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MASTER'S THESIS

AN EMPIRICAL ANALYSIS OF ENERGY POVERTY IN SLOVENIA

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ABSTRACT

Energy poverty is a multidimensional problem that affects households' ability to access essential energy services and remains closely linked to health, well-being, and social inclusion. In the European Union, the problem has recently become even more pronounced due to rising energy prices, the COVID-19 pandemic and geopolitical tensions, which have further increased energy insecurity for many households across Europe. The share of European Union citizens who cannot afford adequate home heating was 9.2% in 2024. However, the percentage is not evenly distributed across Member States. For example, in Slovenia, 6.8% of households were energy poor, and 3.6% of the population could not afford adequate home heating due to poverty. Southern and Eastern Europe have much higher rates, while Northern and some Central European countries have much lower rates.

In my master's thesis, I combined theoretical and empirical insights on the determinants and distribution of energy poverty in Slovenia, focusing on three main indicators: inadequate home heating, inadequate housing conditions, and difficulty paying utility bills. The empirical analysis includes regional and local data and provides further insight into the spatial distribution of energy poverty in Slovenia. Energy poverty in Slovenia is characterized by a high percentage of households living in inadequate housing conditions, being unable to pay utility bills on time, and having a high level of home ownership, especially of houses. This phenomenon is strongly linked to structural, socio-economic, and financial stress factors. Demographic variables do not have a strong direct impact on energy poverty indicators, but rather an indirect impact through income and, consequently, on a greater or lesser likelihood of energy poverty. Economic conditions are closely linked to financial stress and rising energy prices, as they strongly affect all three energy poverty indicators, especially the utility bills indicator. Spatial variables are less important in energy poverty indicators, as they affect energy poverty through inequalities in regions and residential areas. Measures to reduce energy poverty in Slovenia must combine social, infrastructural, economic, and institutional policies to ensure a sustainable energy transition.

KEY WORDS: Energy poverty, Slovenia, European Union, inadequate warm home, inadequate housing conditions, utility arrears, building renovation, demographic, socio-economic, spatial, health and social variables, empirical analysis

SUSTAINABLE DEVELOPMENT GOALS



POVZETEK

Energetska revščina je večdimenzionalen problem, ki vpliva na sposobnost dostopa gospodinjstev do osnovnih energetske storitev. Ostaja tudi tesno povezana z zdravjem, dobrim počutjem in socialno vključenostjo. V Evropski uniji je problematika v zadnjih letih postala še izrazitejša zaradi rasti cen energentov, COVID-19 pandemije in geopolitičnih napetosti, ki so dodatno povečale energetske negotovost številnih gospodinjstev po Evropi. Leta 2024 je delež prebivalcev Evropske unije, ki si niso mogli privoščiti ustreznega ogrevanja doma, znašal 9,2%. Vendar pa ta delež med državami članicami ni enakomerno porazdeljen. V Sloveniji je bilo na primer 6,8 % gospodinjstev energetske revnih, 3,6 % prebivalstva pa si zaradi revščine ni moglo zagotoviti ustreznega ogrevanja doma. Stopnje energetske revščine so bistveno višje v državah južne in vzhodne Evrope, medtem, ko so v severnih in nekaterih srednjeevropskih državah precej nižje.

V magistrski nalogi sem združila teoretične in empirične ugotovitve o determinantah in razporeditvi energetske revščine v Sloveniji z vidika treh ključnih kazalnikov – neustreznega ogrevanja doma, neustreznih bivalnih razmer in težav pri plačevanju stroškov komunalnih storitev. Empirična analiza vključuje regionalne in lokalne podatke ter ponuja vpogled v prostorsko razporeditev energetske revščine v Sloveniji. Za energetske revščine v Sloveniji je značilen visok delež gospodinjstev, ki živijo v neustreznih stanovanjskih razmerah, ne zmorejo pravočasno poravnati stroškov komunalnih storitev ter imajo visoko stopnjo lastništva stanovanjskih nepremičnin, zlasti hiš. Ta pojav je tesno povezan s strukturnimi, socialno-ekonomskimi dejavniki in finančnimi pritiski. Demografske spremenljivke nimajo neposrednega vpliva na kazalnike energetske revščine, temveč vplivajo posredno prek dohodka. Ekonomske razmere gospodinjstev so tesno povezane s finančnimi obremenitvami in rastjo cen energentov, saj močno vplivajo na vse tri kazalnike energetske revščine, zlasti na kazalnik težave pri plačevanju stroškov komunalnih storitev. Prostorske spremenljivke imajo pri kazalnikih energetske revščine manj izrazito vlogo, saj nanjo vplivajo prek neenakosti med regijami in stanovanjskimi območji. Ukrepi za zmanjševanje energetske revščine v Sloveniji morajo združevati socialne, infrastrukturne, ekonomske in institucionalne politike, da bi zagotovili trajnostni energetski prehod.

KLJUČNE BESEDE: Energetska revščina, Slovenija, Evropska unija, stanovanje ni primerno ogrevano, neustrezne bivanjske razmere, zamujanje s plačili stanovanjskih stroškov, prenova stavb, demografske, socialno-ekonomske, prostorske, zdravstvene in socialne spremenljivke, empirična analiza

CILJI TRAJNOSTNEGA RAZVOJA



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LIST OF ABBREVIATIONS

2M - Energy poverty indicator income spent on energy expenditure
 AIC - Akaike Information Criterion
 AW - Energy poverty indicator inability to keep home adequately warm
 CO₂ - Carbon dioxide
 COVID-19 - Coronavirus disease 2019
 ECHP - European Community Household Panel
 EDEPI - Domestic Energy Poverty Index
 EE - Energy efficiency
 EP - Energy poverty
 EP-0 - Project Energy Poverty Zero
 EPBD - Second Directive Energy Performance of Buildings
 EPOV - EU Energy Poverty Observatory
 EU - European Union
 EU 27 - European Union which consists of 27 countries
 EU-SILC - Statistics on Income and Living Conditions survey
 GDP - Gross Domestic Product
 LILEE - Low Income, Low Energy Efficiency indicator
 M2 - Energy poverty indicator households whose energy expenditure is below the national median energy consumption
 MS - Member states
 NEPC - National energy and climate plans
 NGO - Nongovernmental Organizations
 PPS - Purchasing power standards
 RES - Renewable Energy Sources
 RQ - Research question
 SCF - Social Climate Fund
 SURS - Statistical Office of the Republic of Slovenia
 UB - Energy poverty indicator arrears on utility bills
 UK - United Kingdom
 UN - United Nations
 WHO - The World Health Organization

1 INTRODUCTION

Energy poverty (hereafter EP) is a significant social and economic challenge, as it affects households' ability to afford basic energy services, such as heating, cooling, lighting, and the use of appliances, and is closely linked to health and social inclusion (Fabbri, 2019). It occurs when households spend a large proportion of their income on energy or must limit their consumption, often due to a combination of low-income, high-energy prices, and poor energy efficiency of buildings (European Commission, 2025a). Measuring energy poverty is methodologically challenging because it is a multidimensional phenomenon that includes economic, social, geographical, and technical factors, such as income level, housing conditions, household characteristics, and geographical and climatic context (Bouzarovski, 2013).

In the European Union, the problem has become even more pronounced in the recent years due to rising energy prices, the COVID-19 pandemic, and geopolitical tensions, which have further increased energy insecurity for many households across Europe (European Commission, 2025a; Lausberg & Croon, 2023). According to Eurostat, the proportion of citizens in the European Union (EU) who cannot afford adequate home heating has increased from 6.9% in 2021 to 10.6% in 2023, before decreasing slightly to 9.2% in 2024 (European Commission, 2025a). It is also unevenly distributed among Member States, with significantly higher rates observed in Southern and Eastern Europe, while lower levels are reported in Northern and some Central European countries (Dell'Anna & Yilmaz, 2025). There are still significant research gaps in knowledge about which factors most strongly influence the occurrence of energy poverty, and which measures are most effective in reducing it. Existing research is limited by differences in national definitions, subjective self-reporting, and the predominance of European-level measurement, while regional and local levels remain under-researched (Halkos & Gkampoura, 2021).

The goal of this thesis is to provide theoretical and empirical analysis of energy poverty in Slovenia with the aim of improving the understanding of its key determinants, patterns, and distribution. The focus is on the existing research gap, as there is a lack of analyses at the regional level, which could allow for a more in-depth identification of differences in energy poverty across urban and regional contexts. The purpose is to examine the concept and determinants of energy poverty in the European Union and Slovenia, then to empirically analyse the relationship between demographic, geographic, and socio-economic variables and energy poverty indicators in Slovenia using statistical methods, and finally to evaluate potential policy measures for alleviating energy poverty.

Based on the identified research gap and the purpose of the study, four research questions (RQs) were formulated: RQ1: How is energy poverty defined, and which are the factors that affect the energy poverty at the level of a household or an individual? RQ2: What is the

nature of energy poverty in the EU? RQ3: What is the nature and the determinants of energy poverty in Slovenia? From this research question, two sub-questions derived: RQ3.1: What is the impact of demographic variables on energy poverty? and RQ3.2: What is the impact of geographic and general economic conditions on energy poverty? RQ4: Which measures can be used / are used in Slovenia to alleviate energy poverty?

Methodologically, the master thesis will be divided into two parts. First, the theoretical part will include a review of foreign and domestic literature, with which I will present the definition and problem of energy poverty and show published data and research on variables that affect energy poverty. Second, the empirical part will conduct a statistical analysis based on already selected responses to the 4th European Quality of Life Survey (4th EQLS), which took place in 2016 (4th European Quality of Life Survey Source Questionnaire, 2016). This is the most recent available data we have to study the relationship between variables, which is not conditioned by time, but by relative relationships (who is more at risk).

The structure of the master thesis is divided into four parts. First, I will start with EP definition and theoretical analysis of the determinants. Then I will look at global trends in energy poverty, compare measurements for EP and analyse characteristics in EU and Slovenia. Here I will present data and analysis from other researchers or institutions. The third part is based on the analysis of the data obtained from the questionnaire. And at the end there is a discussion of the results and answering research questions, with measures to alleviate energy poverty.

2 ENERGY POVERTY: THEORETICAL BACKGROUND

Energy is essential for maintaining adequate living standards, including heating, cooling, lighting, and the operation of household appliances. Access to these services is closely linked to health, wellbeing, and social inclusion (Fabbri, 2019). When households are forced to reduce their energy consumption to a degree that negatively affects their health and wellbeing, we are talking about EP, which is mainly driven by three underlying root causes: a high share of household expenditure spent on energy bills, low income, and poor energy efficiency of buildings and appliances (Portal energetika RS, 2023). Despite increasing policy attention, energy poverty remains a significant challenge across the EU, particularly among vulnerable groups such as pensioners, unemployed individuals, and low-income households, mainly due to its private nature and its complexity. Recent crises, including the COVID-19 pandemic, rising energy prices and Russia's invasion of Ukraine in 2022, have worsened the problem and reversed the declining trend in percentage of EU households unable to keep their homes adequately warm (European Commission, 2025a).

2.1 Concept and definitions of energy poverty

Despite the fact that there is no single universal definition of energy poverty, we can track how definitions and calculations have changed throughout history, and the differences between EP in developed and developing countries remain visible today. Historically, the concept began with access and affordability issues, especially in cold climates (Thomson, 2017). Modern definitions (e.g., EU policy) integrate multiple dimensions such as access, affordability, income, efficiency, and essential energy services, as well as criteria that reflect the inability to heat homes, pay bills, or live in adequate housing (Widuto, 2022).

The World Health Organization (WHO) distinguishes between Energy poverty, which is a characteristic of developing countries, and is defined as the difficulty of supplying renewable energy sources and fuels for producing energy. and Fuel poverty, which is a typical phenomenon of developed countries, and is defined as the difficulty or impossibility in paying for energy consumption (energy bills) in a context where an energy infrastructure already exists (Li et al., 2014). For the purposes of this analysis, the term EP will be used, as fuel poverty is a narrower term than EP and is mainly used in the United Kingdom (UK) and Ireland (GOV UK, 2025).

2.1.1 Historical development and measurements of energy poverty

Definitions of EP have changed over time, depending on the country's economic development and the energy-related problems at the time. Boardman (1991) first stated that households are unable to obtain an adequate level of energy services, particularly warmth, if heating costs exceed 10% of their income. This definition emerged in the UK in the post-industrial revolution period, amidst the UK's energy crises, specifically the oil shocks and the miners' strike of the 1970s, which caused fuel shortages and high prices (Boardman, 1991). At that time, based on Boardman's definition, the term fuel poverty was developed, which the UK and Ireland still use this definition today. Fuel poverty occurs when a household spends more than 10% of its income on fuel costs and the remaining household income is insufficient to maintain an adequate standard of living. It is calculated using the Low Income, Low Energy Efficiency (LILEE) indicator (GOV UK, 2025).

Between 1990 and 2000, the focus shifted to developing countries, particularly in Sub-Saharan Africa and South Asia, and the term energy access poverty was defined as the absence of electricity and modern fuels necessary for development due to infrastructure deficits. The key idea was that access to energy is essential for generating income, education, and health. But poverty persists due to the lack of electricity and adequate infrastructure, and households rely on traditional biomass (wood, dung, charcoal) (ESMAP, 2000).

In the period from 2010 to 2020, multidimensional conceptual definitions began to emerge, which formed the basis for recent legislation and definitions within the EU. Bouzarovski & Petrova (2015) proceed from the assumption that all forms of EP, in developed and

developing countries, involve the inability to achieve socially and materially necessary levels of energy services in households. They also began to emphasize that energy deprivation is tied to household vulnerability and the ineffective link between new technologies (like solar or smart grids) and social elements (policies and user behaviours) in sustainability transitions (Bouzarovski & Petrova, 2015).

In the EU law, the concept of EP was first introduced by the Directive on common rules for the internal electricity market (2009/72/EC). Since then, it has been broadened within the narrative of a just and fair energy transition, and over the past decade, the EU has increased its efforts and made EP a key concept (Table 1) (European Commission, 2025a).

2.1.2 Energy poverty in EU policy framework

In the 2023 Social Climate Fund regulation and the revised Energy Efficiency Directive, the European Union officially defined Energy poverty as a “household’s lack of access to essential energy services, that 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 social policy and other relevant policies, caused by a combination of factors, including but not limited to nonaffordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes” (Widuto, 2023). This definition is aligned with the European Pillar of Social Rights and the UN 2030 Agenda for Sustainable Development, which consider energy as an essential service with universal access (Segurado & Serrano, 2024).

Energy poverty has become an important part of the European energy and social policy framework in recent years. The EU is addressing the problem mainly through energy efficiency policies and through reducing structural inequalities, including the Second Directive Energy Performance of Buildings (EPBD) (EU/2024/1275), the National energy and climate plans (NECPs) and the Renovation Wave Strategy, adopted in October 2020 as part of the European Green Deal (Segurado & Serrano, 2024). Under the NECPs framework, EU Member States (MS) are required to assess the extent of energy poverty and integrate targeted measures into their national strategies, while also developing their own definitions, measurement methods, monitoring systems, and policy solutions to protect vulnerable households. The phenomenon is individual, spatially and temporally dynamic, and culturally conditioned. In support of these efforts, the European Commission published a Recommendation on energy poverty in 2020 within the Renovation Wave Strategy, promoting building renovation and energy efficiency improvements, in order to reduce the number of people affected by energy poverty (European Commission, 2025a; Segurado & Serrano, 2024).

The Fit for 55 legislative packages, adopted in 2021, also introduced further measures to identify and address key drivers of energy poverty, such as high energy prices, low household incomes, and energy-inefficient buildings and appliances. (European

Commission, 2025a). The Social Climate Fund (SCF) helps with finance investments in energy efficiency, building rehabilitation, and sustainable heating and cooling systems (Regulation (EU) 2023/955) (Segurado & Serrano, 2024). Together, these policy tools emphasize structural solutions such as improving the energy efficiency of the housing stock and reducing social and economic inequalities that contribute to energy poverty (European Commission, 2025a).

2.1.3 Energy poverty in Slovenian policy framework

Based on the Electricity Supply Act (Table 1), the Government of the Republic of Slovenia issued the Decree on Criteria for Defining and Assessing the Number of Energy Poor Households on October 13th, 2022 (Official Gazette of the Republic of Slovenia, No. 132/2022). The Decree on Criteria for Defining and Assessing the Number of Energy Poor Households mirrors the EU policy definition but adds national eligibility criteria. EP occurs when a household is materially vulnerable, meaning that its income is below the at-risk-of-poverty threshold, and it lives in energy-inefficient housing where the required heat for heating exceeds 150 kWh/m² per year. Inadequate living conditions are also common, such as leaking roofs, damp walls, floors, or foundations, and rotten window frames or floors. In addition, the household spends a disproportionately large share of its disposable income on energy, with energy expenditures amounting to at least 50% of disposable income or exceeding the average share of energy expenditures, in order to cover basic energy needs such as the costs of heating, sanitary water preparation, cooling, cooking and lighting (Portal Energetika RS, 2023).

This also differs from older definitions, because before they often used fuel poverty or affordability indicators, such as that spending threshold on energy that was higher than 10% of income. The current definition is broader and multidimensional, incorporating income, dwelling conditions, affordability, and energy efficiency (RS Statistical Office, 2018).

Table 1: Overview of major energy poverty concepts or policies through years

Energy Poverty Policy / Concept	Year	Level	Source
Fuel Poverty Definition, “10% rule” and LILEE indicator	1991 (updated in 2025)	National (UK/Ireland)	Boardman (1991); GOV UK (2025).
Energy Access Poverty Concept	2000	Global / Developing countries	ESMAP (2000).
Directive on Common Rules for the Internal Electricity Market (2009/72/EC)	2009	EU	European Commission (2025a).
Multidimensional Energy Poverty Concept	2015	Global / Academic	Bouzarovski & Petrova (2015).
National Energy and Climate Plans (NECPs)	2018 (framework), updated regularly (last revision 2024)	EU / Member States	Segurado & Serrano (2024).
Renovation Wave Strategy	2020	EU	European Commission (2025a); Segurado & Serrano (2024).
European Commission Recommendation on Energy Poverty	2020	EU / Member States	European Commission (2025a).
Fit for 55 Package	2021 proposed, 2023 adopted	EU	European Commission (2025a).
Electricity Supply Act (basis for decree)	2022	Slovenia	Portal Energetika RS, 2023.
Decree on Criteria for Defining and Assessing Energy Poor Households	2022	Slovenia	Portal Energetika RS (2023).
Social Climate Fund Regulation	2023	EU	Segurado & Serrano (2024); European Commission (2025a).
Revised Energy Efficiency Directive	2023	EU	Widuto (2023).
Energy Performance of Buildings Directive (EPBD)	2024	EU	Segurado & Serrano (2024).

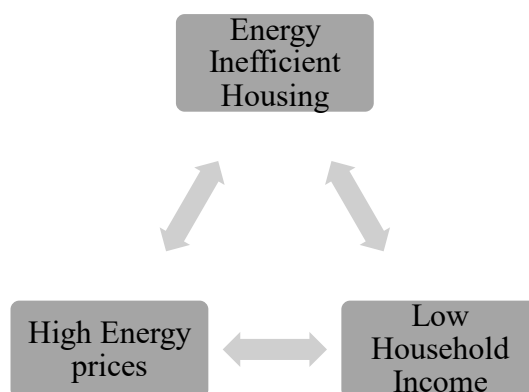
Source: Own work.

2.2 Theoretical analysis of the determinants of energy poverty

Theoretical literature and definitions demonstrate that energy poverty is a multidimensional phenomenon resulting from economic, social, and structural factors (Figure 1). Although definitions of EP vary across countries and institutions, most of the literature recognizes

three main underlying root causes (as also shown in Figure 1): energy efficiency of housing, household income, and energy prices (Boardman, 1991; European Commission, 2025a).

Figure 1: Three main underlying root causes of energy poverty



Source: Own work based on Boardman (1991); Bouzarovski in Petrova (2015); Thomson et al. (2017); European Commission (2025a).

In later studies, this was expanded to include additional determinants such as socio-demographic characteristics, housing tenure, geographic conditions, and institutional contexts (Table 2) (Bouzarovski in Petrova, 2015; Thomson et al., 2017). All these factors have been observed to occur in developed and underdeveloped countries and in cold and warm areas (Neacsu et al., 2020).

2.2.1 Income and socio-economic vulnerability

EP influences a large part of the population, not only people in income poverty, such as the homeless, but also older people, families with children, and households affected by disabilities, long-term illness, or infirmity (Bouzarovski, 2013). A study by the Commission's Directorate General for Employment, Social Affairs and Inclusion by European Commission (2024a) found that about 30% of energy-poor households are also income-poor, falling below the poverty threshold. The distinction between the poor and the energy poor is that those with lower earnings tend to spend their money first on food and water, and only then on energy and heating, resulting in many more people being energy poor (Fabbri, 2019). Pensioners, single parents, the unemployed, people receiving social security payments, and low-income households could also be classified as energy-poor consumers if the state does not provide social safety measures (Bouzarovski, 2013). These groups often experience limited financial capacity to absorb fluctuations in energy prices or invest in energy efficiency improvements. In addition, socio-economic vulnerability can lead households to adopt coping strategies such as underheating homes or delaying payment of energy bills, which may exacerbate long-term financial and health risks (Thomson et al., 2017). A higher income not only has a direct effect on EP, but it may also have an indirect

effect, since it is positively related to other variables that affect EP, especially education, affordability, and energy efficiency of buildings and housing conditions (Río et al., 2025).

Boardman (1991) defined that households are considered energy poor when the cost of meeting basic energy needs represents a disproportionately high share of their disposable income. In such cases, households may be forced to reduce their energy consumption below adequate levels, which can negatively affect health and well-being.

Igawa and Managi's (2022) analysis show that lower income households are more likely to experience EP because of their energy burden, which raises the percentage of the household budget allocated to energy, and because of investment limitations, which limit their capacity to make investments in energy efficiency upgrades, including heating, cooling, and lighting. Regardless of the household's characteristics, households in nations with greater income inequality are more likely to subjectively experience higher levels of EP, especially in terms of affordability (Igawa & Managi, 2022).

Low-income households living in poorly insulated apartments are forced to buy more expensive energy services compared to other residents, as they usually have fewer resources. Although raising income can help solve poverty, it will not necessarily solve EP, as poor energy efficiency of housing is a major cause of this type of poverty, with low-income households often having to pay higher heating costs (Bouzarovski, 2013). Although the wealthiest 20% of households consume more energy in absolute terms, the poorest 20% of households in most European countries have twice the energy load (proportion of income spent on domestic energy services) (Lausberg & Croon, 2023). According to the cross-country data for 19 EU nations, the poorest quintile spent up to 34.4% of household energy income in Greece in 2023 and 30.1% in Croatia in 2020, compared to just 8.3% and 7.5% in Luxembourg. The richest quintile's highest observed shares were 12.4% in Bulgaria in 2020 and 14.8% in Greece in 2023; Luxembourg once more had the lowest values, with 2.8% in 2020 and 3.9% in 2023 (Ackermann & Radulescu, 2026).

