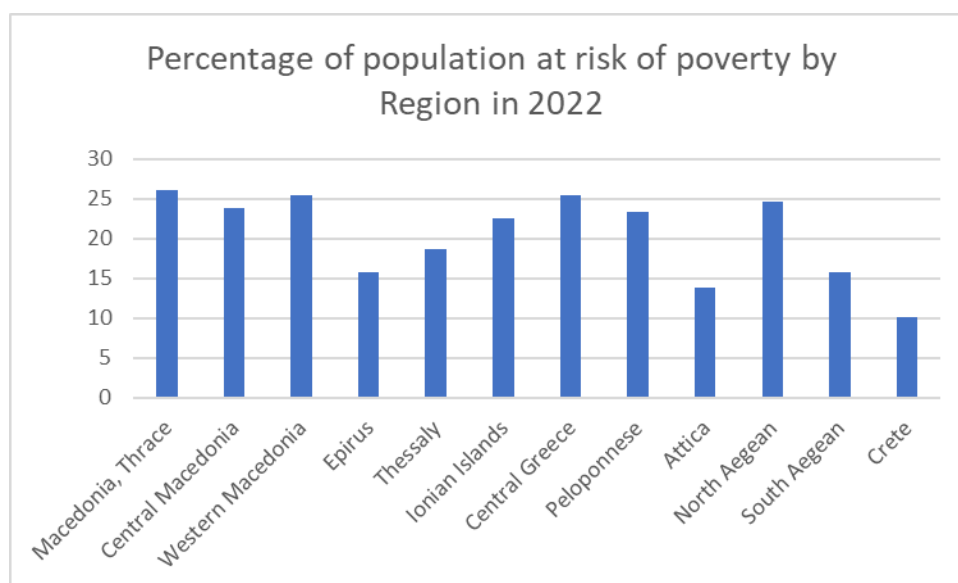


Figure 10: Rate (%) of population at risk of poverty by region in 2022 (Hellenic Statistical Authority).

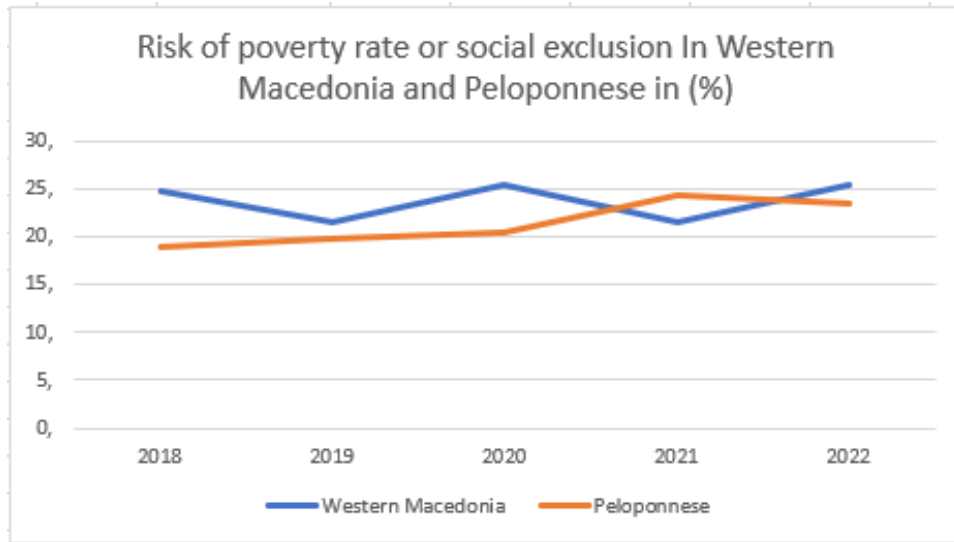


Figure 11: Rate (%) of population at risk of poverty or social exclusion in Western Macedonia and Peloponnese (Hellenic Statistical Authority).

### Severe material and social deprivation indicator

Regarding severe material and social deprivation, Greece records one of the highest percentages of 13.9%, after Romania (23.1%) and Bulgaria (19.1%) in EU. Among this percentage, women register a percentage of 14.6% higher than men's 13.1%, in 2022. (EC, 2022) The indicator in the Figure 13, refers to the inability to afford some items considered by most people to be desirable or even necessary to lead an adequate life. Estimating this result, it is expected that women will face such a situation, since statistically, as analyzed above, the female gender in Greece is more prone to the situations of poverty, unemployment and social exclusion, indicators that are all interrelated.

