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Synergies between heating and energy poverty - the injustice of heat

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Author's declaration

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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The energy transition offers the opportunity for designing the energy systems of tomorrow, but due to its focus on technologies and misalignment with social policies, it might exclude energy vulnerable citizens. Energy poverty is a spatially depended and structurally embedded phenomenon, affecting heating as a space where multiple vulnerabilities clash. There is a knowledge gap about the complex relationship of energy poverty and the heat market, in the context of the energy transition in different European countries.

Through the lenses of energy justice, I explored the synergies between energy poverty and the type of heating in developing and developed European contexts. The conceptual framework applied distributive, recognition, and procedural energy justice to study the relationship between energy poverty and the type of heating. The framework was enriched with energy culture, coping, right to energy, and institutional good governance literature. I used a comparative case study with maximum variation sampling of an 'eastern' and 'western' European country enhanced by mixed qualitative and qualitative methods and a focus on the lived experience of the energy-poor. The studied countries North Macedonia and Austria have diverse levels of energy poverty, energy markets, standards of living, and socio-political legacy. I analyzed qualitatively and quantitatively the empirical data of 300 phone surveys with households; 219 online interviews with households; 54 interviews with stakeholders, and several documents in both counties.

Not having installed energy efficiency measures, having a non-central type of heating, and living in large, old dwellings in the rural areas predict energy poverty in both countries. The material deprivation is experienced by citizens without a university education, who are a non-majority population, women, pensioners, ill persons, and large or single-person households. The material deprivation is visible through the coping strategies aimed at reducing energy needs and warmth compensation. Hidden energy poverty indicators include the energy market structure and ownership, how energy utilities treat citizens, the strength of the social welfare system, and the availability of support. While heating is relevant in both countries, energy poverty as an experience of material deprivation affects all energy services. Electric heating and fuelwood are more related to energy poverty, while central forms of heating are less related, although they might be related to injustices.

Energy poverty is a vulnerable space determined by infrastructural path-dependencies and projected into technological inequalities that further deepen its spatial vulnerability. Energy poverty is at the core an experience close to material deprivation visible in the path-dependently determined fuels and technologies to maximize the coping of energy-poor households to cultivate a culturally distinct life on the subsistence level. The institutional good governance and the consideration for the right to energy principle determine the ability of citizens to enjoy affordable, modern, and efficient energy services, as well as to include their voices and needs in that process. The relationship between energy poverty and the type of heating is highly complex. The energy transition needs to be a human-focused, inclusive and empowering socially just energy transformation which brings closer the visionary concept of energy justice to citizens.

Keywords: energy poverty; energy justice; type of heating; energy vulnerability; energy transition

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List of Abbreviations

24/7 – 24 hours, 7 days

2M – twice the median

AG – corporation (Aktiengesellschaft)

AIT – Austrian Institute of Technology

AMAN – expression with the meaning Come on/ It is enough

AT – Austria

B – the amount of increase or decrease of predicted odds

BEG – Balkan Energy Group

CEU – Central European University

CO2 – Carbon dioxide

CRPM – Center for Research and Policy Making

d.f. - degrees of freedom

DPA – Democratic Party of Albanians

DUI – Democratic Union for Integration

EAPN – European Anti-Poverty Network

EBRD - European Bank for Reconstruction and Development

E-Control - Energie-Control

EE – energy efficient

ELEM – Power plants of Macedonia

EPOV – Energy Poverty Observatory

EPSU – European Public Service Union

E-Sieben - e7 energy innovation & engineering

EU – European Union

EUR - Euro

EVN - electricity supplier in North Macedonia

Exp(B) – odd ratios for the predictors

FEIT - Faculty of Electrical Engineering and Information Technologies

GAMA - Joint Stock Company GA-MA

GDP – Gross Domestic Product

GEF - Global Environment Facility

GIZ - German Association for International Cooperation

IFZ – Interdisciplinary Research Center for Technology, Work and Culture

IWO – Institute for Heat and Oil Technology

JKU - Johannes Kepler University Linz

KFW - Kreditanstalt für Wiederaufbau (development bank)

LPG – Liquefied petroleum gas

M/2 – half the median

m^2 -square meter

MK - North Macedonia

no. - number

OÖ – Upper Austria

p.m. – after noon

S.E. – standard errors

SDSM – Social Democratic Union of Macedonia

Sig. - significance

SPSS - Statistical package for the social sciences

T – temperature

TE-TO - co-generation utility in North Macedonia

TU – University of Technology

UK – United Kingdom

UNDP - United Nations Development Program

US – United States of America

USAID - United States Agency for International Development

VMRO - Internal Macedonian Revolutionary Organization vs. - versus

WIFO – Austrian Institute of Economic research

1. CHAPTER 1: BACKGROUND AND SETTING THE SCENE

This chapter introduces the research topic, the research objectives and justifies the topic's selection. I begin with an introductory subsection showing how my proposed research would fill in the literature gaps, while I introduce the main concepts. In the following subsection, I formulate the research questions and justify the relevance of my doctoral research.

1.1 Introduction

The EU-led energy transition has received much-needed academic attention, however, it should not be only focused on studying technologies and fuels (Jenkins *et al.* 2017). At the core of the energy system are, however, its citizens who along with institutions and policies are part of a specific energy culture (LaBelle 2020). From an energy justice point of view, everyone is entitled to use affordable, safe, and clean energy (Heffron and McCauley 2014)[1]. However, almost 50 million people across the EU are affected by energy poverty (Thomson and Bouzarovski 2018), defined as the inability to attain a socially and materially necessitated level of domestic energy services (Bouzarovski and Petrova 2015a)[2]. Being vulnerable to energy poverty impedes their participation in the energy transition process (Bouzarovski and Tirado Herrero 2017a; Sovacool *et al.* 2019), and raises questions about the inclusiveness of the energy transition (Stojilovska 2020). Anticipating the challenges of an inclusive and just energy transition, under the slogan 'leaving no one behind' and with efforts to fight climate change, the Brussels administration launched the European Green Deal underlying energy poverty (European_Commission n.d.). Energy poverty and energy justice discourses uncover a complex and spatially-depended socio-economic system

[1] This understanding is the basis for developing the working definition of energy justice and its operationalization in this thesis as presented in Table 2.
[2] This understanding is the basis for developing the working definition of energy poverty and its operationalization in this thesis as presented in Table 2.

that co-produces energy vulnerability (Bouzarovski and Simcock 2017; Heffron *et al.* 2015; Petrova 2018).

As a spatially and structurally embedded phenomenon, energy poverty is most visible through the heat market, which is an understudied area in the context of the European energy transition. The initial understanding is that the heat market is co-shaped by the available infrastructure, fuels, and building quality, but also by the market and decision-makers, and finally by the needs, features, and practices of the households, making it a distinct space in which multiple injustices interact. And at the heart of these policy crossroads are the struggles and the resilience of the energy-poor. Fuels and technologies are a focal point of energy-poor households' coping strategies, and gain attention for the spatial inequalities they represent and reinforce. There is a knowledge gap about the complex relationship of energy poverty and the heat market from an energy justice point of view considering both the developing and developed countries' perspective. The spatial divide of energy poverty between the 'east' and the 'west' seems not to be merely physical, but it is also embedded in the economic and political space determined by path-dependencies. This dissertation addresses this lack of knowledge through a comparative case study in a European context with maximum variation sampling of an 'eastern' and 'western' country enhanced by mixed qualitative and quantitative methods in which the focus is on the lived experience of the energy-poor.

The literature talks about the significance of heating to energy poverty (Buzar 2007a; Fahmy *et al.* 2011) and mentions how some ways of heating the dwelling are related to energy poverty (Boardman 2010; Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016; Brunner *et al.* 2012; Tirado Herrero and Ürge-Vorsatz 2012). However, there is a lack of systematic and holistic knowledge about the synergies between heating and energy poverty. There is a lack of research about how energy poverty is experienced based on how the dwelling is heated and the energy injustices embedded in different heating systems in both developed and developing European contexts. In this line, if fuelwood in a post-socialist context is connected to the presence of energy poverty (Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016), there is a lack of knowledge about this relationship in a developed European country. The reason for comparing different countries regarding the synergies between energy poverty and the way dwellings are heated is to test the more general applicability of these synergies in the European context.

According to the energy justice concept, energy poverty is one important injustice (Walker Gordon and Day 2012). In this regard, energy poverty is an injustice due to the unequal access to energy services, different rights and needs of vulnerable consumers and access to information, and inclusion in decisions (Walker Gordon and Day 2012). One of the intended uses of energy justice is to be an evaluative and normative tool for detecting injustices (Jenkins *et al.* 2016). What the energy justice literature is missing is context-specific examples that go beyond the western world, and empirical knowledge about the application of this concept to detect and rectify injustices, especially energy poverty. In this line, there has been no specific research focusing on energy injustices in the region of Central Eastern Europe, although some injustices are detected in the energy poverty literature such as specific vulnerable groups in North Macedonia (Buzar 2007b). The EU, which to a large extent shapes the energy policies in EU member states and candidate countries, has begun integrating energy justice within its Energy Union concept, while it has finally embraced energy poverty in the European Green Deal.

I use energy justice to analyze energy poverty and its relation to heating due to a set of reasons. Firstly, energy justice demands a holistic approach to a problem, a whole systems approach (Jenkins *et al.* 2016), which means inspecting all involved aspects. This means that energy justice requires inspecting injustices in the heating sector, including the role of the relevant stakeholders and market players. These stakeholders shape decision about the heating and energy infrastructure. In this line, some decisions about heating and energy use in the households may not depend on the households themselves, thus certain injustices such as inability to connect to or disconnect from district heating may prevent households from addressing energy poverty. Furthermore, legislation might contain injustices. For example, if the district heating does not have consumption-based billing, the district heated households might be unmotivated to invest in energy efficiency. Second, energy justice can potentially broaden the understanding of energy poverty by considering consumers' choices (Jenkins *et al.* 2016) and not only their needs (energy needs were defined to be crucial to energy poverty – see Table 3). Moreover, the procedural justice aspect will also bring new knowledge about the state of energy poverty, such as whether protests against increasing energy prices have taken place as a result of a lack of debate on the topic. The energy justice concept is adequate to analyze energy poverty as its three tenets – distributive, procedural, and recognition justice – serve as a holistic evaluative and normative tool to inspect the synergies between energy poverty and the type of heating.

North Macedonia and Austria are chosen as case studies in this dissertation. Studying the relationship between energy poverty and heating, which is context-dependent, requires contrasted cases to help understand these synergies. If similar conclusions are drawn from cases with different contexts in a case study, generalizations beyond the two cases can be made (Yin 2003). North Macedonia and Austria have different historic, political, and socio-economic legacy, and different standards of living. North Macedonia is still a developing country, unlike Austria which is a developed one. Austria is in the EU, and North Macedonia is an EU candidate country. The situation of energy poverty is very different: Austria has a lower level of energy poverty (Thomson and Snell 2013), while in North Macedonia a large share of the households are energy-poor (Buzar

2007b). The heat markets of both countries are different – while Austria predominantly uses district heating or central heating (Statistik_Austria 2016b), approximately 91% of the households in North Macedonia use either electricity or fuelwood for heating (State_Statistical_Office 2015a). Both countries have to implement the EU policies on the low-carbon transition, while North Macedonia is still going through the process of energy market liberalization. Both liberalization and low-carbon transitions are related to energy vulnerability risks (Boardman 2010; Bouzarovski and Tirado Herrero 2017a; Buzar 2007a).

I use qualitative and qualitative methods. I am exploring the relationship between the type of heating and energy poverty which can be effectively statistically analyzed through a set of statistical operations, such as cross-tabulations and regression analyses of a representative sample of household surveys, energy-poor and not energy-poor, showing some aspects of this relationship, such as what type of households are in energy poverty, or which type of heating do energy-poor households use. To study the lived experience of the energy-poor (Middlemiss and Gillard 2015) I need to hear their stories, and conduct ethnographic interviews with energy-poor households, and explore how they perceive their situation, and use energy services at home. To get more information about the overall setup of policies and path-dependencies co-shaping energy poverty and energy justice, I need to interview relevant stakeholders which have experience with studying this material.

The proposed research follows up on the recommendations for further research on indicators to better measure energy justice around particular technologies (Sovacool and Dworkin 2015) and on advancing energy justice literature in developing country contexts (Yenneti and Day 2015). This is an opportunity to develop further the energy justice framework by applying it to European developing and developed contexts.

In the following section, I elaborate on the research questions, and then in the following chapter, I introduce the theoretical framework supported by a detailed literature review on energy justice and energy poverty. Next, I justify and explain the methodology and methods. In the subsequent chapter, I introduce the case studies, after which follow three chapters analyzing the findings, each on one energy justice tenet. The last chapter is the overall discussion and conclusion.

1.2 Objectives and research questions

The main aim of this dissertation is to analyze the relationship between energy poverty and the type of heating in both developing and developed European contexts. In order to do that, it will test the relevance of heating among other energy services in regard to the presence of energy poverty; will assess the injustices per type of heating; and will explore how types of heating are related to various aspects of energy poverty. Exploring the relationship between the type of heating and energy poverty would produce knowledge about their correlation, but also about their synergies at the crossroad of path-dependencies, policies, and coping strategies, allowing for causational links. Although the relationship between two key variables is studied, in order to approach the main research question in an unbiased and holistic way, the starting definition of energy poverty in this dissertation refers to all energy services (Bouzarovski and Petrova 2015a).

It is relevant to explain the notion "type of heating" used in this dissertation. Type of heating refers to the way households are heated. The statistical categorization of how dwelling are heated in Austria follows a breakdown per technology, such as central heating, electric heating, gas convector, and similar (Table 1, first column from left). Moreover, the division of the types of heating in Austria is similar to the one by Eurostat (see Table 1, second column from left), which is space-oriented, meaning whether there is a central form or heating, other fixed or mobile heating. In North Macedonia, the statistical categorization is done mainly by a breakdown per fuel, although a more detailed division combining technologies and fuels is also used (Table 1, third and fourth column from left), such as fuelwood, electricity, derived heat, and similar. Table 1 shows that the type of heating can be sampled around technologies or fuels. In my understating the difference in how the statistical offices of both countries classify the type of heating is to reflect the local practices of heating.

The type of heating can be divided into individual types of heating and central heating, out of which the individual type refers to types of heating for which no public infrastructure has been provided, such as heating with electricity or fuelwood. This allows enables finding a common ground between the different types of heating used in the studied countries. I categorize the types of heating to combine the technologies and fuels. Therefore, the type of heating used in this dissertation (column on the right) represents a mix of fuels and technologies in order to find the common denominator and combine the statistically different ways the types of heating in households are described in the two countries.

Table 1: Type of heating according to different statistics and used in this dissertation

Austria	**Eurostat**	**North Macedonia (primary energy commodity used for heating)**	**North Macedonia (type of heating)**	**Use of types of heating in this dissertation**
District heating	Central heating or similar	Fuelwood	Public central heating	District heating
Central house heating	Other fixed heating	Coal	Central heating from a shared boiler in a collective building	Central heating

Floor-level heating	Non-fixed heating	LPG	Central heating with a boiler installed in the apartment	Fuelwood
Gas converter	No heating	Other biomass	Air conditioner	Electricity
Electric heating		Derived heat	Heater on solid or liquid fuels	Gas converter
Heating on a single heater		Electricity	Thermal heaters	Combined - specify
No heating		Heating oil	Electrical panels	Other – specify
			Electrical heaters	No heating
			Floor electrical heating	
			Combined heating with solar collectors	
			Other types of heating	
Source: (Statistik_Austria 2016c)	Source: (Eurostat 2010)	Source: (State_Statistical_Office 2015a)	Source: (State_Statistical_Office 2015a)	Source: author

To pursue the stated aim, the central research question is:

What is the relationship of energy poverty to the type of heating in developing and developed European contexts?

The objective of the main research question is to test whether types of heating and energy poverty have a significant relationship and whether single types of heating are increasingly related to the presence of energy poverty. Less technologically advanced heating systems such as fuelwood or electricity (resistive heating) are increasingly related to the presence of energy poverty in the literature (Bouzarovski *et al.* 2016; Brunner *et al.* 2012). New technologies with high energy efficiency are considered as measures to alleviate energy poverty; however, they might not be accessible for the energy-poor (Boardman 2010). Analyzing this question from an energy justice perspective, in two different country contexts, and by using mixed methods, would generate both new theoretical insights about energy poverty as injustice, adding to the discussions about why the heat market and household heating can be an energy vulnerable space affecting energy-poor citizens, and highlighting any hidden injustices. This research aim will generate empirical results relevant to policies on energy poverty and for exploring energy justice indicators in the studied countries. Since energy poverty is defined as a phenomenon experienced in households (for more definitions, see Table 3), the analysis will be confined only to the residential sector.

In order to answer the main question, the following sub-questions guide the research:

What energy injustices do households with different types of heating experience?

The concrete objective of this question is to apply the energy justice concept to uncover the various energy injustices (distributive, procedural, and recognition) which households experience per type of heating. Distributive justice is most concrete about the injustices related to the types of heating, however, recognition and procedural justice are relevant as they are also shaped by distributive justice as noted by Walker Gordon and Day (2012), and thus they could be informative about the type of heating. For example, a vulnerable group like the elderly (recognition justice) might find a specific type of heating such as fuelwood more problematic due to the frequent physical activities needed to maintain the sparkle. Furthermore, a person might be affected by the actions of the district heating supplier (procedural justice) if the supplier misuses its dominant market position to increase prices. This question is broader than the main research question, but it assists the answering of the main question by focusing on what is relevant for energy poverty. For example, I will not explore supply-side injustices, such as how energy is produced, and any other areas that do not directly affect citizens and the use of their energy services at home.

How significant is heating among other energy services in regard to energy poverty?

The aim of this question is to test the relevance of heating among other energy services in regard to the presence of energy poverty. Since the types of heating are at the center of the analysis, it is crucial to approach this hypothesis holistically and test whether the heating is more relevant to energy poverty compared to other energy services. It is justified because the energy justice concept might uncover injustices that contribute to energy poverty related to other energy services rather than the heating.

What types of heating are related to specific aspects of energy poverty?

This question aims to discover whether certain types of heating are related to specific aspects of energy poverty, such as affordability, access, or comfort issues. Affordability refers to the financial ability to satisfy heating or energy needs. Access refers to limited options for heating which might keep the household in a cold home or with high energy or heating costs. Comfort refers to the level of indoor temperature and whether all occupied rooms are heated. This question helps to answer the main one by breaking down energy poverty into more applicable categories. It draws on the rich existing energy poverty literature and most commonly used energy poverty indicators, which I discuss in more detail in the following two chapters.

2. CHAPTER 2: CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

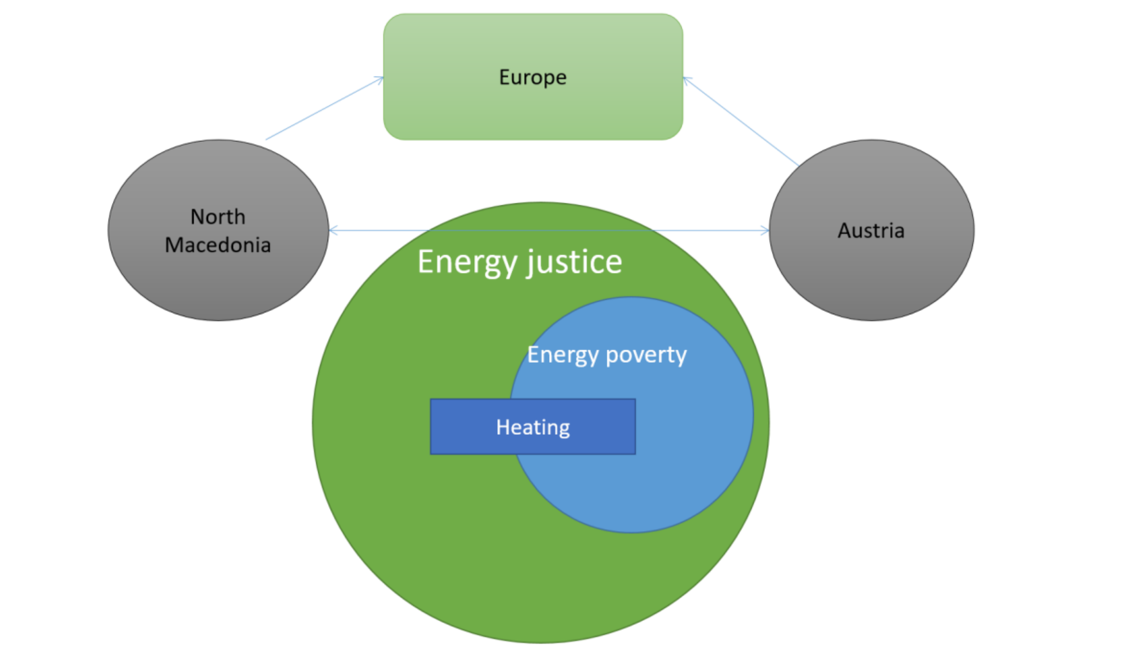
This lengthy chapter introduces the conceptual framework and explains how I have developed it. After I describe the conceptual framework, I provide a detailed literature review about energy justice and energy poverty. These two sets of literature review support the development of the conceptual framework, and in the next chapter, they help develop the methodology.

2.1 Conceptual framework

This section elaborates on the construction of the conceptual framework while defining and operationalizing the concepts used in this dissertation. To do so, first I show how the three main variables interact with each other also in relation to the geographical scope of the empirical case studies. Then, I elaborate in detail on the main concepts in Table 2. I provide their definitions, and I show how I use them in the dissertation. I do this not only for the primary concepts – the type of heating, energy justice, and energy poverty but also for the secondary which appear in the sub-research questions or in the interpretation of the main concepts. After that, in Figure 2 I summarize how the conceptual framework comes together to guide my research. And lastly, I show in Figure 3 how the conceptual framework feeds into the development of the research questions.

Recognizing the complex use of multiple concepts, two cases, various types of data, and mixed methods, I begin to visually depict my conceptual framework with Figure 1. It shows how the two main variables – heating and energy poverty are examined from an energy justice angle (the third main variable in my thesis). Figure 1 shows that energy justice is broader in scope than energy poverty, and the heat market might experience injustices beyond energy poverty. Having this scope and relationship between these three variables in mind, I examine mostly injustice with relevance for energy poverty. In fact, my main research question requires that the sub-research question about injustice per type of heating explore those of relevance for energy poverty. There are two very different cases in which commonalities in regard to the relationship between the two main variables might be relevant for a broader European context.

Figure 1: Visual depiction of the main concepts and geographical scope of the dissertation



Source: author

Next, I show in Table 2 the key definitions used for energy poverty, energy justice, the type of heating, and related relevant concepts, and I explain how they are operationalized in this dissertation. In the first column, I distinguish between the 'core' and 'secondary' concepts; the core being the two concepts used – energy justice and energy poverty, and the type of heating as a key variable. The secondary concepts appear in either the sub-research questions or are elements of the core concepts. The third column is a further elaboration and operationalization of these concepts into concrete indicators and variables used for data collection and discussion of the findings. For example, I follow the dominant definition of energy poverty by Bouzarovski and Petrova (2015a), but in order to apply this concept, I rely on the developed body of literature (presented in the following chapter) to break it down into 3 key aspects of experiencing energy poverty by households (access, affordability, and comfort). These three are relevant for connecting to the other key element, the type of heating, and are related to a set of well-known indicators collecting data about energy poverty, such as the subjectively assessed adequate warmth at home, the presence of condensation, and similar issues in the home. Energy justice is still this visionary concept of some form of energy 'paradise' of everyone having access to modern and affordable energy, but in the dissertation, it is developed through its three most commonly used tenets, as well as by borrowing inputs from energy culture, coping strategies, institutional good governance, and the right to energy concept. Each of the three tenets based on the cited literature is practically operationalized to absorb the latest literature and the empirical findings in the dissertation, at the same time upgrading these concepts, which is in more detail discussed in the concluding sections of the empirical chapters. The type of heating is presented as a combination of technology and fuel and in practice electric heating and fuelwood as mostly referred to as energy fuels, while central forms of heating are about the technology of centrally installed heating. I also present how I define the separate justice tenets based on which key articles. The concepts of lock-ins and path-dependencies are explanatory for the type of heating, such as the reasons for preference or dependence on certain fuel or technology, and for answering the research questions.

Table 2: Key concepts, definitions, and their operationalization in this dissertation

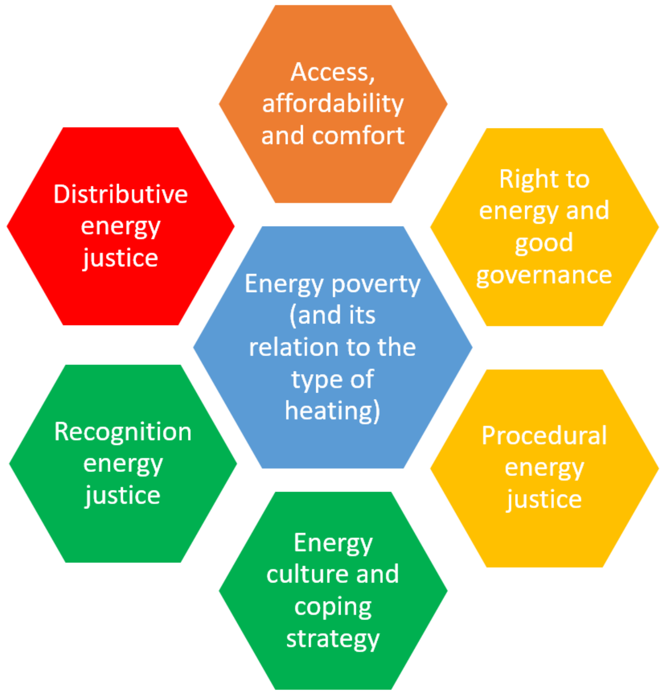
Concepts	Definition	Operationalization
Energy poverty (core)	Inability to attain a socially and materially necessitated level of domestic energy services (Bouzarovski and Petrova 2015a)	Affordability (inability to pay), access (lack of access), and comfort (cold dwelling, mold, damp, leaks, condensation, and rot) issues; referring to all energy services, but accounting for heating separately Developed into energy poverty indicators, and collection of socio-demographic, housing, and technological variables – for more see Figure 14 and 15
Access (secondary)	Inability to access a fuel or technology of one's choice (Buzar 2007b; Spagnoletti and O'Callaghan 2013)	Energy poverty indicator: Would you use another type of heating (another type)
Affordability (secondary)	Financial inability to use energy (Bouzarovski 2014; Brunner *et al.* 2012; Gaigalis *et al.* 2016; Scarpellini *et al.* 2015; Thomson and Snell 2013; Tirado Herrero and Ürge-Vorsatz 2012)	Energy poverty indicators: Can you afford energy costs for lighting, cooling, cooking, appliances, and hot water (afford energy services) Can you pay to keep the home adequately warm (afford warm) Do you economize your heating (economize heating) All are rooms heated (all heated) Does the household have arrears on electricity (arrears electricity) Does the household have arrears on heating (arrears heating)
Comfort (secondary)	Inability to stay warm/ keep the dwelling warm (Boardman 2010;	Energy poverty indicators: Can you adequately heat your home (heat ok)

	Brunner *et al.* 2012; Moore 2012; Waddams Price *et al.* 2012)	Do you economize your heating (economize heating) All are rooms heated (all heated) Presence of leaking roof, rotten windows, condensation, or damp walls (EE criteria) What is the average T (average T)
Type of heating (core)	The form of fuel and technology used for heating in households based on Austrian, Macedonian, and European standards (Eurostat 2010; State_Statistical_Office 2015a; Statistik_Austria 2016c)	A mix of technology and fuels – fuelwood and electricity are referred to as fuels, while central heating to the technology of heating installed with the capacity to heat the entire dwelling They have been divided into the following: district heating, central heating, fuelwood, electricity, gas converter, combined type of heating, other types of heating, and no heating
Energy justice (core)	Providing everyone with safe, affordable and, sustainable energy (Heffron and McCauley 2014), while burdens are shared and communities are included in energy decisions (Sovacool and Dworkin 2015)	Lack of energy poverty, and lack of distributive, recognition and procedural injustice, lack of acknowledgment of energy culture, and lack of practicing of right to energy, no institutional good governance of energy stakeholders, lock-ins contribute to household coping strategies
Distributive energy justice (secondary)	Energy poverty is shaped by the characteristics of localities and at the same time reproduces them (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012)	Spatial and distributive character of energy poverty
Recognition energy justice (secondary)	Energy poverty is considered an energy recognition injustice when the profiles of energy-poor are not recognized (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012)	Energy-poor vulnerable groups are misrecognized and structurally marginalized materially deprived citizens

	It also considers the misrecognition of coping strategies (Anderson *et al.* 2012; Brunner *et al.* 2012; Lazarus and Folkman 1984) which present a distinct cultural meaning of energy use (Horta *et al.* 2019; Wilhite *et al.* 1996)	
Procedural energy justice (secondary)	Energy poverty is influenced by the fairness of the decisions and policies affecting the energy-poor households (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012) It also considers the unfairness of not practicing the right to energy concept (EPSU and EAPN 2017; Hesselman and Herrero 2020; Hesselman *et al.* 2019; Walker Gordon 2015) It also draws on understanding the role of institutions and their good governance following global perspectives on energy justice (Rawls 1971; Sovacool and Dworkin 2015; Sovacool *et al.* 2017)	(Un)just institutions and policies enabling citizens to use affordable and clean energy or entrapping them to use expensive and polluting energy due to political, economic and, technological path-dependencies
Path-dependencies (secondary)	Phenomenon predicated upon a series of socio-technical lock-ins in which legacies are inherited from the past regarding infrastructure, energy supply and, housing (Bouzarovski *et al.* 2016)	How past decisions on infrastructure, housing, energy supply, and institutional setup have limited the choices and opportunities of the energy-poor. Leading to lock-ins
Lock-ins (secondary)	Unrealized energy and carbon saving potentials that result of below state-of-the-art energy efficiency technologies (Ürge-Vorsatz and Tirado Herrero 2012); the situation in which households are locked into their current residential situation (ENPOR n.d.); and customers locked in into consumption pathways outside of their control (Wilson 2012)	Result of path-dependencies and situation of being trapped in a current institutional, infrastructural, housing and, an energy supply situation
Source: author, by using the referenced definitions in the middle column		

After defining the main concepts and presenting the main definitions, I visually depict the complete conceptual framework developed around the relationship between the type of heating and energy poverty in Figure 2. In the center are the two main variables of the main research question – energy poverty and the type of heating. Energy poverty and its relationship to the type of heating is analyzed through the lenses of the energy justice concept and additional relevant literature. One set of input to understand the relationship is by using the developed energy poverty literature, through its main aspects – affordability, comfort, and access (orange color). Energy poverty is analyzed as a distributive (in red color), procedural and, recognition energy justice. Some aspects of energy culture and coping strategy literature feed into the understanding of energy poverty as recognition justice (both in green color). The right to energy and institutional good governance literature complement the procedural energy justice (both in yellow color). I have developed this conceptual framework to study comprehensively the synergies between energy poverty and the type of heating from an energy justice lenses and by integrating the additional literature to mainly better adapt and extend the recognition and procedural energy justice tenets. The main articles on which I base the development of this conceptual framework are in Table 2.

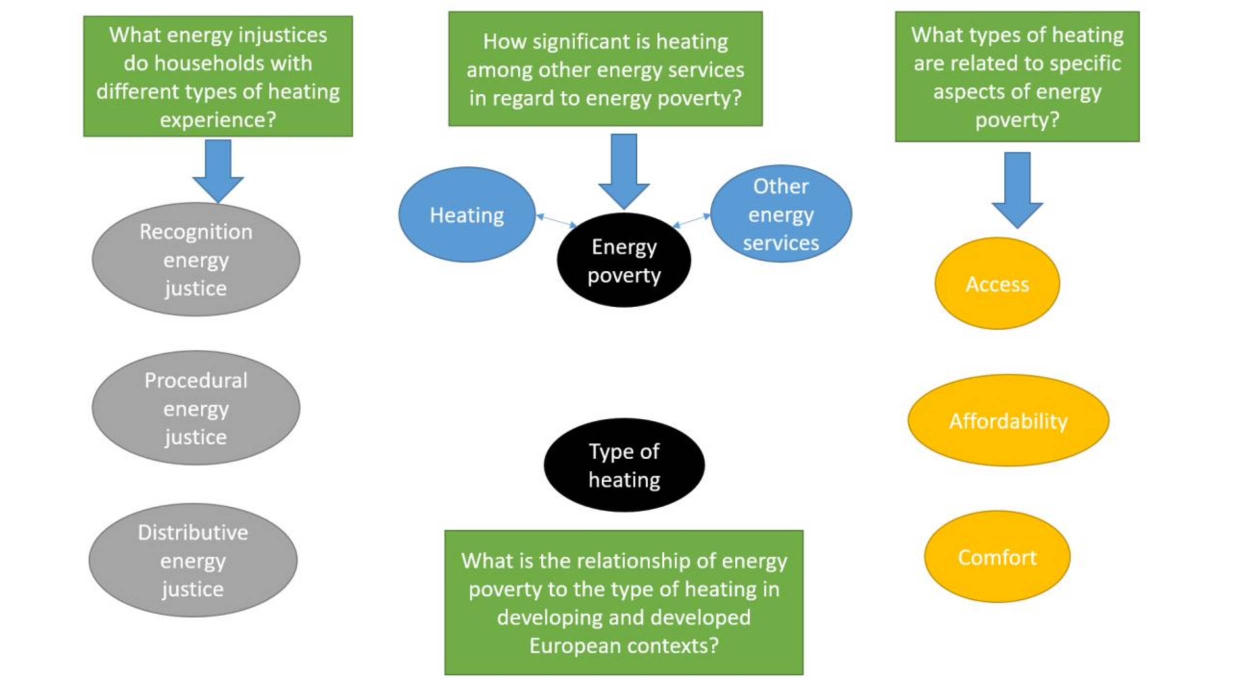
Figure 2: Conceptual framework



Source: author

After introducing the comprehensive conceptual framework, I show in Figure 3 how the conceptual framework helps answering the research questions. The question on the left is about the three energy injustices households experience per type of heating. To explore this question, I use the three tenets, two extended with additional literate as discussed earlier. The question about the relevance of heating among other energy services in the middle is about exploring the scope of energy poverty referring to all energy services or heating only. To address this question, I separately treat heating among other energy services, with the use of the developed energy justice literature. The third question on the right explores how different types of heating are related to aspects of energy poverty and this relationship is also explored through energy poverty, in more detail through the aspects of energy poverty being access, affordability and comfort. These three sub-questions complement and support the main research question about exploring the relationship between the type of heating and energy poverty by having explored different scopes and aspects of this complex relationship.

Figure 3: Development of the research questions



Source: author

The next section is a detailed literature review covering the energy justice and energy poverty literature. I also review the additional literature I integrate in the conceptual framework. It shows how the conceptual framework was developed, and also how it paved the way for the development of the methodology and choice of methods.

2.2 Justice as a theory and concept

This part focuses on the energy justice concept, which is one of the two main concepts guiding this research. The first part of this section gives a brief overview of the origins of the justice concept, and the predecessors of energy justice, environmental and climate justice. The second part of this section is only about energy justice, how it has developed, and how it informs the link to energy poverty. I end this section with a brief conclusion about the knowledge gap, and I clarify how I use this concept in the development of the conceptual and methodological framework, and for discussing the findings in the empirical chapters.

2.2.1 Origins of the concept of justice

Although the concept of energy justice is still evolving, justice as a concept is not new. The liberal theorist John Rawls has developed the theory of justice, while other justice concepts that have emerged before energy justice are environmental and climate justice.

What is very evident in Rawls' theory of justice is the distributive aspect of justice and the role of institutions (Rawls 1971). These features are evident in the second of his two principles of justice: wealth and income may not be equally distributed, but social and economic inequalities are arranged in a way that everyone benefits (Rawls 1971). Rawls' second justice principle states that the market creates inequalities (Rawls 1971). However, institutions are to rectify the distributive inequalities since justice is how social institutions distribute fundamental rights and duties (Rawls 1971). Institutions have to be just and in case they are not, they need to be abolished (Rawls 1971). We can draw a conclusion that justice as a concept emphasizes the responsibility and capacity of institutions to deliver justice. I use this understanding about institutions to discuss their role in rectifying or preventing energy injustices.

The concept of environmental justice was first to introduce the three-tenets structure composed of distributive, procedural and, recognition justice. The distributive aspect refers to sharing of environmental risks; the recognition includes the diversity of communities, and; procedural encompasses the participation in political processes which create environmental policies (Schlosberg 2004). The environmental justice concept has been related to social movements of activists with diverse demands for justice that go beyond the distributive aspect of justice (Schlosberg 2004). Newer contributions to environmental justice literature include incorporating cultural justice claims (Banerjee and Steinberg 2015), the relationship between vulnerability and the state of the natural world (Schlosberg 2013), environmental injustices towards people of color, the elderly, immigrants, and ethnic minorities (Filcak 2007; Moreno-Jiménez *et al.* 2016), and concerns about the exclusion of values and lifestyles of those opposing a chosen policy (Bustos *et al.* 2017). Since environmental justice has helped develop energy justice, the focus on citizens and their various capacities and identities in environmental justice, can inspire energy justice, and more specifically recognition energy justice to consider these newer categories.

The environmental justice discourse has further developed into climate justice to address the concerns of climate change (Schlosberg 2013). Climate justice is a matter of sharing burdens and benefits between countries or individuals, a matter of enhancing legitimacy in decision-making (Bulkeley *et al.* 2013), and the inclusion of non-human species (Steele Wendy *et al.* 2015). This concept also analyzes how vulnerable groups respond to climate change impacts (Smith and Rhiney 2016; Steele Wendy *et al.* 2015). Some of the most current justice concerns include transport or mobility justice (Gössling 2016; Mullen and Marsden 2016). The climate justice literature, although I discuss it here briefly, brings potentially a new understanding about demanding quality in decision-making processes, relevant for procedural energy justice.

2.2.2 Energy justice: the growing scope of this concept

This subsection presents the development of the energy justice literature. This literature overview clarifies how I have developed the conceptual framework, and how I have integrated this knowledge in the development of the methodological framework.

Inspired by the development of the environmental justice concept introducing its tenets of distributive, procedural, and recognition justice (Schlosberg 2004), energy justice has developed from mainly focusing on its distributive aspect, to incorporate recognition and procedural justice. Since it has been the 'oldest' justice tenet, and the most developed one, distributive justice is interpreted broadly as it deals with access to energy, affordability, quality, security, or safety of energy sources and sharing the burden of environmental deficiencies or the costs of the energy system (Goldthau and Sovacool 2012; Heffron and McCauley 2014; Jenkins *et al.* 2016; Sovacool and Dworkin 2015; Walker Gordon and Day 2012). Recognition justice deals with who is not recognized as a vulnerable group (Jenkins *et al.* 2016; Walker Gordon and Day 2012), while procedural justice focuses on the fairness of the process (Jenkins *et al.* 2016), such as the access to information and participation in decisions (Walker Gordon and Day 2012). Inclusion of local knowledge, different levels of governance including the local community, greater information disclosure, and better institutional representation are some of the characteristics of procedural justice (Jenkins *et al.* 2016; Walker Gordon and Day 2012). Researchers have also applied this energy justice tenet structure to energy poverty. In regard to distributive justice, energy justice enables a broader view on energy poverty, namely that it is not only about the physical access to heating and electricity, but about the extent to which the consumer can choose (Jenkins *et al.* 2016). The most developed approach is offered by Walker Gordon and Day (2012) who consider that energy poverty is a distributive injustice in regard to access to energy services which is determined by the interaction between the inequalities related to income, energy prices, and housing; it is a matter of recognition justice regarding the need to recognize different rights and needs of vulnerable groups; and a matter of procedural justice concerning access to information, legal process and participation in decisions. This three-tenet energy justice structure is suitable to study energy poverty and further develop its understanding through its relation to energy poverty.

This three-tenet structure helps energy justice to be an applicative tool for discovering injustices and finding solutions (Jenkins *et al.* 2016). Respectively, distributive justice assesses the location of injustices, recognition justice uncovers the marginalized actors, while procedural justice analyzes whether the process is fair (Jenkins *et al.* 2016). Regarding the normative contribution, distributive justice is interested in the way injustices are solved, recognition justice focuses on how injustices are recognized, while procedural justice is interested in discovering the new processes (Jenkins *et al.* 2016). This analytical and normative application of energy justice is used in developing the methodological framework.

What makes energy justice a good concept to analyze energy poverty, is its comprehensiveness and its capacity to evaluate the current system. The energy justice concept promotes the whole systems approach or energy systems justice which means that energy justice accounts for the social, economic, and environmental impact of energy, by looking at entire energy system (Jenkins *et al.* 2016). The whole systems approach can be realized by applying the three-justice pillars (Jenkins *et al.* 2016). The energy justice also questions the neo-classical economics thinking and puts forward the just and equitable approach rather than just an efficient one (Heffron *et al.* 2015). By doing so, energy justice can balance the competing aims of economics, politics, and the environment, the energy trilemma (Heffron *et al.* 2015). Since energy poverty is an interdisciplinary issue, this wholesome approach enables the study of energy poverty through its various manifestations.

Some more recent developments in the literature include greater considerations for the human element in the energy system and the demand for justice delivery by institutions. Cosmopolitan energy justice emphasizes that all human beings have equal moral worth (McCauley *et al.* 2019; Sovacool and Dworkin 2015), restorative justice, imported from criminal law, aims to repair the harm done to people, rather than solely focus on punishing the offender (Heffron and McCauley 2017), and particular energy justice is about recognizing the cultural and environmental factors influencing choices around energy technologies for the distribution of energy services (LaBelle 2017). The energy justice scholarship tends to humanize the energy transitions by pointing out the relevance of including a moral dimension (Jenkins *et al.* 2018; Sovacool and Dworkin 2015). It also applies to understanding energy poverty as an immoral act since it restricts the ability of people to fulfill their functions and realize their capacities (Sovacool and Dworkin 2015). Regarding the quality of service delivery by institutions, energy justice means also respect for human rights; access to information and fair decision-making; transparent and accountable forms of energy decision-making; right to fairly access energy services, as well as showing resistance to energy injustices (Sovacool and Dworkin 2015; Sovacool *et al.* 2017). The literature also points out the need for governmental intervention to address the effects of the energy transition or to address energy poverty (Goldthau and Sovacool 2012; Schlör *et al.* 2013; Sovacool 2015). This moral and human narrative in energy justice enables us to see citizens including the energy-poor as empowered participants in the energy transition.

In this dissertation, I define energy justice as an aim to provide all individuals with safe, affordable, sustainable, and secure energy sources (Heffron and McCauley 2014), whereas both the benefits and burdens involved in the production and consumption of energy services are shared, and communities are treated fairly in the energy decision-making (Sovacool and Dworkin 2015). Using energy justice as a framework in my dissertation is an opportunity to extend the use of its geographical application. In the event that the energy justice articles are context-specific, the literature mainly focuses on cases in the western world, such as Denmark, the UK, France, Germany, the United States, Norway, and the Arctic (Fuller and McCauley 2016; Heffron and McCauley 2014; Knudsen *et al.* 2015; Liddell *et al.* 2016; McCauley *et al.* 2016; Rehner and McCauley 2016). I would bring an additional layer of understanding to energy justice through exploring activism as a case of energy justice. The literature states that energy justice does not evolve from anti-establishment social movements as was the case with environmental and climate justice according to Heffron *et al.* (2015), which is an opportunity to expand this knowledge.

2.2.3 Conclusions about energy justice and identified gaps

Energy justice is an adequate concept to analyze energy poverty. It may offer a broader view of the causes and features of energy poverty by inspecting all involved stakeholders, the choices and the needs of the households, and by analyzing the relevance of heating among other energy services. The concept of energy justice is applied through its three tenets. One of the practical uses of energy justice is as an analytical and normative tool. Energy justice has been applied mostly in the literature in western world contexts. It is a visionary concept which underlines the 'ultimate energy good', thus it invites contributions about its practical application and operationalization. The inclusion of good governance within institutions and the highlights on the human and moral dimension of energy supply offer an opportunity for extending its recognition and distributive tenets.

2.3 Energy poverty in the literature

This section is dedicated to reviewing the relevant energy poverty literature since energy poverty is one of the two main concepts in the dissertation. This literature review will serve both as a preparation for developing the methodological framework, and for indicating how my research will address the identified knowledge gaps. I will first clarify the use of terminology and the guiding energy poverty definition I use in this dissertation. I also review how energy poverty as a concept has expanded. Then, I will discuss indicators, measurements, and characteristics, which help in formulating the methods. Then, I discuss the lived experience of the energy-poor which helps the understanding of energy-poor households' behavior and coping practices. After that, I review causes and suggested solutions to alleviating energy poverty which is relevant to understanding the drivers of energy poverty. I also discuss the role of heating and infrastructure in regards to energy poverty since the type of heating is one of the three main studied variables. Furthermore, I discuss the role of geographical location in the prevalence of energy poverty which is relevant to the use of two case studies located in different geographical regions. The next subsection is about incorporating the newer energy poverty literature which shifts the focus away from the energy-poor to exploring the lock-ins which cause energy poverty. At the end of this subsection I reflect on the energy poverty literature about the case studies.

2.3.1 Energy poverty: introduction, terminology, and definitions

Energy poverty keeps on receiving both academic and policy attention. After the capital work in the area by Boardman (1991), followed later by (Boardman 2010; Buzar 2007a) the energy poverty literature keeps expanding. The research on energy poverty explores various aspects of this phenomenon, as I discuss in the following subsections. This deepening of the understanding of energy poverty goes with expanding the geographical locations which underwent energy poverty research. It started with mostly Europe and in particular the UK (Boardman 2010), and Ireland (Healy and Clinch 2004), to expand to other European counties, such as Spain (Scarpellini *et al.* 2015), Greece (Papada and Kaliampakos 2016; Petrova and Prodromidou 2019), Austria (Brunner *et al.* 2012), France (Legendre and Ricci 2015), Portugal (Horta *et al.* 2019; Simoes *et al.* 2016), the Netherlands (Feenstra *et al.* 2021), post-socialistic countries (Kyprianou *et al.* 2019; Teschner *et al.* 2020) as well as countries outside of Europe, such as Indonesia (Andadari *et al.* 2014), Nigeria (Sesan *et al.* 2013), and China (Robinson *et al.* 2018) to name a few. The diverse geographical locations in which energy poverty is being studied show the importance of this problem in a global context.

Before I settle on terminology, I am explaining that apart from energy poverty, the notions of fuel poverty and energy vulnerability have been used. The notion of fuel poverty has been mostly used in the UK. Some argue that energy poverty and fuel poverty as the same phenomenon (Boardman 2010), and others distinguish between the use of fuel poverty to refer to the problem in the developed world dealing with inadequate heating in the home, while energy poverty is related to its use in the developing world characterized by issues such as lack of access to energy services (Bouzarovski and Petrova 2015a). To overcome this discrepancy, the notion of energy service poverty is proposed to argue that the problem in all contexts is about the adequate and necessary energy needs of households (Bouzarovski and Petrova 2015a). Academics use also energy vulnerability and energy deprivation (Bouzarovski 2014; Bouzarovski and Petrova 2015a; Bouzarovski and Petrova 2015b) which are often used as synonyms for energy poverty. Energy vulnerability especially refers to the risk of falling into energy poverty (Roberts *et al.* 2015). The EU uses the notion of vulnerable consumers to explain energy-poor or energy vulnerable households (European_Union 2009b). In the dissertation, I am using energy poverty and at times energy vulnerability interchangeably to refer to the same phenomenon. One practical reason for using energy poverty is since it is the most commonly used notion, especially with the establishment of the EU Energy Poverty Observatory by the European Commission with the aim to unite efforts to addressing energy poverty in the EU (EU_Energy_Poverty_Observatory 2021).

In this paragraph, I am reviewing some of the most commonly used definitions of energy poverty which I also listed in Table 3. We can see that most definitions explicitly refer to energy poverty as experience in the residential sector. Two definitions limit the energy services to warmth only; while many have expanded the understanding of energy poverty to include all energy services. Boardman's definition about the 10% is one the very first and also very applicable, but not beyond its original context – the UK, since this 10% threshold does not capture the specifics of energy poverty in the former communist countries. Households in Bulgaria spend on average 14% of their income on water and energy bills (Bouzarovski *et al.* 2012); the same percentage (14%) applies to North Macedonia in 2014 (State_Statistical_Office 2015b). The definition from a developing country context, Indonesia includes the understanding of access to fuels and their quality (Andadari *et al.* 2014). In this dissertation, I am using the working definition of energy poverty to refer to the inability to attain a socially and materially necessitated level of domestic energy services (Bouzarovski and Petrova 2015a). It is the most commonly used definition in the literature, which explains that at the core of the problem are the needs of the households (Bouzarovski and Petrova 2015a). Although my research is about the links between energy poverty and heating, in order to approach the research integrally, I begin by acknowledging that all energy services matter for experiencing energy poverty.

Table 3: Definitions of energy poverty

Definition	**Localization**[3]	**Source**
Energy poverty is understood as the economic inability of the home to meet its domestic energy needs.	Aragon – region of Spain	(Scarpellini *et al.* 2015)
Energy poverty is the inability to heat the home up to a socially- and materially-necessitated level.	North Macedonia and the Czech Republic	(Buzar 2007a)
Energy occurs when a household is unable to have adequate energy services for 10% of their income. This applies to heating, hot water, lighting, and all the other energy services within the home, not just warmth.	UK	(Boardman 1991)
Energy poverty should not only include expenditure on energy, but also the relative quality of fuels and ease of access.	Indonesia	(Andadari *et al.* 2014)
A household is considered to be energy-poor when they are unable to afford to maintain their dwelling at an adequate level of warmth at a reasonable cost.	England	(Fahmy *et al.* 2011)
Inability to attain a socially and materially necessitated level of domestic energy services.	Global	(Bouzarovski and Petrova 2015a)
Source: different sources given separately in the right column		

The energy poverty definition has been upgraded over time. This expansion is not only about expanding beyond the link to heating (Buzar 2007a; Fahmy *et al.* 2011), to all energy services in the home, such as lighting, cooling, appliances, heating, hot water, and cooking (Bouzarovski and Petrova 2015a; Day *et al.* 2016; Scarpellini *et al.* 2015), but to a much broader area. One new understanding is incorporating transport (Mattioli *et al.* 2017) and highlighting cooling/summertime energy poverty (Gouveia *et al.* 2019; Horta *et al.* 2019; Thomson *et al.* 2019).

[3] Not necessarily mentioned by the author(s) that the respective definition applies to the region they analyze.

Energy poverty is related to many other areas which remain largely under-researched, such as human rights implications or climate change links (Stojilovska *et al.* 2020). The links between environmental degradation and energy poverty are visible (Bouzarovski *et al.* 2016; Papada and Kaliampakos 2016), but under-explored (Kyprianou *et al.* 2019; Reyes *et al.* 2019). In this dissertation, I keep the focus on energy services at home, but I do build upon the findings to deepen the understanding of energy poverty.

2.3.2 Energy poverty: indicators, measurement, and characteristics

In this subsection, I am reviewing indicators and ways of measuring energy poverty, including some relevant characteristics of households and their environment indicative of energy poverty. This informs the following chapter on the methodological framework for the development of the indicators and methods I use to collect the household data.

Assessing energy poverty requires indicators. I use this subsection for the development of energy poverty into its three main aspects used here – affordability, comfort, and access. Some indicators measure the affordability of energy services, such as the relation between energy expenditures and household income (Scarpellini *et al.* 2015), arrears on utility bills, and the ability to pay to keep the home adequately warm (Thomson and Snell 2013). Other indicators measure the comfort level at home, such as the dwelling quality (Thomson and Snell 2013) and the indoor temperature (Moore 2012). Related to the latter, the World Health Organization has estimated that affordable warmth means 21 degrees Celsius in the living room and 18 degrees Celsius elsewhere in the occupied rooms (Boardman 2010). However, assessing these aspects of energy poverty, such as comfort and affordability, is not straightforward. The indoor temperature is not a good indicator of energy poverty in district-heated dwellings since the temperatures are adequate but the issue is in the lack of control of the heating costs (Tirado Herrero and Ürge-Vorsatz 2012). However, reducing comfort is considered typical energy poverty (Tirado Herrero and Ürge-Vorsatz 2012), and various coping practices of households tend to be indicative of energy poverty, such as reduction of the heated space (Brunner *et al.* 2012; Waddams Price *et al.* 2012). In a developing country context, or in a developed rural country context, access to energy services is relevant for energy poverty. Energy-poor households use traditional solid fuels such as biomass due to a lack of access to adequate energy services (Spagnoletti and O'Callaghan 2013). Similarly, having a limited choice of energy sources/ lack of access to certain fuel types in the rural UK means vulnerability to energy price increases (Roberts *et al.* 2015).

There are two types of measurements of energy poverty. There is the expenditure approach based on actual or required fuel spent – practically an objective criterion and the consensual approach that uses subjective indicators (Bouzarovski 2014; Thomson and Snell 2013). However, there could be a mismatch between the objective (measurable) and subjective (opinion/self-reported) measure, as a household could be energy-poor according to the subjective criterion and non-energy-poor according to the objective or vice versa (Waddams Price *et al.* 2012). The consensual approach tends to prevail in collecting data on and measuring energy poverty. This may be the case due to the dominant understanding of energy poverty based on the subjective understanding of households whether they can satisfy their energy needs. The EU-SILC collects indicators based on households' self-evaluation about adequate heat, energy arrears of households, and presence of leaking roof, damp walls, and rotten windows (Eurostat 2019a, 2019b, 2019c), the first two proposed as primary indicators and the last as secondary indicator by EPOV (EU_Energy_Poverty_Observatory 2020). These indicators have been commonly used in research to evaluate the levels of energy poverty in European countries (Thomson and Snell 2013). I am using predominantly subjective self-reported indicators since they show the situation from the point of view of the affected, but in order to get a better sense of their situation, I also include a set of more objective self-reported questions, such as the indoor temperature or presence of disconnections.

There is a tendency to construct composite indicators and indices to measure energy poverty. Some of the most relevant and primary indicators of EPOV include the 2M metric which states that energy-poor is a household if its share of income on energy is larger than twice the national median; and M/2, according to which a household is affected by energy poverty in case its energy spending is lower than half the national median energy spending (EU_Energy_Poverty_Observatory 2020). Researchers construct indices integrating socio-demographic variables, the final energy demand and consumption, the geographical location and climate, the health implications, and available support (Castaño-Rosa *et al.* 2019; Gouveia *et al.* 2019; Mahoney *et al.* 2020). Existing metrics are subject to critique, and there is no single best measurement. Castaño-Rosa *et al.* (2019) concluded that the 10% and the 2M do not capture the heating or eating dilemma; and that 10%, 2M, and M/2 do not consider the vulnerable groups, such as those with illness, disability, children, and elderly. The use of different indicators gives different insights into energy poverty. Applied to European countries, 2M is more common in Eastern, Northern, and Western Europe, while the M/2 indicator has greater spatial variation than the 2M, and some of the highest rates of M/2 are in Northern and Western Europe (Thomson *et al.* 2018). Herrero (2017) criticized the perception that expenditure-based indicators are superior, and claimed that narrow definitions might leave out some of the most vulnerable groups. Researchers advocate for a combination of metrics to measure energy poverty (Herrero 2017; Papada and Kaliampakos 2016; Thomson *et al.* 2018). Therefore, I am using a set of various questions as energy poverty indicators (more in the next chapter). I also address the critique about missing socio-demographic indicators of vulnerable groups by including questions that gathers such data. I, however, do not construct a composite since developing an index or a new measurement is out of the scope of my research. But, I do contribute to the energy poverty indicator discussion reflecting on my findings regarding the most relevant indicators.

This part focuses on the characteristics of energy poverty referring to dwelling and household composition. I use these findings to build my methods in the next chapter. Relevant socio-demographic variables for predicting energy poverty include income (Boardman 2010; Fahmy *et al.* 2011; Healy and Clinch 2004; Thomson and Snell 2013; Waddams Price *et al.* 2012); employment status (Brunner *et al.* 2012), long-term illness and disability (George *et al.* 2013; Healy and Clinch 2004; Snell *et al.* 2015); household size (Waddams Price *et al.* 2012); the level of education; and marital/partnership status (Healy and Clinch 2004). Regarding dwelling characteristics, important are the housing quality/its energy efficiency (Boardman 2010; Brunner *et al.* 2012; Buzar 2007a; Fahmy *et al.* 2011; Healy and Clinch 2004; Thomson and Snell 2013), the presence of damp or condensation (Healy and Clinch 2004), the age of the dwelling (Boardman 2010; Brunner *et al.* 2012; Healy and Clinch 2004), and the housing tenure (Healy and Clinch 2004; Walker Gordon 2008). Some authors have found that rural or urban locations of the dwelling (Boardman 2010; Thomson and Snell 2013) and the energy prices to be significant for energy poverty (Fahmy *et al.* 2011).