2.2.2 Energy prices and affordability

Rising energy prices, particularly gasoline prices, are increasingly recognized as a major concern (Igawa & Managi, 2022). The impact of the COVID-19 pandemic and the spike in energy prices that began in 2021 and increased when Russia invaded Ukraine in February 2022 have worsened an already difficult situation for many EU citizens (Fabbri, 2019). Although bilateral trade increases energy accessibility, it also raises energy costs, negatively impacting affordability for the poorest populations (Zhao et al., 2022). Currently, energy prices are too high and increase living expenses in Europe, yet the effects are not equally felt by all citizens. Geopolitical unpredictability and the shift to low-carbon sources are predicted to keep energy prices high until the end of the decade (Lausberg & Croon, 2023). EP can be made worse by austerity measures that are coupled with climate change, such as increased energy taxes, which disproportionately affect low-income households. The negative

correlation between income and EP may be mitigated by energy prices, energy efficiency, and EP policies (Igawa & Managi, 2022). Affordability problems are worse in nations with higher GINI coefficients (meaning that they have greater income inequality) (Igawa & Managi, 2022). Recent evidence from the European Commission shows that rising costs of housing and energy, along with an inefficient building stock, make it even harder for vulnerable households to pay their bills and get the energy services they need, like heating and cooling (European Commission, 2025b). These dynamics become particularly visible during periods of economic and energy crises. During the 2008-2009 financial crisis, the EU experienced unemployment, declining household incomes, and reduced investment, all of which contributed to greater vulnerability to energy poverty (Szczepanski, 2019). With the COVID-19 pandemic, a similar effect occurred when energy prices rose sharply, there were supply disruptions, and Russia's invasion of Ukraine in 2022, significantly worsened energy affordability across Europe (European Commission, 2025a).

Energy price rises have the biggest impact on well-being at low-income levels, according to empirical findings for gas and electricity costs. In the case of oil and gas prices, a U-shaped link between price and well-being develops. High income households usually live in larger homes and, hence, have higher heating needs, which could account for the high coefficient at high income (Welsch & Biermann, 2014).

2.2.3 Energy efficiency of buildings and housing conditions

Energy-inefficient dwellings include outdated technologies, poorly designed systems, inadequate insulation and heating systems, rotten window frames, patches of condensation on the indoor walls, and even simple behavioural habits (Sustainability Directory, 2025). Even households with moderate income may experience EP if they live in old and energy-inefficient dwellings (Río et al., 2025). A recent systematic review concludes that the older the dwelling, the higher the probability that a household will be energy poor, as older dwellings are more likely to be energy inefficient. It cites German evidence showing that living in dwellings built after 1979 reduces the risk of persistent energy poverty (Río et al., 2025). In the EU there is about 75% of housing stock that was built before 1979 (European Commission, 2019). In Slovenia, more than half of dwellings/houses were built before 1980 (Burja & Južnič, 2021).

Low-income households living in poorly insulated apartments are forced to buy more expensive energy services compared to other households, as they usually have fewer resources to improve their living situation. Although raising income can help solve poverty, it will not necessarily solve EP, as poor energy efficiency of housing is a major cause of this type of poverty, and low-income households often must pay higher heating costs (Bouzarovski, 2013).

There are two different views on the impact of housing size on EP. Sharma et al., (2019) state that a larger size is positively associated with the likelihood of a household being energy

poor, due to greater heating or cooling needs for a larger space and additional expenditure on more electrical appliances. However, Ismail and Khembo (2015) consider that larger homes are mostly inhabited by wealthier people and that higher income means better access to modern energy sources.

2.2.4 Housing tenure and structural barriers

Tenancy refers to whether the household owns the house where they live or whether they live in a rented dwelling (Zang et al., 2021). Households that live in a rented dwelling are more likely to be energy poor compared to those who own their homes. Due to having less income to spend on energy, since they must pay a rent (Dogan et al., 2021), although there are also owner-occupiers with significant housing (mortgage) costs. And, because they are not allowed to energy-improve and insulate the house themselves, but they need to pay the energy bills (Dogan et al., 2021).

2.2.5 Socio-demographic and behavioural factors

Research tends to diverge on the relationship between EP and the age of the household head. Crentsil et al., (2019), Tabata and Tsai (2020), and Zhang et al., (2023) believe that EP is more likely to occur in households where the head of the family is older, as older people prefer traditional energy sources, often have lower incomes, show higher energy consumption due to impaired health, and live in larger, older, and poorly insulated homes with lower energy efficiency. Alem and Demeke (2020), Brown and Vera-Toscano (2021), and Halkos and Kostakis (2023) state that as the household head ages, the household is less likely to be energy poor. This may be because income levels may be higher with increasing age, certain needs and consequently costs decrease, resulting in households having more disposable income (Dogan et al., 2021), and housing costs are lower among the older population (Belaïd, 2022; DECC, 2016).

Households in which the head is married are less likely to be energy poor, although the level of evidence is low. Compared to single individuals, married couples pool their incomes and share the costs, which reduces the probability of EP. Beyond that, it is difficult to prove how marital status can affect the needs and behaviour of a household in terms of energy consumption (Halkos & Kostakis, 2023).

A greater household size increases the probability of falling into EP, as it leads to greater energy needs and lower disposable income levels (Crentsil et al., 2019; Dogan et al., 2021). Furthermore, a lower disposable income leads to the use of cheap and unsafe household fuels, which increases household vulnerability to poverty (Crentsil et al., 2019). The same was confirmed with the determinant of a higher number of children in the household, as it increases with low correlation the probability that the household will be energy poor (Besagni & Borgarello, 2019). The most common reason is that having children means

additional expenses and a lower level of disposable income to spend on energy services, which increases the likelihood that households will fall in EP (Dogan et al., 2021; Zhang et al., 2023). However, some papers contradict this finding and state that the larger the household, the less likely it is to fall into in EP (DECC, 2013; Ren et al., 2023).

Households in which the head is a female have a slight correlation with being energy poor. This may be due to physiological reasons: sensitivity to cold and heat is higher for women than for men, as well as socioeconomic reasons: women have lower income and pension levels and less time for remunerated work, as they usually have more domestic responsibilities. (Mosquera López, 2023).

The higher the education level of the household head, the less likely the household will be energy poor. The capability to follow energy-efficient practices and to improve housing insulation is lower for less educated people, which leads them to have higher energy expenditures (Chaton and Lacroix, 2018). On the other hand, it can be expected that more educated household heads have higher income levels, which allow them to spend more on energy (Lyra et al., 2022).

Employment status plays an important role in explaining EP, as it is a main source of income for the household. Firstly, it is a main source of income for the household. Income levels are higher when the household members work. They are also higher for high-skilled jobs compared to low-skilled ones, which can lead to increased financial stability and improved quality of life for those employed in such positions. Secondly, unemployed and retired people usually spend more time at home, which means that they have higher domestic energy needs and consume more energy there (Drescher & Janzen, 2021). Eurostat data shows that people aged 65 and overspend around 20 hours per day at home, which is 5-6 hours more than the youngest age group (European Commission & Eurostat, 2004). A different study finds that retirement can increase household electricity consumption by 20% to 32% because people spend more time at home (Lv et al., 2022).

2.2.6 Geographic and climate factors

Energy poverty is affected by the level of economic growth in a country. In countries with low GDP, low income mainly makes it difficult to purchase essential household equipment. In countries with high GDP, low income mainly makes energy unaffordable. Countries with middle incomes are affected both by the cost of energy and by the availability of appliances. Eastern and Southern European countries often use less energy than Northern and Western European countries because of their history (energy-inefficient dwellings) and economic (low GDP) factors (Igawa & Managi, 2022).

In both developing and developed countries, rural households are more vulnerable to energy poverty than urban households. Rural areas often have limited and less reliable access to modern energy sources. Housing inefficiency is reflected in poor thermal efficiency, high

energy poverty, burdensome housing costs, and low levels of satisfaction with living (Crentsil et al., 2019; Kettani & Sanin, 2022). On the other hand, urban households usually have higher incomes and better job prospects, which makes it easier for them to pay for energy. However, the differences between urban and rural areas are smaller in developed countries. In such contexts, households more often face problems of dampness and overcrowding (Ismail & Khembo, 2015; Qurat-ul-Ann & Mirza, 2021).

The EP is not related only to the location of the dwelling, it is also related to the climatic conditions of the region and its temperature. Households in colder climates require greater heating demand. Warmer locations tend to reduce the probability of being energy poor. However, warmer regions across the EU tend to have higher EP rates due to poorer energy efficiency standards and a lack of central heating in residential buildings (Río et al., 2025).

When we look at urban areas, we see that they tend to use more electricity, while rural areas tend to use more primary energy sources such as wood, biomass, and gas, because of the availability of heating systems, as well as transportation, and storage issues (Santos Pereira & Cardoso Marques, 2023).

2.2.7 Institutional and policy determinants

The affordability of energy services and the capacity of households' to improve their energy efficiency are influenced by energy market regulation, social welfare systems, energy taxation, housing policies, and consumer protection mechanisms (Table 2) (Bouzarovski, S. et al., 2021). Countries with strong social protection systems and targeted energy assistance programmes tend to mitigate the impact of low income and high energy prices on vulnerable households (Bouzarovski, S. et al., 2021). Studies indicate that more stringent environmental regulations can worsen EP by complicating households' transition to cleaner but more expensive energy sources, negatively affecting local employment, reducing energy trade, and increasing volatility in energy market pricing. By contrast, good regulation and control of corruption reduce EP by improving energy accessibility, ensuring fair resource allocation, and maintaining stable prices. Therefore, a balanced policy that simultaneously protects the environment, improves institutional efficiency, and promotes access to affordable, clean energy is key to reducing EP (Ullah et al., 2024).

Table 2: Overview of energy poverty determinants

Determinants of energy poverty	Findings	Key authors
Income and socio-economic vulnerability	Low-income and vulnerable groups are more exposed to EP due to limited financial capacity, high energy burden, and inability to invest in efficiency; income inequality in countries increases EP risk.	Bouzarovski (2013); European Commission JRC (2024a); Fabbri (2019); Thomson et al. (2017); Río et al. (2025); Igawa & Managi (2022); Lausberg & Croon (2023); Boardman (1991).
Energy prices and affordability	Rising energy prices significantly increase EP and have unequal welfare impacts, especially for low-income households; geopolitical crises and inequality worsen affordability.	Igawa & Managi (2022); Fabbri (2019); Zhao et al. (2022); Lausberg & Croon (2023); Welsch & Biermann (2014).
Energy efficiency of buildings and housing conditions	Poor insulation, outdated systems, and inefficient housing increase energy needs and costs, building age and quality are key determinants; even middle-income households can be affected.	Sustainability Directory (2025); Río et al. (2025); Bouzarovski (2013); Sharma et al. (2019); Ismail & Khembo (2015).
Housing tenure and structural barriers	Renters are more likely to experience EP due to rent burden and inability to invest in energy efficiency, while still paying high energy costs.	Zang et al. (2021); Dogan et al. (2021).
Socio-demographic and behavioural factors	EP is influenced by age, gender, education, employment, and household size.	Crentsil et al. (2019); Tabata & Tsai (2020); Zhang et al. (2023); Alem & Demeke (2020); Halkos & Kostakis (2023); Dogan et al. (2021); Mosquera López (2023); Chaton & Lacroix (2018); Lyra et al. (2022); Drescher & Janzen (2021).
Geographic and climate factors	EP varies by region, GDP level, rural vs urban location, and climate; colder climates increase heating demand; rural areas face access and infrastructure issues.	Igawa & Managi (2022); Crentsil et al. (2019); Kettani & Sanin (2022); Ismail & Khembo (2015); Qurat-ul-Ann & Mirza (2021); Río et al. (2025); Santos Pereira & Cardoso Marques (2023).
Institutional and policy determinants	Policies, regulation, and welfare systems shape EP; strong social protection reduces EP, while poorly designed environmental policies may increase costs and vulnerability.	Bouzarovski et al. (2021); Ullah et al. (2024).

Source: Own work.

2.3 Impacts and consequences of energy poverty

Energy poverty has significant negative consequences for health, education, social exclusion, financial stress, economic development, exposure to climate risk, and overall human well-being (Table 3). Inadequately heated homes are associated with a higher risk of health problems, such as respiratory diseases, asthma, cardiovascular diseases, and a higher likelihood of hospitalization or medical procedures (Szczygieł, et al., 2024; Halkos & Gkampoura, 2021). Additional risks are posed using traditional biomass and poor indoor air quality, which can cause serious respiratory diseases and increase premature mortality (Szczygieł, et al., 2024; Halkos & Gkampoura, 2021). Lack of access to electricity can also limit educational opportunities. Households without enough light and electrical devices find it harder to study at night and use information and communication technologies, which can negatively affect children's academic progress (Halkos & Gkampoura, 2021). The invisibility of the problem is also a factor of energy poverty, especially among people with lower incomes, as they may not want to expose themselves and may therefore become even more socially excluded. By contrast, persons living in conditions of absolute deprivation are more visible (for example, homeless people, and people cared for by social services) (Fabbri, 2019).

Table 3: Overview of energy poverty impacts and consequences

Impacts and consequences of energy poverty	Findings (short summary)
Social consequences	Energy poverty leads to serious health issues (respiratory, cardiovascular diseases), higher mortality, and poor indoor air quality; limits education due to lack of electricity; increases social exclusion and invisibility of vulnerable groups.
Economic development	Energy poverty hinders economic growth by reducing productivity, employment, and efficiency; increases household financial stress and contributes to environmental degradation (e.g., deforestation, desertification).

Source: Own work based on Fabbri (2019); Halkos & Gkampoura (2021); Szczygieł et al. (2024).

In addition to social consequences, energy poverty also hinders economic development, as limited access to energy reduces productivity, employment opportunities, and the efficiency of production sectors. This is especially pronounced in developing countries, where energy is crucial for agricultural and industrial activity (Halkos & Gkampoura, 2021). Consequently, energy poverty contributes to economic deprivation, thereby imposing financial strain on households. At the same time, increased use of traditional fuels, such as biomass, can also have environmental consequences, such as higher rates of deforestation, land degradation, and desertification (Halkos & Gkampoura, 2021).

3 CHARACTERISTICS OF ENERGY POVERTY IN EUROPEAN UNION AND SLOVENIA

Global trends such as geopolitical instability, COVID-19, energy market imbalances, and rising energy prices have increased the risk of energy poverty, particularly for vulnerable households (IEA, 2025; Fabbri, 2019). While the transition to renewable energy may remain expensive for low-income households without policy support, climate change and record global temperatures are also increasing winter and summer energy vulnerability (IEA, 2025). With 2024 being the hottest year on record and the first year in which global temperatures exceeded 1.5 degrees Celsius (°C) above pre-industrial levels, climate risk is rising for energy-poor households. In 2024, around 9.2% of the EU population were unable to keep their homes adequately warm, which was more pronounced in Southern and Eastern Europe due to lower incomes, inefficient housing, and structural energy system factors (Eurostat, 2025a; Bouzarovski, 2013). In 2025, about 6.8% of households in Slovenia were energy poor. This situation was most common among older people, single-person households, and renters (Statistical Office of the Republic of Slovenia, 2026a; 2026b). Compared with the EU average, Slovenia has fewer households unable to keep their homes adequately warm but higher energy expenditure and more utility payment arrears, indicating that affordability and housing quality remain key challenges (Eurostat, 2025a; Eurostat, 2020; Ministrstvo za okolje, podnebje in energijo RS, 2023a). Many countries are moving toward a greener future by focusing on energy security and affordability through renewable energy and better efficiency. However, if the state does not intervene through appropriate measures, these solutions remain very unaffordable for energy-poor households, leading to increased energy inequality and potential social unrest (IEA, 2025).

3.1 Measuring energy poverty in EU

The most common method of monitoring at the EU level uses data from the Statistics on Income and Living Conditions (EU-SILC) survey, which replaced the earlier European Community Household Panel (ECHP). These surveys include self-reported indicators measuring the share of the population that is unable to keep its home adequately warm (AW), has arrears on utility bills (UB), and experiences housing inefficiencies, which represent some of the most important internationally comparable indicators for assessing the prevalence of energy poverty across EU countries (Bouzarovski, 2013).

The simplest method of measuring energy poverty is to use the LILEE indicator, which examines the share of income spent on energy expenditure (2M) and is more commonly employed in developed countries to determine whether heating expenses exceed 10% of income (GOV UK, 2025).

Newer methods for monitoring and measuring energy poverty in the EU are based on several complementary data sources and indicators, which basically take all three EU-SILC factors

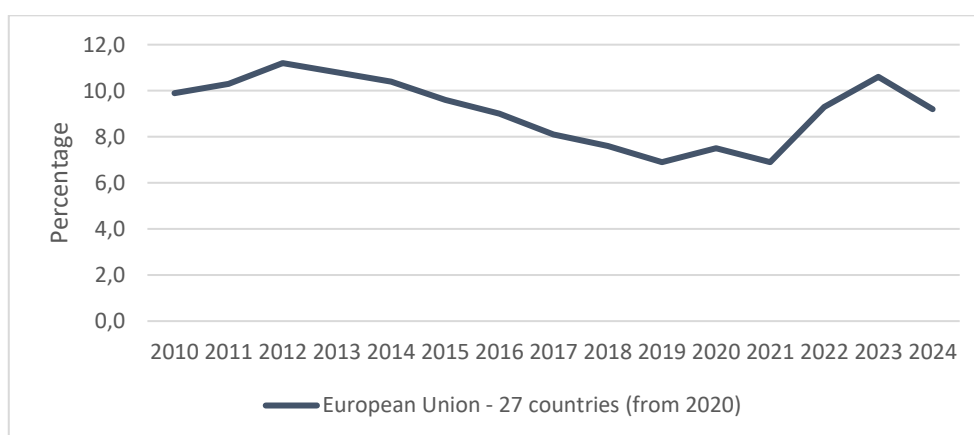
and expand them. The EU Energy Poverty Observatory (EPOV) developed a methodological framework in 2020 that defines a set of primary and secondary indicators for assessing energy poverty across Member States. The four primary indicators include “utility arrears (UB), absolute energy expenditure below half the national median (M2), the share of energy expenditure above twice the national median relative to income (2M), and the inability to maintain an adequate temperature in the home (AW)” (Thema & Vondung, 2020). In addition, 19 secondary indicators provide a broader contextual understanding of the phenomenon, including factors such as “energy prices, risk of poverty or social exclusion, energy expenditure across income groups, housing conditions, energy efficiency of dwellings, and health-related indicators such as excess winter mortality” (Widuto, 2022).

So, with the EU-SILC indicators and the methodological framework developed by EPOV (which uses a more extensive and in-depth set of determinants), we can measure the determinants of the ability to keep the home adequately warm, unpaid utility bills, and housing inefficiencies. With the LILEE indicator, we can measure the determinant of income expenditure. It has also been found that all four energy poverty indicators (AW, UB, M2 and 2M) do not overlap in identifying the energy-poor population, as they target different parts of the population (Eurostat, n.d.). This also represents the biggest challenge in measuring energy poverty, because if we follow the EU approach, in which someone is energy poor according to at least one indicator, then as many as 40% or 180 million EU residents would be classified as energy poor. If we choose the intersection approach, where a person or household must have all four indicators, it will show low energy poverty of 0.3% or 330 thousand people in the EU population. In practice, the indicator most often used is the share of the population that is unable to keep their home adequately warm (AW) (European Commission, 2024a).

3.2 Energy poverty characteristics in the European Union

The number of households unable to keep their homes adequately warm in Europe increased from 6.9% in 2021 to 10.6% in 2023, and then slightly decreased in 2024 to 9.2%, which is still equivalent to 41.5 million people (Eurostat, 2025a). In Figure 2 we can see that the recent jump in the percentage of households unable to keep their homes adequately warm occurred between 2019 and 2020, mainly because of the COVID-19 pandemic and the spike in energy prices that began in 2021 (Fabbri, 2019). The year 2022 also had a bigger jump, mainly because Russia invaded Ukraine and the EU imposed a trade ban on Russia, and from then on, there was geopolitical unrest in the countries with the most oil (IEA, 2025).

Figure 2: EU-27 population unable to keep home adequately warm by poverty status

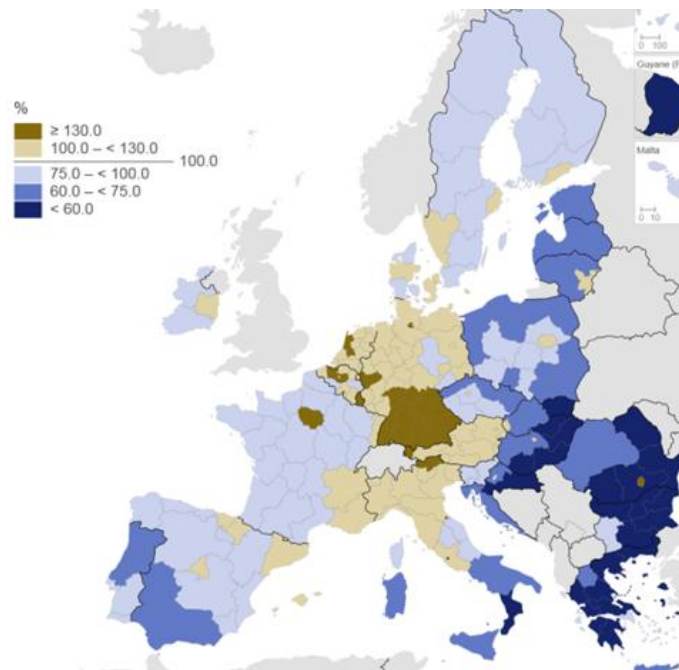


Source: Eurostat (2025a).

The 27 countries in the EU with the highest percentage of the population unable to keep their homes adequately warm due to poverty status (Appendix 1) are Bulgaria, Greece, Lithuania, and Spain. Three of those countries are in Southern Europe, and Lithuania is in Eastern Europe. In Portugal, Spain, Romania, and France, this percentage has also increased the most over the years 2020-2023. The countries in the EU 27 with the lowest percentages are Finland, Slovenia, Poland, Luxembourg, and Estonia. Most of these countries are in the central or northern part of Europe (Eurostat, 2025a). Spain's worsening trend from 7.5% in 2019 to 17.5% in 2024, is due to structural inefficiencies in housing, rising summer temperatures with frequent heatwaves and increased demand for cooling and consequently higher costs. Bulgaria reduced its indicator for the ability to keep the home adequately warm through the year, from an extremely high 30.1% in 2019 to 19% in 2024. This decline is due to increased air-conditioning usage, energy efficiency measures, and targeted policy interventions (Koukoulakis et al., 2026).