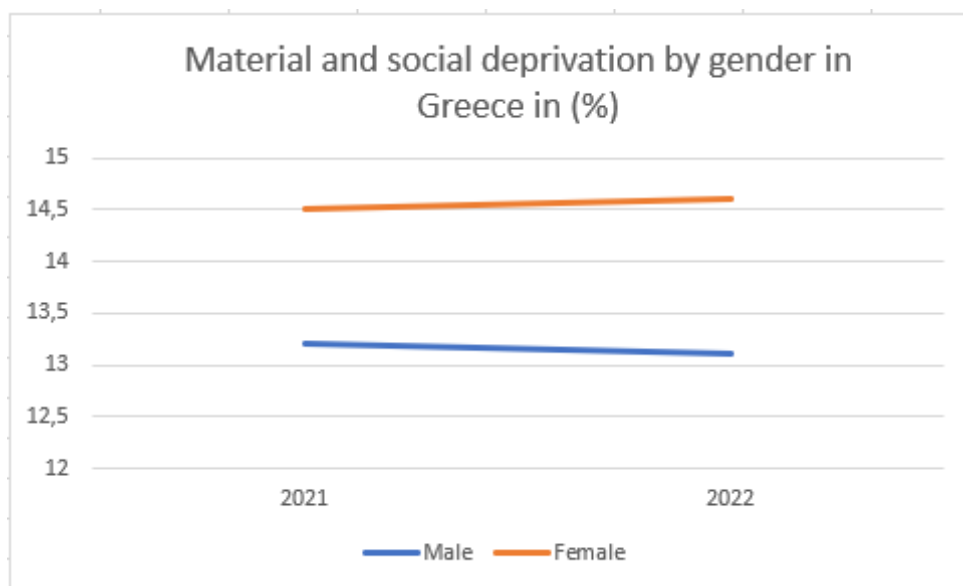


Figure 12: Material and social deprivation rate (%) by gender in Greece 2021 and 2022 (Hellenic Statistical Authority).

From the Figure 14 presented below, it is clear that the Peloponnese with a percentage of 22.4 in 2022 exceeds the average of Greece by about 10% more (13.9%), in contrast to Western Macedonia with 10.2%, where it ranges at the average prices of the country. Comparing the two regions, it is observed that for Western Macedonia there is a relative reduction of the phenomenon despite the small increase in the last year, while in the case of the Peloponnese there is a general increase. Social deprivation may be the outcome of a combination of different factors such as unemployment, low incomes, poor housing, social exclusion, as observed to exist in the previous analyses.

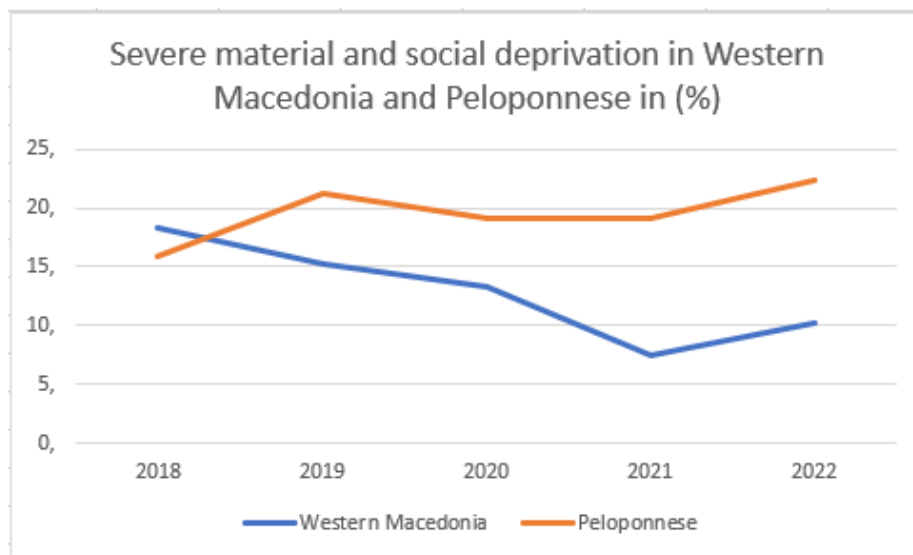


Figure 13: Material and social deprivation rate (%) in Western Macedonia and Peloponnese (Eurostat).

### Disposable income indicator

Gender inequalities that lead to energy poverty may be related to income. When on average women have a lower income than men, the phenomenon of energy poverty worsens more for women since it will be more difficult for them to meet their energy needs. By extension of labor income, so is the gender pension gap. Also, women usually have more limited work opportunities compared to men due to the household and family care (HETUS, 2019). The difference between the average annual earnings of women versus men is also affected by the higher proportion of part-time workers among women. Looking at the Figure 15, "gender hours gap" is presented, which shows the difference between the average monthly hours paid to men and women, expressed as a percentage of the average hours paid to men. In Europe in 2018, women were paid on average 12% fewer hours per month than men. When the average of EU was approximately 13% in 2018, in Greece, the gender gap in hours was 5%, meaning that female workers are paid on average 5% fewer hours per month than men, a fact that is likely to swell by the years, as the gap between men and women widens. The relationship between the gender gap in employment and energy poverty is complex and multifaceted. In countries with a bigger gender gap, a higher rate of energy poverty is also observed.