2.3.3 The lived experience of the energy-poor

This section reflects on the newer discussions in the literature about studying the experiences and practices of the energy-poor which uncover a new set of previously unrecognized features and unstudied behavior. This helps not only to better detect energy-poor households but to recognize their lived experience (Middlemiss and Gillard 2015) as valuable input in understanding energy poverty. I use this set of literature to make meaning of the findings of which socio-demographic variables predict energy poverty, and for the observed distinct behavior of energy-poor households.

Apart from the discussed socio-demographic features of energy vulnerable households in the previous subsection, the literature brings forward gender (Clancy and Feenstra 2019; Feenstra and Özerol 2021; Petrova and Simcock 2019; Robinson 2019; Tirado Herrero 2020), and minority status (Tirado Herrero and Ürge-Vorsatz 2010) as relevant to energy poverty. Other than physical health, the literature has paid attention to exploring the link to mental illnesses (Harris *et al.* 2010) and the manifestation of social exclusion (Middlemiss *et al.* 2019). But, it is also about the specific energy needs of households (Bouzarovski 2014) which dictate households' behavior in regard to energy use.

The literature explores the often misrecognized actions of energy-poor households towards managing their basic needs and energy costs. Households in energy poverty adopt coping strategies as a way of managing their energy challenges (Longhurst and Hargreaves 2019). The literature on coping strategies comes from psychological insights about managing stress when people either have emotional reactions or problem-solving intentions (Lazarus and Folkman 1984). Households develop different methods aimed at reducing energy needs, comfort or food, prioritizing certain basic needs, or becoming indebted (Anderson *et al.* 2012; Beatty *et al.* 2014; De Haro and Koslowski 2013; Papada and Kaliampakos 2016; Tirado Herrero and Ürge-Vorsatz 2010). Coping with energy poverty also entails restrictions of energy use and heating, compensation for the lack of warmth, negotiations within the family, and developing informal solutions (Anderson *et al.* 2012; Brunner *et al.* 2012; Chard and Walker 2016; Horta *et al.* 2019; Petrova and Simcock 2019; Shortt and Rugkåsa 2007; Teschner *et al.* 2020; Willand and Horne 2018). This reduced quality of life through the use of energy and other basic needs illustrates the context of subsistence, which is defined as a minimum standard of productive living in society (Sharif 1986). Fuels and technologies become the focus of households' coping strategies. Among these, fuelwood gains a cultural relevance since it is preferred as it not only economizes on heating costs but avoids reliance on more expensive options (Stojilovska 2020). This use of fuelwood has echoes in the cultural importance of fuelwood in developing countries (Ariztia *et al.* 2019; Coelho *et al.* 2018; Jagadish and Dwivedi 2018). With their energy behavior, households express their culture (Horta *et al.* 2019; Steele Andrew and Todd 2006; Wilhite *et al.* 1996).

2.3.4 Energy poverty: possible causes and solutions

In this section, I explore the known causes and solutions to energy poverty. This is relevant in understanding the broader socio-political context in which energy poverty appears and dominant approaches to alleviating energy poverty. I use this subsection to develop an understanding of how energy poverty arises in the studied countries which is reflected in the data I collected.

The prevailing understanding of energy poverty drivers includes the triangle of low incomes, low energy efficiency, and high energy costs (Boardman 2010; Bouzarovski 2014; Brunner *et al.* 2012). Academics have situated these drivers within a transition process. Due to the inherited subsidized energy prices and inefficient residential sector from the previous system, the former communist countries have been facing energy poverty (Bouzarovski *et al.* 2012; Tirado Herrero and Ürge-Vorsatz 2012). Thus, once the subsidies were removed, households had to give up a big share of their budgets for heating costs (Boardman 2010). In this transition process, domestic policies failed in balancing the increased prices with adequate social protection and energy efficiency support as research on North Macedonia and the Czech Republic shows (Buzar 2007a). This means that the issues with a slow rate of improving the energy efficiency of the residential sector (Brunner *et al.* 2012) and high levels of unemployment (Brunner *et al.* 2012), which appeared in the transition from the previous socialist system, can cause energy poverty. Energy sector liberalization has been critical for energy poverty (Boardman 2010; Bouzarovski and Tirado Herrero 2017a; Buzar 2007a). The new transition to a low-carbon energy future has too contributed to being at energy poverty risk (Bouzarovski and Tirado Herrero 2017a).

The following paragraph reviews the measures to alleviate energy poverty. This is relevant to relate to the type of heating which is often a subject to upgrade in energy poverty alleviating approaches. The dominant approach is that improving energy efficiency in the residential sector will address energy poverty (Boardman 2010; Thomson and Snell 2013; Tirado Herrero and Ürge-Vorsatz 2012). There are more specific suggestions for the demand side such as passive-house retrofits (Tirado Herrero and Ürge-Vorsatz 2012), installation of smart meters for electricity and gas, gas-powered co-generation, solar collectors, as well as cavity wall and loft insulation (Boardman 2010). On the supply side, alleviating measures include an upgrade of the district heating systems (Tirado Herrero and Ürge-Vorsatz 2012) and fuel substitution (Boardman 1991). Addressing energy poverty is more than a technical intervention as it is about the energy vulnerable people and their lives. Investing in energy efficiency seems costly for households (Healy and Clinch 2004; Tirado Herrero and Ürge-Vorsatz 2012). Therefore measures for addressing energy poverty should be funded by some other capital and not by the energy-poor (Boardman 2010). The discussion on solutions comes down to properly identifying the energy-poor (Bouzarovski *et al.* 2012; Fahmy *et al.* 2011). The UK energy poverty policy had a poor targeting as a 2010 study found that only one-quarter of the funds reached the energy-poor (Boardman 2010).

2.3.5 Energy poverty: fuels and infrastructure

As exploring the links between energy poverty and the type of heating are at the front of this dissertation, in this subsection, I review the literature about the role of the heat market in the prevalence of energy poverty. I use this subsection to start exploring the links between various types of heating and aspects of energy poverty, such as access, affordability, and comfort and use them in the development of the methods.

District heating as a type of heating is less related to energy poverty because there are rarely comfort issues or reduced spatial heating. District heating is less indicative of energy poverty due to effective heating mechanisms and implemented energy efficiency measures (Waddams Price *et al.* 2012). On the contrary, findings in Hungary relate the district heating to affordability challenges, and not comfort. This is because households pay the highest heating costs per m2 and per person, but cannot change the supplier nor implement energy efficiency measures (Tirado Herrero and Ürge-Vorsatz 2012). Due to these obstacles, district heating in a post-socialist context is considered a new type of energy poverty since the comfort is not affected – the district-heated households are adequately and fully heated (Tirado Herrero and Ürge-Vorsatz 2012).

Certain fuels have been more linked to energy poverty. For example, fuelwood has been associated with energy poverty or energy degradation as it is less technologically advanced and polluting fuel that the affected households have shifted towards as shown in Bulgaria and Hungary (Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016). The reason for this shift to fuelwood involves the need to reduce domestic energy expenditures to cope with increasing energy poverty (Bouzarovski *et al.* 2016). Also, in developing context, fuelwood is a choice of fuel by the poorest (Andadari *et al.* 2014). Research has also shown that the use of electric heating in energy-poor households results in high energy costs (Brunner *et al.* 2012).

There are factors affecting the choice of heating. In some cases, it is income (Andadari *et al.* 2014; Gaigalis *et al.* 2016). As the poorest choose fuelwood (Andadari *et al.* 2014), wealthy people can choose heat pumps based on the research on heat pump use in Lithuania (Gaigalis *et al.* 2016). But it is not only affordability that determines the choice of fuel, it can also be due to missing infrastructure. For instance, poor rural UK households without access to natural gas are likely to be in energy poverty and have polluting homes (Boardman 2010).

2.3.6 Geography of energy poverty in Europe

In this section, I am discussing the geography of energy vulnerability in Europe with the aim to learn about which regions are more vulnerable to energy poverty and why. This will support the contextualization of the findings from the two geographically different case studies.

The geography of energy poverty shows that three European regions have high shares of energy poverty: Eastern Central Europe, the Mediterranean countries, and Ireland and the UK (Bouzarovski 2014). All three regions have a poor quality of the residential buildings that contribute to energy poverty (Bouzarovski 2014; Bouzarovski and Petrova 2015a); whereas for the UK, Ireland, Eastern Central Europe the income was mentioned as a factor (Bouzarovski 2014; Bouzarovski and Petrova 2015a). Causes of energy poverty in the Mediterranean countries are the need for cooling and the lack of adequate heating systems, while Eastern Central Europe additionally suffers from energy poverty because of lack of proper infrastructure, cold homes, and systemic deficiencies in the management of housing, energy, and social welfare (Bouzarovski 2014). Upgrading on the previous findings of the three more vulnerable regions to energy poverty, there is a core versus periphery distribution in energy poverty in the EU as Western and Northern member states are in a better state than Southern and Central Eastern Europe regarding the domestic energy deprivation (Bouzarovski and Tirado Herrero 2017a). Similarly, another research supports the findings that energy poverty is especially affecting eastern and southern EU member states (Thomson and Snell 2013). The studied cases in this dissertation belong to the more vulnerable region of Central Eastern Europe (North Macedonia), and to the 'geographical core' of EU (Austria).

Despite the overall conclusions about which regions are more prone to be affected by energy poverty, research shows that local circumstances matter too (Bouzarovski 2014; Bouzarovski and Tirado Herrero 2017a). That means, there are differences between individual member states on the periphery, which means that national, regional, and local conditions matter more (Bouzarovski and Tirado Herrero 2017a). The importance of local conditions shows that energy poverty is the lowest in Scandinavia and is higher in Southern Europe, despite the temperature differences between these regions; while Germany has low energy poverty despite having high energy prices and Bulgaria has high energy poverty despite the lower energy prices (Bouzarovski 2014). This means that although belonging to a certain region predicts to some extend the size of the energy poverty challenge, there are many national and local factors that affect how and to which extend is energy poverty manifested.

2.3.7 From needs of the energy-poor to drivers and institutional lock-ins

This section is devoted to the newer discussions in the literature which shift the interest from inspecting the features and practices of energy-poor households, to focus more on the broader socio-political circumstances that keep households entrapped in energy poverty. This trend is an opportunity for the empowerment of energy-poor households and seeing them as citizens with human rights. They are not to be seen as needing to comply with top-down requirements for participation in the energy transition, but through recognizing that their situation is a result of systematic deficiencies which need to be the main subject of rethinking.

As I have reviewed earlier, the dominant approach to addressing energy poverty is through energy efficiency in a top-down manner. Until the Green Deal, but still, currently, the EU's dominant approach towards the low-carbon transformation is in the expectation that households are able to invest in energy efficiency measures (European_Commission 2011). This invited a techno-economic approach to alleviating energy poverty. The attempt to see energy poverty as a predominantly techno-economic issue is criticized for ignoring the social environment from which it arises (Baker Keith J. *et al.* 2018). Energy poverty is much more than improving the dwelling's insulation, but it is about people's lives.

The need to consider the wellbeing of energy vulnerable households highlighted the human rights of energy consumers, and the need to rethink the role of the state's involvement in the energy market. This gives birth to the right to energy concept which has raised the discussion of whether the right to energy services is a human right (Bouzarovski 2018; Hesselman *et al.* 2019). The 'right to energy' activists put pressure on utilities and the role of the state by requiring enhanced protection of vulnerable consumers through a ban on disconnections, social prices, and funded energy efficiency interventions (EPSU and EAPN 2017). At the same time, there is a criticism about portraying citizens only in the capacity of consumers (Lennon *et al.* 2019; Ryghaug *et al.* 2018). The discussions come down to whether energy is considered more than just a commodity (Teschner *et al.* 2020; Walker Gordon 2015) but a basic requirement needing protection from its marketization and rising energy prices (Demski *et al.* 2019), in which case the state and other actors in energy provisioning have obligations to go beyond market relations (Walker Gordon 2015).

More recent energy poverty discussions try to shift the focus away from energy-poor households and put pressure on the policies and institutional path-dependencies which keep the energy-poor locked in (Petrova 2018). It is not people's fault to be in energy poverty, but it is the fabric of society that co-creates energy poverty (Bouzarovski and Simcock 2017; Petrova 2018). There is an increased interest in the role of institutions, policies, and processes that should rectify energy injustices across the entire energy system (Jenkins *et al.* 2016) and balance different economic, environmental, and political goals (Heffron *et al.* 2015). At the same time, the shift away from the energy-poor gives space for multiple actors to contribute to a fairer and just energy system. Activists engage in social movements (Yoon and Saurí 2019) and citizen-led initiatives demand affordable energy (Frankowski and Tirado Herrero 2021; Fuller and McCauley 2016). There is also criticism of the neo-classical economics thinking and putting forward efficiency over equity (Heffron *et al.* 2015). In a nutshell, energy poverty as a multidisciplinary and complex phenomenon is embedded in the current system (Guyet *et al.* 2018), inviting a further study of new or hidden structural drivers of energy poverty.

2.3.8 Energy poverty literature on North Macedonia and Austria

The literature on energy poverty in North Macedonia and Austria is rather scarce, especially about how different types of heating are correlated with energy poverty. I summarize here only the academic literature on energy poverty in the studied countries, in which I also briefly reflect on the research I have published so far stemming from this dissertation.

As evident so far North Macedonia belongs to the Central Eastern Europe region of energy vulnerability classification (Stojilovska 2020). The change of the previous system had a huge impact on shaping energy poverty vulnerability in the country. The process of liberalization of the energy sector and the removal of energy price subsidies after the end of the communist system, in an absence of suitable energy, housing, and social welfare policies contributed to energy poverty in North Macedonia (Buzar 2007b). In summary, there are three main energy poverty drivers in the country: the widespread material deprivation, the inefficient housing stock of large size and individually owner-managed dwellings, and over-dependency on subsidized electricity and fuelwood used with inefficient heating devices (Stojilovska 2020). An overall evaluation is that the energy poverty in the country can be compared to a subsistence-like economy which is the minimal level of productivity (Stojilovska 2020). The prognosis is pessimistic as it is estimated that energy poverty due to its systematic embeddedness will be here to stay (Stojilovska 2020). To add to the severity of the situation, citizens of North Macedonia have little trust in institutions and tend to address their vulnerability on their own (Grossmann *et al.* 2021). The monopolistic energy market is a new energy poverty driver since it treats citizens as able to afford their energy bills no matter their material situation (Stojilovska 2021). Considering the profile of the energy-poor, the most vulnerable households in North Macedonia are households living in rural areas, urban households with low incomes as well as families with unemployed adults or more than two children (Buzar 2007b). Energy poverty in scope is much larger than income poverty as it affects the middle-class as well (Buzar 2007b). There is some research about the importance of infrastructure in shaping how energy poverty is experienced. In urban areas in North Macedonia without district heating where fuelwood is not available, households have no option but to heat with electricity (Buzar 2007b). Households using electric heating and fuelwood more often experience energy poverty (Stojilovska 2020).

The academic literature on Austria is even more limited, one reason is that energy poverty is not an issue affecting a large part of the population. One of the key articles is about how energy poverty in Vienna is correlated to income poverty (Brunner *et al.* 2012). This article is also one of the earlier ones about understanding how energy-poor households come with energy poverty (Brunner *et al.* 2012). These coping strategies were not performed only by the elderly, but by all age groups and even in households not affected by energy poverty during some periods (Brunner *et al.* 2012). As a country where living in the rented sector is widespread, one of the issues affecting energy poverty is energy efficiency improvements. An author whom I interviewed for this dissertation has published that renovation does not bring reduced costs as energy-poor households aim to use renovation benefits for increased comfort rather than reduced consumption (Berger and Höltl 2019). The latter is due to the unrecognized issue of under-consumption of energy-poor households which is not included in the informal definition of energy poverty in Austria (discussed later in the dissertation). However, as a country with a developed social welfare system, even the energy utility in state ownership undertakes measures to detect and help those who cannot pay their energy bills (Stojilovska 2021) (discussed in detail later in the dissertation).

2.3.9 Conclusions about the energy poverty literature and identified gaps

The energy poverty literature is rich and detailed on many aspects of this problem. The distributive aspect of energy poverty is at the core of this issue, meaning the inequalities in affordability, lack of access, and lack of comfort. The recognition part is also relevant, especially in regard to recognizing that a certain group is more vulnerable than other groups. From the literature, it is evident that there is no single definition of energy poverty, but I follow the most commonly used understanding that energy poverty is the inability to attain a socially and materially necessitated level of domestic energy services (Bouzarovski and Petrova 2015a). I consciously use energy poverty to refer to all energy services in order to explore the relationship to heating in a wholesome manner. I use self-reported indicators to measure energy poverty, and I have constructed methods to integrate the existing knowledge on energy poverty in regard to characteristics, and indicators. The newer contributions of energy poverty offer the opportunity to explore the lived experience of energy-poor households and of policies and path-dependencies which keep households in energy poverty. The existing knowledge on the geography of energy poverty is that North Macedonia is a much more vulnerable space than Austria. Although heating and heating types have been present in the energy poverty literature, there is no comprehensive and comparative view on how energy poverty is related to different types of heating in both developing and developed country contexts in Europe. Both cases have been largely under-researched in regard to energy poverty.

3. CHAPTER 3: METHODOLOGY AND METHODS

In this chapter I elaborate and justify the chosen methodology, and show I have developed and used the methods. I first show the bigger picture of the choice of research design and the main methodological approach. I also show how I have followed the ethical guidelines. I devote a section to show how I have utilized the conceptual framework and the literature review to develop the methods. I elaborate in detail on the construction and justification of the methods, and how I have sampled, collected, and analyzed the data.

3.1 Research design: comparative case study integrating mixed methods

The overall research design is a comparative case study integrating a mixed-method approach. In the following subsections, I define the methodology and the methodological approach and I justify their use in the dissertation.

3.1.1 Comparative case study

A case study is adequate to inspect contemporary issues (Yin 2003), in which the problem is an empirical analysis of a small sample of bounded phenomena that are instances of a population of similar phenomena (Rohlfing 2012). This description of a case study makes it applicable to study energy poverty as an issue that receives lots of research attention, but it is still an ongoing challenge to millions of European citizens. A case study can combine various sources of data and methods (Punch 2005). I follow up on this by integrating a mixed-methods approach. This case study is called a multiple case study or a comparative case study due to the number of cases it entails (Punch 2005). The case study in this dissertation includes two cases – North Macedonia and Austria. The two countries are chosen following the maximal variation sampling (Miles *et al.* 2014). The value of finding commonalities in cases with significant differences (discussed in detail in the following chapter) is that they can expand the external generalizability of the findings (Yin

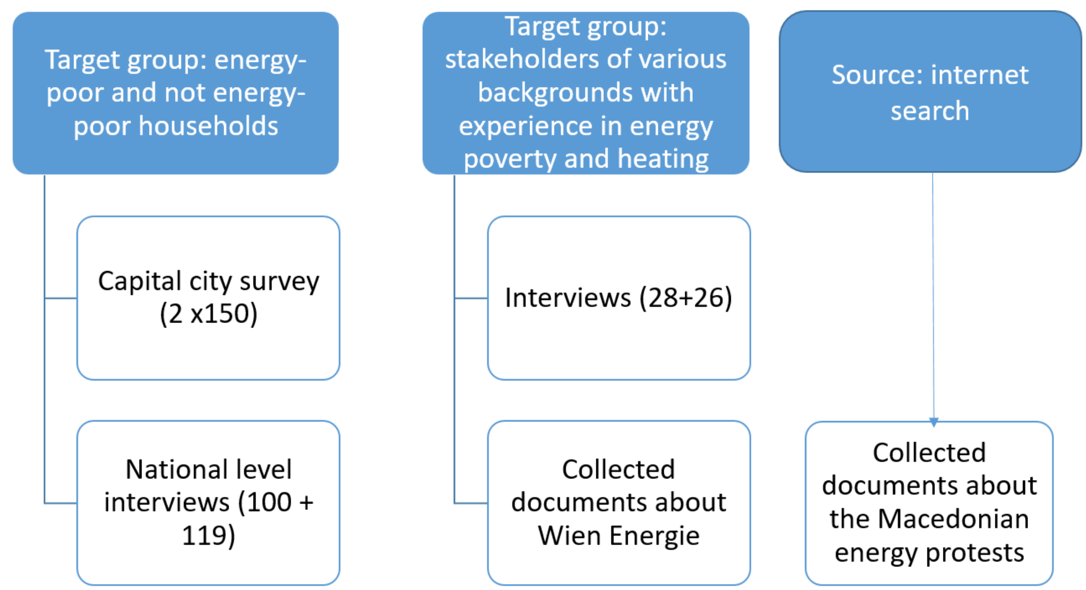
2003). The development of abstract concepts in a case study can contribute to potentially generalizable findings (Punch 2005). Both countries are chosen due to being under-researched in regard to energy poverty, and relevant for understanding the synergies between energy poverty, energy justice, and the type of heating in two different European developing and developed country contexts.

3.1.2. Mixed methods

One way of applying mixed methods is the integration of qualitative and quantitative data (Miles *et al.* 2014). Qualitative and quantitative methods are combined in order to balance their strengths and weaknesses (Punch 2005). The qualitative approach is sensitive to context and enables a holistic understanding; however, it is rarely generalizable (Punch 2005). Quantitative research explains the relationship between variables, but it is weak to reveal the reasons for the relationships (Punch 2005). I integrate both qualitative and quantitative methods not only to counter-balance the weaknesses of each method, but also to explore energy poverty comprehensively. The use of mixed methods is also aligned with the target group of these methods, and the aims of the research. I am exploring the relationship between the type of heating and energy poverty which can be effectively statistically analyzed through a set of statistical operations, such as cross-tabulations and regression analyses of a representative sample of household surveys, energy-poor and not energy-poor, showing some aspects of this relationship, such as what type of households are in energy poverty, or which type of heating do energy-poor households use. To study the lived experience of the energy-poor (Middlemiss and Gillard 2015) I need to hear their stories (Moezzi *et al.* 2017), and conduct ethnographic interviews with energy-poor households, and explore how they perceive their situation and use energy services at home. The interviews such as those with households can be an ethnographic character as they allow for an in-depth study of people and to discover their cultural knowledge expressed from their point of view (Robben and Sluka 2007; Spradley 1979). To get more information about the overall setup of policies and path-dependencies co-shaping energy poverty and energy justice, I need to interview relevant stakeholders which have experience with studying this material. A review of relevant policies and existing documents would add to understanding the overall situation in the studied countries.

Figure 4 shows the type of data collected. Households and stakeholders were two distinct subjects of data collection. The stakeholders are representatives of various points of view, such as public institutions, the regulatory body, companies, individual experts, churches, international organizations, utilities, and civil society representatives. The stakeholders were targeted with purposive sampling and the method used was an interview. The interviews with stakeholders were conducted face-to-face in most cases. I use purposive sampling for conducting the interviews with households which were collected via an online interview form, while the surveys were done via phone by using random sampling. I have also collected relevant documents from the stakeholders and through a search on my own. Since I am studying the relationship between being in energy poverty and the use of the heating types in a comprehensive manner, I talked with both energy-poor and not energy-poor households. I explain and justify the sampling, data collection and analysis, and separate methods in the following subsections. I have additionally used secondary data, mostly statistical for the introduction of the case studies, and enhancement of some of the findings.

Figure 4: Type of data collected



Source: author

3.1.3 Ethical research

I fully complied with the CEU Ethical research policy in this dissertation, and beyond that, I have obtained written consent from the stakeholder interviewees. To begin with, I collected data only after obtaining consent from the interviewees. Before undertaking the interviews and surveys, the interviewees were informed about the objectives of the survey or interview and the affiliation of the researcher. I have guaranteed my interviewees confidentiality and anonymity. Confidentiality is defined in the CEU Ethical research guidelines as a requirement concerning data storage, processing, and publishing according to which the personally identifiable data is available only to research participants and the researcher (Central_European_University n.d.). According to the CEU Ethical research guidelines, anonymity is a requirement regarding data storage, processing, and publishing whereby no personally identifiable data is recorded, stored, or published during and upon conclusion of research activities (Central_European_University n.d.).

In practice, when I approached the stakeholder interviewees via email, I wrote a detailed explanation of the purpose of my research, and the reason I am approaching them. If they have agreed to talk to me, I have asked them to sign a written consent form which was bilingual English/Macedonian or English/German (available in the Appendix 8 only in English). With this form I got their written consent for participation, and an additional matter of consent was whether whey would allow the interview to be recorded. I followed the same procedure with the few interviewees with whom I did the interview via skype. I have received from all of them written consent, only 3 interviewees have given an informal consent. I report in this dissertation their input in an anonymized way through their affiliation or capacity. The latter was a point to consent to in the written form. Two interviewees did not want to be mentioned through their organization, so I mention them in relation to their very broad capacity, for example, a representative of the private sector. Most of the interviewees agreed to be recorded, only few did not, in which case I took notes while they were talking. In regard to documents, I received some from an stakeholder interviewee, and some I have found as publically available information from the internet pages of relevant institutions.

Regarding the online interviews with households, I had at the first page of the interview platform info about myself and my research. I did not collect at all data which could reveal their identity. By participating in the online interview, they had consented to participate in the research. They filled out the interview on an online platform, and I received the data in an excel sheet format. Regarding the phone survey, I had a separate excel sheet for the numbers of the respondents, and I am the only person who has access to this information, and I am not using this for my research.

In a separate sheet are the collected responses of the surveyed households in which there are no data to reveal the personal identity of the respondents. When I was calling the households, I introduced myself, my affiliation and the reason for calling them, and the time duration of the survey. Those who decided to participate gave me their oral consent. While they were talking, I was filling out the excel sheet with their responses. I did not make an audio recording of the conversations with them.

3.2 Development of the methodology

In this subsection, I illustrate how I have developed the conceptual framework and the methods. I use the literature review on energy justice and energy poverty as a basis for the construction of the conceptual and methodological framework. In this subsection, I first elaborate on applying energy justice as a key concept, and then I use the developed body of energy poverty literature to develop the conceptual framework presented in the second chapter and the methods described in this chapter.

I apply energy justice through its most commonly used three-tenet structure proposed by Jenkins *et al.* (2016) and shown in the Table 4. One key departing point is how energy justice is applied to energy poverty. The visual depiction of Walker Gordon and Day (2012) shown in Table 5 is used to develop the overall conceptual framework. This formulation of the three-justice tenets as evaluative and normative tools shows what kind of questions need to be asked in order to apply the energy justice concept for analysis and solution-creating (see Table 4). Distributive justice is mainly about the location of injustices; the recognition is about the characteristics of persons or groups, while procedural is about the process.

Table 4: Evaluative and normative contributions of energy justice

Tenets	**Evaluative**	**Normative**
Distributive	Where are the injustices?	How should we solve them?
Recognition	Who is ignored?	How should we recognize?
Procedural	Is there a fair process?	Which new processes?
Source: (Jenkins *et al.* 2016)		

After deciding on using the three-tenet approach, it useful is to review how researchers have used it to evaluate energy poverty. According to Walker Gordon and Day (2012), and Table 5, the core of energy poverty lies in its distributive aspect which is about access to energy services. The procedural injustice of energy poverty is manifested in access to information and participation in policies, while the recognition injustice is seen in the different vulnerabilities and needs (Walker Gordon and Day 2012). Both procedural and recognition injustices impact and are shaped by distributive injustice (Walker Gordon and Day 2012).

Table 5: Energy poverty as seen through the three justice tenets according to Walker Gordon and Day (2012)

Procedural injustice	Inadequate access to information on energy poverty, energy prices, and solutions	Lack of participation in energy policy, housing policy, climate policy, fiscal policy	Restricted access to legal rights and requirements, and barriers in the ability to challenge these
Distributional injustice	Inequalities in income	Inequalities in housing and technology energy efficiency	Inequalities in energy prices

Injustice in recognition	Lack of recognition of differences in vulnerability and need for energy services	Unequal accordance of cultural and political respect
Source: (Walker Gordon and Day 2012)		

I continue to develop the conceptual and methodology framework by distilling some core aspects of the energy poverty literature. I have grouped the most relevant findings from the literature review in Tables 6 till 9 to capture the alignment of the aspects of energy poverty, such as affordability, access, or comfort with various types of heating – Table 6; the findings in the literature about recognizing the characteristics of the energy-poor – Table 7; the findings of housing relevant to energy poverty – Table 8; and findings of challenges to energy poverty in the context of the energy liberalization and transition processes – Table 9. The tables summarize the findings discussed in the literature review chapter. They show how the findings in the literature pave the way for developing the energy poverty indicators, and the interview and survey questionnaires, which I describe in detail later in this chapter.

Table 6: Findings in the literature for aspects of energy poverty linked to the type of heating

Issue (aspect of energy poverty)	**Type of heating (if mentioned)**	**Question**	**Source**
Affordability	District heating, electricity, heat pumps (in some of the articles the type of heating was not specified)	Is it too expensive –all energy services – (self-reported) or measured (household income vs. all energy costs)?	(Bouzarovski 2014; Brunner *et al.* 2012; Gaigalis *et al.* 2016; Scarpellini *et al.* 2015; Thomson and Snell 2013; Tirado Herrero and Ürge-Vorsatz 2012)

Affordability	Not specified	Does the household have arrears on utility bills?	(Thomson and Snell 2013)
Affordability	Not specified	Is the household able to pay to keep the home adequately warm?	(Thomson and Snell 2013)
Barriers to energy efficiency/ affordability	District heating	Can you implement energy efficiency measures and would they impact your heat bills?	(Tirado Herrero and Ürge-Vorsatz 2012)
Access	Electricity, fuelwood	Is electricity/fuelwood used for heating because of lack of other choices?	(Buzar 2007b; Spagnoletti and O'Callaghan 2013)
Comfort	Not specified	Are all occupied rooms heated?	(Brunner *et al.* 2012; Waddams Price *et al.* 2012)
Comfort	Not specified	Is the temperature in the occupied room satisfactory (self-reported) or measured (World Health Organization standards)?	(Boardman 2010; Moore 2012)
Source: author by using sources given in the right column			

Table 7: Findings in the literature for aspects of energy poverty linked to vulnerable groups

Categories relevant to vulnerable groups	**Question**	**Source**
Household size	How many people live in your household?	(Buzar 2007b; Healy and Clinch 2004; Waddams Price *et al.* 2012)

Unemployment	Do you have unemployed adults in your household?	(Brunner *et al.* 2012; Buzar 2007b)
Level of education	What is the highest level of education of the household's head(s)?	(Healy and Clinch 2004)
Location	Living in rural or urban areas?	(Boardman 2010; Buzar 2007b; Thomson and Snell 2013)
Disability/ Long-term illness	Do you have a disabled/long-term ill person in your household?	(Healy and Clinch 2004)
Coping strategies	Do you economize your heating and do you minimize your energy needs on account of other needs?	(Brunner *et al.* 2012)
Specific needs	Do you need more heat in your home (above 21 degrees)?	(Bouzarovski 2014)
Measures against energy poverty	Have you ever received any support to cover your energy costs or install energy efficiency measures in your household?	(Boardman 2010)
Social welfare recipients	Does the household receive any social welfare assistance?	(Stojilovska and Zuber 2013)
Ethnicity	Your ethnicity?	(Filcak 2007)
Source: author by using sources given in the right column		

Table 8: Findings in the literature for aspects of energy poverty linked to housing quality

Indicators for housing quality	**Question**	**Source**
Age of dwelling	How old is the dwelling?	(Boardman 2010; Brunner *et al.* 2012; Healy and Clinch 2004)

Tenure	Who owns the dwelling?	(Healy and Clinch 2004; Walker Gordon 2008)
Leaking roof/ damp walls/ rotten windows condensation	Presence of leaking roof/ damp walls/ rotten windows/ condensation?	(Healy and Clinch 2004; Thomson and Snell 2013)
Source: author by using sources given in the right column		

Table 9: Findings in the literature for aspects of energy poverty linked to energy transition challenges

Indicators capturing the energy transition challenges	**Question**	**Source**
Switching to fuelwood	Have you changed the type of heating?	(Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016)
Increase of energy service costs	Have the costs of energy services in the household increased?	(Bouzarovski 2014; Brunner *et al.* 2012; Fahmy *et al.* 2011)
Household income has decreased or remained the same, increase in unemployment	Has the household income decreased or remained the same?	(Boardman 2010; Bouzarovski 2014; Brunner *et al.* 2012)
Slow rate of energy efficiency improvements	Has the household undertaken any energy efficiency measures?	(Brunner *et al.* 2012)
Access to new technologies	Would you buy solar collector, heat pump, smart meter?	(Healy and Clinch 2004)
Lack of awareness of energy efficiency measures	Which energy efficiency measures do you know that you can implement in your household?	(Healy and Clinch 2004)
Source: author by using sources given in the right column		

To ease the complexity of a large quantity of collected data (elaborated later in this section), I used in certain chapters additional methodological approaches. In the chapter about recognition justice (chapter 6), I relied on grounded theory to conceptualize the observed coping strategies of households. Grounded theory, encourages continuous interaction with data, and leads to examining all possible theoretical explanations for the empirical findings (Bryant and Charmaz 2007). I have not intended to collect various coping strategies in detail, but I had by collecting the data I intended, especially with the open-ended questions. When analyzing the data, and reading the literature on coping (see previous chapter), I started to make sense of the coping strategies, to code, and characterize them. I have also used narrative storytelling which is that stories provide a different kind of evidence because they have a different emphasis, and can convey emotions (Moezzi *et al.* 2017). This was useful to have in mind when approaching the personal stories and struggles of energy-poor households which I conveyed by using many citations of households to give a human dimension to the findings resulting from the quantitative data, such as about the variables predicting energy poverty. I have also used the personal story narrative in the last empirical chapter when I described two different stories of procedural (in)justice.

3.3 Data collection

In this subsection, I show the data sampling procedures and the type of data I collected. The data collection includes the use of these methods: documents, a survey questionnaire for households, an interview questionnaire for households, and an interview questionnaire for non-household stakeholders. Each method followed a different sampling procedure.

3.3.1 Sampling of cases

In this subsection, I elaborate a bit more about the selection of the two cases – North Macedonia and Austria. The sampling of case(s) for a case study entails their identification and setting their boundaries (Punch 2005). Cases are chosen in order to advance our understanding of the subject of interest, and this could potentially lead to better theorizing about a larger collection of cases (Stake 1994). Using more than one case strengthens the confidence in the findings (Miles *et al.* 2014). When the maximum variation sampling strategy is used for choosing the cases, any common patterns resulting from different cases are relevant for finding shared dimensions of a phenomenon (Patton 2002).

I have chosen two contrasting cases, North Macedonia and Austria, a developing and a developed country, an EU candidate country, and an EU member state, countries with different legacies, different standards of living, different types of heating in households, and importantly different levels of energy poverty. Additionally, when deciding about the cases, I wanted to choose countries in which I can speak the language; countries that do not have a too large difference in size, are not too far from my location, Budapest, Hungary. The first choice was North Macedonia, my home country where I have previously worked as an energy researcher and explored energy poverty; and my second choice was a country with a different legacy (not post-socialistic), a developed social welfare system, a small share of energy poverty, and a developed public heating infrastructure. I have, therefore, chosen countries that differ in the two main variables of the research question – level of energy poverty, and the dominant types of heating.

3.3.2 Qualitative sampling

In this subsection, I explain the sampling of the qualitative data, namely the documents, and the two types of interviews – with households, and with stakeholders. The sampling strategy used for qualitative data is called deliberate or purposive sampling, with the meaning that the sampling is made in a deliberate way (Punch 2005), and with a purpose to answer the research questions (Patton 2002). When it comes to the sample size in qualitative inquiry, there is no rule as the size of the sample depends on the purpose of the study (Patton 2002). This means that the interviewees for the interviews with stakeholders and households were chosen with the purpose to answer the research questions in the most effective way.

The interviewed stakeholders as shown in Appendix 7 represent relevant sectors and points of view which allow a holistic understanding of energy poverty, heating technologies, policies, and solutions. I have found the stakeholders in North Macedonia by relying on my previous knowledge of the country and access to a network of collaborators. I have additionally looked up other stakeholders via Google search, such as companies that sell heat pumps. The stakeholders in Austria I have found through a Google search with the aim to find all relevant experts and stakeholders that had to do any research or had any experience or authority regarding energy poverty, and heating fuels and technologies. I justify this approach by following the scope of the energy justice framework, to have a systematic approach analyzing the research from various angles and levels.

I have sampled the documents in two ways. First, I received some documents from the stakeholder interviewees, which some of which I used in my dissertation, for example, the documents I have received from Wien Energie Ombudsman in Austria describing their post and work. I have also received some materials on previous research the stakeholder interviewees have done. I have also done an internet search for some documents. This was done to complement the data I needed, for example, the documentation around the draft energy law initiated by citizens in North Macedonia. I have used the official notes published on the internet page of the Parliament of North Macedonia. The collection of documents was a complementary activity, to add to the interviews I have conducted (with the Austrian Wien Energie Ombudsman), or as a replacement for not getting an interview with the stakeholders I wanted (with representatives of the AMAN citizen movement).

The interviewed households were targeted to represent all regions within the selected countries – 8 regions in North Macedonia; and 9 states in Austria; to offer good rural-urban coverage, representation of various types of heating, inclusion of vulnerable citizens, and of good stories, such as the use of passive houses, solar heating, and heat pumps. In North Macedonia, I tried to have a diverse ethnic representation. I have interviewed both energy-poor and not energy-poor households. I have administered the interview questionnaire for households online. I used the online tool Limesurvey to collect this data. All household interviewees were anonymous. I found the households in Austria through a few of the interviewed stakeholders that had contact with vulnerable households or customers of heating technologies for their company. In North Macedonia, I used personal contacts to reach out to various locations and ethnic groups, and I used Facebook groups of various regions, cities, and rural areas to reach out to a diverse group of citizens. I have approached both energy-poor and not energy-poor households because in order to explore the synergies between the type of heating and energy poverty, the inclusion of non-energy-poor makes the task more objective. When I approached households to fill out the survey, I did not know if they were energy-poor, I only accounted for the diversity of types of heating, and geographical scope and I adjusted my approach as I was reviewing the results. For example, if I was missing a certain kind of variable, such as households of a certain ethnicity, I tried to target households of that ethnicity.

3.3.3 Quantitative sampling

In this subsection, I explain the sampling of the quantitative data, namely the survey questionnaire for households. Unlike qualitative sampling, quantitative methods have different sampling strategies and sample size considerations. The sample that has been randomly selected and is statically representative permits generalization from the sample to the population it represents

(Patton 2002). By random selection, each member of the population has an equal chance of being chosen (Punch 2005). The size of the sample is relevant to determine the outcome of a statistical significance test (Punch 2005). The statistical concepts, sampling error, and confidence intervals are instrumental for specifying the degree of accuracy, while the concept of confidence level determines the level of confidence in the generalization (de Vaus 2002). That means that the households I have chosen to randomly sample, are both energy-poor and not energy-poor. This allows for a comprehensive and statistical assessment of the relationship between the two main variables – energy poverty and the type of heating. Thus, I am open to exploring hidden energy poverty and energy injustices, but also good examples of avoided or addressed energy poverty.

The preparation for the surveys was very time-consuming and carefully planned. In a lengthy manner, I describe all steps I undertook to prepare the survey samples. I have only conducted surveys in the capital cities of Skopje and Vienna. The reason was to make the data collection process easier since a country-level survey would have required a listing of all households in the country, which will take a lot of time to complete. The survey sampling and collection process for both capitals lasted about 10 months. I justify this approach of a combination of a representative sample per capital and a purposive sample per country level, through the use of mixed methods which balance their weaknesses. I cannot generalize the findings of the national-level interview sample to the entire population in the country, but I can draw conclusions by comparing the survey and interview datasets, also the results from the interviews with stakeholders. With a randomly sampled survey at a capital level, I can draw conclusions about the entire population of these cities.

Here I justify the choice of the capital cities for the survey. Skopje is chosen because it is the only area in North Macedonia, where district heating is used, apart from the national-wide dominant electricity and fuelwood (State_Statistical_Office 2015a). Skopje is also an ethnically diverse city and has also parts that are classified as rural (Official_Gazette 2008). Vienna is chosen because it is the only area in Austria, where the gas convector is better represented (Statistik_Austria 2016a), which is relevant for studying all various types of heating. Since energy poverty affects a small minority in Austria of 3,1% of all households (Statistik_Austria 2017b), (more on this in the next chapter), Vienna is a good location since the share of at-risk-of-poverty rate in Vienna is 17,4%, the highest share in Austria per country (Bundesland) (Statistik_Austria 2009). Vienna has also many very old buildings, and social housing, two variables also relevant for energy poverty.

In the following paragraphs, I show how I have constructed the randomized samples in the capital cities. The Skopje region had 161 841 households in 2014 (State_Statistical_Office 2015a), and Vienna 865 157 in 2014 (Statistik_Austria 2016d). If the confidence level is 95% and the confidence interval is 8, for each of the cities, the sample size is 150 (Survey_System n.d.). That means I had to have a sample of 150 respondents per city. There was no comprehensive publically available list of all households in either city, thus I had to construct by myself the list of the entire population (the capital cities). In order to maintain the overall quality of the population, I needed to perform it in carefully controlled steps.

To construct the entire population per city, I took a spatial approach. I used the publicly available list of all streets per district/municipality for both capital cities (Stadt_Wien n.d.; State_Election_Commission 2016) as a point of departure. This spatial approach is convenient as it is easily traced to the distribution of the types of heating. However, having a list of streets does not mean that there is a list of households. To transform the list of streets into a list of households, I obtained the approximate number of households per district/municipality and classified the streets into three sizes with the help of google maps, or the name of the street (Gasse means a small street in German, and boulevard is a long street in North Macedonia). This careful procedure resulted in quotas of households per district/municipality.

The approach of selecting the survey samples was simple randomization. However, I tried to make small adjustments per municipality/ area within the city to maximize the chance of including energy-poor households since I aimed for a small sample of 150 respondents per city. This concern was especially justified for Austria which has a low level of energy poverty (Thomson and Snell 2013). I used statistical data to locate in which areas in Vienna and municipalities in Skopje are variables relevant for energy poverty more present. For Vienna relevant is the location of older buildings, and dwelling without central heating, and social housing which might be relevant based on income eligibility for accessing social housing (Wohn_Beratung_Wien n.d.-a), and considering previous research on energy poverty in the country (Statistik_Austria 2017b). That means these locations are relevant for Vienna: 10, 21, and 22 for social housing (Willhaben 2017; Wohn_Beratung_Wien n.d.-b), 1, 3, 4, 5, 6, 7, 8, 9, and 15 where older dwellings are located (Stadt_Wien 2015), and dwellings with categories B, C and D which are without central heating: 5, 9, 15, 16, 17, and 20 (Stadt_Wien 2015). Additionally, I considered which areas could have more non-Austrians, and these were 17, 16, 15, 12, 10, 4, 5, 9, 2, 20 (Statistik_Austria 2013). Vienna does not have rural areas according to statistics (Statistik_Austria 2017a).

In Skopje I took into consideration the location of the district heating, which is much less used than electric heating and fuelwood (State_Statistical_Office 2015a); the rural parts of the city are more vulnerable to energy poverty (Buzar 2007b), and the location of ethnic minorities which could be also more vulnerable to energy poverty (Tirado Herrero 2013). That means these municipalities in Skopje need to be adjusted for district heating: Kisela Voda, Centar, Chair, Aerodrom, Gjorce Petrov, Butel, Karposh, and Gazi Baba (Stojilovska 2012); all municipalities except Centar and Chair have rural parts (Official_Gazette 2008); and these 4 have a multi-ethnic character: Saraj, Butel, Chair and Shuto Orizari (Bliznakovski 2014).

Based on the above-mentioned justifications and steps, I have developed quotas per area out of the 23 areas in Vienna to account for a balanced spatial representation of the areas, and also to give a slightly higher share of more deprived areas. After setting up the quotas per area in Vienna, I used the Herold 2016/2017 phonebook of landline numbers (Herold 2017) as a source of households' numbers. I have used a well-developed randomization procedure to choose the number randomly within the quotas I have set up. The randomization procedure means I would first choose which area out of the 23 I was phoning and then randomly choose 6 pages from the phonebook using this online tool for randomization (Urbaniak and Plous 2021). I would then call all the numbers. I would call the numbers which were not responding the first time one more time. In reality, I have managed to complete to a large extent the designed area-quotas, but I also had to make adjustments if there was a high rejection rate in an area. I have dialed 6762 different phone numbers in Vienna at least once in order to collect the 150 survey participants.

I have followed a similar logic to develop quotas for the 10 municipalities in Skopje. I have made both a balanced spatial representation of the municipalities and added a slightly higher share of more deprived areas. Following the quotas per municipality in Skopje, I followed a self-designed randomization procedure. I have listed the smaller areas within each municipality and located them on google maps to choose randomly streets from them which I would then search for at the online phone registry (P3_Infomedia 2013) and call all households living on that street. I chose landline numbers only. I would call the numbers which did not respond the first time one more time. In reality, I have managed to achieve to a large extent the designed municipality-quotas, but I also had to make adjustments if there was a high rejection rate in an area. I have dialed 1156 different numbers in Skopje at least once to collect the 150 survey participants.

In both cases, I have collected the data via phone by using Skype for households in Vienna or a landline number for most of the households in Skopje. I was calling mostly on workdays between 10 am and 8 pm. I conducted all the surveys by myself. I collected the data in a prepared excel document while I was speaking to the households. I used Macedonian and German languages. In few cases for the Austrian households, I used English when I encountered migrants with poor German skills. I collected the survey data from April till December 2017.

3.3.4 Interviews

In this subsection, I justify the use of interviews as a method, and I elaborate on the design of the two interview questionnaires – for stakeholders and households. The interview is also of the typical sources of data collection for a case study (Yin 2003). Interviews give information about people's experiences, perceptions, opinions, and knowledge (Patton 2002; Punch 2005). It is one of the most powerful ways of understanding others (Fontana and Frey 1994; Punch 2005). The research interview is a conversation between two partners about a theme of mutual interest (Kvale 1996). The research interview proceeds like a normal conversation but has a specific structure and purpose (Kvale 1996). The number of interviewees depends on the purpose of the study (Kvale 1996). I am using the interview as a method since it allows for an in-depth view of the respondent's experience and knowledge. Interviewing experts and households has been a very common way of gathering data on energy poverty (Anderson *et al.* 2012; Grossmann *et al.* 2021; Horta *et al.* 2019; Longhurst and Hargreaves 2019).

I here distinguish between the interviews with households, and with stakeholders. The interviews with the stakeholders aim to get a good overview of the countries' situation regarding energy poverty, to understand the previous research done on energy poverty, energy justice, and heating, and to understand some of the main policies with relevance to energy poverty. I have prepared one interview questionnaire for the stakeholders, but I adapted the questions per interviewee depending on their experience. In Appendix 2 I show this interview questionnaire for stakeholders. Each question embodies an energy justice tenet and is drawn on relevant material from the literature review. The interview with stakeholders was semi-structured, made of prepared questions but open to changes to follow up the answers of the interviewees (Kvale 1996). In Appendix 7 I show all interviewed stakeholders in North Macedonia and Austria. They belong to various sectors. I also added notes about how the interview was conducted, either face-to-face, which were most of them, or a few via skype or email. Most of the interviewees allowed me to record our conversation. The interviewees gave their written consent to participate in the interview, while in three cases the consent was oral/ informal only. They are presented in the dissertation with their affiliation only. I interviewed a total of 54 stakeholders from both countries. I have transcribed all the interviews manually in Macedonian and German, respectively.

The interview questionnaire for households was administrated online, via an online tool, which allowed me to collect not only typical qualitative data, such as open-ended questions to which the interviewees can respond in their own words (Patton 2002) but also socio-demographic and household data, such as the age of dwellings, number of households members and similar. This made this interview questionnaire a combination of a survey type of data (multiple-choice questions) which helped to make meaning of the households' challenges in relation to relevant household and housing variables, and more of an in-depth ethnographic inquires (Robben and

Sluka 2007; Spradley 1979) in which the households could express their views, and experiences. I justify this combination of household ethnographies along with survey data as it allowed for the data to be assessed both qualitatively and quantitatively. And the manner in which the data was collected, online, it allowed for both types of survey and the ethnographic type of data to be collected. Appendix 3 is a list of the interview questions for households. The questions are formulated to reflect the findings in the literature review. I have collected a total of 100 interviews with households in Austria and 119 in North Macedonia in 2017.

3.3.5 Survey

In this subsection, I justify the use of survey as a method, and I elaborate on the design of the survey questionnaire for households. Surveys are structured interviews with pre-determined questions with a limited set of response categories (de Vaus 2002; Fontana and Frey 1994; Punch 2005). There is little room for variation in response (Fontana and Frey 1994). All participants answer the same questions and in the same order (Punch 2005). Important principles for the survey design are reliability and validity (de Vaus 2002). An unreliable question is one that fails to achieve consistent responses (de Vaus 2002). Ambiguous or vague question wording may produce unreliable responses (de Vaus 2002). A valid question is the one that measures what we think it does (de Vaus 2002). These principles are integrated into the survey. I justify the use of a survey since by following a simple randomized sampling, it can generate results generalizable to the population it represents. It is also adequate for statistical analyses, such as cross-tabulation and regressions, which can tell about the correlation or predicting power of variables. This is relevant since I am exploring the relationship between two main variables.

I have designed the survey questionnaire in Appendix 4 reflecting the findings in the literature. More than half of the questions are filter questions. I have also integrated at some instanced where it was relevant open-ended questions. The qualitative questions are not typical for a survey, but I did integrate some to understand in more detail the experiences and opinions of households. These open-ended questions have generated valuable and unexpected data, such as the coping strategies of households. The survey took approximately 7-10 minutes. I have collected 150 surveys in Vienna and 150 in Skopje in 2017.

3.3.6 Documents

In this subsection, I describe the type of documents I collected for this dissertation and why. Documents are written materials, official publications, and reports (Patton 2002). Documents can be part of the data collection materials for a case study accompanying interviews and observations (Punch 2005). Following this elaboration, I used documents in this dissertation as a complementary method to my primary methods – interviews and surveys. I have collected documents as a way to fill in the data needs when I could not collect it as primary data, or when there was written documentation that facilitated the interviews I conducted. The type of documents I collected was of legal or administrative nature. That means I received documents from stakeholder interviewees to show their work in written form, and I have collected documents on my own from the internet page of relevant institutions when I could not collect that data through interviews. In Appendix 6 I list the documents I collected and use in this dissertation. I have collected a much larger set of documentation from the interviewed stakeholders than I use, but some I had to disregard because it was covering material outside the scope of my research. The main documents I collected include a set of written materials from Wien Energie Ombudsman about their work, and a set of documents downloaded from the website of the Parliament of the Republic of North Macedonia concerning the procedure around the draft energy law proposed by citizens. I have also used materials from the internet page of the social movement Aman. I also used one leaflet I collected document from a stakeholder interviewee in Austria about fuelwood use. I collected this data in 2017.

3.4 Data analysis

This part shows how both qualitative and quantitative data were analyzed and which software was used. I discuss also how each method was analyzed, how the two cases were compared, and how I achieved triangulation through the use of various methods and levels of analysis. Before analyzing the household data, I transformed it into 4 datasets (also listed in Appendix 5), one per survey per capital, and one per interview collection per country level: Vienna survey dataset, Skopje survey dataset, North Macedonia interview dataset, and Austria interview dataset. This way of structuring of the household data enabled me to distinguish the operations I can perform and which results are generalizable.

3.4.1 Qualitative analysis

In this subsection, I describe how I analyzed the collected qualitative data. Qualitative data was analyzed following the steps of data condensation, data display, and conclusion drawing/verification (Miles *et al.* 2014). Data condensation is selecting, focusing, coding, or abstracting the data from interview transcripts, documents, and other empirical materials (Miles *et al.* 2014). Codes can be summarized in themes, causes/explanations, contrasts/comparisons, relationships, or theoretical constructs (Miles *et al.* 2014). Data display is an organized, compressed presentation of information from which conclusions can be drawn (Miles *et al.* 2014). The three steps are interconnected during and after the data collection (Miles *et al.* 2014). Regarding the analysis of documents, I followed (Punch 2005), stating that understanding the context of the document affects its interpretation. As depicted in Figure 5, all collected data were analyzed in a qualitative manner. This is because even in the quantitative data (surveys) I had open-ended questions which I could analyze qualitatively. The main qualitative methods were the interviews with stakeholders, interviews with households, and documents. All data I analyzed with the help of the software Atlas.ti which is adequate for qualitative data analysis (Atlas.ti n.d.). This tool enables the coding of all types of data and offers various tools for the analysis and visualization of data (Atlas.ti n.d.).

I here reflect briefly on how I approached the qualitative analysis of all data. I have analyzed the qualitative data coming from interviews with stakeholders, interviews, and surveys with households and documents by following the broad themes of distributive, recognition, and procedural justice. In particular, the distributive injustices were mapped around the use of technologies, fuels, and the role of infrastructure. I organized the material for distributive justice as demand-side and supply-side features of heating used by vulnerable households. The recognition injustices I mapped around the socio-demographic features of vulnerable groups and I studied in detail their behavior. The procedural injustices I mapped around the market structure and the role of relevant stakeholders in creating or preventing energy poverty. I have chosen two different cases or stories of the Wien Energie Ombudsman, and the Macedonian energy protests to depict procedural energy (in)justice. In the following chapters, starting with chapter 5, I have organized the material around one energy justice tenet.

3.4.2 Quantitative analysis

In this subsection, I describe how I analyzed the collected quantitative data. Quantitative research is based on relationships between variables (Punch 2005). In order to analyze quantitative data, it needs to be coded (de Vaus 2002). Variables can be independent, control, or dependent (Punch 2005). Regarding the level of measurement, the most important is to differentiate between nominal and interval variables, as the measurement level determines the operations of quantitative analysis

(Punch 2005). The analysis can be univariate, bivariate, or multivariate depending on the number of variables analyzed, one, two, or more than two, respectively (de Vaus 2002). Statistics are used to analyze quantitative data (Punch 2005), and two basic types of statistics are descriptive and inferential (de Vaus 2002). Test for analysis of quantitative data include chi-test for cross-tabulation analyzing whether variables are related (Punch 2005), and regression with looks for predictors and determines how well they predict (Griffith 2007). As shown in Figure 5, I have analyzed in a quantitative way the surveys, but also the interview datasets collected with households. This is because even in the qualitative data (interviews) I had multiple-choice questions which I could analyze quantitatively. The main quantitative methods were the surveys collected with households. I used SPSS which is adequate to do a wide range of statistical functions (IBM n.d.; Punch 2005).

I elaborate in the following paragraph the two main statistical operations I undertook and to which data. I also reflect on the needed preparatory steps for doing the statistics. The 4 household datasets, Vienna survey, Skopje survey, North Macedonia interview, and Austria interview datasets have collected nominal and ordinal data. Nominal variables represent categories with no intrinsic ranking, while ordinal values have some intrinsic ranking (de Vaus 2002; IBM n.d.). Due to the small sample (de Vaus 2002; Hoyle 1999), the data had to be re-coded in order to be able to be analyzed statistically. I performed cross-tabulations for all 4 datasets and binary logistic regression for the two survey datasets only.