EP shows significant differences between EU MS, as it is influenced by purchasing power standards, energy prices, geography and climate, natural resources, infrastructure, and national public policies. Cornelis (2024) uses the indicators of households whose share of energy expenditure in income is more than twice the national median (2M), households whose energy expenditure is below the national median energy consumption (M2), arrears on utility bills (UB), and households that are unable to keep their home adequately warm (AW). Indicators 2M and M2, which are expenditure-based, complement each other and exhibit a similar geographical distribution across Europe. Eastern and Southern Europe have higher burdens of excessive energy costs and energy under-consumption, the latter particularly often indicating hidden energy poverty. The UB indicator shows that more than 20% of households in Greece, Bulgaria, and Croatia do not have the ability to pay energy bills (Cornelis, 2024). This is correlated with Figure 3, which shows that these three countries have a purchasing power standard below 60% (Eurostat, 2025b).

Figure 3: Percent of the EU average of household primary income per inhabitant in purchasing power standards (PPS), 2023



Source: Eurostat (2025b).

Cornelis (2024) shows in Indicator inability to keep the home adequately warm (AW) that more than 20% of the population cannot adequately heat their home in Portugal, Bulgaria, Greece, and Lithuania. This contrasts with Sweden or the Netherlands, where the indicator is almost zero (Cornelis, 2024). Contrary to popular belief, energy poverty is more prevalent in Southern Europe due to factors such as higher rates of income poverty, poorly insulated homes, and inadequate heating systems in dwellings. Similarly, despite the fact that Germany has some of the highest energy prices in Europe, energy poverty there is significantly lower than in Bulgaria, where energy prices are lowest (Bouzarovski, 2013). According to EU SILC 2023 data (Eurostat, 2023d), 29% of Portuguese households have a dwelling with a leaking roof, damp walls, floors or foundations, or rot in window frames or floor, as do 23% of households in Spain, and 21.1% of households in France, and 30% of the population in the eight states bordering the Mediterranean Sea report that they are unable to keep their homes adequately cool in summer. Almost 66% of such households are considered income poor, whereas 70% of them are above 65 years of age (Bouzarovski, 2013). Climate change and regular heat waves are making summer energy poverty (the inability to maintain comfortable indoor temperatures during the summer) an urgent and growing issue, especially in Europe as it is warming up twice as fast as the global average. Up to 19% of households do not have comfortably cool homes in the summer, mainly due to poor insulation, poor ventilation, lack of sun protection, and the absence of air conditioning (N. P., 2024). Heat brings significant public health, economic, and social challenges, particularly for vulnerable groups. European Commission (2025a) shows that those already affected by energy poverty during winter, such as households in Central and

Northern Europe, may struggle in summer too, as rising temperatures exacerbate their inability to afford adequate cooling solutions and increase their risk of heat-related illnesses.

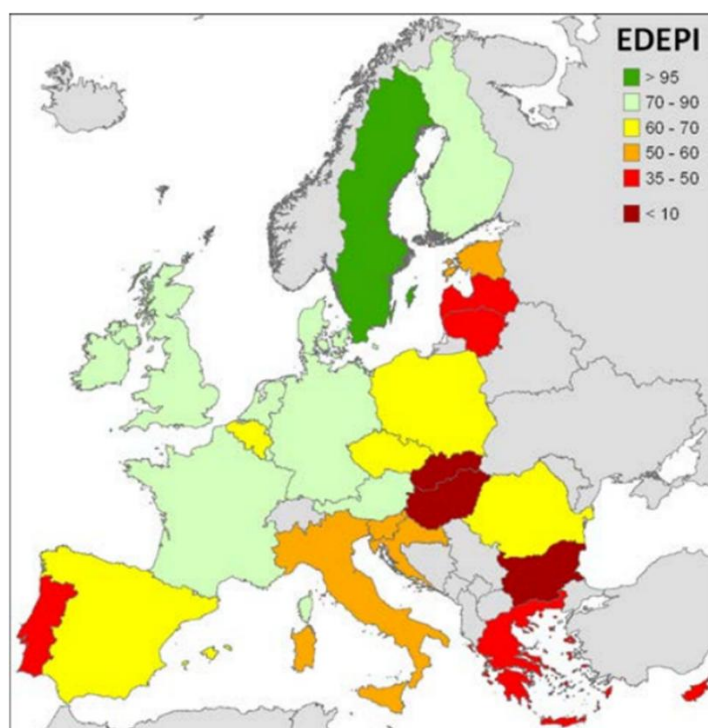
Energy poverty is also relatively evenly distributed according to the AUB indicator by degree of urbanization, although it is slightly more common in cities. 2.5% of city residents are energy poor compared with 1.8% in rural areas. The IKHW indicator shows 2.8% in cities, 2% in towns and suburbs, and 1.6% in rural areas. Expenditure-based measures show somewhat higher shares, with 5.9% (2M) and 4.9% (M/2) of city residents, 5.2% and 4.1% in towns and suburbs, and 4.6% and 4% in rural areas experiencing energy poverty (Eurostat, n.d.).

The most vulnerable social group in the EU is single-parent households with children; 19% of them struggle with low temperatures in winter, especially in Cyprus with 42%, in Greece with 34.5%, and in Spain with 34%. The second most vulnerable group in the EU is single women, with 14% unable to have an adequately warm household, especially in Bulgaria with 34%, and in Portugal and Lithuania with 31% (Dell'Anna & Yilmaz, 2025). The at-risk-of-poverty or social-exclusion rate, which ranges from 10.9% for employed people to 66.6% for unemployed people, is also significantly influenced by employment status (Eurostat, 2025c).

The European Fuel Poverty and Energy Efficiency (EPEE) project, using EU-SILC data, found that many countries in South-East Europe still lack adequate social mechanisms to protect the energy poor. In Eastern Europe, energy price increases since the fall of communism are a significant factor in energy poverty, while in Central and Western Europe the problem often stems from energy-inefficient buildings. Countries with the worst housing conditions, such as Portugal, Greece, and Ireland, also have the highest excess winter mortality, with socio-economic well-being playing an important role (Bouzarovski, 2013).

To measure progress in alleviating domestic energy poverty, the Domestic Energy Poverty Index (EDEPI) uses a combination of factors such as lack of affordability, inability to keep homes warm in winter, inability to keep houses cool in summer, and poor housing quality due to leaks or dampness. The results in Figure 4 show differences between countries in Western/Northern Europe, and Eastern/Southeastern Europe, and the Baltic States. Residents in Northern/Western Europe are more at risk of energy poverty in winter, while residents in Southern/Eastern and Southern Europe may experience energy poverty in both summer and winter. EU MS with GDP per capita above the EU average and with long-term strategies to address energy poverty also have the best outcomes. According to the research, it is evident that Sweden achieves the highest score in the assessment of progress toward reducing energy poverty in households, while Slovakia, Hungary, and Bulgaria have the lowest scores (OpenExp, 2019). EP in Southern Europe is driven by mild winters, inefficient building traditions, and economic constraints; in Eastern Europe by centrally planned economies and reliance on Russian imports; and in Western and Northern Europe by its concentration in specific housing types and demographic groups (Lourenço et al., 2025).

Figure 4: Member States' progress in alleviating domestic energy poverty (EDEPI index)



Source: OpenExp (2019).

Note: EDEPI index is European Domestic Energy Poverty Index.

3.3 Measuring energy poverty in Slovenia

Similarly to the EU, for statistical purposes the Statistical Office of the Republic of Slovenia (SURS) defines energy-poor households as households that had an income below the at-risk-of-poverty threshold in the year before the Living Conditions survey (EU-SILC) and met at least one of the following three criteria: "they were financially unable to keep their home adequately warm, they were unable to pay utility bills at all or on time (waste disposal, water, electricity, heating), and they lived in inadequate housing conditions (problems with leaking roofs, damp walls, floors and foundations, or rot in window frames and floors in their dwellings)" (Statistical Office of the Republic of Slovenia, 2025a).

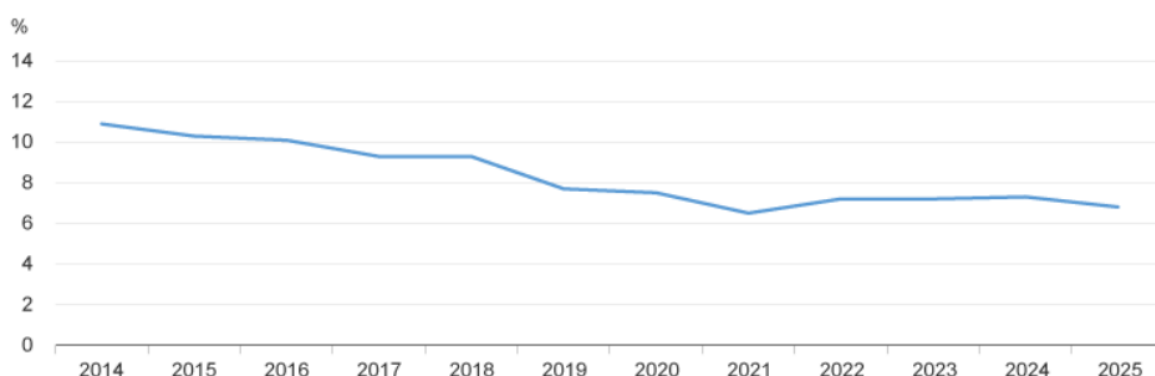
In practice, through the Public Call ZER - Non-repayable Financial Support for Reducing Energy Poverty (Javni poziv ZER - Nepovratne finančne spodbude za zmanjševanje energetske revščine) and the Eco Fund, data and application forms are collected from households through the program for improving energy efficiency in vulnerable households (Eko sklad, Slovenski okoljski javni sklad, n.d.; Republika Slovenija, e-Uprava, n.d.). The status of energy-poor households is verified through proof of low income (e.g., a social assistance decision or a decision on income support), low energy efficiency of the dwelling (an energy certificate or the opinion of an energy advisor), inadequate living conditions

(photographs and a statement from the household), and high energy costs relative to available income (documents on the monthly financial situation) (Government of the Republic of Slovenia, 2022).

3.4 Characteristics of energy poverty in Slovenia

In 2025 there were 6.8% of households that were energy poor, which corresponds to around 59,000 households and 100,000 persons living in them. Compared to the previous year, the share was 0.5 of a percentage points or 10,000 persons lower than in 2025, which shows that energy poverty is gradually declining (Figure 5). However, we still see the impact of the latest COVID-19 crisis on the increase in the share of energy-poor households after 2021, which approached the percentage from 2021 in 2025. Among energy poor households in 2025 there were around 49,000 households without dependent children and 10,000 households with dependent children (Statistical Office of the Republic of Slovenia, 2026a).

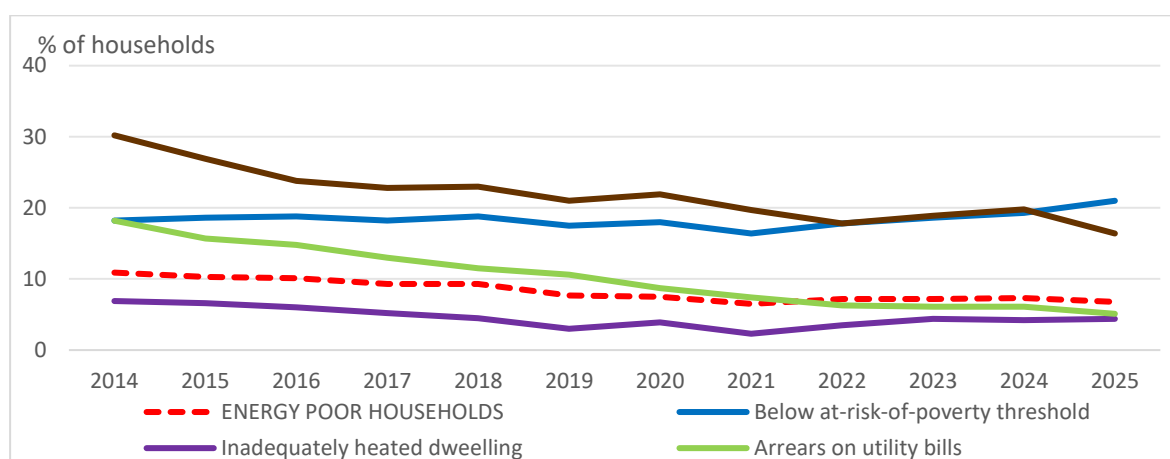
Figure 5: Share of energy poor households in Slovenia



Source: Statistical Office of the Republic of Slovenia (2026a).

Between 2014 and 2025, as shown in Figure 6, fewer households experienced three of the four factors that determine energy poverty: the percentage of households that were unable to pay their utility bills on time because of financial difficulties decreased by nearly three quarters (72%), the percentage of households that lived in substandard housing conditions decreased by nearly half (46%), and the percentage of households that were unable to keep their homes warm enough decreased by more than a third (36%). On the other hand, in the same period, the share of households below the at-risk-of-poverty level increased by 15% (Statistical Office of the Republic of Slovenia, 2026a). Slovenia is one of the countries that has both summer and winter energy poverty. Compared to other EU members, Slovenia has an above-average share of energy expenditure in total household consumption, at 5.2%, while the EU average is 4.1% (Ministrstvo za okolje, podnebje in energijo RS, 2023a). Slovenia has a relatively small energy sector, with oil accounting for about 45% of energy use, while electricity production is divided between hydropower, nuclear energy, and coal (Živčič & Tkalec, 2019).

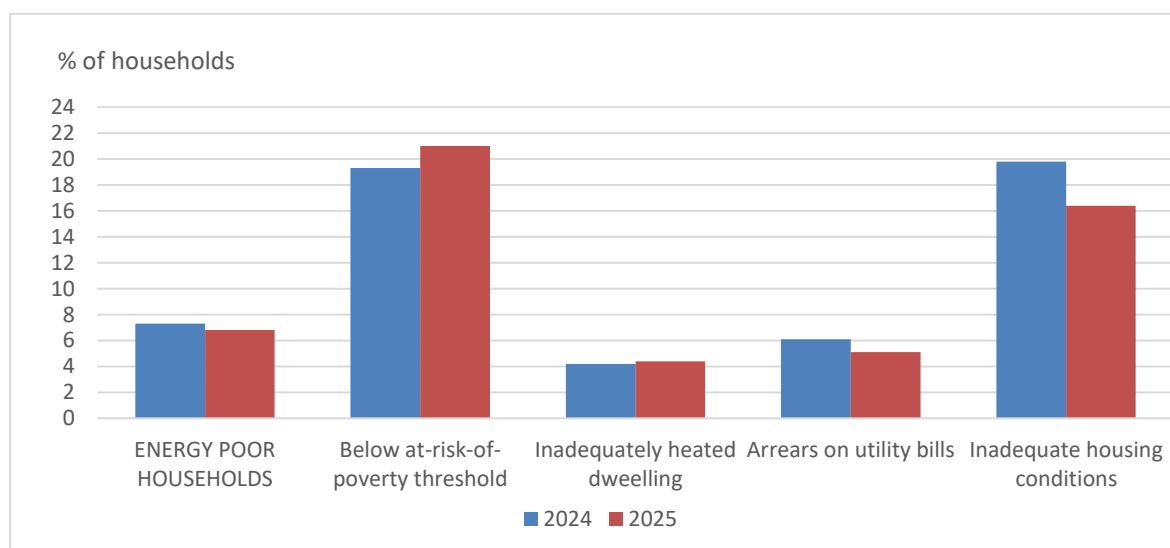
Figure 6: Elements defining energy poor household in Slovenia by % of households



Source: Statistical Office of the Republic of Slovenia (2026a).

Below at-risk-of-poverty threshold (21%) and inadequate housing conditions (16.1%) are the two most common elements of energy poverty (Figure 7). On the other hand, the elements that increased in the last year are below at-risk-of-poverty threshold and inadequately heated dwelling (Statistical Office of the Republic of Slovenia, 2026a). Energy poverty is particularly evident among low-income households, which also contribute significantly to emissions and pay a large share of environmental taxes (Živčič & Tkalec, 2019).

Figure 7: Share of households by elements of energy poverty in Slovenia

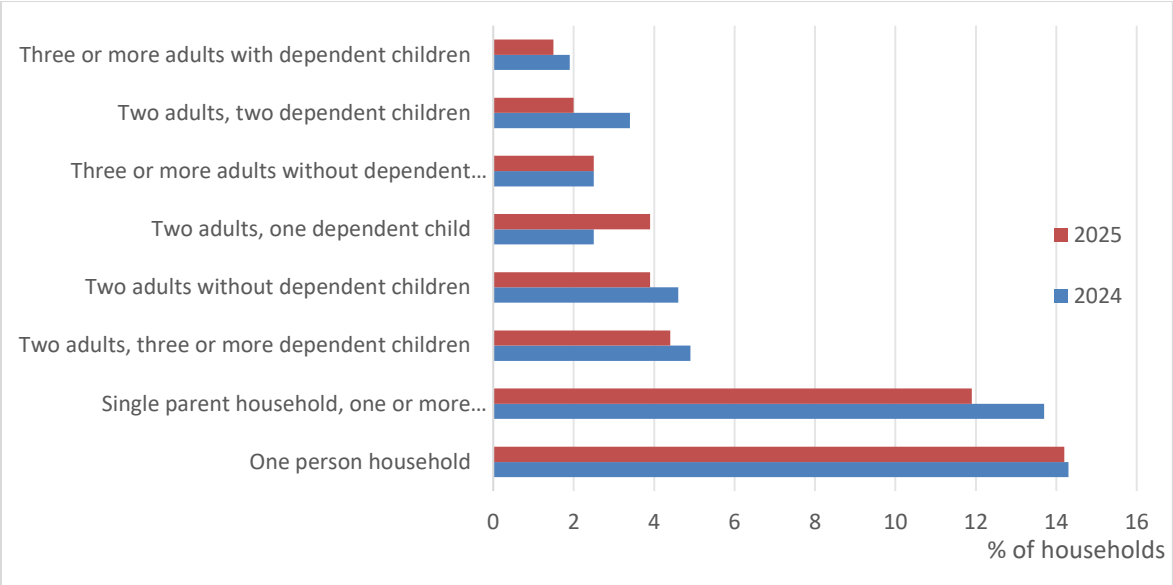


Source: Statistical Office of the Republic of Slovenia (2026a).

The largest share of energy poor households consists of one-person households (14.2%), and this share is especially high among the elderly (14.2%) in comparison to younger persons (11.5%). In second place there are single-parent households with at least one dependent child

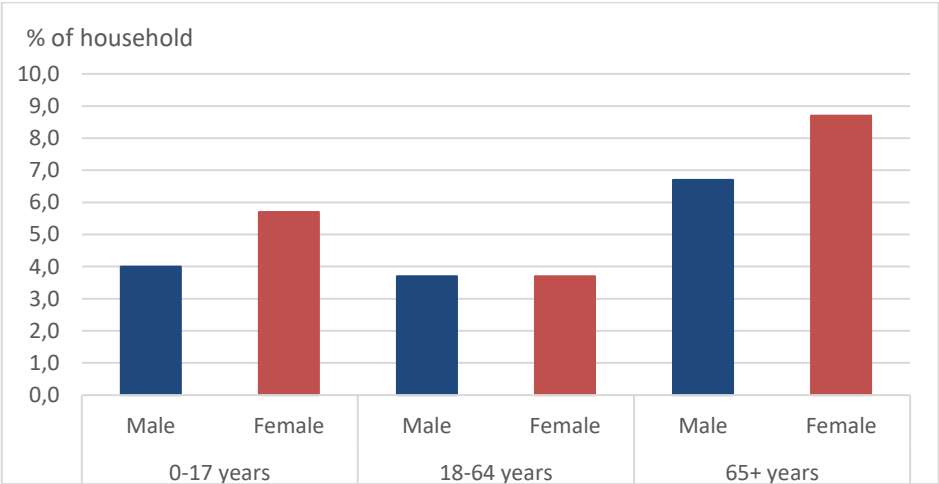
(11.9%). We can see in Figure 8 that both groups decreased in percentage in comparison to 2024. Only the household group of two adults with one dependent child and one-person households with older members increased in percentage (Statistical Office of the Republic of Slovenia, 2026a).

Figure 8: Energy poor households by household type in Slovenia



Source: Statistical Office of the Republic of Slovenia (2026a).

Figure 9: Share of energy poor households per age group and gender in Slovenia, 2025



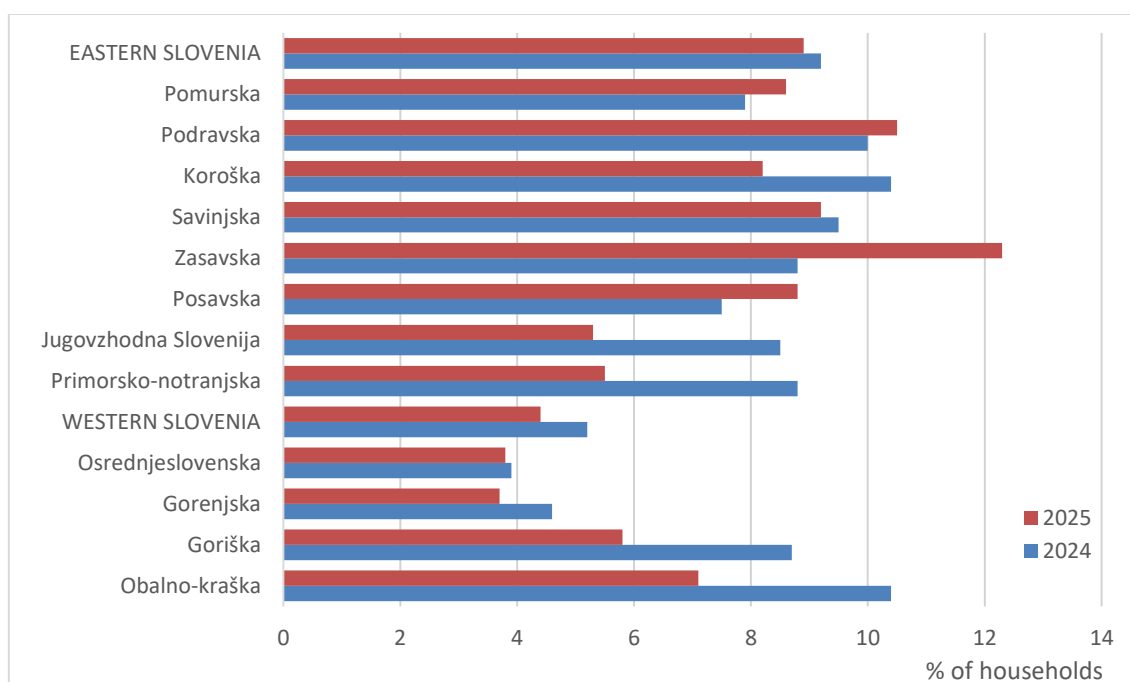
Source: Statistical Office of the Republic of Slovenia (2026a).