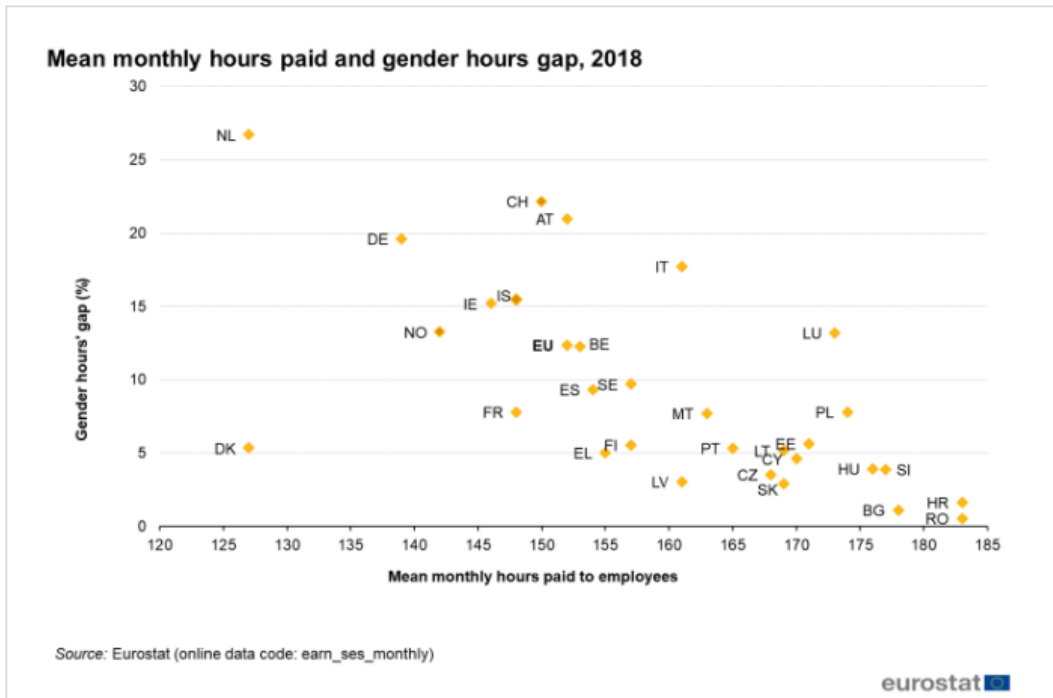


Figure 14: Mean monthly hours paid and gender hours gap, 2018 (Eurostat).

While at the national level, the EU countries with the highest median disposable income for 2022 were Luxembourg (33214 PPS), the Netherlands (25437 PPS), and Austria (25119 PPS), Greece came in low with (10841 PPS). Median equivalent disposable income, expressed in PPS, takes into account income distribution as well as household size and composition. Regarding the two regions in Greece, for the disposable income of private households found data, Figure 16 shows that Peloponnese has a higher disposable income than Western Macedonia by 3000 PPS.

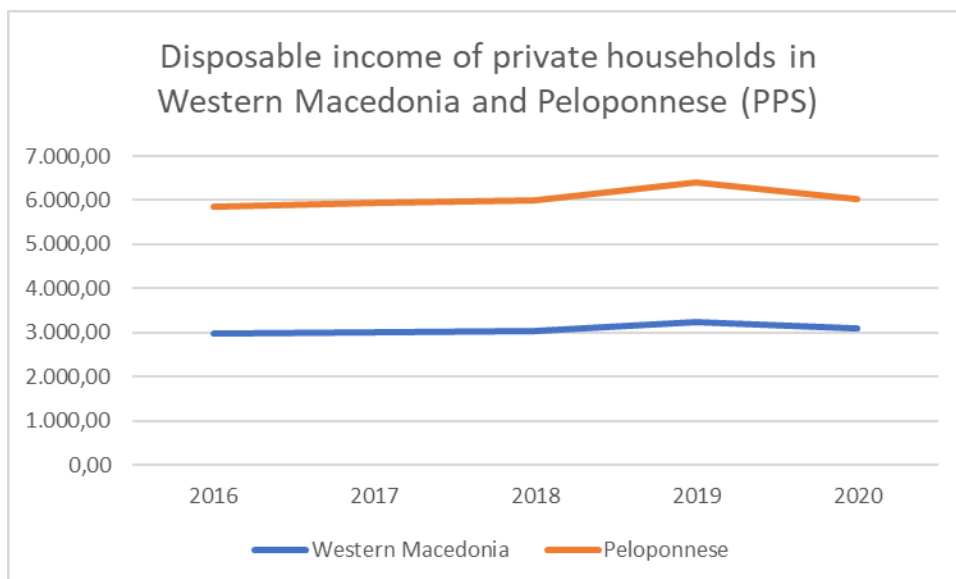


Figure 15: Disposable income of private households in Western Macedonia and Peloponnese in PPS (Eurostat).

### Inability to keep house warm indicator

As regards the indicator measuring the difficulty of heating homes for 2021, there are increased rates of incapacity in several European countries, with the largest percentage of people in southern Europe. According to Eurostat data, in the year 2021 6.9% of households in the EU were late on their utility bills and 6.4% failed to have thermal comfort in their home. Bulgaria, a country affected by energy poverty, is struggling to cope with the challenges brought by the negative effects of the phenomenon, as the percentage of households unable to meet their heating needs for 2021 is 26.53%. As can be noticed from Figure 17, Cyprus, Spain, Portugal, are countries that are also affected by energy poverty. Focusing on Greece, with a rate of 18.7%, it comes second in the whole of Europe after Bulgaria, with the highest levels of difficulty in meeting heating needs. The economic challenges in Greece have increased energy poverty, mainly affecting vulnerable people.