To perform cross-tabulations, the data was transformed into nominal binary data. For example, the various types of heating were combined into central and non-central types of heating. The cross-tabulation is appropriate for nominal data and shows the correlation between two variables. To perform cross-tabulation in SPSS I use the chi-square to discover the significance with the Fisher’s

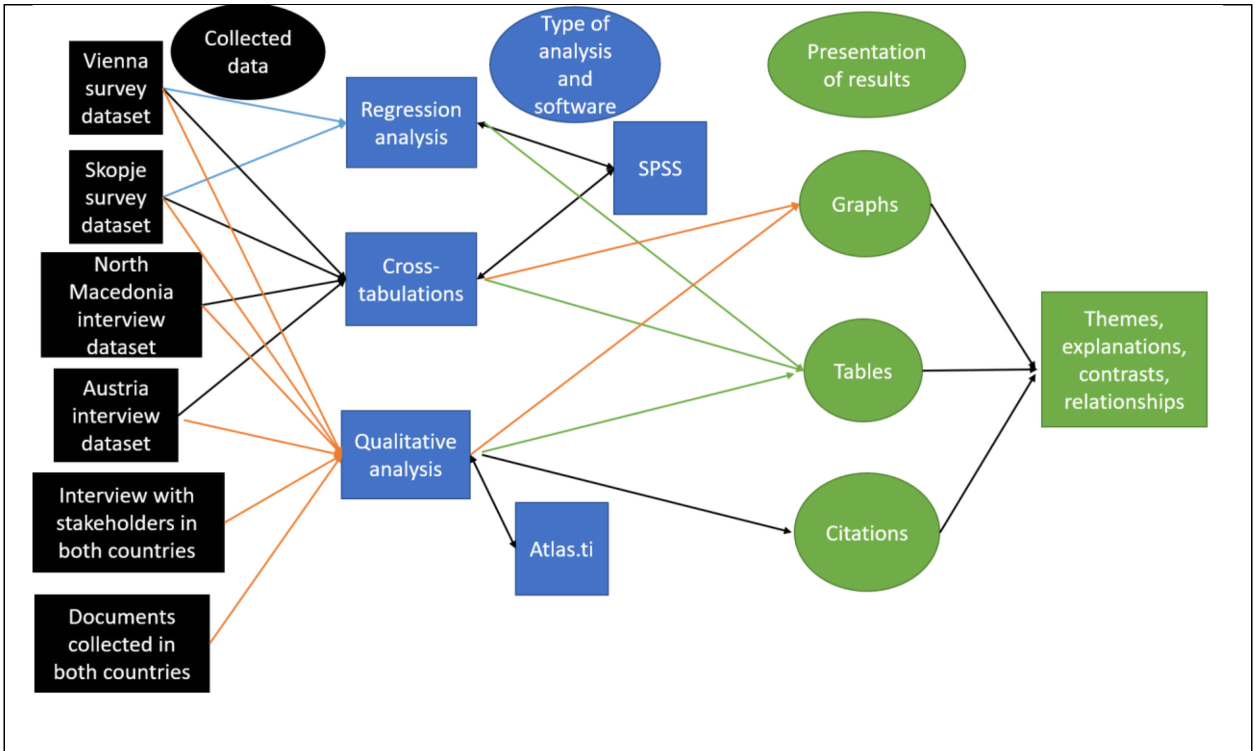
Exact Test and the likelihood ratio, and from symmetric measures the contingency coefficient and Phi to assess the significance of the relationship and the strength of the relationship. If the significance is less than 0.05, the relationship is significant (Andersen 1994). If the values are higher than 0.300, the relationship is strong (de Vaus 2002). I have only considered results as relevant from the cross-tabulation if they are both significant and strong in order to get a better quality of data. All 4 datasets went through cross-tabulation.

Only the Vienna and Skopje survey datasets were used for a regression analysis since the data were collected randomly. I used a binary logistic regression which is used for categorical data and a useful tool for predicting the value of a categorical response variable with two possible outcomes (IBM). To perform regression analysis, I had to use the binary data and transform it into dummies, 0 or 1, whereas 1 means the value which is analyzed. For example, the non-central type of heating was coded as 1, and central as 0 (shown more in Appendix 10). The run the binary logistic regression, I used the defined energy poverty indicators as dependent variables (Figure 14 and more elaborated in the following chapter), and the socio-demographic, technological, and housing variables as independent variables (Figure 15 and Appendix 10 – more elaborated in the following chapter). Due to a small sample, I could use a combination of 2 independent variables. In order to improve the quality of the results and avoid multi-collinearity, I have excluded from the regression calculations the strong and significant correlated results between the independent and dependent, and among the independent variables by following the values of Fisher's Exact Test, likelihood ratio, Phi and the contingency coefficient described above. I have also excluded the independent variables which have a small number of respondents, those which were below 5% (more details the in descriptive statistics of the household data in Appendix 9). To run binary logistic regression, I have marked the independent variables in SPSS as categorical with 0 as the reference category, and then I have performed the Hosmer-Lemeshow goodness of fit test which if not significant means that the model is good (IBM n.d.). I have used only the significant results which is when all independent variables have a significant effect on the dependent variable – each was less than 0.05. In Appendix 12 only the relevant regressions are shown pointing out the following values: Model chi-square (Sig.); -2 log-likelihood; Nagelkerke R square; correctly predicted in %; as well as B, S.E., Wald, df, the significance and Exp (B). If the significance level of the Wald statistic is less than 0.05 then the parameter is useful to the model (IBM n.d.). The most important apart from the significance is the Exp(B) which is the ratio-change in the odds of the event of interest for a one-unit change in the predictor (IBM n.d.). Exp(B) shows which of the single independent variables has the highest effect on predicting the dependent variable. I have used the results about the housing, technological, and socio-demographic variables of households which predict being in energy poverty (more elaboration about the results in the following chapter). These results shaped the structure of the distributive and the recognition energy justice chapters (chapters 5 and 6).

3.5 Triangulation

In this subsection, I show how all the data combined leads to triangulation. Triangulation can be method triangulation when different/several methods are used to check the consistency of findings from different data collection methods (Fontana and Frey 1994; Patton 2002), and sources triangulation when different/multiple sources of evidence are used to check the consistency of data sources (Patton 2002; Yin 2003). Benefits of triangulation include strengthening the validity (Yin 2003), testing the consistency of the research, reducing systematic bias, increasing credibility and quality of findings (Patton 2002) as well as clarifying meaning and verifying the repeatability of interpretations (Stake 1994). Triangulation is considered to be a strength of a case study data collection (Yin 2003). In this dissertation, I achieve triangulation through the use of different methods, including a mixed-method approach and multiple primary and secondary sources. The different methods facilitate the development of conclusions and will contribute to the validity of the results. Figure 5 shows how the collected data was analyzed and presented. As I discussed earlier, I used regression analysis to survey datasets, while cross-tabulations of all household data. All types of data I analyzed qualitatively. This shows that I could analyze qualitatively the quantitative data too, and quantitatively some of the qualitative data. In the framework of qualitative analysis, I also generated stories shown through ethnographies of households throughout the empirical chapters, and in the last empirical chapter. Similarly, I have used grounded theory to make sense of the collected coping strategies of households for the recognition justice chapter (chapter 6). To present the data in a form of evidence in the dissertation, I generated citations from the qualitative analysis; tables from the qualitative analysis, regression analysis, and cross-tabulations. Finally, I produced graphs from the cross-tabulations and qualitative analysis. All types of results feed into themes, contrasts, relationships, or explanations. At the core of the comparative case study is showing the similarities and differences between the two studied countries. I have mostly focused on the common findings from these different cases as they gives a greater confidence that the theory in generic (Miles *et al.* 2014), but when relevant I point to the difference in the key findings.

Figure 5: Triangulation of data collection, analysis and presentation



Source: author

3.6 Conclusions about methodology and methods

In this subsection, I summarize the methodology and methods used in this dissertation. It is a comparative case study integrating a mixed-method approach. The methods are interviews, surveys, and documents. I have developed the methods by following the findings in the energy justice and energy poverty literature. I have collected in both countries 54 interviews with stakeholders, a few documents; 150 surveys per capital city per country; and 100 interviews with households in Austria, and 119 interviews with households in North Macedonia. The stakeholders are experts in the area of various backgrounds, and the households are both energy-poor and not energy-poor. The interviews with households collected also quantitative data, and the surveys with households included also qualitative data. I sampled the surveys using simple randomization, and the two types of interviews by using purposive sampling. I have analyzed all data in a qualitative manner, and all household data in a quantitative manner. I have respected the standard research ethical guidelines. The use of various methods and data ensures the triangulation of the results. The chosen methodology and methods are adequate to answer the research question because they offer both an in-depth and statistical analysis which is relevant to both measures the relationship between the two main variables and to offer a more in-depth understanding of it. The chosen methodology and methods are also in line with the common practices of studying energy poverty. Finding common results from different cases strengthens the analytical generalization.

4 CHAPTER 4: INTRODUCTION TO CASE STUDIES[4]

The aim of this chapter is to introduce the two cases studied in this dissertation, North Macedonia and Austria. First, I introduce some statistical data about the level of energy poverty, the type of heating, and the general socio-economic context by relying mostly on secondary data to get a good sense of the maximum variation sampling. Second, I do a short overview of the EU policies relevant for energy poverty by reviewing the relevant legal documents with the aim of anticipating any energy transition challenges the countries might be facing. Third, I use some of the primary data from households and stakeholders to give a better understanding of the work done in the following chapters. In this line, I introduce the results from the statistical analysis by showing the choice of energy poverty indicators, and variables I used, to show which indicators are the most relevant. I then present the results from the regression analysis in order to show which variables predict energy poverty. Lastly, I have developed three subsections, relying on primary data from interviews with stakeholders and collected household data, to introduce insights into a) material deprivation, housing, and heating; b) the energy market and support system; and c) profile of vulnerable households and their behavior. Each of these three topics is further discussed in each of the next three chapters.

4.1 General socio-economic context[5]

In this subsection, I show the differences in political legacy shaping the current socio-economic standard and quality of life. North Macedonia, a Western Balkan country, and Austria, a Central

[4] Some ideas and findings of North Macedonia presented throughout this thesis were published in: Stojilovska, A. 2020. Energy Poverty in a Subsistence-Like Economy: The Case of North Macedonia. In Perspectives on Energy Poverty in Post-Communist Europe, ed. G. Jiglau, A. Sinea, U. Dubois and P. Biermann, Routledge.

[5] Some of the secondary statistical data about energy poverty, the general socio-economic situation, and the type of heating refers to a period before the data collection in 2017. I keep this data since it had factored in into constructing, sampling, and collecting the data, but in some cases, I add more recent statistical data which shows the energy poverty does not change much over a period of few years.

European country, have different historic legacies, whereas North Macedonia belongs to the list of former socialist countries. Austria has a much higher standard of living and is a much richer country than North Macedonia, if the ranking according to the Human Development Index[6] and GDP values, respectively, are compared (see Table 10). North Macedonia has an approximately four times smaller population than Austria.

Table 10: Basic socio-economic data about North Macedonia and Austria

Socio-economic data	**North Macedonia**	**Austria**
Population in 2015	2, 078 Million	8, 6 Million
GDP in US dollars in 2015	10,086 Billion	374,056 Billion
Human Development Index rank in 2014	81	23
Source: (UNDP n.d.; World_Bank 2016, 2019)		

Following the maximum variation sampling strategy, the studied cases, do not only differ regarding the two main variables at the core of the thesis – the type of heating and the size of energy poverty (discussed later in this chapter), but a broad set of variables mainly related to the three main energy poverty drivers – being income, energy prices and energy efficiency (Table 11), and also due to their different political and economic legacy. In sum and according to fresh data from (Eurostat n.d.), the income poverty, housing deprivation, and unemployment is higher in North Macedonia, where the social welfare system is weaker (Table 11). Households in North Macedonia use about 3 times less energy than households in Austria; pay two times cheaper

[6] Human Development Index measures achievement in having a long and healthy life, being knowledgeable, and having a decent standard of living.

electricity, but have about 9 times lower income (Eurostat n.d.). I reflect on this table also later in this chapter.

Table 11: A broad list of indicators of relevance to energy poverty in 2019

Category	Country/ Indicator	Austria	North Macedonia
Income	At-risk-of-poverty rate	13.3%	21.6%
	People at risk of poverty or social exclusion	16.9%	39.9%
	Severe material deprivation	2.6%	30.4%
	Mean and median income	25729 EUR	2727 EUR
Employment	Unemployment rate	4.5%	17.3%
	Long-term unemployment	1.1%	12.4%
Housing	Severe housing deprivation rate	3%	9.7%
Energy	Final energy consumption in households per capita (in 2018)	740 kgoe	233 kgoe
	Electricity prices for household consumers per kWh (2020 S1)	0.1358 EUR	0.0662 EUR
Social welfare system	Impact of social transfers (excluding pensions) on poverty reduction	49.24%	14.96%
Source: (Eurostat n.d.)			

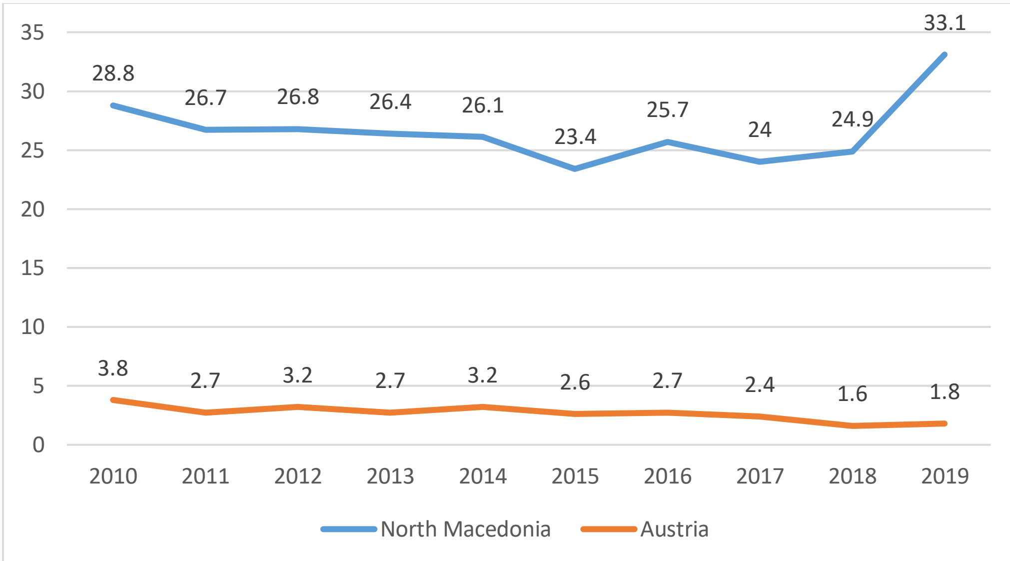
4.2 Background information on energy poverty

In this subsection, I show the discrepancies in the levels of energy poverty between the two cases with North Macedonia being very affected, and Austria having a minority of households suffering from energy poverty. I this case, I use secondary statistical data from a period before and after the data collection, showing that the situation has not changed too much, but I also include some of the collected household data. Due to the post-communist legacy, North Macedonia faces a higher share of energy poverty which is a broader phenomenon than income poverty (compare Table 11 and Figures 6-8). A small minority in Austria is affected by energy poverty between 2 and 10% (Eurostat 2019a, 2019b, 2019c), lower based on the study of their Energy Regulatory body (Energie_Control_Austria n.d.), and correlates with the income poverty share. This difference between the countries is visible also in the household data I collected. For example, more than half of the Skopje survey participants (53.7%) reported that they cannot adequately heat their home compared to only 8.1% in Vienna (Skopje survey dataset; Vienna survey dataset).[7]

Figures 6-8 show the most commonly used self-reported indicators of energy poverty (Thomson and Snell 2013), two of which are also primary indicators of EPOV (EU_Energy_Poverty_Observatory 2020). The first two indicators about affording warmth and arrears show a massive discrepancy in energy poverty between the studied countries. The third indicator about dwelling quality shows that Austria is only slightly better off. Through the last decade, in both countries there is a slight decrease in energy poverty; except in North Macedonia households are more exposed to heating affordability issues. Austria has reduced even its already small share (3.8% to 1.8% and 4.4% to 2.4%). North Macedonia has been exposed to a severe level of energy poverty, constant in the past decade.

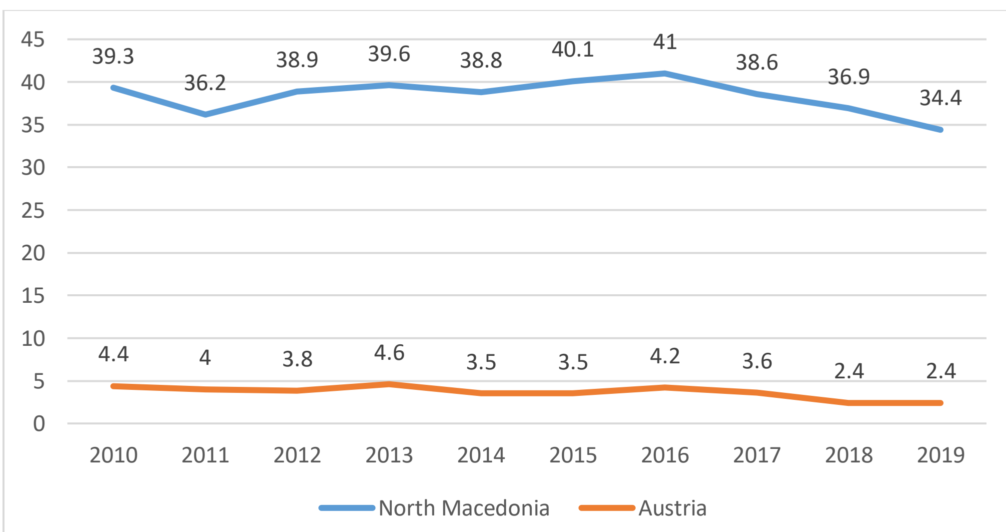
[7] Other data about the state of energy poverty from the collected survey data is available in Appendix 9.

Figure 6: Percentage of total population unable to keep home adequately warm in North Macedonia and Austria 2010-2019



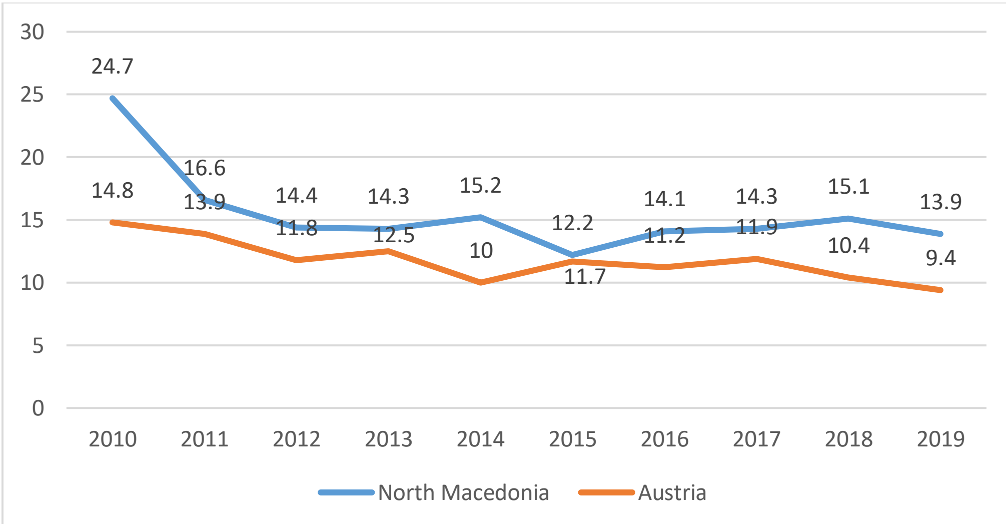
Source: (Eurostat 2019b)

Figure 7: Percentage of total population with arrears on utility bills in North Macedonia and Austria 2010-2019



Source: (Eurostat 2019c)

Figure 8: Percentage of total population living in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames of floor in North Macedonia and Austria 2010-2019

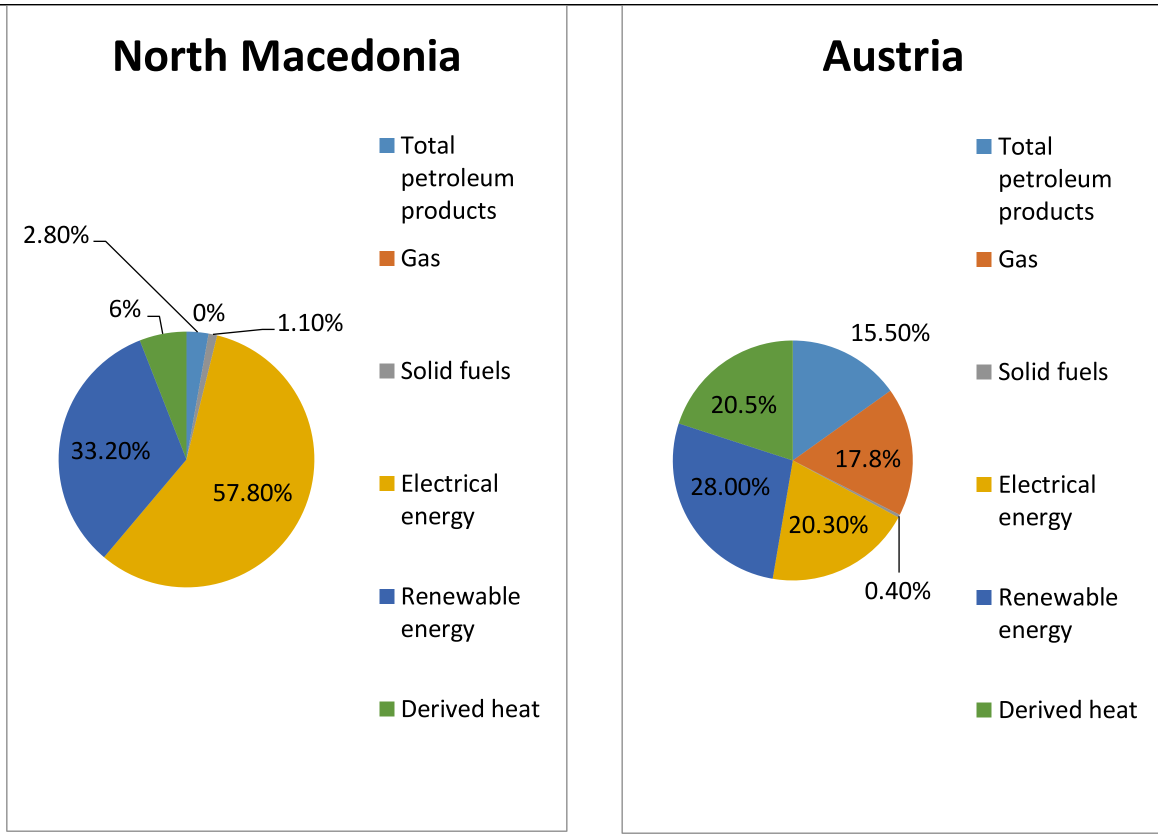


Source: (Eurostat 2019a)

4.3 Background information on the type of heating

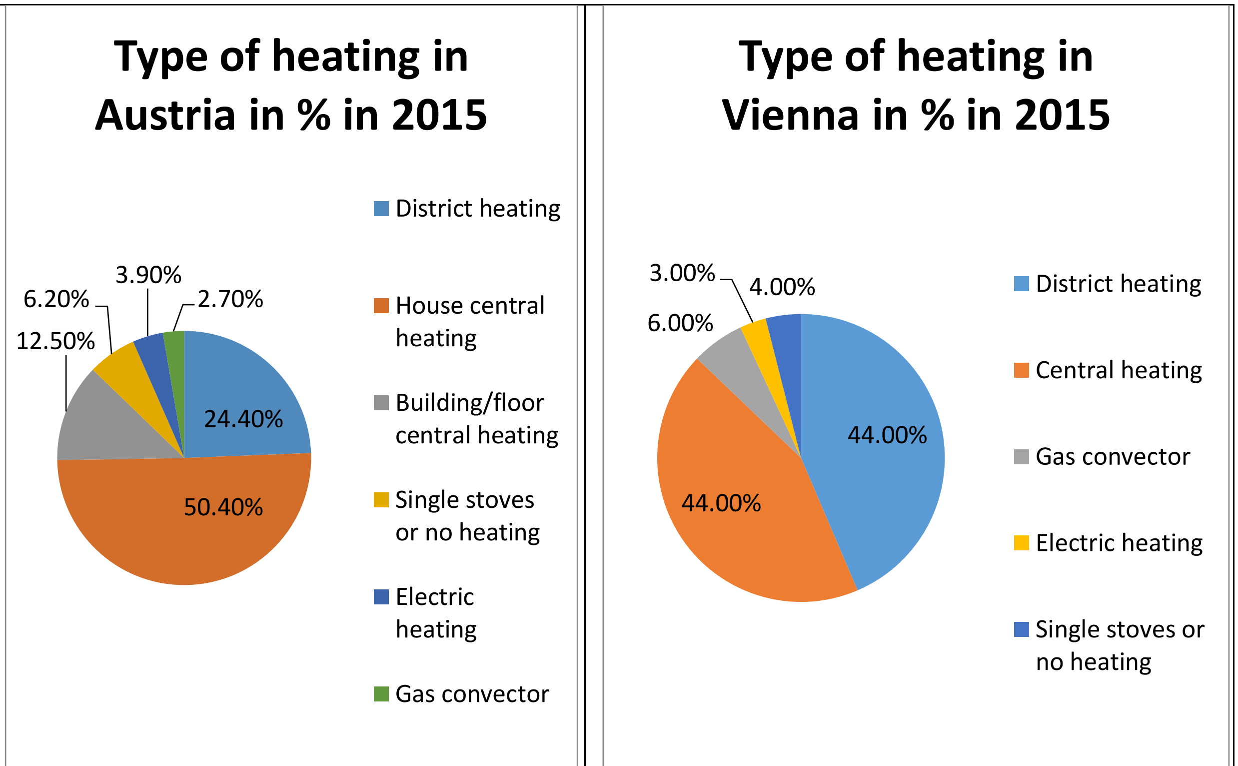
In this subsection, I show the differences in the types of heating in both countries. I use statistical data referring to the situation before the data collection. I also focus on the capitals, since the surveys were administrated in the capital cities only. In sum, I show that about 90% of households in Austria use some form of central heating allowing them to heat the dwelling entirely, while about 90% of households in North Macedonia do not have access to a central form of heating (see Figure 9 and 10). In fact, in North Macedonia individual type of heating with electricity and fuelwood is mostly used. Figure 9 depicts the differences in households in both countries when it comes to fuels used – in North Macedonia electricity and renewable energy (fuelwood) dominate, while in Austria there is a balance in the use of various fuels.

Figure 9: Final energy consumption in households by fuel in 2014 in % in North Macedonia and Austria



Source: (Eurostat 2015)

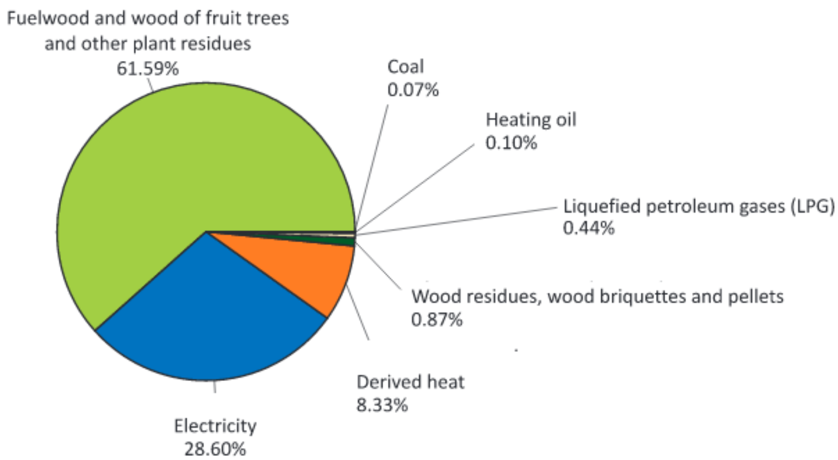
Figure 10: Type of heating in Austria and in Vienna in % in 2015



Source: (Statistik_Austria 2016a, 2016b)

Figure 10 shows the types of heating in Austria and Vienna. Without mentioning the fuel used, both district heating and central heating dominate. The next option in Austria is single stoves and no heating options, while in Vienna is the gas convector. Electric heating has a minor share.

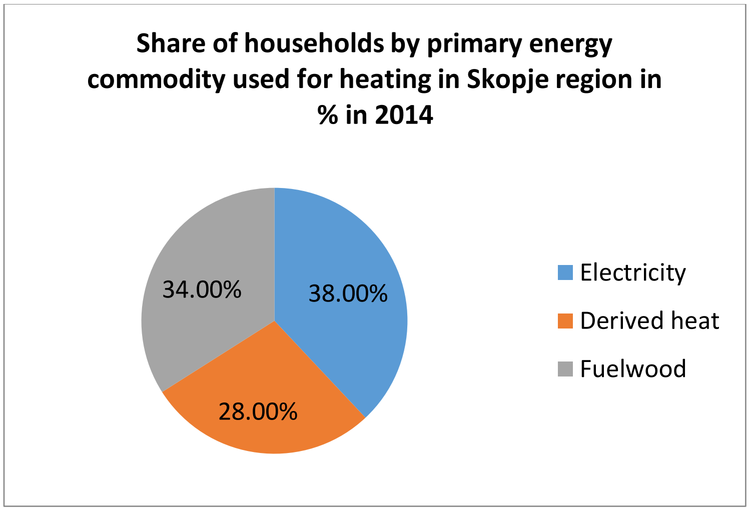
Figure 11: Share of households by primary energy commodity used for heating in North Macedonia in % in 2014



Source: (State_Statistical_Office 2015a)

Figure 11 shows the primary energy commodity used for heating in North Macedonia, where fuelwood and electricity dominate.

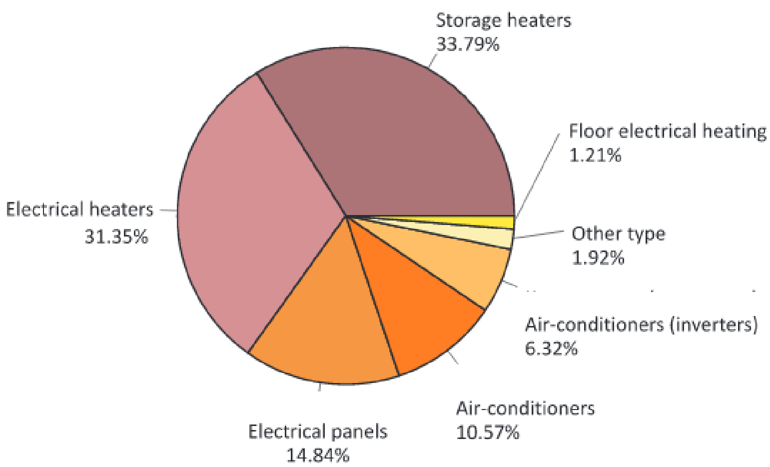
Figure 12: Share of households by primary energy commodity used for heating in Skopje region in % in 2014



Source: (State_Statistical_Office 2015a)

Electricity and fuelwood dominate in the Skopje region too (see Figure 12). One difference to other regions is that there is district heating only in Skopje (State_Statistical_Office 2015a).

Figure 13: Share of electrical heating appliances in % in 2014 in North Macedonia



Source: (State_Statistical_Office 2015a)

Depicting the share of electrical heating appliances in North Macedonia is relevant since many households use them for additional heating, not only for basic heating (see Table 12). From this breakdown, it can be seen that some of the least energy-efficient technologies that use electricity for heating, such as electrical heaters and storage heaters, are used the most (see Figure 13).

Table 12: Share of households by type of heating and its characteristics in Skopje region in % in 2014

Type of heating	**%**
Public central heating – basic	18,23%
Public central heating – additional	0%
Central heating from a shared boiler in a collective building - basic	0,54%
Central heating from a shared boiler in a collective building – additional	0%
Central heating with a boiler installation in the apartment – basic	2,58%
Central heating with a boiler installation in the apartment – additional	0%
Air conditioner and air conditioner (inverter) - basic	0,25%
Air conditioner and air conditioner (inverter) – additional	9,16%
Heater (solid or liquid fuels) – basic	17,5%
Heater (solid or liquid fuels) – additional	7,69%
Storage heaters (thermal heaters) – basic	11,65%
Storage heaters (thermal heaters) – additional	2,07%
Electrical panels – basic	4,21%
Electrical panels – additional	4,23%
Electrical heaters - basic	7,32%
Electrical heaters - additional	10,05%
Floor electric heating – basic	0%
Floor electric heating – additional	0,27%

Combined heating with solar collectors	0%
Other type of heating	1,74%
Source: (State_Statistical_Office 2015a)	

This detailed breakdown of types of heating used as a basic or additional source of heating in the Skopje region shows that district heating and other forms of central heating are used only as basic heating (see Table 12). Electric heating is very commonly used both as main and additional types of heating (see Table 12).

4.4 EU policies in the energy area relevant for energy poverty

In this section, I review briefly the relevant EU policies in the context of the energy liberalization and energy transition with relevance to energy poverty for Austria and North Macedonia, an EU member and an EU candidate country and Energy Community[8] contracting party, respectively. I do not review the literature on this, I only review the legal documents with the anticipation of any transition challenges for both countries with implications for energy poverty. Important is to know that while North Macedonia is still going through the energy liberalization process, both countries are on the way to the low-carbon energy transition.

The Energy Union strategy is the first EU document in the energy area to start integrating elements of energy justice seen through its focus on consumers (European_Commission 2015). On the strategic level, the 2050 Roadmap envisages the decarbonization process till 2050 (European_Commission 2011). The EU directives set up goals for energy efficiency and renewables shares. For instance, the EU energy performance of buildings directive stipulates that

[8] The Energy Community is an international organization that enables transposing of EU energy and related acquis to non-EU member states.

by the end of 2020 the member states will ensure that all new buildings are nearly zero-energy buildings; and that decentralized energy systems utilizing renewables, co-generation, heat pumps are used (European_Union 2010). The Renewable energy directive envisages renewable district and cooling (European_Union 2009a). While the focus is on technological improvement, energy poverty is not forgotten. The Heating and Cooling Strategy enforces the Energy Union's main goals of reducing emissions and improving its security of supply, but it mentions energy poverty (European_Commission 2016). One source of worry is the expectation that the market has to develop itself, and households are expected to afford energy investments (European_Commission 2016). There is the understanding that vulnerable consumers need to be protected (European_Commission 2011), but each member state needs to define vulnerable consumers on their own (Energy_Community n.d.). In a scenario where technological improvement takes the forefront, it shows that the protection of vulnerable consumers seems to be an exception to the rule that households are able to actively participate in the energy transition.

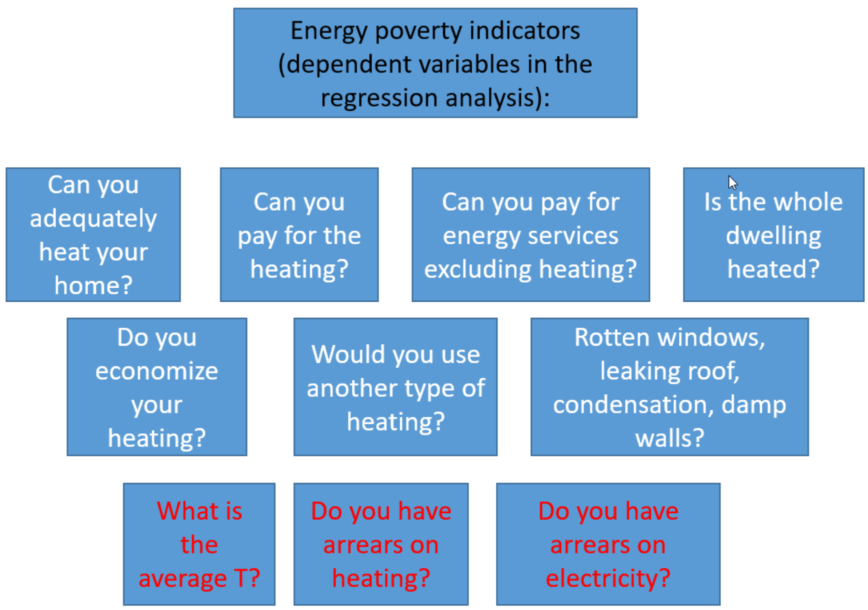
After focusing on its technological advance towards the energy transition, and considering energy security a more relevant goal than the social consequences of the energy transition, the new European Green Deal has made a difference. One of its key pillars is that no place or no person is left behind (European_Commission n.d.). This is a development from the previous EU energy strategies, such as the Energy 2050 Roadmap and the Energy Union since it explicitly mentions its intention to be inclusive rather than only achieve its decarbonization and energy security goals. Energy poverty is explicitly recognized as a threat, and the energy transition is labeled as a socially just transition (European_Commission 2019). In addition, member states and EU candidates need to address energy poverty in the renewable energy actions plans (Sareen and Thomson 2019). This gives a solid ground for holistic assessment of energy poverty and alignment of social with energy and climate goals of the EU.

4.5 Regression analysis results

In this subsection, I present the energy poverty indicators I used for the regression analysis and explain which variables predict energy poverty in the studied cases. The information presented here follows the material I presented about the analysis of the quantitative data and the development of the methodology subsections in the methodological chapter. I present here, namely, the results of the choice of the indicators and variables which I used to run the regression analysis, and the results of the regression analysis. I consider it is relevant to show these results here, as it enables the following chapters to develop an analytical narrative following these findings, but not being overburden by them in those chapters. I present here the energy poverty indicators which I discuss in regard to their relevance in the last chapter; and I present which variables predict energy poverty, as these shape how I structure the next two chapters. I have run regression analysis only of the Vienna and Skopje survey datasets.

Figures 14 and 15 show visually which energy poverty indicators and which variables I used for the regression analysis. I have used the three subjective energy poverty indicators collected by EU-SILC about adequate heat, energy arrears of households, and presence of leaking roof, damp walls, and rotten windows (Eurostat 2019a, 2019b, 2019c; Thomson and Snell 2013), but I have expanded on these. That means I accounted for the need to study *heating as an energy service separately* (separately collected about the affordability of heating and about other energy services; arrears on electricity and on heating), *the relationship between energy poverty and the type of heating*, and for *other potential indicators related to the spatiality of heating* (size of the heated space in the dwelling; whether the heating is subject to economizing), *objective needs of warmth* (the level of indoor temperature) and *access issues* (would you use another type of heating). The energy poverty literature findings helped in shaping these (Tables 6-9). In red font are three energy indicators that were statistically not relevant. This is because no combination of variables predicted these.

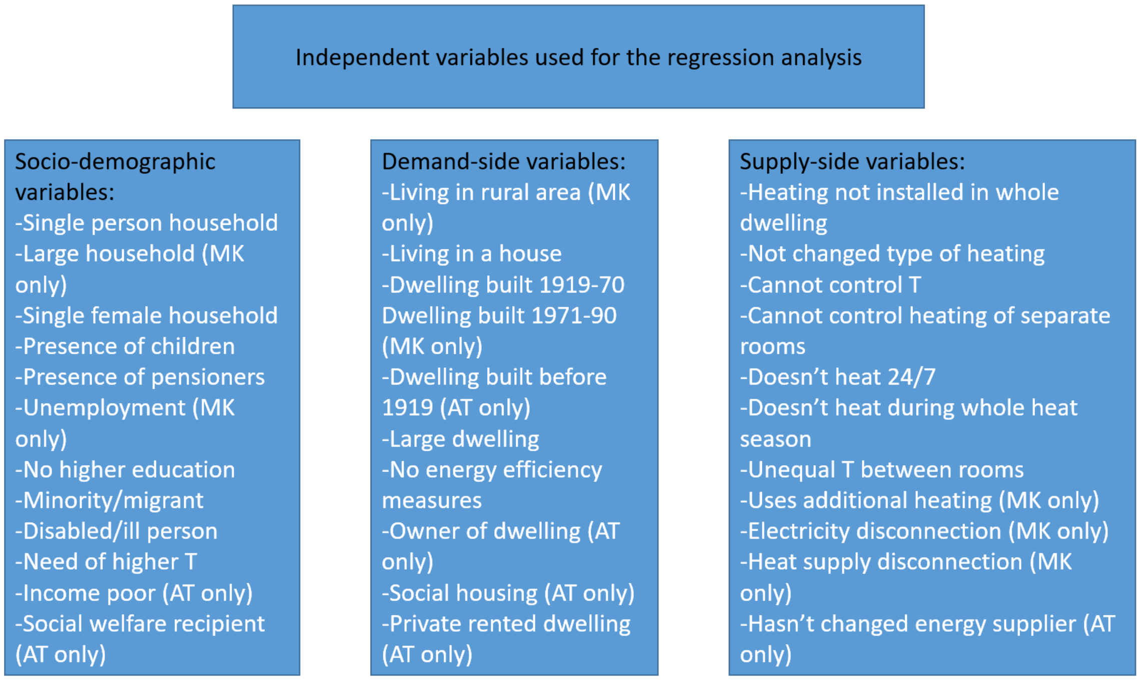
Figure 14: Energy poverty indicators used as dependent variables



Source: author based on Vienna survey dataset; Skopje survey dataset

As seen in Figure 15, I have grouped the variables into socio-demographic, demand-size (housing), and supply-side (technological) variables. This selection comes from the energy poverty literature (see Tables 6 to 9) and I have collected with the household survey and interview (see Appendix 3 and 4). In few cases, I have not asked for certain information, but I have developed a variable after analyzing the collected data. This refers to the variable additional heating. I have asked households about their type of heating, and some have added that they use additional heating. I coded this as a separate variable because it was frequent and information about their energy behavior. The socio-demographic variables are about the household characteristics – such as their size, the gender of the interviewee, their income level, and similar. I also included here expressing their need for increased temperature as part of understanding their behavior. The housing variables are about the dwelling quality in which the households live. These refer to the age of the dwelling, ownership, dwelling quality, and location. The technological variables are about the features of the heating fuel and technology. These are, for example, whether the heating is centrally installed, does it allow for interrupted heating, and control over the heated space, and whether households have experienced energy disconnections which I consider as part of this group since it represents energy access. Some variables have either AT or MK only next to them because for the other country, this data was either not collected (for example about the change of the supplier), or it was collected, but the share of one of the binary responses of the independent variable is lower than 5% which then had to be disregarded for the regression analysis (descriptive data in Appendix 9).

Figure 15: Three types of variables used to as independent variables



Source: author based on Vienna survey dataset; Skopje survey dataset

After setting up the variables and indicators, I run the regression analysis of a combination of each two variables and I present in Appendix 10 only the significant independent variables predicting the respective energy poverty indicators for both the Skopje survey and Vienna survey datasets. I have explained in the methodological chapter which preparation procedures I have undertaken before the regression analysis, and that due to a small sample I could only run a combination of 2 variables. I show which combinations of 2 variables predict energy poverty and which single variables are most frequent to predict energy poverty per city.

I only list here the regression analysis results, which I discuss and contextualize in the next two chapters. From the pool of housing variables, *not having implemented energy efficiency measures* predicts energy poverty in both cities (Skopje survey dataset; Vienna survey dataset). For Vienna specifically, these are all the housing characteristics that predict energy poverty too: *having a dwelling built before 1919*, *dwelling built between 1919 and 1970*, *living in rented accommodation*, and in a *large dwelling* (Vienna survey dataset). For Skopje, the other housing characteristics which predict energy poverty are: living in a *house*, *dwelling built between 1971 and 1990*, and *dwelling in a rural area* (Skopje survey dataset).

Out of the technological variables, there are a set of common ones predicting energy poverty shared by both cities. In particular, *not having installed heating in the whole dwelling*; *unequal indoor temperature*; *inability to control the heating of single rooms*; *not heating during the whole heat season*; and *inability to control the indoor temperature* are the common technological variables (Skopje survey dataset; Vienna survey dataset). Additionally, having experienced a *cut off from heat supply*; *electricity disconnection*; *not heating 24/7*; *using additional heating*, and; not *having changed the type of heating* predict energy poverty in Skopje (Skopje survey dataset).

In regard to socio-demographic variables, being a *minority or migrant* and *not having higher education* are the two common socio-demographic variables predicting energy poverty in Vienna and Skopje (Skopje survey dataset; Vienna survey dataset). On top of that, in Vienna, these are the other relevant socio-demographic variables: *single female household*, *the need for higher temperature*, *single-person household*, *income-poor household*, and a presence of *pensioner* (Vienna survey dataset). The socio-demographic variables which predict energy poverty in Skopje include having an *unemployed member* in the household, *disabled or ill person*, *large household*, and presence of *children* (Skopje survey dataset).

Since I have run the regression analysis between all 2 variables, no matter whether they are socio-demographic, housing, or technological, I list here the combinations of variables predicting energy poverty per city. In Vienna, these are the combinations: a) single female households of minority background; b) migrants who do not have heating installed in the whole dwelling; and c) migrants who cannot control the heating of single rooms (Vienna survey dataset). In Skopje the most common combinations include: a) not having higher education and having been cut off from heat supply; b) being a minority and having been cut off from heat supply; c) living in a house without energy efficiency measures; d) not having the heating installed in the whole dwelling and having been cut off from heat supply; e) having a disabled or ill person and not having equal indoor temperature; f) having a disabled or ill person and having been cut off from heat supply; g) not having installed heating in the whole dwelling and no energy efficiency measures; h) no energy efficiency measures and unequal indoor temperature; i) having an unemployed household member and not having installed heating in the whole dwelling; and j) having an unemployed household member and not heating 24/7 (Skopje survey dataset).

Figure 16: Most frequent relevant independent variables predicting energy poverty in Skopje

Source: author based on Skopje survey dataset

Figure 17: Most frequent relevant independent variables predicting energy poverty in Vienna

Source: author based on Vienna survey dataset

I also reflect on the single most common variables per city. To allow for visual illustrations of the single most relevant variables predicting energy poverty in both cities, I present in Figures 16 and 17 as word clouds the most important variables per city. To produce this, I have added the list of combinations of variables, and I made the word cloud. The larger the word, the more frequent it appears as a predictor for energy poverty in the respective city. I have removed the smallest words. Per city, the most relevant single variables predicting energy poverty are *migrant status* and *not having installed heating in the whole dwelling* in Vienna, and h*aving been cut off from heat supply*; *having an unemployed household member*; *having a disabled or ill person*; being a *minority*; *not having installed heating in the whole dwelling*; and *not having energy efficiency measures* in Skopje (Skopje survey dataset; Vienna survey dataset). This means that some socio-demographic and technological features in Vienna play a more frequent role in predicting various energy poverty indicators, but in Skopje, all three kinds of variables predict energy poverty.

4.6 Material deprivation, housing, infrastructure, and heating[9]

This subsection expands on the income situation and the use of energy in the households presented in the statistics earlier in this chapter, to contextualize the situational differences between the two cases using the collected data. The presented data here aims to prepare for the following chapters where I discuss how the findings of the type of heating add to the spatial understanding of energy poverty, and the need to recognize the coping of vulnerable citizens.

Households in Austria enjoy a better quality of life, while those in North Macedonia face a widely spread material deprivation. Austria has a comparatively lower share of income poverty, material deprivation, inequality, unemployment, and risk of social exclusion than North Macedonia (Table 11). However, both countries have a similar pattern of vulnerable groups; they are the elderly (Vienna survey dataset; Skopje survey dataset), and households with a migrant background (Vienna survey dataset), or larger minority families (Skopje survey dataset).

The studied countries differ regarding the fuels and technology they use, and their ability to access heat infrastructure, which is related to how energy poverty is experienced. Only a limited share of households in North Macedonia have access to natural gas for heating (North Macedonia interview dataset), while gas heating is very commonly used in Austria (Austria interview dataset; Vienna survey dataset). However, Austrian households in rural areas without access to fuelwood or gas are vulnerable due to being left without cheaper alternatives (Austria interview dataset). The gas convector is an older technology used only in Vienna (6%), which correlated with energy poverty

[9] Descriptive tables of the collected data about households from all 4 datasets are available in Appendix 9.

(Vienna survey dataset). In many cases, households in North Macedonia have to use electric heating due to a lack of other choices. Thus, the electric heating is much larger in Skopje than in Vienna (19.3% compared to 3.3%) and this type of heating is often related to experiencing energy poverty (Vienna survey dataset; Skopje survey dataset). I have collected some good examples of 2 passive houses in Vienna, and few households using solar heating in both countries (Vienna survey dataset; North Macedonia interview dataset; Austria interview dataset). Pellets heating as a more environmentally friendly alternative to fuelwood was found in Skopje (Skopje survey dataset). However, most of these good examples were affluent households. The initial conclusion is that the access to infrastructure and the ability to afford this access shape the spatiality of energy poverty.

Fuelwood, used to a different extent in the two countries, plays a relevant role in coping with energy poverty but has also a set of implications. Fuelwood is the most used type of heating in Skopje (42.7%), which in Vienna is used only by 1.3% of the participants (Vienna survey dataset; Skopje survey dataset). It is used for economizing in both countries, but also for additional coziness in Austria only (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset, Austria interview dataset). The extensive of use fuelwood in households leads to externalities. In winter due to the intensive use of fuelwood for heating by most households, the bigger cities face dangerous levels of outdoor air pollution in North Macedonia (World_Bank_Group 2014). There are cases of floods in peri-urban areas due to deforestation (Interview with a representative of GIZ North Macedonia, 2017). On the other hand, due to under-heating and energy under-consumption in North Macedonia, the energy consumption in households is about 3 times lower than in Austria (Table 11). Not only is fuelwood used for coping, but other cheap options, such as coal and tree branches in Skopje are used (Skopje survey dataset). This explains that in a case that the heating market is more flexible, for example, lack of developed heating infrastructure, the individual management of heating is used to maximize the economizing over the choice of the cheapest fuel if even polluting to the environment.

The choice of heating determines the spatiality of heating in the home. While 70.5% of Skopje survey participants do not heat their dwelling fully, only 39.3% of Vienna participants do not heat their entire dwelling (Skopje survey dataset; Vienna survey dataset). This is because outdated technology limits the quality of the heating. For example, fuelwood is mostly used in old stoves allowing for partial spatial and time-limited heating (Skopje survey dataset; North Macedonia interview dataset). While over 90% of Vienna participants can control the indoor temperature, only one-third of Skopje participants can do so (Skopje survey dataset; Vienna survey dataset). Also, in Skopje, most households do not know their indoor temperature (Skopje survey dataset). This opens the discussion of how important is the ability to heat the dwelling fully as if this possibility is limited, it is a good predictor of energy poverty.

I add to this initial discussion about the material deprivation and use of fuels by presenting the housing quality challenges. The housing sector in North Macedonia is poorly insulated (around 18% of the stock is insulated), and old as a large share has been built after the Skopje earthquake in 1963 (Stojilovska 2020). The housing stock is old in Austria, but a share of it has been renovated (Statistik_Austria 2017b). Over 98% of Skopje participants are homeowners, while only a third are in Vienna (Skopje survey dataset, Vienna survey dataset). This means that the housing is managed individually in North Macedonia (Stojilovska 2020), while housing associations in Vienna organize building refurbishments through installment payments for the residents (Vienna survey dataset). In Vienna, one can reside in social housing, private rent, or cooperative (Vienna survey dataset). Houses prevail in the Skopje sample (69.8% compared to 22.1% in Vienna)

(Skopje survey dataset, Vienna survey dataset). This shows that although both countries experience challenges – such as old and largely poor or not renovated building sector, the approach to dealing with housing in North Macedonia is largely individual, while there are several individual and communal approaches to this in Austria.

4.7 Energy supply, support and regulation

In this subsection, I introduce the situation in the studied countries regarding energy supply, social welfare, and support mechanisms, and I review the relevant legislation of relevance to energy poverty. The aim is again to present more descriptive information from the primary data in order to support the understanding of the last empirical chapter (chapter 7).

The different energy supply structure in the studied countries plays a role in how energy poverty is experienced. The electricity and gas markets in Austria have been liberalized since 2001 and 2002, respectively (Interview with a representative of E-Control, 2017). In North Macedonia, the electricity supply is a monopoly in private ownership, and the electricity market for households was recently liberalized in 2018 (Official_Gazette 2018a). Due to this still ongoing process of energy liberalization in North Macedonia, since 2008, the electricity price for households has increased by 95% (Energy_and_Water_Services_Regulatory_Commission 2008, 2020), but it is still half the price in Austria (Table 11). The cheap electricity tariff in North Macedonia was abolished when I was collecting the data, but since then it has been reintroduced and is during the day (2-4 pm), at night (from 10 pm) and during Sunday for all households in North Macedonia. The Austria electricity consumers have experienced only a slight electricity price increase in the past 11 years in Austria (Eurostat n.d.). The actions of the electricity utility in monopolistic position in North Macedonia is often a subject of criticism by the Macedonian Ombudsman noting down its abuse in many annual reports, such as disconnecting after one unpaid bill (Ombudsman

2011). This shows a diametrically opposite situation with the energy market – a private monopoly with human rights implications of its actions, constantly increasing its price, and a liberalized market with a stable price.

The two countries have different approaches and tools for tackling energy poverty. North Macedonia's social welfare is low and restrictive (40 EUR per month for persons without any income) (Interview with a representative of Platform against poverty, 2017), thus ineffective (Table 16). Energy poverty in North Macedonia is mostly targeted with an energy poverty subsidy which is low (16 EUR per month), restrictive (only for social welfare recipients) and serves only as a relief (it is a reimbursement), rather than a solution, and there are issues with its timely payment (Interview with a representative of Platform against poverty, 2017; Interview with a representative of Ekosvest, 2017). Vulnerable consumers in North Macedonia are mentioned in the Energy law of 2018 (Official_Gazette 2018a) and there is a national strategy for reduction of poverty and social exclusion 2010-2020 which mentions energy poverty explicitly, but no further information about its implementation is available (Ministry_of_Labor_and_Social_Policy 2013). It shows that social welfare and the complementary measures in North Macedonia are too limited to do anything about the energy-poor, although there is legal recognition of energy poverty.

Contrary, in Austria there is a developed social welfare system with various funding schemes, such as attendance allowance, child allowance, guaranteed minimum income, heating allowance (210-215 EUR per year), and accommodating the different needs of the elderly as well, including medical or in-house support (Wien Energy Ombudsman materials, Vienna survey dataset). Austrian vulnerable groups (unemployed, people at risk of poverty, persons with certain limit of income, care recipients, and similar) can be released from the obligation to pay TV and radio fee and the part of electricity bill referring to eco-electricity tax (Interview with a representative of the

Ministry of Social Affairs, 2017). Austria's support does not end with social welfare. At least two public suppliers have developed programs to deal with households with arrears. Wien Energie, the supplier in Vienna has established an Ombudsman to deal with severe social cases which is a notion broader than energy poverty (Interview with a representative of Wien Energie Ombudsman, 2017). In a legal sense, the Austrian Energy efficiency law obliges energy suppliers to implement energy efficiency measures in households. On top of that, the energy regulator has developed an unofficial definition of energy poverty seen as a phenomenon of inefficient energy use by income-poor households which is solvable by energy efficiency measures (Interview with a representative of E-Control, 2017). The situation in Austria shows that the social welfare system can counter-balance energy poverty, and there are additional efforts to recognizing and addressing the problem.

Other than addressing energy poverty within the social welfare system, the countries have taken additional national and local initiatives in both countries. In North Macedonia, there are several small-scale public or donor-driven projects. They are schemes to improve energy efficiency or increase the share of renewables but are not linked to energy poverty since they target all households. Some of these include EPRG part-grant-part-subsidy (Interview with a representative of Webseff program of EBRD, 2017), and the renovation of collected buildings by the municipality of Karposh (Interview with a representative of Municipality of Karposh, 2017). The Ministry of Economy gave subsidies for the replacement of windows and solar collectors for households (Interview with a representative of Analytica think tank, 2017), while the City of Skopje subsidized the replacement of oil and fuelwood stoves with pellet stoves (Interview with a representative of Info center for EE of City of Skopje, 2017). None of these programs targeted income or energy-poor households. In Austria, the initiatives about reducing energy poverty, are either financial or entail a change of appliance. They generally target income-poor households. Some examples include 100 EUR prevention from Caritas to avoid disconnection (continuous program) (Interview with a representative of Caritas, 2017); 150 EUR to change refrigerator (project-based) (Interview with a representative of Heilandskirche, 2017); and 125 EUR from Ministry of Social Affairs to invest in energy efficiency (project-based) (Interview with a representative of the Ministry of Social Affairs, 2017). Oil heating in rural areas and its funding by private organizations (Interview with a representative of IWO, 2017) raises concerns that it keeps these households dependent on fossil fuels (Interview with a representative of Biomasse Verband, 2017). The differences in approach could be since in North Macedonia there is much more to do around adequate building infrastructure for heating, while the Austrian approach reflects the understanding that energy poverty and income poverty are highly correlated. One exception in Austria is the dependence of households on oil in rural areas which still exists.

4.8 Households' profiles and coping strategies[10]

In this subsection, I am preparing the ground for the upcoming chapter on coping strategies of households (chapter 6). Before I do that, I reflect on the findings from the household data about the socio-demographic profile of the respondents, and the prevalence of energy poverty.

The household composition is different in Vienna and Skopje, and I highlight the main differences. In Vienna, there is a much larger share of single-person households than in Skopje (40.7% compared to 16.7%), and a much smaller share of households of 5 or more members (3.3% compared to 28.7%) (Vienna survey dataset; Skopje survey dataset). The unemployment share is significantly higher in Skopje (41.3% compared to 5.3%) (Vienna survey dataset; Skopje survey dataset). Social welfare recipients are more represented in the Vienna sample, while there are two

[10] Descriptive tables of the collected data about households from all 4 datasets are available in Appendix 9.

times more minority members and ill or disabled persons in Skopje than in Vienna (Vienna survey dataset; Skopje survey dataset). These differences are also visible in the results of the regression analysis, such as unemployment predicts energy poverty in Skopje, but single-person households do in Vienna (Vienna survey dataset; Skopje survey dataset).