Among age groups, the highest proportion of energy-poor is among people over 65 years of age (7.8% in 2025), with women being the most affected within this group (8.7% in 2025; Figure 9) (Statistical Office of the Republic of Slovenia, 2025b). SiStat statistics also show that the share of energy-poor persons in households is highest among tenants (12.1% of

households in 2025) and lowest among owners of dwellings (4.9% of households in 2025) (Statistical Office of the Republic of Slovenia, 2026b).

If we look at the regional level, Figure 10 shows us that on average there are fewer energy poor households in West Slovenia (Zahodna Slovenija 4.4%) than in East Slovenia (Vzhodna Slovenija 8.9%), where on average, most regions increased the share of energy poor households in the last year. The Zasavska (12.3%) and Podravska (10.5%) regions have the highest share of EP households in Slovenia in comparison to Gorenjska statistical region (3.7%) which has the smallest share (Statistical Office of the Republic of Slovenia, 2026a). The local energy concept of the Trbovlje municipality states that the biggest problem is the high heating costs, and the statistically higher average age of the population with lower incomes (23.6% vs. the average of 22%) (Mohar, 2024; Statistical Office of the Republic of Slovenia, 2024). The measures proposed to improve the Zasavje region are reducing emissions, promoting green jobs, developing knowledge of sustainable energy use, reshaping the economy into a sustainable one, and improving the region's transport connectivity (Pravični prehod Zasavja, 2025).

Figure 10: Share of energy poor households per cohesion and statistical regions

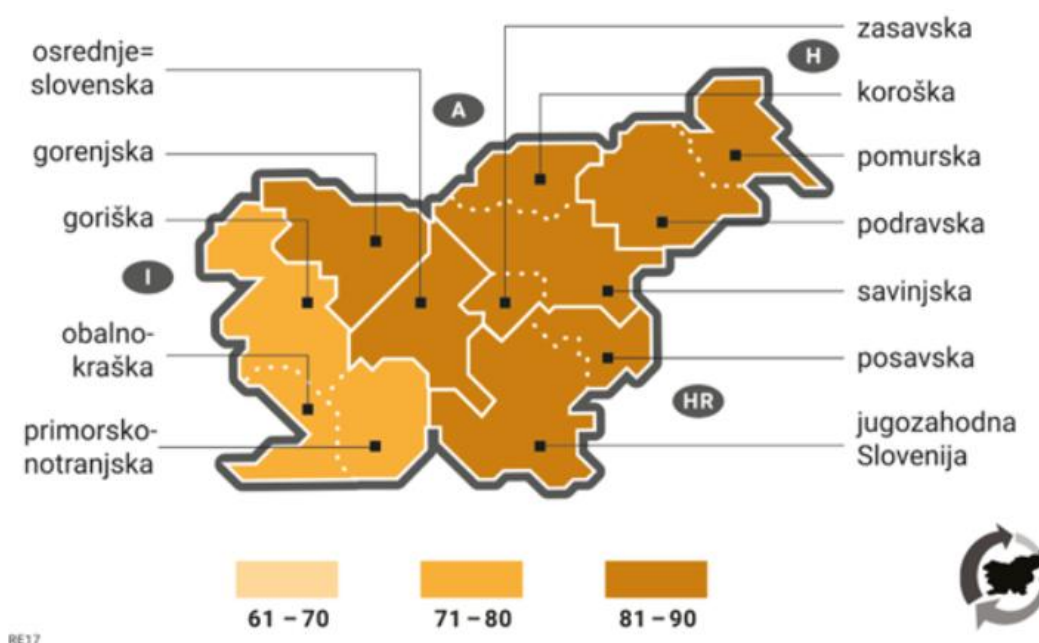


Source: Statistical Office of the Republic of Slovenia (2026a).

Slovenia is one of the countries where many people are late in paying their housing costs and live in energy-inefficient dwellings where there are problems with moisture, mold, or drafts (Ministrstvo za okolje, podnebje in energijo RS, 2023a; Ministrstvo za infrastrukturo Republike Slovenije, 2021). Part of the problem of energy-inefficient dwellings could also lie in energy-inefficient appliances. However, research in Figure 11 shows that this is not entirely the case. In Slovenia, the household index of propensity for energy-saving

household appliances is between 79.46 in Primorsko-notranjska, Obalno-kraška, and Goriška, and 88.40 in Posavska and Jugovzhodna Slovenija, which is a very high index (Agencija Republike Slovenije za okolje, 2025).

Figure 11: Index of household propensity for energy-saving household appliances by merged statistical regions in Slovenia, 2025



Source: Agencija Republike Slovenije za okolje (2025) from Survey on Energy Efficiency in Slovenia.

3.5 Comparison of Slovenia with the EU average

Because each EU country defines energy poverty and its calculation differently (either when at least one factor applies or when all of them apply simultaneously), we cannot compare energy poverty in Slovenia with the EU average directly. However, we can compare each factor separately. Both the Slovenian and the EU definition of EP include factors such as inadequate heating, income below the at-risk-of-poverty threshold, energy-inefficient housing, and high energy expenditure (Widuto, 2023; Portal Energetika RS, 2023). Table 4 shows that Slovenia ranks below the EU 27 average in the share of the population unable to keep their homes adequately warm due to poverty status (3.6% vs. 10.6%). This figure suggests that fewer households experience severe winter thermal discomfort (Eurostat, 2025a). The opposite is true for the indicator of energy expenditure in total household consumption, as Slovenia's household energy expenditure is higher than the EU 27 average (5.2% vs. 4.1%) (Ministrstvo za okolje, podnebje in energijo RS, 2023a). This is also consistent with the fact that in Slovenia more households live in a dwelling with a leaking roof, damp walls, floors or foundations, or rot in window frames or floors (18.5% vs. 15.6%), and are also unable to pay utility bills on time compared with the EU 27 average (12.5% vs.

6.6%) (Eurostat, 2020). Slovenia is characterized by a relatively high level of home ownership, with 76% of the population living in their homes. The EU average is 70% of the population living in their own homes (Eurostat, 2021). There is also an above-average share of the population living in a house: 72% compared to the EU average of 53%. On the other hand, significantly fewer Slovenians live in overcrowded homes (11%) than the average in the EU (17%), and this share has been decreasing over the years. It follows from the above that the risks of a higher incidence of energy poverty and vulnerability are mainly associated with houses, where larger investments are needed for energy renovation, which increases the risk of energy poverty (Ministrstvo za okolje, podnebje in energijo, 2026). In Slovenia, households at the highest risk of poverty are in cities (12.1%), but the share does not differ substantially from the poverty rates in rural areas, towns, or the suburbs. In contrast, the EU 27 average has the highest number of households at risk of poverty in rural areas (18.2%) (Eurostat, 2021). We can connect this to the fact that detached houses mostly use central heating or individual heating. The district heating network is most prevalent in cities and in apartment buildings. In Slovenia, most households at risk of poverty or social exclusion use central heating (68.6%) (Eurostat, 2023a). In central heating, heat is produced by a boiler or heat pump located inside the building, using gas, electricity, oil, or biomass as fuel (Stare et al., 2026). This is also seen in Slovenia, where most households at risk of poverty or social exclusion use wood logs (44.1%) as an energy source (Eurostat, 2023b). In contrast, in the EU 27 average, most households use individual heating (51.1%) and gas (45.2%) as energy sources (Eurostat, 2023a; Eurostat, 2023b). In individual heating, each room or dwelling is heated separately with its own device, such as electric heaters, gas heaters, wood stoves, or fireplaces. Common fuels here are mostly electricity, gas, or biomass. It is often found in older or poorly insulated buildings (Stare et al., 2026).

Table 4: Comparison of Slovenian and EU 27 average indicators of energy poverty in %

Indicators of energy poverty in %		Slovenia	EU 27 average
EU Domestic energy poverty index (EDEPI), 2019		51.34	57.49
Population unable to keep home adequately warm by poverty status, 2023		3.60	10.60
Energy expenditure in the total consumption of households, 2023		5.20	4.10
Households unable to pay utility bills on time in the past 12 months, 2018		12.50	6.60
Persons living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floor		18.50	15.60
Housing tenure - home ownership		76.00	70.00
Accommodation type - house		72.00	53.00
At-risk-of-poverty rate by degree of urbanisation, 2021	Cities	12.10	16.40
	Towns and suburbs	11.60	16.10
	Rural areas	11.60	18.20

To be continued

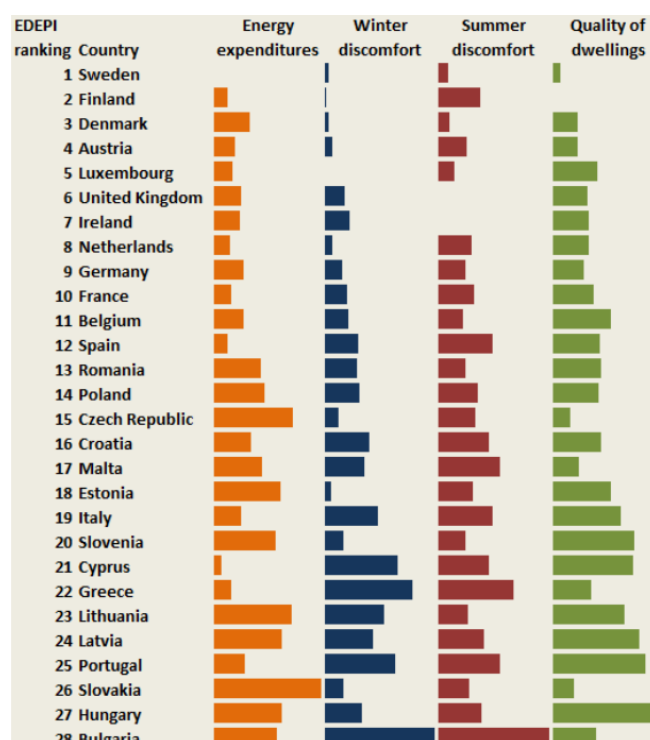
Table 4: Comparison of Slovenian and EU 27 average indicators of energy poverty in %
(cont.)

Indicators of energy poverty in %		Slovenia	EU 27 average
Persons at risk of poverty or social exclusion by heating system used in the dwelling, 2023	Central heating	68.6	23.6
	District heating network/teleheating	13.0	11.5
	Individual heating	16.3	51.1
	No fixed heating	1.9	6.2
	No heating	0.2	6.2
	Unknown	0.1	1.4
Person's risk of poverty or social exclusion situation by used energy source, 2023	Electricity	10.8	17.9
	Gas (natural or propane)	15.7	45.2
	Oil or coal	10.8	13.0
	Wood logs	44.1	16.1
	Renewable energy or biomass	13.4	4.3
	Other	3.8	0.6
	Unknown	1.4	2.9
Persons living in dwellings with improved energy efficiency in the last 5 years, 2023	At risk of poverty or social exclusion	29.0	17.7
	Not at risk of poverty or social exclusion	34.8	27.5

Source: Own work based on OpenExp (2019); Eurostat (2025a); Ministrstvo za okolje, podnebje in energijo RS (2023a); Ministrstvo za okolje, podnebje in energijo (2026); Eurostat (2020); Eurostat (2021); Eurostat (2023a); Eurostat (2023b); Eurostat (2023c); Eurostat (2023d).

In Table 4 we can see that Slovenia's EU Domestic energy poverty index (EDEPI) is below the EU 27 average. The countries with the highest EDEPI have the best progress in alleviating energy poverty. From Figure 12 we can see the impact of different dimensions used in the calculation of the EDEPI from 2018. Here Slovenia ranks 20th, which is in the bottom half of all countries. Energy expenditures refer to the lack of affordability, winter discomfort is due to the inability to keep homes warm, summer discomfort is due to the inability to keep homes cool, and the quality of dwellings is due to the presence of leaks or damp. Energy poverty in Slovenia is most affected by the dimension's energy expenditures and quality of dwellings, which should be its focus in addressing energy poverty (OpenExp, 2019). In Table 4, we see that 29% of persons in Slovenia who are at risk of poverty or social exclusion have improved energy efficiency in the last 5 years, whereas the EU 27 average improved by just 17.7%. This indicates that Slovenia is paying a lot of attention to improving energy efficiency (Eurostat, 2023c).

Figure 12: Contribution of each dimension of domestic EP to the EDEPI ranking



Source: OpenExp (2019).

3.6 Policy challenges and future trends

Future trends are directed towards reducing carbon dioxide (CO₂) emissions (as part of the European Green Deal by 2050), accelerating clean cooking and electricity, increasing demand for energy services, energy price volatility, a changing nature of energy security, a rising role for renewables, and a comeback of nuclear energy, as well as a shift in the centre of gravity of the energy system towards India and other emerging economies beyond China. Studies show that by 2035, 80% of energy consumption growth will occur in regions with high-quality solar irradiation. This trend helps explain the swift uptake of solar technologies, as well as the rise in demand for cooling. Therefore, the EU energy policy framework includes the Net Zero Emissions by 2050 Scenario, which outlines a path to reduce global energy-related CO₂ emissions to net zero by 2050, as well as the IEA ACCESS plan to achieve universal access to electricity by 2035 and clean cooking by 2040. These are all ambitious policies and therefore may increase the risk of energy poverty. To enable a just and fair transition measures to mitigate energy poverty need to be an integral part of their implementation. (IEA, 2025).

4 ANALYSIS OF ENERGY POVERTY IN SLOVENIA

The empirical part will conduct a statistical/econometric analysis in Excel and R Studio based on already selected responses to the 4th European Quality of Life Survey (4th EQLS) from 2016, exploring issues around quality of life, quality of society and quality of public services (4th European Quality of Life Survey Source Questionnaire, 2016). Although the data are old, I do not analyse the trend of the data over the years, but focus on the determinants of energy poverty, which remain the same over the years. I use the time component only to compare the data before and after the crisis. The questionnaire included 104 questions in total, among which I selected three questions that are the best indicators of energy poverty based on EU-SILC measuring indicators (Bouzarovski, 2013). I then analysed them based on several independent variables to answer the research questions.

4.1 Presentation of the problem and research questions

Slovenia aims to reduce the share of energy-poor households from 6.8% to between 3.8% and 4.6% by 2030 (Statistical Office of the Republic of Slovenia, 2025a; Ministry of Environment, Climate and Energy, 2023). This requires a thorough investigation of the regional level and all factors influencing the EP to determine how to address it. Then, households should be monitored to see if their situation has improved after the measures.

One of the key research gaps is related to the analysis being conducted primarily at the national or European level, while regional, local, and household differences are still under-researched. Comparing the EP is also a problem, due to different methods of measurement and definition, as it is a multidimensional phenomenon that includes economic, social, geographical, and technical factors (Bouzarovski, 2013). All four main indicators of the EP do not overlap their explanatory power, as they target different parts of the population, so we can follow the union or intersection approach (European Commission, 2024a). In this case, we will stick to the Slovenian definition (chapter 2.1.4) and the EP measurement (chapter 3.4). The correct way of asking the question for measurement is also a challenge. Since a direct question about energy poverty often encourages social stigma, it is preferable to ask about the EP indicators (Bouzarovski, 2013).

To obtain more data and address the above research gaps at EU level and in Slovenia, the following research questions (RQ) will be analysed:

RQ1: How is energy poverty defined, and which are the factors that affect the energy poverty at the level of a household or an individual?

RQ2: What is the nature of energy poverty in the EU?

RQ3: What is the nature and the determinants of energy poverty in Slovenia? From this research question, I will further derive two sub-questions:

- RQ3.1: What is the impact of demographic variables on energy poverty? I hypothesize (H3.1.) that demographic variables are positively associated with higher levels of energy poverty, especially education and employment status.
- RQ3.2: What is the impact of geographic and general economic conditions on energy poverty? I hypothesize (H3.2.) that economic conditions significantly influence energy poverty the highest, while geographic variables do not have much significance.

RQ4: Which measures can be used / are used in Slovenia to alleviate energy poverty?

4.2 Presentation of the questionnaire and sample

The 4th European Quality of Life Survey (4th EQLS) questionnaire (Table 5) was translated into 37 languages for 28 EU and five non-EU countries. Interviews were conducted face-to-face in national languages in the participants' homes using Computer Assisted Personal Interviewing (CAPI). In each of the four years - 2003, 2007, 2011, and 2016, when the questionnaire with 104 questions was carried out, approximately sample of 1,000 Slovenian households was interviewed (Eurofound, 2016).

From the whole questionnaire I selected three dependent variables (questions) that closely align with the SURS statistical measure of energy poverty (Table 5). Since I am examining energy poverty indicators, the answers '1 = yes' were selected for all three questions in the analysis. Based on these three dependent variables, I calculated a fourth dependent variable: Combined EP burden, from which we can see whether households have no problems with keeping the warm home, paying utility bills, and living in adequate housing conditions, whether they have one of these problems, or all three.

Table 5: 4th European Quality of Life Survey (4th EQLS) questionnaire - used questions in for dependent and independent variables in the research

Y16_uni queid	Description	Dependent / independent variable	Year of interview s (Wave)
Y16_Re gion	Regions: 746 - Pomurska, 747 - Podravska, 748 - Koroška, 749 - Savinjska, 750 - Zasavska, 751 - Posavska, 752 - Jugovzhodna Slovenija, 753 - Osrednjeslovenska, 754 - Gorenjska, 755 - Primorsko-notranjska, 756 - Goriška, 757 - Obalno-kraška	Independent spatial variable	2003, 2007, 2011, 2016
Y16_Q2 5SUM	Problems with accommodation - inadequate housing conditions (1 = yes, 0 = no, don't know, refusal)	Dependent	2003, 2007, 2011, 2016

To be continued

Table 5: 4th European Quality of Life Survey (4th EQLS) questionnaire - used questions in for dependent and independent variables in the research (cont.)

Y16_uni queid	Description	Dependent / independent variable	Year of interview s (Wave)
Y16_Q8 9a	Can you afford keeping your home adequately warm (1 = No, cannot afford it, 0 = Yes, can afford if want, Don't know, Refusal)	Dependent	2003, 2007, 2011, 2016
Y16_Q9 3b	Has your household been unable to pay during the past 12 months: Utility bills, such as electricity, water, gas (1 = yes, 0 = no, don't know, refusal)	Dependent	2003, 2007, 2011, 2016
Y16_Q2 5SUM_ Q89a_Q 93b	All three dependent variables are confirmed (0 = no, 1 = at least 1 EP problem, 2 = two EP problems, 3 = all 3 EP problems)	Dependent	2003, 2007, 2011, 2016
Y16_HH 1	Number of household members (1 = 1-2 members, small household; 2 = 3-4 members, medium sized; 3 = 5-6 members, large; 4 = 7+ members, extended)	Independent demographic variable	2003, 2007, 2011, 2016
Y16_HH 2a	Gender of responder (1 = male, 0 = female)	Independent demographic variable	2003, 2007, 2011, 2016
Y16_Ag egroup	Age group (1 = 18-24 Young Adults, 2 = 25-34 Early Career Adults, 3 = 35-49 Established Adults, 4 = 50-64 Midlife and Pre-retirement, 5 = 65-95 Seniors)	Independent demographic variable	2003, 2007, 2011, 2016
Y16_HH 2dv2	Economic status of responder (1 = Employed; 2 = Unemployed; 3 = Retired; 4 = Other inactive)	Independent socio- economic variable	2003, 2007, 2011, 2016
Y16_Q2 3v2	Size of accommodation - number of rooms excluding e kitchen, bathrooms, hallways, storerooms and rooms used solely for business (1 = 1-2 rooms, small; 2 = 3-5 rooms, medium; 3 = 6-12 rooms, large)	Independent spatial variable	2003, 2007, 2011, 2016
Y16_Q2 4	Which of the following best describes your accommodation? (1. Owned without mortgage (i.e. without any loans) 2. Owned with mortgage 3. Rented, from social, municipal or non-profit housing provider 4. Rented, from private landlord or company 5. Other)	Independent spatial variable	2016
Y16_Q2 7b	How frequently do you use the Internet other than for work (1 Every day or almost every day, 2 At least once a week, 3 One to three times a month, 4 Less often, 5 Never)	Independent social and health variable	2011, 2016

To be continued

Table 5: 4th European Quality of Life Survey (4th EQLS) questionnaire - used questions in for dependent and independent variables in the research (cont.)

Y16_uni queid	Description	Dependent / independent variable	Year of interview s (Wave)
Y16_Q3 6a	I feel left out of society (1 Strongly agree, 2 Agree, 3 Neither agree nor disagree, 4 Disagree, 5 Strongly disagree)	Independent social and health variable	2003, 2007, 2011, 2016
Y 16 _ Q 36 d	Some people look down on me because of my job situation or income (1 Strongly agree, 2 Agree, 3 Neither agree nor disagree, 4 Disagree, 5 Strongly disagree)	Independent social and health variable	2003, 2007, 2011, 2016
Y16_Q3 7	Marital status (1. Never married, 2. Married, 3. Separated, 4. Widowed, 5. Divorced)	Independent demographic variable	2016
Y16_Q4 1v2	Worried that your income in old age will not be sufficient? (1 = Not concerned, 2 = Slightly concerned, 3 = Moderately concerned, 4 = Very concerned, 5 = Extremely concerned)	Independent social and health variable	2016
Y16_Q4 8	How is your health? (1. Very good 2. Good 3. Fair 4. Bad 5. Very bad)	Independent social and health variable	2003, 2007, 2011, 2016
Y16_Q4 9	Chronic (long-standing) physical or mental health problem, illness or disability? (1 = yes, 0 = no)	Independent social and health variable	2003, 2007, 2011, 2016
Y16_Q5 3	Would you consider the area in which you live to be...? (1. The open countryside 2. A village/small town 3. A medium to large town 4. A city or city suburb)	Independent spatial variable	2003, 2007, 2011, 2016
Y16_Q8 7v2	Education groups (1 = ISCED 0-2 low; 2 = ISCED 3-4 + 9 medium; 3 = ISCED 5-6 lower tertiary; 4 = ISCED 7-8 higher tertiary)	Independent socio- economic variable	2016
Y16_Q8 8v2	Thinking of your household's total monthly income: is your household able to make ends meet....? (1. yes (Very easily, Easily, Fairly easily); 0 = no (With some difficulty, With difficulty, With great difficulty))	Independent socio- economic variable	2003, 2007, 2011, 2016
Y16_Q9 6_97	Net monthly income range in EUR (1 = 0-1200 EUR, low; 2 = 1201-2400 EUR, lower-middle; 3 = 2401-3600 EUR, upper-middle; 4 = 3601-6500 EUR, high income)	Independent socio- economic variable	2016

To be continued

Table 5: 4th European Quality of Life Survey (4th EQLS) questionnaire - used questions in for dependent and independent variables in the research (cont.)

