University of Hohenheim
Institute of Social Sciences in Agriculture (Societal Transition and Agriculture / Rural Sociology) 430b

Energy cultures in rural Armenia: examining heating and cooking fuel use from a gendered perspective

Master's thesis in the Faculty of Agricultural Sciences

by
Alyssa Bougie

Matriculation Number: 763536

submitted
in February 2021

First examiner:
Prof. Dr. Claudia Bieling, Institute for Societal Transitions and Agriculture, University of Hohenheim

Second examiner:
Alen Amirkhanian, Acopian Center for the Environment, American University of Armenia

Abstract

Transitioning to clean and fair energy systems is a challenging yet urgent task with the potential to address climate change, ensure energy access for all, support poverty alleviation, and improve gender equality. Implementing clean energy goes beyond technical factors, as it should be socially acceptable and address users' needs. Rural areas have largely been excluded from the discourse on energy transitions, despite their differing needs and resources. Gender is crucial to developing inclusive clean energy systems, but has only recently begun to inform research on energy transitions. The aim of this study is to add to the existing body of literature on rural energy transitions, provide insight into the energy culture of rural Armenia, and how it is linked to natural resources and gender.

In total, 380 respondents from thirty-one rural Armenian communities participated in both individual surveys and in small focus group discussions. The questions focused primarily on the material culture, the heating and cooking practices in peoples' daily lives, as well as their perceived impacts of heating fuels on their health and the environment.

The diverse group of respondents demonstrated a cohesive energy culture strongly shaped by the material culture around heating and cooking fuels, where fuel affordability and efficiency were key. Fuel conservation was a key practice, to the point where peoples' health is impacted by inadequately warm housing. Women spend much more time on heating and cooking tasks, yet perceive fewer health effects from fuels. Recent fuelwood harvesting restrictions and forest degradation is a major concern in the study communities, with some communities facing very limited heating options in the near future.

The study highlights the dire energy situation in rural Armenia, and underscores the need for gender-specific, inclusive programs to improve energy efficiency and implement alternative energy projects. Although the study was not able to demonstrate strong differences on energy cultures between genders, it shows key inequalities between men and women in rural Armenia. Further study on acceptability of potential energy efficient and clean energy interventions is necessary.

Acknowledgements

I would like to thank my supervisors, Prof. Dr. Claudia Bieling, director of the Institute of Societal Transition and Agriculture at the University of Hohenheim, and Alan Amirkhanian, director of the Acopian Center of the Environment at the American University of Armenia, for their support, guidance, and expertise.

I truly mean it when I say this thesis would not have been possible without the invaluable expertise and input of Alla Berberyan and Siranush Galstyan from GIZ Armenia. Thank you so much for your dedication to the project, even in the most difficult circumstances. I would also like to express my deep gratitude to everyone who carried out the challenging field work and translated the extensive data in uncertain times.

To my friends and family, thank you for your love and support.

The survey design and data collection for this thesis has been done in partnership with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Armenia, specifically with their ECOserve project, and the Environmental Sustainability and Assistance Center NGO (ESAC).

Table of Contents

List of Tables

List of Figures

List of Abbreviations

M	Male
F	Female
ECF	Energy cultures framework

Chapter 1: Introduction

1.1 Clean and Just Energy Systems for Health, Environment, and Poverty Alleviation

As an essential aspect of daily life, energy plays a central role in most peoples' lives. The way energy is produced and consumed, however, can have detrimental impacts on those who must pay for it (consumers) and the environment.

Inefficient energy systems contribute to climate change through overuse of polluting fuels, resulting in high greenhouse gas emissions. The relationship between fuel usage and natural resources has been extensively studied from a purely ecological point of view (Cooke et al, 2008). However, consideration of human perceptions of impacts of fuel usage on the environment and ecosystem is little studied. Beyond emissions, energy sources such as fuelwood can negatively impact the local environment through resource depletion or pollution (DeFries and Pandey, 2010).

Inefficient energy systems also contribute to higher-than-necessary energy costs, which can contribute to poverty, given that more fuel must be used compared to efficient systems (Bouzarovski and Petrova, 2015). Additionally, the most vulnerable populations often live in energy inefficient housing, causing excessive heat loss through uninsulated walls, windows, or roofs (Sonal et al, 2019). Inefficient housing can exacerbate poverty, or even push people into energy poverty, when one is unable to afford adequate energy for 'basic modern energy services' (Jessel et al, 2019).