The collected data on households show diverse examples of energy poverty. There are cases of no energy poverty, but also a less (economizing on energy, partial energy affordability, cooler rooms, and limited heated space) to a more severe manifestation of energy poverty (disconnection, no income, those that can barely satisfy energy needs, inability to pay their energy bills and no heating; and one-fourth of costs goes to energy) in the studied countries (Vienna survey dataset; Skopje survey dataset; Austria interview dataset, North Macedonia interview dataset). However, as mentioned earlier, the size of energy poverty is much smaller in Austria. This is also linked to the correlation between energy-poor and income-poor Vienna participants (Vienna survey dataset) since income poverty is also low (Table 11). How households use energy is a matter of cultural behavior. For example, more Vienna participants economize their heating than Skopje participants (Vienna survey dataset; Skopje survey dataset) which one might understand that energy poverty is not a big issue in Skopje. But, based on their reasons, Vienna participants tend to not waste energy but satisfy their needs, while Skopje households do not economize because warmth is necessary for them, by which they mean that they need to balance the warmth and energy costs needs and often do hot get the needed warmth from the heating they use (Vienna survey dataset; Skopje survey dataset). This is important for recognizing the cultural differences in energy use, but which are determined by the local circumstances, such as available public heating.

There are interesting observations about the use of heating and related coping strategies. 36% of Skopje households heat one room only (Skopje survey dataset). This is a very typical example of deprivation and coping in the country. The limitations of old technologies bring challenges. Many households admit that their comfort depends on the external temperature (Vienna survey dataset; Skopje survey dataset). But, many have embraced the use of fuelwood to its advantage. For example, almost half of Skopje participants use their heating for cooking and/or preparing hot water which is not done at all in Vienna (Vienna survey dataset; Skopje survey dataset). However, fuelwood is not perfect. Skopje participants are highly reliant on additional heating to make up for the spatial and temporal limitations of the main heating, mostly fuelwood (Skopje survey dataset). Coping with energy poverty requires setting up priorities. 18% of Skopje participants pay their costs first compared to 2% of Vienna participants, but more Vienna than Skopje participants highlighted the tension between economizing heating and the need to stay warm (7.3% compared to 6.7%) (Vienna survey dataset; Skopje survey dataset). Coping with cold homes forces households to creative solutions. There are few examples of forced migration into another dwelling to avoid a cold home (Skopje survey dataset; North Macedonia interview dataset). Last but not least, I have collected information also from outspoken citizens who are convinced that the energy utility is abusing its monopolistic power (North Macedonia interview dataset). This is relevant for understanding the limitations in terms of heating, housing, and energy use energy-poor households are facing, and how technologies and fuel both help and make it difficult to cope with energy poverty.

4.9 Conclusions about setting up the case studies

In this chapter, I introduced the general socio-economic situation in North Macedonia and Austria, and have shown that the former is faced with a much deeper material deprivation. North Macedonia has much higher level of energy poverty, and a prevalence of individual types of heating; while the opposite is the case for Austria. This justifies the difference between the countries following a maximal variation sampling. I have also discussed that North Macedonia is still finalizing its electricity liberalization. Not having installed energy efficiency measures; having a non-central type of heating; having secondary or lower education, and being a migrant or minority is what predicts energy poverty in Vienna and Skopje. The access to infrastructure, and the ability to afford this access shape the spatiality of energy poverty. There is a more individual approach to managing housing and heating in North Macedonia. The social welfare system is better equipped in Austria. The energy market in North Macedonia is monopolized and privatized. The limitations of the heating, housing, and energy use co-shape households' coping strategies.

5 CHAPTER 5: SPATIALITY OF ENERGY POVERTY: INFRASTRUCTURE, HOUSING AND HEATING

This chapter is the first of three which is organized in an 'article' style by including a short literature review, empirical section, discussion, and conclusions. The reason is that I combine my empirical findings with my theoretical contribution. I start with an aspect of the conceptual framework to expand it as a result of my empirical findings. I have organized the empirical findings by following the results of the regression analysis and the main findings around distribution justice. I also contribute to answering aspects of some of the research questions. This chapter in sum applies the distributive justice tenet to energy poverty. In this chapter, I use the evidence around technological features of heating and housing characteristics which are linked to experiencing energy poverty. It builds up the argument about the spatiality of energy poverty by integrating the findings of the case studies.

5.1 Introduction

Energy poverty is a spatial injustice embedded in existing infrastructure, fuel, and building patterns. Energy poverty is shaped by the characteristics of localities and at the same time reproduces them (Bouzarovski and Simcock 2017; Walker Gordon and Day 2012). These spatially sensitive inequalities producing energy poverty, are at the core of energy injustice. Conceptually, the starting point for this chapter is the theorization of distributive energy justice and its application to energy poverty (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012). Jenkins *et al.* (2016) define distributive justice through its location by raising the question: 'where are the injustices'. Walker Gordon and Day (2012) argue that energy poverty is a distributive injustice that refers to inequalities in income, energy prices, and housing, and technology energy efficiency. Bouzarovski and Simcock (2017) introduce the notion of spatial justice to explain that energy poverty is underpinned by, and reproduces, distinct forms of spatial inequalities.

Distributive energy justice is about energy access, affordability of energy, and concerns of energy quality, safety, and security (Goldthau and Sovacool 2012; Heffron and McCauley 2014; Jenkins *et al.* 2016; Sovacool and Dworkin 2015; Walker Gordon and Day 2012). Distributive justice concerns how the deficiencies of the energy system, such as environmental and social hazards of energy production, are distributed (Sovacool and Dworkin 2015). The location of infrastructure, subsidies, pricing, and consumption determine the unequal distribution of the burdens (Heffron and McCauley 2014). This spatial lens of energy justice emphasizes the geographical space as a dominant factor in predicting distributive energy (in)justice.

The literature on energy justice expands the understanding and applicability of this concept. Starting from the understanding that distributive injustice is about the location of infrastructure (McCauley *et al.* 2016), authors claim that unequal distribution is not an injustice per se, but are systematic inequalities and uneven distributional impacts of policies (Chatterton *et al.* 2016). Gillard *et al.* (2017) add that from an energy justice point of view, energy poverty is more than uneven distribution, but a socio-political injustice. Bouzarovski and Simcock (2017) claim that energy poverty is an unevenly spatially distributed phenomenon, but driven by deeper socio-material inequalities, economic inequalities, as well as disparities in household incomes and energy prices. According to Willand and Horne (2018), distributional fairness addresses households' capabilities of keeping warm and affording energy. This means the energy justice literature tries to uncover the policies of lock-ins and how they are related to households' socio-demographic characteristics and their coping strategies.

This chapter illustrates how the siting of infrastructure, as well as features of technology and building environment co-shape distributive energy injustices, such as energy poverty. It also argues that the spatiality of energy poverty results from policies leading to lock-ins and these determine the cultural and behavioral preferences of households concerning fuel and technology use. The chapter's contribution is in the empirical findings of energy poverty as a distributive injustice that energy-poor households experience in Austria and North Macedonia. Theoretically, the chapter adds to the energy justice and energy poverty literature as started by Walker Gordon and Day (2012) by explaining how certain fuels, technologies and infrastructure co-shape energy poverty by creating unequal access to energy services.

The chapter offers answers to these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What distributive energy injustices do households with different types of heating experience?
- What types of heating are related to specific aspects of energy poverty?

The chapter uses the empirical data from North Macedonia and Austria composed of surveys at the city level with households, interviews with households in both countries, and interviews with stakeholders from both countries. The data is presented through relevant citations from stakeholders and households, graphs from the survey and interview datasets, and regression analysis about the technological and housing features of households which predict energy poverty. Based on the key literature guiding this chapter (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012), energy poverty is seen as an energy injustice based on inequalities in infrastructure, access to technology and fuels as well as income and energy prices. The main research question in this chapter is answered mostly through the lenses of distributive energy justice, thus about how location and infrastructure impact the type of heating used, and the probability of being in energy poverty.

The chapter is organized in a way that after the introduction in section 1, the regression analysis results about the technological and housing variables that predict energy poverty are contextualized by first explaining the lock-ins created by the housing sector and localities in section 2. Section 3 explains the role of infrastructure, technology, and fuels in creating energy poverty. Due to the nature of the empirical data where the view of households dominates, the household data explains the narratives, while the interviews with stakeholders are used to make additional points. The chapter ends with a discussion and conclusions.

5.2 Housing injustices

This subsection of housing injustices is structured by following the main findings from the regression analysis about the housing characteristics which predict energy poverty, which then I complement with another type of data. These housing or demand-side injustices are the lack of energy efficiency measures, the rental sector, the size, age, and location of dwellings (Skopje survey dataset; Vienna survey dataset). The section also discusses how these characteristics are related to the type of heating. This section empirically draws from the qualitative data, and it explains context-wise why these housing characteristics predict energy poverty.

5.2.1 The role of energy efficiency and the rental sector

Lack of installed energy efficiency measures is the only common housing variable for both Vienna and Skopje which predicts energy poverty while living in the rental sector predicts energy poverty in Vienna (Skopje survey dataset; Vienna survey dataset). This section discusses the policies with relevance to the housing sector which create a situation of lock-in for energy-poor households, as well as few policies which can prevent energy poverty. The key arguments in this section are that energy-poor households cannot afford energy efficiency measures and that is why they do not invest in these measures or specifically in the case of Austria they cannot afford to pay rent for an energy-efficient dwelling.

The energy-poor cannot afford energy efficiency since investing in energy efficiency is an expensive undertaking. An interviewed stakeholder explains this: "*... when you see that the monthly income of a given family is not higher than 8000 denars [130 EUR] you cannot expect that family to decide to finish the façade. This money is not enough to buy bread, milk, and a kilogram of potatoes daily…"* (Interview with a representative of the think tank CRPM, 2017). If these households could do any investments, they are usually not of a larger scale: "*It is affordable to change light bulbs, but these [energy-poor] people cannot afford new heating boiler or hot water [boiler]*." (Interview with a representative of the nationally funded donor Klimafonds, Austria, 2017).

While in North Macedonia renting is not common, the issue with affording a dwelling in the rental sector is a challenge specific for Austria. A negative outcome of energy efficiency investments is that energy efficiency 'forces' households to leave their rented accommodation as renovated dwellings have higher rent. As explained by an interviewed stakeholder: "*The affected are tenants. When the renovation increases the rent, the affected cannot afford anymore to live in this building and move to a worse building where the rent is lower, the insulation standard is lower, and they again have high utility costs for heating that they cannot afford. It is a race to the bottom*." (Interview with a representative of Donau Uni Krems, 2017). On a positive note, policies that stimulate passive houses can prevent energy poverty. Two interviewed households in Vienna had a passive house, and the findings are that a yearly bill for heating is 70 EUR for one of them (Vienna survey dataset). One of the passive house residents is a single female pensioner who has an income below the poverty line (Vienna survey dataset).

This section shows that a vicious circle of deprivation keeps energy-poor households in dwellings of poor building quality. Due to their low affordability, there are unable to improve the efficiency of their dwelling or access rented accommodation of good quality. The inability to access and afford efficient dwellings is a clear distributive injustice of energy poverty according to Walker Gordon and Day (2012) because the distributive injustice is about inequality in accessing energy services, and housing is one of the elements affecting the quality of the energy services.

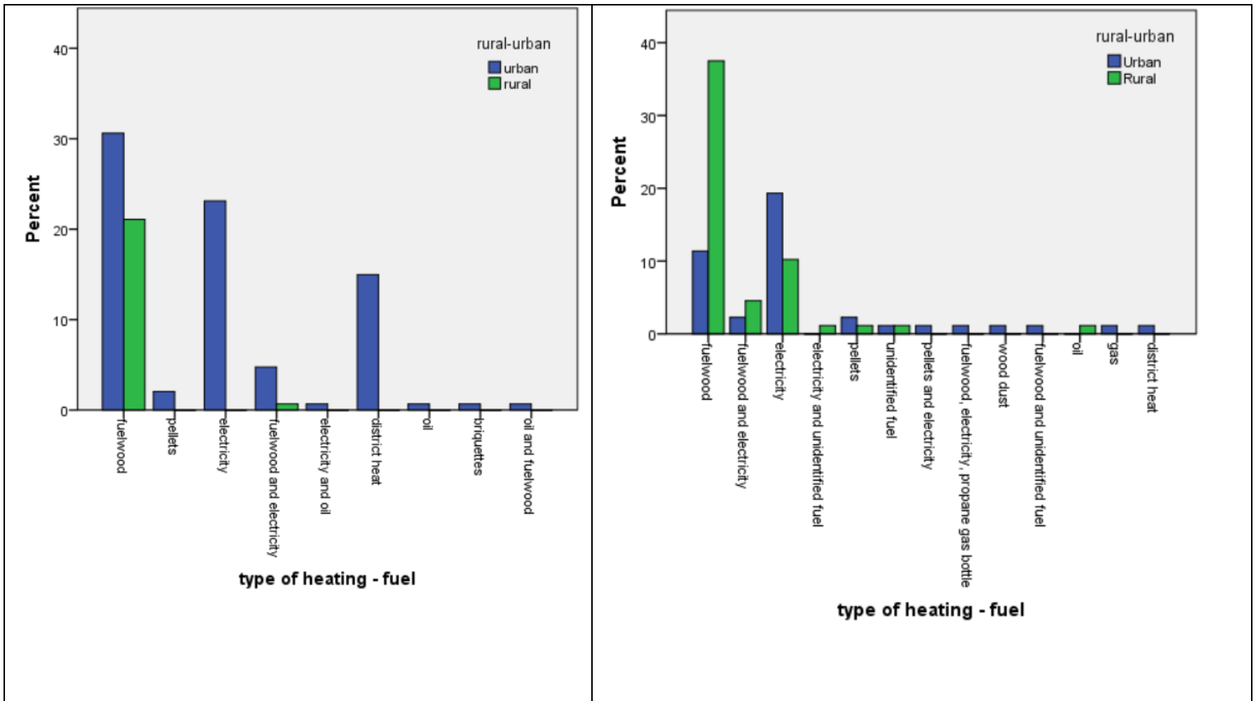
5.2.2 Size, age, and location of dwellings

The regression analysis pointed out that apart from energy efficiency, the age of the building stock predicts energy poverty, specifically dwellings built before 1919 and between 1919 and 1970 in Vienna, and dwellings built between 1971 and 1990 in Skopje (Skopje survey dataset; Vienna survey dataset). The regression analysis also emphasizes that large dwellings in Vienna, as well as houses and dwellings in a rural area in Skopje, predict energy poverty (Skopje survey dataset; Vienna survey dataset). This section discusses how path-dependencies impacting the housing sector shape the features of energy poverty directly or indirectly through the type of heating they are related to. The section argues that spatial, such as the age of dwelling, and temporal aspects of housing, such as location and size predetermine the type of heating used, and these factors combined provide lock-in situations for energy-poor households.

A legacy of the past is the age of the building stock. The one in Vienna is much older than the one in Skopje (Vienna survey dataset; Skopje survey dataset). This explains why the regression analysis shows that older dwellings in Vienna compared to those in Skopje are predictive of energy poverty. In 1963 a disastrous earthquake happened in Skopje, destroying most of the city; thus most of the dwellings in Skopje are built after it (Skopje survey dataset). A humanitarian action took place to rebuild the city and that is why the housing stock in Skopje is younger. The path-dependencies of the housing stock have to do with the fact that some types of heating are located in certain types of dwellings. For example, the central heating in Vienna which compared to other types of heating has a higher share of energy-poor households, is mostly located in dwellings older than 100 years (Vienna survey dataset). Similarly, the gas convector in Vienna which is an old technology, and has also some cases of energy-poor households, is mostly located in an old dwelling (Vienna survey dataset). The latter I support with a citation of a single female pensioner using gas convectors: "*I can't fully adequately heat my home. At night, I put the temperature at a minimal level since I'm economical. I have to be able to afford the utility costs. I can partly afford to heat. I economize the heating by reducing the temperature to a minimal level at night, but I heat more when it's cold.*" (Household no. 39, Vienna survey dataset, 2017).

The size of the dwelling affects the dwelling's ability to be properly heated and the energy demand it requires. The regression analysis points out that a larger dwelling of at least three rooms is predictive of energy poverty in Vienna. Central heating and fuelwood heating in Vienna are mostly used in larger dwellings (Vienna survey dataset). Both fuelwood and central heating in Vienna accommodate energy-poor households (Vienna survey dataset) and this finding reinforces the assumption of the spatial lock-in of energy-poor households. The qualitative data from Austria points out that large dwellings are indicative of energy poverty since elderly people might occupy them for a long time in which case they pay low rent. An interviewee elaborated: "*If you live in Vienna or Austria for a long time in a large dwelling, the rent stays lower than rent in a dwelling one just moves in. And then you have difficulties with energy, energy poverty. A woman lived alone in a 90 m2 large dwelling. And the rent is 150 EUR, so affordable that she could not find a small apartment with such low rent*." (Interview with a representative of Wien Energie Ombudsman, 2017). The regression analysis shows that houses in Skopje are predictive of energy poverty and based on the Skopje survey, fuelwood is mostly reserved for heating a house in Skopje, while there are also cases of houses using electric heating (Skopje survey dataset). Fuelwood and electricity are mostly correlated with energy poverty (Skopje survey dataset). The link between large under-heated space and energy poverty can be seen with this citation: "*We are most of the time not home, so there is no big consumption. The bad side is that we don't heat the whole dwelling, we heat only one room*." (Household no. 96 North Macedonia dataset, which uses electricity and lives in a 3-room dwelling).

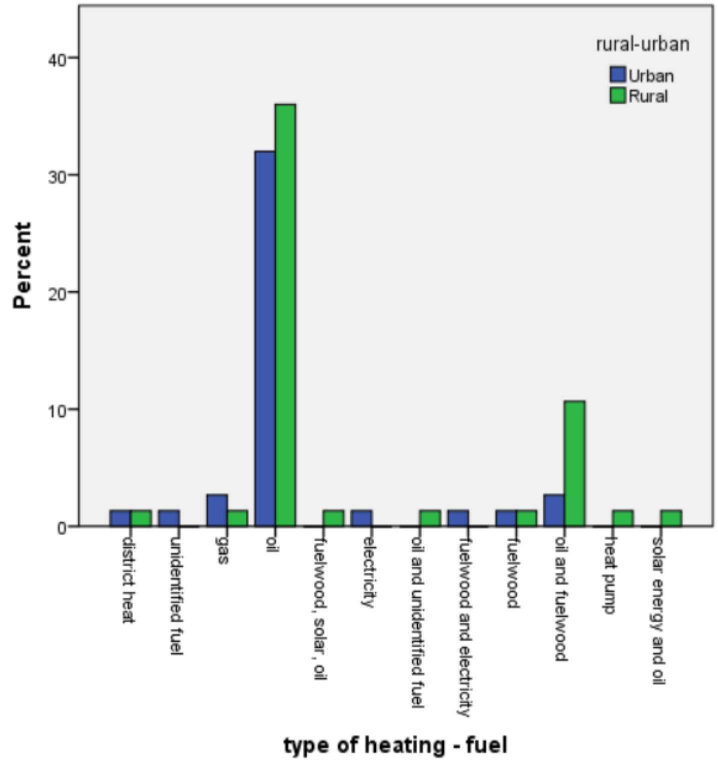
Figure 18: Heating fuels in Skopje and North Macedonia used in rural and urban areas



Source: Skopje survey dataset	Source: North Macedonia interview dataset

The location of the dwelling determines the type of heating. The location plays a relevant role in shaping the geographies of energy poverty. The regression analysis points out that rural areas in Skopje are predictive of energy poverty. In rural areas households in Skopje and North Macedonia mostly use fuelwood as indicated in Figure 18 (Skopje survey dataset; North Macedonia interview dataset). Fuelwood is also widely used in urban parts of Skopje and North Macedonia, while electricity is mostly a choice of urban households in Skopje, but used in rural parts across the country (North Macedonia interview dataset; Skopje survey dataset). As seen in Figure 19, households in rural parts of Austria tend to use oil and fuelwood (Austria interview dataset). Interviewed households in Austria reported being vulnerable to oil price changes (Austria interview dataset). An oil lobby organization in Austria gives support for households to change their oil heating boiler with a new one, for which they give from 2500 to 25000 EUR (Interview with a representative of IWO, 2017). This can further make households dependent on oil use. This limitation of the choice of fuels for heating due to the location is relevant since it might add to households' vulnerability. It means households have a limited choice of heating fuels, such as the expensive oil in Austrian rural parts and the widespread use of cheap but polluting fuelwood in Skopje and North Macedonia (Austria interview dataset; Skopje survey dataset; North Macedonia interview dataset). I support this with the following citation of a household using fuelwood: "*Interviewer: Why do you use this type of heating? Household: There is no infrastructure [for anything else]. Those are the conditions. There is no district heating. Interviewer: Why did you say you are satisfied with your heating? Household: We have to be satisfied, there is no other choice.*" (Household no. 137, Skopje survey dataset). The literature points out that households based on their location face lock-ins by needing to use a certain type of heating, such as expensive oil in rural parts of England (Robinson *et al.* 2019) and fuelwood in peri-urban areas in Greece (Petrova and Prodromidou 2019).

Figure 19: Heating fuels in Austria used in rural and urban areas



Source: Austria interview dataset

5.3 Heating injustices

This subsection discusses the technological characteristics of heating that predict energy poverty based on regression analysis. Empirically, this section draws on the qualitative data too and explains the contexts of lock-ins. But, first I discuss the path-dependencies of infrastructure and material deprivation which determine what kind of technologies and fuels households use for heating. The regression analysis shows that common technological predictors for energy poverty for both Vienna and Skopje are: a) not having installed heating in the whole dwelling; b) unequal temperature in the dwelling; c) inability to decide about the heating of single rooms; d) not heating during the whole heat season; and e) inability to control the indoor temperature (Skopje survey dataset; Vienna survey dataset). Additionally, a) having experienced a cut off from heat supply; b) electricity disconnection; c) not heating 24/7; d) using additional heating, and; e) not having changed the type of heating predict energy poverty in Skopje (Skopje survey dataset).

5.3.1 Infrastructural divide: the access to infrastructure

This section explains how infrastructure creates patterns of lock-ins of using certain technologies and fuels for heating. It argues that the lack of choice of households to use adequate, modern, and clean heating technology and fuels due to infrastructural and spatial inequalities can push households into energy poverty. Jenkins *et al.* (2016) discuss that the lack of freedom to choose as an individual is considered an energy injustice. This situation of lock-ins is discussed through the different infrastructural landscapes in Austria and North Macedonia.

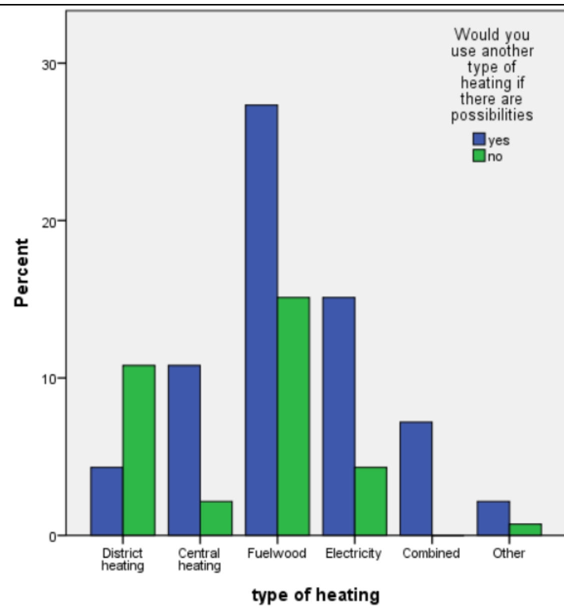
The heat infrastructure or the lack of it determines the technologies used for heating and the aspects of energy poverty. Bouzarovski (2018) argues that there is an infrastructural divide whereas Central Eastern Europe suffers more from energy poverty due to the lack of gas infrastructure preventing the use of more affordable energy. The lack of developed public heat infrastructure in North Macedonia has seemingly given households the freedom to choose their heating but from a limited market of technologies and appliances (Skopje survey dataset; North Macedonia interview dataset). On the other hand, the availability of gas central heating in Austria, and the presence of district heating in Austria and in the capital city of Skopje safeguard households from under-heated dwellings since central heating technology can heat the whole dwelling (Austria interview dataset; Skopje survey dataset). However, once connected to the district or central heating in Vienna, one does not have the choice to abandon it (Vienna survey dataset). In Skopje, households can abandon the district heating which is criticized for harming the existing heat infrastructure (Interview with an independent expert – mining sector, 2017). However, households using the district heating in Skopje cannot decide when to heat, sometimes are not comfortably warm, and cannot economize their heating (Skopje survey dataset). The latter is the case since the heat spent in the collective building is metered at the level of substation and then divided per m2 among the apartments, so any individual-level of economizing will not be reflected in their district heat bill (Interview with an independent expert - consultancy, 2017).

5.3.2 Lock-ins of technological choice

After having discussed the role of infrastructure in shaping geographical patterns of energy poverty, this section focuses on material deprivation which impacts households' choices of heating technology. It explains how affordability is a relevant factor in limiting the technological choices of households. However, some policies also create lock-ins entrapping energy-poor households in using polluting fuels. Being able to afford new technology determines whether households can benefit from the energy transition.

As a reaction to the need to reduce energy costs, energy-poor households use technologically backward heating technologies. In the case of Austria, this trend is marginal since the number of gas convectors, as well as of households using fuelwood and oil is low (Vienna survey dataset, Austria interview dataset). In North Macedonia, apart from using fuelwood stoves and energy-wasting electric heaters, there is a trend of vulnerable groups using unconventional materials for heating. Among the evidenced unconventional heating materials were tires, wooden boxes for fruit, lath, plastic bottles, oil from cars, lubricating oils, varnished parquet from renovating, construction waste, heated bed spring via electricity, used oil, duvet, shoes, especially soles of shoes, old doors, and windows (Interview with a representative of CRPM, 2017; Interview with a representative of Habitat Skopje, 2017; Interview with a representative of UNDP, 2017; Interview with a representative of EVN, 2017). The use of these materials is linked to municipalities where predominantly minorities live and especially Roma families (Interview with a representative of CRPM, 2017; Interview with a representative of UNDP, 2017). The survey data from Skopje indicate a minor use of coal, propane gas bottle, and tree branches as additional heating, the latter of which is collected daily by the interviewed Roma household (Skopje survey dataset). Not having changed the type of heating is one of the variables predicting energy poverty in Skopje. Figure 20 shows a 'stagnant' group of households in the Skopje survey that would not give up fuelwood as this group cannot afford modern types of heating (Skopje survey dataset).

Figure 20: Households per type of heating answer whether they would use another type of heating



Source: Skopje survey dataset

Material deprivation of households prevents them from accessing more sophisticated heating technology. Due to affordability challenges, households in Austria cannot afford dwellings with central heating because their rent is high. Households in energy poverty less often live in dwellings with central heating: "*The cooperative consciously has not installed central heating because experience has shown that people living there are low-income which could not afford rent in a building with central heating*." (Interview with a professor at Donau Uni Krems, 2017).

The higher price of modern technology, compared to that of older heating technology, prevents energy-poor households from using it. The survey data uncovered a few cases of households using solar heating which were statistically not income poor (North Macedonia interview dataset; Austria interview dataset). In North Macedonia, a household in a house disconnected from district heating switched to solar heating and by doing so it reduced its energy costs, while a household in Austria claims that it has free heating as a result of using solar energy for heating (North Macedonia interview dataset; Austria interview dataset). An interview with a representative of a company selling heat pumps confirmed the correlation between better affordability of households and the use of new technologies, since heat pumps are usually bought for new houses in areas known for high migration rates (Interview with a representative of Eterna solar, 2017). Pellet heating seems to be the new technological alternative to fuelwood heating. Pellets heat the whole dwelling, allow for automatization of the heating, the temperature is even, are not labor-intensive, and pollute less (Skopje survey dataset). However, an initial investment is needed since pellets need an adequate stove (Interview with an independent expert - consultancy, 2017) which might prevent energy-poor households from buying it. However, based on a pilot project on supporting low-income households in Austria, pellets cannot compete with free fuelwood (Grossgasteiger 2013; Rakos n.d.).

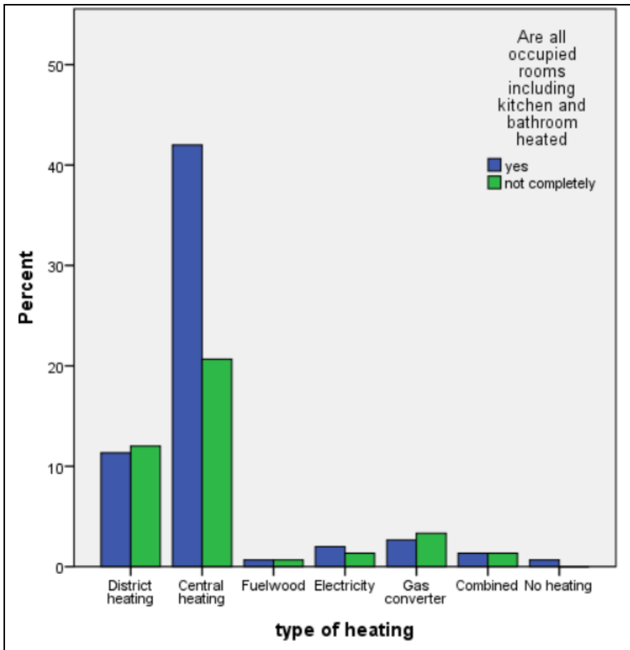
5.3.3 Spatiality of heating and technological sophistication

This section goes one step further in analyzing the characteristics of different types of heating and how these reinforce energy poverty. This section reflects on some findings from the regression analysis of certain technological characteristics of heating that predict energy poverty and explains the reasons for them based on the qualitative data. The section explains how each of these relevant technological characteristics which predict energy poverty relates to certain types of heating. This section discusses separately central types of heating, fuelwood, and electricity since they are the most relevant regarding energy poverty.

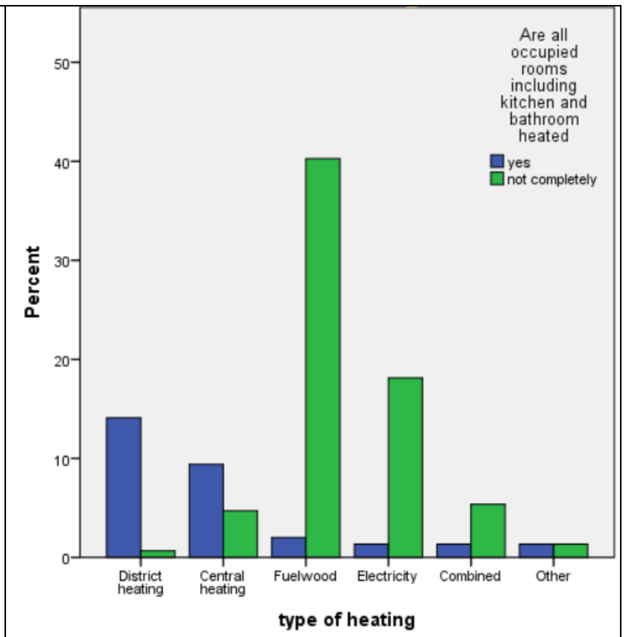
5.3.3.1 Central forms of heating linked to a lower likelihood of energy poverty

District heating and central heating are central forms of heating that have technological features less predictive of energy poverty than the non-central types of heating, such as fuelwood or electricity. For example, these central forms of heating are installed in the whole dwelling (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset; Austria interview dataset), while the opposite feature of not having installed heating in the whole dwelling is predictive of energy poverty. This seems logical since not having the ability to heat the whole dwelling leads to partial heating of single rooms, loss of heat, and potentially under-heated dwelling. However, having the technological preconditions to heat the whole dwelling, does not mean that households utilize this possibility. As Figure 21 shows, many users of central and district heating especially in Vienna mostly keep the bedroom cooler or unheated (Vienna survey dataset; Skopje survey dataset).

Figure 21: Whether all rooms are heated per type of heating in Vienna and Skopje



Source: Vienna survey dataset



Source: Skopje survey dataset

Central heating in both countries also can heat single rooms and control the indoor temperature (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset; Austria interview dataset). The opposite case: the inability to decide about the heating of single rooms and the inability to regulate the indoor temperature are indicative of energy poverty which makes the central heating less related to energy poverty. These two features of the central heating show a level of technological sophistication allowing for more control over the heating and its costs by the user, and in that way can meet the household's needs. District heating in Austria comes also with the ability to control the heating of single rooms and control the temperature (Vienna survey dataset; Austria interview dataset), but in the case of Skopje, the district heating users cannot control the temperature nor decide how many rooms they heat (Skopje survey dataset; Figure 21).

This situation with the district heating in Skopje translates into fully heated dwellings with equal indoor temperature among rooms in Skopje, while the opposite feature – unequal indoor temperature among rooms is predictive of energy poverty. The reason behind this control limitation in North Macedonia is that the control for the overall temperature for the whole building is at the sub-station level, and at the apartment-level, there is mostly the option to only turn the radiators on or off (Interview with a representative of GIZ North Macedonia, 2017). However, for some households this lack of control means they are pushed to heat even when they do not need heating, making them incur unwanted energy costs, which is similar to the "trapped in the heat" type of energy poverty documented for Hungary (Tirado Herrero and Ürge-Vorsatz 2012). I support this claim with the following citation of a household explaining that the control over the district heating by the supplier and not by themselves at times increases their electricity costs: "*There are times during the heating season and at night when they don't turn on the heating and it's colder. Sometimes we have to use additionally electric heater.*" (Household no. 25, Skopje survey dataset, a pensioner couple using district heating).

5.3.3.2 Fuelwood 'as necessary as bread'

Fuelwood is very relevant for a separate study because in both countries it correlates with energy poverty, especially in North Macedonia where the technology in which it is used is obsolete and inefficient (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset; Austria interview dataset). Additionally, households in North Macedonia are locked in choosing mostly between electricity and fuelwood since there are no other options unless they live in an area connected to the district heating. In many cases, especially for North Macedonia, fuelwood has many of the technological features which predict energy poverty, such as inability to control the temperature or inability to decide how many rooms to heat (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset; Austria interview dataset).

These technological limitations of fuelwood heating, especially relevant for North Macedonia, contribute to the under-heating of dwellings. According to a UNDP-commissioned survey about the heating in Skopje, around 71% of households using fuelwood, use a fuelwood stove (Skopje_se_zagreva 2017) which is old, highly inefficient, and can heat one room only. The survey data for Skopje shows that using fuelwood to heat one room only is not uncommon (Skopje survey dataset). This type of spatial under-heating automatically classifies a household as energy-poor if one of the indicators of energy poverty is whether a whole dwelling is heated. Figure 22 shows how the fuelwood stove in North Macedonia looks like illustrating that it enables localized heating of a single room. Figure 21 shows that households using fuelwood in Skopje mostly do not heat their dwelling fully. The use of such stoves involves a lot of physical labor of cutting logs and constantly putting them in the stove and keeping the doors of other rooms open to enable indirect transmission of the heat to other unheated rooms (Skopje survey dataset; North Macedonia interview dataset). The experience of using fuelwood by a family of 11 members I present through the following citation: "*It's expensive. We need one and a half salary for [the yearly supply of] fuelwood. It helps us that we have our forest, but it's almost depleted. It's difficult, the electricity in our country is the most expensive in Europe. We use more bottled gas to avoid the use of electricity. We have an issue with the quality of electricity, the voltage is not good [there are often blackouts due to overload]. When one cooktop is on, instead of half an hour [needed time for cooking], it will take an hour – we spend both time and money.*" (Household no. 149, Skopje survey dataset, 2017).

Despite the lower technological sophistication of fuelwood heating and precisely for its cheap price, fuelwood is used by energy-poor households as a mean to keep their energy costs low. Fuelwood is less used in Vienna, but out of 5 cases of Vienna households using either fuelwood only or in combination with another type of heating, 2 cases were of single elderly female households with income below the poverty line which cannot pay their heating bills; while a third household is a single elderly woman with income above the poverty line which uses fuelwood for an energy-saving purpose (Vienna survey dataset). In Austria, fuelwood is also used as a way to reduce energy costs by taking over the main heating fuel in the interim period before and after winter (Vienna survey dataset; Austria interview dataset). A household that uses gas as main heating explains the use of fuelwood as additional heating: "*I have added one masonry heater on fuelwood which I'm using in the interim period or when it is very cold*." (Household no 135, Vienna, 2017). In a few cases and only in Austria, the use of fuelwood is not only out of necessity but for additional comfort and coziness in an already heated room (Vienna survey dataset).

Figure 22: Storage heater and fuelwood stove used in North Macedonia

	
Source: (Pazarce 2014)	Source: (Najevtino 2021)

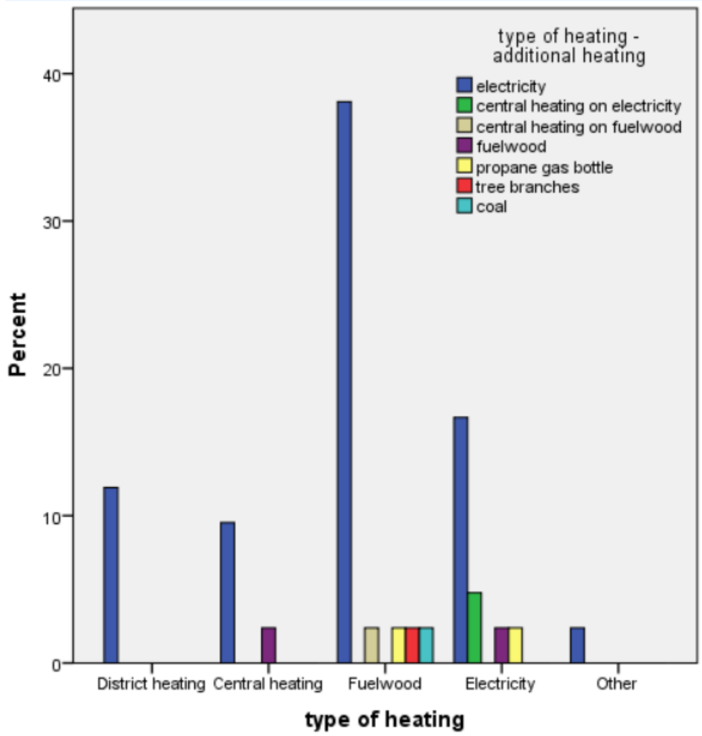
5.3.3.3 Resistive electric heating 'user-friendly but adding to vulnerability'

Electric heating deserves a separate section since it has many technological features that predict energy poverty, such as not being installed in the whole dwelling, related to unequal temperature in the dwelling, and especially for North Macedonia being used as additional heating. Figure 22 shows one of the most commonly used electric heaters in North Macedonia – the storage heater which allows for heating of a spatially limited space and is an energy-inefficient technology. Based on the survey data, both countries use an electric radiator, storage heater, electrical panel, and electrical heater; additionally, Skopje households use an air conditioner and air conditioners-inverter and those in Vienna electric convector and fan heater (Skopje survey dataset; Vienna survey dataset). The problem with using resistive electric heating is that these various electric appliances have low investment costs, but high running costs, which makes them affordable to purchase but expensive to use (Interview with a representative of TU Wien, 2017). Electric heating is even more relevant for North Macedonia since it is one of the two only options for heating apart from fuelwood (North Macedonia interview dataset; Skopje survey dataset), making the households locked in inefficient ways of heating.

A technological feature predictive of energy poverty for North Macedonia is the use of additional heating which in most cases is electric heating as seen in Figure 23 (Skopje survey dataset; North Macedonia dataset). Additional heating predicts energy poverty since it is used to make up for the spatial and capacity limitations of their primary type of heating, usually fuelwood, but rarely achieves a full heated dwelling (Skopje survey dataset; North Macedonia interview dataset), which is by definition an under-heated dwelling. One household explains: "*We have additionally electric radiator to heat a room which is not heated if there is need for it.*" (Household no 106, Skopje, 2017). Also, households using district heating in Skopje use additional electric heating as seen in

Figure 23 (Skopje survey dataset). A household using district heating explains: "*During the heating season in the evening when they do not turn on the heating and is cold, sometimes we have to use additional electric heater*" (Household no 34, Skopje, 2017). This means that additional electric heating is used to accommodate the needs of households using district heating when this main heating cannot meet the needs due to the household's inability to control the time and period of the heating (Skopje survey dataset).

Figure 23: Types of additional heating per the main type of heating in Skopje



Source: Skopje survey dataset

5.4 Discussion

Distributive energy justice is about discovering the location and spaces of injustice (Jenkins *et al.* 2016) and how this spatial component shapes energy poverty (Bouzarovski and Simcock 2017). Energy poverty is a distributive energy injustice when inequalities in access to energy services result from inequalities in income, energy prices, housing, and technology efficiency (Walker Gordon and Day 2012). Following this initial conceptualization, this chapter inspected energy poverty in Austria and North Macedonia as a distributive injustice based on the siting of infrastructure, technology, and spatiality. It reinforces the idea discussed by Bouzarovski and Simcock (2017) that the spatial dimension of energy poverty is a result of geographical inequalities embedded in energy systems, the sitting of infrastructure, and the cultural fabric of society. This chapter goes further and shows how the location of infrastructure and characteristics of technology and building environments co-shape energy poverty as a distributive energy injustice. The spatiality of energy poverty is a result of policies leading to lock-ins and these determine the cultural and behavioral preferences of households regarding fuel and technology use.

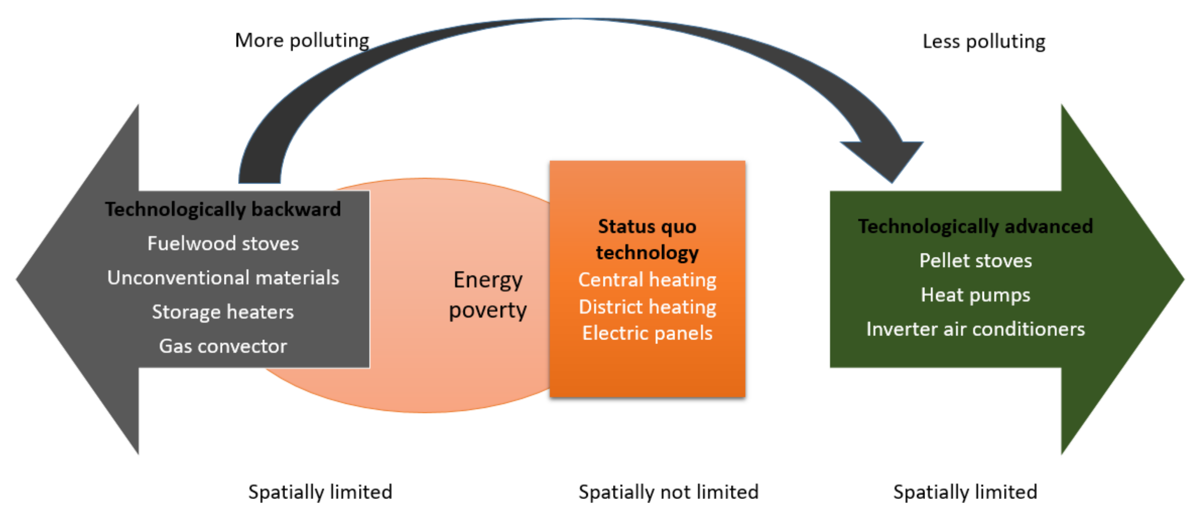
The spatiality of energy poverty does not dictate only its spatial variability, but the size of the problem. Bouzarovski (2018) argues that there is an infrastructural divide in Europe, singling out Central Eastern Europe as a victim of energy poverty also due to lacking access to gas infrastructure. The comparison between North Macedonia which geographically belongs to this region and Austria which belongs to the geographical core of Europe with lower levels of energy poverty according to Bouzarovski and Tirado Herrero (2017a) is an illustration of this divide which shapes the distribution and nature of energy poverty in both countries. The difference between the availability of heat infrastructure between North Macedonia and Austria or the 'infrastructural divide' reinforces the knowledge that infrastructure shapes energy poverty geographies. A relevant notion which explains the infrastructural and geographical divide which shapes energy poverty is 'a poverty of infrastructure'. The poverty of infrastructure means a lack of access to adequate infrastructure and the built environment (Robinson *et al.* 2018). Similarly, the unavailability of certain fuels in rural areas pushes households to use more expensive fuels (Roberts *et al.* 2015; Robinson *et al.* 2019). This infrastructure divide or the expansion of the distribution of the public heating infrastructure is the only key difference between the studied countries.

In more detail, the section on housing injustices showed how energy-poor households are locked in by their material deprivation unable to improve the energy efficiency of their homes or afford to rent an energy-efficient dwelling. This lack of access to good quality housing is an inequality in access to housing elaborated by Walker Gordon and Day (2012) as a distributive injustice of energy poverty. This section also discussed that spatial and temporal path-dependencies of housing determine the choice of the type of heating and these housing features create lock-ins for energy-poor households.

The part on heating injustices analyzed how path-dependencies of infrastructure and material deprivation determine what kind of technologies and fuels households use for heating. This means that infrastructure and affordability create patterns of lock-ins of using certain technology and fuels for heating, thus shaping the spatiality of energy poverty. The lack of individual choice concerning energy use is considered an injustice by Jenkins *et al.* (2016). Distributive injustices experienced by households in both countries to a different extent are not having access to more sustainable fuels and technologies as discussed by Sovacool and Dworkin (2015). This inability to access modern heating technologies either due to affordability issues or spatial or technological limitations means exposure to polluting fuels or the inability to regulate the temperature or heating time. This finding clarifies the lock-in of technology and market poverty, meaning it is about the limited choice of heating technologies to choose from, due to affordability or infrastructural challenges, and this ‘technology poverty’ further shapes energy poverty.

The detailed inspection of the central types of heating, fuelwood, and electricity showed that central forms of heating have technological characteristics that are less predictive of energy poverty than non-central forms of heating, such as fuelwood and electric heating. These technological characteristics of non-central forms of heating, such as not being installed in the whole dwelling; having unequal indoor temperature; inability to control the heating of single rooms; and not heating during the whole heat season reinforce energy poverty as a spatial inequality. This is due to the technological inefficiency, spatial limitation, and market availability of these types of heating. The socio-technical lock-ins resulting from the past which characterize energy poverty as a path-dependency in a post-socialistic context (Bouzarovski et al., 2015) is relevant to pattern the technological, housing, and deprivation lock-ins created in both Austria and North Macedonia. Figure 24 summarizes the ‘location’ of energy poverty per type of heating based on the heating technology’s spatiality and the heating fuel’s quality. It shows that energy poverty is mostly linked to the use of polluting fuels and technology which offers spatially limited heating, but it is also visible to some extent in central forms of heating, mostly due to the expensive district heating in Skopje or income-poor elderly persons living in a centrally heated dwelling in Vienna.

Figure 24: Technological sophistication of types of heating and their relation to energy poverty



Source: author

This chapter aims to provide answers to these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What distributive energy injustices do households with different types of heating experience?
- What types of heating are related to specific aspects of energy poverty?

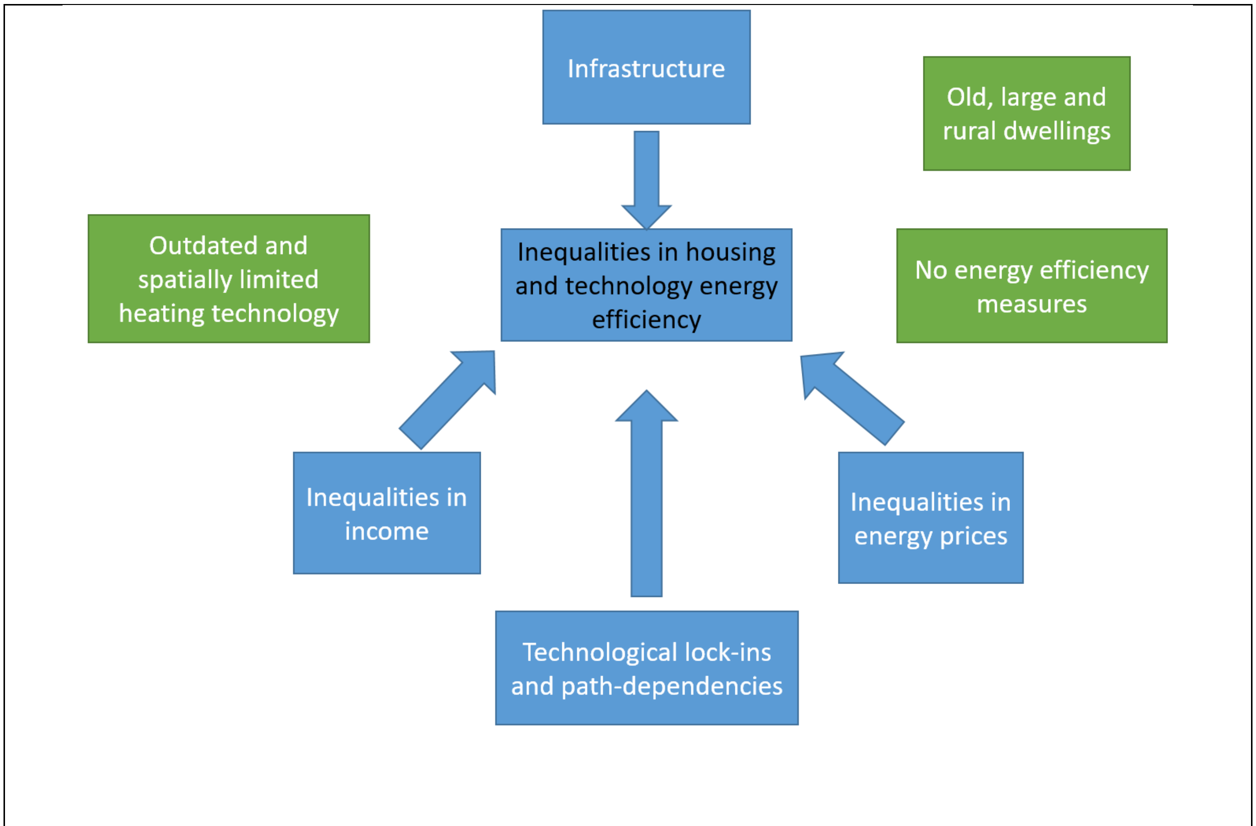
To offer a complex answer to these questions, each relevant type of heating is assessed regarding its capacity to co-produce distributive injustices, to which aspect of energy poverty, such as access, comfort, and affordability it is related, and its correlation to energy poverty. As discussed, the choice of technologies and fuels is determined by the location of infrastructure, housing, and household affordability. This means that the issue of access to certain fuel or technology is a predetermined choice by path-dependencies and technological lock-ins. This infrastructural setup means some rural households in Austria and some urban households in North Macedonia do not have a choice but to use oil, and fuelwood or electricity, respectively. The access aspect of energy poverty, meaning the lack of choice of other heating options has been discussed by (Buzar 2007b; Spagnoletti and O'Callaghan 2013).

The use of fuelwood can be seen as a distributive injustice since it is used mostly in old stoves with a limited spatial capacity, especially in the case of North Macedonia, and this creates a lack of comfort in the home, as discussed in the literature the comfort can be a case of partially heating the dwelling (Brunner *et al.* 2012; Waddams Price *et al.* 2012) or lack of adequate indoor temperature (Boardman 2010; Moore 2012). Fuelwood, although polluting and labor-intensive, is used as a coping strategy of energy-poor households due to its cheap price, and is an indicator of energy poverty. Electricity in North Macedonia is used as additional heating to make up for the spatial and technological limitations of the main heating, but because inefficient heating appliances are used, it increases households' vulnerability. As in the case of fuelwood, the spatial limitation of resistive electric heating reduces the comfort enabling spatiality limited heating, which is considered a distributive injustice. Electric heating is also correlated with energy poverty. Central forms of heating are less related to energy poverty since they offer greater comfort due to their technical availability to heat the whole dwelling. One aspect of energy poverty regarding the use of district heating is the issue with its affordability (Tirado Herrero and Ürge-Vorsatz 2012). A distributive injustice of district heating is found in North Macedonia where households are unable to economize their heating, so they are trapped in the heat as discussed for Hungary (Tirado Herrero and Ürge-Vorsatz 2012).

5.5 Conclusions

The concluding section summarizes the empirical conclusions and reflects on their theoretical implications. Figure 25 summarizes the theoretical (in blue) and empirical (in green) contribution of this chapter. This stems from the conceptual framework about distributive justice being applied to energy poverty and I upgrade this part following the empirical findings. I mostly update the work of Walker Gordon and Day (2012) about how energy poverty is a distributive injustice due it its already developed application of energy justice to energy poverty. Figure 25 adds the following (in blue): first that among the three elements of Walker Gordon and Day (2012) comprising a distributive injustice – income, energy prices, and technology and housing efficiency, the last element – housing and energy efficiency are the most relevant in shaping energy poverty, while the other two – income and energy prices are secondary, and they shape the choice of technology and housing efficiency. Additionally, infrastructure and policies of technological lock-ins and path-dependencies are the two new elements added which determine the choice of housing and technology efficiency. The theoretical contribution is that the inequalities in housing and technology efficiency co-shape energy poverty as a distributive injustice and a spatial inequality, and the other factors – lock-ins, infrastructure, income, and prices impact these central housing and technology inequalities. Figure 25 shows the empirical findings common for the two different countries (in green). Figure 25 shows that these central housing and technology inequalities which make energy poverty a spatial and distributive injustice are lack of energy efficiency measures, outdated and spatially limited heating technology, as well as old large and rural dwellings. Based on Yin (2003), the same findings from two different cases, such as North Macedonia and Austria might be relevant for a broader generalization to some extent.

Figure 25: Theoretical and empirical upgrade of Walker Gordon and Day (2012)'s depiction of energy poverty as distributive injustice



Source: author upgrading (Walker Gordon and Day 2012)

The chapter's findings completed the work of Walker Gordon and Day (2012) by highlighting the technology and housing efficiency as core factors in shaping distributive injustices which are influenced by the prices of fuels and technology and the households' income situation. Energy prices and income are relevant factors for the choice of housing and technology. This chapter also adds to the literature by showing how non-central forms of heating create spatial heating inequalities at the household level, thus reinforce energy poverty. Furthermore, it adds to the work of Walker Gordon and Day (2012) and as discussed by Bouzarovski and Simcock (2017) it emphasizes how important infrastructure is in creating inequalities in access to technology and fuels. Regarding the new literature trends to politicize energy poverty and energy justice, this chapter highlights the lock-ins created by localities and policies which entrap energy-poor households to use certain fuels and technologies at a sub-standard level. The next chapter will discuss the recognition injustice of energy poverty by focusing on the household's coping strategies and energy use, contributing to understanding how energy poverty and types of heating are related to household characteristics.

6. CHAPTER 6: RECOGNIZING THE CULTURE OF COPING WITH ENERGY POVERTY[11]

This chapter is the second one presented in an 'article' format by starting with a relevant literature review, results based on the empirical findings, and ending with discussion and conclusions. In this chapter, I present the conceptual framework on understanding energy poverty as recognition justice which is the starting point for its expansion following the presentation of the empirical results. The empirical results factored into this chapter include the results of the regression analysis and findings of recognition justice. I also provide an answer to aspects of some of the research questions. This chapter in sum applies the recognition justice tenet to energy poverty, enriched by insights from coping strategies and energy culture. In this chapter, I use the evidence around socio-demographic features of energy-poor households, their use of heating, and their coping with energy poverty. I present the lived experience of the energy-poor (Middlemiss and Gillard 2015) by using ethnographies of households (Robben and Sluka 2007; Spradley 1979), and grounded theory (Bryant and Charmaz 2007) to categorize their coping strategies. It builds up the argument about the misrecognition of vulnerable groups and their specific behavior by integrating the findings of the case studies. I also reflect on how policies with relevance to energy poverty misrecognize the needs of the energy-poor.

6.1 Introduction

The needs, practices, and characteristics of energy-poor households, and especially their drivers, are largely under-recognized. Energy poverty is considered an energy recognition injustice when the profiles of energy-poor are not recognized (Bouzarovski and Simcock 2017; Walker Gordon

[11] Some ideas and materials in this chapter were used to develop the article: Out of the margins, into the light: Exploring energy poverty and household coping strategies in Austria, North Macedonia, France, and Spain; accepted by ERSS with authors: Stojilovska, A., Yoon, H., and Robert, C.

and Day 2012). Conceptually, this chapter is based on the formulation of recognition justice and its application to energy poverty (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012). Walker Gordon and Day (2012) argue that energy poverty is an energy recognition injustice when the vulnerability and needs for energy services are not recognized and there is a lack of cultural and political respect for these challenges. Bouzarovski and Simcock (2017) reflect that a recognition injustice is the lack of respect of different identities in social, cultural, and political relations, and misrecognition of vulnerable geographical spaces. Recognition justice is a matter of 'who' is marginalized (Jenkins *et al.* 2016). I additionally incorporate the literature on coping (Anderson *et al.* 2012; Brunner *et al.* 2012; Lazarus and Folkman 1984) and the cultural meaning of energy use (Horta *et al.* 2019; Wilhite *et al.* 1996) which help uncover the specific behavior of energy-poor households.