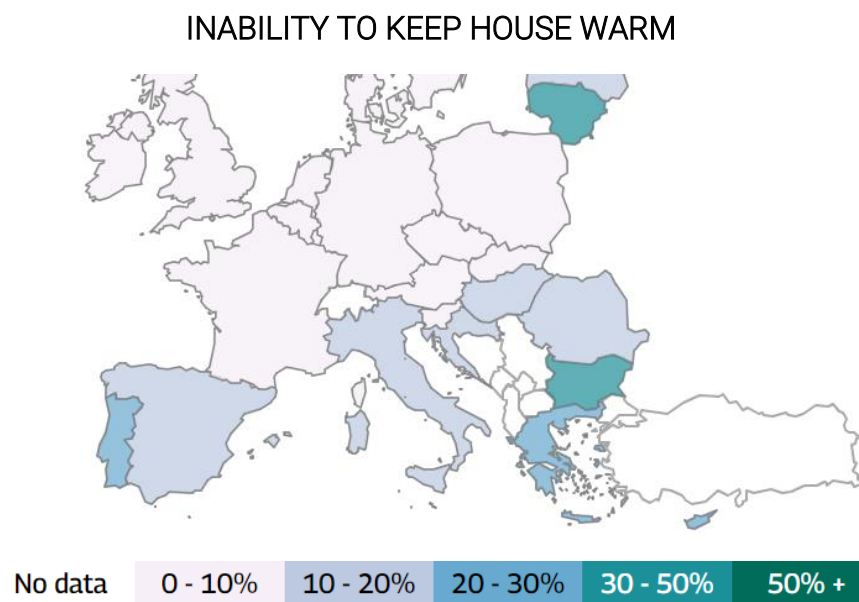


Figure 16: Inability to keep home adequately warm indicator in 2021 (ENPOR).

No analysis data were found for the two sexes in this index. Nevertheless, there are statistical data for grouped regions of Greece. More specifically for Greece (Figure 18), studying the lack of warmth at home, in northern Greece, where the region of Western Macedonia belongs, the percentage is 16.71% and in southern Greece, where the Peloponnese and Arcadia are also located, the percentage is 23.02%. The south of Greece compared to the north faces a bigger problem in terms of the warmth of the house, with the percentage of the inability to maintain thermal comfort in the homes of the residents exceeding the average of Greece in this specific indicator.

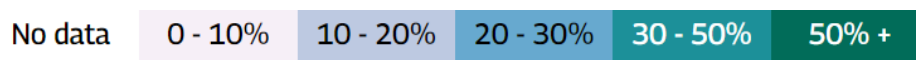


Figure 17: Regions of Greece that are unable to keep home adequately warm in 2021 (ENPOR).

### Utility bills indicator

For European countries where data is available, in terms of utility bills, with an average European rate of 6.1% in 2019, Greece comes first with a rate of 26.3% for the year 2021, with Bulgaria and Croatia coming seconds (Figure 19). The result of the inability of the citizens of Greece to pay their utility bills is to be expected given that unemployment is at high levels and the difficulty of household and personal maintenance is difficult.

### ARREARS ON UTILITY BILLS



Figure 18: Utility bills indicator for 2021 (ENPOR).

In the regions of Greece, the available data are divided into northern and southern Greek data. Available data regarding women and men for this indicator do not exist. Nevertheless, for the northern part of Greece, which includes Western Macedonia, the rate of inability to pay utility bills is 22.37% and in the southern part of Greece, where the Peloponnese and Arcadia are included, the rate is 29.34% (Figure 20). And in this energy poverty measurement index, it is observed that the measuring section that includes the Peloponnese shows a higher percentage for utility bills than the northern section that



also includes Western Macedonia. Also, the southern part of Greece exceeds the average of Greece in the measurement of this index, since Greece has a percentage of 26.3% and southern Greece 29.34%. The case of southern Greece having a higher percentage than the average of the country was also found in the previous indicator, that of the inability of households to be able to have thermal comfort in their space.

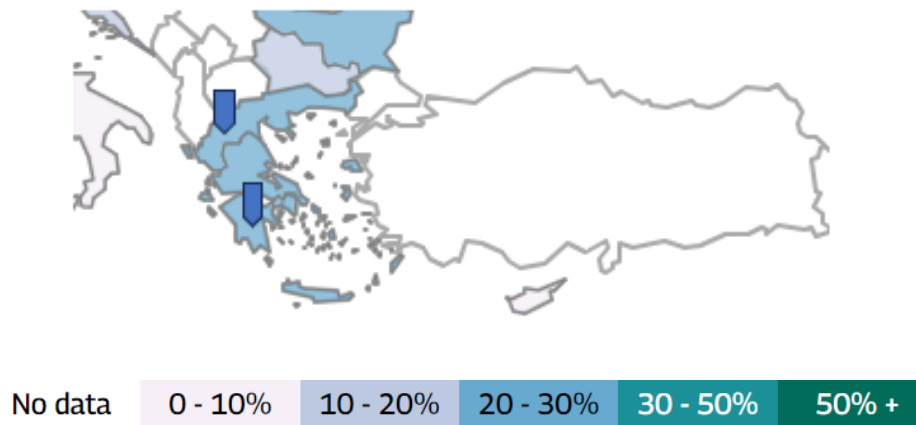


Figure 19: Regions of Greece with arrears on utility bills (ENPOR).

### High share of energy expenditure in income indicator

Despite the Figure 21 for the year 2015, it is observed that most countries in Europe have a higher share of energy expenditure in revenue of more than 10%, with Greece reaching 16.26%. This is due to the relatively low incomes received by Greeks and the corresponding energy prices. These rates today will certainly be different since people's incomes may have stayed relatively similar, but energy prices have increased due to the Russia-Ukraine war.