The health of those who cannot afford adequate energy often suffers (Sonal et al, 2019). For example, inadequate heating during winter can lead to higher rates of infectious diseases and respiratory illness (Jessel et al, 2019). Some energy sources used for heating and cooking such as wood or dung can also cause health challenges via airborne particulate matter, such as anemia (Demirchyan et al, 2015), slowed physical development (Nazif-Muñoz et al, 2020), and mortality (Sulaiman et al, 2017). Children are particularly at risk of complications from energy poverty (Jessel et al, 2019). Social and mental well-being can also be affected by energy poverty (Jessel et al, 2019).

Climate change is a growing threat to the world, and quick action is needed to mitigate the potentially devastating consequences (IPCC, 2018). A key aspect of climate action is the transition to renewable energy sources (Moomaw et al, 2012). While the technical requirements of such a clean energy transition are well-researched, there is a lack of research on the social and political aspects. For a successful transition away from fossil fuels and inefficient energy systems, societal acceptance is a key aspect, and therefore research examining acceptability of new clean energy and energy efficiency technology is necessary. These insights are of particular importance when considering rural energy transitions (Naumann and Rudolph, 2020).

Consideration beyond technical specifications contributes to the the concept of a 'just' energy transition, where energy systems should provide reliable, culturally acceptable energy at fair prices, and should consider the unique ways communities use energy. The United Nations' Sustainable Development Goal number seven sums the concept up well: "Ensure access to affordable, reliable, sustainable and modern energy for all." Efficient, clean, and just energy systems also contribute to environmental protection by reducing emissions and, depending on the type of fuel used, can also reduce air pollution, reduce the amount of natural resources needed for fuel supply, and support biodiversity conservation.

1.2 Considering Gender in Energy and Development Studies

1.2.1 Unequal impacts of inefficient energy systems

Over the last decade, literature on energy and development has begun to recognise the important role gender plays in differences in health and domestic workload, particularly in relation to energy management. According to the World Health Organisation, women and children are more strongly affected by indoor air pollution from traditional energy sources like charcoal and dung, given that they spend more time in the home compared to men. This is confirmed by a large body of literature (Sonal et al, 2019; Parikh, 2011; Permana et al, 2014). Additionally, women may face physical health challenges from excess time spent collecting and transporting fuel woods (Parikh, 2011).

There is a consensus within the literature that in many countries, women spend more time collecting fuels, managing heating, and cooking than men (Kaygusuz, 2011; Köhlin et al, 2011). This is particularly true in rural areas where access to electricity may be limited or too expensive, or more traditional energy sources such as firewood or dung may be used for heating and cooking.

Evidence is growing that moving away from energy systems that rely on fossil fuels or labor-intensive fuel like charcoal can significantly benefit women (Mang-Benza, 2021; Kaygusuz, 2011). In a study examining communities in rural China, Ding et al (2014) found improved devices (e.g. biogas digesters, solar cookers and water heaters) decrease the amount of time and energy women spent cooking and collecting firewood, for example. The benefits go far beyond lowered time investment, though, as women can also improve their standing in society, achieve income parity, and generally empower themselves through economic opportunities related to clean energy (Mang-Benza, 2021).

1.2.2 Relating gender to energy behaviour and management decisions

A lesser-studied body of work is the role of gender on energy decisions, like the question of whether women or men make more energy efficient decisions. In Indonesia, a study by Permana, Aziz and Siong (2015) found that when energy decisions were made solely by women, the energy consumption was lowest. A study examining energy consumption in four European countries found that men used significantly more energy in Greece and Sweden, whereas there was no significant difference in Germany and Norway (Räty and Carlsson-Kanyama, 2009). Very little literature on heating fuel and gender is available as most is focused on electricity or energy for transportation. Additionally, socioeconomic status is a major factor in most works, making it difficult to differentiate the effects of gender. A survey across all states in India found women's access to salaried work and level and responsibility or household decisions were positively correlated with clean energy uptake (Choudhuri, P. & Desai, S., 2020).

1.3 Research Objectives

Given how crucial clean and just energy systems are to improving lives, reducing environmental impacts, and reducing overall global emissions, there is a strong need for more research on both current energy systems as well as how communities can join the energy transition. Recognising the importance of gender within this research is also essential. In rural Armenia, current heating systems are often inefficient and use fuels that either pose a threat to human health and/or to the environment. In many cases, they likely require hours out of the day to operate and maintain.