Y16_uni queid	Description	Dependent / independent variable	Year of interview s (Wave)
Y16_Q9 2_1 & Q92_3	Over the last 12 months have you moved to save on housing costs? - 1 = Yes, moved to cheaper home or into someone else's home; 0 = No	Independent socio-economic variable	2003, 2007, 2011, 2016
Y16_Q9 4f	Have you or someone else in your household received any of the following types of income over the past 12 months? Unemployment benefit (1 = yes, 0 = no)	Independent socio-economic variable	2016
Y16_Q9 4g	Have you or someone else in your household received any of the following types of income over the past 12 months? Disability benefit/pension (1 = yes, 0 = no)	Independent socio-economic variable	2016
Y16_Q9 4i	Have you or someone else in your household received any of the following types of income over the past 12 months? Social assistance or minimum income benefit (1 = yes, 0 = no)	Independent socio-economic variable	2016
Y16_Q9 9	In which country were you born?	Independent demographic variable	2016

Source: Own work based on Eurofound (2016).

Across all years (Table 6), the gender distribution of respondents is relatively stable, with women representing approximately 56% of the sample and men 44%. The sample is predominantly composed of individuals aged 35 and over; especially in later years, the distribution shifts towards older age groups (50-64 and 65+). Regarding marital status, most respondents in 2016 were married (59%), followed by those who had never been married (24%). Household size shows a consistent pattern across years, with small (1-2 members) and medium-sized households (3-4 members) dominating the sample. In 2016, over 90% of respondents hailed from Slovenia, with other countries contributing only marginally (less than 4%). The regional distribution is uneven, with the largest shares of respondents in 2016 coming from Posavska (21%) and Jugovzhodna Slovenia (19%), followed by Goriška and Pomurska (around 10% each).

The socio-economic structure of the sample shows that the largest share of respondents consists of people who are employed and retired (Appendix 2, Appendix Table 3). In most years, employed individuals represent the largest group, although in 2007, retired individuals slightly outnumber them. This reflects the aging structure of the sample observed earlier. Educational attainment in 2016 is concentrated in the medium education group (ISCED 3-4), followed by lower tertiary education (ISCED 5-6), indicating a relatively moderate educational profile of respondents. Most people in 2016 did not want to answer how much

they earn (38.38%), so this is a significant limitation. Among those who did respond, the majority fell into lower and lower-middle income categories (up to 2,400 EUR per month). Throughout the years, 40-58% of households had problems making ends meet or could do so only with difficulty. In contrast, the percentage of respondents receiving social transfers remained low.

Table 6: Key sample characteristics, 2003-2016, in % (full table at Appendix 2)

Independent variables	2003	2007	2011	2016	Total
Woman	57.6	58.6	54.7	53.3	55.9
Age group 50+ years	37.1	53.7	48.4	57.9	50.7
Households with 1-2 members	37.4	52.8	39.5	44.8	44.4
Employed	49.4	40.3	42.9	46.7	44.3
Retirees	26.1	41.8	34.6	37.5	36.1
Medium education (ISCED 3-4+ 9)	/	/	/	43.8	43.8
Households struggling to make ends meet	58.4	58.5	51.3	56.1	55.8
Countryside and village/small town	63.9	66.2	69.6	70.8	68.0
Accommodation with 3-5 rooms	53.6	57.5	59.4	60.4	58.2
Ownership without mortgage	/	/	/	84.4	84.4
Born in Slovenia	/	/	/	90.9	90.9
Living in Posavska region	/	/	/	21.1	21.1
Living in Jugovzhodna Slovenia region	/	/	/	19.3	19.3

Source: Own work.

Regarding housing circumstances, most respondents resided in medium-sized dwellings (3-5 rooms), followed by smaller dwellings (1-2 rooms), a trend that persisted across all years (Appendix 2, Appendix Table 4). Homeownership is the dominant tenure type, with more than 90% of respondents in 2016 living in owner-occupied accommodation. Most respondents lived in rural areas, particularly villages and small towns (52% to 64%).

Patterns of internet use show a clear transition over time (Appendix 2, Appendix Table 5). While in 2011 responses were polarized between daily users and non-users, by 2016, daily internet use had become more dominant, reflecting broader digitalization trends. Health

status is generally positive, with most respondents describing their health as good or fair. Similarly, the majority report no chronic physical or mental health conditions. Most respondents report feeling included in society and perceiving no stigma related to their employment or income situation. However, economic insecurity remains evident, as more than half of respondents report being highly concerned about the adequacy of their income in old age.

4.3 Empirical analysis

The analysis proceeded in three steps. First, descriptive statistics were used to examine the distribution of variables. A sample of 1,003 interviewees was analyzed using all the above-mentioned dependent and independent variables, and the results were presented as frequencies, distributions of all variables, and crosstabs for key variables. Furthermore, a comparison with previous years was included, to compare the data before and after the crisis. Then I prepared a bivariate analysis using the Chi-square test to assess the association between the dependent and independent variables. Later I performed a multivariate logistic regression, which shows which independent variables and their groups are truly significant for each dependent variable.

4.3.1 Descriptive analysis

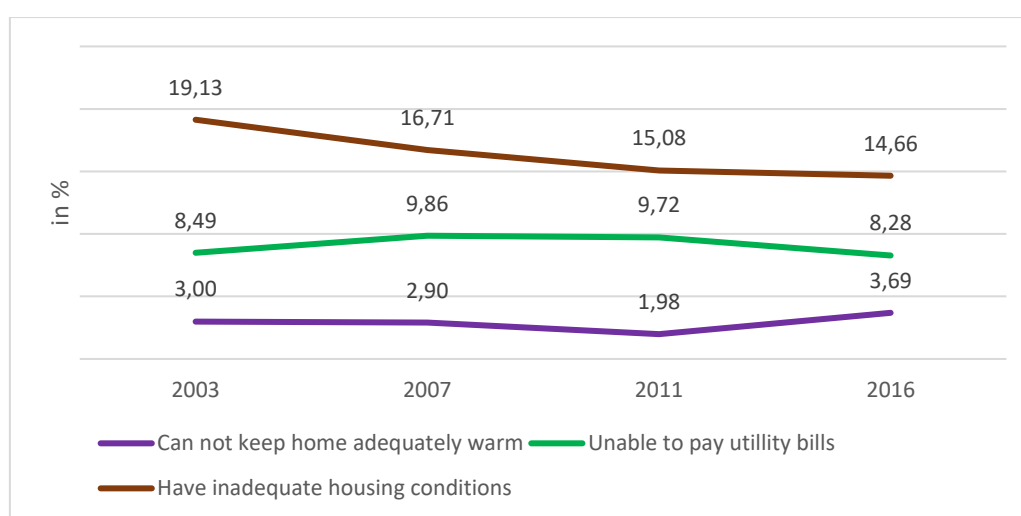
Through descriptive analysis (Figure 13) we see that out of 1,003 households, 3.69% were unable to keep their homes adequately warm in 2016. The value of this indicator first decreased from 2003, but then in the year 2016 increased sharply. This indicator is the most subjective, as everyone can interpret whether they can sufficiently heat their home differently and may differ in what temperature they consider adequate. In 2016, 8.28% of households were unable to pay utility bills and 16.66% of households had inadequate housing conditions. The indicator for utility bills increased in 2007 and 2011, which was most likely the impact of the 2008 crisis, as this indicator is sensitive to short-term financial stress. It then decreased until 2016, falling below the 2003 figure. The indicator for inadequate housing conditions has been falling throughout the years, because we have seen through theory (Chapter 5.2) that Slovenia is investing heavily in infrastructure policy.

The aim is to identify the main socio-economic, demographic, spatial, and social-health patterns associated with energy poverty before proceeding to bivariate and multivariate analysis (Table 7). Instead, the three indicators tend to cluster among certain groups, particularly women, older respondents, smaller households, financially constrained households, and residents of rural areas or small settlements.

A consistent gender pattern is visible across all survey years (Appendix 3, Appendix Table 6). Even though women are already overrepresented in the sample, they also report energy poverty problems more frequently than men, especially problems with housing conditions (10.3% in 2003, 11.8% in 2007, 8.2% in 2011, and 8.8% in 2016). Age also seems to have

an impact, especially for the housing conditions indicator, as the average age of respondents reporting inadequate housing conditions is over 50 years, indicating that this dimension of energy poverty is more closely associated with older age groups. By contrast, the age pattern for utility bill problems is less stable, with the most affected age group shifting across years. In 2016, married individuals formed the largest group among respondents with energy poverty problems, followed by never-married respondents, but they also constituted the largest overall group. Small households with one or two members consistently report the highest prevalence of energy poverty problems. This suggests that smaller households may be more at risk, especially regarding home quality.

Figure 13: Descriptive analysis of energy poverty indicators in Slovenia through years 2003, 2007, 2011 and 2016



Source: Own work based on 4th EQLS data (Eurofound, 2016).

Most respondents who reported energy poverty problems across all four years were either employed or retired (Appendix 3, Appendix Table 7). This indicates that energy poverty affects not only the unemployed but also employed and retired households. Respondents with medium education (ISCED 3-4) and lower tertiary education (ISCED 5-6) experienced the highest rates of energy poverty problems in 2016. Most respondents experiencing energy poverty belong to households with a net monthly income of up to EUR 2,400, corresponding to the low and lower-middle income groups. Respondents who say they can't make ends meet or can only do so with difficulty are much more likely to report all three energy poverty indicators. On average, these households report 8.9-12.0% inadequate housing conditions, 1.7-2.7% reporting problems keeping the home warm, and 6.8-9.0% reporting utility bill problems.

In Appendix 3, Appendix Table 8, we can see the accommodation variables. In all four years, most respondents with energy poverty problems live in small or medium-sized dwellings. Most respondents with energy poverty problems live in owner-occupied housing without a mortgage and in villages or small towns.

The social and health variables can be found in Appendix 3, Appendix Table 9. By 2016, daily internet use had become more prevalent, reflecting broader digitalization trends compared to 2011. The health of respondents, which was self-reported, is most often described as good or satisfactory at all ages, and most do not report chronic physical or mental health problems. Most do not feel excluded or despised because of their job or income. However, they worry that their income will not be sufficient in old age.

*Table 7: Group of spatial and demographic variables in comparison to low income that indirectly impact at least one energy poverty problem in 2016, in %
(full table at Appendix 3)*

Variables	Group	Income		
		0-1200 EUR, low	1201-2400 EUR, lower- middle	SUM N = 1003 (100%)
Gender	Female	18.1	11.1	53.3
	Male	14.3	10.1	46.7
Age group	50-64 Midlife and Pre-retirement	11.4	5.6	30.7
	65-95 Seniors	13.8	4.6	27.2
Education group	ISCED 3-4 + 9 medium	17.8	8.1	43.8
Economic status	Retired	17.8	6.8	37.5
Tenancy	Owned	28.7	19.0	90.6
Living area	A village/small town	16.9	11.3	54.1
Accommodation size	1-2 rooms, small	16.7	4.4	31.8
	3-5 rooms, medium	15.2	15.7	60.4
Regions	Posavska	5.4	5.6	21.1
	Jugovzhodna Slovenija	7.6	3.7	19.3

Source: Own work.

Demographic and spatial variables indirectly affect indicators of energy poverty with a low income. Women, older people, pensioners, people with at most secondary education, those owning their accommodation, those living in smaller apartments, those in rural areas or smaller towns, and those in less developed eastern regions are more likely to be in the lower income bracket (Table 8).

Table 8: Key descriptive patterns by energy poverty indicators in %, 2003-2016 (full table at Appendix 3)

Main pattern of independent variable	Housing conditions	Problem with warm home	Problems paying utility bills
Women report more problems	2003: 10.3, 2007: 11.8, 2011: 8.2, 2016: 8.8	Higher among women (few cases)	Higher among women
Older respondents more affected	Mostly 50+	No clear pattern	25-64 most common
Married most affected (2016)	7.6	1.9	4.1
Small households (1-2 members)	2003: 11.0, 2007: 10.3, 2011: 6.3, 2016: 7.0	2003: 1.7, 2007: 2.1, 2011: 0.9, 2016: 2.2	2003: 4, 2007: 9.9, 2011: 4.7, 2016: 3.6
Slovenia-born (sample effect)	12.8	3.2	7.4
Employed & retired dominate	5.4 / 5.6	1.3 / 1.8	3.8 / 2.1
Medium & lower tertiary education	12.0	3.0	7.1
Income ≤ 2,400 EUR	10.3	2.1	5.7
Difficulty making ends meet	8.9-12.0	1.7-2.7	6.8-9.0
Small/medium dwellings	14.2	3.7	7.5
Owned without mortgage	11.5	2.9	5.7
Village/small town	8.7	1.3	4.6
Health mostly good/fair	6.9	Low	Present
Chronic conditions	Present	Present	Present
Perceived exclusion	Low	Low	Low
Concern about old-age income	6.4	1.8	3.7

Source: Own work.

4.3.2 Association of dependent and independent variables

A bivariate analysis was conducted using Pearson's Chi-square test (χ^2) to examine the significant association between dependent and independent variables. The test evaluates whether the observed distribution, which uses data from one dependent and one independent

variable, differs significantly from the expected distribution under the assumption of independence (Agresti, 2018). If there were no relationship, the share of people with energy poverty problems would be similar across all groups. If there is a relationship, some groups will have noticeably more or fewer energy poverty problems than expected (JMP Statistical Discovery, n.d.). For a significant association, the p-value needs to be lower than 0.05, and the evidence of a relationship between variables is stronger if we have a higher χ^2 . In addition to the Chi-square test, contingency tables were used to calculate column percentages to better interpret the distribution of the dependent variable (energy poverty indicators) across groups of the independent variables.

All variables were treated as categorical and coded into groups (factors). Missing responses were excluded, resulting in a final sample of 616 observations in 2016. The analysis included dependent variables (housing conditions, ability to keep the home warm, and utility bill burden) and three groups of independent variables: socio-economic variables (economic status, education level, net monthly income, ability to make ends meet), spatial variables (housing size, housing tenure, living area, region), and demographic and health variables (household size, gender, age group, health status, marital status). Due to small sample sizes in certain categories (e.g. income and region), some categories were merged to ensure the validity of statistical testing. In the case of the variable marital status, expected frequencies were too low, so Fisher's Exact Test was used instead of the Chi-square test to ensure reliable results.

$$\chi^2 = \sum \frac{(\text{observed frequencies} - \text{expected frequencies})^2}{\text{expected frequencies}} \quad (1)$$

First, the Chi-square tests were conducted to examine bivariate associations between housing problems and selected categorical predictors (Table 9). There is a statistically significant association between housing problems and economic status ($\chi^2 = 26.83$, $p < 0.001$), education ($\chi^2 = 17.96$, $p < 0.001$), making ends meet ($\chi^2 = 22.35$, $p < 0.001$), living area ($\chi^2 = 9.01$, $p = 0.029$), and the number of rooms ($\chi^2 = 8.67$, $p = 0.013$). Based on the Chi-square test I calculated with R Studio, I estimated the percentage within each category of the independent variable that reported have housing problems. The percentage of respondents reporting housing problems was substantially higher among unemployed individuals (35.9%) compared to employed individuals (11.5%). Similarly, respondents with low education reported substantially higher levels of housing problems (33.3%) compared to those with higher tertiary education (7.8%). Financial strain also played a key role, as 20.9% of respondents who reported difficulties making ends meet experienced housing problems, compared to 9.9% among those without such difficulties. Spatial differences were also evident, with a higher prevalence in rural areas (approximately 16%) compared to urban areas (6.4%). Accommodation characteristics further reflect these inequalities, as respondents living in smaller dwellings reported higher levels of housing problems (18.5%) compared to those in larger dwellings (5.7%).

Table 9: Bivariate associations between housing problems and key socioeconomic and spatial variables, year 2016 (full table at Appendix 4)

Predictor	Category	Housing problem (%)	χ^2	df	p	Interpretation
Economic status	Employed	11.5	26.83	3	< 0.001	Significant association
	Unemployed	35.9				
	Retired	14.9				
	Other inactive	14.7				
Education	Low (ISCED 0-2)	33.3	17.96	3	< 0.001	Significant association
	Medium (ISCED 3-4 +9)	15.9				
	Lower tertiary (ISCED 5-6)	14.9				
	Higher tertiary (ISCED 7-8)	7.8				
Make ends meet	No (difficulty)	20.9	22.35	1	< 0.001	Significant association
	Yes (no difficulty)	9.9				
Living area	Countryside	16.2	9.01	3	0.029	Significant association
	Village/Small town	16.0				
	Town	15.9				
	City/Suburb	6.4				
Accommodation size	Small (1-2 rooms)	18.5	8.67	2	0.013	Significant association
	Medium (3-5 rooms)	13.7				
	Large (6-12 rooms)	5.7				
Marital status	Never married	15.5	Fisher's exact test /	/	0.069 (N = 37)	Marginal association
	Married	12.8				
	Separated	23.1				
	Widowed	17.2				
	Divorced	27.5				

Source: Own work.

Note: χ^2 = Chi-square test (larger value has stronger evidence of association), df = degrees of freedom (df = (number of rows - 1) $\times$ (number of columns - 1)).

A weak or marginal association was observed between housing problems and marital status with Fisher's exact test (used because of small, expected frequencies; p = 0.069), with higher prevalence observed among divorced and separated respondents. On the other hand, income, gender, age group, household size, health, and region are not significantly associated with housing problems. These results broadly support the subsequent logistic regression models,

in which socio-economic and spatial factors emerged as the main predictors of housing problems.

Table 10: Bivariate associations between warm home and key socioeconomic and spatial variables, year 2016 (full table at Appendix 4)

Predictor	Category	Heating deprivation (%)	χ^2	df	p	Interpretation
Make ends meet	No (difficulty)	6.1	10.47	1	p = 0.001**	Significant association
	Yes (no difficulty)	2.0				
Education	Low (ISCED 0-2)	13.9	15.02	3	p = 0.002**	Significant association
	Medium (ISCED 3-4 +9)	4.3				
	Lower tertiary (ISCED 5-6)	3.3				
	Higher tertiary (ISCED 7-8)	1.0				
Living area	Countryside	5.4	9.70	3	p = 0.021*	Significant association
	Village/Small town	2.4				
	Town	7.3				
	City/Suburb	2.8				
Income	Low	6.2	15.9	2	p < 0.001***	Significant association
	Middle	0.5				
	Higher	0.0				
Accommodation size	Small	6.1	10.47	2	p = 0.001**	Significant association
	Medium	2.0				
	Large	/				
Region	754 (Gorenjska)	15.2	35.65	#	p < 0.001***	Significant association
	747 (Podravska)	12.8				
	Other regions	~1.5-6.4				

Source: Own work.

Note: χ^2 = Chi-square test (larger value has stronger evidence of association), df = degrees of freedom (df = (number of rows - 1) $\times$ (number of columns - 1)).

Second, with the Chi-square test, there is a statistically significant association between heating deprivation (Table 10) and making ends meet ($\chi^2 = 10.47$, p = 0.001) and income ($\chi^2 = 15.90$, p = 0.001). Secondary drivers are education ($\chi^2 = 15.02$, p = 0.002), living area (χ^2

= 9.70, $p = 0.021$), accommodation size ($\chi^2 = 10.47$, $p = 0.001$), and spatial context/region ($\chi^2 = 35.65$, $p = 0.001$). The percentage of respondents reporting problems with heating their home was substantially higher among individuals with the lowest income (6.2%) and households that cannot make ends meet (6.1%), which is three times higher than the risk for those who have no difficulty.

Table 11: Bivariate associations between utility arrears and key financial and spatial variables, year 2016 (full table at Appendix 4)

Predictor	Category	Utility arrears (%)	χ^2	df	p
Make ends meet	Difficulty	16.2	57.53	1	$p < 0.001^{***}$
	No difficulty	2.5			
Income	Low	13.2	13.91	2	$p = 0.001^{**}$
	Middle	6.6			
	Higher	1.2			
Economic status	Employed	8.1	50.17	3	$p < 0.001^{***}$
	Unemployed	31.3			
	Retired	5.6			
	Other inactive	4.2			
Accommodation size	Small	16.2	57.53	2	$p < 0.001^{***}$
	Larger	2.5			
Ownership	Owned (no mortgage)	6.7	26.49	4	$p < 0.001^{***}$
	Mortgage	19.4			
	Social rent	25.8			
	Private rent	15.8			
	Other	8.1			
Age group	18-24	3.8	14.20	4	$p = 0.007^{**}$
	25-34	14.5			
	35-49	11.6			
	50-64	7.1			
	65+	5.5			

Source: Own work.

Note: χ^2 = Chi-square test (larger value has stronger evidence of association), df = degrees of freedom (df = (number of rows - 1) $\times$ (number of columns - 1)).

With these results, it is shown that heating deprivation is primarily a financial constraint. Education reflects long-term socioeconomic position and shows that low education is associated with a much higher vulnerability to heating deprivation (13.9%). Furthermore, households that live in towns (7.3%) and in the countryside (5.4%) are more strongly associated with the problem of keeping a warm home, compared to household living in cities and in villages. Smaller dwellings also reflect a higher risk of heating deprivation (6.1%), which likely reflects poorer housing quality. Regional inequalities also exist in the variable

warm homes, but one should interpret these results with caution due to small sample sizes in certain regions. The prevalence of heating deprivation was particularly high in the Gorenjska and Podravska regions, with 15.2% and 12.8%, compared to lower levels in other regions, ranging between 1.5% and 6.4%. Health, age, and gender are not significant for heating deprivation.

Table 12: Overview of the relationship of three energy poverty indicators with independent variables performed with the Chi-square test, year 2016

Dependent variables	Main driver	Significant predictors	Underlying mechanisms
Housing problems	Structural housing inequality & socio-economic status	Make ends meet ($\chi^2 = 22.35$, $p < 0.001$), Accommodation size ($\chi^2 = 8.67$, $p < 0.05$), Economic status, Education, Living area	Long-term structural disadvantage
Heating deprivation	Financial constraints (energy affordability)	Make ends meet ($\chi^2 = 10.47$, $p < 0.01$), Income ($\chi^2 = 15.9$, $p < 0.001$), Accommodation size ($\chi^2 = 10.47$, $p < 0.01$), Education, Living area	Insufficient financial resources to afford energy, long-term socio-economic vulnerability
Utility arrears	Financial stress and liquidity constraints	Make ends meet ($\chi^2 = 57.53$, $p < 0.001$), Income ($\chi^2 = 13.91$, $p < 0.01$), Accommodation size ($\chi^2 = 57.53$, $p < 0.001$), Economic status, Age, Health	Short-term inability to meet financial obligations

Source: Own work.