### HIGH SHARE OF ENERGY EXPENDITURE IN INCOME

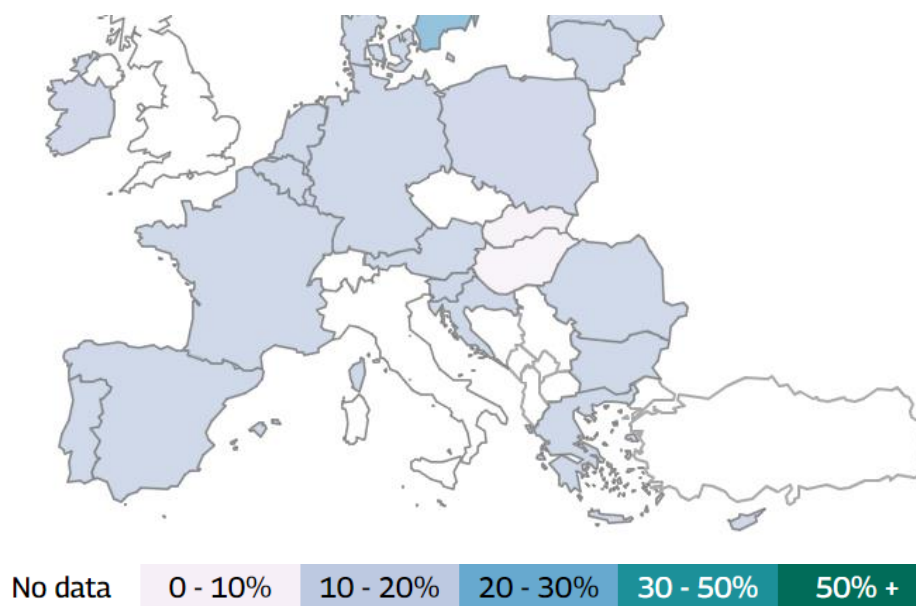


Figure 20: European countries with high share of energy expenditure in income in 2015 (ENPOR).

Regarding the percentage of the high share of energy costs in income, there are no separate data for women and men in Greece. Nevertheless, the percentage is high in northern Greece with the value being 28.49%, and in the rest of the country where the Peloponnese is included, the percentage is 18.68% (Figure 22). It is observed that northern Greece, where Western Macedonia is included, far exceeds the average price of the country, at least by 10%. This probably happens because the northern part of the country has a greater need for energy consumption for heating purposes, especially in the winter months, due to reduced temperature.



Figure 21: Regions of Greece with high share of energy expenditure in income in 2015 (ENPOR).

### Low absolute energy expenditure indicator

In the index low absolute energy expenditure, it is observed that from available data of 2015, European countries in which data are available record a maximum percentage of up to 20% (Figure 23). In the case of Greece, this percentage is quite low at 8.9%, one of the lowest percentages together with other Balkan countries.

### LOW ABSOLUTE ENERGY EXPENDITURE

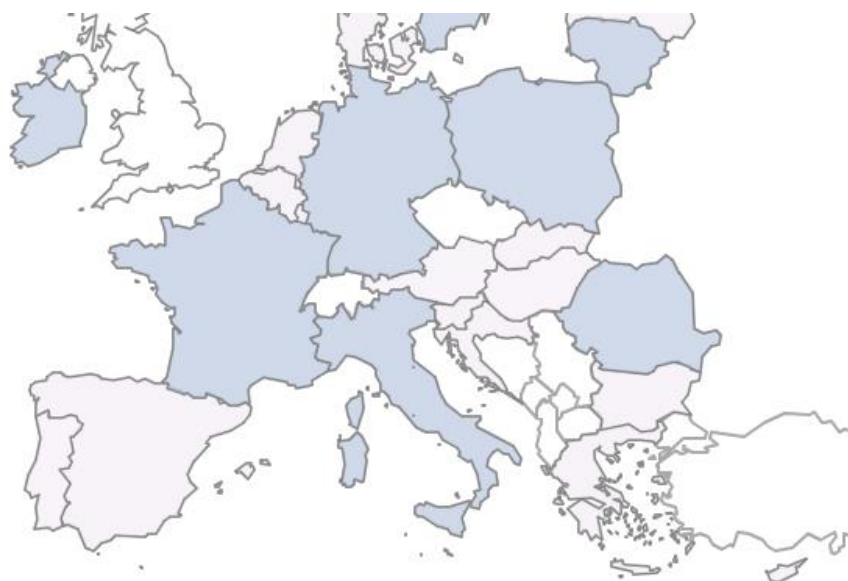


Figure 22: Low absolute energy expenditure 2015 in EU and Greece (ENPOR).

The available data for the specific regions of Greece Western Macedonia and Peloponnese did not exist individually nor were they separated by sex. As in the above indicators, the data are categorized up to 2015 and are available for northern Greece and the rest of it. For northern Greece, with Western Macedonia belonging to this category, the percentage of low absolute energy expenditure rose to 5.16%, while in the rest of Greece, including the Peloponnese, it rose to 11.66%. With Greece showing an average rate of 8.9%, the southern part of the country exceeds the national average (Figure 24).