In order to develop the research base on energy transitions in Armenia, the following research objectives were developed:

a. Understand energy behaviours in rural Armenia and how they are linked to gender and natural resources.

b. Identify potential socially and environmentally acceptable energy-related interventions that increase energy security for rural residents that also reduce energy costs and maintain or improve ecosystem services and biodiversity.

Specifically, the thesis addresses the following questions:

1. What are the current energy behaviours in diverse communities in rural Armenia, including material culture, practices and norms?

2. What is the role of gender in energy behaviours?
    a. How does gender affect energy management and decisions, and perceptions about energy usage and fuel type?
    b. How do different energy behaviours differently impact men and women (i.e. management time, workload, etc.)?
    c. How could women in the regions surveyed be empowered to participate in sustainability transitions?
    d. Are impacts of current energy behaviours on health considered, and if so, how are they perceived?

3. How are biodiversity and ecosystem services interlinked with energy behaviours?
    a. Which natural resources and ecosystem services are available to and used by local residents in each community?
    b. Are impacts of current energy behaviours on ecosystem services or biodiversity considered, and if so, how are they perceived?
    c. Are residents interested and willing to transition to more efficient and environmentally friendly alternatives (i.e. straw briquettes)?

In the following chapters, I will provide an overview of the literature on energy and society. I Will then discuss the Energy Cultures Framework, which provides the basis for my analysis. I will then present the methodology, results, discussion, and conclusion.

Chapter 2: State of Research

2.1 The Energy-Society Discourse So Far

Energy and societal progress are deeply interlinked, but before the 1900s, little scientific literature existed on the subject. It is important to note that my findings on the energy-society discourse is very North America-centric, as I was not able to find much work from other parts of the world. With this in mind, the conclusions of the authors may not be entirely applicable to different contexts, such as in Armenia. Nonetheless, I believe some concepts found within the literature can provide insight to diverse contexts.

Rosa et al (1988) were one of the first to review the state of the literature on energy and society, which I will use to outline the literature from the late 19th century to the late 20th century. Their review was precipitated by energy concerns around limited fossil fuel resources and other challenges. The authors highlighted that energy both impacts society and that society influences energy use.

Spencer (1880) initiated the field of energetics by concluding that since energy is defined as the ability to do work, more energy means more societal development. Many scholars since then based their research on this theory (Rosa et al, 1988), developing ideas to the ultimate end that “energy, technology and social values were viewed as inexorably linked to progress”. White (1943) took this argument much further and declared that so-called ‘cultural evolution’ was directly correlated with the amount of energy harnessed (Rosa et al, 1988).

Their review found that most literature from the 1900s ignores limits of energy use and consumption, although a few authors around the mid-century onwards consider those. One example was Cottrell (1955), who stated that the amount of energy available determines the possible extent of activity. Interestingly, his work focused on energy transitions – specifically, a ‘low-energy’ society to a ‘high-energy society’ (Rosa et al, 1988) – and concluded that energy was the fundamental reason for social change, considering the Industrial Revolution.

A new field of energy, ecology, and society emerged around the 1960s (Rosa et al, 1988). Many of these studies involved case studies of unique human-nature relationships and the energetic flows between them. This work then developed into a formula predicting the energy productivity in societies (Rosa et al, 1988).

Nearing the end of the 19th century, energy was recognised as essential to economic growth, and thereby 'societal well-being' due to broad studies that correlated quality of life to energy consumption (Rosa et al, 1988). The 1970s oil crisis in the United States led to a jump in interest in energy consumption and energy efficiency in that country, and along with it came more scientific interest as well (Rosa et al, 1988; Moezzi and Lutzenhiser, 2011). Most of this literature, however, focused mainly on material variables as well as climate, ignoring cultural and individual factors.

The overlap of social science and energy science only came into its own near the start of the 21st century, with many attempting to reduce energy use by identifying those who conserve energy and examining their behaviours (Rosa et al, 1988). These early studies noted a difficulty in getting people to conserve energy – namely, energy is invisible except on energy bills.

The next focus of research linking energy and society was a scientific debate between two models that explained energy behaviours, economic rationality vs. attitude-behaviour consistency (Rosa et al, 1988). Neither model is without faults, however. Overall, the consensus from this era was that while economic factors were important, other factors (social, etc.) were by far more influential on energy decisions.