Third, the Chi-square analyses for utility arrears reveal a distinct pattern compared to other forms of energy poverty (Table 11). Strong and statistically significant associations were found for financial variables, including the ability to make ends meet ($\chi^2 = 57.53$, $p < .001$), income ($\chi^2 = 13.91$, $p = .001$), and economic status ($\chi^2 = 50.17$, $p < .001$), which is a direct measure of financial stress. Other significant variables are also accommodation size ($\chi^2 = 57.53$, $p < 0.001$), ownership ($\chi^2 = 26.49$, $p < 0.001$), and age group, with a weaker effect ($\chi^2 = 14.20$, $p = 0.007$). Respondents who reported difficulties making ends meet were over six times more likely to experience arrears (16.2%) compared to those without such difficulties (2.5%). There was a clear income gradient, with arrears declining from 13.2% in the lowest income group to only 1.2% in the highest income group. Economic status further highlights this pattern, as nearly one-third of unemployed respondents (31.3%) reported arrears,

compared to only 8.1% among employed individuals. Smaller accommodation size has a higher prevalence of utility arrears (16.2%), which can be an indicator of poorer housing and a higher cost burden relative to income. Social renters (25.8%) and owners with mortgages (19.4%) are more vulnerable to utility arrears due to less control over costs and less financial security. Age differences indicate that arrears are most common among younger working-age adults (14.4%). This weaker age effect is still relevant, as it suggests that financial instability and housing costs may disproportionately affect this age group. No significant association was found for education, region, living area, or health status.

With the Chi-square analysis, the financial factor of making ends meet shows the strongest significance across all three energy poverty indicators (Table 12). The other two financial factors, income and economic status, are also significant. Income is significant especially for heating deprivation and utility arrears, and economic status is significant for housing problems and utility arrears. With this we can conclude that financial stress is a core driver of all three EP indicators. The spatial factor of living area also shows a statistically significant relationship with housing problems and heating deprivation, while region has a relationship only with heating issues. Accommodation size is not the strongest variable but also shows a relationship with all three EP indicators, so we can conclude that housing conditions matter consistently. Although education affects housing and heating issues, it does not significantly impact utility bills, because utility arrears indicate immediate liquidity problems rather than long-term status. Age and health have a weaker relationship with utility arrears, since both variables indirectly affect monthly income.

4.3.3 Multivariate logistic regression

Logistic regression is used to obtain odds ratios in the presence of more than one independent variable. The result shows the effect of each independent variable on the odds ratio for causation on the three observed EP indicators (Sperandei, 2014). Where p is a probability of experiencing the dependent variable, X represents the independent variables, and β represents the coefficient of the independent variables. The coefficients were exponentiated to obtain odds ratios (OR), which indicate the change in the odds of the outcome associated with a one-unit change in the predictor. An OR greater than 1 indicates a higher likelihood of experiencing energy poverty, while an OR less than 1 indicates a lower likelihood. An OR equal to 1 suggests no effect. Also, 95% confidence intervals (CI) were calculated to assess statistical significance (Agresti, 2018). I slowly built the regression to find the best possible model fit with the smallest possible Akaike Information Criterion (AIC) and residual deviance.

$$\text{logit}(p) = \ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \quad (2)$$

Table 13: Logistic regression predicting inadequate housing conditions - only significant variables (full table at Appendix 5)

Variable	Estimate	OR	95% CI	Std. Error	z	p
(Intercept)	-0.011	0.99	[0.09, 9.46]	1.177	-0.01	.992
Married status	-0.736	0.48	[0.23, 1.01]	0.377	-1.95	.051†
Unemployed status	1.627	5.09	[2.13, 12.35]	0.447	3.64	0.0003***
Retired status	0.828	2.29	[1.01, 5.20]	0.416	1.99	0.047*
Medium education (ISCED 3-4 + 9)	-1.275	0.28	[0.09, 0.83]	0.550	-2.32	0.020*
Lower tertiary education (ISCED 5-6)	-1.329	0.26	[0.08, 0.84]	0.586	-2.27	0.023*
Higher tertiary education (ISCED 7-8)	-1.627	0.20	[0.05, 0.71]	0.656	-2.48	0.013*
Making ends meet with difficulty or not able	-0.607	0.54	[0.31, 0.95]	0.284	-2.14	0.032*
Living in a city or city suburb	-2.550	0.08	[0.02, 0.23]	0.580	-4.39	0.00001***
Posavska region	1.986	7.29	[2.73, 21.48]	0.523	3.80	0.0001***
Jugovzhodna Slovenia region	1.152	3.17	[1.19, 9.22]	0.518	2.22	0.026*

Source: Own work.

Note: Estimate: effect (log-odds); Std. Error: uncertainty; z-value: strength of evidence; p-value: significance; OR (Odds ratio): interpretation; CI (Confidence interval) = Estimate $\pm$ 1.96 $\times$ Std. Error; *** very significant (p < 0.001); ** significant (p < 0.01); * significant at 5% (p < 0.5); † (p < 0.10).

Three binary logistic regression models were estimated to examine the determinants of energy poverty, with the indicators being housing conditions, warm home, and utility-bill burden. All variables were coded as categorical factors. Missing responses were excluded, resulting in a final sample of 616 observations. Thirteen independent variables included in the first (housing conditions) and third regression (utility bills) were socio-economic

variables (economic status, education level, net monthly income, ability to make ends meet), spatial variables (housing size, housing tenure, living area, region), and demographic and health variables (household size, gender, age group, health status, marital status). For the second regression (warm home), only four independent variables with all groups were included (health, education groups, ability to make ends meet, living area), due to the small number of samples that reported that they had problems with warm home ($N = 105$), and consequently an even smaller number of responses in most groups within the variables. Because of small sample sizes in certain categories (e.g. income, household size, and region), some categories were merged to ensure model stability.

The results of the logistic regression for inadequate housing conditions show that socio-economic and spatial factors are statistically more important than demographic and housing characteristics. Among the socio-economic variables, being unemployed ($p < 0.001$) and retired ($p = 0.047$) are significant predictors (Table 13). The unemployed are approximately five times more likely to be housing deprived than the employed ($OR \approx 5.1$). Education also has a significant impact ($p = 0.013$), as a higher level of education reduces the likelihood of inadequate housing by 80% ($OR \approx 0.20$). Similarly, individuals who can make ends meet have about 46% lower odds of housing deprivation ($OR \approx 0.54$). Among spatial factors, differences between urban and rural areas stand out ($p < 0.001$). Individuals living in urban or suburban areas have an 82% lower probability of inadequate housing compared to those living in rural areas ($OR \approx 0.08$). Regional differences are also significant, especially in Posavska and Jugovzhodna Slovenija, where the risk of housing deprivation is higher ($p < 0.001$ and $p = 0.026$). Among demographic variables, marital status shows a marginal effect ($p = 0.051$), while age, gender, household size, apartment size, and ownership are not statistically significant.

When analyzing the inability to adequately heat the home, the proportion of households reporting this problem is relatively low (3.69%), which may affect the stability of the model estimates (Table 14). For this reason, a simplified model with selected key variables was used. The results show that health is a statistically significant factor ($p = 0.016$). Individuals with the worst health status are 6.5 times more likely to be unable to afford adequate heating than healthy individuals ($OR \approx 6.53$). The ability to make ends meet is also significant ($p = 0.041$), with households that can make ends meet having about 56% lower odds of heating deprivation ($OR \approx 0.44$). Education shows a marginal effect ($p = 0.059$), suggesting a potential association between higher education and lower risk ($OR \approx 0.17$). Residential location also shows a weaker effect ($p = 0.075$), as households in less rural areas are less likely to lack heating ($OR \approx 0.44$). Other variables, including economic status and home ownership, are not statistically significant.

The results of the third model show that the inability to pay utility bills is mainly associated with financial factors (Table 15). The key variable in the model is making ends meet ($p < 0.001$), as individuals who can make ends meet are 85% less likely to have problems paying bills ($OR \approx 0.15$). Income level also has a significant effect ($p = 0.025$). Individuals with

higher incomes (above EUR 2,401 per month) are significantly less likely to be late with payments than individuals with lower incomes (OR $\approx$ 0.07, $p = 0.025$). Other variables, including health, education, demographic characteristics, and housing factors, are not statistically significant, suggesting that this aspect of energy poverty is primarily directly related to the financial capacity of households.

Table 14: Logistic regression predicting inability to afford adequate heating

Variable	Estimate	OR	95% CI	Std. Error	z	p
Intercept	-2.051	0.13	[0.02, 0.64]	0.861	-2.383	0.017*
Good health	0.227	1.26	[0.42, 4.62]	0.595	0.382	0.703
Fair health	-0.168	0.85	[0.24, 3.38]	0.656	-0.256	0.798
Bad health	0.823	2.28	[0.64, 9.34]	0.669	1.229	0.219
Very bad health	1.876	6.53	[1.40, 32.16]	0.783	2.397	0.017*
Medium education (ISCED 3-4 + 9)	-0.697	0.50	[0.16, 1.74]	0.596	-1.171	0.242
Lower tertiary education (ISCED 5-6)	-0.721	0.49	[0.14, 1.90]	0.662	-1.089	0.276
Higher tertiary education (ISCED 7-8)	-1.778	0.17	[0.02, 0.98]	0.940	-1.891	0.059†
Making ends meet with difficulty or not able	-0.810	0.44	[0.20, 0.95]	0.396	-2.045	0.041*
Living in a village/small town	-0.817	0.44	[0.18, 1.12]	0.459	-1.779	0.075†
Living in a medium to large town	0.390	1.48	[0.57, 3.95]	0.490	0.797	0.425
Living in a city or city suburb	-0.507	0.60	[0.16, 1.97]	0.630	-0.804	0.421

Source: Own work.

*Note: Estimate: effect (log-odds); Std. Error: uncertainty; z-value: strength of evidence; p-value: significance; OR (Odds ratio): interpretation; CI (Confidence interval) = Estimate $\pm$ 1.96 $\times$ Std. Error; *** very significant ($p < 0.001$); ** significant ($p < 0.01$); * significant at 5% ($p < 0.5$); † ($p < 0.10$).*

Table 15: Logistic regression predicting inability to pay utility bills - only significant variables (full table at Appendix 5)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Intercept	-1.581	0.21	[0.01, 4.85]	1.676	-0.944	0.345
Lower-middle income	-0.863	0.42	[0.17, 1.00]	0.446	-1.934	0.053†
Upper-middle income	-2.615	0.07	[0.00, 0.50]	1.168	-2.239	0.025*
Making ends meet with difficulty or not able	-1.926	0.15	[0.06, 0.33]	0.443	-4.353	<0.001***

Source: Own work.

Note: Estimate: effect (log-odds); Std. Error: uncertainty; z-value: strength of evidence; p-value: significance; OR (Odds ratio): interpretation; CI (Confidence interval) = Estimate $\pm$ 1.96 $\times$ Std. Error; *** very significant ($p < 0.001$); ** significant ($p < 0.01$); * significant at 5% ($p < 0.5$); † ($p < 0.10$).

Table 16: Comparison of determinants across three dependent variables from logistic regression

Dependent variables	Main driver	Significant predictors	Underlying mechanisms	Time dimension
Housing problems	Socio-economic and spatial structure	Economic status, Education, Make ends meet, Region (selected), Living area (weak)	Structural (housing) inequality	Long-term
Heating deprivation	Health and financial strain	Health, Make ends meet, Education (weak), Living area (weak)	Vulnerability - health and finances	Medium-term
Utility arrears	Immediate financial capacity	Make ends meet, Income	Direct financial hardship (financial stress)	Short-term

Source: Own work.

With logistic regression, the financial factor of making ends meet has the strongest significance across all three energy poverty indicators (Table 16). Strong predictors for housing problems includes economic status and education; for heating deprivation, it includes health; and for utility arrears, it includes income. While housing problems reflect long-term socio-economic inequalities, and heating deprivation captures vulnerability related to health and financial strain, utility bill arrears represent the most direct manifestation of immediate financial hardship.

5 DISCUSSION ON RESULTS AND ANSWERING RESEARCH QUESTIONS

This chapter discusses the main empirical analysis in relation to the theoretical part. The aim of the chapter is to answer the research questions and identify the key determinants of energy poverty in Slovenia. The questions about the definition of energy poverty and its factors will be answered, the nature of EP in the EU and Slovenia, and a detailed analysis of demographic variables and geographic variables in Slovenia and discuss which measures can be used to alleviate energy poverty. Finally, we will touch on research limitations.

5.1 Definition and determinants of energy poverty and its nature in EU

In the EU and in Slovenia, energy poverty is treated as a multidimensional problem. It is defined as a situation in which a household has an income below the at-risk-of-poverty threshold and experiences problems with at least one of the following factors: living in energy-inefficient housing, inadequate living conditions, and using a disproportionate amount of income on energy. From this, key indicators were developed that are used in the EU-SILC questionnaire and in Slovenia: inability to keep the home adequately warm (AW), arrears on utility bills (UB), inadequate housing conditions, and whether the share of energy expenditure in income is more than twice the national median (2M) or falls below the national median energy consumption (M2).

The determinants affecting energy-poor households or individuals can be grouped into economic, housing, socio-demographic, geographic, and institutional factors. All these factors have been observed in both developed and underdeveloped countries and in cold and warm areas. The analysis confirms that income, the ability to make ends meet, and housing conditions are the main drivers of energy poverty. The analysis also shows that regional diversity is important, an area that remains less explored in the existing literature.

Energy poverty shows significant differences between EU Member States, as it is influenced by purchasing power standards, energy prices, geography and climate, natural resources, infrastructure, and national public policies within each country. The nature of energy poverty is only similar in each Member State in terms of socio-demographic factors, but the levels of economic, structural, and geographical determinants are different. The EU is addressing

this by implementing institutional policies to guide Member States towards the appropriate measurement and prevention of energy poverty. Energy poverty is also more severe in Eastern and Southern Europe because lower purchasing power, inefficient housing, economic constraints, and limited policy support increase vulnerability. Climate and seasonality also play a role in this, as the increasing frequency of heatwaves is worsening summer energy poverty, particularly in Southern Europe, where buildings are often poorly adapted to cooling needs.

5.2 Nature, determinants and impact of variables in Slovenia

A characteristic of energy poverty in Slovenia is the high percentage of households living in inadequate housing conditions, being unable to pay utility bills on time, and having a high level of home ownership, especially of houses. Slovenia has an above-average share of energy expenditure, mainly because of inadequate housing conditions and both summer and winter energy poverty. Energy poverty is evident among low-income households, the elderly, older women, one-person households, single parents, tenants, and people living in the Zasavska and Podravska regions.

Energy poverty indicators, namely housing problems, heating deprivation, and utility arrears, have strong significance in relation to structural, socio-economic, and financial stress determinants. From the bivariate analysis we can see that the housing problems are closely linked to factors such as making ends meet, accommodation size, economic status, education, and living area, indicating a long-term structural disadvantage. Heating deprivation is closely linked to factors such as making ends meet, income, accommodation size, education, and living area, indicating a lack of financial resources and long-term socio-economic vulnerability. Utility arrears are related to determinants such as making ends meet, income, accommodation, economic status, age, and health, indicating short-term financial inability.

Demographic variables do not have a strong direct impact on energy poverty indicators (as shown by the logistic regression). Only education level and economic status affect the indicator of housing problems, so that a higher education level and employed status reduce the likelihood of energy poverty. Health and education affect the indicator of heating deprivation, so that people with better health and higher education levels are less likely to experience energy poverty. From the analysis, the indirect impact of demographic variables in Slovenia is such that the older population tends to have lower incomes and, with this, a higher probability of energy poverty. Older women are the most at risk in this regard, due to their more frequent lower incomes and their inability to renovate their homes. Employment, economic status, and higher levels of education are more likely to increase income and, with this, reduce the likelihood of energy poverty.

Economic conditions are closely related to financial stress and energy price increases, as seen in the variable ability to make ends meet, which has the strongest significance across

all three energy poverty indicators. In addition to the above-mentioned variable, the utility bill arrears indicator is also significantly related to the income variable, which represents immediate financial hardship. This is also seen in the descriptive analysis where utility bills increased in 2007 and 2011, which is most likely an effect of the 2008 crisis. The same event is supported by theory, as the latest COVID-19 crisis increased the share of energy-poor households in Slovenia after 2021, with the share returning to the 2021 level only in 2025. Spatial variables have less significance for energy poverty indicators (as seen in logistic regression), as they affect energy poverty indirectly through income, industry and infrastructure inequality in regions, and a high level of ownership of houses, for which substantial renovation income is required. Region and living area have weak significance on housing problems, whereas specific regions and living in a city or suburb increase the likelihood of energy poverty. Living in a city or suburb also increases the likelihood of the EP indicator of heating deprivation.

5.3 Measures to alleviate the energy poverty

Measures to alleviate energy poverty in Slovenia should combine social, infrastructural, economic, and institutional policies, as energy poverty is driven not only by low income but also by poor housing quality, inefficient heating systems, and limited access to affordable energy (Bouzarovski et al., 2021; OpenExp, 2019). However, the findings of this study suggest that the greatest challenge in Slovenia relates to inadequate housing conditions, which, together with the high level of home ownership—particularly of houses—points to the importance of structural and infrastructural measures. Many owner-occupied houses require substantial renovation and face problems related to low energy efficiency, outdated heating systems, and poor housing quality, increasing the risk of energy poverty (Ministrstvo za okolje, podnebje in energijo, 2026).

In this context, the most important measures include building renovation, insulation improvements, replacement of inefficient heating systems, and support for renewable energy use. The European Union's Renovation Wave, the Energy Performance of Buildings Directive, and the Energy Efficiency Directive collectively support these efforts, with a particular focus on the least efficient buildings and vulnerable households (European Commission, 2022; European Commission, 2025a). In Slovenia, these policies are implemented through initiatives such as RENOVERTY, which targets rural areas, and the Eko Fund, which provides financial assistance for energy renovations, heating system upgrades, renewable energy adoption, and energy-related counselling (SLOGA, 2025; Ministrstvo za okolje, podnebje in energijo, 2026). Nevertheless, access to Eko Fund support could be improved, as current schemes are often more accessible to households able to provide part of the upfront investment.

At the same time, the analysis showed that difficulty paying utility bills remains an important dimension of energy poverty. Therefore, infrastructural measures should be complemented

by temporary financial support, targeted subsidies, social tariffs, and energy vouchers aimed at vulnerable households. Slovenia will receive 300 million EUR from the Social Climate Fund after 2026, representing an important opportunity to reduce energy poverty, improve energy efficiency, and support renewable energy investments in at least 8,000 energy-poor households (STA, 2023; Ministrstvo za okolje, podnebje in energijo, 2023b).

Slovenia could further strengthen its approach by drawing on good practices from other EU Member States. France applies income-based renovation subsidies, Greece and Portugal provide social tariffs or energy discounts, Belgium and Portugal support energy communities that lower household expenses, and the UK promotes transitions to more affordable heating systems (Bouzarovski, 2013; European Commission, 2024b; Fabulova et al., 2022). The most crucial insight for Slovenia is that, while infrastructure efficiency should remain the primary policy focus, it should be complemented by stronger tenant protections, temporary bill assistance, localized advisory services such as ENSVET, REACH, and ZERO, and integrating multiple generations into the same household (Informa Echo, 2025; Ministrstvo za okolje, podnebje in energijo, 2026).

5.4 Research limitations

The Questionnaire from the 4th European Quality of Life Survey (4th EQLS) has limitations in terms of data availability, measurement, and survey design. First, the analysis is based on data up to 2016, which may not fully capture recent developments and energy price increases, so it would be sensible to include more recent data from 2025, to rephrase the question of keeping home adequately warm, because it can be very subjective, and to expand the set of questions to include the problem with cooling their home (Koukoufikis et al., 2026). Second, the representativeness of the sample could be improved by ensuring a balanced distribution across age groups, educational levels, living areas, and regions, to enhance the comparability of the results. Finally, a panel structure (i.e. a survey that followed households over time) would allow for a more accurate assessment of changes in energy poverty indicators and the impact of energy efficiency interventions.

6 CONCLUSION

This thesis addressed energy poverty as a multidimensional problem that affects households' ability to access essential energy services and remains closely linked to health, well-being, and social inclusion. The study provided both theoretical and empirical insights into the determinants and distribution of energy poverty in Slovenia according to its three main indicators. A key contribution of this thesis is the inclusion of regional and local data, which remains under-researched in existing literature (representing a key research gap) and provides additional insights into the spatial distribution of energy poverty in Slovenia (Bouzarovski, 2013).

The analysis and theory confirm that income, the ability to meet basic needs, and housing conditions are the primary factors contributing to energy poverty. The analysis also highlighted the significance of regional diversity, a topic that existing literature has not thoroughly explored. The characteristics of energy poverty exhibit similarities across Member States regarding socio-demographic factors; however, the levels of economic, structural, and geographical determinants vary. The EU is addressing the issue by implementing institutional policies to guide Member States towards the correct measurement and prevention of energy poverty. A characteristic of energy poverty in Slovenia is the high percentage of households living in inadequate housing conditions, being unable to pay utility bills on time, and having a high level of home ownership, especially of houses (Eurostat, 2020; Ministrstvo za okolje, podnebje in energijo, 2026). This phenomenon has a high correlation with structural, socio-economic, and financial stress determinants. Demographic variables do not have a strong direct impact on energy poverty indicators, but rather an indirect impact on income and consequently a higher or lower probability of energy poverty, which did not fully confirm my hypothesis (H3.1). Economic conditions are closely related to financial stress and energy price increases, as they have strong significance across all three energy poverty indicators, especially the utility bills indicator. Spatial variables have lower significance for energy poverty indicators, as they affect energy poverty through inequality in regions and living areas. The results of economic and spatial variables fully confirm my hypothesis (H3.2). Measures to alleviate energy poverty in Slovenia should combine social, infrastructural, economic, and institutional policies to ensure a sustainable energy transition. Policies like this include building renovation, insulation improvements, replacement of inefficient heating systems, and support for renewable energy use (European Commission, 2022; European Commission, 2025a). The analysis relies on outdated data and certain self-reported indicators. Future research should include longitudinal data and additional indicators to better capture the evolving nature of energy poverty.