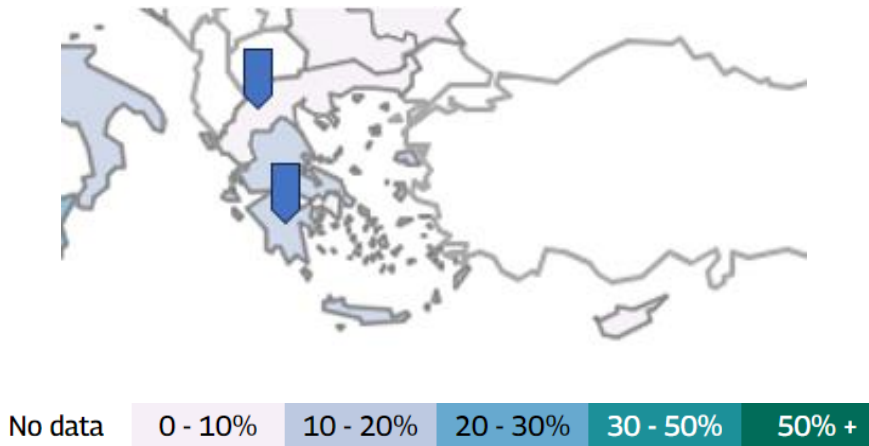


Figure 23: Regions of Greece with low absolute energy expenditure (ENPOR).

## Analysis of policies to alleviate energy poverty and gender inequality in Greece

### National Energy and Climate Plans (NECP)

The Greek NECP (European Commission, 2019b) which was submitted at the end of the year 2019, provides a roadmap for substantial reduction in greenhouse gas emissions (GHG), and it addresses the phenomenon of energy poverty. All Member States must update their NECPs including energy poverty and addressing it at national level through effective policy packages by considering the combination of the three causes of energy poverty: low income, higher energy bills and low energy efficiency. In general, the goal of the NECP in Greece, is to reduce energy poverty by at least 50% by 2025, and by 75% by 2030, compared to the year 2016 by implementing specific policy measures and emphasizing the prevention of energy poverty. To tackle energy poverty, the NECP intends to protect the households, strengthen the development dimension - financing measures for increasing the energy efficiency of the buildings and fostering the higher penetration of RES, and to raise awareness by informing people. The outlined policy measures to deal with the phenomenon are expected lead to the coverage of the predicted comfort conditions and the avoidance of the associated problems such as the ability for all households to have access to energy. The NECP does no specific policy measures and analysis on gender equality and social inequalities. The proposed measures concern both sexes as a whole without giving greater weight to women. In

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particular, the provision of financial mechanisms for the energy upgrade of vulnerable households and other social groups with specific electricity consumption standards is foreseen. The action plan will include both the definition of energy poor households, through specific quantitative criteria, and a specific process for monitoring and evaluating the evolution of the phenomenon. Specifically, the measures that have been taken are mainly financial and regulatory. Financing was given to the lignite areas for the development of a natural gas network for the safe energy transition of the areas in order to supply households with heat without a license, as well as for the energy upgrade of buildings with specific conditions. Some measures concerning mountainous areas such as Western Macedonia are the subsidy for the supply of firewood to citizens living in these areas, to cover part of their winter biomass needs. An objective mentioned by the NECP in relation to social cohesion is that a more effective energy policy should be implemented with a view to achieving not only economic but also social cohesion. Therefore, it is stated that a redesign of the existing Energy Poverty Observatory (European Commission, 2016) will be launched, so that the National Energy Poverty Observatory will be an effective tool for monitoring the evolution of the phenomenon. The updated version of NECP sets targets to reduce total greenhouse gas (GHG) emissions by 55% by 2030, by 80% by 2040 and to reach net zero emissions by 2050.

### **The National Recovery and Resilience Plan**

The National Recovery and Resilience Plan includes a set of proposals aimed at promoting gender equality and ensuring equal opportunities for all. In this direction, Pillar 3 formulates policies and practices that can strengthen the balance of professional and family life for both sexes, the equal participation of women in the labor market and ensure the smooth (re-)integration of women into the professional life after having a child, with the aim of reducing unemployment. Gender inequality in participation in the labor market and equal opportunities for women and young parents to remain in the labor market are reflected as key objectives in Pillar 3 of the Plan through subsidizing the creation of new nurseries (with an emphasis on places for infants and children up to 2.5 years of age) and with the subsidy for the creation of childcare facilities in businesses. These two interventions aim to increase the coverage of the need for comprehensive and quality childcare provision, thereby enhancing equal opportunities for women to remain professionally active, resulting in lower unemployment rates for women, thus greater economic income, and therefore not so vulnerable to energy poverty since they will have more financial comfort to cover their energy needs. It is also proposed to strengthen the Equality Observatory of the Ministry of Labor and Social Affairs with the aim of strengthening the multifaceted collection and recording of data describing the image of inequalities and discrimination in the country and the relative assessment of progress in the field of equality and equal opportunities for everyone regardless of gender, race, religion, nationality, etc.