Most of the work from the 20th century was highly theoretical and did not produce any useful frameworks or models (Rosa et al, 1988), while also ignoring environmental considerations. Only into the 2000s were practical models and frameworks introduced that could begin to analyze 'real-world' relationships between society and energy, many of which fell under the 'sustainability transitions' heading. In the 1990s, the role of gender in energy began to enter the mainstream scientific-political discourse (Ceceiski, 1995).

Shove and Walker (2014) suggested "that energy supply and demand are realized through artefacts and infrastructures that constitute and that are in turn woven into bundles and complexes of social practice." This hints at the importance of energy on society and its transformation, and underscores how any change in how energy is produced or used must also influence social practice and vice-versa. The authors' key point is that energy is "an ingredient of the social practices and complexes of practices of which societies are composed".

2.2 Energy & Society Frameworks

According to a review by Hirt et al (2020) on the energy and sociology discourse, the recent literature (2008 – 2018) consists of quantitative models and socio-technical frameworks. Since the nature of my research questions is qualitative in nature, I will focus mainly on frameworks and qualitative examinations of society and energy.

A key benefit to utilising frameworks is the possibility to include complex interactions such as culture, which are very difficult to model (Hirt et al, 2020). Additionally, frameworks are better able to describe non-linear behaviour, and qualitatively different states, according to Köhler et al (2018), which would include energy usage. Frameworks may provide more detailed and complex descriptions (Köhler et al, 2018). It is noted, however, that models and frameworks lack realism and may be limited in their applicability in sustainable transitions (Hirt et al, 2020), or in other words, are abstract (Köhler, 2018). Other criticisms of energy-society frameworks exist, namely that they often exclude environmental factors (Köhler et al, 2018) and fail to model transitions, but rather describe on a snapshot in time.

Since 2010, energy research has attempted to pair models and frameworks (Hirt et al, 2020), which can sometimes output beneficial information, but often fails to deliver on the intended goal of recommending actions towards sustainability transitions (Hirt et al, 2020). Using a framework rooted in observable, 'real' information can improve the applicability of its outcomes (Hirt et al, 2020).

In a review of modern household energy use, Moezzi and Lutzenhiser (2010) suggested that much research and policy had been designed with the purpose of influencing how energy is used, rather than understanding how it is used. This is another challenge with the literature predating the 21st century. Models and frameworks that don't seek to change behaviour, rather just to understand it, are critical to developing an accurate overview of the current situation.

Examining the frameworks recently developed and used in the energy-society literature, the Value / Beliefs / Norms theory has been applied to energy conservation in the past (Ibtissem, 2010). This theory is used to understand ecological behaviours. However, this theory excludes many factors such as the available resources as well as external influences. As the author (Ibtissem, 2010) noted, this framework also becomes less useful when ecologically-friendly choices cost more or are more physical work to attain.

The energy ladder framework has also been popular in the past decade, which states that as households grow their income, they will progress up a 'ladder' of fuel types, moving from dirtier fuels to cleaner ones (Sabyrbekov and Ukueva, 2019). However, many have criticized this view, and argue that households do not move from one fuel to the next – rather, they 'stack' them, utilising different fuel sources when they are most appropriate, known as 'fuel stacking' (van der Kroon et al, 2013).

Seyfang and Haxeltine (2011) utilised strategic niche management theory (SNMT) to describe community-based sustainability transitions in the United Kingdom. The idea is to examine 'niches' or spaces where experimentation is possible without the interference of 'regime selection pressures'. Their study examined how transition towns – those who developed grassroots initiatives to transition away from fossil fuels – have spread throughout the UK. The authors found that by attempting realistic achievements, networking, and utilising experiential learning for its members, the transition towns movement contributed significantly to the sustainable energy transition of the UK. SNMT appears to be useful in examining how sustainability transitions can occur on the community level. The work also highlights what other recent literature (Moezzi and Lutzenhiser, 2010); Shove and Walker, 2014) has concluded: in sociotechnical transitions, social aspects are far more influential in shaping behaviours.

Given the overarching importance of energy in most aspects of daily life, the complex relationships between people and energy, and the urgency of a clean and just energy transition, approaching research on energy requires a framework that looks beyond the technical capacity for a clean energy transition to socio-cultural factors. In order to gain a better understanding of how, why, and when people use energy, an analytical approach that considers the social aspects of energy is useful. In order to gain a current, 'real-time' view of energy usage and the factors for its use, I will use the Energy Cultures Framework to analyze the energy cultures around heating fuel usage in rural Armenia.