Recognition injustices refer to the vulnerable and marginalized groups (Jenkins *et al.* 2016; Walker Gordon and Day 2012), the diversity of communities (Schlosberg 2004), and the non-recognized groups affected by energy poverty (Heffron and McCauley 2014; Heffron *et al.* 2015). Households develop various coping strategies to deal with energy poverty (Anderson *et al.* 2012; Brunner *et al.* 2012) which is a distinct way of behavior, but is largely unrecognized in policies and solution approaches towards energy poverty. At the same time, recognition injustices are shaping and are shaped by the distributive injustices (Walker Gordon and Day 2012), the latter of which are at the center of producing and reinforcing energy poverty. This means that the geographical embeddedness in energy poverty is the main driver of inequalities, while the scope of recognition justice, on one hand, zooms on the socio-demographic characteristics, needs, and behavior of energy-poor households and on the other hand exposes the systematic and policy lock-ins leading to marginalization of energy-poor households.

The literature about recognition energy justice acknowledges the different needs of households, such as those of disabled people and low-income families (Gillard *et al.* 2017; Snell *et al.* 2015), how some energy poverty policies affect certain groups in a negative way (Snell *et al.* 2015), as well as how it is under-recognized that some ethnicities, such as the indigenous Sami who are more vulnerable due to the dependence on their local eco-system (McCauley *et al.* 2016). Willand and Horne (2018) add that also the capacity of households to participate in the energy market as well as the special needs of more vulnerable groups should not be overlooked. This shows that the recognition justice in the context of energy poverty is about discovering the profiles, needs, and vulnerabilities of the energy-poor, but also how they are targeted by policies across different geographical spaces.

This chapter introduces the concept of a culture of coping with energy poverty, which is discussed here in more detail. Culture is a very broad notion used to describe different behaviors. LaBelle (2020) conceived the concept of energy cultures to capture the behavior of nations and countries by defining it to refer to the social and physical interactions forming relations in the energy system, extending from resource extraction through technologies of conversion, combustion, and networks, providing for society's material and physical wellbeing. Glück (2018) also uses the concept of energy cultures which is collectively constructed, established, and stabilized through different practices and shared understandings about how energy is produced, distributed, used, and valued. Wilhite *et al.* (1996) argue that energy services are energy-intensive when they are culturally significant, such as bathing in Japan and heating in Norway. This shows that no matter what part of the energy system is inspected or which actor– the behavior of households, production of energy, or geopolitical energy projects – there is the idea that culture is embedded in the energy system and impacts the energy use.

At a more demand-side level, Stephenson *et al.* (2010) have introduced the concept of energy cultures to understand what determines consumption behavior with the aim to better optimize behavioral change. This framework lists three levels which interact: cognitive norms, such as expected comfort level and environmental concerns, material culture, such as energy sources, insulation, and energy practices, such as a number of rooms heated and hours of heating (Stephenson *et al.* 2010) Stephenson *et al.* (2010) also lists the external factors to each of these levels, such as socio-demographic characteristics impacting cognitive norms, income, and availability of energy efficiency programs affecting material culture, and energy prices shaping energy practices. In a later study upgrading this framework, Stephenson *et al.* (2015) reflect that external factors may lock patterns of behavior resulting in either resistance to change or adoption of new behavior. In the latest study, this concept is applied to energy poverty to discover how external factors that lock families in energy poverty can be changed (Stephenson 2018). The application of this concept by other authors focuses more on the individual behavior, to best understand the 'culture' of households as opposed to that of experts (Jürisoo *et al.* 2019) or how to identify households more willing to change their behavior and reduce their energy use (Rau *et al.* 2020). To oppose this over-focusing on households and to expose more the government practices, material, and socio-spatial conditions that shape energy poverty, Petrova (2018) has coined the notion of energy precarity with the purpose to shift the focus away from personal circumstances to a broader infrastructural and policy context.

Still, these more general conceptualizations of households' energy behavior do not get the gist of the priorities and particularities of energy-poor households and how their behavior is a specific 'culture' driven by necessity and reduced quality of life. The categorization of coping strategies introduced in this chapter builds a comprehensive picture of households' priorities and struggles, therefore a strong case that their behavior is different from those of non-energy-poor households. This culture of coping with energy poverty shows that it is a life on a subsistence level. The latter is defined as a minimum standard of productive living in society (Sharif, 1986) which is a result of material deprivation but elevated to a normal way of life for energy-poor households (Chard and Walker 2016). Thus, it represents a distinct way of life or culture. Horta *et al.* (2019) discuss cultural embeddedness in coping strategies, for example, thermal comfort is not considered a priority for Portuguese energy-poor, and that is socially constructed.

This distinct culture refers to the tension between energy and other basic needs, but also the spatiality and materiality of energy poverty through the use of reduced heated space and specific fuels. Stojilovska (2020) argues that the cultural relevance of fuelwood in North Macedonia means that it is preferred as it not only economizes on heating costs but also often replaces other energy services usually satisfied by electricity, such as cooking and preparing hot water which reminds of the cultural importance of fuelwood in developing countries. With their energy behavior, households express their culture. Japanese culture dictates a preference for person-heating (Wilhite *et al.* 1996). Steele Andrew and Todd (2006) found out that the Pakistani and Bangladeshi communities in the UK use two living rooms rather than one and spend more on cooking and appliance usage.

This chapter shows how systematic inequalities along with unrecognized vulnerable spaces and technological lock-ins impact recognition energy justices, such as energy poverty. It also argues that household coping strategies, which also extend to the choice of technology and fuels, bring energy poverty closer to material deprivation, and uncover a district culture of coping with energy poverty. Coping strategies of energy vulnerable households are unrecognized as a form of material deprivation, and this understanding is especially missing in policies with relevance to energy poverty. It adds to the previous chapter which focused on how infrastructure, technology, and buildings co-shape energy poverty as a distributive injustice, by showing how cultural and behavioral preferences of households concerning fuel and technology use are influenced by lock-ins and geographical spaces. The chapter's contribution is in the empirical findings of energy poverty as a recognition injustice that energy-poor households experience in Austria and North Macedonia. Theoretically, the chapter adds to the energy justice and energy poverty literature as started by Walker Gordon and Day (2012) by adding which factors shape vulnerabilities for energy services and initiate political and cultural disrespect.

The chapter offers answers to these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What recognition energy injustices do households with different types of heating experience?

The chapter uses the empirical data from North Macedonia and Austria composed of surveys at the city level with households, interviews with households in both countries, and interviews with stakeholders from both countries. The data is presented through relevant citations from stakeholders and households, graphs from the survey, and interview datasets, and it also refers to the regression analysis about the socio-demographic features predicting energy poverty. Based on the key literature shaping this chapter (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012) energy poverty is seen as an energy injustice based on misrecognition of vulnerabilities, needs, characteristics of energy poverty households, and their identities in social, cultural, and political contexts. The main research question in this chapter is answered mostly from the lenses of recognition energy justice, and about the characteristics of energy-poor households, their behavior and the type of heating they use.

The chapter is organized in a way that after the introduction, in section 2 the profiles of energy-poor households are discussed by reflecting on the results of the regression analysis about relevant socio-demographic characteristics predicting energy poverty and on the qualitative findings. These are contextualized by explaining the lock-ins and systematic inequalities that make certain groups more vulnerable to energy poverty. Section 3 discusses the various coping strategies, by discussing that the vulnerable groups mentioned are practicing them, after what follows their categorization, and analyzing reasons for coping. I also address their use of heating, and how they are misrecognized in policies, to argue that coping strategies are a manifestation of material deprivation. Section 4 is the discussion, and the last section is the conclusion.

6.2 Profiles of energy-poor households

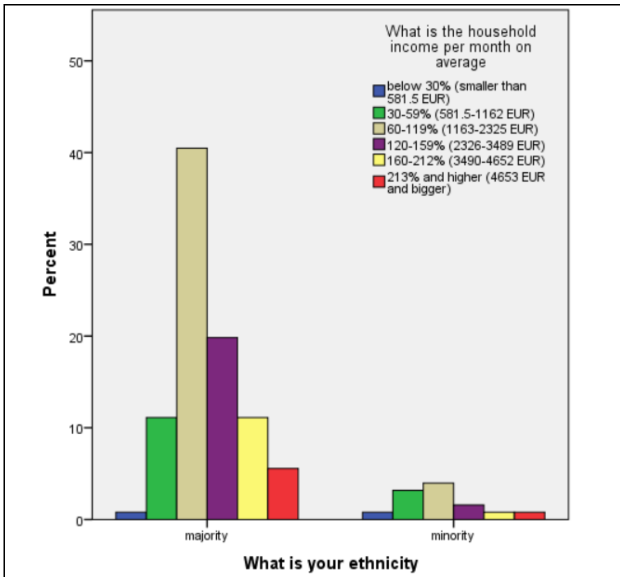
This section discussed the socio-demographic characteristics which are predictive of energy poverty based on the regression analysis. Being a non-minority, a woman, without higher education, income-poor, unemployed, elderly, or ill or disabled, or with children increases the probability to be in energy poverty. This section also shows that these characteristics of households are more indicative of energy poverty because of system inequalities, material deprivation, and special needs in the household. The aim is first to get the overall picture of which socio-demographic variables are relevant to energy poverty, and then contextualize these and focus on the lock-ins which create these vulnerabilities. To do this I both present my empirical findings and discuss them with the relevant literature.

6.2.1 System inequalities manifested in ethnicity and gender

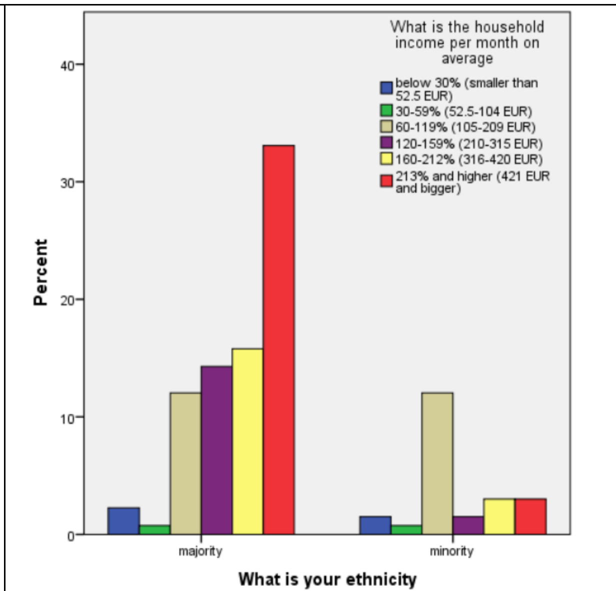
In this section, I am showing that minorities or migrants, and women are more likely to be affected by energy poverty in both countries mostly because of unequal opportunities making them more affected by material deprivation.

Having a minority or migrant status means a greater likelihood to be in energy poverty in North Macedonia and Austria. The regression analysis shows that being a non-majority household in both Vienna and Skopje predicts energy poverty (Skopje survey dataset; Vienna survey dataset). A key reason for the greater energy vulnerability of non-majority groups is their lower income levels than Macedonians and Austrians respectively as seen in Figure 26. The minority or migrant status has been little explored in the literature about energy vulnerability. Immigrants in Austria are often at high risk of energy poverty due to their likelihood of being affected by income poverty (Brunner *et al.* 2012). Ethnic minorities in England are a potentially new vulnerable group affected by increasing energy prices (Fahmy *et al.* 2011). As a result of non-majority groups being less integrated or with fewer changes for good earning opportunities, they are more often affected by material deprivation.

Figure 26: Average household income for a majority and minority households in Vienna and Skopje



Source: Vienna survey dataset



Source: Skopje survey dataset

The minority Roma households are considered the poorest, most disadvantaged, and discriminated ethnic group, in North Macedonia and beyond. A Roma household in Skopje which has no income and no social welfare support, surviving only from donations, explains their daily search for money: "*Better not be poor. There is no bread for Roma. I beg I search the dumpsters.*" (Household no 103, Skopje survey dataset)[12]. The interviewed representative of the Platform against poverty explained that Roma is affected by trans-generation poverty which is a vicious circle of not sending children to school to become unemployed adults, this locking them into a bad quality of life

[12] I used this citation in this published article: Grossmann, K., Jiglau, G., Dubois, U., Sinea, A., Martín-Consuegra, F., Dereniowska, M., Franke, R., Guyet, R., Horta, A., Katman, F., Papamikrouli, L., Castaño-Rosa, R., Sandmann, L., Stojilovska, A. and Varo, A. 2021. The critical role of trust in experiencing and coping with energy poverty: Evidence from across Europe. Energy Research & Social Science 76 102064.

(Interview with a representative of the Platform against poverty, 2017). The use of unconventional materials, such as used furniture, shoes, and tires for heating was mentioned in the previous chapter to be used by vulnerable groups, such as Roma. A representative of UNDP Macedonia made the connection between air pollution and energy poverty by explaining that parts of Skopje with the highest air pollution are where poorer households live including Roma due to heating with unconventional materials (Interview with a representative of UNDP Skopje, 2017). The vulnerability of Roma as a socio-economically disadvantaged ethnic group in Europe has been a bit better explored in the literature citing grave system inequalities and extreme poverty. Their vulnerability lies in their material deprivation and housing inequality, but also due to structural discrimination and inequality, leading to their ghettoization (Bouzarovski and Tirado Herrero 2017b). Similarly, Roma tend to have lower chances of having a clean, safe, and healthy environment than non-Roma neighbors (Filcak 2007). As an ethnic group, they face extreme forms of energy poverty, such as informal housing, but also social marginalization and segregation (Teschner et al. 2020).

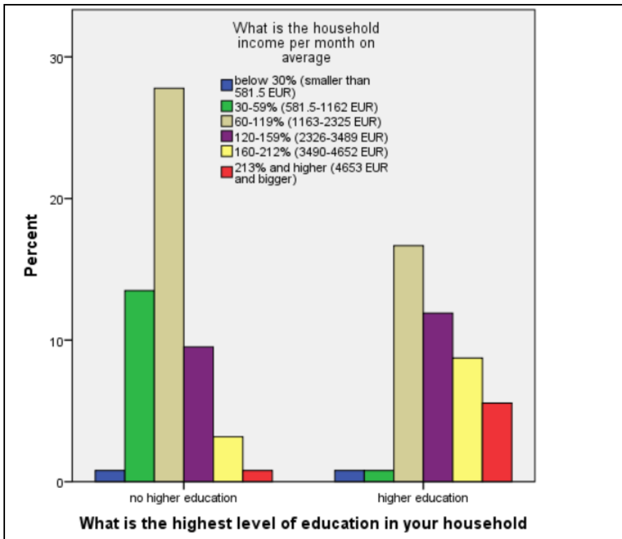
Gender is a relevant predictor of energy poverty, especially in Austria. The regression analysis shows that a single female household in Vienna is predicting energy poverty (Skopje survey dataset; Vienna survey dataset). In Vienna, single female households are mostly pensioners on a minimal pension which is below the poverty line, thus as a result they are automatically income poor. Also, the combination of single female households and a migrant background predicts energy poverty in Vienna (Vienna survey dataset). Figure 29 (right) shows that more recipients of minimal pension are single female households in Vienna. The literature explains that female pensioners due to their greater longevity more often than men have low incomes (Clancy *et al.* 2017). Also, according to Robinson (2019), women are more often excluded by the economy through part-time unemployment, provision of unpaid care, and similar. The systematic inequalities providing women with less favorable earning possibilities. The qualitative data indicate that elderly women living alone in North Macedonia often experience energy poverty citing material dependence on other family members or needing to economize their costs to be able to pay with their pension (Skopje survey dataset; North Macedonia interview dataset). A single female elderly woman without education and no income in Skopje financially dependent on other family members: "*I have no own income, no pension. My grandchildren pay all my costs. They supply and cut the fuelwood. I economize in order not to cause costs* for them." (Household no. 27, Skopje survey dataset). The literature explains there are gendered coping strategies, for example, that attempt to control energy costs by rationing heating is undertaken by women, and these activities are more emotionally draining for them (Petrova and Simcock 2019). Although energy poverty is studies generally by taking the household as a unit, there is a need to treat energy poverty at an individual level (Robinson 2019).

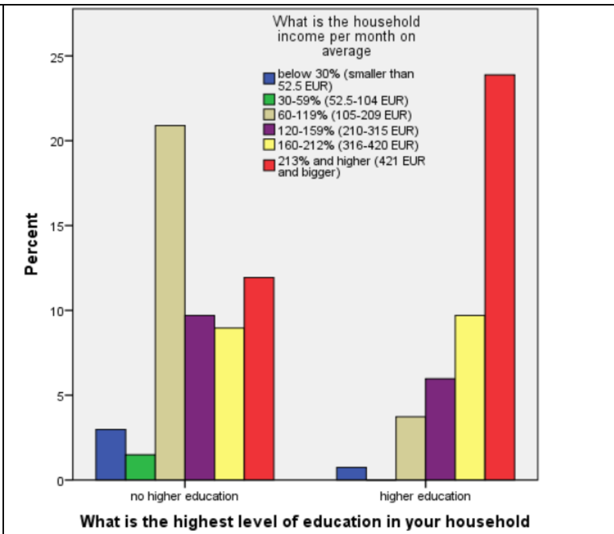
6.2.2 Material deprivation manifested through the educational level, income loss, and household size

This subsection is about that a household without university education in both countries, unemployment in North Macedonia but also single-person households in Austria, and large households in North Macedonia are more likely to be in energy poverty since they are more likely to be affected by material deprivation.

Having lower earnings as a result of a lack of higher education is why lower education in both cities predicts energy poverty (Skopje survey dataset; Vienna survey dataset). Figure 27 shows that in Skopje and Vienna the absence of higher education brings less income and in both cases, and more income-poor are without higher education. Lower education brings less income and limited earning opportunities which pushes households into material deprivation.

Figure 27: Education level and income level in Vienna and Skopje





Source: Vienna survey dataset	Source: Skopje survey dataset

Income loss is a key contributor to lower affordability. This is differently manifested in the studied countries. Unemployment is s a factor in energy poverty in North Macedonia since it means income loss. Households with an unemployed member tend to be more often in energy poverty according to the regression analysis (Skopje survey dataset). The issue is that unemployment is widespread in the country. About 43% of the Skopje dataset had at least one unemployed member (Skopje survey dataset). In addition, the combination of unemployment and a large household signals a high chance of energy poverty in North Macedonia (Skopje survey dataset). A large household can be affected by energy poverty as non-income receiving household members, such as children, students or unemployed contribute to household expenditure, while the income is insufficient to cover their needs. One particularity for Skopje is the dependency on one source of income even in the case of large households (Skopje survey dataset). An example of an Albanian household of 11 members including 7 children and unemployed members, which relies on grey employment and experiences energy affordability challenges: "*We use one fuelwood stove to heat one room. We have unpaid electricity bills. We are careful with the spending of fuelwood, not to go over 15 m3.*" (Household, no. 131, Skopje survey dataset). Similarly, low income is behind energy poverty in Austria, but it is experienced in single-person households and income-poor households. These two groups in Vienna are more likely to be in energy poverty following the regression analysis (Vienna survey dataset). As discussed in the previous section, this is mostly the case of single female pensioners on a minimal pension who are automatically income poor (Vienna survey dataset).

These findings are in line with the literature about the following socio-demographic variables being related to energy poverty: income (Boardman 2010; Fahmy *et al.* 2011; Healy and Clinch 2004; Thomson and Snell 2013; Waddams Price *et al.* 2012); household size (Waddams Price *et al.* 2012); employment status (Brunner *et al.* 2012; Ntaintasis *et al.* 2019) and level of education (Gouveia *et al.* 2018; Healy and Clinch 2004). The challenges with low income no income due to unemployment show the underlining state of material deprivation in the countries, the main difference between the type of vulnerable groups, and the size of energy poverty. In North Macedonia, energy poverty is a post-socialist one that correlates with a widespread material deprivation (Bouzarovski and Tirado Herrero 2017b) manifested by higher shares of unemployment, thus affecting large households relying on little income. In Austria, energy poverty is also seen as material deprivation, but it is limited to certain vulnerable groups, such as single female pensioners on a minimal pension, in some instances of migrant background.

6.2.3 Special needs in the household manifested in age groups and health

This subsection discusses the special needs in the household which might put people at greater risk of energy poverty. Households with pensioners, disabled or ill persons or those needing higher temperature in both countries are more exposed to energy poverty. In North Macedonia, vulnerable are also households with children. Many of these needs are interlinked, such as children, pensioners, and the ill needing higher temperature, thus needing to spend more on energy costs.

Households with children and pensioners might be vulnerable to energy poverty on the basis that children are a cost, but often need higher temperature or more heated rooms, while pensioners have increased expenditure due to their age, but receive less income and might need more warmth. Based on the regression analysis, the need for higher temperature predicts energy poverty in Vienna, while the presence of a disabled or ill person and children indicate energy poverty in Skopje (Skopje survey dataset; Vienna survey dataset). The qualitative data shows that households with an ill or disabled person in Austria are vulnerable to energy poverty too (Austria interview dataset). One-fourth of the Skopje survey participants expressed the need for warmth when they have elderly and/or children (Skopje survey dataset) which discloses that they are experiencing a lack of sufficient warmth. A household in Vienna composed of 3 pensioners without any affordability issues explains the need for warmth: "*Sometimes I need higher temperature because I'm old.*" (Household no. 90, Vienna survey dataset). The literature has studied that heating is important when children are present (Anderson *et al.* 2012), and that elderly in the UK tend to use warmer clothes and economize the heating (Chard and Walker 2016).

Pensioners also due to their reduced income are often affected by material deprivation. Based on the regression analysis, the presence of pensioners predicts energy poverty in Vienna (Vienna survey dataset). One specificity for Austria concerning the elderly is that they often continue to live in large dwellings after their children move out (Interview with a representative of Wien Energie Ombudsman, 2017). Another more Austrian-specific challenge which was also mentioned in the previous section is the minimal pension since households with a minimal pension are income poor. The qualitative data shows that pensioners in North Macedonia are vulnerable to energy poverty too (North Macedonia interview dataset). For example, when pensioners live in a large household their pension often is the single source of income (Skopje survey dataset), which means they are supporting unemployed and other non-income receiving members of the household.

Health issues could mean income loss due to the inability to work or extra costs related to the illness. Having a member with a disability and/or long term illness in the household might imply higher energy or other expenditure, however, some health issues were mentioned due to living in colder than optimal dwelling or indoor pollution (Skopje survey dataset; Vienna survey dataset; North Macedonia interview dataset). One single female pensioner of migrant background in Vienna explained that she has rheumatism due to the lack of heating since she economizes and has issues with affording her heat and energy services (Vienna survey dataset). When asked about the reason for needing a higher temperature, illness was mentioned as a leading reason in Vienna (Vienna survey dataset). Healy and Clinch (2004) have already emphasized the relevance of illness and disability to experiencing energy poverty.

6.3 Coping strategies of energy-poor households

After presenting the results about which socio-demographic features of households are more prone to energy poverty, I focus next on the behavior of these energy-poor households. Energy-poor households have different priorities in the households than those who are not energy-poor. Understanding their behavior unlocks insights into lock-ins they are facing with and opportunities found in their living environment which help them to deal with their situation. I discuss the type of coping strategies I have observed from the large set of survey and interview household data I collected, in line with grounded theory, which encourages continuous interaction with data and leads to examining all possible theoretical explanations for the empirical findings (Bryant and Charmaz 2007). In this subsection I start with listing the type of coping strategies, categorize them, discuss their use of heating, the reasons for coping, and I relink the profiles of the vulnerable groups with the coping strategies. Studying how energy-poor households behave through their coping strategies is important for understanding how energy poverty is a form of material deprivation. By reorganizing their household needs and priorities, energy-poor households develop a special 'culture' of coping with energy poverty. This understanding is largely unrecognized, especially in policies with relevance to energy poverty.

6.3.1 Type of coping strategies

I start with presenting the various types of coping strategies I observed, their aim, the basic need they affect, and the reason for practicing. To illustrate this I have presented the observed coping strategies in Table 13, and I discuss one by one and contextualize them with citations from households. I will also reflect on the characteristics of the vulnerable groups who perform these coping strategies. To be able to follow better the coping strategies, I have numbered them.

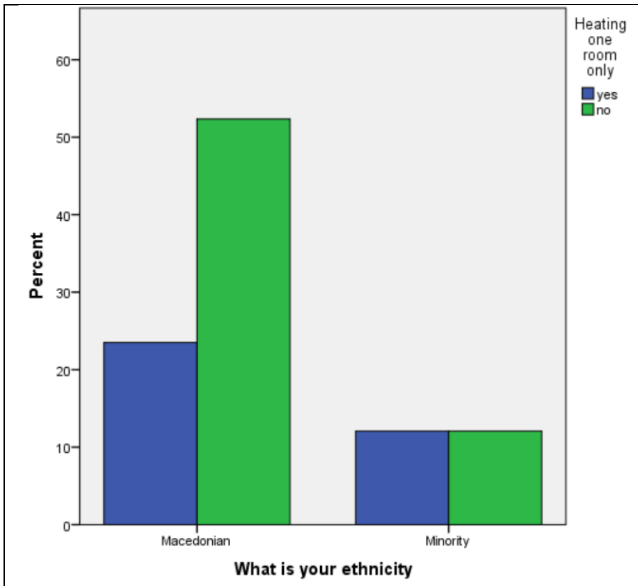
Table 13: Energy-poor households' coping strategies, their aims and drivers

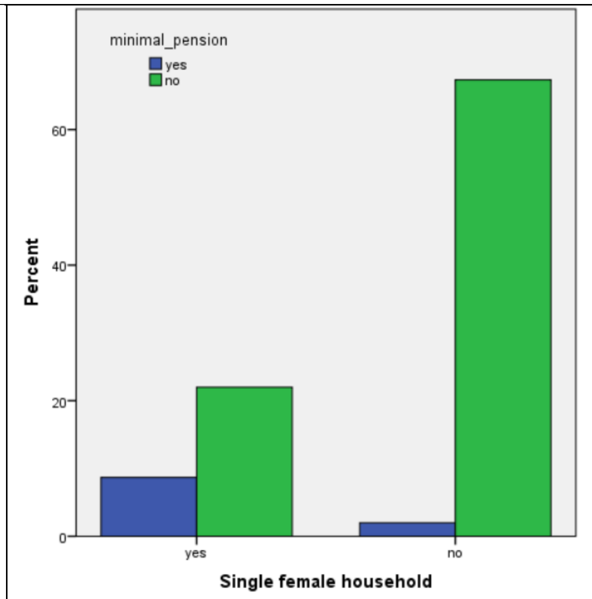
Observed coping strategies	Basic need affected	Their aim	The reason for coping
1)Cannot economize heating when cold	Heating	Heating is more needed than other energy services	Needs in the households; already reduced warmth quality
2) Use warmer clothes to stay warm	Heating	Warmth compensation	Avoiding extensive heating or electricity costs

3) Heat one room only	Heating	Reduced heating costs, but one comfortable room	Sub-standard, material deprivation, flexibility or lock-in of the heating market
4) Economize electricity	Electricity	Lowered need for costs on appliances compared to heating; avoid using electricity, reducing electricity bills	More liberalized electricity market; cheaper heating (fuelwood); saving costs for other energy and housing costs
5) Use the heating to prepare hot water/ and or cook too (MK only)	Electricity	Avoid using electricity, replacing services satisfied by electricity with fuelwood	Prevent electricity disconnection or getting into debt, electricity market monopoly with a strict payment policy
6) Rely on cheap electricity tariff (MK only)	Electricity	Avoid using expensive electricity, reducing electricity bills	Expensive electricity, electricity market monopoly with a strict payment policy
7) Pay energy costs first	Energy services	Keeping their dwelling or the access to energy services	Fear of losing their dwelling or of disconnection
8) Economize other basic needs, such as food	Food	Keeping their dwelling or the access to energy services	More flexible food market, fear of losing their dwelling or of disconnection
Source: Vienna survey dataset; Skopje survey dataset; North Macedonia interview dataset; Austria interview dataset			

I have observed several coping strategies regarding the use of heating practiced for different reasons. A household of 2 pensioners on central gas heating explains the importance of warmth for them and why they cannot economize the heating in winter (coping strategy 1): "*It is a necessity, one has to heat when it is cold*." (Household no. 147, Survey Vienna dataset). Similarly, an Albanian household with 5 or more members including 3 children who use electric heating and can barely satisfy their basic needs clarifies (coping strategy 1): "*I cannot economize [heating]* *because I have small children.*" (Household no. 3, North Macedonia interview dataset). These examples show that the comfort of a heated home is more relevant when there are elderly or children in the home. With the purpose of keeping the energy costs below a certain threshold, households do various activities to compensate for the lack of sufficient warmth. A household of 2 pensioners using electric heat which reported to partly afford their energy services, explains (coping strategy 2): "*Because we economize, if we are cold, first we would cover ourselves with a blanket.*" (Household no. 61, Skopje survey dataset). In order to make use of the opportunity of a flexible fuelwood market, households especially in North Macedonia are satisfying their heating needs at a reduced sub-standard level. They heat one room only. A household with an unemployed member who can partly pay the energy costs and heats on fuelwood elaborates (coping strategy 3): "*Yes, [the rooms] are cold because we have the heating on fuelwood which can heat one room only*." (Household no. 66, North Macedonia interview dataset). More than one-third of Skopje households reported heating one room only (Skopje survey dataset). Figure 29 (left) shows that in Skopje half of the minority households heat one room only, while only a third of Macedonians can do this. Not heating the dwelling fully is not only an economizing strategy but a result of the technical limitations of the heating technology, as discussed in the previous chapter. Heating a reduced number of rooms in the dwelling in North Macedonia although could be considered a substandard way of life, is becoming a normalized way of living according to an interviewed representative of the civil sector: "*I see it as a substandard, but they see it as a normal way of life.*" (Interview with a representative of Ekosvest, 2017).

Figure 28: Heating one room per ethnicity in Skopje and minimal pension of single female households in Vienna





Source: Skopje survey datset	Source: Vienna survey dataset

Similar to heating, electricity is affected by coping to either make use of its flexibility compared to the inflexible heat market or to avoid it due to its high price. The first case of using the greater flexibility of the electricity market compared to the central heating has been observed in Vienna. An income-poor single female pensioner who reported not being able to adequately heat her dwelling and uses central gas heating economizes the electricity through appliances incurring fewer costs (coping strategy 4): "*I do not heat in April and I also economize electricity. I use smaller lamps.*" (Household no. 15, Survey Vienna dataset). The different circumstances in North Macedonia, such as a private monopoly in the electricity sector combined with the already widely spread material deprivation, force energy-poor households to develop strategies to avoid using electricity or reduce its costs. Thus, households tend to use heating for preparing hot water and/or cooking which is done by almost half of Skopje households to avoid spending electricity (Skopje survey dataset). A household of 2 pensioners which uses wood dust for heating explains its multitasking of energy services (coping strategy 5): ".*[W]e heat the living room and the kitchen and on wood dust, we cook in winter. To have lower electricity bills.*" (Household no. 77, Interview North Macedonia dataset). The availability of a cheap electricity tariff in North Macedonia stimulates households to use it (which at the time of the data collection was on weekdays started at 10 p.m.). An example of the use of cheap electricity tariff by a household of 1 pensioner and 1 unemployed adult which heats on electricity and can partly heat its dwelling (coping strategy 6): "*Whenever possible, I use cheap electricity tariff for all chores needing electricity, such as washing or similar. I economize electricity for other needs other than heating.*" (Household no. 50, Survey Skopje dataset).

Households experiencing energy poverty also have different priorities which are about avoiding a greater threat, such as losing their home (if renting, for example in Vienna) or experiencing disconnection (which comes with additional costs and fears to deal with the monopoly utility, such as in Skopje). Thus, vulnerable households prioritize the payment of energy costs. A household of 2 adults and 2 children heating on fuelwood has explained its priorities (coping strategy 7): "*Because we have to [pay the energy costs, otherwise] you will get disconnected from electricity and it is not comfortable to sit in cold.*" (Household no. 82, Interview North Macedonia dataset). Another feature of energy-poor households reflecting in their coping is that affording the energy costs or having sufficient warmth is more important than other basic needs, which often include food. This is also enabled due to the more flexible food market which can be more subjected to reduction. An example of an interviewed household of 5 or more members including 2 children being able to afford energy costs is a must (coping strategy 8): "*I have to afford [the energy costs], and therefore one needs to economize something else.*" (Household no. 17, Interview Austria dataset).

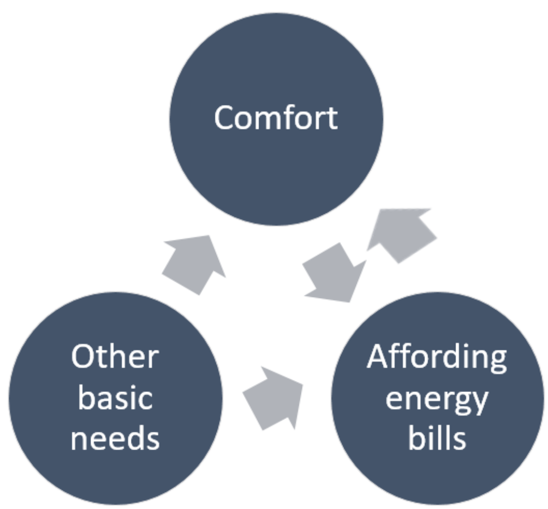
I summarize the findings from the listing of the coping strategies regarding the reasons for practicing them, and for the type of households who practice them. It is clear that the internal factor for coping is the material deprivation of these households. But, the nature of the activities they undertake depends on external factors. For example, some households wanted to avoid losing access to energy or housing, while others tried to maximize their savings by using the flexibility of the heating or food markets. I have also shown the features of the households who cope, which reflects the socio-demographic findings from the sections above. For example, these are households with children, pensioners, single female households, or with unemployed members.

6.3.2 Categorizing coping strategies

In this section after explaining and contextualizing the various coping strategies of energy-poor households, I go a step further to categorize them regarding households' consideration for the basic needs in the home.

Table 13 and the citations above have illustrated that households' decisions often mean juggling with their basic needs. They either make use of cheap fuel, are happy with reduced spatial heating, or reduce the quality or quantity of food. The choice of the coping strategies is shaped by the composition of the household, and the structure of the housing and heating markets. Depending on these circumstances, households choose their priorities. One of the core priorities is being able to afford the energy bills which includes having them below a certain threshold or prioritizing their payment. Another core priority is having a warm or at least have part of the home warm which involves reducing the heating at a sub-standard level, prioritizing the heat bills, or practicing warmth compensation strategies. The least of the priorities is what I refer to as other basic needs, which does not include only leisure expenditures but also food. In the section below I demonstrate that often there is a tension between satisfying these basic energy and other needs in the household. Inability to afford all of these basic necessities is a clear sign of overall material deprivation. I show this trade-off in Figure 28 that food and other basic needs are the least important needs, while affording energy bills and comfort are more important. Between the last two, there is often a tension resulting from the household composition, for example, households with elderly and children tend to prioritize warmth.

Figure 29: Dynamic ranking of households' coping strategies and priorities



Source: author based on Vienna survey dataset; Skopje survey dataset; North Macedonia interview dataset; Austria interview dataset

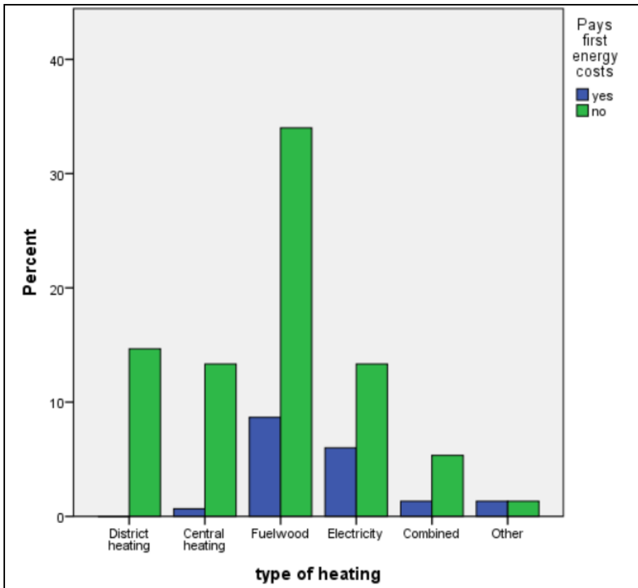
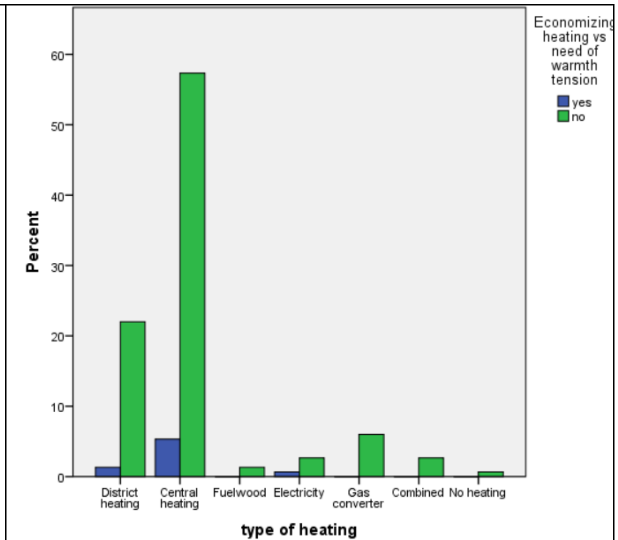
Through citations of households' coping strategies, I illustrate the tension between satisfying energy and other basic needs to support the argument that energy poverty is a phenomenon similar to material deprivation. There is a thin line between the balance of getting sufficient warmth and affording the energy bills. A household using fuelwood for heating of 2 adults and 2 pensioners can economize by using cheap fuelwood, but on the cost of heating a limited space of the dwelling: "*We have savings but only one room is heated*." (Household no. 54, Interview North Macedonia dataset). It is often a challenge to both stay warm and manage the heat expenditure. A household of an income-poor single female pensioner using central gas heating which can partly heat its dwelling adds: "*Sometimes it would be better to be warmer, but I cannot, I must economize*." (Household no. 42, Survey Vienna dataset). Some affected households economize some needs to afford their energy bills. A household of 2 adults and 1 child using central oil heating explain their struggle: "*I have to economize in order to fill yearly the oil tank*." (Household no. 44, Interview Austria dataset). Similarly, faced with limited funds for energy and other basic needs, some households have to choose between eating and heating. A household of an income-poor single female pensioner of Polish nationality using central gas heating which cannot adequately heat its dwelling explains her opinion: "*I would go hungry, but I pay the energy bills.*" (Household no. 15, Survey Vienna dataset). Single pensioners are facing similar economic restrictions. A single female pensioner from Skopje finds it difficult to afford her energy bills with a single pension: "*It is difficult to cover everything with one pension. I need to decide between bills, food, and other needs*." (Household no. 45, Skopje survey dataset). A single female pensioner in Vienna who has a health condition that requires lots of warmth explains her priorities: "*Warmth is important. In case I need to economize, I economize on food*." (Household no 68, Vienna dataset). The citations show again that socio-demographic variables of energy-poor households are households with pensioners, single female households, with children, non-majority groups, or income-poor.

6.3.3 The use of heating to cope with energy poverty

In this section, I focus on the types of heating used for coping with energy poverty. As it is visible in Table 13, the heating or fuel appears either as a lock-in which households aim to avoid, therefore develop coping strategies. Or they go for the fuel or technology which allows them maximal economizing, and relief from their precarious situation.

Electricity and fuelwood as non-central forms of heating are related to energy poverty, but with different approaches to coping. It is visible that in the case of Skopje (Figure 30 left), households that use fuelwood and electricity tend to prioritize their energy bills. Using a non-central type of heating along with unemployment or minority members or person with an illness or disability increases household's chances of being in energy poverty in Skopje (Skopje survey dataset). The combination of migrant households with heating with characteristics of a non-central type in Vienna means higher chances of energy poverty (Vienna survey dataset). The difference in the use of these energy sources for coping is in their price and the technologies in which they are used for heating. Fuelwood was in most cases used to reduce the energy costs, but also to control the space and time of heating. On the other hand, electricity enables control of the space and time of heating, but increased energy vulnerability. One household elaborates how electric heat leads to big energy bills in winter: "*In a family in which the common income is about 45.000 denars (732 EUR), 8000-9000 denars (130-146 EUR) for electricity in the coldest months is a lot and it burdens the household budget*." (Household no. 56, North Macedonia interview dataset). In Austria, households which do coping strategies use non-central, but also central forms of heating. In Vienna households that experience the tension between economizing the heating and staying warm are mostly located in a dwelling with central heating, followed by district heating and electricity (Figure 30 right). This shows that in Vienna when available non-central forms of heating can be used for reducing costs, but in the case of central forms of heating, there is not much what the households can do to reduce their heating.

Figure 30: Some coping strategies of households and their type of heating in Skopje and Vienna

	
Source: Skopje survey dataset	Source: Vienna survey dataset

However, using fuels to cope with energy poverty can have health impacts. In the case of Skopje, respiratory illness was reported in some households which happen to use fuelwood for heating (Skopje survey dataset). In a more globalized context, Clancy *et al.* (2017) found that in most cases women are exposed to smoke from fuelwood due to their major responsibility for cooking. Furthermore, the physical difficulty of working with fuelwood for elderly people can be a challenge. In the case of one household with one 3 adults and one pensioner, the physicality of heating with fuelwood was one of the factors to convince the household from Skopje to switch to pellets: "*We would make the fire, she (the pensioner) would only add [logs]…but she got a hernia. This was torture and my husband could not manage it anymore, he got back pain, so we said we would go for pellets*." (Interview with Household no. 1, Interview dataset North Macedonia). A single female household from Vienna explains her use of fuelwood: "*Fuelwood is good, it is fitness. My daughter brings the logs from the attic. I use fuelwood because I'm healthy to use it*." (Household no. 38, Vienna survey dataset). But, avoiding the physical difficulty to deal with fuelwood can increase the household's energy vulnerability. A single female pensioner is experiencing energy poverty due to the passing away of her husband forcing her to change from fuelwood to electricity since she cannot manage the physicality of fuelwood use. Since heating on electricity is more expensive, she is left with less for other basic needs monthly after paying the bills: "*First [I pay] the bills, and what is left [is for other things]. I just paid the bills and I'm left with 2-3000 denars (33-49 EUR) for food."* (Household no. 135, Skopje survey dataset).

6.3.4 Coping strategies as unrecognized material deprivation of energy vulnerable households

In this section, I reflect on the importance of recognizing coping strategies of energy vulnerable households as a form of material deprivation. I will also argue that it is largely unrecognized that material deprivation underlines energy poverty and that the housing and heating markets and socio-demographic features of households reinforce this link. This understanding that energy poverty as a form of material deprivation is especially missing in policies with relevance to energy poverty. I show this misrecognition of energy poverty as material deprivation in policies through the example of the informal definition of energy poverty in Austria, and the measures for improving energy efficiency and reducing energy poverty in North Macedonia.

An interviewed civil servant criticizes the informal definition of energy poverty of the Austrian Regulatory Commission which entails two key elements – being at risk of income poverty and having high energy costs since it does not include households that deprive themselves of energy: "*I do not heat the whole dwelling, but therefore I can pay the electricity bill or I can buy food. And that is not integrated [in the definition]. Indicators [of the proposed definition] are only income and high energy bills. For us [the Ministry] energy poverty is part of income poverty and many poor people have problems with energy bills because they have little money for them.*" (Interview with a representative of the Ministry of Social Affairs, 2017). This shows that energy-poor households are more likely to be materially deprived and coping with energy poverty through measures aimed at reducing their energy costs, and under-spending. This understanding is not integrated into the informal definition of energy poverty with the rationale to be able to adopt objective measures for assessing energy poverty (Interview with a representative of the regulator E-Control, 2017).

In North Macedonia as presented in chapter 4, the measures with relevance to energy poverty, such as replacement of fuelwood stoves with pellets, taking favorable grants to invest in energy efficiency, or installing solar collectors, are directed towards all households without any low-income criteria. That means those who can afford these measures would likely apply (Interview with a representative of EE Blog, 2017), especially because many of these are a part loan – part grant, or require the purchase of the technology in advance and then getting reimbursed. On the other hand, the energy poverty subsidy in North Macedonia is also for social welfare recipients, but this group is too narrow (Stojilovska and Zuber 2013), as discussed previously a much larger part of the population is affected by energy poverty.

I conclude this subsection with the statement of the European network against poverty which advocates for a wholesome approach to energy poverty as integrant to material deprivation. The interviewed representative of the civil sector explains the position of the European network against poverty: "*In the materials of the European Platform [Against Poverty] there is a nice sentence that on European level the pledge is to be in a state when one does not need to choose between energy and food, but there should be enough of both. We cannot have people not have enough of one of the two. They have to have the basics to be functional.*" (Interview with a representative of the Platform against Poverty, 2017).

6.4 Discussion

This section discusses the findings of this chapter with the relevant literature. I discuss the profiles of energy-poor households, the coping strategies, and I answer the research questions of this chapter. But, first, I summarize the reflections about how energy poverty is a recognition injustice, along with some of the most relevant findings.

Recognition energy justice is about discovering marginalized groups (Jenkins et al. 2016), not recognized vulnerable spaces, and disrespect of different identities in social, cultural, and political relations (Bouzarovski and Simcock 2017). Energy poverty is an energy recognition injustice when household vulnerability and needs for energy services are not recognized and there is a lack of cultural and political respect for their challenges (Walker Gordon and Day 2012). Following this initial conceptualization, this chapter inspected energy poverty in Austria and North Macedonia as a recognition injustice by focusing on the profile of the energy-poor households, their use of heating, and their coping strategies. It agrees that recognition injustices are shaping and are shaped by distributive injustices (Walker Gordon and Day 2012) and integrates the idea of Bouzarovski and Simcock (2017) that recognition injustice is about a lack of recognizing vulnerable spaces.

This chapter shows how systematic inequalities along with unrecognized vulnerable spaces and technological lock-ins impact recognition energy justices, such as energy poverty, and determine the cultural and behavioral preferences of households concerning fuel and technology use. This chapter also shows how household coping strategies such as those discussed by (Anderson *et al.* 2012; Brunner *et al.* 2012) extend to the choice of technology and fuels, and bring energy poverty closer to material deprivation, to uncover a district culture of coping with energy poverty. The chapter argues that coping strategies of energy vulnerable households are unrecognized as a form of material deprivation, and this understanding is missing in policies with relevance to energy poverty.

I have shown the relevant socio-demographic variables predicting energy poverty and showing the energy poverty typologies. The section on system inequalities showed that households of non-majority ethnic groups and single female households are a vulnerable group in both countries. These 'system outsiders' are more affected by energy poverty. This contributes to the understanding of spatial and socio-economic segregation of energy poverty as energy-poor households are materially more disadvantaged and structurally have fewer access opportunities. The spatial aspect refers to the fact that minorities in North Macedonia tend to live in a specific part of the country. Gender plays a role in predicting energy poverty as a result of the embedded system weaknesses of women disproportionally more receiving a minimal pension or are left financially dependent on other members which makes them more vulnerable to energy poverty. The section on material deprivation showed that households without higher education in Vienna and Skopje tend to be more affected by energy poverty, while single-person households and income poor households in Vienna and large households and households with an unemployed member are more likely to be affected by energy poverty in Skopje. The section on special needs emphasizes that households with pensioners, disabled, or ill persons or those needing higher temperate are more prone to energy poverty in both countries, while the presence of children indicates energy poverty in Skopje too.

The conceptualization of the coping strategies aims to contribute to both empirical knowledge about dealing with energy poverty, but also to a more conceptual understanding of the coping strategies and how they are related to material deprivation. There is one group of authors who tried to conceptualize the coping strategies, such as Brunner *et al.* (2012) which distinguish between sufficiency and efficiency strategies of the energy-poor. This means that sufficiency strategies are aimed at making up for the lack of heat or the need to economize, while efficiency refers to smaller investments in the efficiency of the home (Brunner *et al.* 2012). Baker John P. and Berenbaum (2007) refer to the conceptualization of emotion-focused and problem-focused coping developed by Lazarus and Folkman (1984). Lazarus and Folkman (1984) argue that emotion-focused coping is about managing emotional stress, while problem-focused coping is about dealing with the problem and actively trying to solve it. Baker John P. and Berenbaum (2007) try to redefine the emotional coping strategies positively as an active and not passive way of reacting to a problem. Research shows giving some priority to fuel over food which is explained by the greater flexibility of the food over the heating market in the UK (Anderson *et al.* 2012). These concepts about coping strategies are mostly about how households in energy poverty react, but they do not go into detail about how decisions are made between essential needs. Based on grounded theory Bryant and Charmaz (2007), the collected data led to the categorization of coping strategies about the basic need they affect, what they aim to achieve, and the reasons for their practicing. Households reduce their other basic needs to give priority either to comfort or affording their energy needs. The conceptualization tries to develop the argument that at their core the coping strategies of the energy-poor is the tension between basic energy and other basic needs, which brings energy poverty as a phenomenon closer to material deprivation. This understanding of energy poverty as a form of material deprivation is unrecognized in the policies of relevance to energy poverty in the studied countries. Coping strategies are performed by the vulnerable household profiles.

Energy poverty is a form of material deprivation according to Watson and Maitre (2014) for the case of Ireland and relevant for the post-socialistic context based on Bouzarovski and Tirado Herrero (2017b). Since the nature of the studied coping strategies is the same for both countries, it brings a strong case to argue about the correlation between material deprivation and energy poverty for a more general European context. The coping strategies reveal that energy poverty is a material deprivation by the tension around the priorities of the energy and other basic needs in the household. The current most used definition of energy poverty, household lacking a socially and materially necessitated level of energy services in the home (Bouzarovski and Petrova 2015a) captures the trade-off between the affordability (materially necessitated level) and comfort (socially necessitated level) aspects of energy poverty, meaning that an energy-poor household might succeed in paying their energy bills and having the materially necessitated level of energy services, but on the account of living in cold, or heating one room. However, the definition does not capture the trade-offs between energy and other basic needs. The analysis has shown that energy-poor households might succeed in paying their energy bills and having the materially necessitated level of energy services, but also on the account of eating less or poorly. Thus, this sheds light on the complexity of 'satisfying energy needs' as it refers to affordability, comfort, and even access to energy. The analyzed coping strategies and priorities have shown that the energy needs might be satisfied in one regard, but not the other, or satisfied fully but on the account of deprivation of other basic needs at the household level such as food. This finding of the tensions underlying the household decisions of affected households has the potential to redefine energy poverty by putting the tension aspect at its core.

Technology and fuel types are at times at the focal point of household coping strategies. These coping strategies also expose a policy, technology, and social lock-ins which shape energy-poor households' behavior. Most energy-poor households in Austria are located in central forms of heating which has more to do with the socio-demographic profiles of households rather than the type of heating. However, in line with Anderson *et al.* (2012), the heating market is less flexible, such as lack of opportunity to switch off, which explains why Austrian households tend to either emphasize that they need to economize other needs or the must feeling of needing to prioritize their energy bills. On the other hand, since the type of heating is more an individual choice in case of North Macedonia, it is used to reduce energy costs, such as fuelwood, or due to a lack of other alternatives, add to their vulnerability, such as electricity. Both types of heating accommodate more energy-poor profiles.

The chapter offers answers to these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What recognition energy injustices do households with different types of heating experience?

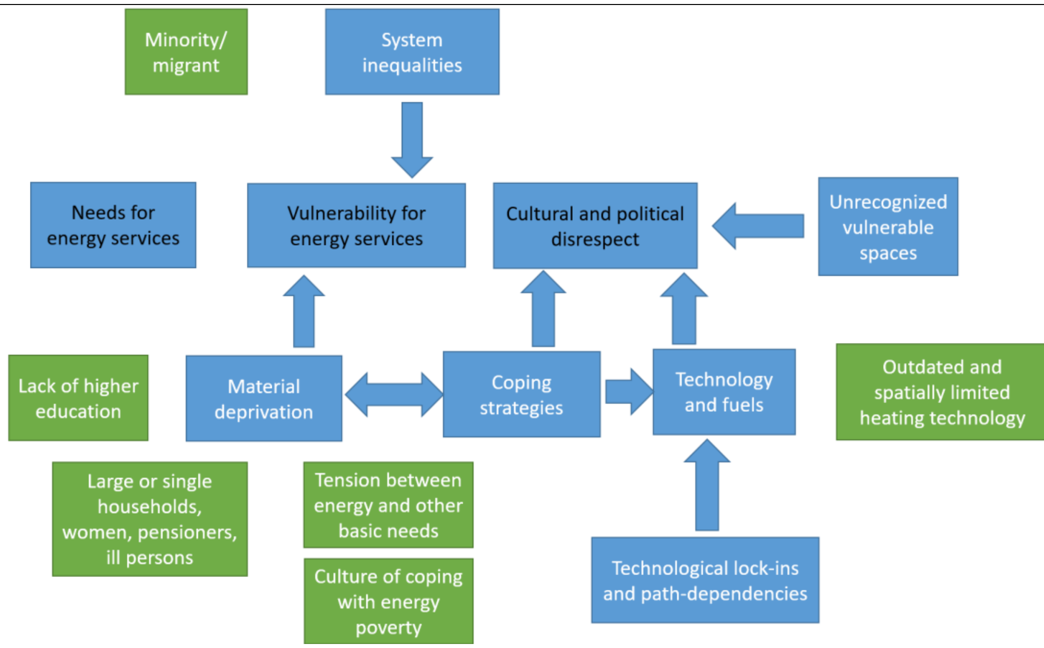
The main argument presented in this chapter is that energy-poor households are materially deprived citizens. This chapter answers the research question about the recognition injustices by arguing that certain socio-demographic features, such as minority/ migrant status, women, lower education, large or single-person households, pensioners, and ill or disabled are the most relevant recognition injustices to energy poverty. This is a result of structural inequalities, special needs, and material deprivation that impact households' vulnerability. Households in energy poverty have to deal with a tension between satisfying energy and other basic needs which argues that they are affected by a more general issue of material deprivation and formulate a distinct culture of coping with energy poverty by the way they balance their household needs. In North Macedonia energy-poor are mostly found in dwellings using fuelwood or electric heat as a result of path-dependencies and lock-ins, but also due to the flexible heat market allowing them to use fuels as a way of coping with energy poverty. In Austria mostly those in energy poverty use central heating which forces them to economize on other needs due to the inflexible heat market. In North Macedonia households affected by energy poverty are related to certain vulnerable spaces, such as more deprived parts of the country.

6.5 Conclusions

This section summarizes the empirical findings and reflects on its theoretical contribution. Figure 31 summarizes the theoretical (in blue) and empirical contribution (in green) of this chapter which upgrades the work of Walker Gordon and Day (2012) about how energy poverty is a recognition injustice. Figure 31 separates the needs and vulnerabilities mentioned by Walker Gordon and Day (2012) and adds several factors which impact the vulnerabilities and the lack of cultural and political respect. System inequalities and material deprivation contribute to the vulnerability of households. Technological lock-ins and path-dependencies discussed in the previous chapter co-shape the choice of technology and fuels. The use of technology and fuels and household coping strategies are culturally and politically not recognized issues. Unrecognized vulnerable spaces as discussed by Bouzarovski and Simcock (2017) also contribute to cultural and political disrespect. Figure 31 also shows the complex relationship between material deprivation, coping strategies and technologies, and fuels. It depicts that coping strategies are a sign of material deprivation and that households in material deprivation develop coping strategies to deal with energy poverty. Technology and fuels are also used as means to cope with energy poverty. The theoretical contribution is that household needs, vulnerability and the lack of cultural and political respect for energy-poor households co-shape energy poverty as recognition injustice, while system inequalities, material deprivation, household coping strategies, technologies, and lock-ins, as well as vulnerable spaces, impact the vulnerabilities and the cultural and political disrespect for these issues.

Figure 31 shows also the empirical findings common for North Macedonia and Austria. These are being a non-majority, female, absence of higher education, pensioner, ill, and large or single-person households as socio-demographic characteristics which make households more vulnerable to energy poverty. Other commonalities are the tension between energy and other basic needs seen in the coping strategies which bring energy poverty closer to material deprivation, and at the same time, these strategies represent a distinct culture of coping with energy poverty. From the previous chapter, outdated and spatially limited technology is also a common feature. According to Yin (2003), common findings from different cases can allow a broader generalization beyond the cases.

Figure 31: Theoretical and empirical upgrade of Walker Gordon and Day (2012)'s depiction of energy poverty as recognition injustice



Source: author upgrading (Walker Gordon and Day 2012)

This chapter upgraded the work of Walker Gordon and Day (2012) by adding which factors shape vulnerabilities for energy services and initiate political and cultural disrespect. It also contributed to the discussion on coping strategies (Anderson *et al.* 2012; Baker John P. and Berenbaum 2007; Brunner *et al.* 2012) by ranking them and explaining the tensions which occur between satisfying energy and other basic needs, and arguing that energy poverty is a form of material deprivation as discussed by Watson and Maitre (2014). It also discussed that this behavior of coping represents a culture of coping with energy poverty. Recognition justice focuses on the socio-demographic characteristics, needs, and behavior of energy-poor households and exposes the systematic and policy lock-ins leading to marginalization of the energy-poor households. It relates to the previous chapter by recognizing the role of technology lock-ins in shaping the cultural and behavioral preferences of households concerning fuel and technology use. The next chapter will discuss the procedural injustices of energy poverty through two different cases reflecting the role of institutions and the rights of energy-poor households.