### **Action Plan for Combating Energy Poverty**

The Action Plan (Ministry of Environment and Energy, 2021a) concerns the specification of policy measures to achieve the ambitious objective of the NECP to tackle energy

poverty in Greece. The dimensions of the policy measures concern information and education actions, consumer protection, and actions to improve energy efficiency and increase the use of RES. All three of these dimensions contain important policies to address the phenomenon, but nothing specific is mentioned regarding gender. Regarding education measures will be carried out in affected households, both through the Energy Performance Obligation Enforcement Regimes for the period 2021-2030, and through centrally planned information and awareness-raising actions for affected consumers and energy saving professionals. For consumers, three policy measures will be implemented, combining both support for affected households in extreme and exceptional energy poverty conditions, as well as protecting them through regulatory and policy measures. For improving energy efficiency, four different policy measures will be implemented, in line with the key design principles outlined in the NECP.

The Action Plan outlines key policy measures to reduce energy poverty in Greece. A summary is provided in Table 5.

*Table 5: Policies/Measures in order to reduce energy poverty in Greece, Action Plan.*

|   |  |
|---|--|
| <b>Energy Communities to Combat Energy Poverty</b>                                    | The aim is to reduce energy poverty, through targeted actions, such as financial incentives, the energy produced by RECs and CECs will cover the needs of households affected by the phenomenon. (Ministry of Environment and Energy, 2021a)   |
| <b>Energy Efficiency Obligation Scheme Information Campaign for Vulnerable Groups</b> | The Obligated Parties carry out targeted education and information activities with vulnerable groups to manage energy demand and combat energy poverty, through the creation of personalized actions based on the characteristics of the affected household.   |
| <b>Targeted Energy Poverty Information &amp; Training</b>                             | The Design and implementation of information and training programs both for households affected by energy poverty and for professionals involved in energy efficiency measures. Actions specific energy saving tips, information on energy tariffs and advice on available financial assistance for energy efficiency. (Ministry of Environment and Energy, 2021a) |

|  |  |
|--|--|
| Energy Card for Vulnerable Households  | Purchase of a certain amount of energy at a preferential price using an "energy card" to cover minimum thermal comfort conditions for households in energy poverty in emergency situations. (Ministry of Environment and Energy, 2021a)                          |
| Installation of Energy Efficiency Systems & RES in Vulnerable Households         | 120,000 energy poor households are expected to have RES or energy saving technologies installed with up to 80% of investment costs subsidized. (Ministry of Environment and Energy, 2021a)   |
| Incentives to Support Actions for Vulnerable Households in Just Transition Areas | Upgrade 10,000 vulnerable households with energy saving technologies and RES systems with a subsidy of up to 90% in regions of Greece affected by the delignitisation of the power sector under the Just Transition. (Ministry of Environment and Energy, 2021a) |

### Energy community law 4513

Law 4513 (PRESS OF THE GOVERNMENT OF THE HELLENIC REPUBLIC, 2018) on Energy Communities has entered into force in Greece in 2018, and put citizens, local municipalities, and medium-sized enterprises at the heart of the energy transition. The law explicitly emphasizes on the role of energy communities in tackling energy poverty, also through virtual net metering. In this vulnerable households can access free solar energy even if they are not members of an energy community. This law states that the energy community may take actions to support vulnerable consumers and address the energy poverty of citizens living below the poverty line within the Region where the Energy Community is located, such as energy supply or offsetting, energy upgrading of dwellings or other actions that reduce energy consumption in the dwellings of the above mentioned. However, there is no specific mention of a gender policy or a gender-specific policy.

### Just Development Transition Programme

The Just Development Transition Programme 2021-2027 is co-funded by the Just Transition Fund. It provides support to those regions and people affected by the social, labor, economic and environmental impacts of transition, following the 2030 goals and the 2050 target towards a climate-neutral economy. The programme focuses on supporting regions that depend on the extraction and combustion of lignite for



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electricity generation such as Megalopolis and Western Macedonia, and island regions dependent on the combustion of fuel oil and diesel. The policies include the intention to ensure equal opportunities and avoid discrimination.

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*“The design of the Just Development Transition Program takes into account the EU policy measures on energy poverty identification, monitoring and response. In parallel, ensuring equal opportunities, inclusion and combating all forms of discrimination” (JDTP)*

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### **Territorial Just Transition Plans of Western Macedonia and Megalopolis**

The Just Transition Fund (JTF) regulation requests from the TJTP to address diverse social, demographic, economic, health and environmental impacts of the transition to a climate-neutral economy. The analysis of the TJTPs of Western Macedonia and Megalopolis, does not specifically address the “impacts” of the transition but rather outline needs, define “intended” actions, and provide “expected results”. This might be the case because the status quo of certain transition issues as gender part, is not well known. The results from the analysis of the effects of the TJTPs on Western Macedonia and Megalopolis will be presented below. The challenge of energy poverty and gender aspects in coal regions in Greece, is to define and take concrete measures to prevent and address energy poverty for the most vulnerable groups, including women.

In the case of gender, there has not been a thorough analysis nor much mention as has been made, for example, in general for unemployment and the plans to deal with it in these areas, for the applications of energy technologies for clean energy, etc. In both TJTPs, “gender” was mentioned only twice, and while it states that the goal is gender equality and social cohesion, no specific measures are mentioned to achieve the goal. So, gender aspects are hardly addressed for the Greek coal regions, or the impact is not clearly defined. In the TJTP of Megalopolis, a plan measure to minimize the negative impacts on gender and equality, is The Peloponnese Regional Strategy for Social Inclusion (PESKE), which includes the combating discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation, but this has not been further analysed.