2.3 Analyzing Social Dimensions of Energy: Energy Cultures Framework

The Energy Cultures Framework (ECF), developed by Stephenson et al (2015) (Fig.1) offers a way of understanding energy behaviour that accounts for material goods, cultural norms, and other aspects of daily life.

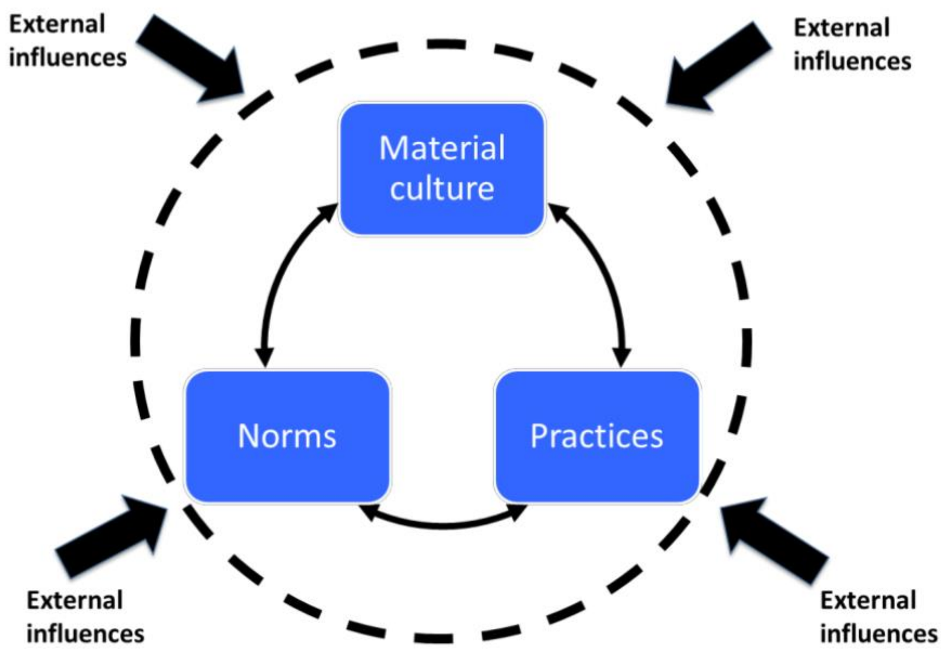


Figure 1- Energy Cultures Framework (Stephenson et al, 2015)

Within the framework, the concept of ‘norms’ encompasses the attitudes of individuals and communities and social expectations. Practices, in this case, means any routine activities that are done regularly or infrequently. Material culture is defined as “the technologies, structures and other assets that play a role in how energy is used” (Stephenson et al, 2015). External influences, then, are generally considered to be demographic traits such as income, and can also be other factors like available options, government, etc.

I believe the ECF is an appropriate choice to analyze the rural Armenian context because it does not prescribe any prerequisites in terms of infrastructure, culture, or otherwise. In its simplicity, it is accessible and widely applicable.

To date, the ECF has been used in a number of works across the world, including New Zealand, Zambia, and Romania, among many others, (Stephenson et al, 2015; Jürisoo et al, 2019; Klaniecki et al, 2019) to explore concepts ranging from rural energy transitions to clean cooking uptake. The most relevant literature, in terms of subject matter, include an examination of household energy transitions in Zambia (Jürisoo et al, 2019) and urban energy use in Nepal from a gendered perspective (Shrestha et al, 2019). Currently, there is no literature using the ECF to examine the Armenian context.

Chapter 3: Methodology

3.1 Study Area: Republic of Armenia

3.1.1 Geography, climate, and natural resources of Armenia

The study area is entirely within Armenia, a mountainous country with a population of approximately three million (*Fifth Armenian Convention on Biological Diversity,* 2014). Armenia is a landlocked country, bordered by Georgia to the north, Azerbaijan to the east, and Turkey to the west, and Iran to the south. Its total landmass is slightly less than 30 000 square kilometers (Bezemer and Lerman, 2004).