7. CHAPTER 7: ENERGY POVERTY AND RIGHT TO ENERGY[13]

This chapter is the last one presented as an 'article' by presenting a relevant literature review, after which follows the empirical findings, and a discussion and conclusions at the end. I use in this chapter the conceptual framework about understanding energy poverty as procedural justice as a point of departure for its expansion following the presentation of the empirical results. The empirical results presented in this chapter include two cases of procedural (in)justice based on document collection which follow a story narrative presentation (Moezzi *et al.* 2017). I also answer aspects of some of the research questions. This chapter in sum applies the procedural justice tenet to energy poverty, enhanced by insights from the right to energy concept and more general energy justice discussion on good governance of institutions. It builds up the argument about procedural energy justice applied to energy poverty to be a case of how institutions treat citizens over access to energy services (Stojilovska 2021).

7.1 Introduction

Energy poverty is a procedural injustice when institutions are unjust ignoring the voice and needs of the energy-poor and creating unjust policies that affect negatively households in energy poverty. Energy poverty is influenced by the fairness of the decisions and policies affecting the energy-poor households (Bouzarovski and Simcock 2017; Walker Gordon and Day 2012). Conceptually, this chapter is based on the conceptualization of procedural justice and its application to energy poverty (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012). Energy poverty is a matter of procedural justice regarding the information on energy poverty, energy prices and solutions, the participation in energy, housing, climate, fiscal policies, and the

[13] This chapter was used as a basis to develop this publication: Stojilovska, A. 2021. Energy poverty and the role of institutions: exploring procedural energy justice – Ombudsman in focus. Journal of Environmental Policy & Planning 1-13.

access to legal rights and barriers to challenging these rights (Walker Gordon and Day 2012). Bouzarovski and Simcock (2017) refer to the inadequate recourse to fair decision-making procedures. The question of the process and its fairness is of interest to procedural justice (Jenkins *et al.* 2016). I additionally reflect on the emerging right to energy concept (EPSU and EAPN 2017; Hesselman and Herrero 2020; Hesselman *et al.* 2019; Walker Gordon 2015), and relevant energy justice literature emphasizing the good governance of institutions (Sovacool and Dworkin 2015; Sovacool *et al.* 2017).

The procedural energy justice tenet is mostly about the fairness of the process (Jenkins *et al.* 2016) and the participation in decision-making but is still shaped by the distributive injustices (Walker Gordon and Day 2012). Inclusion of local knowledge, different levels of governance including the local community, greater information disclosure, and better institutional representation are also features of procedural justice (Jenkins *et al.* 2016; Walker Gordon and Day 2012). Burdens need to be shared and communities included in energy decisions (Sovacool and Dworkin 2015). Recent demands at the European level about the right to energy emphasize the role of institutions in securing access to affordable and modern energy services for everyone (EPSU and EAPN 2017). While geographical inequalities are at the core of co-shaping energy poverty, procedural justice is about just or unjust policies, procedures, and institutions and how they include the energy-poor in the policy outcomes with implications to energy poverty.

The literature extends the understanding of procedural energy justice. Gillard *et al.* (2017) understand procedural justice as stakeholder engagement in policy and governance, while McCauley *et al.* (2016) argue that procedural justice is about inclusive stakeholder engagement in a non-discriminatory way and setting up equitable procedures. Regarding more inclusive participation and decision-making, NGOs and ordinary people are seen are new forms of governance that can contribute to better detection of vulnerabilities (Fuller and McCauley 2016; Gillard *et al.* 2017; Walker Gordon *et al.* 2016). The matter of activism around energy justice is differentiated between actions around income equality and low carbon transition regarding the consumption side and matters of environmental justice considering the production side (Fuller and McCauley 2016). Willand and Horne (2018) argue that procedural fairness is also a matter of who has power, influence, and control.

The procedural energy poverty tenet touches upon more general subjects, such as institutions, governance, and policies, unlike the more narrowly defined distributive and recognition justice. Another typology of energy justice elements puts principles such as due process, which includes consideration for human rights, good governance, which is about access to information and fair decision-making (Sovacool and Dworkin 2015), and resistance, which is opposing energy injustices (Sovacool and Dworkin 2015; Sovacool *et al.* 2017). The energy justice concept is also questioning the neo-classical economics thinking and putting forward the just and equitable approach rather than just an efficient one (Heffron *et al.* 2015).

Another aspect that adds to the rethinking of the system is the new right to energy concept which can be considered a legal (human or consumer right) or moral right (Hesselman *et al.* 2019). The philosophical approach is that energy poverty is immoral when prevents people from realizing their needs and functions (Sovacool and Dworkin 2015). The legal view is that energy poverty is a threat to protecting civil rights and fulfilling socio-economic obligations (Christman and Russell 2016), and that right to energy is a derived right based on other human rights, such as housing (Löfquist 2019). Christman and Russell (2016) argue that European Convention rights are infringed in case individuals are subject to extreme conditions of poverty, including energy poverty. Demski *et al.* (2019) add that energy is a basic need that needs protection from the marketization of energy and rising energy prices. The discussion comes down to whether energy is considered more than just a commodity (Teschner *et al.* 2020; Walker Gordon 2015) rethinking the institutional responsibility to households in energy poverty. The right to energy concept has been used by organizations as an overarching solution to eradicating energy poverty in Europe. They demand the prohibition of disconnections, regulated prices for households, special tariffs for low-income households, and public funds for energy efficiency in low-income households (EPSU and EAPN 2017).

This chapter shows the function and role of relevant institutions involved in policy-making, energy regulation, and energy supply, in creating just or unjust policies with relevance to energy poverty. Furthermore, it shows the policies of entrapment as a result of technological path-dependencies that lock households in energy poverty. The chapter clarifies that the key aspect which links access to information, participation in decision-making, and access to legal remedies is how the relevant institutions communicate with energy-poor households and other stakeholders and whether they are willing to build good communication practices. It adds to the previous two chapters which showed how infrastructure and technological lock-ins affect energy poverty and households' use of energy and technology, by focusing on the role of institutions and the policies of entrapment as a result of the lock-ins. The chapter's contribution is in the empirical findings of energy poverty as a procedural injustice that energy-poor households experience in Austria and North Macedonia. Theoretically, the chapter adds to the energy justice and energy poverty literature as started by Walker Gordon and Day (2012) by explaining the role of institutions, their policies, and their communication with households in energy poverty which lead to solutions or further entrapment in energy poverty.

The chapter offers answers to these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What procedural energy injustices do households with different types of heating experience?

The chapter uses the empirical data from North Macedonia and Austria made of interviews with stakeholders and collected documents about Wien Energie Ombudsman and the Macedonian energy protests. It focuses on two illustrative cases showing ethnographies of the relevant institutions and policies– the Macedonian energy protests and the Wien Energie Ombudsman representing two different ways of communicating with energy-poor households in both countries, showcasing unjust and just institutions. The cases are presented one by one in a narrative storytelling style as discussed by Moezzi *et al.* (2017). Drawn on the key literature shaping this chapter (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012), energy poverty is a procedural energy injustice when there is insufficient participation in the decision-making and unfair policies. The main research question is discussed in this chapter through the point of procedural energy justice and how policies and stakeholders make households vulnerable (or not) to certain fuels and types of heating.

The chapter is organized in a way that after the introduction in section 1, section 2 is about the Macedonian case of energy protests. It has three subsections, the first explaining the protests and the policies leading to the protests, the second discusses the arguments presented in the Parliament about the draft law resulting from the protestors' demands, and the third section additionally explains the reasons and policies of entrapment leading to the protests. Section 3 is about the Austrian case of the Energy Ombudsman. Its first subsection explains the reasons behind the establishment of the Wien Energie Ombudsman, the second shows the profile of the energy-poor detected by the Ombudsman, while the third subsection shows the broader institutional set-up which enables support of vulnerable consumers, and a right to energy-thinking. Section 4 is the discussion, and section 5 is the conclusion.

7.2 Macedonian energy protests

The Macedonian case focuses on the 2012-2013 energy protests which show the direct and indirect reasons for the dissatisfaction of citizens with the increasing energy prices, and how these increases constitute an unjust regulation established by unjust institutions. This section will first explain the development of the protests to discuss the demands of the citizens and the legal and economic environment in which the protests took place. Then, it will discuss the actions of the relevant institutions regarding the protest and its outcome. This section shows how the energy protests were a weak, but united voice of citizens which felt ignored by the instructions and forced to live at the crossroads of market restructuring which further impoverishes the already high share of people stricken by energy poverty and material deprivation. It will discuss how this movement came to be in the context of a monopolized energy market in predominantly private ownership with a weak social welfare protection system and politicized institutions which see their constituents first and foremost as energy consumers who need to keep the energy system stable.

7.2.1 Protesting against policies of entrapment

The massive energy protests took place as a result of the increasing energy prices. They began in August 2012 to express dissatisfaction with the increase of the prices of district heat, oil, and electricity, leading to additional impoverishment of citizens (Aman n.d.). The reason to start in August is that the Regulatory Commission decides about the energy prices at the end of each July. On the 25th of July 2012, the Regulatory Commission increased the electricity price by around 18% for households (Energy_and_Water_Services_Regulatory_Commission 2011c, 2012b). The district heat price also increased for households by around 15% as decided on the 27th of July 2012

(Energy_and_Water_Services_Regulatory_Commission 2011b, 2012a). The organizer of the protests was the citizen initiative AMAN which invited all citizens to join the protests, while meetings took place in an open public space area in the center of the city (Aman n.d.). Their motto shows the awareness of the organizers about energy poverty, material deprivation, the energy transition, and the structure of the energy system:

"*To achieve a decent living standard for all citizens of the Republic of Macedonia. This means that the electricity prices, oil/gas, and heating must be made appropriate to the standard of living of the majority of the people of Macedonia. If it is so that we must pay for electricity, heating, and gas (some of the basic needs to be able to function in the modern world) the state should make it so that everyone will be able to do so, without cutting back on other basic needs such as education, health care, food and so on. We believe the most appropriate way to achieve this is the state to invest in domestic renewable and clean energy sources like solar, geothermal, wind power, etc. which must not be owned by a private corporation*." (Aman n.d.).

The protests took place in several cities showing a large body of concerned citizens about paying their energy bills. The initial target of the protests was the Regulatory Commission which formulates the energy prices. The photos below show the signs of the protesting citizens criticizing the behavior of the Regulatory Commission, such as "*Who is regulating the Regulatory (Commission)?*" (left photo on Figure 32); and "*Get up tomorrow earlier, come back ever later in the evening to wash on cheap (electricity tariff)*" (right photo), the latter is reminiscent of a famous lyric by a Macedonian poet about the difficult life and labor conditions of tobacco workers. Important to clarify is the cheap electricity tariff which was available during the daytime in times of communism and many years after, was used citizens, and especially pensioners and unemployed people, staying at home during the day, as a measure to keep their energy bills low.

Figure 32: AMAN protests

Source: (Aman n.d.)

AMAN's posters emphasized the values of social justice and citizens' activism (Figure 33). The poster on the left says: "*Stop against the increase in prices. You have taken our bread (=livelihood). Social justice. Power of the people. Enough with the silence*." The poster on the right announces one of the bigger protests which took place on the 21st of August 2012: "*Protests against the continuous increase of prices of electricity, district heat and oil. Time to say – it is enough*." The protests lasted over 5 months with over 10 000 citizens protesting throughout the period (Aman n.d.). The main supporters of this initiative were civil society organizations working on labor, human rights, and poverty issues, and some with leftist orientation (Aman n.d.).

Figure 33: AMAN's posters

Source: (Aman n.d.)

The citizen initiative representatives were strongly claiming their independence from any political party since the ruling party stated that they are a result of the actions of the opposition. One of the representatives of AMAN gave this statement for the media: "*I do not belong to any political party. We are a citizen initiative, we don't have a leader, but we have awareness and strength to be activists about the rights of the citizens*." (Aman n.d.). Emphasizing that political independence is very important in North Macedonia because of the common practices of nepotism and clientelism in the country. Important to mention is that in 2012 North Macedonia was governed by the government of Nikola Gruevski whose governance a few years later was referred to by the

European Commission as state capture due to the political dependence of institutions (European_Commission, 2016, European_Commission, 2015).

The increase of the energy prices in August 2012 which started the energy protests was just the last drop for many citizens. The country is affected by widespread material deprivation and a high unemployment rate. The at-risk-of-poverty rate in North Macedonia was 22.2% in 2017 (State_Statistical_Office, 2018d), and even higher back in 2012 is 26.2% (State_Statistical_Office 2014). The 2017 unemployment rate in the country was 22.4% (State_Statistical_Office, 2018c), while the unemployment in that period in 2012 was 38.8% (State_Statistical_Office 2012). 36.9% of the households had arrears in 2018, and in 2012 the share was 38.9% (Eurostat, 2019a). Consumers are at the same time 'entrapped' to use the electricity supply from a monopoly in private ownership and a district heat from two possible suppliers which cover different parts of the capital, the larger being in private ownership. The electricity market liberalization for a household is very recent and not fully implemented. At the same time, no other significant efforts were made in the country to build a gas infrastructure to supply households or refurbish the household sector leaving households to develop individual heating and housing solutions (Stojilovska 2020). Furthermore, the feed-in tariff to increase the share of renewables supports only companies but has increased the electricity price which is paid by all consumers including the vulnerable (Stojilovska 2018).

7.2.2 Parliament debate about the citizen initiative

This initiative resulted in a draft law to amend the energy law signed by 13 169 people (Draft energy law materials) and was presented in front of the Parliament. The initiative demanded to allow releasing the disconnected consumers from the obligation of paying any reimbursement for district heat, gas and electricity if disconnected and introducing a cheap daily electricity tariff of 3 hours between 10 am and 6 pm (Draft energy law materials), but it did not succeed. Before submitting the draft law, for months people were protesting every week on the streets and in front of the Regulatory Commission which determines the energy prices and which was deaf to the pleads of the many dissatisfied consumers. This draft law went to three levels of Parliament discussion, the first one was on the 7th of February 2013 when the Parliament's Committee on Economic Affairs discussed it, then on the 11th of February the Parliament's Legal Committee discussed it, and finally, the Parliament discussed it on the 13th of February (Legal Committee, Economic Committee, Parliament debate materials). All three discussions ended with the conclusion that the majority of members of Parliament do not support the adoption of this draft law (Legal Committee, Economic Committee, Parliament debate materials). On all three occasions, members of AMAN were present, also relevant institutions, such as the Regulatory Commission, the Energy Agency, and the Ministry of Economy, as well as members of the ruling party of VMRO and its coalition, the ruling Albanian party DUI, and the Albanian opposition party DPA (Legal Committee, Economic Committee, Parliament debate materials). The members of the ruling party voted against the draft law, the Albanian ruling party DUI was reserved, while the Albanian party in opposition DPA supported the draft law (Legal Committee, Economic Committee, Parliament debate materials). The Macedonian opposition party at that time SDSM boycotted the Parliament since many of its members were forcefully removed from the Parliament a few weeks earlier when the annual budget was voted, calling that day a Black Monday referring to a black day for democracy.

The following sections will analyze the different arguments and positions of the various participants in this Parliament's debate. The arguments are organized as legal, market, social, cultural, and political. Additionally, some arguments align with the concept of the right to energy.

The key legal discussion was whether the electricity price can be determined by law. This was one of the key arguments of the side against adopting the draft energy law stating that the electricity price is determined by the Regulatory Commission which is an independent body and is not determined by law (VMRO and Ministry of Economy, Legal Committee; VMRO, Economic Committee; VMRO, Parliament debate materials). AMAN responded that the legal basis is the energy law which states that the Parliament checks the work of the Regulatory Commission (AMAN, Economic Committee materials). This shows the views of the decision-makers against the draft law in line with the neoliberal open market principles.

A big focus of the debate was about the market aspect, especially concerning the methodology for determining the electricity price, the effect of the electricity import, and the structure of the energy market. The defenders of the draft law pointed out the monopoly position of the energy companies. The main goal of the draft law was the protection of the economic and social rights of citizens through protection from energy monopolies (Draft energy law materials). AMAN pointed out that the district heating company is in a dominant market position with no pressure to improve its services, opening the option to misuse its dominant position (AMAN, Economic Committee materials), and limits the right of choice of citizens, putting those in collected buildings with district heating in an unequal position with other district heating consumers (AMAN, Parliament debate materials). AMAN also considered that when defining the energy price, the Regulatory Commission does not take into consideration the rights of consumers and their protection from energy monopolies (AMAN, Parliament debate materials).

The key market argument of the side against the draft law was that the introduction of the cheap daily electricity tariff would increase the price of electricity. The elaboration is that North Macedonia imports electricity due to a lack of sufficient domestic production (VMRO, Parliament debate materials). One example was during a very cold period of 8 days in February 2012 when during the peak more than 4 Million EUR were spent on electricity import due to a shortage of electricity and based on the methodology of the Regulatory Commission leading to an increase of the electricity price (VMRO, Parliament debate materials). The cheap daily electricity tariff is a problem since imported electricity is the most expensive to buy during the day since electricity is most used during the day and a cheap daily tariff would mean an increase of imported electricity bought at a higher price (VMRO, Economic Committee; VMRO, Parliament debate; Regulatory Commission, Legal Committee materials). This argumentation has shown differentiating views between market-focused policies of the decision-makers against the draft law and a more right-to-energy view of the defenders of the draft law.

AMAN and the present opposition in the Parliament elaborated on the social arguments stating that the widespread material deprivation is impeding households' ability to pay their energy bills. AMAN argued that the increase in energy prices affects the prices of other existential products (AMAN, Legal Committee materials). Both AMAN and DPA mentioned crucial social indicators, such as the high unemployment rate, poverty rate, low social welfare support, and low energy poverty subsidy as examples of why the increase of energy prices affected a large share of the population while there are no adequate measures to protect them (AMAN, Economic Committee; DPA, Legal Committee; DPA, Parliament debate materials). The side against the law did not address these social arguments and kept their argumentation about the market rules.

There were a set of arguments presented which explained that having the cheap daily tariff with years in the past and the upbringing contributed to developing a behavior around the use of energy embedded in the culture of the population. The current cheap electricity tariff (at the time of this event and at the time of the data collection) started at 10 pm which according to AMAN impacts their habits as they are stimulated to do laundry, cook, and bathe after 10 pm, affecting their work efficiency the next working day (AMAN, Parliament debate materials). A member of DUI explained the path-dependencies and education around saving energy: "*They do not ask for anything exclusive or luxurious, but they simply demand a return of a right which the citizens of the Republic of Macedonia used it in the past, for years and decades. We are here members of Parliament and I agree that we come from the middle class and I think we have all were taught of the logic that we need to economize electricity as much as possible. I still remember my mother saying while growing up, she raised us with the same logic, to turn on the boiler and the washing machine during the cheap tariff, and I think that is a really good education because makes us a good economizer of electricity*." (DUI, Parliament debate materials). The cultural discussion is about the habits of citizens to economize energy and that the current market rules prevent them from doing that.

The draft law debate brought to light a set of political arguments about potential political influence in the formulation of the Regulatory Commission's methodology, the commitments towards the EU and the Energy Community, the democratic capacity of allowing direct democracy, and the transparency of institutions. Both AMAN and DPA raised the question of the Regulatory Commission's methodology stating that not all costs of the energy companies should be covered by the electricity price (DPA, Legal Committee; AMAN, Economic Committee materials). DPA member explained that the operative costs of the electricity generation and electricity transmission companies which the Regulatory Commission accepts, have been increased by 346% from 2010 to 2012, while the increase of electricity import is only 6.9% (DPA, Parliament debate materials). DPA member claims that the increase of these operative costs is due to the employment in these companies of members of the ruling political parties and new expensive vehicles (DPA, Parliament debate materials). These arguments raise issues of nepotism and regulation of monopolies in the context of the previously mentioned state of political entrapment of a country.

Some political arguments on the side against the draft law were piggybacking on the EU as an authority by stating that the abolishment of the cheap daily electricity tariff is an obligation coming from the EU and the Energy Community. Member of the VMRO coalition stated: "*The cheap tariffs if we want to become a member of the European Union, we should forget because they do not exist*." (VMRO, Parliament debate materials). AMAN has used the same obligations to criticize that the electricity market has not been fully liberalized although it is an obligation stemming from the Energy Community membership (AMAN, Economic Committee materials). The democratic capacity of the country to organize an initiative of direct democracy was discussed. The 13 169 signatures were collected in barely 30 working days while members of AMAN faced threats, obstacles, and pressure, and spent a lot of money and time to enable the collection of signatures (AMAN, Parliament debate materials). AMAN representative said that it speaks for 13 169 citizens and asks whether any of the members of Parliament have been elected with that many voters (AMAN, Parliament debate materials).

Some of the discussions echoed the right to energy concept. AMAN representative stated: "*Our living standard is not adequate to the bills we get from EVN* (the single electricity supplier). *Macedonia has one of the lowest salaries in the region. We want to be responsible citizens, but we cannot pay our bills. With this increase, we are aware that the electricity price will continue to increase, we question how we are doing to survive till the end of the month. I speak about people which are in no condition to pay their bills. Their dignity is affected*." (AMAN, Parliament debate materials). To this, the representative of VMRO replied: "*But the question is: who does not have money, will not have money for the entire bill, not only for the cheap tariff from 1 to 4 pm.*"

(VMRO, Parliament debate materials). AMAN's thinking resonates with the suggestion to reject neoclassical economics thinking and put forward equity over efficiency (Heffron *et al.* 2015). Interesting is the assessment of the role of the key institution – the Regulatory Commission –is viewed to be in function of the government and the energy monopolies by DPA, and AMAN thinks that it should protect the energy consumers (DPA, Legal Committee; Regulatory Commission, Economic Committee; Draft energy law materials). The Regulatory Commission states that its role is protecting the energy system (DPA, Legal Committee; Regulatory Commission, Economic Committee; Draft energy law materials).

7.2.3 Protest as a way of establishing communication with institutions

This section will additionally explain the reasons which forced a large group of citizens to protest and to demand law amendments to make their energy bills affordable. The section will show the entrapment of citizens by the electricity and district heating monopolies, acting with a lack of consideration for the living situation of their many consumers. It will also show that the decision-makers did not do much to prevent the negative effects of the increasing energy prices on citizens' livelihood.

One of the draft law demands was not paying the basic fee for district heating when disconnected. After the increase of the district heat price, there has been a set of massive disconnections so that in 2013 there were around 16% fewer consumers compared to 2010 (Energy_and_Water_Services_Regulatory_Commission 2011a, 2014). There are two district heating companies, each supplying a different part of the capital, the smaller is in public ownership and the larger is in private. When one disconnects from the private supplier, one has to pay the basic fee for using passive energy (valid at the time of this event). As discussed in the previous chapter, Macedonian households have developed a cultural subsistence level of satisfying their energy needs at which core lies their need to control their energy resources and costs. The inability to economize and inability to control the time of heating and indoor temperature is prevented due to the dominant district heat company's fear of losing profits knowing this cultural preference for subsistence. It presents a cultural clash of business interests and coping strategies of materially deprived households. The dominant district heat company is against individual apartment bills since the individual heat meters enable energy savings, but their use is not economically justified since with individual heat meter people would switch the heating off when going to work, causing peaks when turning it again on (Interview with a representative of BEG, 2017). The management of the dominant district heating company changed at the beginning of 2013 and connected households are more satisfied since the district heat price was reduced in the following years (Skopje survey dataset). About 8% of the 20% disconnected district heat consumers reconnected after the management change (Interview with a representative of BEG, 2017).

As seen from the previous sections, the increase in the electricity price seems to be the biggest issue. Households reported that the electricity bill is the biggest energy expense (North Macedonia interview dataset). There is a single electricity utility that is in private ownership. It tends to sue consumers with arrears and employs an enforcement agent to collect debts (Interview with a representative of EVN, 2017). This is so since after 12 months the bills get the status of old debts and need not be paid (Interview with a representative of EVN, 2017). The Ombudsman raised the issue of disconnections from electricity without warning even after only one unpaid bill and the subsequent condition set by the utility to charge the debt in full along with a reconnection fee, causing irremediable damage to households (Ombudsman 2011). In case a consumer has debts, often to the electricity utility, an enforcement agent has the right to enforce the payment of the debt by blocking the consumer's account or claiming its property. The law, however, protects social welfare recipients from enforcement based on their status, and also the enforcement agents cannot enforce more than one-third of the consumer’s income (Ombudsman 2011). Many enforcement agents disregard these legal provisions and end up threatening the existence of the consumers (Ombudsman 2011).

The electricity price has been increasing in line with the opening up of the market. However, a few years ago the electricity liberalization for households in North Macedonia was postponed till 2020 with the excuse to prevent the increase of electricity prices affecting the households and was criticized by the Energy Community that this move is protecting the monopoly of the single electricity supplier (Blazevska, 2014). Thus consumers still do not have a real opportunity to choose a supplier, as the efforts to liberalize the electricity sector for households are only recent, via the new Energy Law passed in May 2018 (Stojilovska 2020). This leaves space for misuse of the electricity monopoly. The so-called collective electricity disconnections are a clear indicator of the misuse of the single electricity utility's monopoly position. Over the years in neighborhoods where there is a high concentration of non-payers of electricity, the electricity utility would disconnect not only the consumers which were not paying but also those paying (Ombudsman 2011). In 2008 alone, there were 10 groups of collective disconnections affecting from 170 to 2100 consumers, and a total of 9510 (Energy_and_Water_Services_Regulatory_Commission 2009). The Ombudsman concludes that these collective disconnections threaten basic human rights (Ombudsman 2011).

The social welfare system and social support for vulnerable consumers in North Macedonia are limited and inadequate. The monthly social welfare in North Macedonia is only 40 EUR for households without any income which is low and also gets cut if the household receives one-time income from other sources (Interview with a representative of the Platform against poverty, 2017).

There is a 16 EUR worth of monthly energy poverty subsidy for social welfare recipients after having paid the last energy bill (Official_Gazette 2018b). This subsidy is problematic because it is reimbursement and can put households at risk if their payment is delayed (Interview with a representative of the Platform against poverty, 2017). The Ombudsman alerted that the current social protection system does not respond to the needs of the citizens at risk and as a result, a social welfare recipient family living in a bad illegal dwelling was affected by fire killing three children (Ombudsman 2011). The Ombudsman has also stated that the social welfare does not help the affected out of poverty and does not enable them a normal life as they can barely pay for food and clothes, let alone for energy forcing them to live without basic conditions for life (Ombudsman 2011). The country is a social state but does not implement this principle in reality (Ombudsman 2011). The Ombudsman has also recommended an increase in the amount of the energy poverty subsidy and the scope of its target group (Ombudsman 2011).

7.3 Austrian Energy Ombudsman

The Austrian case focuses on the establishment of the Ombudsman within the state-owned energy supplier in Vienna Wien Energie and their work to deal with consumers unable to pay their energy bills. It explains the reasons for this establishment, the profile of the affected consumers, the networking of institutions that enabled the work of the Ombudsman, as well as the concrete work with affected consumers. This case shows the response of this establishment to a social issue of inability to pay energy bills, and how it constitutes a just institution. The section first explains the reasons which led to the establishment of the Ombudsman, which was based on a common response by several instances. Then, it scans the work of the Ombudsman, such as their criteria of affected consumers, the profile of these affected, and the response of the Ombudsman. The section shows how the relevant institutions led by the energy supplier united to accommodate the needs of consumers in poverty. It discusses how the work of the Ombudsman was established in the context of a state-owned energy market with a strong social welfare system and devotion to tackling energy poverty, and how it supports consumers in having a dignified life in which they can afford their energy bills.

7.3.1 Establishment of the Wien Energie Ombudsman

The Austrian state-owned energy supplier in Vienna Wien Energie has begun to build up a team to answer the requests of its clients who were facing problems paying their energy bills. The interviewed representative of the Ombudsman explains the beginnings: "*We have begun in 2011 to build our team because we experienced to get more and more requests from social institutions directed to Wien Energie with special questions, and we could not offer solutions which we give to a normal customer, and the access and cooperation were difficult because two different worlds meet – the economic and the social. And we did not have sufficient know-how about both aspects. We did not have the know-how of a social worker, such as what does one do with customers, and on the other side, how does one deal with economic subjects in the social area. Then, it was decided to build a customer unit here, the Ombudsperson, and to employ social workers. That is me and another colleague, we started as two, and now we are five. Out of which two are social workers*." (Interview with Wien Energie Ombudsman representative, 2017). It shows the awareness of the institution that the market has also a social side that needs to be addressed.

One of the key aspects of the success of the Ombudsman's work is in its good networking and cooperation with other relevant institutions, especially social institutions, about the profile and challenges of consumers who cannot pay their energy bills: "*We have begun intensive networking, to contact single social institutions and to clarify who they are, what do the social institutions see as difficult social cases, which are their clients which need our support or special care from the* *energy supplier. We have found out that people have multiple problems and in only a few cases they have a single problem*." (Interview with Wien Energie Ombudsman representative, 2017). The interviewee from the Ombudsman also pointed out that affected consumers can find out about them through the social institutions, and that the cooperation with the social institutions reduces the bureaucracy since they consumer does not have to prove that they are facing affordability issues to be considered by the Ombudsman (Interview with Wien Energie Ombudsman representative, 2017).

The Ombudsman at Wien Energie offers payment in installments, reduction of certain costs, such as for disconnection and warning, fast reconnection in case of need, such as for dependents on care, payment through pre-payment meters, as well as the inclusion of the social services in the development of solutions (Wien Energie Ombudsman materials). In some cases, they might even prevent a disconnection (Interview with Wien Energie Ombudsman representative, 2017). When working on solutions, it is crucial to consider the entire living situation of the consumer: "*For example, when a customer is at risk of eviction in a very affordable apartment, we would not make additional pressure when we find out from social institutions that the person is trying to keep an apartment, we try not to ask to get our money back so soon, the debts, we say, it is in our interest that this person, this family can live in an affordable apartment and when that is settled, then we can go and regulate the debts towards Wien Energie*. " (Interview with Wien Energie Ombudsman representative, 2017). The Ombudsman also emphasized that refugees in Austria come from a different culture and they have problems with energy so Wien Energie can help them deal with the new situation they are in (Interview with Wien Energie Ombudsman representative, 2017). It shows that the Ombudsman works on developing solutions for consumers in line with neoliberal principles, that everyone pays their energy costs.

7.3.2 Voices of the affected energy consumers

The key achievement of the Wien Energie Ombudsman is the development of the criteria for "a severe social case". This notion is broader than energy poverty and takes into consideration the entire life situation (Interview with Wien Energie Ombudsman representative, 2017). A severe social case is a customer who fulfills any at least 3 different sub-criteria out of 6 main criteria (income, illness, housing situation, family situation, debts, and life crises) in Table 14 (Interview with Wien Energie Ombudsman representative, 2017). It can be seen that the definition is very broad, and not only considering issues with income and housing deprivation, but also with various life crises (even a refugee status), and health problems.

Table 14: Main and their sub-criteria defining a severe social case according to Wien Energie Ombudsman

Main criteria	Sub-criteria
Income	-Persons on the guaranteed minimum income or minimal pension -Long-term unemployed person eligible for support from labor market authorities -Owner of a card of the City of Vienna with discounts for persons on minimal income or minimal pension -Household which energy costs are more than 10% of the household income -Person not entitled to the guaranteed minimal income -Person which receives support for child care and allowance
Illness	-Household with a member receiving attendance allowance -Person on life-support equipment -Person with disability (certificate of disability) -Chronically ill person (e.g. cancer)

	-Person with appointed special guardian -Person with psychological illness -Person with current addiction
Housing situation	-Former homeless person or family who have been taken care of by an institution -Person at the risk of eviction
Family situation	-Single parent with children required to attend school -Single mother-to-be or family-to-be with children required to attend school
Debts	-Rent arrears -Energy arrears or disconnection or risk at disconnection from Wien Energie (electricity/heat) -Person in debt/person under execution (attachment) -Person working on paying back debts
Life crises	-Separation/divorce, death in the family -Domestic violence (restraining order for domestic violence) -Job loss -Person on probationary service -Person with a refugee status -Person with an ongoing asylum procedure
Source: Wien Energie Ombudsman materials	

An additional impression from the Ombudsman is that often the severe social cases live in social housing, in the old dwelling from the 1950s of older and inefficient dwellings, and usually not in property of the affected persons (Interview with Wien Energie Ombudsman representative, 2017). The in-house statistics of the Ombudsman showing that 58% of the severe social cases are women and 68% are single-person households, while in 40% of the cases they have a minor in the household (Wien Energie Ombudsman materials). 40% of the cases have a maximum of 827 EUR, while from the 6 main criteria, the most relevant are debts (46%), followed by income (30%), and family situation (15%) (Wien Energie Ombudsman materials). The Ombudsman representative explains that on one hand one crisis can suddenly happen to put people into a very difficult situation, but also there are set of personal and circumstantial lock-ins: "*Today you have a job, tomorrow you are unemployed*." (Interview with Wien Energie Ombudsman representative, 2017). It also shows that these criteria and the experience the Ombudsman collects come from directly working with the affected consumers or the social institutions.

To concretely illustrate their work with their clients – the severe social cases, Wien Energie Ombudsman provided a few real cases of clients' requests and the response of the Ombudsman. I have selected one to show it in its entirety in Table 15. We can see the multiple vulnerabilities the client experiences – mental health issues and no access to adequate energy services. It shows that the Ombudsman does not offer an 'easy' solution, such as allowing the debts to be forgiven, but works on developing complex and sustainable solutions in cooperation with the consumer and social institutions which would allow the consumer to pay their bills, but concerning their current life situation. For example, district heating was installed for free and this was enabled in cooperation with social and health institutions. The client was enabled to access an adequate level of energy services and to pay their running energy bills.

Table 15: Real example of severe social case's request and the response from Wien Energie Ombudsman

Client's request	I have a psychiatric illness and I am often treated by a doctor. In the past, I have tried more than 20 times to commit suicide and for one period I was given a custodian. I am handling my obligations now, as well as I can. Due to not working the heating system and the resulting urgent situation, I have contacted the office of the Vice Mayor Mrs. Brauner asking for help. I was referred from there to the Ombudsman Wien Energie with the request for help. Based on the information of the installation assistant, the heating system can be fixed at an expensive rate, but because of the age of the heating, that does not pay off. In my dwelling unit, we all have access to district heating, which would be my dream, to have once again hot water and a warm home. For many years I have not had a full bath. What is normal for many, is at the moment an unaffordable luxury for me. I still want to pay my bills to Wien Energie. Despite my illness, I am a responsible client. What one in such a situation can hope for help from the Ombudsperson of Wien Energie?
Ombudsman's response	The solution of the Ombudsman: Mr. S's request to Ombudsman Wien Energie was supported. It was looked for a sustainable solution that would include in the future affordable energy supply. Regarding the discussions with the district heating unit of Wien Energie, access to district heating was offered with an opportunity for installation of the district heating for free. The financing was organized in cooperation and the help of the psychic-social services of Vienna, social services, and the district heating unit of Wien Energie. Mr. S has financed his financial contribution for this solution. He wanted and was convinced he is a 'good' customer. He pays regularly his bills. He was extremely happy about the improvement of his quality of life.
Source: Wien Energie Ombudsman materials	

7.3.3 Enabling environment for fighting energy poverty

This section will additionally explain the favorable institutional environment for the establishment of the work of the Ombudsman and the set of social institutions that supported its development and contributed to serving the vulnerable citizens unable to pay their energy bills. It will also mention the awareness of the state-owned energy supplier that it exists to serve all kinds of citizens.

Wien Energie is a state-owned energy utility supplying district heat, gas, and electricity in Vienna. Their Ombudsman representative has a high awareness about its obligation to serve all consumers: "*It is not the goal to have a consumer who will not be able to buy energy anymore. We have to participate, to know the consumer and what the options are*." (Interview with Wien Energie Ombudsman representative, 2017). The Ombudsman thinks it is crucial for them that they are state-owned as they would not be able to take care of their consumers if they were not (Interview with Wien Energie Ombudsman representative, 2017). "*We work on the open market, but we work for the citizens*" (Interview with Wien Energie Ombudsman representative, 2017). The Ombudsperson thinks there would be protests in case they do not care about their customers (Interview with Wien Energie Ombudsman representative, 2017). From April 2011 till March 2017 (interview) the Ombudsman processed 17 000 requests from social institutions and clients referring to 12 000 households (Wien Energie Ombudsman materials).

The collaborators of the Ombudsman have praised their work. The Ombudsman had 270 networking meetings with private and public social organizations (Wien Energie Ombudsman materials). The Red Cross has stated: "*In our line of duty it is essential to react fast and in a sustainable way to the problems of the persons seeking help, to prepare individual and adequate solutions. The Ombudsteam has become for us in the last few years one of the most important and most reliable partners because they manage to deal with people in urgency in a brave, non-complicated, and effective manner.*" (Wien Energie Ombudsman materials). Social services Suchthilfe Wien said: "*Since the existence of the Ombudsperson, the debts to Wien Energie are regulated significantly more efficient. The good accessibility, such as the opportunity for direct and socially responsible agreement for the return of debts are characteristics of the cooperation with them.*" (Wien Energie Ombudsman materials). Psychological counseling for addicts Dialog explained: "*The Ombudsperson is an important service for materially underprivileged people which is rare to find in companies*." (Wien Energie Ombudsman materials).

There is a good social welfare system in Austria in place with a set of subsidies and support for vulnerable people and consumers. In Austria, there is also a subsidy for heating which amounts to 210-215 EUR per year (Interview with a representative of E-Sieben, 2017). The Austrian Ministry of Social Affairs supports vulnerable consumers who are unemployed, people at risk of poverty, persons with a certain limit of income, and care recipients which are exempted from paying the broadcast fee and contribute less to the eco electricity tax (Interview with a representative of the Ministry of Social Affairs, 2017). Wien Energie is not the only utility that has developed a unit to help its customers. Linz AG, another energy supplier, has a red telephone for consumers (Interview with a representative of LINZ AG, 2017). Linz AG has introduced a longer period before disconnection and also a disconnection 3 weeks before Christmas is forbidden (Interview with a representative of LINZ AG, 2017). Electricity and gas prices in Austria have been liberalized since 2001 and 2002, respectively (Interview with a representative of the regulator E-Control, 2017).

7.4 Discussion

Procedural energy justice is about the fair process (Jenkins *et al.* 2016) and fair decision-making (Bouzarovski and Simcock 2017). Energy poverty is a procedural energy injustice when there is a lack of information on energy poverty, energy prices and solutions, lack of participation in energy, housing, climate, fiscal policies, and lack of access to legal rights and barriers to challenging these rights (Walker Gordon and Day 2012). Following this conceptualization, this chapter inspected energy poverty in Austria and North Macedonia as a procedural injustice by discussing two cases about (un)fairness of policies and institutions which impact energy-poor households. It agrees that procedural injustices are shaping and are shaped by distributive injustices (Walker Gordon and

Day 2012) while emphasizing the fairness of the decision-making processes (Bouzarovski and Simcock 2017). This chapter shows the function and role of relevant institutions involved in policy-making, regulatory, or energy supply, in creating just or unjust policies with relevance to energy poverty. Furthermore, it shows the policies of entrapment as a result of technological path-dependencies that lock households in energy poverty. The chapter clarifies that the key aspect which links access to information, participation in decision-making, and access to legal remedies is how the relevant institutions communicate with energy-poor households and other stakeholders and whether they are willing to build good communication practices. It also shows how relevant institutions and their actions emphasize the right to energy concept (EPSU and EAPN 2017).

The Macedonian case focused on the 2012-2013 energy protests which were triggered by the increase in energy prices. This movement came to be in the context of a monopolized energy market in predominantly private ownership with a weak social welfare protection system and politicized institutions which see their constituents first and foremost as energy consumers. Consumers are to a large extend suffering from material deprivation and energy poverty, thus are in a need of an affordable energy source. The implementation of the liberalization policies, such as through the increase of the electricity price, negatively affects a large size of the population. The weak institutional system embedded in path-dependencies is unable to deal with the impacts of the increasing energy prices on citizens by enforcing a neoliberal approach of 'energy is a commodity' and 'efficiency over equity' which according to Heffron *et al.* (2015) needs rethinking in the context of energy justice. An institution can be either mute to citizens' demands, or even enforce policies of punishment, such as suing consumers with arrears and employing an enforcement agent to collect debts. This increases the mistrust of citizens towards the decision-makers, the regulator, and utilities, which as seen as unjust, especially in a case of political and monopolistic entrapment of citizens with no other relief policies or solutions. Out of all energy sources, electricity is the biggest issue in North Macedonia since its price has been constantly increasing and in an absence of other sources for heating, such as gas, it increases the energy vulnerability of citizens. The institutions which enforce this, the single electricity supplier, the regulatory body, and the decision-makers in the energy area, are seen as unjust.

The Austrian case focused on the Ombudsman within the state-owned energy supplier in Vienna Wien Energie and their work to deal with consumers unable to pay their energy bills and how it constitutes a just institution. The work of the Ombudsman was established in the context of a state-owned energy market with a strong social welfare system and devotion to tackling energy poverty, and showing support of consumers to have a dignified life. It shows the pro-activeness of institutions from different thematic areas to develop networks of exchange and cooperation to build up expertise for a new issue. The utility and the social institutions came together to develop both socially minded and energy sustainable solutions which are in line with neoliberal policies so that everyone pays their energy bills. However, they are putting forward a human approach to the situation by studying the entire life situations of consumers unable to pay their bills which resonates with the right to energy concept (Hesselman *et al.* 2019). The Ombudsman has developed its criteria for vulnerable consumers which are broader than those for energy poverty and has done so by cooperating with the social institutions and by direct contact with affected consumers. This cooperation of the institutions to support the severe social cases shows their priority to enable access to modern energy services which citizens they can afford. The criteria of the severe social cases show that there is a high correlation between income poverty and energy poverty. At the same time, the social welfare system is composed of different social institutions that can offer a wide variety of services, such as already listed in the criteria of the Ombudsperson (attendance allowance, child allowance, guaranteed minimum income, and similar).

The two contrasting cases show the role of institutions. Institutions to act in a just way need to develop adequate government policies (Schlör *et al.* 2013) and have clear authority (Goldthau and Sovacool 2012). Institutions need to rectify the distributive inequalities since justice is how social institutions distribute fundamental rights and duties (Rawls 1971). The literature also discusses the concept of activism regarding energy justice which is relevant concerning the energy protests in North Macedonia contrasted to the pro-activeness of the Wien Energie Ombudsman in Austria. Heffron *et al.* (2015) state that energy justice does not evolve from anti-establishment social movements as it was the case with environmental and climate justice. The procedural tenet of environmental justice encompasses the participation in political processes that create environmental policies (Schlosberg 2004). Climate justice is a matter of sharing burdens and benefits between countries or individuals, a matter of enhancing legitimacy in decision-making (Bulkeley *et al.* 2013). Contrary to the mentioned lack of activism in energy justice (Heffron *et al.* 2015), street protests might be implicitly part of a reaction to the lack of participation in the decision-making according to Walker Gordon and Day (2012), and they can be considered as manifestations of procedural (in)justice.

The cases expose the importance of energy market system structure, ownership of energy utilities, and the type of energy liberalization and decarbonization policies. It also shows the impact of how energy prices are formulated, the effectiveness of the social welfare system, availability, target, and relevance of support against energy poverty. The key aspect is communication with all relevant institutions, such as decision-makers, representatives of the welfare system, the regulatory body, and energy suppliers. Dealing with the energy affordability of households depends on the market structure and ownership, the openness of the energy market, the strength of the social welfare system, and the willingness of stakeholders to develop just policies. The empirical findings show a case of good communication in Austria through the energy supplier which in collaboration with other institutions has developed a program to support consumers unable to pay their energy bills. The Macedonian case refers to a negative example of communication with the regulatory body, the single energy supplier, and decision-makers in the energy area resulting in energy protests due to increased energy prices. These arguments complement the discussion at the European level about the right to energy as a reaction to the treat of disconnections and the damage they cause to households (EPSU and EAPN 2017). The right to energy concept by bringing forward the idea that access to energy could be more than a consumer right, possibly a human right (Hesselman *et al.* 2019), shows that institutions can act as 'injustice inflictors' or receptive institutions and protectors of consumers (people). By doing so, they enjoy their trust or mistrust (Grossmann *et al.* 2021). In North Macedonia, households feel total detachment from the 'system' and do not even try to contact institutions to address their energy challenges (Grossmann *et al.* 2021).

The chapter aims to answers these research questions:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What procedural energy injustices do households with different types of heating experience?

Households in energy poverty experience procedural injustices inflicted by private monopolies in the energy sector, such as the single utility in North Macedonia, and decision-makers, such as the regulatory body, enforcement agents, and the Parliament in North Macedonia which strictly enforce the neo-liberal energy policies without consideration for the right to energy. They are either ignorant or rejecting citizens' demands for access to affordable energy services. On the contrary, institutions convey procedural energy justice when they consider the citizens' life situations before demanding payment of energy arrears and cooperate with other institutions to develop sustainable and human-focused solutions, such as in Austria.

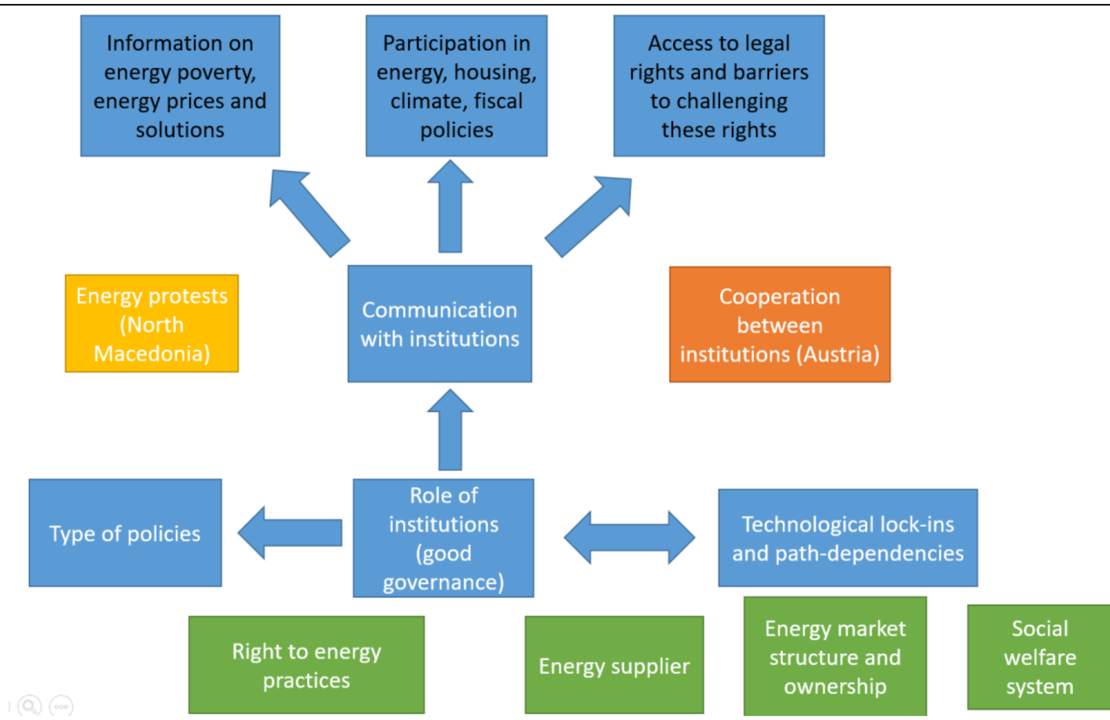
Regarding the type of heating related to procedural justice, the institutions impacting the electricity price in North Macedonia are problematic, such as the private electricity utility, the Regulatory Commission, and other stakeholders. Electricity increase adds to households' vulnerability due to a set of reasons. First, there are limited options for heating leaving households to choose mostly between electricity and fuelwood. There is also a widespread material deprivation among citizens who are vulnerable to any significant electricity increase. The problem has become more serious in a context of a private monopoly and institutions which protect the energy system over citizens' needs. That means that electricity price increases have the potential to increase households' coping on fuelwood or if unable to do so, to perform other coping strategies aimed at reducing their electricity costs. The Macedonian case has also shown that households are affected by district heat price increases, and their entrapment to use district heating rather than switch to more affordable energy sources puts them at energy poverty risk. The case shows that households in North Macedonia are affected by energy poverty regarding the use of all energy services. In Austria, there is no sharp distinction between different types of heating, since the vulnerable consumers are mostly specific groups also affected by income poverty, as discussed in the previous chapter. That means that affording heating is part of the overall energy and material affordability of households in Austria. As the Energie Ombudsman also treats this problem, the inability to pay the electricity and heating bills is one aspect of an overall state of material deprivation shaped by factors, such as income, housing, but also personal circumstances, and life situations. The energy utility in state ownership in Vienna Wien Energie conveys a procedural justice when supporting vulnerable consumers to pay their heating and electricity bills without disconnecting and additionally impoverishing them.

7.5 Conclusions

The concluding section summarizes the findings and explores the results theoretically. Figure 34 summarizes the theoretical (in blue) and empirical contribution (common in green; yellow for North Macedonia only; and orange for Austria only) of this chapter which upgrades the work of Walker Gordon and Day (2012) about how energy poverty is a procedural injustice. It summarizes the information, participation, and access to legal rights into a more general communication with institutions since this interaction with institutions can be much more diverse. It adds the role of institutions that depending on their features, institutions can have different communication practices with citizens. Different institutions develop different policies which affect the energy-poor. At the same time, the technological lock-ins and path depending co-shape the role of institutions. The theoretical contribution is that communication with institutions defines energy poverty as procedural (in)justice. It is also defined by the role of relevant institutions, whether they convey good governance. This role determines the communication, the policies they produce, and the path-dependencies which co-shape the institutions.

Figure 34 shows also the common empirical findings for Austria and North Macedonia in green and two country-specific in yellow and orange respectively. Figure 34 shows that common for both countries, although the empirical experience is different, it is about the relevance of the right to energy practices and the role of the energy supplier. While in Austria the energy supplier is a relevant institution that develops policies in line with the right of energy concept, in North Macedonia the energy supplier is considered an unjust institution that sees citizens mainly as consumers who need to pay their energy bills. It also shows the relevance of the social welfare system, as well as the structure and ownership of the energy market. According to Yin (2003), the same findings from two different cases might be relevant for a broader generalization to some extent. The difference in the empirical findings is the positive communication practices in Austria seen through the cooperation between institutions led by the Wien Energie Ombudsman, and an energy protest in North Macedonia as citizens' reaction to lack of communication of institutions with citizens in energy poverty.

Figure 34: Theoretical and empirical upgrade of Walker Gordon and Day (2012)'s depiction of energy poverty as procedural injustice



Source: author upgrading (Walker Gordon and Day 2012)

This chapter upgrades the work of Walker Gordon and Day (2012) by summarizing the different means of participation as communication with institutions, and by further pointing out the role of institutions, their policies, and the lock-ins they co-create as factors in understanding energy poverty as procedural energy justice. It showed that the communication with institutions can constitute a procedural energy justice in case of cooperation of institutions aiming to support consumers, and can be an injustice as a result of lack of communication leading to protests. It adds to the right to energy discussion (Hesselman *et al.* 2019; Walker Gordon 2015) and institutional good governance (Rawls 1971; Sovacool and Dworkin 2015; Sovacool *et al.* 2017) by concluding that one of the key institutions is the energy supplier which can be just or unjust depending on whether it practices the right to energy concept. Procedural energy justice is about the role of institutions, their policies, and their communication with households in energy poverty which leads to solutions or further entrapment of households in energy poverty. It adds to the previous two chapters by showing the role of institutions and the policies of entrapment as a result of the lock-ins. The next and final chapter on discussion and conclusions will focus on energy poverty indicators, especially the scope of energy services, their relation to the type of heating, and it will summarize the overall energy justice conceptual upgrade of Walker Gordon and Day (2012) while discussing the energy poverty and energy justice interactions.

8. CHAPTER 8: OVERALL DISCUSSION AND CONCLUSIONS

This is the last chapter which gives an overall discussion and conclusion about the empirical and theoretical contributions of the dissertation while outlining the relevance of the research, and the limitations. I present a comprehensive answer to the research questions by building on the partial answers I provided in the previous three chapters. I have organized this chapter by summarizing the theoretical contributions about a more nuanced understanding of energy poverty coming from the three previous chapters: energy poverty as a vulnerable space, material deprivation, and shaped by institutional good governance. Next, I summarize the findings of the energy poverty indicators including reflection on emerging or hidden indicators. Lastly, I provide a detailed analysis of the role of the type of heating, fuels, and technologies in experiencing energy poverty and energy injustice. At the same time, I combine my additions to Walker Gordon and Day (2012) by linking them through the path-dependencies and lock-ins which co-create energy poverty.

8.1 Introduction

The dissertation analyzed the synergies between energy poverty and the type of heating in both developing and developed European contexts by having Austria and North Macedonia as case studies. Energy poverty or the inability of the household to satisfy their energy needs (Bouzarovski and Petrova 2015a) is studied as an energy injustice. Energy justice carries the visionary ideal of enabling everyone access to safe, sustainable, and affordable energy (Heffron and McCauley 2014), along with people's active participation and fair treatment (Sovacool and Dworkin 2015). The energy justice concept was applied with its three separate tenets: distribution, recognition, and procedural justice (Jenkins *et al.* 2016) by following the conceptualizations of (Bouzarovski and Simcock 2017; Walker Gordon and Day 2012). The reason to study this is since there is a knowledge gap about the complex relationship of energy poverty and the heat market, especially heating fuels and technologies, from an energy justice point of view considering both the developing and developed perspective. At the same time, the research emphasizes the need to further the European energy transition to be an inclusive and citizen-focused process. To address the research needs mentioned, the key research question is about the relationship between energy poverty and the type of heating in developing and developed European context, while supporting questions are about the importance of heating among other energy services, the injustices per type of heating, as well as the aspects of energy poverty related to various heating fuels and technologies.

Energy poverty is a spatially depended and structurally embedded phenomenon and visibly affecting heating as one of the most energy-intensive energy services in the home. However, the heat market is co-shaped by the infrastructure and building environment, but also by the market and policies, and finally by the needs, features, and coping strategies of the households, making it a district space in which multiple injustices interact. Fuels and technologies are the focal point of energy-poor households' resilience and resistance strategies and showcase the spatial inequalities they represent and reinforce. The spatial divide of energy poverty between the ‘east’ and the ‘west’ (Bouzarovski 2018) is physical, but also reflected in the economic and political space determined by path-dependencies.

This dissertation addresses this topic through a comparative case study in the European context with maximum variation sampling of an 'eastern' and 'western' country enhanced by mixed qualitative and quantitative methods (Miles *et al.* 2014) in which the focus is on the lived experience of the energy-poor (Middlemiss and Gillard 2015). The reason for a comparative approach between contrasted cases is to test the general applicability of these synergies in the European context if similarities between them are found (Yin 2003).

North Macedonia and Austria, are developing and a developed countries, EU candidate country and EU member state, countries with different historic, political, and socio-economic legacies, and different standards of living. Austria has a lower level of energy poverty (Thomson and Snell 2013), while in North Macedonia energy poverty is widespread (Buzar 2007b). While Austria predominantly uses district heating or central heating (Statistik_Austria 2016b), approximately 91% of the households in Macedonia use either electricity or fuelwood for heating (State_Statistical_Office 2015a). Both countries have to implement the EU policies on the low-carbon transition, while North Macedonia is still going through the process of energy market liberalization.

The empirical data consists of 300 phone surveys with 150 per capital city by using random sampling (Patton 2002); online interviews conducted with purposive sampling at the national level with 100 in Austria and 119 in North Macedonia; 28 interviews with different stakeholders in North Macedonia and 26 in Austria, in both cases with purposive sampling (Punch 2005). Additionally, several documents were collected from both countries. The surveys and interviews with households were conducted with both energy-poor and not energy-poor households. The data was collected in 2017. The qualitative data was analyzed following (Miles *et al.* 2014) and the quantitative data analysis was done following (de Vaus 2002; Punch 2005). The results from the data analysis were presented in regression analyses from the two survey datasets, citations from documents, interviews with stakeholders and interviews and surveys with households, and graphs and visualizations from the survey and interview data.

The last chapter aims to deepen the discussion in the last three empirical chapters and to summarize the main theoretical and empirical findings of the dissertation along with a more elaborate answer to the research questions. It also builds on findings that are common for both countries and of greater importance for the European context, following the maximal variation sampling (Miles *et al.* 2014). This chapter builds upon the literature and empirical material covered in the previous chapters to bring new perspectives. The chapter is organized in a way that after the introduction which summarizes the dissertation, 5 sections are set up to discuss various relevant points of the dissertation. The chapter ends with conclusions.