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APPENDICES

Appendix 1: Energy poverty characteristics in EU

*Appendix Table 1: Population unable to keep home adequately warm by poverty status (%)
- top 8 and bottom 6 countries*

Population unable to keep home adequately warm by poverty status (AW) in%	2019	2020	2021	2022	2023	2024
European Union - 27 countries (from 2020)	6.9	7.5	6.9	9.3	10.6	9.2
Bulgaria	30.1	27.5	23.7	22.5	20.7	19.0
Greece	17.9	17.1	17.5	18.7	19.2	19.0
Lithuania	26.7	23.1	22.5	17.5	20.0	18.0
Spain	7.5	10.9	14.2	17.1	20.8	17.5
Portugal	18.9	17.5	16.4	17.5	20.8	15.7
Cyprus	20.6	21.0	19.2	19.0	17.1	14.6
France	6.2	6.7	6.0	10.7	12.1	11.8
Romania	9.3	10.0	10.1	15.2	12.5	10.8
Austria	1.8	1.5	1.7	2.7	3.9	4.0
Estonia	2.5	2.7	2.0	3.4	4.1	3.6
Luxembourg	2.4	3.6	2.5	2.1	2.1	3.6
Poland	4.2	3.2	3.2	4.9	4.7	3.3
Slovenia	2.3	2.8	1.7	2.6	3.6	3.3
Finland	1.8	1.8	1.3	1.4	2.6	2.7

Source: Eurostat (2025a).

Appendix 2: Sample analysis

Appendix Table 2: Sample analysis of demographic variables (%)

	Years	2003	2007	2011	2016	SUM
Gender (HH2a)	Female	57.6	58.6	54.7	53.3	55.9
	Male	42.4	41.4	45.3	46.7	44.1
	SUM	100.0	100.0	100.0	100.0	100.0
Age group (Agegroup)	18-24 Young Adults	17.6	10.1	10.7	7.8	10.9
	25-34 Early Career Adults	21.3	16.6	16.8	11.1	15.9
	35-49 Established Adults	24.0	19.6	24.1	23.2	22.6
	50-64 Midlife and Pre-retirement	20.8	26.6	25.2	30.7	26.4
	65-95 Seniors	16.3	27.1	23.2	27.2	24.3
	SUM	100.0	100.0	100.0	100.0	100.0
Marital status (Q37)	Never married				23.7	23.7
	Married				59.1	59.1
	Separated				1.3	1.3
	Widowed				11.6	11.6
	Divorced				4.0	4.0
	(empty)				0.3	0.3
	SUM				100.0	100.0
Number of household members (HH1)	1-2 members, small household	37.4	52.8	39.5	44.8	44.4
	3-4 members, medium sized	47.4	37.1	48.4	41.7	43.2
	5-6 members, large	12.8	9.2	11.0	12.0	11.1
	7+ members, extended	2.3	1.0	1.1	1.6	1.4
	SUM	100.0	100.0	100.0	100.0	100.0
In which country were you born? (Q99)	Albania				0.1	0.1
	Austria				0.2	0.2
	Belgium				0.1	0.1
	Bosnia				4.0	4.0
	Croatia				1.6	1.6
	Macedonia				0.4	0.4
	Germany				0.6	0.6
	Montenegro				0.3	0.3
	Republic of Serbia				0.7	0.7
	Slovakia				0.2	0.2
	Slovenia				90.9	90.9
	Switzerland				0.1	0.1
	Other country				0.8	0.8
	SUM				100.0	100.0

Source: Own work.

Appendix Table 3: Sample analysis of socio-economic variables (%)

	Years	2003	2007	2011	2016	SUM
Economic status of responder (HH2dv2)	Employed	49.4	40.3	42.9	46.7	44.3
	Unemployed	6.3	4.7	10.0	6.4	6.9
	Retired	26.1	41.8	34.6	37.5	36.1
	Other inactive	18.1	13.1	12.5	9.5	12.8
	SUM	100.0	100.0	100.0	100.0	100.0
Education groups (Q87v2)	ISCED 0-2 low				3.6	3.6
	ISCED 3-4 + 9 medium				43.8	43.8
	ISCED 5-6 lower tertiary				33.4	33.4
	ISCED 7-8 higher tertiary				19.2	19.2
	SUM				100.0	100.0
Net monthly income range in EUR (Q96/97)	0-1200 EUR, low				32.4	8.9
	1201-2400 EUR, lower-middle				21.1	5.8
	2401-3600 EUR, upper-middle				6.5	1.8
	3601-6500 EUR, high income				1.6	0.4
	didn't want to answer				38.4	83.1
	SUM				100.0	100.0
Is your household able to make ends meet? (Q88v2)	Yes	40.6	40.7	48.1	42.5	43.2
	No	58.4	58.5	51.3	56.1	55.8
	(empty)	1.0	0.9	0.6	1.4	1.0%
	SUM	100.0	100.0	100.0	100.0	100.0
Recipient of: Unemployment benefit (Q94f)	Yes				5.3	5.3
	No				94.6	94.6
	(empty)				0.1	0.1
	SUM				100.0	100.0
Recipient of: Disability benefit/pension (Q94g)	Yes				7.8	7.8
	No				92.0	92.0
	(empty)				0.2	0.2
	SUM				100.0	100.0
Recipient of: Social assistance or minimum income benefit (Q94i)	Yes				3.8	3.8
	No				96.1	96.1
					0.1	0.1
	SUM				100.0	100.0

Source: Own work.

Appendix Table 4: Appendix 4: Sample analysis of accommodation variables (%)

	Years	2003	2007	2011	2016	SUM
Size of accommodation by no of rooms (Q23v2)	1-2 rooms, small	38.8	33.3	34.8	31.8	34.2
	3-5 rooms, medium	53.6	57.5	59.4	60.4	58.2
	6-12 rooms, large	7.7	7.4	4.8	7.0	6.6
		0.0	1.7	1.0	0.8	1.0
	SUM	100.0	100.0	100.0	100.0	100.0
Ownership status (Q24)	Owned without mortgage				84.4	84.4
	Owned with mortgage				6.2	6.2
	Rented, from social, municipal or non-profit housing provider				3.1	3.1
	Rented, from private landlord or company				1.9	1.9
	Other				3.7	3.7
	(empty)				0.7	0.7
	SUM				100.0	100.0
Living area (Q53)	The open countryside	6.0	14.3	5.0	16.7	11.0
	A village/small town	57.9	51.9	64.6	54.1	57.0
	A medium to large town	28.3	28.8	23.7	15.1	23.5
	A city or city suburb	7.7	5.0	6.7	14.1	8.4
	(empty)	0.2	0.0	0.0	0.1	0.1
	SUM	100.0	100.0	100.0	100.0	100.0
Did you move to save housing costs? (Q92_1 & Q92_3)	No		100.0	100.0	99.8	99.9
	Yes		0.0	0.0	0.2	0.1
	SUM		100.0	100.0	100.0	100.0
Region (Region)	746 - Pomurska				10.5	10.5
	747 - Podravska				4.7	4.7
	748 - Koroška				7.0	7.0
	749 - Savinjska				4.7	4.7
	750 - Zasavska				4.6	4.6
	751 - Posavska				21.1	21.1
	752 - Jugovzhodna Slovenija				19.3	19.3
	753 - Osrednjeslovenska				6.8	6.8
	754 - Gorenjska				4.6	4.6
	755 - Primorsko-notranjska				3.0	3.0
	756 - Goriška				10.6	10.6
	757 - Obalno-kraška				3.2	3.2
	SUM				100.0	100.0

Source: Own work.

Appendix Table 5: Sample analysis of social and health variables (%)

	Years	2003	2007	2011	2016	SUM
Usage of Internet (Q27b)	Every day or almost every day			48.4	50.5	49.5
	At least once a week			10.3	10.9	10.6
	One to three times a month			2.0	2.2	2.1
	Less often			4.8	5.7	5.2
	Never			33.9	30.1	32.0
	(empty)			0.6	0.6	0.6
	SUM			100.0	100.0	100.0
How is your health? (Q48)	Very good		17.8	21.5	18.7	19.3
	Good		37.4	39.5	40.2	39.0
	Fair		30.5	28.6	28.3	29.2
	Bad		11.9	8.4	10.6	10.3
	Very bad		2.2	2.0	2.0	2.1
	(empty)		0.2	0.0	0.2	0.1
	SUM		100.0	100.0	100.0	100.0
Chronic (long-standing) physical or mental health problem, illness or disability? (Q49)	No		68.8	79.0	69.1	72.3
	Yes		30.9	20.7	30.5	27.4
	(empty)		0.3	0.3	0.4	0.3
	SUM		100.0	100.0	100.0	100.0
I feel left out of society (Q36a)	Strongly agree		0.8	0.7	1.3	0.9
	Agree		4.8	3.5	5.7	4.7
	Neither agree nor disagree		9.0	9.7	9.1	9.3
	Disagree		44.5	42.7	39.9	42.4
	Strongly disagree		40.9	43.5	44.1	42.8
	SUM		100.0	100.0	100.0	100.0
Some people look down on me because of my job situation or income (Q36d)	Strongly agree		1.3	1.3	1.5	1.3
	Agree		11.5	8.8	12.1	10.8
	Neither agree nor disagree		11.7	13.1	11.3	12.0
	Disagree		44.3	43.8	38.7	42.3
	Strongly disagree		28.8	31.0	35.6	31.7
	(empty)		2.5	2.0	0.9	1.8
	SUM		100.0	100.0	100.0	100.0

To be continued

Appendix Table 5: Sample analysis of social and health variables (%) (cont.)

	Years	2003	2007	2011	2016	SUM
Worried that your income in old age will not be sufficient? (Q41v2)	Not concerned				14.8	14.8
	Slightly concerned				11.0	11.0
	Moderately concerned				22.5	22.5
	Very concerned,				19.9	19.9
	Extremely concerned				30.9	30.9
	(empty)				0.9	0.9
	SUM				100.0	100.0

Source: Own work.

Appendix 3: Descriptive analysis

Appendix Table 6: Descriptive analysis of demographic variables with EP problems (%)

Independent variable	Years	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Gender	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	Female	47.3	10.3	57.6	55.2	2.3	57.6	51.9	5.7	57.6
	Male	33.6	8.8	42.4	41.8	0.7	42.4	39.6	2.8	42.4
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	Female	46.9	11.8	58.6	57.1	1.5	58.6	52.3	6.4	58.6
	Male	36.4	4.9	41.4	40.0	1.4	41.4	37.9	3.5	41.4
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	Female	46.4	8.2	54.7	53.6	1.1	54.7	49.6	5.1	54.7
	Male	38.5	6.8	45.3	44.4	0.9	45.3	40.7	4.7	45.3
	2016	85.3	14.7	100.	96.3	3.7	100.0	91.7	8.3	100.0
	Female	44.6	8.8	53.3	51.3	2.0	53.3	48.7	4.7	53.3
	Male	40.8	5.9	46.7	45.0	1.7	46.7	43.1	3.6	46.7
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0
Age group	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	18-24 Young Adults	15.8	1.8	17.6	17.6	0.0	17.6	16.6	1.0	17.6
	25-34 Early Career Adults	17.1	4.2	21.3	20.6	0.7	21.3	18.8	2.5	21.3
	35-49 Established Adults	20.6	3.3	24.0	23.0	1.0	24.0	22.0	2.0	24.0
	50-64 Midlife and Pre-retirement	16.1	4.7	20.8	20.5	0.3	20.8	19.0	1.8	20.8
	65-95 Seniors	11.1	5.2	16.3	15.3	1.0	16.3	15.1	1.2	16.3
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	18-24 Young Adults	8.4	1.7	10.1	10.1	0.0	10.1	9.6	0.6	10.1

To be continued

Appendix Table 6: Descriptive analysis of demographic variables with EP problems (%)
(cont.)

Independent variable	Years	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Age group	25-34 Early Career Adults	14.4	2.2	16.6	16.3	0.3	16.6	14.9	1.7	16.6
	35-49 Established Adults	15.8	3.8	19.6	18.8	0.8	19.6	17.1	2.5	19.6
	50-64 Midlife and Pre-retirement	22.3	4.3	26.6	25.6	1.0	26.6	23.4	3.2	26.6
	65-95 Seniors	22.3	4.7	27.1	26.2	0.9	27.1	25.2	1.8	27.1
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	18-24 Young Adults	9.0	1.7	10.7	10.7	0.0	10.7	9.9	0.8	10.7
	25-34 Early Career Adults	15.1	1.7	16.8	16.5	0.3	16.8	15.6	1.2	16.8
	35-49 Established Adults	21.3	2.8	24.1	23.7	0.4	24.1	21.5	2.6	24.1
	50-64 Midlife and Pre-retirement	21.6	3.6	25.2	24.5	0.7	25.2	22.1	3.1	25.2
	65-95 Seniors	17.9	5.4	23.2	22.6	0.6	23.2	21.1	2.1	23.2
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	18-24 Young Adults	7.1	0.7	7.8	7.7	0.1	7.8	7.5	0.3	7.8
	25-34 Early Career Adults	9.6	1.5	11.1	11.0	0.1	11.1	9.5	1.6	11.1
	35-49 Established Adults	19.4	3.8	23.2	22.4	0.8	23.2	20.5	2.7	23.2
	50-64 Midlife and Pre-retirement	25.8	4.9	30.7	29.3	1.4	30.7	28.5	2.2	30.7
	35-49 Established Adults	19.4	3.8	23.2	22.4	0.8	23.2	20.5	2.7	23.2
	50-64 Midlife and Pre-retirement	25.8	4.9	30.7	29.3	1.4	30.7	28.5	2.2	30.7
	65-95 Seniors	23.4	3.8	27.2	25.9	1.3	27.2	25.7	1.5	27.2
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0

To be continued

Appendix Table 6: Descriptive analysis of demographic variables with EP problems (%)
(cont.)

Independent variable	Years	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Marital status	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Never married	20.0	3.	23.7	23.0	0.7	23.7	21.0	2.7	23.7
	Married	51.5	7.6	59.1	57.2	1.9	59.1	55.0	4.1	59.1
	Separated	1.0	0.3	1.3	1.3	0.0	1.3	1.1	0.2	1.3
	Widowed	9.6	2.0	11.6	10.8	0.8	11.6	10.9	0.7	11.6
	Divorced	2.9	1.1	4.0	3.7	0.3	4.0	3.4	0.6	4.0
	(empty)	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
Number of household members	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	1-2 members, small household	26.5	11.0	37.4	35.8	1.7	37.4	33.4	4.0	37.4
	3-4 members, medium sized	41.1	6.3	47.4	46.4	1.0	47.4	44.1	3.3	47.4
	5-6 members, large	11.5	1.3	12.8	12.5	0.3	12.8	11.8	1.0	12.8
	7+ members, extended	1.8	0.5	2.3	2.3	0.0	2.3	2.2	0.2	2.3
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	1-2 members, small household	42.4	10.3	52.8	50.6	2.1	52.8	47.2	5.5	52.8
	3-4 members, medium sized	32.6	4.5	37.1	36.5	0.6	37.1	33.8	3.3	37.1

To be continued

Appendix Table 6: Descriptive analysis of demographic variables with EP problems (%)
(cont.)

Independent variable	Years	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Number of household members	5-6 members, large	7.3	1.8	9.2	9.0	0.2	9.2	8.1	1.1	9.2
	7+ members, extended	1.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0	1.0
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	1-2 members, small household	33.2	6.3	39.5	38.6	0.9	39.5	34.8	4.7	39.5
	3-4 members, medium sized	40.9	7.5	48.4	47.5	0.9	48.4	44.3	4.1	48.4
	5-6 members, large	9.9	1.1	11.0	10.8	0.2	11.0	10.1	0.9	11.0
	7+ members, extended	0.9	0.2	1.1	1.1	0.0	1.1	1.0	0.1	1.1
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	1-2 members, small household	37.8	7.0	44.8	42.6	2.2	44.8	41.2	3.6	44.8
	3-4 members, medium sized	36.2	5.5	41.7	40.3	1.4	41.7	38.6	3.1	41.7
	5-6 members, large	10.2	1.8	12.0	11.9	0.1	12.0	10.6	1.4	12.0
	7+ members, extended	1.2	0.4	1.6	1.6	0.0	1.6	1.4	0.2	1.6
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0

To be continued

Appendix Table 6: Descriptive analysis of demographic variables with EP problems (%)
(cont.)

Independent variable	Years	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Country of birth	2016	85.3	14.7	100.0 %	96.3	3.7	100.0	91.7	8.3	100.0
	Albania	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1
	Austria	0.1	0.1	0.2	0.2	0.0	0.2	0.2	0.0	0.2
	Belgium	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1
	Bosnia and Herzegovina	3.3	0.7	4.0	3.8	0.2	4.0	3.5	0.5	4.0
	Croatia	0.9	0.7	1.6	1.5	0.1	1.6	1.5	0.1	1.6
	Former Yugoslav Republic of Macedonia	0.3	0.1	0.4	0.4	0.0	0.4	0.3	0.1	0.4
	Germany	0.6	0.0	0.6	0.5	0.1	0.6	0.5	0.1	0.6
	Montenegro	0.2	0.1	0.3	0.3	0.0	0.3	0.3	0.0	0.3
	Republic of Serbia	0.6	0.1	0.7	0.7	0.0	0.7	0.7	0.0	0.7
	Slovakia	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2
	Slovenia	78.2	12.8	90.9	87.7	3.2	90.9	83.5	7.4	90.9
	Switzerland	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1
	Other country	0.7	0.1	0.8	0.7	0.1	0.8	0.7	0.1	0.8
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0

Source: Own work.

Appendix Table 7: Descriptive analysis of socio-economic variables with EP problems (%)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Economic status of responder	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	Employed	41.8	7.7	49.4	48.4	1.0	49.4	46.1	3.3	49.4
	Unemployed	5.2	1.2	6.3	6.0	0.3	6.3	5.5	0.8	6.3
	Retired	18.6	7.5	26.1	24.8	1.3	26.1	24.1	2.0	26.1
	Other inactive	15.3	2.8	18.1	17.8	0.3	18.1	15.8	2.3	18.1
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	Employed	34.0	6.3	40.3	39.7	0.6	40.3	36.0	4.3	40.3
	Unemployed	3.7	1.1	4.7	4.0	0.8	4.7	3.6	1.2	4.7
	Retired	34.9	7.0	41.8	40.5	1.4	41.8	39.0	2.8	41.8
	Other inactive	10.7	2.4	13.1	12.9	0.2	13.1	11.5	1.6	13.1
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	Employed	37.7	5.2	42.9	42.4	0.5	42.9	39.2	3.7	42.9
	Unemployed	8.2	1.8	10.0	9.3	0.7	10.0	8.4	1.6	10.0
	Retired	28.4	6.3	34.6	33.8	0.8	34.6	31.2	3.5	34.6
	Other inactive	10.6	1.9	12.5	12.5	0.0	12.5	11.5	1.0	12.5
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Employed	41.3	5.4	46.7	45.4	1.3	46.7	42.9	3.8	46.7
	Unemployed	4.1	2.3	6.4	6.1	0.3	6.4	4.4	2.0	6.4
	Retired	31.9	5.6	37.5	35.7	1.8	37.5	35.4	2.1	37.5
	Other inactive	8.1	1.4	9.5	9.2	0.3	9.5	9.1	0.4	9.5

To be continued

Appendix Table 7: Descriptive analysis of socio-economic variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Economic status of responder	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Employed	41.3	5.4	46.7	45.4	1.3	46.7	42.9	3.8	46.7
	Unemployed	4.1	2.3	6.4	6.1	0.3	6.4	4.4	2.0	6.4
	Retired	31.9	5.6	37.5	35.7	1.8	37.5	35.4	2.1	37.5
	Other inactive	8.1	1.4	9.5	9.2	0.3	9.5	9.1	0.4	9.5
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0
Education groups	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	ISCED 0-2 low	2.4	1.2	3.6	3.1	0.5	3.6	3.4	0.2	3.6
	ISCED 3-4 + 9 medium	36.8	7.0	43.8	41.9	1.9	43.8	39.4	4.4	43.8
	ISCED 5-6 lower tertiary	28.4	5.0	33.4	32.3	1.1	33.4	30.7	2.7	33.4
	ISCED 7-8 higher tertiary	17.7	1.5	19.2	19.0	0.2	19.2	18.2	1.0	19.2
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
Net monthly income range in EUR	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	0-1200 EUR, low	25.9	6.5	32.4	30.4	2.0	32.4	28.1	4.3	32.4
	1201-2400 EUR, lower-middle	17.3	3.8	21.1	21.0	0.1	21.1	19.7	1.4	21.1
	2401-3600 EUR, upper-middle	5.6	0.9	6.5	6.5	0.	6.5%	6.4	0.1	6.5

To be continued

Appendix Table 7: Descriptive analysis of socio-economic variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Net monthly income range in EUR	3601-6500 EUR, high income	1.6	0.0	1.6%	1.6	0.0	1.6	1.6	0.0	1.6
	didn't want to answer	34.9	3.5	38.4	36.8	1.6	38.4	35.9	2.5	38.4
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
Is your household able to make ends meet?	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	No	28.6	12.0	40.6	38.3	2.3	40.6	33.8	6.8	40.6
	Yes	51.4	7.0	58.4	57.7	0.7	58.4	57.1	1.3	58.4
	(empty)	0.8	0.2	1.0	1.0	0.0	1.0	0.7	0.3	1.0
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	No	30.6	10.0	40.7	38.0	2.7	40.7	31.7	9.0	40.7
	Yes	52.0	6.5	58.5	58.3	0.2	58.5	57.6	0.9	58.5
	(empty)	0.7	0.2	0.9	0.9	0.0	0.9	0.9	0.0	0.9
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	No	38.2	9.9	48.1	46.4	1.7	48.1	39.3	8.8	48.1
	Yes	46.2	5.1	51.3	51.0	0.3	51.3	50.4	0.9	51.3
	(empty)	0.5	0.1	0.6	0.6	0.0	0.6	0.6	0.0	0.6
Is your household able to make ends meet?	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	No	33.6	8.9	42.5	39.9	2.6	42.5	35.6	6.9	42.5
	Yes	50.5	5.6	56.1	55.0	1.1	56.1	54.7	1.4	56.1
Did received: Unemployment benefit	(empty)	1.2	0.2	1.4	1.4	0.0	1.4	1.4	0.0	1.4
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Yes	3.4	1.9	5.3	91.2	3.4	94.6	87.7	6.9	94.6
	No	81.9	12.8	94.6	5.0	0.3	5.3	3.9	1.4	5.3
	(empty)	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1

To be continued

Appendix Table 7: Descriptive analysis of socio-economic variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Did received: Disability benefit/pension	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Yes	5.9	1.9	7.8	7.3	0.5	7.8	7.1	0.7	7.8
	No	79.3	12.8	92.0	88.8	3.2	92.0	84.4	7.6	92.0
	(empty)	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2
Did received: Social assistance or minimum income benefit	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Yes	1.9	1.9	3.8	3.4	0.4	3.8	2.6	1.2	3.8
	No	83.3	12.8	96.1	92.8	3.3	96.1	89.0	7.1	96.1
	(empty)	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1

Source: Own work.