The country features diverse topography, including mountainous regions and valleys. Armenia is home to ten different ecozones across six climatic zones including steppe, semi-desert, forest, and subalpine, among others (*Fifth Armenian Convention on Biological Diversity,* 2014) (Fig.2). The country is noted for its exceptional biodiversity, particularly for vascular plants, many of which are endemic as well as for agrobiodiversity. Armenia is also home to vast freshwater resources, in particular Lake Sevan. Altitude plays an important role in shaping the geography and climate, as 90% of Armenia's area lies above 1000 meters above sea level (*Fourth National Communication on Climate Change*, 2020).

Forests within Armenia generally fall within one of five different types: oak forests, beech forests, hornbeam forests, dry shrub vegetation, and wooded grasslands (Sayadyan and Moreno-Sanchez, 2006). In 2011, 11.7% of Armenia was forest cover (*Fifth Armenian Convention on Biological Diversity,* 2014). The Armenian government launched a 'National Forest Program' in January 2020. The aims of this program including expanding the forest cover in Armenia to 20.1% (*Fourth National Communication on Climate Change*, 2020). The government has listed forestry priorities including sustainable management, conservation, and reforestation/afforestation (*Fourth National Communication on Climate Change*, 2020). Forests within Armenia are owned by the state (Mkrtchyan & Grigoryan, 2014), with protected areas are managed by the Ministry of Nature Protection, and all other areas managed by the state forest agency, known as *Hyantar*.

Climate change is expected to impact Armenia significantly, with serious impacts on human activity and the environment (*Fourth National Communication on Climate Change* 2020). Particularly concerning are decreasing precipitation and increasing frequency of severe weather events such as hail, which can damage infrastructure and crops. Droughts are also of concern, as they have occurred more frequently and in expanded regions across Armenia in recent years (*Fourth National Communication on Climate Change*, 2020). Soil erosion is also a major concern, as well as forest degradation due to increased spreading of pests and diseases (Aghababyan et al, 2010).

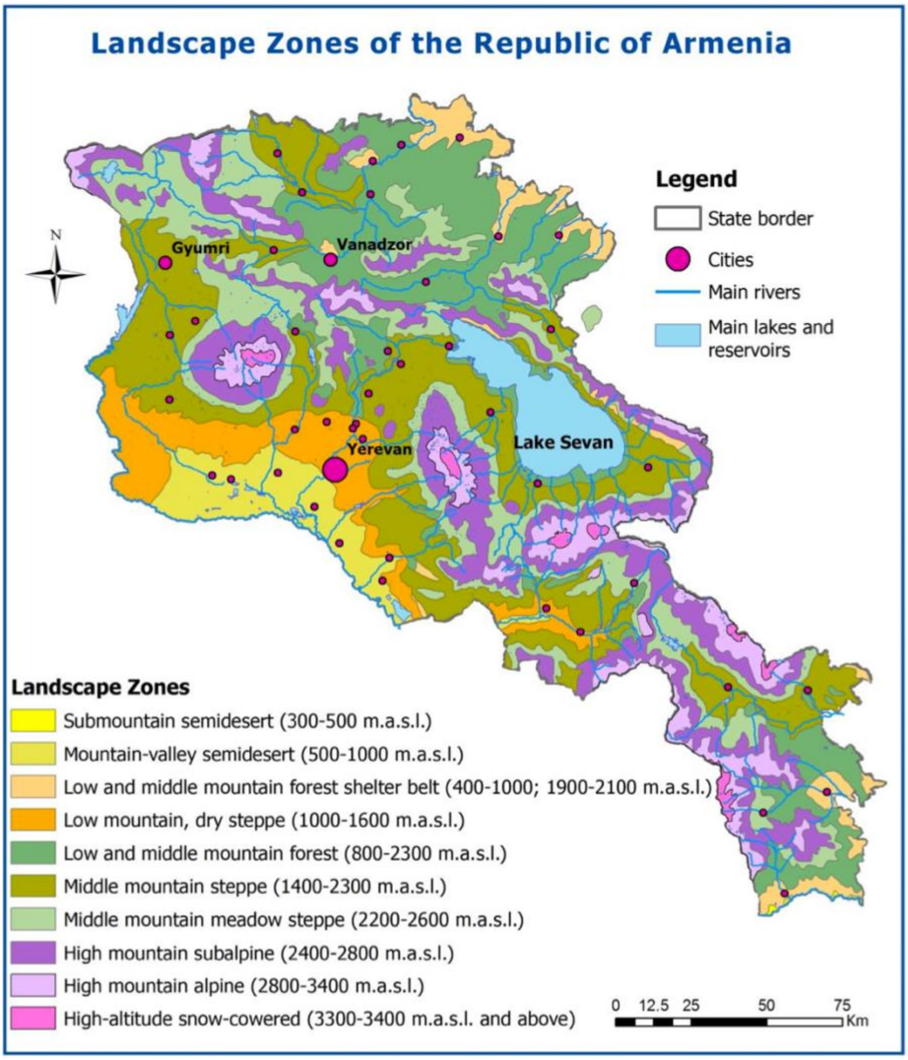


Figure 2 – Varying landscape zones across Armenia (Fifth Armenian Convention on Biological Diversity, 2014)