8.2 Energy poverty as a vulnerable space

Based on the theorization of distributive energy justice and its application to energy poverty (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012) as part of the conceptual framework, this section is all about reconfirming the spatial and distributive character of energy poverty. In this section, I summarize the main empirical and conceptual findings mainly from the empirical chapter discussing distributive justice, and elaborate further on the interpretation of findings, contribution to literature, and the research questions. It provides the summarized evidence and arguments to support the overall conclusion of the thesis. I build the argument that energy poverty is a vulnerable space determined by infrastructural path-dependencies and projected into technological inequalities that further deepen its spatial vulnerability.

The empirical data concluded that not having energy efficiency measures is a common predictor of energy poverty in both cases (Vienna survey dataset, Skopje survey dataset). Affordability challenges are what prevents energy-poor households to afford energy-efficient dwelling and invest in energy efficiency (Brunner *et al.* 2012; Healy and Clinch 2004). This is in line with appeals to make sure that policies supporting energy efficiency do not reinforce the existing inequalities (Gillard *et al.* 2017), and they do not create more narrow circles of vulnerabilities (Bouzarovski and Simcock 2017) which chase away energy-poor households out of renovated dwellings, for example through ‘renovictions’ (Baeten *et al.* 2017), or gentrification (Bouzarovski *et al.* 2018). Energy efficiency is not a panacea for energy poverty (Gillard *et al.* 2017), and energy poverty should not be considered as an issue solvable with technologies only as it undermines the human factor which co-creates this problem (Baker Keith J. *et al.* 2018).

The empirical data also shows that spatially limiting heating technologies that do not allow controlling of the volume or time of heating found mostly in non-central types of heating, predict energy poverty in both cases (Vienna survey dataset, Skopje survey dataset). It concludes that the technological sophistication of heating devices is at the crossroads of vulnerabilities: households affected by affordability challenges have access to more polluting and technologically backward heating appliances, and at the same time these heating devices prevent households from fully heated dwellings, stable indoor temperature and optimal use of heating (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). This creates a vicious circle of heating deprivation in which the heating fuels and technologies are the focal points of energy-poor households coping strategies (Anderson *et al.* 2012; Beatty *et al.* 2014; Longhurst and Hargreaves 2019; Papada and Kaliampakos 2016), reinforcing the spatially limited heating and unmet heating needs. Among these technologies stand out fuelwood which has played a role in vulnerability mitigation in post-socialist context (Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016), developing country context (Ariztia *et al.* 2019; Coelho *et al.* 2018; Jagadish and Dwivedi 2018), and even developed country context (Grossgasteiger 2013), and electricity in some post-socialistic (Buzar 2007a) and developed country contexts (Brunner *et al.* 2012). However, also central types of heating could be linked to energy poverty, either due to inability to economize the heating (North Macedonia) or ‘trapped in the heat’ (Tirado Herrero and Ürge-Vorsatz 2012), or to accommodate long-term residing single pensioners on a minimal pension (Austria).

I also found out from the data in both case studies that old and large and well as rural dwellings predict energy poverty (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). It has to do with the energy losses and greater energy needs in old and large spaces, respectively. The findings are in line with previous studies (Boardman 2010; Primc *et al.* 2019; Roberts *et al.* 2015; Thomson and Snell 2013). These two features often correlate with non-central types of heating as found from the data (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). It reinforces the path-dependencies co-shaping energy poverty patterns (Bouzarovski *et al.* 2016). This means that the decisions in the past to build an individual house (which prevails in North Macedonia) or to stay in the large dwelling after other family members have moved out (which prevails in Austria) would put these households at greater risk of energy poverty. Living in a more distant location limits fuel availability (Petrova and Prodromidou 2019; Robinson *et al.* 2019).

8.3 Energy poverty as material deprivation

Following the same theorization about considering energy poverty as a recognition injustice (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012), and additionally considering the literature on coping (Anderson *et al.* 2012; Brunner *et al.* 2012; Lazarus and Folkman 1984) and cultural meaning of energy use (Horta *et al.* 2019; Wilhite *et al.* 1996), this section underlines that energy-poor groups are misrecognized and structurally marginalized materially deprived citizens. I summarize the main empirical and conceptual findings mainly from the empirical chapter about culture of coping with energy poverty and further interpret the findings, summarize the contribution to literature and the research questions. This subsection provides the summarized evidence and arguments to support the overall conclusion of the thesis. I build the argument that energy poverty is at the core of an experience close to material deprivation visible in the path-dependently determined fuels and technologies to maximize the coping of energy-poor households to cultivate a culturally distinct life on the subsistence level.

According to the empirical data, a non-majority citizen without a university degree is more likely to be in energy poverty in the studied cases (Vienna survey dataset, Skopje survey dataset). Being an ethnic minority (North Macedonia) or of migrant background (Austria) puts households at a greater likelihood of energy poverty due to structural system inequalities offering less earning possibilities for the non-majority group leading to lower-income levels. Previous studies have underlined that minority ethnicities and migrants might suffer more often from energy poverty (Bouzarovski and Tirado Herrero 2017b; Brunner *et al.* 2012; Tirado Herrero and Ürge-Vorsatz 2010). Similarly, non-university education is related to lower incomes, thus greater exposure to energy poverty (Healy and Clinch 2004). The greater risk of being materially deprived makes them a vulnerable group to energy poverty. They often find themselves developing various coping strategies as seen from the data (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset), and reported for other countries, such as dealing with the eat or heat dilemma, reduced heated space, using cheap fuels, either fuelwood or even unconventional materials (Teschner *et al.* 2020; Tirado Herrero and Ürge-Vorsatz 2010). As previously mentioned the comparatively lower-income levels often links them to deeper structural poverty drivers these vulnerable groups face, such as minimal pension (Austria) and higher levels of unemployment (North Macedonia) (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset).

Through the general poverty link, the household size, gender, age, and health have been found in a relation to energy poverty (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). Larger households which often include unemployed adults and often minorities in North Macedonia and single persons, often female pensioners on a minimal pension in Austria are more likely to be affected by energy poverty, mostly through lower household income levels (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). Similarly, being a pensioner and a woman due to lower incomes are more related to energy poverty (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). Previous studies have proven these links to gender (Clancy and Feenstra 2019; Feenstra and Özerol 2021; Petrova and Simcock 2019; Robinson 2019; Tirado Herrero 2020), age (Chard and Walker 2016; Wright 2004), health (Healy and Clinch 2004; Shortt and Rugkåsa 2007; Snell *et al.* 2015) and household size (Waddams Price *et al.* 2012). However, it is not only the material deprivation that makes these groups more vulnerable, it is also due to the fuels and technologies they are using for heating. Fuelwood is labor-intensive and a challenge for the elderly (widows) (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). The use of fuelwood is also linked to indoor air pollution which has health impacts (World_Bank_Group 2014). Certain illnesses require increased heating needs which put households at a greater energy poverty risk (Vienna survey dataset, Skopje survey dataset), similarly to the elaboration that disabled people have increased energy costs due to their specific needs (George *et al.* 2013).

The empirical data focusing on households' coping strategies argue that the coping strategies are a trade-off between energy and other basic needs (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset), thus it brings energy poverty closer to material deprivation (Bouzarovski and Tirado Herrero 2017b; Watson and Maitre 2014). It also builds the argument that by reorganizing their household needs and priorities, energy-poor households develop a special 'culture' of coping with energy poverty, which normalizes energy-deprived spaces. For example, some energy-poor households are used to heat one room, ration their food, and compensate the needed warmth or energy service with cheap alternatives, all to keep their energy costs under a manageable threshold (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). Wilhite *et al.* (1996) found out that person-heating rather than space heating is common in Japan, while Horta *et al.* (2019) found out in Portugal that objectively lower levels of warmth are subjectively acceptable for households in energy poverty. The greater reason for the trade-off between the basic energy needs is to prevent a greater loss, such as disconnection, losing the rented dwelling, or depriving more vulnerable household members (children, ill persons) of certain basic needs, such as nutrition, warmth, or education (Vienna survey dataset, Skopje survey dataset, Austria interview dataset, North Macedonia interview dataset). Longhurst and Hargreaves (2019) argue that people's emotions are an important factor in determining energy use, thus co-shaping energy poverty. I develop this argument about energy poverty being a similar phenomenon to material deprivation by exploring implications for the most common definition of energy poverty. The latter is about not satisfying energy needs (Bouzarovski and Petrova 2015a), while I argue that the coping strategies show us that energy needs might be satisfied at a reduced or subjectively sufficient level, on account of other basic needs.

8.4 Energy poverty as shaped by institutional good governance

Based on the same theorization about considering energy poverty as a procedural injustice (Bouzarovski and Simcock 2017; Jenkins *et al.* 2016; Walker Gordon and Day 2012), and additionally reflecting on the emerging right to energy concept (EPSU and EAPN 2017; Hesselman and Herrero 2020; Hesselman *et al.* 2019; Walker Gordon 2015) and the good governance capacity of institutions (Rawls 1971; Sovacool and Dworkin 2015; Sovacool *et al.*

2017), this section emphasizes that (un)just institutions and policies enabling citizens to use affordable and clean energy or entrapping them to use expensive and polluting energy due to political, economic and technological path-dependencies is procedural energy (in)justice. I summarize the key empirical and conceptual findings from the last empirical chapter to offer a deeper interpretation of the findings, summarize the contribution to literature and underline the answers to research questions. I provide an overview of the evidence and arguments to support the overall conclusion of the thesis. I build the argument that institutional good governance and the consideration for the right to energy principle determine the ability of citizens to enjoy affordable, modern, and efficient energy services, as well as to include their voices and needs in that process.

The empirical data presented in the last empirical chapter is focused on two cases, the Macedonian energy protests and the Austrian Wien Energie-based Ombudsman as examples that uncover (un)just, policies and institutions, and show how these are profoundly related to citizens having a dignified life and sufficient energy services at home. The Macedonian energy protests are an example of socially-minded activism rooted in citizens dissatisfaction with how the energy system deteriorates their quality of life (Aman n.d.), similar to protests that happened in Bulgaria, France, and Spain, mostly trigged by increased energy prices but voiced dissatisfaction with deeper system policies (Badcock 2016; Clercq 2019; Euractiv 2013; Yoon and Saurí 2019). These street protests show that demands for energy justice are not without activism unlike claimed by Jenkins (2018), and they have the potential to give the floor to citizens as the new actor (Frankowski 2020; Frankowski and Tirado Herrero 2021; Fuller and McCauley 2016). The protesting citizens in North Macedonia used this form of activism because they felt ignored by the respective institutions and entrapped in an unjust system. They even put their efforts on paper and submitted a draft law to the Parliament requiring cheap daily electricity tariff and district heating disconnection without any running costs after disconnection (Aman n.d.), which did not succeed.

The key question is what was unjust about the Macedonian case. It was due to the entrapment of Macedonian citizens already largely affected by energy poverty and material deprivation, in a monopolized energy market in predominantly private ownership without consideration for the standard of living of the citizens. And this was done by misusing their dominant market position, thus endangering human rights (Ombudsman 2011). On top of that, there is a weak social welfare protection system, lack of investment in infrastructure development to offer a range of heating sources, leaving households even more isolated in their coping strategies and individual management of their housing and energy services. The increase in the energy prices hit citizens even more since they lost control over their energy costs which have been reduced already at a sub-standard level. The institutions see their constituents as energy consumers (Lennon *et al.* 2019) who need to afford their energy bills in a neoclassical economics setting (Heffron *et al.* 2015), while the protesting party echoed the right to energy concept demanding the basic requirements to be able to afford their energy bills (Walker Gordon 2015). The overall impression is that the institutions are either ignoring citizens' demands (the Parliament and the Regulatory Commission) (Legal Committee, Economic Committee, Parliament debate materials) or are even punishing them (the enforcement agents and the energy utilities in private ownership) (Ombudsman 2011). The most problematic is the electricity utility which is a monopoly in private ownership and supplying the energy source which citizens are most concerned about (Skopje survey dataset, North Macedonia interview dataset).

The Austrian case was about the establishment of the Ombudsman within the state-owned energy supplier in Vienna Wien Energie and their work to support consumers unable to pay their energy bills. The Ombudsman team was established as a result of getting requests from social institutions about citizens being unable to pay their energy bills (Wien Energie Ombudsman materials). Based on their experience in working with vulnerable consumers and the social institutions, they have coined a special set of criteria to identify their vulnerable group (Interview with Wien Energie Ombudsman representative, 2017). While academics usually use subjective definitions of energy poverty (Bouzarovski and Petrova 2015a; Fahmy *et al.* 2011; Scarpellini *et al.* 2015), in practice more objective ones serve a purpose (Herrero 2017) in detecting the energy-poor (Boardman 2010), especially by a utility which 'commands' one of the three dominant energy poverty drivers (Boardman 2010)– energy prices.

The Austrian case argues institutions and policies deliver justice since the state-owned energy utility has shown an awareness to serve the needs of all citizens including the vulnerable and support them in having a dignified life. The solution of Wien Energie Ombudsman is not in forgiving the unpaid bills but considering the human stories of the citizen behind the consumer. They seem to practice the right to energy principle (Walker Gordon 2015; Walker Gordon *et al.* 2016; Walker Ryan *et al.* 2014), while there is also a good social protection system and a fully liberalized energy market in place. The overall impression is that the energy utility in state ownership is in service of all citizens including the vulnerable ones.

8.5 Emerging energy poverty indicators

This section will reflect on the energy poverty indicators which were used and new ones which were discovered from the empirical cases. Both the findings from the qualitative (thematic coding of the 4 household datasets) and quantitative data (regression analysis of the Skopje and Vienna survey datasets; and cross-tabulation in all 4 datasets) were used to get to these indicators. The indicators are grouped as follows: 1) more traditionally accepted quantitative indicators compared to emerging ones; 2) the relevance of heating among other energy services, and energy poverty aspects; 3) correlation between the type of heating with energy poverty and other variables; and 4) new emerging injustices predicting energy poverty from the qualitative coding. Table 16 is a list of the indicators used for the regression analyses applied to the Vienna and Skopje datasets, and their analysis regarding three aspects. The first one is whether the indicators are traditional, meaning more commonly used to assess energy poverty (Thomson and Snell 2013) or additional, added to assess not so common aspects of energy poverty, such as referring to the spatiality of heating (Bouzarovski and Simcock 2017), coping strategies (Brunner *et al.* 2012), access issues (Spagnoletti and O'Callaghan 2013), or objective measurements (Boardman 2010). The aspects of energy poverty are affordability (Tirado Herrero and Ürge-Vorsatz 2012), access (Buzar 2007b) and comfort (Brunner *et al.* 2012). The third column is about the relevance of heating (Buzar 2007a) or all energy services (Bouzarovski and Petrova 2015a). Cross-tabulations were made with binary variables from Vienna, Skopje, North Macedonia, and Austria datasets, where the type of heating was coded as central and non-central, correlated with socio-demographic, technology, housing characteristics, the energy poverty indicators, and the type of coping strategies.

Table 16: Energy poverty indicators us as dependent variables for the regression analysis

Energy poverty indicator (and abbreviation)	Type of energy poverty indicator	Aspect of energy poverty	All energy services or heating
Can you adequately heat your home (heat ok)	Traditional	Comfort	Heating
Can you afford energy costs for lighting, cooling, cooking,	Traditional	Affordability	All energy services minus heating

appliances, and hot water (afford energy services)			
Can you pay to keep the home adequately warm (afford warm)	Traditional	Affordability	Heating
Do you economize your heating (economize heating)	Additional	Affordability, comfort	Heating
All are rooms heated (all heated)	Additional	Affordability, comfort	Heating
Does the household have arrears on electricity (arrears electricity)	Traditional	Affordability	Potentially all energy services
Does the household have arrears on heating (arrears heating)	Traditional	Affordability	Heating
Presence of leaking roof, rotten windows, condensation, or damp walls (EE criteria)	Traditional	Comfort	Potentially heating
What is the average T (average T)	Additional	Comfort	Heating
Would you use another type of heating (another type)	Additional	Access	Heating
Source: author based on (Boardman 2010; Bouzarovski and Petrova 2015a; Bouzarovski and Simcock 2017; Brunner *et al.* 2012; Buzar 2007a, 2007b; Spagnoletti and O'Callaghan 2013; Thomson and Snell 2013; Tirado Herrero and Ürge-Vorsatz 2012)			

In both cities, affording the heat is a common relevant indicator, and heating is the most relevant energy service, however for Skopje all energy services matter (Skopje survey dataset; Vienna survey dataset). The ‘traditional’ type of indicators prevail in both cities, however, some additional are relevant as well (Skopje survey dataset; Vienna survey dataset). Regarding the aspects of energy poverty, affordability is the most relevant for both cities, while access is only relevant for Skopje (Skopje survey dataset; Vienna survey dataset). This summary of the most relevant indicators shows that despite the trends to have a broader view on energy poverty (Mattioli *et al.* 2017; Thomson *et al.* 2019), it remains a deeply spatial issue (Bouzarovski and Simcock 2017) both at a geographical scale (Dubois and Meier 2016) and at a household level, embedded in infrastructural deficiency (Robinson *et al.* 2018), technological lock-ins (Bouzarovski *et al.* 2016), warmth deprivation, and unmet heating affordability.

The results from the cross-tabulation between the type of heating and other variables bring a similar conclusion (calculations available in Appendix 11). The only two common strong and significant relationship is between the type of heating and having the heating fully installed (Skopje survey dataset; Vienna survey dataset, North Macedonia interview dataset), and the ability to control the number of rooms heated (Skopje survey dataset; Vienna survey dataset). This brings into focus the spatiality of energy poverty (Bouzarovski and Simcock 2017) at a household level expressed through non-central and technologically backward forms of heating. It underlines the technology poverty at crossroads of household coping strategies and material deprivation (Anderson *et al.* 2012; Bouzarovski *et al.* 2012; Bouzarovski *et al.* 2016; Chard and Walker 2016), also shaped by infrastructure inequalities and path-dependencies.

The empirical research in North Macedonia and Austria gave a glance at energy poverty features known to be relevant to energy poverty as well as new emerging injustices predicting energy poverty. Among the usual predictors are the three energy poverty drivers (Boardman 2010) – low energy efficiency, low income, and high energy prices. In particular, not having installed energy efficiency measures, having a non-central type of heating, and living in large, old dwellings in the rural areas predict energy poverty in both countries (Skopje survey dataset; Vienna survey dataset, North Macedonia interview dataset, Austria interview dataset). The low income is expressed through material deprivation mostly of citizens without a university education, and non-majority population, similarly to other vulnerable groups, such as women, pensioners, ill persons, and housing size (large in North Macedonia and single persons in Austria) (Skopje survey dataset; Vienna survey dataset, North Macedonia interview dataset, Austria interview dataset). The material deprivation is also visible not only through the income levels but through the various coping strategies households do aimed at reducing their energy needs and compensation for warmth deficiency (Skopje survey dataset; Vienna survey dataset, North Macedonia interview dataset, Austria interview dataset).

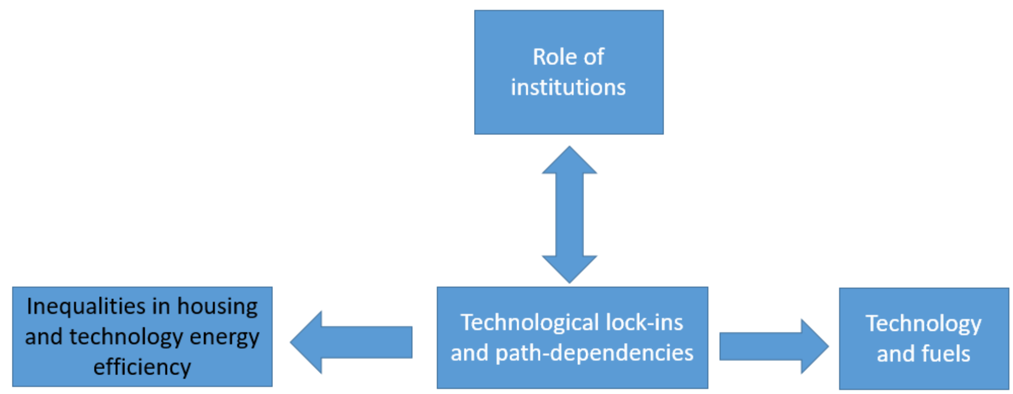
The third chapter using procedural justice as a concept along with the right to energy and institutional good goevrnance delivered fresh insights into discovering hidden energy poverty indicators and injustices. They are: the energy market structure (monopolized or not), and ownership of the energy utilities, as well as whether private energy monopolies misuse their position; the treatment of citizens or consumers by energy utilities (Lennon *et al.* 2019); the strength of the social welfare system, and availability of other support against energy poverty; and whether the increase of energy prices affects a large portion of citizens.

This reflection shows that energy poverty affects vulnerable groups affected by material deprivation, which live in more spatially deprived areas furnished with old heating technologies. However, the emerging or hidden drivers show the market actors, especially the energy utilities as well as the design of the social welfare system to co-create or mitigate energy poverty. These actors are rarely seen in energy poverty matrixes or indices. There is rarely a consideration for vulnerable groups in indices (Castaño-Rosa *et al.* 2019).

8.6 Fuels and technologies at the crossroads of energy injustice and energy poverty

In an attempt to integrate the application of the three energy justice tenets to energy poverty, this section summarizes the discussions about the common element in all three cases – the technological lock-ins and the path-dependencies. This dissertation's findings upgrade (Bouzarovski and Simcock 2017; Walker Gordon and Day 2012) by underlining that energy poverty is determined by and shapes the characteristics of localities where the profiles of energy-poor are not recognized and are affected by the fairness of the decisions and policies. Figure 35 shows the visual depiction of this common factor as a snapshot combining the three previous visualizations applying energy justice to energy poverty inspired by Walker Gordon and Day (2012). It shows the interconnection between the three-justice tenets to be around lock-ins and path-dependencies which shape the dwelling and heating quality, the specific technologies and fuels used by the vulnerable groups, and the nature and behavior of institutions. Only in the case of the role of institutions, it is both shaped by and shapes the technological lock-ins and path-dependencies.

Figure 35: Path-dependencies at the intersection of energy poverty shown as energy injustice



Source: author based on (Walker Gordon and Day 2012)

The type of heating technology depends on the households' physical access to it, but also on their ability to afford it. Thus, cheap and technologically modest heating aligns more with households in energy poverty. Non-central forms of heating reduce heating comfort. The use of outdated and spatially limited heating technology has negative environmental and developmental impacts (Stojilovska 2020) as it contributes to air pollution, the inability to invest in infrastructure development, and negatively impacts households' health. The housing and technology inequalities households experience due to spatial and technological lock-ins make energy poverty a distributive injustice, while fuelwood and resistive electric heating deepen these spatially dependent inequalities and injustices. The poverty of infrastructure (Robinson *et al.* 2018) sharpens the infrastructural divide (Bouzarovski 2018) which also determines the size of the energy poverty problem. That means differences in access to affordable and modern infrastructure will be a dominant factor in co-shaping energy poverty.

Fuels and technologies are at the core of energy-poor household coping and are used to maximize coping strategies. This means the price of fuels and their uses can be of benefit to households to keep their heating costs low. Fuelwood echoes the subsistence level (Sharif, 1986) of energy services and its cultural importance in developing countries (Ariztia *et al.* 2019; Coelho *et al.* 2018; Jagadish and Dwivedi 2018). However, losing access to affordable heating can put households at risk of energy poverty. On the other hand, the use of cheap and technologically background heating technologies prevents good comfort due to its technological limitations, such as reduced heated space, indoor pollution, and other health impacts, and allows for normalizing and culturalizing energy poverty. It shows the lived experience of energy-poor households (Middlemiss and Gillard 2015). The choice of fuels and technologies is also determined by a broader set of market or technological lock-ins, such as the flexibility of markets (Anderson *et al.* 2012).

The application of procedural energy justice to energy poverty has revealed the importance of the energy market structure (monopolized or not), ownership (state or private), and openness (liberalized or not), the strength of the social welfare system, and whether stakeholders (utilities, social institutions, the Parliament) practice neo-liberal energy policies or consider the right to energy principle (Hesselman *et al.* 2019) in their policy-making. That shows how relevant is the political, economic, and infrastructural setup to shape which fuels and technologies will citizens use, how affordable they will be, and whether they would be assisted into getting access to them or other affordable options. The energy utility plays the most crucial role about how it communicates with citizens and especially whether it is punishing or supporting the vulnerable groups. This opens up a deeper systematic discussion whether energy as a basic requirement needs protection from its marketization and rising energy prices (Demski *et al.* 2019), while the state and other actors involved in energy provisioning have obligations that go beyond market relations (Walker Gordon 2015), and whether we need a system rethinking (Heffron *et al.* 2015).

This summary shows that although technologies and fuels are at the forefront of experiencing energy poverty, the visionary energy justice perspective allows us to see beyond technologies and fuels, and to highlight the dynamic behind the people and their institutions. As energy justice points out, that it is a question of moral and human rights (Jenkins *et al.* 2018; McCauley *et al.* 2019; Sovacool and Dworkin 2015), that people are more than just consumers, but citizens (Lennon *et al.* 2019) with multiple agencies (Baker John P. and Berenbaum 2007; Lennon *et al.* 2019), with the ability to protest and organize themselves in social movements (Yoon and Saurí 2019) demanding their rights. By showing the lived experience of energy-poor households (Middlemiss and Gillard 2015), putting them in focus is only the first step, and acknowledging all their capabilities and not turning them into passive consumers should follow (Ryghaug *et al.* 2018). On the other hand, the energy justice literature brings out the responsibility and capacity of institutions (Rawls 1971), the requirements for retribution to those who suffered injustices (Heffron and McCauley 2017), and transparent, fair, and accountable decision-making processes (Sovacool *et al.* 2017). Institutions will be just if they possess and practice good governance principles. Finally, if there are disempowered citizens facing unjust institutions, there is a need to rethink the current system (Heffron *et al.* 2015) which co-produces energy poverty and cements the energy-poor spaces.

Reflecting on the discussion about the three tenets applied to energy poverty, and on the empirical findings, it is visible that there is an interconnection between the three tenets. That means that vulnerable people who live in vulnerable spaces dependent on old technologies and polluting fuels are affected by unjust policies which amplify the problem. For example, some North Macedonia's households affected by energy poverty live in more deprived parts of the country. This contributes to the understanding of spatial and socio-economic segregation of energy poverty as energy-poor households are materially more disadvantaged and structurally have fewer access opportunities. Similarly, Macedonian households have been pushed into developing a cultural subsistence level of satisfying their energy needs at which core lies their need to individually control their energy resources and costs (Stojilovska 2020) to escape the high prices set by monopolies. Building on (Bouzarovski and Simcock 2017; Walker Gordon and Day 2012), energy poverty exists in infrastructure, fuel, and building patterns where the needs, practices, and characteristics of energy-poor households are under-recognized, and when institutions are unjustly deaf to energy-poor citizens demands and create unjust policies which further entrap them into energy poverty.

I reflect on the limitations of the dissertation. First, the use of randomly collected household data in the capitals only prevents country-level generalizations. This conscious choice to study the capital cities only is made due to resource, time, and capacity considerations. However, the mixed methods help to get the complete picture of energy poverty and injustices in the households. But, I have been cautious about how I link the findings from the survey data and the rest of the data about the national level. I firstly follow the results of survey data, and then check if there are qualitative findings from the rest of the data which could extend the theorization about the findings to the national level. Second, I have faced some challenges in the data collection process which affect the quality of data. I have done the household interview via phone or online, without physically meeting them, which prevented deeper ethnographies of their circumstances, for example taking photos. I had experienced a high rejection rate of the household survey in Vienna (2.2% acceptance rate) which resulted in needing to be more flexible with the data collection, such as sampling more areas in Vienna with a better response rate. I also have the impression that I have a higher share of elderly persons because they were the ones who most likely have a landline phone. I have faced challenges in reaching out to public stakeholders in North Macedonia which at the time of the data collection the country just left a state of deep political crisis. But, from previous experiences in the country, the public sector in the energy area is generally closed for cooperation. Another type of challenge I experienced in the data collection process was about the questions on procedural energy justice which did not lead to any valuable collected data. If I asked households, have you had an opportunity to contribute to the decision-making on heating in your area, it did not mean anything to them. Therefore, I had to collect data about procedural justice in a different way, and this initial insight made me realize how I can contribute to modify the conceptualization proposed by Walker Gordon and Day (2012).

Third, I am acknowledging that the survey data I collected is a small sample. In order to analyze it with regression analysis, I had to recode the answers into a binary format, which reduced the quality of the data. For example, I had to neglect some data which had a very small share, such as independent variables with shares lower than 5% (as seen in the descriptive tables of the collected data in Appendix 9). The share of the energy-poor in the Vienna survey and Austria interview datasets is very small, and I make conclusions based on this small share. I justify this since these percentages are in line with the share of energy-poor according to national statistics, and Austria as a country is affected by a low share of energy poverty. I also use the mixed methods to complement the deficiencies of my quantitative data. Although the data explore various regions of the countries, the urban context is over-represented. Lastly, although similar conclusions from different cases allow for broader generalization, applicable to the European context only, this has to be still interpreted carefully, as the link between energy poverty is very complex and context-embedded. The findings of the dissertation allow for inspecting whether the use of fuels for coping;

the coping strategies, the role of access to infrastructure to determine the size of the problem; and how stakeholders treat citizens over access to energy are relevant for other European countries. This invites further research to inspect the relevance of this dissertation's findings for the broader European context.

8.7 Conclusion

This final section will focus on providing more developed answers to the research questions. This dissertation has the following research questions, the first being the main one:

- What is the relationship of energy poverty to the type of heating in developing and developed European contexts?
- What energy injustices do households with different types of heating experience?
- How significant is heating among other energy services regarding energy poverty?
- What types of heating are related to specific aspects of energy poverty?

That means in this section I summarize and upgrade the answers to these questions. The sections will be organized by first starting with the importance of heating among other energy services. After that, the most important types of heating, technology, and fuels, will be assessed concerning the aspect of energy poverty and the distributive, recognition, and procedural injustices they are related to. Finally, the section will summarize the findings around the relationship of energy poverty to the type of heating and their theoretical contribution. It concludes with reflections about the meaning of the findings and the contribution in the context of the energy transition.

One of the crucial questions was about reassessing the importance of heating among other energy services. We know that the first definitions about energy poverty focused on heating (Buzar 2007a), but new knowledge keeps expanding its understanding to all energy services (Bouzarovski and Petrova 2015a), and even transport (Mattioli *et al.* 2017). I have inspected this question based on the relevance of the used energy poverty indicators assessing the heating and other energy services separately; and based on empirical inputs from the findings of distributive, recognition, and procedural injustices which households experience. According to the regression analyses in Skopje and Vienna (most relevant dependent and independent variables), and cross-tabulations in all 4 datasets, in both countries heating is important, however, all energy services are relevant in North Macedonia too. The latter is underlined by the profiling of an unjust monopolized energy utility in private ownership in North Macedonia because it misused its monopolized position and raised human rights concerns, as noted in multiple annual reports of the Ombudsman (Ombudsman 2011). At the market level, this distinction between electricity being a problematic energy source in North Macedonia and not in Austria has to do with the level of the electricity market liberalization. In Austria, it was liberalized in 2001, and North Macedonia in 2018, but still, the mentioned monopoly dominates. It makes the electricity market inflexible for consumers in North Macedonia, thus they focus on coping on a flexible market (Anderson *et al.* 2012) – heating on fuelwood. This means although heating remains the focal energy service (Buzar 2007a), in an absence of an alternative provider or another type of energy source (Jenkins *et al.* 2016) such another affordable option for heating, the procedural injustices of a monopolized privatized electricity market can make electricity, can make middle-income households (Buzar 2007b) vulnerable to energy poverty. It is then about the availability of choice (Jenkins *et al.* 2016), access to modern and affordable energy sources (Heffron and McCauley 2014), and the market structure. However, the empirical data from Austria has shown that energy poverty and income poverty are highly related, and that energy-poor are in Austria are most likely experiencing issues with all energy services.

Fuelwood has received much attention in relation to energy poverty. It is mostly used as a non-central type of heating which we know that correlates with energy poverty in both countries (Skopje survey dataset, Vienna survey dataset). As a non-central type of heating mostly used in outdated technology, fuelwood contributes to spatially limited heating. Its distributive injustice character also leaves a spatial mark on the coping strategies. Fuelwood is a cheap fuel which in both countries is used to reduce heating costs. The distributive aspect is that the access to fuelwood is determined by the location and the type of dwelling. It has an ambiguous relation to comfort – overall it reduces the comfort of a fully heated dwelling, but it brings good warmth in at least one heated room. It is a priceless resource that can replace more expensive heating or other energy services, or can be acquired at a reduced price (Vienna survey dataset; Skopje survey dataset) or even for free (Grossgasteiger 2013). That shows that affordability is the defining factor in choosing fuelwood. It allows mental comfort to vulnerable groups and energy security at a household level. Its recognition feature is that fuelwood is mostly chosen by households affected by material deprivation. The use of cheap fuelwood is not without consequence, as it may affect the physical health of households. At a more macro level, it contributes to air pollution (World_Bank_Group 2014) and deforestation. The extensive use of fuelwood in North Macedonia is incentivized by its subsidized price and the status quo of lock-in – the lack of affordable alternatives. Fuelwood wears the crown of energy cultural subsistence (Ariztia *et al.* 2019; Coelho *et al.* 2018; Jagadish and Dwivedi 2018; Stojilovska 2020) preventing households from further deprivation. It is an irreplaceable tool for coping with energy poverty. In few cases in a developed country context fuelwood could also mean additional warmth to the already good level of warmth achieved by another main type of heating (Vienna survey dataset; Austria interview dataset).

Electric resistive heating is also a non-central type of heating, sharing the issues of localized household heating, correlation to energy poverty, causing a distributive injustice. As a non-central type of heating, it offers less comfort, but unlike fuelwood it creates an affordability issue, increasing households' vulnerability (Skopje survey dataset, North Macedonia interview dataset). Access is a relevant factor (Jenkins *et al.* 2016) since many choose electric heating due to a lack of other options. The case of North Macedonia brings into light the electricity stakeholders related to the increase of electricity price which affects citizens due to the lack of alternatives and the already widespread material deprivation. The electricity utility threatens the existence and human rights (Hesselman *et al.* 2019; Walker Gordon 2015) of many already living on the subsistence level (Stojilovska 2020) by misusing its dominant market position (Ombudsman 2011) and remaining unchecked by other institutions, while citizens stay locked-in (Petrova 2018). It t was one of the key reasons to bring people out on the streets in North Macedonia demanding their rights (Aman n.d.).

Central forms of heating are less related to energy poverty since access to them is related to the greater affordability of households. They already safeguard the comfort of a mostly fully heated dwelling. In some cases, households wanting to use central heating cannot due to the lack of infrastructure (Petrova and Prodromidou 2019; Robinson *et al.* 2019; Robinson *et al.* 2018), putting them at a greater spatial disadvantage (Bouzarovski and Simcock 2017). In particular, the district heating in North Macedonia is a monopoly which also triggered households to protest due to the inability to disconnect without continuing to pay for its basic fee (Aman n.d.). They cannot economize the heating prevented technically due to the fear of the utility (Informal interview with BEG, 2017) that households would practice their sub-standard economizing and coping (Stojilovska 2020), leading to less profit for the utility. It again shows that citizens are locked in the heat (Tirado Herrero and Ürge-Vorsatz 2012), but also by the will of energy monopolies. Households in Vienna cannot disconnect from central types of heating (Vienna survey dataset), which sometimes locks in long-term residing single pensioners on a minimal pension, keeping them energy-poor.

The relationship between energy poverty and the type of heating is highly complex. My first assumption was to discover a correlation between these two variables. While I have shown this correlation in both developing and developed European context, the employment of the energy justice concept, the ever-developing energy poverty literature, and the rich empirical data I collected outline a larger let of empirical and theoretical contributions. It is clear that certain fuels and technologies for heating are the core of coping with energy poverty but this is enabled by policies and determined by social, political, and economic lock-ins, such as flexibility of markets (Anderson *et al.* 2012), neoliberal policies, and market structures. Space co-determines heating inequality and divisions, but above it is the processes (policies and institutions) that cement these existing divides by turning a blind eye on citizens' need for affordable energy services. The use of these certain heating fuels and technologies as coping strategies although allow for present relief, deepen these spatial injustices making vulnerable households dependent on the use of cheap, polluting, and outdated types of heating. Energy poverty becomes a vulnerable space through the infrastructural path-dependencies being further projected into technological inequalities that further deepen its spatial vulnerability.

Fuels and technologies are only one side of the coin. Energy poverty is close to material deprivation seen through the choice of fuels and technologies shaped by path-dependencies aimed to maximize the coping to a point of energy cultural subsistence (Stojilovska 2020). Energy-poor vulnerable groups are misrecognized and structurally marginalized materially deprived citizens which are in this state due to having a lower chance of opportunities to for a good quality of life. Non-majority citizens (Brunner *et al.* 2012; Tirado Herrero and Ürge-Vorsatz 2010) with lower education (Healy and Clinch 2004), female (Clancy and Feenstra 2019; Feenstra and Özerol 2021; Petrova and Simcock 2019; Robinson 2019; Tirado Herrero 2020), pensioners (Chard and Walker 2016; Wright 2004), ill or disabled (Healy and Clinch 2004; Shortt and Rugkåsa 2007; Snell *et al.* 2015) and large or single-person households are more affected by energy poverty through the general income poverty link. Not having energy efficiency measures is the common predictor of energy poverty which is also due to lack of affordability. Vulnerable people who live in vulnerable spaces are dependent on old technologies and polluting fuels. The lock-ins and path-dependencies shape the dwelling and heating qualities, the specific technologies and fuels used by the vulnerable groups, and the nature and behavior of institutions.

The type of heating and the related technologies and fuels which are related to energy poverty is only the visible material part of the problem. (Un)just institutions and policies either support citizens in using affordable and clean energy or lock them in to use expensive and polluting energy due to political, economic, and technological path-dependencies. The Austrian case shows that institutions can step up to break the chain of multiple vulnerabilities to establish communication between vulnerable customers and the respective institutions (Wien Energie Ombudsman materials). Institutional good governance and the consideration for the right to energy principle enable citizens to enjoy affordable, modern, and efficient energy services, and to include their voices and needs in that process. There is a need not only to demand fair and transparent decision-making (Sovacool *et al.* 2017), but to call out institutions on their responsibility (Rawls 1971), demand rights (Hesselman *et al.* 2019; Yoon and Saurí 2019), and retribution from institutions

(Heffron and McCauley 2017). This calls for the need to politicize energy poverty through considering the lock-ins, dependencies, and their enforcers as the common threat.

I highlight the importance of my research and its empirical and theoretical contributions. First, the dissertation is a witness of my growth as an academic researcher. I was at first interested in the quantitative approach in finding the energy-poor and finding the best solution to energy poverty. The linearity of my research questions shows my initial interest in the topic, also influenced by the technologically dominant energy poverty discussions about 5-6 years ago. My results and contributions show that the link of energy poverty to the type of heating is only one puzzle of a complex system that co-produces vulnerabilities. The application of the energy justice framework, and the inclusion of a newer discussion on right to energy, good governance, energy culture, and coping, enable me to inspect the relationship between energy poverty and the type of heating in a very detailed manner. In fact, my theoretical contributions go much beyond my research questions. Second, regarding my theoretical contribution, I have deepened the understanding of energy poverty in its links to heating, but my most novel is about the understanding of recognition and procedural energy justice. This is because energy poverty has been since long time ago considered a distributive and spatial injustice. But the snapshot of how energy poverty is a procedural and recognition justice introduced by Walker Gordon and Day (2012) needed an upgrade. Especially due to the use of grounded theory, I conceptualized the coping strategies, and with the guidance of the existing literature on coping, I analyzed these strategies which increased the understanding that energy poverty is a material deprivation in disguise. And with this, I added to the understanding that energy vulnerable households are not only a combination of socio-demographic features predicting energy poverty, but they are manifesting a culturally substandard behavior. Regarding procedural energy justice, I realized that citizens’ participation in the decision-making is either an abstract or foreign idea, and these processes are more about how relevant institutions in the energy area treat citizens in regard to their use of energy services. In this way, I simplify and add to the understanding of energy poverty as energy injustice. By this, I contribute to the recommendations in the literature about making energy justice more measurable around technology use (Sovacool and Dworkin 2015). I have added to the latter by adding the aspect of coping strategies and the culture of coping with energy poverty which can develop around technology and fuel use. I have proposed the procedural justice applied to energy poverty to step back from the very detailed proposals about access to legal rights and participation in decision-making, by first assessing how relevant institutions treat citizens in regard to their access to energy.

Third, I have shown that experiencing energy poverty is very similar in the different studied countries. There are mainly two big differences- how institutions treat citizens, and the development of the heat infrastructure as factors in shaping the size of the problem. In all other bigger aspects, experiencing energy poverty was the same. This means, that both lack of energy efficiency in the housing sector, and living in a large dwelling increase the chances of energy poverty in both countries, same as the more vulnerable categories of households, such as women, pensioners, non-minority and similar. The same applies to using non-central forms of heating, and especially fuelwood in both countries. All my theoretical contributions is based only on the similarities of the two studied countries, which increases the generalizability and the confidence of findings (Miles *et al.* 2014; Yin 2003). The only differences were as mentioned, around the infrastructural divide and the two sides of procedural (in)justice. This brings closer the experience of energy poverty between the developing and developed European contexts. Living with energy poverty feels very similar in North Macedonia and Austria, especially about who the energy-poor are, their heating and dwelling quality, and their energy behavior. Fourth, I believe my research is relevant because it tackles the energy transition, is human-focused, uses a comparative case study of diverse countries and a mixed-method approach with a rich dataset, is interdisciplinary, and uses a complex conceptual framework. It shows that energy poverty is an interdisciplinary problem, building on synergies of environmental, social, economic, energy, and political matters. My research is relevant since it signals that in order to make the energy transition a success, it needs to be inclusive, and should 'leave no one behind'. Lastly, my research can be translated into policy recommendations, and can open up new research avenues. Regarding the policy recommendations, measures to alleviate energy poverty should be directed towards the households with variables mostly predicting energy poverty, but these citizens should also be encouraged and empowered to co-create the solutions to their deprivation. These are some of the new research avenues my research opens: the role of the Ombudsman in relation to energy poverty (Stojilovska 2021); coping strategies as a result of institutional and personal lock-ins[14]; culture of energy poverty; social movements and activism regarding energy poverty; energy democracy and energy citizenship; climate change vulnerability of households; and ethnicity and air pollution at crossroads of intersectionality of energy poverty.

Finally, this dissertation analyzes a complex problem affecting millions of citizens in Europe in the context of the energy transition. Energy poverty is spatially and structurally embedded in the economic and political space which co-produces energy poverty (Bouzarovski and Simcock 2017; Heffron *et al.* 2015; Petrova 2018) and co-shaped by path-dependencies (Bouzarovski *et al.* 2016) needing to be redesigned. The heat market is a space where multiple vulnerabilities clash. The energy transition needs to be remodeled into a human-focused, inclusive, and empowering socially

[14] Out of the margins, into the light: Exploring energy poverty and household coping strategies in Austria, North Macedonia, France, and Spain; accepted by ERSS with authors: Stojilovska, A., Yoon, H., and Robert, C.

just energy transformation which brings closer the visionary concept of energy justice to citizens (Heffron and McCauley 2014) and fulfills the visions of the European Green Deal. Since the path-dependencies have played a key role in defining today's energy poverty face, shape and policies, it is of crucial importance to develop the energy transition in line with the needs of the energy-poor for tomorrow.

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10. APPENDICES

10.1 Appendix 1: Type of heating according to different statistics

The Statistical Office of Austria refers to the way dwellings are heated by using the notion type of heating (Heizungsart) and follows a breakdown per technology as shown in Table 1 (Statistik_Austria 2016c). The options are: 1) district heating which refers to a heating system installed outside the house or building that supplies more houses/buildings; 2) central house heating which is central heating system outside the apartment, but inside the house or the building and this also includes heating of passive houses with solar energy or heat pumps; 3) floor-level heating which is a central heating for a single apartment, which means there is a heating boiler in the apartment; 4) gas converter, which means that single rooms have a gas heater; 5) electric heating in which case there are fixed heaters on the floor or the wall; 6) heating on a single heater which means that single rooms are heated with a single heater on wood, coke or oil and this does not include single heaters on gas or electricity; 7) and no heating where there are no fixed installed heaters and the heating is done with gas stove, electric radiator or similar (Statistik_Austria 2016c).

The Austrian way of heating is described is similar to Eurostat's understanding of dwellings equipped with heating facilities (Eurostat 2010), which makes this division to be space-oriented. The first option is central heating or similar, in which case the heating is provided from a community heating center or from an installation in the building or house regardless of the heating fuel (Eurostat 2010). Fixed electrical radiators, electrical panel heaters, fixed gas heaters are included if they are part of the heating installation and the heating is available in most rooms (Eurostat 2010). The second option is other fixed heating, such as stoves, heaters, fireplaces or air conditioners (Eurostat 2010). The next option is non-fixed heating which could be portable air conditioning. The last option is no heating at all, which means the dwelling is not equipped with any device for heating (Eurostat 2010).

The North Macedonian Statistical Office uses the notion of primary energy commodity used for heating to refer to the way dwellings are heated (State_Statistical_Office 2015a). In North Macedonia, the statistical categorization is done mainly by a breakdown per fuel (Table 1). The options include: fuelwood, coal, heating oil, LPG, other biomass (wood residues, wood briquettes and pellets), derived heat and electricity (State_Statistical_Office 2015a). However, there is a more detailed division referred to as per the type of heating in which case both technology and fuels are combined, and it is indicated whether a certain type of heating is used as a basic or additional type of heating (State_Statistical_Office 2015a). The possible types of heating include: public central heating, which is the district heating, central heating from a shared boiler in a collective building, central heating with a boiler installed in the apartment, air conditioner, heater on solid or liquid fuels, thermal heaters, electrical panels, electrical heaters, floor electrical heating, combined heating with solar collectors and other types of heating (State_Statistical_Office 2015a). In addition, there is separate data about the availability of electrical heating appliances (State_Statistical_Office 2015a), since they are often used as a main or secondary type of heating.

10.2 Appendix 2: Interview questionnaire for stakeholders

Questions
How can the quality of households' heating and other energy services be improved? Who should play a key role in this regard?
How is the choice of heating systems related to energy poverty? Is some type of heating related to colder homes? Why?
Do renewable energy and energy efficiency technology reach the end user, regardless of their income level? If not, why?
What are the schemes for renewable energy and energy efficiency? What is the result of such schemes – higher electricity price, higher taxes? Who pays for these schemes? Who benefits from support schemes for renewable energy and energy efficiency – households, private sector?
How does electricity liberalization affect households? Which households are most affected? Why?
What is the most adequate definition of energy poverty?
What is the most adequate measure to address energy poverty? How important is the type of heating in this regard?
Do households have access to information about energy –related decisions? Such as building of local infrastructure, formulation of prices, projects for improving the housing quality?
Have there been prominent legal cases in the energy area with relevance to energy poverty? About heating, utilities?
Were there any energy protests? What were the reason and the demands? Outcomes?
What are the future plans for the heat market? Building infrastructure? Improving energy efficiency?
What are the policies on energy poverty? Are the relevant energy strategies and laws on energy poverty properly implemented?
What injustices (for example access, affordability, availability) are embedded in different types of heating: district heating, gas, fuelwood, electricity? Can a household access only individual type of heating if there is no district heating or gas infrastructure? How easy is to disconnect from district heating? Which type of heating is the most and which is the least affordable? Which type of heating is the most polluting, which is the least polluting?
Who are your customers? How many? Has the number of customers increased, remained the same or decreased in the past few years? Why? How do you improve your services? Individual heat meters, expanding the infrastructure for district heating?
How is the price for heating, electricity, fuelwood formulated?
What are the rules if households have unpaid heat/electricity bills? Disconnecting, legal procedures, fees?
What are the strengths and weaknesses of heating on fuelwood/electricity/district heating/heat pumps/gas? Can they heat adequately the home?

How much do solar collectors/heat pumps cost? Can an average household afford them? What are the impacts on energy costs in the household? How feasible is their installation?
What is the use of co-generation in district heating? What is the effect of this high efficient way of heat production on the households?
What are the feasibility, pre-conditions and impacts of decentralized heat generation? Can the households benefit?
Source: author

10.3 Appendix 3: Interview questionnaire for households

Interview questions for households
What type of heating do you use? Please explain
Is the heating installed in the entire dwelling
Do you have individual heat meter?
What are the good and bad sides of your type of heating?
Can you satisfy your basic needs in the household (food, rent, energy costs, other)?
Can you afford your utility bills (heating, electricity, other)?
Which energy costs are the largest?
How comfortable is the heat in your home during the heating season? Why? How do you feel?
Is your home ever cold in heating season? If yes, explain why?
Are you satisfied with the heating you have? Are you satisfied with the heating supply service? Why (not)?
Have you changed your heating? Please explain the reasons the and the differences before and after the change
What kind of heating would be optimal for your household? Why?
Do you economize your heating? How? Why?
How many rooms are there in your dwelling?
Are all rooms heated?
Do you have control over the number of rooms heated?
What is the average indoor temperature?
Are you satisfied with the average indoor temperature?
Do you have control over the indoor temperature?
Do you have arrears on heating bills?
Do you have arrears on electricity bills?
Were you ever disconnected from heating?
Were you ever disconnected from electricity?
Do you receive social welfare?
Have you ever received support for energy costs?
What kind of dwelling do you have?

Who owns the dwelling?
When was the dwelling built?
Do you have damp walls, leaking roof, rotten windows or condensation?
Have you ever implemented energy efficiency measures? If you have, explain which and how they had an effect on your energy costs and indoor temperature?
What is the household income per month?
How many people live in the household?
How many children (by age 18) live in the household?
How many pensioners live in the household?
Are there unemployed members?
Highest education level?
Your ethnicity?
Where do you live – rural or urban?
Source: author

10.4Appendix 4: Survey questionnaire for households

Questionnaire for households
1. Name of municipality and address
2. Rural or urban area
3. Date
4. Does one household live on this address?
5. What type of heating does your household use? a) District heating – go to Q7, Q8, Q10, Q13 b) Central heating - go to Q6, Q7, Q8, Q10, Q13 c) Fuelwood – go to Q8, Q9, Q10, Q13 d) Electricity – go to Q8, Q10, Q11, Q12, Q13 e) Gas converter – go to Q8, Q9, Q10, Q13 f) Combined – specify g) Other - specify h) No heating – Q13
6. Where is the boiler? In the building In the apartment Other – specify
7. What kind of boiler? Oil Gas Heat pump Co-generation Other - specify
8. Is your dwelling a passive house? Yes No Don't know
9. How many stoves? 1 2 3 or more
10. Is the heating installed through the whole dwelling? Yes Partly – specify No Don't know
11. How many electrical devices for heating? 1 2 3 4 5 or more
12. What kind of electric devices for heating? Air conditioner Thermal heater Electrical panel

Electrical heater Floor electrical heating Combination – specify Other - specify
13. Can you heat adequately your home? Yes - go to Q15 Partly – specify – go to Q14, Q15 No – go to Q 14, Q15 Don' t now – go to Q15
14. Why can or cannot you adequately heat your home?
15. How do you pay for heating? Once yearly Monthly through the whole year Monthly only during the heating season Other – specify Don't know
16. Do you heat during the whole heating season (15. October – 15. April) Yes – go to Q18 Partly – specify – go to Q17, Q18 No – go to Q17, Q18 Don't know – go to Q18
17. Why?
18. During the heating season do you heat 24/7? Yes - go to Q20 Partly – specify – go to Q19, Q20 No - go to Q19, Q20 Don't know - go to Q20
19. Why?
20. Why do you use your current way of heating?
21. Have you changed the type of heating in the past few years? Yes – from one to another type -specify - go to Q22, Q23, Q24, Q25 Yes – changed supplier (but same type) – go to Q22, Q23, Q24, Q25 Partly – go to Q22, Q23, Q24, Q25 No – go to Q25 Don't know – go to Q25
22. What was the reason?
23. How has the change of the heating impacted your heating bills? Reduced them Increased them Remained the same Don't know
24. How has the change of heating impacted your indoor temperature? Increased it to an optimal level Increased it to a higher than optimal level Reduced it to an optimal level Reduced it to a lower than optimal level Remained the same Don't know
25. Are you satisfied with your current way of heating? Yes - go to Q27 No - go to Q26, Q27 Don't know – go to Q27
26. Why?
27. Would you use another heating type if there are possibilities? Yes –go to Q28, Q29, Q30, Q31

No – go to Q29, Q31 Don't know – go to Q31
28. Which type of heating would you choose?
29. Why?
30. Which conditions are needed for you to use your wanted type of heating? More information More finances Help from the authorities Other - specify Don't know
31. Have the costs for heating changed in the past few years? Yes – increased Yes – decreased No – remained the same Don't know
32. Do you economize your heating? Yes –go to Q33, Q34, Q35 No – go to Q34, Q35 Don't know – go to Q35
33. How?
34. Why?
35. Can you afford for energy costs for lighting, cooling, cooking, appliances, hot water? Yes Partly Other - specify No Don't know
36. Does the household have arrears on heating bills/costs? Yes No Don't know
37. Is the household able to pay to keep the home adequately warm? Yes Partly - specify No Don't know
38. Excluding heating, do you use other fuels in the household apart from electricity? Yes – solar energy for hot water Yes – gas for hot water Yes – gas for cooking Yes – other – specify No Don't know
39. Have you ever been disconnected from electricity? Yes – go to Q40, Q41 No – go to Q41 Don't know – go Q41
40. Have you ever been disconnected from heating? Yes – go to Q42, Q43 No - go to Q43 Don't know – go to Q 43
41. Does the household have arrears on electricity bills? Yes No

Don't know
42. What is the household income per month on average?[15] Below 60% of the median 60-179 % of the median 180% or above of the median
43. Has the household income changed in the past few years? Yes – increased Yes – decreased No – remained the same Don't know
44. How many rooms do you have in your dwelling (all rooms excluding kitchen, bathroom and hallway)? 1 2 3 4 5 or more
45. Are all occupied rooms including kitchen and bathroom heated? Yes Partly – specify No Don't know
46. Do you have control over how many rooms are being heated? Yes Partly - specify No Don't know
47. Is the indoor temperature the same in all heated rooms? Yes – go to Q50, Q52 No – go to Q50, Q51, Q52 Don't know – go to Q50, Q52
48. What is the average level of indoor temperature in degrees Celsius in the heating period in your dwelling? Below 15 15-18 18-20 21 22-23 Above 23
49. What is the difference in indoor temperature from room to room?
50. Do you have control over the indoor temperature in the heating period in your dwelling? Yes Partly – specify No Don't know
51. Are you satisfied with the average level of indoor temperature in the heating period in your dwelling? Yes Partly – specify No Don't know
52. Do you need more heat in your home (above 21 degrees)? Yes – go to Q55, Q56

[15] In North Macedonia in 2015 the monthly value lower than 60% of the median is below 105 EUR, and in Austria below 1163 EUR (based on official statistics of both countries).