Appendix Table 8: Descriptive analysis of accommodation variables with EP problems (%)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Size of accommodation by no of rooms	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	1-2 rooms, small	27.3	11.5	38.8	36.9	1.8	38.8	33.4	5.3	38.8
	3-5 rooms, medium	46.8	6.8	53.6	52.4	1.2	53.6	50.7	2.8	53.6
	6-12 rooms, large	6.8	0.8	7.7	7.7	0.0	7.7	7.3	0.3	7.7
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	1-2 rooms, small	26.1	7.2	33.3	31.3	2.0	33.3	28.8	4.5	33.3
	3-5 rooms, medium	49.7	7.8	57.5	57.0	0.5	57.5	52.8	4.7	57.5
	6-12 rooms, large	6.5	1.0	7.4	7.4	0.0	7.4	7.1	0.4	7.4
	(empty)	1.1	0.7	1.7	1.4	0.4	1.7	1.5	0.2	1.7
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0

To be continued

Appendix Table 8: Descriptive analysis of accommodation variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Size of accommodation by no of rooms	1-2 rooms, small	26.8	8.0	34.8	33.4	1.4	34.8	30.7	4.2	34.8
	3-5 rooms, medium	53.0	6.4	59.4	58.8	0.6	59.4	54.4	5.1	59.4
	6-12 rooms, large	4.4	0.4	4.8	4.8	0.0	4.8	4.5	0.3	4.8
	(empty)	0.8	0.2	1.0	1.0	0.0	1.0	0.8	0.2	1.0
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	1-2 rooms, small	25.9	5.9	31.8	30.2	1.6	31.8	28.2	3.6	31.8
	3-5 rooms, medium	52.1	8.3	60.4	58.3	2.1	60.4	56.5	3.9	60.4
	6-12 rooms, large	6.6	0.4	7.0	7.0	0.0	7.0	6.2	0.8	7.0
	(empty)	0.7	0.1	0.8	0.8	0.0	0.8	0.8	0.0	0.8
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0
Ownership status	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Owned without mortgage	73.0	11.5	84.4	81.6	2.9	84.4	78.8	5.7	84.4
	Owned with mortgage	5.6	0.6	6.2	6.1	0.1	6.2	5.0	1.2	6.2
	Rented, from social, municipal or non-profit housing provider	2.0	1.1	3.1	2.8	0.3	3.1	2.3	0.8	3.1

To be continued

Appendix Table 8: Descriptive analysis of accommodation variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Ownership status	Rented, from private landlord or company	1.7	0.2	1.9	1.7	0.2	1.9	1.6	0.3	1.9
	Other	2.6	1.1	3.7	3.5	0.2	3.7	3.4	0.3	3.7
	(empty)	0.5	0.2	0.7	0.7	0.0	0.7	0.7	0.0	0.7
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
Living area	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	The open countryside	4.8	1.2	6.0	5.5	0.5	6.0	5.2	0.8	6.0
	A village/small town	45.8	12.1	57.9	56.6	1.3	57.9	51.2	6.7	57.9
	A medium to large town	23.8	4.5	28.3	27.3	1.0	28.3	27.6	0.7	28.3
	A city or city suburb	6.3	1.3	7.7	7.5	0.2	7.7	7.3	0.3	7.7
	(empty)	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	The open countryside	11.7	2.6	14.3	14.2	0.1	14.3	13.4	0.9	14.3
	A village/small town	43.2	8.7	51.9	50.5	1.4	51.9	46.2	5.7	51.9
	A medium to large town	24.1	4.7	28.8	27.4	1.4	28.8	26.2	2.6	28.8
	A city or city suburb	4.3	0.7	5.0	4.9	0.1	5.0	4.3	0.7	5.0
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	The open countryside	3.4	1.6	5.0	4.9	0.1	5.0	4.0	1.0	5.0
	A village/small town	54.6	10.0	64.6	63.6	1.0	64.6	57.8	6.7	64.6

To be continued

Appendix Table 8: Descriptive analysis of accommodation variables with EP problems (%)
(cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Living area	A medium to large town	21.0	2.7	23.7	22.9	0.8	23.7	22.2	1.5	23.7
	A city or city suburb	6.0	0.8	6.7	6.6	0.1	6.7	6.3	0.5	6.7
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	The open countryside	14.0	2.7	16.7	15.8	0.9	16.7	15.9	0.8	16.7
Living area	A village/small town	45.5	8.7	54.1	52.8	1.3	54.1	49.6	4.6	54.1
	A medium to large town	12.7	2.4	15.1	14.0	1.1	15.1	13.4	1.7	15.1
	A city or city suburb	13.2	0.9	14.1	13.7	0.4	14.1	12.9	1.2	14.1
	(empty)	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0
Did you move to save housing costs?	2003	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	No	80.9	19.1	100.0	97.0	3.0	100.0	91.5	8.5	100.0
	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	No	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	No	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	No	85.1	14.7	99.8	96.1	3.7	99.8	91.6	8.2	99.8
	Yes	0.2	0.0	0.2	0.2	0.0	0.2	0.1	0.1	0.2
	SUM	83.9	16.1	100.0	97.1	2.9	100.0	90.8	9.2	100.0

Source: Own work.

*Appendix Table 9: Descriptive analysis of social and health variables with EP problems
(%)*

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Usage of internet	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	Every day or almost every day	43.9	4.5	48.4	48.0	0.4	48.4	45.3	3.1	48.4
	At least once a week	9.2	1.1	10.3	10.1	0.2	10.3	9.3	1.0	10.3
	One to three times a month	1.4	0.6	2.0	1.8	0.2	2.0	1.6	0.4	2.0
	Less often	3.9	0.9	4.8	4.5	0.3	4.8	4.2	0.6	4.8
	Never	26.0	7.9	33.9	33.0	0.9	33.9	29.6	4.4	33.9
	(empty)	0.5	0.1	0.6	0.6	0.0	0.6%	0.3	0.3	0.6
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Every day or almost every day	43.8	6.8	50.5	48.9	1.7	50.5	46.3	4.3	50.5
	At least once a week	9.7	1.2	10.9	10.5	0.4	10.9	9.8	1.1	10.9
	One to three times a month	1.8	0.4	2.2	2.1	0.1	2.2	2.1	0.1	2.2
	Less often	5.2	0.5	5.7	5.6	0.1	5.7	5.3	0.4	5.7
	Never	24.4	5.7	30.1	28.8	1.3	30.1	27.7	2.4	30.1
	(empty)	0.5	0.1	0.6	0.5	0.1	0.6	0.6	0.0	0.6
	SUM	85.1	14.9	100.0	97.2	2.8	100.0	91.0	9.0	100.0
How is your health?	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	Very good	15.7	2.1	17.8	17.7	0.1	17.8	17.0	0.8	17.8
	Good	31.7	5.7	37.4	37.0	0.4	37.4	34.3	3.1	37.4
	Fair	25.6	4.9	30.5	29.6	1.0	30.5	26.9	3.7	30.5

To be continued

Appendix Table 9: Descriptive analysis of social and health variables with EP problems
(%) (cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
How is your health?	Bad	8.6	3.3	11.9	10.7	1.2	11.9	10.2	1.6	11.9
	Very bad	1.6	0.6	2.2	1.9	0.3	2.2	1.6	0.6	2.2
	(empty)	0.1	0.1	0.2	0.2	0.0	0.2	0.1	0.1	0.2
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	Very good	19.5	2.0	21.5	21.4	0.1	21.5	20.3	1.2	21.5
	Good	35.1	4.4	39.5	39.0	0.5	39.5	37.0	2.5	39.5
	Fair	23.1	5.5	28.6	28.4	0.2	28.6	24.3	4.3	28.6
	Bad	5.6	2.9	8.4	7.4	1.0	8.4	6.9	1.5	8.4
	Very bad	1.6	0.4	2.0	1.8	0.2	2.0	1.7	0.3	2.0
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Very good	16.3	2.5	18.7	18.3	0.4	18.7	17.2	1.5	18.7
	Good	35.5	4.7	40.2	39.0	1.2	40.2	36.9	3.3	40.2
	Fair	23.3	5.0	28.3	27.6	0.7	28.3	26.0	2.3	28.3
	Bad	8.9	1.7	10.6	9.7	0.9	10.6	9.7	0.9	10.6
	Very bad	1.2	0.8	2.0	1.5	0.5	2.0	1.7	0.3	2.0
	(empty)	0.2	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0.2
	SUM	84.5	15.5	100.0	97.1	2.9	100.0	90.7	9.3	100.0
Chronic physical or mental health problem, illness or disability?	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	No	58.8	10.0	68.8	68.0	0.8	68.8	63.2	5.6	68.8
	Yes	24.2	6.8	30.9	28.8	2.1	30.9	26.7	4.3	30.9
	(empty)	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	No	68.5	10.5	79.0	78.0	1.0	79.0	71.7	7.2	79.0
	Yes	16.2	4.6	20.7	19.7	1.0	20.7	18.3	2.5	20.7
	(empty)	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	No	61.3	7.8	69.1	67.1	2.0	69.1	63.2	5.9	69.1
	Yes	23.6	6.9	30.5	28.8	1.7	30.5	28.2	2.3	30.5
	(empty)	0.4	0.0	0.4	0.4	0.0	0.4	0.3	0.1	0.4
	SUM	84.5	15.5	100.0	97.1	2.9	100.0	90.7	9.3	100.0
Feeling left out of society	2007	83.3	16.7	100.0	97.1	2.9	100.0	90.1	9.9	100.0
	Strongly agree	0.4	0.4	0.8	0.7	0.1	0.8	0.4	0.4	0.8
	Agree	3.1	1.7	4.8	4.4	0.4	4.8	3.6	1.3	4.8

To be continued

Appendix Table 9: Descriptive analysis of social and health variables with EP problems (%) (cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Feeling left out of society	Neither agree nor disagree	6.5	2.5	9.0	8.4	0.6	9.0	7.1	1.8	9.0
	Disagree	37.8	6.8	44.5	43.0	1.5	44.5	40.2	4.3	44.5
	Strongly disagree	35.6	5.3	40.9	40.6	0.3	40.9	38.8	2.0	40.9
	2011	84.9	15.1	100.0	98.0	2.0	100.0	90.3	9.7	100.0
	Strongly agree	0.6	0.1	0.7	0.7	0.0	0.7	0.7	0.0	0.7
	Agree	1.9	1.6	3.5	3.1	0.4	3.5	2.7	0.8	3.5
	Neither agree nor disagree	7.6	2.1	9.7	9.1	0.6	9.7	8.0	1.7	9.7
	Disagree	36.8	5.9	42.7	42.1	0.6	42.7	38.8	3.9	42.7
	Strongly disagree	38.0	5.5	43.5	43.1	0.4	43.5	40.1	3.4	43.5
	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Strongly agree	0.8	0.5	1.3	0.9	0.4	1.3	1.0	0.3	1.3
	Agree	4.8	0.9	5.7	4.8	0.9	5.7	5.0	0.7	5.7
	Neither agree nor disagree	7.4	1.7	9.1	8.9	0.2	9.1	8.5	0.6	9.1
	Disagree	34.0	5.9	39.9	38.8	1.1	39.9	35.6	4.3	39.9
	Strongly disagree	38.4	5.7	44.1	43.0	1.1	44.1	41.7	2.4	44.1
	SUM	84.5	15.5	100.0	97.1	2.9	100.0	90.7	9.3	100.0
Worried that your income in old age will not be sufficient?	2016	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0
	Not concerned	12.5	2.3	14.8	14.6	0.2	14.8	13.9	0.9	14.8
	Slightly concerned	9.8	1.2	11.0	10.6	0.4	11.0	9.8	1.2	11.0

To be continued

Appendix Table 9: Descriptive analysis of social and health variables with EP problems (%) (cont.)

Independent variable	Year	Have inadequate housing conditions?			Afford adequately warm home?			Unable to pay utility bills?		
		No	Yes	SUM	No	Yes	SUM	No	Yes	SUM
Worried that your income in old age will not be sufficient?	Moderately concerned	20.2	2.3	22.5	21.7	0.8	22.5	21.7	0.8	22.5
	Very concerned	17.5	2.4	19.9	19.4	0.5	19.9	18.3	1.6	19.9
	Extremely concerned	24.5	6.4	30.9	29.1	1.8	30.9	27.2	3.7	30.9
	(empty)	0.8	0.1	0.9	0.9	0.0	0.9	0.8	0.1	0.9
	SUM	85.3	14.7	100.0	96.3	3.7	100.0	91.7	8.3	100.0

Source: Own work.

Appendix 4: Logistic analysis

Appendix Table 10: Logistic regression predicting inadequate housing conditions

Variable	Estimate	OR	95% CI	Std. Error	z	p
(Intercept)	-0.011	0.99	[0.09, 9.46]	1.177	-0.01	0.992
Age Early Career Adults (25-34)	-0.239	0.79	[0.16, 4.38]	0.836	-0.29	0.775
Age Established Adults (35-49)	0.727	2.07	[0.42, 11.75]	0.838	0.87	0.386
Age Midlife and Pre-retirement (50-64)	0.343	1.41	[0.27, 8.22]	0.858	0.40	0.689
Age Seniors (65-95)	-0.775	0.46	[0.07, 3.16]	0.955	-0.81	0.417
Medium sized household members (3-4)	-0.267	0.77	[0.39, 1.50]	0.345	-0.77	0.439
Large household members (5-6)	0.141	1.15	[0.42, 3.06]	0.503	0.28	0.780
Extended household members (7+)	0.413	1.51	[0.15, 12.79]	1.097	0.38	0.706
Gender	-0.043	0.96	[0.57, 1.59]	0.259	-0.17	0.868
Good health	-0.440	0.64	[0.31, 1.35]	0.371	-1.19	0.236
Fair health	-0.250	0.78	[0.36, 1.72]	0.399	-0.63	0.531
Bad health	-0.583	0.56	[0.20, 1.55]	0.526	-1.11	0.268
Very bad health	0.534	1.71	[0.37, 7.52]	0.763	0.70	0.484
Married status	-0.736	0.48	[0.23, 1.01]	0.377	-1.95	0.051†
Separated status	-0.491	0.61	[0.03, 5.41]	1.250	-0.39	0.694
Widowed status	-0.521	0.59	[0.20, 1.70]	0.539	-0.97	0.334
Divorced status	0.299	1.35	[0.42, 4.16]	0.579	0.52	0.606
Unemployed status	1.627	5.09	[2.13, 12.35]	0.447	3.64	0.0003***
Retired status	0.828	2.29	[1.01, 5.20]	0.416	1.99	0.047*

To be continued

Appendix Table 14: Logistic regression predicting inadequate housing conditions (cont.)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Other inactive status	0.099	1.10	[0.28, 3.92]	0.663	0.15	0.881
Medium education (ISCED 3-4 + 9)	-1.275	0.28	[0.09, 0.83]	0.550	-2.32	0.020*
Lower tertiary education (ISCED 5-6)	-1.329	0.26	[0.08, 0.84]	0.586	-2.27	0.023*
Higher tertiary education (ISCED 7-8)	-1.627	0.20	[0.05, 0.71]	0.656	-2.48	0.013*
Middle income (1201-2400 EUR)	0.276	1.32	[0.70, 2.50]	0.324	0.85	0.394
High income (2401-6500 EUR)	0.054	1.06	[0.37, 2.88]	0.520	0.10	0.918
Making ends meet with difficulty or not able	-0.607	0.54	[0.31, 0.95]	0.284	-2.14	0.032*
Medium accommodation (3-5 rooms)	-0.242	0.79	[0.45, 1.38]	0.286	-0.85	0.398
Large accommodation (6-12 rooms)	-0.591	0.55	[0.12, 2.02]	0.709	-0.83	0.404
Owned accommodation with mortgage	-0.449	0.64	[0.20, 1.74]	0.547	-0.82	0.411
Rented accommodation, from social, municipal or non-profit housing provider	0.411	1.51	[0.40, 5.40]	0.659	0.62	0.533
Rented accommodation, from private landlord or company	-0.810	0.44	[0.06, 2.20]	0.893	-0.91	0.364
Other accommodation	0.632	1.88	[0.60, 5.46]	0.559	1.13	0.258
Living in a village/small town	-0.250	0.78	[0.41, 1.51]	0.332	-0.75	0.452
Living in a medium to large town	-0.417	0.66	[0.24, 1.76]	0.506	-0.82	0.410

To be continued

Appendix Table 14: Logistic regression predicting inadequate housing conditions (cont.)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Living in a city or city suburb	-2.550	0.08	[0.02, 0.23]	0.580	-4.39	0.00001***
Podravska region	0.399	1.49	[0.28, 6.55]	0.786	0.51	0.612
Koroška region	0.502	1.65	[0.47, 5.82]	0.635	0.79	0.430
Savinjska region	0.049	1.05	[0.21, 4.54]	0.768	0.06	0.949
Zasavska region	-0.517	0.60	[0.08, 3.10]	0.910	-0.57	0.570
Posavska region	1.986	7.29	[2.73, 21.48]	0.523	3.80	0.0001***
Jugovzhodna Slovenija region	1.152	3.17	[1.19, 9.22]	0.518	2.22	0.026*
Osrednjeslovenska region	0.885	2.42	[0.72, 8.33]	0.619	1.43	0.153
Gorenjska region	0.814	2.26	[0.46, 10.02]	0.774	1.05	0.293
Goriška region	0.452	1.57	[0.49, 5.14]	0.591	0.76	0.445
Obalno-kraška and Primorsko-notranjska regions	0.015	1.02	[0.19, 4.41]	0.780	0.02	0.984

Source: Own work.

Appendix Table 11: Logistic regression predicting inability to pay utility bills

Variable	Estimate	OR	95% CI	Std. Error	z	p
Intercept	-1.581	0.21	[0.01, 4.85]	1.676	-0.944	.345
Age Early Career Adults (25-34)	1.076	2.93	[0.38, 30.74]	1.092	0.986	.324
Age Established Adults (35-49)	-0.070	0.93	[0.12, 10.08]	1.115	-0.063	.950
Age Midlife and Pre-retirement (50-64)	-0.212	0.81	[0.10, 8.83]	1.128	-0.188	.851
Age Seniors (65-95)	-0.020	0.98	[0.09, 12.83]	1.237	-0.016	.987
Medium sized household (3-4 members)	-0.309	0.73	[0.29, 1.79]	0.458	-0.674	.500

To be continued

Appendix Table 16: Logistic regression predicting inability to pay utility bills (cont.)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Large household (5+ members)	0.059	1.06	[0.28, 3.85]	0.662	0.089	.929
Gender	0.098	1.10	[0.57, 2.14]	0.337	0.292	.771
Good health	-0.602	0.55	[0.22, 1.39]	0.468	-1.284	.199
Fair health	-0.840	0.43	[0.15, 1.24]	0.534	-1.573	.116
Bad health	-0.821	0.44	[0.12, 1.54]	0.642	-1.279	.201
Very bad health	0.314	1.37	[0.21, 8.02]	0.917	0.342	.732
Married status	0.194	1.21	[0.47, 3.30]	0.497	0.391	.696
Separated status	0.468	1.60	[0.06, 18.27]	1.341	0.349	.727
Widowed status	-0.534	0.59	[0.13, 2.48]	0.747	-0.715	.474
Divorced status	0.524	1.69	[0.39, 6.83]	0.719	0.728	.467
Unemployed status	0.495	1.64	[0.58, 4.44]	0.514	0.963	.336
Retired status	-0.417	0.66	[0.19, 2.15]	0.612	-0.681	.496
Other inactive status	0.059	1.06	[0.20, 4.84]	0.796	0.074	.941
Medium education (ISCED 3-4 + 9)	0.959	2.61	[0.56, 20.08]	0.881	1.089	.276
Lower tertiary education (ISCED 5-6)	1.048	2.85	[0.55, 23.12]	0.919	1.139	.255
Higher tertiary education (ISCED 7-8)	0.149	1.16	[0.16, 11.36]	1.054	0.141	.888
Middle income (1201-2400 EUR)	-0.863	0.42	[0.17, 1.00]	0.446	-1.934	.053†
High income (2401-6500 EUR)	-2.615	0.07	[0.00, 0.50]	1.168	-2.239	.025*
Making ends meet with difficulty or not able	-1.926	0.15	[0.06, 0.33]	0.443	-4.353	<.001***
Medium accommodation (3-5 rooms)	0.080	1.08	[0.54, 2.17]	0.351	0.227	.820

To be continued

Appendix Table 16: Logistic regression predicting inability to pay utility bills (cont.)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Large accommodation (6-12 rooms)	0.760	2.14	[0.26, 12.26]	0.948	0.801	.423
Owned accommodation with mortgage	0.890	2.44	[0.75, 7.17]	0.569	1.564	.118
Rented accommodation, from social, municipal or non-profit housing provider	0.525	1.69	[0.40, 6.49]	0.699	0.751	.453
Rented accommodation, from private landlord or company	-0.700	0.50	[0.06, 2.54]	0.909	-0.771	.441
Other accommodation	0.152	1.16	[0.23, 4.43]	0.735	0.207	.836
Living in a village/small town	0.109	1.12	[0.41, 3.40]	0.531	0.205	.837
Living in a medium to large town	-0.025	0.98	[0.24, 4.07]	0.715	-0.035	.972
Living in a city or city suburb	0.066	1.07	[0.28, 4.19]	0.679	0.097	.923
Podravska region	-1.016	0.36	[0.02, 3.01]	1.218	-0.834	.404
Koroška region	0.675	1.96	[0.44, 9.15]	0.768	0.879	.379
Savinjska region	-0.534	0.59	[0.06, 3.89]	1.010	-0.528	.597
Zasavska region	-0.052	0.95	[0.15, 5.23]	0.889	-0.059	.953
Posavska region	0.404	1.50	[0.41, 5.98]	0.678	0.596	.551
Jugovzhodna Slovenija region	-0.210	0.81	[0.22, 3.19]	0.671	-0.314	.754
Osrednjeslovenska region	-1.309	0.27	[0.03, 1.61]	0.962	-1.361	.174
Gorenjska region	-0.993	0.37	[0.02, 3.31]	1.245	-0.798	.425
Goriška region	-0.987	0.37	[0.06, 1.88]	0.844	-1.170	.242

To be continued

Appendix Table 16: Logistic regression predicting inability to pay utility bills (cont.)

Variable	Estimate	OR	95% CI	Std. Error	z	p
Obalno-kraška and Primorsko-notranjska regions	-0.029	0.97	[0.15, 5.56]	0.906	-0.032	.974

Source: Own work.