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*“The Peloponnese Regional Strategy for Social Inclusion (PESKE) includes a coherent and integrated strategy for social inclusion and poverty reduction in the Peloponnese (Peloponnese Region - Regional Strategy for Social Inclusion (PESKE)” (TJTP, Megalopolis)*

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The region of Western Macedonia may not have adopted a gender-specific solution, but it has nevertheless taken into account the social inclusion of vulnerable groups, especially in retraining in its TJTPs. The region of Western Macedonia has the Regional Strategy for the Social Integration of Western Macedonia (2015). Regarding energy poverty, it is identified as an impact of transition. Western Macedonia sees the transition plans as an opportunity to combat energy poverty by promoting renewable energy, self-consumption, energy storage, renewable hydrogen and improving living conditions in the buildings. It is believed that the strengthening of energy infrastructure and interconnections between Western Macedonia in Greece and other countries, will tackle energy poverty.

Table 6: Other measures/policies to reduce energy poverty in Greece.

|   |  |
|---|--|
| <b>Energy Efficiency in Households Programme “Exoikonomo”</b> | It aims to improve the energy class of households by at least 3 energy categories (30% primary energy savings), with separate incentives to support low-income and vulnerable households with an increased subsidy. (Ministry of environment and energy, 2021) |
| <b>Energy Upgrade of Buildings</b>                            | It focuses on energy poor households and involves the provision of financial assistance to energy poor households to improve the energy efficiency of their housing. (Ministry of environment and energy, 2020)  |
| <b>Energy Efficiency Obligation Scheme (EEO Scheme)</b>       | This measure aims to improve the existing Energy Efficiency Obligation Scheme, which foresees that Obligated Parties that must deliver measures targeting energy poor households. (Ministry of Environment and Energy, 2021a)                                  |

## 5. DISCUSSION AND CONCLUSION

Greece is among the countries with the highest rates of arrears on utility bills, inability to keep homes adequately warm, with a high share of energy costs in income, with the highest rates of unemployment and especially female unemployment. In addition, Western Macedonia also presents the highest percentage of households with very low work intensity and among the highest rates of female unemployment, not only relative



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to men in the region, but also relative to the Greek average. Which shows that Western Macedonia has a very high unemployment rate among the other regions of the Greek territory. The Peloponnese follows with the same logic of increased female unemployment, at slightly lower levels than Western Macedonia, but significant for bringing social inequalities and energy poverty situations, as the energy poverty and social exclusion risk rates for Greece also show in relation to with the rest of Europe, and for the study areas, which record records in this part as well in relation to the rest of the regions of Greece. The employment gap between the two sexes in Greece is also among the highest in all of Europe. Growing gender income inequality is a concern, implying that economic growth is not inclusive and its benefits are not distributed equally. Income inequality can reduce economic growth, while raising concerns about sustainable development, thereby exacerbating energy poverty as the gap between women and men widens. The gradual decline of the youth population for both study areas does not help the sustainable development of the places. The fact that the average age of residence in these areas is from 30-65+ with high percentages of age being 45-64 mainly from the female population, i.e. ages that are considered productive in terms of employment, in simultaneous combination with the high percentages of female unemployment, prove that there is a problem of social and racial inequality in these areas, and that this situation does not help women to face their energy needs equally as men. This can also be seen from the index of severe material and social deprivation, where Greece comes almost first in Europe, with women experiencing deprivation to a greater extent than men. The Peloponnese in this measurement registers at least 10% higher percentages than Western Macedonia, and higher percentages compared to the average of Greece. Therefore, it is understandable that the female gender is more prone and vulnerable to energy poverty both in Greece, and specifically in Western Macedonia and the Peloponnese.

Moreover, from the statistical analysis it is observed that most available data for the measurement of energy poverty between the two sexes are mainly economic and demographic related. The selection of several different indicators helped to obtain a more complete picture to understand the existing situation for both genders and how they experience energy poverty. But in order to establish a more comprehensive gender analysis, all the selected analysis indicators must provide data for both genders separately. For the case of Greece, in the context of the Hellenic Energy Poverty Observatory, more importance must be given to aspects related to gender, and the Hellenic Statistical Authority (ELSTAT), can introduce more specialized indicators that will concern both gender, as well as specific regions of the country (NUTS2, NUTS3).

Regarding Greece's policies to address energy poverty, many measures refer to technologies and energy upgrading programs. The only policy that includes concrete measures for the empowerment of women is The National Recovery and Resilience Plan. Nevertheless, it is critical to give more emphasis both to vulnerable social groups and more specifically to the most vulnerable gender. For future research on energy

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poverty measurement, it is essential to also pay attention to the gender aspect, taking into account measurement indicators, such as economic, social, demographic, energy, since as it is proven, the two sexes are affected and face each other in different ways in the phenomenon of energy poverty. For future research following this study, in order to further understand the relationship between energy poverty and gender in Greece and in the coal regions, it is proposed to conduct field research in the regions of Western Macedonia and Arcadia, using the specific indicators of energy poverty measurement, giving weight to each gender separately, by conducting interviews with the residents of these regions.

In conclusion, the study in Greece and the coal regions shows that on the issue of energy poverty, there is a big difference in how gender is affected. Plans to mitigate gender inequality should be accompanied by innovative and targeted strategies that radically address the issue of alleviating energy poverty.

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