No – go to Q56 Don't know – go to Q56
53. Why?
54. How many people live in your household? 1 2 3 4 5 or more
55. How many children (by age of 18) live in your household? 0 1 2 3 4 5 or more
56. How many pensioners? 0 1 2 3 4 5 or more
57. Do you have unemployed adults in your household? Yes No
58. Do you have disabled/long-term ill person in your household? Yes No
59. What is the highest level of education of the household's head(s)? Uncompleted primary education Primary education Secondary education Higher education
60. Your ethnicity
61. Does the household receive any social welfare assistance? Yes No Don't know
62. In what kind of dwelling does the household live? a) Detached house b) Terrace house c) Apartment in a collective building d) Other -please specify
63. When the dwelling the household lives in was built? Before 1919 1919-1944 1945-1960 1961-1970 1971-1980

1981-1990 1991-2000 From 2001 Don't know
64. Who owns the dwelling the household lives in? A family member living in the dwelling Renting from third person Social housing Other – specify
65. Presence of leaking roof/ damp walls/rotten windows/condensation? Yes Partly - specify No Don't know
66. Has the household undertaken any energy efficiency measures? Yes – improved insulation – go to Q69, Q70, Q71, Q72, Q74 Yes – changed window(s) – go to Q69, Q70, Q71, Q72, Q74 Yes – changed lighting – go to Q69, Q70, Q71, Q72, Q74 Yes – solar collector – go to Q69, Q70, Q71, Q72, Q74 Yes – individual heat meter – go to Q69, Q70, Q71, Q72, Q74 Yes- smart meter – go to Q69, Q70, Q71, Q72, Q74 Yes – other –specify – go to Q69, Q70, Q71, Q72, Q74 Yes – combination – specify – go to Q69, Q70, Q71, Q72, Q74 No - Q73, Q74 Don't know – Q74
67. How did you finance the energy efficiency improvements? Own savings Bank loan Support program for public sector Combination – specify Don't know
68. How has the energy efficiency improvements impacted your heating bills? Reduced them Increased them Remained the same Don't know
69. How has the energy efficiency improvements impacted your indoor temperature? Increased it to an optimal level Increased it to a higher than optimal level Reduced it to an optimal level Reduced it to a lower than optimal level Remained the same Don't know
70. How has energy efficiency improvements affected the electricity bills? Increased them Decreased them Remained the same Other – specify Don't know
71. Why not? Don't have sufficient information Don't have sufficient funds Don't need to due to comfort at home Can't since I don't own the dwelling Other - specify

Don’t know
72. Have you switched your electricity supplier? Yes – go to Q75, Q76 No – go to Q76 Don’t know – go to Q76
73. How has this affected the electricity bills? Increased them Decreased them Remained the same Other – specify Don’t know
74. Have you ever received any support to help you with your energy costs? Yes – financial Yes – technical Yes – advice Yes – other -specify No Don’t know
Source: author

10.5 Appendix 5: List of datasets

Vienna survey dataset (150), 2017

Skopje survey dataset (150), 2017

Austria interview dataset (100), 2017

North Macedonia interview dataset (119), 2017

10.6 Appendix 6: List of materials

Wien Energie Ombudsman materials (received from Wien Energie Ombudsman)

Economic Committee materials (downloaded from the website of the Parliament of the Republic of North Macedonia)

Draft energy law materials (downloaded from the website of the Parliament of the Republic of North Macedonia)

Parliament debate materials (downloaded from the website of the Parliament of the Republic of North Macedonia)

Legal Committee materials (downloaded from the website of the Parliament of the Republic of North Macedonia)

10.7 Appendix 7: List of interviewed stakeholders

For Austria:

1. Arbeitskammer, 16.03. 2017, Vienna, face to face, recorded, signed consent form
2. WIFO, 10.03.2017, Vienna, face to face, recorded, signed consent form
3. Katolischsoziale Akademie, 31.03.2017, skype, recorded, signed consent form
4. Biomasse Verband, 17.03.2017, Vienna, face to face, recorded, signed consent form
5. Boesch, 15.03.2017, Vienna, face to face, recorded, signed consent form
6. Caritas, 22.03.2017, Vienna, face to face, recorded, signed consent form
7. AIT, 15.03. 2017, Vienna, face to face, recorded, signed consent form
8. E-Sieben, 09.03.2017, Vienna, face to face, recorded, signed consent form
9. Qualitätsgruppe Wärmedämmsysteme, 24.03.2017, Vienna, face to face, recorded, signed consent form
10. IFZ, 07.04.2017, skype, recorded, signed consent form
11. IWO, 16.03.2017, Vienna, face to face, recorded, signed consent form
12. JKU, 23.03.2017, Linz, face to face, recorded, signed consent form
13. Heilandskirche, 28.03.2017, skype, recorded, signed consent form
14. Klimafonds, 17.03.2017, Vienna, face to face, recorded, signed consent form
15. TU Wien, 04.04.2017, skype, recorded, signed consent form
16. Linz AG, 20.04.2017, skype, recorded, signed consent form
17. Volkshilfe, 21.03.2017, Vienna, face to face, recorded, signed consent form
18. Ökosoziales Forum, 28.03.2017, skype, recorded, signed consent form
19. E-Control, 23.03.2017, Vienna, face to face, recorded, signed consent form
20. Heilandskirche (different interviewee), 30.03.2017, skype, recorded, signed consent form
21. Ministry of Social Affairs, 22.03, Vienna, face to face, recorded, signed consent form
22. Donau Uni Krems, 28.03.2017, skype, recorded, signed consent form Tania
23. Wien Energie Ombudsman, 16.03.2017, Vienna, face to face, recorded, signed consent form
24. Representative of the private sector (wanted to remain anonymous), 23.03.2017, Linz, face to face, recorded, signed consent form
25. OÖ Energiesparverband, 18.04.2017, written response, signed consent form
26. Ministry of Economy – informal conversation, 14.03.2017, phone

For North Macedonia:

1. Platform against poverty, 05.06.2017, Skopje, face to face, recorded, signed consent form
2. Ceprosard, 05.06.2017, Skopje, face to face, recorded, signed consent form
3. CRPM, 10.05.2017, Skopje, face to face, recorded, signed consent form
4. FEIT, 09.06.2017, Skopje, face to face, recorded, signed consent form
5. Independent expert (consultancy), 30.05.2017, Skopje, face to face, recorded, signed consent form
6. EE Blog, 29.05.2017, Skopje, face to face, recorded, signed consent form
7. Eterna solar, 19.05.2017, Skopje, face to face, recorded, signed consent form
8. GIZ North Macedonia, 10.05.2017, Skopje, face to face, recorded, signed consent form
9. Habitat North Macedonia, 25.05.2017, Skopje, face to face, recorded, signed consent form
10. Independent expert (civil engineer sector), 07.06.2017, Skopje, face to face, recorded, signed consent form
11. Municipality of Karposh, 26.05.2017, Skopje, face to face, recorded, signed consent form
12. Knauf, 08.06.2017, Skopje, face to face, recorded, signed consent form
13. Webseff program of EBRD, 21.06.2017, skype, recorded, signed consent form
14. Ekosvest, 18.05.2017, Skopje, face to face, recorded, signed consent form
15. Info center for EE of city of Skopje, 31.05.2017, Skopje, face to face, recorded, signed consent form
16. Analytica think tank, 12.05.2017, Skopje, face to face, recorded, signed consent form
17. Representative of the private sector (wanted to remain anonymous), 11.05.2017, Skopje, face to face, recorded, signed consent form
18. UNDP, 23.05.2017, Skopje, face to face, recorded, signed consent form
19. USAID, 22.05.2017, Skopje, face to face, recorded, signed consent form
20. Independent expert (mining sector), 08.06.2017, Skopje, face to face, recorded, signed consent form
21. BEG, 25.05.2017, written response, informal interview
22. Municipality of Kumanovo, 23.06.2017, written response, signed consent form
23. ELEM, 31.05.2017, Skopje, face to face, signed consent form

24. EVN, 19.05.2017, Skopje, face to face, signed consent form
25. GAMA 07.06.2017, Skopje, face to face, signed consent form
26. Rehau, 09.06.2017, Skopje, face to face, signed consent form
27. Independent expert (regulatory sector), 09.06.2017, Skopje, face to face, signed consent form
28. Center for Innovations, 31.05.2017, Skopje, face to face, informal conversation

10.8 Appendix 8: Consent form for interviewed stakeholders

(logo of CEU)

Consent form

University: Central European University Budapest

Doctoral thesis: Synergies between heating and energy poverty - the injustice of heat

PhD student: Ana Stojilovska

Goal of the interview: gathering information about the type of heating and use of energy in Macedonia and how they are related to energy poverty

I give my consent to participate in this interview under the following conditions:

The results from the interview will be published in the doctoral thesis and in other publications of the PhD student.

The interview is anonymous. The results will be published without the name of the interviewee.

The confidentiality of the personally identifiable data is guaranteed.

Your participation is voluntary.

The interview will last about 40 minutes.

I will get one copy of this consent form.

You can ask for the results of this interview after publication of the doctoral thesis Stojilovska_Ana@phd.ceu.edu

The interview can be recorded. YES NO

Signature of the PhD student Date

Signature of the interviewee Date

10.9 Appendix 9: Descriptive variables of the collected household data

Skopje and Vienna datasets (surveys) – energy poverty				
	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
Can you adequately heat your home	Yes 46,3%	Not satisfied 53,7%	Yes 91,9%	Not satisfied 8,1%
Do you economize your heating	Yes 49%	No 51%	Yes 62,2%	No 37,8%
Can you afford energy costs for lighting, cooling, cooking, appliances and hot water	Yes 57,8%	Not completely 42,2%	Yes 96%	Not completely 4%
Can you pay to keep the home adequately warm	Yes 53%	Not completely 47%	Yes 94,7%	Not completely 5,3%
Household income	Up to 59% of the median 5,2%	From 60% of the median 94,8%	Up to 59% of the median 15,9%	From 60% of the median 84,1%
Presence of leaking roof, rotten windows, condensation or damp walls	Yes 35,8%	No 64,2%	Yes 11,4%	No 88,6%
Are all rooms heated	Yes 29,5%	Not completely 70,5%	Yes 60,7%	Not completely 39,3%
Have you undertaken any energy efficiency measures	Yes 39,9%	No 60,1%	Yes 43,4%	No 56,6%
What kind of energy efficiency	None or small (window) 73%	Larger (insulation, combination, other) 27%	None or small (window)	Larger (insulation, combination, other) 23,4%

measures have you installed						76,6%				
How did you finance the energy efficiency improvements	Own savings 83%	Bank loan 3,8 %	Support from public sector 5,7%	Other 3,8%	Combination 3,8%	Own savings 46,6 %	Bank loan 3,4 %	Support from public sector 0%	Other 46,6 %	Combination 3,4%
Why have you not installed energy efficiency measures	Don't have enough funds 56,8%	Don't need due to comfort at home 29,5%	Can't since I don't own the dwelling 1,1%	Other 11,4 %	Don't know 1,1%	Don't have enough funds 2,5%	Don't need due to comfort at home 72,8%	Can't since I don't own the dwelling 8,6%	Other 14,8 %	Don't know 1,2%

Skopje and Vienna datasets (surveys) – Coping strategies and priorities aimed at managing energy costs				
	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
economize other things	Yes 4%	No 96%	Yes 2.7%	No 87.3%
have to be able to afford	Yes 9.3%	No 90.7%	Yes 7.3%	No 92.7%
economize electricity	Yes 9.3%	No 90.7%	Yes 2%	No 98%
first costs	Yes 18%	No 82%	Yes 2%	No 98%
have to be satisfied with heating or T	Yes 10.7%	No 89.3%	Yes 1.3%	No 98.7%
hot water and/or cooking	Yes 45.3%	No 54.7%	Not available	Not available
cheap electricity tariff	Yes 18.7%	No 81.3%	Not available	Not available
minimal electricity use	Yes 5.3%	No 94.7%	Yes 3.3%	No 96.7%

Skopje and Vienna datasets (surveys) – Coping strategies and priorities aimed at managing warmth and comfort

	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
importance of warmth	Yes 48.7%	No 51.3%	Yes 4%	No 96%
warmer clothes	Yes 9.3%	No 90.7%	Yes 2.7%	No 97.3%
cannot economize when cold	Yes 6.7%	No 93.3%	Yes 2%	No 98%
one room only	Yes 36%	No 64%	Yes 6.7%	No 93.3%

Skopje and Vienna datasets (surveys) – Tension between different coping strategies and priorities				
	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
economize in order to pay bills or forced to economize	Yes 8%	No 92%	Yes 2%	No 98%
food vs warmth	Yes 4.7%	No 95.3%	Yes 1.3%	No 98.7%
pay vs warmth	Yes 15.3%	No 84.7%	Not available	Not available
economizing heating vs need of warmth	Yes 6.7%	No 93.3%	Yes 7.3%	No 92.7%

Skopje and Vienna datasets (surveys) – Household structure		
	Valid percent	Valid percent
Variables/Data set	Skopje (150 surveys)	Vienna (150 surveys)

No. of people	1 person 16.7%	2 or more 83.3%	1 person 40.7%	2 or more 59.3%
No. of people	1 to 4 persons 71.3%	5 or more 28.7%	1 to 4 persons 96.7%	5 or more 3.3%
Single female household	Yes 12.7%	No 87.3%	Yes 30.7%	No 69.3%
No. of children	Yes 24.7%	No 75.3%	Yes 8.7%	No 91.3%
No. of children	None to 2 96%	3 or more children 4%	None to 2 100%	3 or more children 0%
No. of pensioners	Yes 78%	No 22%	Yes 76.7%	No 23.3%
One pensioner	Yes 14.7%	No 85.3%	Yes 36%	No 64%
Only pensioners	Yes 27.3%	No 72.7%	Yes 64.7%	No 35.3%
Unemploymen t	Yes 41.3%	No 58.7%	Yes 5.3%	No 94.7%
Income	Up to 59% of median 5.2%	60% of median or higher 94.8%	Up to 59% of median 15.9%	60% of median or higher 84.1%
Low income	Yes 29.9%	No 70.1%	Yes 60.3%	No 39.7%
Education	Higher education 42.7%	No higher education 57.3%	Higher education 44.3%	No higher education 55.7%
Lowest education	Yes 16.7%	No 83.3%	Yes 4%	No 96%
Ethnicity	Majority 75.8%	Minority 24.2%	Majority 89.3%	Minority 10.7%
Non-EU	Not available	Not available	Yes 2.7%	No 97.3%
Roma	Yes 8.1%	No 91.9%	Not available	Not available
Disability/long -term illness	Yes 39.3%	No 60.7%	Yes 17.6%	No 82.4%
Social welfare recipient	Yes 1.3%	No 98.7%	Yes 8.7%	No 91.3%

Skopje and Vienna datasets (surveys) – type of heating		
	Valid percent	Valid percent
Variables/Data set	Skopje (150 surveys)	Vienna (150 surveys)

Type of heating - binary	Central heating 30%	Non-central heating 70%	Central heating 86%	Non-central heating 14%
Type of heating	District heating 14.7%		District heating 23.3%	
	Central heating 14%		Central heating 62.7%	
	Fuelwood 42.7%		Fuelwood 1.3%	
	Electricity 19.3%		Electricity 3.3%	
	Other 2.7%		Gas convector 6%	
	Combined 6.7%		Combined 2.7%	
			No heating 0.7%	

Skopje and Vienna datasets (surveys) – Households' dwelling				
	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
Rural/urban	Urban 78.2%	Rural 21.8%	Urban 100%	Rural 0%
Dwelling	House 69.8%	Apartment 30.2%	House 22.1%	Apartment 77.9%
Owner	In ownership 98.7%	Other 1.3%	In ownership 38.7%	Other 61.3%
Year	Until 2000 88.1%	2001 or later 11.9%	Until 2000 94.9%	2001 or later 5.1%
No. rooms	1 or 2 rooms 30.9%	3 or more rooms 69.1%	1 or 2 rooms 32%	3 or more rooms 68%
EE measures	Yes 39.2%	No 60.8%	Yes 42.8%	No 57.2%
EE size	Larger 27%	No or smaller 73%	Larger 20.8%	No or smaller 79.2%

Skopje and Vienna datasets (surveys) – Households' heating				
	Valid percent		Valid percent	
Variables/Data set	Skopje (150 surveys)		Vienna (150 surveys)	
Installed	Yes 29.3%	Not fully 70.7%	Yes 81.3%	Not fully 18.7%
Satisfied heating	Yes 76.8%	No 23.2%	Yes 98%	No 2%

Change heating	Yes 22.7%	No 77.3%	Yes 11.3%	No 88.7%
Another heating	Yes 66.9%	No 33.1%	Yes 14.1%	No 85.9%
Control T	Yes 36.1%	Not completely 63.9%	Yes 91.9%	Not completely 8.1%
Control rooms	Yes 17.4%	Not completely 82.6%	Yes 83.1%	Not completely 16.9%
Heat 24/7	Yes 17.4%	Not fully 82.6%	Yes 51.4%	Not fully 48.6%
Heat season	Yes 86.6%	Not fully 13.4%	Yes 77%	Not fully 23%
T same	Yes 21%	No 79%	Yes 35.4%	No 64.6%
Change energy provider	Not available	Not available	Yes 18.3%	No 81.7%
Support	Yes 4.1%	No 95.9%	Yes 1.4%	No 98.6%

North Macedonia and Austria datasets (online interviews)-type of heating				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
Type of heating - binary	Central heating 36.6%	Non-central heating 63.4%	Central heating 89.9%	Non-central heating 10.1%
Type of heating	District heating 9.8%		District heating 3%	
	Central heating 24.1%		Central heating 79.8%	
	Electricity 22.3%		Electricity 2%	
	Fuelwood 30.4%		Gas convector 1%	
	Combined 11.6%		Combined 14.1%	
	Other 1.8%			

North Macedonia and Austria datasets (online interviews) – Households' dwelling		
Variables/ Dataset	Valid percent	Valid percent

	North Macedonia (112 interviews)		Austria (99 interviews)	
Rural/urban	Urban 43.2%	Rural 56.8%	Urban 44%	Rural 56%
Dwelling	House 55%	Apartment 45%	House 92.8%	Apartment 7.2%
Owner	In ownership 94.6%	Other 5.4%	In ownership 92.9%	Other 7.1%
Year	Until 2000 80.2%	2001 or later 19.8%	Until 2000 93.9%	2001 or later 6.1%
No. rooms	1 or 2 rooms 21.4%	3 or more rooms 78.6%	1 or 2 rooms 1%	3 or more rooms 99%
EE measures	Yes 34.9%	No 65.1%	Yes 70.7%	No 29.3%
EE size	Larger 27.1%	No or smaller 72.9%	Larger 59.2%	No or smaller 40.8%

North Macedonia and Austria datasets (online interviews) – Households' heating				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
Installed	Yes 43.8%	No 56.3%	Yes 99%	No 1%
Satisfied heating	Yes 62.5%	Not completely 37.5%	Yes 85.9%	Not completely 14.1%
Change heating	Yes 19.1%	No 80.9%	Yes 47.5%	No 52.5%
Control T	Yes 79.5%	No 20.5%	Yes 100%	No 0%
Control rooms	Yes 87.5%	No 12.5%	Yes 98%	No 2%
Biggest energy cost	Heating bill 22.2%	Electricity bill 77.8%	Heating bill 84.4%	Electricity bill 15.6%
Support	Yes 10.7%	No 89.3%	Yes 27.3%	No 72.7%

North Macedonia and Austria datasets (online interviews) – Coping strategies and priorities aimed at managing energy costs		
Variables/ Dataset	Valid percent	Valid percent
	North Macedonia (112 interviews)	Austria (99 interviews)

economize other things	Yes 4.5%	No 95.5%	Yes 1%	No 99%
have to be able to afford	Yes 2.7%	No 97.3%	Yes 1%	No 99%
economize electricity	Yes 9.8%	No 90.2%	Not available	Not available
first costs	Yes 0.9%	No 99.1%	Not available	Not available
hot water and/or cooking	Yes 5.4%	No 94.6%	Not available	Not available
cheap electricity tariff	Yes 8%	No 92%	Not available	Not available

North Macedonia and Austria datasets (online interviews) – Coping strategies and priorities aimed at managing warmth and comfort				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
importanc e of warmth	Yes 8%	No 92%	Yes 2%	No 98%
warmer clothes	Yes 2.7%	No 97.3%	Yes 2%	No 98%
cannot economize when cold	Yes 0.9%	No 99.1%	Not available	Not available

North Macedonia and Austria datasets (online interviews) – Tension between different coping strategies and priorities				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
economize in order to pay bills or forced	Yes 7.1%	No 92.9%	Yes 1%	No 99%

to economize				
food vs warmth	Yes 1.8%	No 98.2%	Yes 1%	No 99%
pay vs warmth	Yes 11.6%	No 88.4%	Yes 2%	No 98%
economizing heating vs need of warmth	Yes 2.7%	No 97.3%	Not available	Not available

North Macedonia and Austria datasets (online interviews) – Household structure				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
No. of children	Yes 44.6%	No 55.4%	Yes 30.3%	No 69.7%
No. of pensioners	Yes 30.4%	No 69.6%	Yes 52.5%	No 47.5%
Unemployment	Yes 35.7%	No 64.3%	Yes 5.1%	No 94.9%
Income	Up to 59% of median 5.4%	60% of median or higher 94.6%	Up to 59% of median 3.1%	60% of median or higher 96.9%
Education	Higher education 88.4%	No higher education 11.6%	Higher education 33.3%	No higher education 66.7%
Ethnicity	Majority 84.8%	Minority 15.2%	Majority 96.6%	Minority 3.4%
Social welfare recipient	Yes 0.9%	No 99.1%	Yes 4%	No 96%

North Macedonia and Austria datasets (online interviews) – energy poverty				
Variables/ Dataset	Valid percent		Valid percent	
	North Macedonia (112 interviews)		Austria (99 interviews)	
Do you economize your heating	Yes 42,9%	No 51,7%	Yes 42,4%	No 57,6%

Household income	Below 30% of the median 3,6%	30-59% of the median 1,8%	60-119% of the median 8%	120-159% of the median 8,9%	160-212% of the median 14,3 %	213% of the median and higher 63,4 %	Below 30% of the median 1%	30-59 % of the median 2,1 %	60-119% of the median 21,1 %	120-159% of the median 32,3 %	160-212% of the median 15,6 %	213% of the median and higher 20,8%
Presence of leaking roof, rotten windows, condensation or damp walls	Yes 28,6%			No 71,4%			Yes 6,1%			No 93,9%		
Are all rooms heated	Yes 37,5%			Not completely 62,5%			Yes 76,8%			Not completely 23,2%		
Have you undertaken any energy efficiency measures	Yes 42,2%			No 57,8%			Yes 77,8%			No 22,2%		
What kind of energy efficiency measures have you installed	None or small (window) 75,2%			Larger (insulation, combination, other) 24,8%			None or small (window) 35,4%			Larger (insulation, combination, other) 64,6%		
Can you pay the energy costs for heating and electricity	Yes 79,5%			Not completely 20,5%			Yes 96%			Not completely 4%		
Can you satisfy your basic needs	Yes 68,5%			Not fully 31,5%			Yes 93,9%			Not fully 6,1%		
Is it sometimes cold in your dwelling	Yes 39,6%			No 60,4%			Yes 8,1%			No 91,9%		

10.10 Appendix 10: Variables predicting energy poverty in Vienna and Skopje for various energy poverty indicators

Energy poverty indicator as a dependent variable	Significant variables – Vienna survey dataset	Significant variables – Skopje survey dataset	Elaboration of the variables
Can you adequately heat your home?	People single + ethnicity Single female + ethnicity Single female + installed Education+ built before 1919 Ethnicity + installed Ethnicity + control rooms Ethnicity + T same Rent + heat season	Education + built 71-90 Education + disconnected heating Ethnicity + built 71-90 built 71-90 + control rooms	People single = 1 person household = 1 People more = large household = 1 Single female = single female household = 1 Children = presence of children = 1 Pensioners = presence of pensioners = 1 Unemployment = at least one unemployed member = 1 Education = no higher education = 1 Ethnicity = minority/migrant = 1 Disabled = presence of disabled or ill person = 1 Need higher T = statement that one needs greater warmth = 1
Can you pay for the heating?	Single female + ethnicity Education + ethnicity Ethnicity + large rooms Ethnicity + installed Ethnicity + control rooms	Education + ethnicity Education + disconnected heating Ethnicity + disconnected heating House + EE Installed + disconnected heating	
Can you pay for energy services excluding heating?	Single female + ethnicity	People more + education People more + ethnicity People more + disabled People more + installed People more + control rooms People more + T same People more + disconnected electricity People more + disconnected heating Unemployment + disabled Unemployment + installed Unemployment + control rooms Unemployment + T same	

		Unemployment + disconnected electricity Unemployment + disconnected heating Education + disconnected electricity Education + disconnected heating Ethnicity + disabled Ethnicity + EE Ethnicity + installed Ethnicity + T same Ethnicity + disconnected heating Disabled + installed Disabled + T same Disabled + disconnected electricity Disabled + disconnected heating House + EE House + disconnected electricity EE + installed Installed + disconnected electricity Installed + disconnected heating Control T + disconnected heating T same + disconnected electricity T same + disconnected heating	Income = income poor household = 1 Rural = living in rural area = 1 House = living in a house = 1 built 19-70 = dwelling built between 1919 and 1970 = 1 built 71-90 = dwelling built between 1971 and 1990 = 1 built before 1919 = dwelling built before 1919 = 1 Large rooms = large dwelling = 1 EE = no energy efficiency measures = 1 Rent = living in private rented dwelling = 1 Installed = heating not installed in the whole dwelling = 1
Rotten windows, leaking roof, condensation, damp walls?	Income + education	Disabled + EE Disabled + installed Disabled + control T Disabled + T same Disabled + disconnected heating built 71-90 + EE	

		built 71-90 + control T EE + installed EE + control T EE + T same EE + disconnected heating Installed + control T Control T + T same	Change no = not changed the type of heating = 1 Control T = cannot control T = 1 Control rooms = cannot control heating of separate rooms = 1 Heat 24/7 = doesn't heat 24/7 = 1 Heat season = doesn't heat during whole heating season = 1 T same = unequal T between rooms = 1 Additional heating = uses additional heating = 1 Disconnected electricity = electricity disconnection = 1 Disconnected heating = heat supply disconnection = 1
Do you economize on your heating?	Income + need higher T Ethnicity + need higher T Ethnicity + built 19-70 Need higher T + built 19-70 Need higher T + EE built 19-70 + EE built 19-70 + installed	Children + unemployment Unemployment + installed Unemployment + heat 24/7	
Is the whole dwelling heated?	Large rooms + installed Installed + control T Control T + control rooms	Unemployment + rural Unemployment + heat 24/7 Unemployment + heat season Unemployment + additional heating Ethnicity + heat 24/7 Ethnicity + heat season Ethnicity + additional heating Rural + additional heating House + heat 24/7 House + additional heating Heat 24/7 + additional heating	
Would you use another type of heating?	Pensioners + built 19-70	House + change no House + heat 24/7 built 71-90 + change no EE + T same	

		Change no + T same Heat 24/7 + T same	
Source: own elaboration based on Skopje survey dataset and Vienna survey dataset			

10.11 Appendix 11: Significant and strong cross-tabulation between the type of heating and other variables

Cross tabulation– significant and strong relationship between the type of heating and other variables –Skopje survey dataset						
Variables/Dataset		Skopje				
	Fisher's Exact Test (Chi-Square Test, Exact Sig. 2-sided)	Likelihood Ratio (Chi-Square Test, Asymptotic Significance 2-sided)	Phi (Symmetric Measure, Approximate Significance)	Phi (Symmetric Measure, Value)	Contingency Coefficient (Symmetric Measure, Approximate Significance)	Contingency Coefficient (Symmetric Measure, Value)
Type of heating * Dwelling	.000	.000	.000	-.361	.000	.339
Type of heating * Installed	.000	.000	.000	.920	.000	.677
Type of heating * Control rooms	.000	.000	.000	.657	.000	.549
Type of heating * T same	.000	.000	.000	.471	.000	.426
Type of heating * heat ok	.000	.000	.000	.357	.000	.336
Type of heating * All heated	.000	.000	.000	.760	.000	.605
Type of heating * one room only	.000	.000	.000	-.430	.000	.395
Type of heating * Education	.000	.000	.000	-.406	.000	.376

Cross tabulation– significant and strong relationship between the type of heating and other variables –Vienna survey dataset						
Variables/Dataset		Vienna				
	Fisher's Exact Test (Chi-Square Test, Exact	Likelihood Ratio (Chi-Square Test, Asymptotic Significance 2-sided)	Phi (Symmetric Measure, Approximate Significance)	Phi (Symmetric Measure, Value)	Contingency Coefficient (Symmetric Measure, Approximate Significance)	Contingency Coefficient (Symmetric Measure, Value)

	Sig. 2-sided)					
Type of heating * Installed	.000	.000	.000	.596	.000	.512
Type of heating * Control rooms	.000	.000	.000	.592	.000	.509

Cross tabulation– significant and strong relationship between the type of heating and other variables –North Macedonia interview dataset						
Variables/Dataset		North Macedonia				
	Fisher's Exact Test (Chi-Square Test, Exact Sig. 2-sided)	Likelihood Ratio (Chi-Square Test, Asymptotic Significance 2-sided)	Phi (Symmetric Measure, Approximate Significance)	Phi (Symmetric Measure, Value)	Contingency Coefficient (Symmetric Measure, Approximate Significance)	Contingency Coefficient (Symmetric Measure, Value)
Type of heating * Installed	.000	.000	.000	.787	.000	.618
Type of heating * Biggest energy cost	.001	.001	.000	.340	.000	.332
Type of heating * All heated	.000	.000	.000	.675	.000	.559

Cross tabulation– significant and strong relationship between the type of heating and other variables –Austria interview dataset						
Variables/Dataset		Austria				
	Fisher's Exact Test (Chi-Square Test, Exact Sig. 2-sided)	Likelihood Ratio (Chi-Square Test, Asymptotic Significance 2-sided)	Phi (Symmetric Measure, Approximate Significance)	Phi (Symmetric Measure, Value)	Contingency Coefficient (Symmetric Measure, Approximate Significance)	Contingency Coefficient (Symmetric Measure, Value)

Type of heating * EE_criteria	.013	.009	.001	-.336	.001	.319

10.12 Appendix 12: Significant regression results

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			67.988			
Nagelkerke R square			.230			
Correctly predicted in %			92.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People single	-2.689	.927	8.420	1	.004	.068
Ethnicity	2.266	.949	5.697	1	.017	9.641
Constant	-1.809	.370	23.875	1	.000	.164

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			68.413			
Nagelkerke R square			.224			
Correctly predicted in %			92.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Single female	-2.375	.754	9.915	1	.002	.093
Ethnicity	1.854	.864	4.612	1	.032	6.388
Constant	-1.587	.395	16.162	1	.000	.205

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			68.208			
Nagelkerke R square			.227			
Correctly predicted in %			91.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Single female	-1.929	.707	7.433	1	.006	.145

Installed	1.400	.655	4.575	1	.032	4.057
Constant	-1.930	.488	15.665	1	.000	.145

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.020			
-2 log likelihood			53.153			
Nagelkerke R square			.154			
Correctly predicted in %			94.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-2.241	1.121	3.992	1	.046	.106
Before 1919	-1.548	.779	3.945	1	.047	.213
Constant	-1.196	.612	3.821	1	.051	.303

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			71.412			
Nagelkerke R square			.181			
Correctly predicted in %			91.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	2.150	.872	6.084	1	.014	8.583
Installed	2.237	.745	9.013	1	.003	9.364
Constant	-3.536	.586	36.451	1	.000	.029

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.018			
-2 log likelihood			75.105			
Nagelkerke R square			.123			
Correctly predicted in %			91.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)

Ethnicity	1.589	.786	4.086	1	.043	4.898
Control rooms	1.655	.674	6.026	1	.014	5.231
Constant	-3.129	.469	44.524	1	.000	.044

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.009			
-2 log likelihood			68.657			
Nagelkerke R square			.150			
Correctly predicted in %			92.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.990	.835	5.686	1	.017	7.319
T same	2.220	1.122	3.916	1	.048	9.208
Constant	-4.585	1.117	16.840	1	.000	.010

Heat ok –Vienna survey dataset						
Model chi-square (Sig.)			.024			
-2 log likelihood			75.707			
Nagelkerke R square			.114			
Correctly predicted in %			91.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Rent	1.523	.691	4.855	1	.028	4.584
Heat season	1.494	.705	4.487	1	.034	4.456
Constant	-3.585	.638	31.567	1	.000	.028

Afford services–Vienna survey dataset	
Model chi-square (Sig.)	.003
-2 log likelihood	38.650

Nagelkerke R square			.263			
Correctly predicted in %			96.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Single female	-2.230	1.034	4.651	1	.031	.108
Ethnicity	2.922	1.019	8.217	1	.004	18.573
Constant	-2.800	.629	19.838	1	.000	.061

Afford warm–Vienna survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			47.822			
Nagelkerke R square			.273			
Correctly predicted in %			95.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Single female	-2.112	.926	5.199	1	.023	.121
Ethnicity	3.029	.924	10.512	1	.001	20.683
Constant	-2.541	.557	20.847	1	.000	.079

Afford warm–Vienna survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			47.931			
Nagelkerke R square			.270			
Correctly predicted in %			94.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-2.326	1.162	4.006	1	.045	.098
Ethnicity	2.845	.856	11.052	1	.001	17.201
Constant	-2.968	.519	32.698	1	.000	.051

Afford warm–Vienna survey dataset	
Model chi-square (Sig.)	.000

-2 log likelihood			44.979			
Nagelkerke R square			.323			
Correctly predicted in %			96			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	3.056	.952	10.298	1	.001	21.346
Large	-2.586	.994	6.763	1	.009	.075
Constant	-2.470	.539	20.975	1	.000	.085

Afford warm–Vienna survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			48.380			
Nagelkerke R square			.263			
Correctly predicted in %			94.7			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	3.555	1.159	9.413	1	.002	35.000
Installed	2.534	1.176	4.642	1	.031	12.600
Constant	-4.654	1.005	21.455	1	.000	.010

Afford warm–Vienna survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			44.855			
Nagelkerke R square			.323			
Correctly predicted in %			95.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	3.531	1.152	9.387	1	.002	34.145
Control rooms	2.965	1.142	6.743	1	.009	19.398
Constant	-4.851	1.024	22.462	1	.000	.008

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			149.050			
Nagelkerke R square			.124			
Correctly predicted in %			63.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Income	1.649	.787	4.396	1	.036	5.203
Need higher T	-1.028	.463	4.923	1	.027	.358
Constant	-1.738	.765	5.165	1	.023	.176

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.004			
-2 log likelihood			181.173			
Nagelkerke R square			.102			
Correctly predicted in %			62.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	-1.576	.784	4.040	1	.044	.207
Need higher T	-.928	.406	5.226	1	.022	.395
Constant	-.094	.211	.198	1	.657	.911

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			168.426			
Nagelkerke R square			.109			
Correctly predicted in %			65			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	-1.615	.791	4.168	1	.041	.199
1919-1970	.938	.381	6.073	1	.014	2.555

Constant	-.761	.239	10.172	1	.001	.467

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.005			
-2 log likelihood			165.489			
Nagelkerke R square			.103			
Correctly predicted in %			67.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Need higher T	-.927	.425	4.761	1	.029	.396
1919-1970	.841	.384	4.802	1	.028	2.318
Constant	-.585	.262	4.976	1	.026	.557

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			178.437			
Nagelkerke R square			.110			
Correctly predicted in %			66.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Need higher T	-1.053	.416	6.397	1	.011	.349
EE measure	-.915	.365	6.271	1	.012	.401
Constant	.339	.299	1.279	1	.258	1.403

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.008			
-2 log likelihood			166.307			
Nagelkerke R square			.095			
Correctly predicted in %			67.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)

1919-1970	.774	.384	4.051	1	.044	2.167
EE measure	-.773	.375	4.257	1	.039	.462
Constant	-.404	.319	1.610	1	.204	.667

Economize heating–Vienna survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			167.570			
Nagelkerke R square			.117			
Correctly predicted in %			67.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
1919-1970	.992	.385	6.636	1	.010	2.696
Installed	-1.378	.597	5.333	1	.021	.252
Constant	-.725	.241	9.040	1	.003	.484

All heated–Vienna survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			185.033			
Nagelkerke R square			.137			
Correctly predicted in %			67.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Large	.871	.428	4.134	1	.042	2.390
Installed	1.797	.497	13.093	1	.000	6.031
Constant	-1.389	.396	12.276	1	.000	.249

All heated–Vienna survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	181.382
Nagelkerke R square	.146
Correctly predicted in %	68.9

Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Installed	1.405	.460	9.315	1	.002	4.074
Control T	1.683	.707	5.672	1	.017	5.382
Constant	-.843	.205	16.883	1	.000	.431

All heated–Vienna survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			183.952			
Nagelkerke R square			.109			
Correctly predicted in %			68			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Control T	1.572	.704	4.989	1	.026	4.819
Control rooms	1.075	.474	5.138	1	.023	2.931
Constant	-.767	.199	14.848	1	.000	.464

EE criteria–Vienna survey dataset						
Model chi-square (Sig.)			.039			
-2 log likelihood			81.181			
Nagelkerke R square			.100			
Correctly predicted in %			88.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Income	1.637	.805	4.134	1	.042	5.142
Education	-1.485	.728	4.161	1	.041	.227
Constant	1.589	.587	7.338	1	.007	4.898

Another type–Vienna survey dataset	
Model chi-square (Sig.)	.001
-2 log likelihood	90.049

Nagelkerke R square			.191			
Correctly predicted in %			84.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Pensioners	1.829	.558	10.750	1	.001	6.225
1919-1970	-1.167	.557	4.399	1	.036	.311
Constant	1.165	.455	6.546	1	.011	3.205

Heat ok–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			169.474			
Nagelkerke R square			.130			
Correctly predicted in %			65.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-.971	.372	6.816	1	.009	.379
1971-1990	1.042	.406	6.603	1	.010	2.835
Constant	.293	.265	1.219	1	.269	1.340

Heat ok–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			191.980			
Nagelkerke R square			.106			
Correctly predicted in %			64.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-.928	.349	7.061	1	.008	.396
Disconnected heating	-1.354	.609	4.944	1	.026	.258
Constant	1.776	.617	8.278	1	.004	5.908

Heat ok–Skopje survey dataset

Model chi-square (Sig.)			.003			
-2 log likelihood			171.240			
Nagelkerke R square			.114			
Correctly predicted in %			64.7			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.039	.471	4.871	1	.027	2.827
1971-1990	1.038	.401	6.699	1	.010	2.823
Constant	-.342	.239	2.060	1	.151	.710

Heat ok–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			161.725			
Nagelkerke R square			.167			
Correctly predicted in %			62.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
1971-1990	1.267	.429	8.705	1	.003	3.549
Control rooms	1.499	.523	8.221	1	.004	4.476
Constant	-1.436	.513	7.834	1	.005	.238

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			183.082			
Nagelkerke R square			.148			
Correctly predicted in %			63.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.398	.419	11.131	1	.001	4.046
Education	-1.113	.389	8.185	1	.004	.328
Constant	-.262	.236	1.238	1	.266	.769

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			181.133			
Nagelkerke R square			.150			
Correctly predicted in %			67.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	.996	.393	6.405	1	.011	2.707
Ethnicity	1.210	.419	8.363	1	.004	3.355
Constant	-.918	.233	15.533	1	.000	.399

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			185.345			
Nagelkerke R square			.129			
Correctly predicted in %			63.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.096	.390	7.919	1	.005	2.993
Disabled	-.911	.358	6.492	1	.011	.402
Constant	-.092	.288	.102	1	.749	.912

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			179.731			
Nagelkerke R square			.175			
Correctly predicted in %			64.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.332	.416	10.247	1	.001	3.790
Installed	1.449	.445	10.609	1	.001	4.259
Constant	-1.764	.431	16.766	1	.000	.171

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			174.604			
Nagelkerke R square			.154			
Correctly predicted in %			65.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.531	.454	11.360	1	.001	4.622
Control rooms	1.656	.585	8.009	1	.005	5.237
Constant	-2.161	.597	13.094	1	.000	.115

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			176.860			
Nagelkerke R square			.135			
Correctly predicted in %			66.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.015	.402	6.368	1	.012	2.758
T same	1.134	.507	5.005	1	.025	3.108
Constant	-1.475	.468	9.946	1	.002	.229

Afford energy services–Skopje survey dataset	
Model chi-square (Sig.)	.001
-2 log likelihood	185.086
Nagelkerke R square	.131
Correctly predicted in %	65.3

Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.155	.390	8.781	1	.003	3.173
Disconnected electricity	-1.303	.513	6.450	1	.011	.272
Constant	.465	.476	.953	1	.329	1.592

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)	.000					
-2 log likelihood	179.189					
Nagelkerke R square	.158					
Correctly predicted in %	66.9					
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
People more	1.143	.393	8.446	1	.004	3.136
Disconnected heating	-1.770	.614	8.303	1	.004	.170
Constant	.914	.586	2.437	1	.119	2.495

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)	.000					
-2 log likelihood	184.059					
Nagelkerke R square	.140					
Correctly predicted in %	63.3					
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.079	.356	9.188	1	.002	.340
Disabled	-.885	.359	6.077	1	.014	.413
Constant	.821	.344	5.687	1	.017	2.273

Afford energy services–Skopje survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	183.884

Nagelkerke R square			.141			
Correctly predicted in %			64.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-.934	.358	6.824	1	.009	.393
Installed	1.027	.422	5.932	1	.015	2.794
Constant	-.542	.436	1.546	1	.214	.582

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			176.981			
Nagelkerke R square			.133			
Correctly predicted in %			66			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-.1.155	.363	10.125	1	.001	.315
Control rooms	1.027	.522	3.871	1	.049	2.792
Constant	-.542	.511	1.127	1	.288	.582

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			176.626			
Nagelkerke R square			.137			
Correctly predicted in %			67.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-.939	.363	6.686	1	.010	.391
T same	1.151	.508	5.135	1	.023	3.160
Constant	-.678	.524	1.675	1	.196	.507

Afford energy services–Skopje survey dataset

Model chi-square (Sig.)			.000			
-2 log likelihood			184.652			
Nagelkerke R square			.135			
Correctly predicted in %			64.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.081	.355	9.254	1	.002	.339
Disconnected electricity	-1.182	.514	5.275	1	.022	.307
Constant	1.309	.525	6.207	1	.013	3.703

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			178.567			
Nagelkerke R square			.163			
Correctly predicted in %			66.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.092	.362	9.102	1	.003	.336
Disconnected heating	-1.581	.617	6.564	1	.010	.206
Constant	1.704	.620	7.548	1	.006	5.497

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			198.375			
Nagelkerke R square			.112			
Correctly predicted in %			62.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-.936	.368	6.475	1	.011	.392
Disconnected electricity	-1.400	.522	7.197	1	.007	.247

Constant	1.266	.531	5.683	1	.017	3.545

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			182.205			
Nagelkerke R square			.133			
Correctly predicted in %			64.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-.858	.367	5.484	1	.019	.424
Disconnected heating	-1.797	.615	8.534	1	.003	.166
Constant	1.631	.619	6.937	1	.008	5.110

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			182.276			
Nagelkerke R square			.141			
Correctly predicted in %			65.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.226	.417	8.659	1	.003	3.407
Disabled	-.831	.360	5.325	1	.021	.436
Constant	-.144	.294	.242	1	.623	.866

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			181.885			
Nagelkerke R square			.122			
Correctly predicted in %			65.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)

Ethnicity	1.307	.421	9.665	1	.002	3.697
EE measure	.741	.374	3.932	1	.047	2.099
Constant	-1.119	.325	11.859	1	.001	.327

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			182.934			
Nagelkerke R square			.136			
Correctly predicted in %			65.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.059	.424	6.238	1	.013	2.882
Installed	.903	.428	4.447	1	.035	2.466
Constant	-1.255	.364	11.854	1	.001	.285

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			175.069			
Nagelkerke R square			.137			
Correctly predicted in %			64.7			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.107	.430	6.632	1	.010	3.026
T same	1.101	.507	4.706	1	.030	3.006
Constant	-1.441	.465	9.600	1	.002	.237

Afford energy services–Skopje survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	179.501
Nagelkerke R square	.142
Correctly predicted in %	68.8

Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.190	.432	7.576	1	.006	3.286
Disconnected heating	-1.352	.627	4.642	1	.031	.259
Constant	.593	.614	.931	1	.335	1.809

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			185.165			
Nagelkerke R square			.130			
Correctly predicted in %			64.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	-.841	.357	5.564	1	.018	.431
Disconnected heating	1.155	.418	7.637	1	.006	3.173
Constant	-.668	.421	2.519	1	.112	.513

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			176.938			
Nagelkerke R square			.135			
Correctly predicted in %			64.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	-.927	.368	6.365	1	.012	.396
T same	1.258	.505	6.193	1	.013	3.517
Constant	-.722	.519	1.939	1	.164	.486

Afford energy services–Skopje survey dataset	
Model chi-square (Sig.)	.001
-2 log likelihood	187.116

Nagelkerke R square			.114			
Correctly predicted in %			63.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	-.935	.356	6.912	1	.009	.393
Disconnected electricity	-1.253	.511	6.007	1	.014	.286
Constant	1.309	.534	6.003	1	.014	3.702

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			181.168			
Nagelkerke R square			.142			
Correctly predicted in %			64.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	-.932	.363	6.602	1	.010	.394
Disconnected heating	-1.741	.613	8.077	1	.004	.175
Constant	1.783	.636	7.869	1	.005	5.946

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.006			
-2 log likelihood			172.986			
Nagelkerke R square			.098			
Correctly predicted in %			62.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	-.849	.409	4.317	1	.038	.428
EE measure	.913	.384	5.662	1	.017	2.491
Constant	-.676	.324	4.359	1	.037	.509

Afford energy services–Skopje survey dataset

Model chi-square (Sig.)			.011			
-2 log likelihood			176.963			
Nagelkerke R square			.086			
Correctly predicted in %			62			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	-.878	.410	4.589	1	.032	.416
Disconnected electricity	-1.174	.556	4.453	1	.035	.309
Constant	.939	.544	2.980	1	.084	2.557

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			183.781			
Nagelkerke R square			.120			
Correctly predicted in %			64.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
EE measure	.750	.369	4.131	1	.042	2.116
Installed	1.298	.421	9.479	1	.002	3.661
Constant	-1.733	.460	14.170	1	.000	.177

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			185.833			
Nagelkerke R square			.125			
Correctly predicted in %			62.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Installed	1.150	.417	7.613	1	.006	3.159
Disconnected electricity	-1.108	.511	4.692	1	.030	.330
Constant	-.214	.575	.138	1	.710	.808

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)	.000					
-2 log likelihood	179.837					
Nagelkerke R square	.153					
Correctly predicted in %	64.1					
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Installed	1.146	.423	7.352	1	.007	3.145
Disconnected heating	-1.623	.615	6.972	1	.008	.197
Constant	.281	.665	.179	1	.672	1.325

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)	.002					
-2 log likelihood	177.418					
Nagelkerke R square	.115					
Correctly predicted in %	64.3					
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Control T	.769	.386	3.964	1	.046	2.158
Disconnected heating	-1.638	.616	7.084	1	.008	.194
Constant	.601	.631	.907	1	.341	1.823

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)	.001					
-2 log likelihood	177.986					
Nagelkerke R square	.126					
Correctly predicted in %	61.4					
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
T same	1.364	.508	7.208	1	.007	3.911

Disconnected electricity	-1.171	.520	5.077	1	.024	.310
Constant	-.380	.622	.373	1	.542	.684

Afford energy services–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			175.705			
Nagelkerke R square			.145			
Correctly predicted in %			62.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
T same	1.285	.508	6.390	1	.011	3.613
Disconnected heating	-1.576	.615	6.570	1	.010	.207
Constant	.084	.721	.014	1	.907	1.088

Afford warm–Skopje survey dataset						
Model chi-square (Sig.)			.004			
-2 log likelihood			193.564			
Nagelkerke R square			.095			
Correctly predicted in %			60.8			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-.720	.355	4.114	1	.043	.487
Ethnicity	.830	.418	3.944	1	.047	2.294
Constant	-.025	.256	.010	1	.922	.975

Afford warm–Skopje survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	188.016
Nagelkerke R square	.141
Correctly predicted in %	60.8

Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Education	-1.006	.360	7.806	1	.005	.366
Disconnected heating	-1.733	.614	7.957	1	.005	.177
Constant	1.826	.623	8.595	1	.003	6.211

Afford warm–Skopje survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			191.623			
Nagelkerke R square			.099			
Correctly predicted in %			63.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	.834	.419	3.965	1	.046	2.303
Disconnected heating	-1.313	.611	4.620	1	.032	.269
Constant	.832	.599	1.927	1	.165	2.298

Afford warm–Skopje survey dataset						
Model chi-square (Sig.)			.011			
-2 log likelihood			178.745			
Nagelkerke R square			.086			
Correctly predicted in %			61			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	-.808	.394	4.198	1	.040	.446
EE measure	.806	.371	4.722	1	.030	2.239
Constant	-.411	.311	1.747	1	.186	.663

Afford warm–Skopje survey dataset	
Model chi-square (Sig.)	.002

-2 log likelihood			191.689			
Nagelkerke R square			.111			
Correctly predicted in %			60.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Installed	.805	.387	4.336	1	.037	2.237
Disconnected heating	-1.481	.601	6.080	1	.014	.227
Constant	.606	.646	.878	1	.349	1.833

Economize heating–Skopje survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			189.374			
Nagelkerke R square			.102			
Correctly predicted in %			58.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Children	.946	.440	4.620	1	.032	2.576
Unemployed	1.127	.377	8.916	1	.003	3.086
Constant	-.856	.330	6.754	1	.009	.425

Economize heating–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			188.906			
Nagelkerke R square			.106			
Correctly predicted in %			60			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	.751	.357	4.418	1	.036	2.119
Installed	-.886	.390	5.169	1	.023	.412
Constant	.216	.414	.272	1	.602	1.241

Economize heating–Skopje survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			189.487			
Nagelkerke R square			.101			
Correctly predicted in %			61.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	.937	.356	6.931	1	.008	2.553
Heat 24/7	-1.005	.477	4.446	1	.035	.366
Constant	.310	.469	.438	1	.508	1.364

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			163.373			
Nagelkerke R square			.127			
Correctly predicted in %			70.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-.886	.410	4.662	1	.031	.412
Rural	1.469	.646	5.177	1	.023	4.347
Constant	1.214	.349	12.098	1	.001	3.366

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.004			
-2 log likelihood			169.720			
Nagelkerke R square			.102			
Correctly predicted in %			71.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.047	.407	6.609	1	.010	.351
Heat 24/7	.959	.460	4.354	1	.037	2.609
Constant	.772	.476	2.634	1	.105	2.164

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			168.244			
Nagelkerke R square			.115			
Correctly predicted in %			70.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.070	.405	6.973	1	.008	.343
Heat season	1.587	.778	4.160	1	.041	4.887
Constant	1.402	.337	17.331	1	.000	4.064

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			160.382			
Nagelkerke R square			.182			
Correctly predicted in %			70.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Unemployed	-1.090	.414	6.921	1	.009	.336
Additional heating	-1.811	.571	10.045	1	.002	.164
Constant	3.009	.622	23.366	1	.000	20.259

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.008			
-2 log likelihood			170.405			
Nagelkerke R square			.090			
Correctly predicted in %			68.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.177	.529	4.952	1	.026	3.244

Heat 24/7	.912	.456	4.000	1	.045	2.489
Constant	-.096	.416	.053	1	.817	.908

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.003			
-2 log likelihood			168.529			
Nagelkerke R square			.107			
Correctly predicted in %			70.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.276	.527	5.867	1	.015	3.581
Heat season	1.591	.777	4.196	1	.041	4.909
Constant	.464	.209	4.906	1	.027	1.590

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			161.301			
Nagelkerke R square			.170			
Correctly predicted in %			70.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Ethnicity	1.173	.535	4.799	1	.028	3.231
Additional heating	-1.764	.568	9.654	1	.002	.171
Constant	2.038	.533	14.636	1	.000	7.675

All heated–Skopje survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	154.812
Nagelkerke R square	.201

Correctly predicted in %			70.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Rural	1.694	.650	6.797	1	.009	5.444
Additional heating	-1.807	.571	10.015	1	.002	.164
Constant	2.042	.531	14.770	1	.000	7.706

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			151.852			
Nagelkerke R square			.184			
Correctly predicted in %			70.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	-1.628	.426	14.585	1	.000	.196
Heat 24/7	1.326	.498	7.094	1	.008	3.767
Constant	.317	.419	.574	1	.449	1.373

All heated–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			146.445			
Nagelkerke R square			.231			
Correctly predicted in %			72.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	-1.482	.423	12.267	1	.000	.227
Additional heating	-1.822	.592	9.458	1	.002	.162
Constant	2.761	.592	21.754	1	.000	15.817

All heated–Skopje survey dataset	
Model chi-square (Sig.)	.000

-2 log likelihood			163.102			
Nagelkerke R square			.160			
Correctly predicted in %			73.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Heat 24/7	1.043	.478	4.761	1	.029	2.839
Additional heating	-1.823	.574	10.074	1	.002	.162
Constant	1.482	.618	5.752	1	.016	4.402

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			175.833			
Nagelkerke R square			.144			
Correctly predicted in %			71.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	.902	.367	6.043	1	.014	2.464
EE measure	-1.171	.395	8.762	1	.003	.310
Constant	.807	.384	4.417	1	.036	2.241

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			178.668			
Nagelkerke R square			.127			
Correctly predicted in %			65.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	.833	.362	5.284	1	.022	2.300
Installed	-1.184	.445	7.098	1	.008	.306
Constant	.984	.446	4.876	1	.027	2.676

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			167.928			
Nagelkerke R square			.168			
Correctly predicted in %			69			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	.804	.377	4.552	1	.033	2.235
Control T	-1.338	.431	9.640	1	.002	.262
Constant	1.001	.444	5.082	1	.024	2.721

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			169.081			
Nagelkerke R square			.160			
Correctly predicted in %			67.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	.970	.374	6.709	1	.010	2.637
T same	-1.563	.579	7.285	1	.007	.210
Constant	1.231	.587	4.401	1	.036	3.426

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			178.511			
Nagelkerke R square			.115			
Correctly predicted in %			66.4			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Disabled	.992	.365	7.399	1	.007	2.696
Disconnected heating	1.230	.535	5.292	1	.021	3.420

Constant	-1.088	.554	3.858	1	.049	.337

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			155.845			
Nagelkerke R square			.150			
Correctly predicted in %			70.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
1971-1990	-.812	.402	4.087	1	.043	.444
EE measure	-1.377	.438	9.877	1	.002	.252
Constant	1.803	.413	19.027	1	.000	6.069

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			147.914			
Nagelkerke R square			.192			
Correctly predicted in %			70.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
1971-1990	-.834	.412	4.086	1	.043	.434
Control T	-1.610	.454	12.544	1	.000	.200
Constant	1.959	.427	21.006	1	.000	7.093

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			169.701			
Nagelkerke R square			.195			
Correctly predicted in %			68.7			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
EE measure	-1.402	.407	11.853	1	.001	.246

Installed	-1.492	.459	10.539	1	.001	.225
Constant	2.588	.529	23.889	1	.000	13.300

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			162.270			
Nagelkerke R square			.209			
Correctly predicted in %			70.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
EE measure	-1.175	.408	8.306	1	.004	.309
Control T	-1.451	.435	11.141	1	.001	.234
Constant	2.285	.472	23.406	1	.000	9.825

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			166.854			
Nagelkerke R square			.172			
Correctly predicted in %			67.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
EE measure	-1.095	.403	7.376	1	.007	.334
T same	-1.580	.580	7.409	1	.006	.206
Constant	2.528	.613	16.994	1	.000	12.525

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			174.760			
Nagelkerke R square			.140			
Correctly predicted in %			68.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)

EE measure	-1.235	.400	9.542	1	.002	.291
Disconnected heating	1.252	.545	5.268	1	.022	3.497
Constant	.269	.553	.236	1	.627	1.308

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			166.091			
Nagelkerke R square			.184			
Correctly predicted in %			67.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Installed	-1.144	.478	5.734	1	.017	.319
Control T	-1.390	.431	10.409	1	.001	.249
Constant	2.385	.532	20.067	1	.000	10.863

EE criteria–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			160.088			
Nagelkerke R square			.200			
Correctly predicted in %			69.3			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Control T	-1.485	.435	11.646	1	.001	.227
T same	-1.479	.592	6.241	1	.012	.228
Constant	2.757	.654	17.777	1	.000	15.748

Another type–Skopje survey dataset	
Model chi-square (Sig.)	.000
-2 log likelihood	146.439
Nagelkerke R square	.185

Correctly predicted in %			69.2			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	.885	.417	4.498	1	.034	2.422
Change heating no	2.202	.766	8.257	1	.004	9.041
Constant	-2.884	.756	14.548	1	.000	.056

Another type–Skopje survey dataset						
Model chi-square (Sig.)			.005			
-2 log likelihood			154.605			
Nagelkerke R square			.107			
Correctly predicted in %			66.9			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
House	.807	.404	3.987	1	.046	2.241
Heat 24/7	1.326	.656	4.090	1	.043	3.768
Constant	-2.117	.630	11.276	1	.001	.120

Another type–Skopje survey dataset						
Model chi-square (Sig.)			.001			
-2 log likelihood			140.214			
Nagelkerke R square			.160			
Correctly predicted in %			67.5			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
1971-1990	-.936	.469	3.994	1	.046	.392
Change heating no	1.756	.650	7.295	1	.007	5.790
Constant	-1.902	.623	9.326	1	.002	.149

Another type–Skopje survey dataset

Model chi-square (Sig.)			.003			
-2 log likelihood			156.727			
Nagelkerke R square			.114			
Correctly predicted in %			72			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
EE measure	.871	.418	4.344	1	.037	2.390
T same	-1.264	.448	7.948	1	.005	.283
Constant	-.296	.426	.482	1	.488	.744

Another type–Skopje survey dataset						
Model chi-square (Sig.)			.000			
-2 log likelihood			153.383			
Nagelkerke R square			.171			
Correctly predicted in %			71.6			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Change heating no	1.832	.648	8.000	1	.005	6.247
T same	-1.048	.446	5.518	1	.019	.351
Constant	-1.422	.690	4.250	1	.039	.241

Another type–Skopje survey dataset						
Model chi-square (Sig.)			.002			
-2 log likelihood			158.359			
Nagelkerke R square			.125			
Correctly predicted in %			70.1			
Variable	B	S.E.	Wald	d.f.	Sig.	Exp(B)
Heat 24/7	1.461	.664	4.841	1	.028	4.311
T same	-1.132	.441	6.603	1	.010	.322
Constant	-1.097	.688	2.542	1	.111	.334