In mountain regions, the average annual temperature is -8°C, whereas in lowland areas, it ranges from 12-14°C (*Fifth Armenian Convention on Biological Diversity,* 2014).

3.1.2 Culture and history

In the Soviet Union era, most Armenians lived in rural communities (Bezermer and Lerman, 2004), but today, 87% of the population lives in regions of intensive development. The capital city, Yerevan, now has a population of one million. The country is divided into eleven administrative districts (*marzes)* which are subsequently divided into municipalities.

After independence from the Soviet Union, most arable land was privatised, making most agriculture done by small-hold farmers (Bezermer and Lerman, 2004), and many rural residents are engaged in agriculture and/or animal husbandry. Approximately 68% of Armenia's landmass is currently managed for agricultural production (*Fourth National Communication on Climate Change*, 2020).

The extreme change during the immediate post-Soviet era, combined with conflicts and natural disasters have strongly influenced the poverty levels in Armenia (Bezermer and Lerman, 2004; Sayadyan and Moreno-Sanchez, 2006). Income inequality and marginalization of the poor within the country is a large problem (Babajanian, 2008). Many Armenians have emigrated to other parts of the world, with a diaspora larger than the in-country population.

Human relations – i.e., social capital – is important in the Armenian context, with regard to social movements and family groups (Babajanian, 2008). Networks of family and friends provided access to scarce resources during the Soviet era, and remains a strong part of society today, often manifesting as cooperation and collective activities in communities (Babajanian, 2008).

3.1.3 Energy in Armenia

3.1.3.1 Current state of building and device efficiency

Energy usage is lower today in Armenia than during the time of the Soviet Union (Pasoyan and Sakanyan, 2019). As of 2017, most energy was consumed in residential buildings (36%) followed by transportation (29%), with the industry, commercial and public services, and agriculture and forestry making up the remaining energy usage (35% total) (Pasoyan and Sakanyan, 2019). According to the same report, in 2017, Armenians spent 20% of their total household budget on average on electricity, heating, or hot water, which exceeds the threshold amount for a household to be defined as in energy poverty, generally accepted to be 10% - 15% of total household expenditure.

Most of Armenia's building stock was built between 1951 and 1988 (Tumasyan et al, 2015) and in rural areas, most buildings are made of stone. According to the same report, the most common device used for heating was a self-made heater (36%) followed by individual heat boilers (26%), indicating probable low energy efficiency. Additionally, most households (63%) use gas stoves for cooking (Tumasyan et al, 2015).

3.1.3.2 Energy sources and supply

Given that this paper focuses on heating and cooking fuels, I will give a brief overview of Armenia's energy system (Tables 1 and 2), and provide a summary of how different types of fuels are used. While access to electricity across Armenia is standard, much of the population relies on natural gas and wood for heating and cooking (Burns et al, 2017).

Table 1 - Total final energy consumption by source in ktoe (kilotons of oil equivalent) by year – Armenia (IEA, 2020)

Energy Source	2000	2010	2018
Electricity	309	401	465
Natural Gas	439	1022	1305
Oil Products	291	382	319
Heat	56	401	-
Biofuels and Waste	12	8	95
Wind and Solar	-	-	5

For 60-70% of electricity generation, Armenia relies heavily on imports of oil, natural gas, and nuclear power (IEA, 2020). The remaining 30-40% is covered by domestic production of hydropower, biofuel, and to a minor extent solar and wind (Pasoyan and Sakanyan, 2019; IEA, 2020).

Table 2 - Electricity generation by source in GWh (gigawatt hours) by year – Armenia (IEA, 2020)

Electricity Source	2000	2010	2019
Natural Gas	2692	1438	3047
Hydropower	1261	2556	2371
Nuclear	2005	2490	2198
Wind	-	7	3
Solar Photovoltaic	-	-	13

In rural areas, use of fuelwood is often higher than in urban areas (Tumasyan et al, 2015) Recent data published in a working paper on energy usage in the Getik Valley in Armenia found that 18.5% of 119 households surveyed use wood for cooking, while 62% of households use wood for heating (Harutyunyan et al, 2019). Electrical heating was used in less than 5% of households. To heat water, natural gas was the preferred source with 50% of respondents using this method, while wood usage was 28%. From that survey, it is clear wood is a significant resource in the Getik Valley communities, although some (4.4%) of households reported having recently shifted from heating their homes with wood to natural gas (Harutyunyan et al, 2019).

A report utilising extensive data on energy consumption across Armenia found 51.4% of households used natural gas as their primary heating source and 31.5% used fuelwood (Tumasyan et al, 2015). Depending on the community's local resources, other sources of heating fuel for rural Armenian communities could also include dung, biogas from dung, or briquettes.

Although energy supply has been adequate in recent years, reliance on external sources for energy has caused hardship in the past in Armenia – for example, winters with limited electricity and extreme price increases over relatively short periods (*Scaling Up Renewable Energy Program*, 2014).

3.1.3.4 Fuelwood usage and the environment in Armenia

In the last decade, illegal deforestation as a source of environmental degradation has been a topic of interest in both the scientific community and wider Armenian public. Despite this, there is very little scientific information available on the subject, and even less in English (Sayadyan and Moreno-Sanchez, 2006). As prices have risen for natural gas, rural communities reliant on this fuel have increasingly switched to alternative heating sources like forest wood (Pasoyan and Sakanyan, 2019), which has, in some cases, led to deforestation and degraded ecosystems. According to Pasoyan and Sakanyan, (2019), in 2018, 74% of households in used wood as their preferred heating source. With rural energy efficiency low due to inefficient heating devices and uninsulated buildings, investing in energy efficiency is key to lowering usage of heating fuels like fuelwood. Additionally, Pasoyan and Sakanyan (2019) note much of the wood used is of poor condition for heating, as it is often wet – greatly decreasing burning efficiency. However, a recent survey found 95% of respondents were aware dry firewood burns better (*Environmental Knowledge, Attitudes and Practices*, 2020).

Burns et al (2017) argue that while much of the discourse has focused on individual households illegally collecting wood, commercial harvesting is also a significant contributor to forest degradation. The focus on individual households has resulted in privatisation of Armenian forests, which has consequently led to larger timber harvests, much of which is exported by companies to other countries (Burns et al, 2017). However, little literature exists to date on this subject, although illegal logging has been noted as an issue in a few other studies (Moreno-Sanchez and Sayadyan, 2005; Junge and Fripp, 2011). Today, forestry and thereby fuelwood harvesting is managed by the state, with forests being state property (Sayadyan and Moreno-Sanchez, 2006). The allowed cut is noted as being far less than the demand, yet still too large to be sustainable given the natural regeneration time of the forests (Junge and Fripp, 2011). Forest management practices are considered to be weakly enforced, with corruption also a challenge (Junge and Fripp, 2011).

3.1.3.5 Building cleaner and more efficient energy systems

Armenia's government has programs aimed at improving the country's energy efficiency (*Scaling Up Renewable Energy Program*, 2014), which would provide numerous benefits including reduced energy costs and greenhouse gas emissions, and a more resilient energy system. According to the government, as of 2014, programs valued at $53 million were available for initiatives that improve energy efficiency. However, in rural areas, inefficient homes and devices remain a challenge. On the household level, the survey by Harutyunyan et al (2019) in the Getik Valley found that 25% had installed 'European' windows while 22% used LED lamps. Around 5% of homes had insulation or solar panels, while 33% reported not having used any of the energy efficiency measures. In a separate report, just 32% of households reported always or often utilising energy efficient materials in buildings (*Environmental Knowledge, Attitudes and Practices*, 2020).

Increasing the renewable energy capacity in Armenia is also of interest to a variety of stakeholders including government, NGOs, and private companies (*Scaling Up Renewable Energy Program*, 2014). According to government strategies, the focus areas are: 'improving energy security, ensuring tariff affordability, and maximizing the use of Armenia's indigenous energy resources,' aiming for total renewable electricity generation of 2 259 GWh and 33 GWh of renewable heating through geothermal heat pumps and solar thermal by 2025 (*Scaling Up Renewable Energy Program*, 2014).

In the face of steadily increasing energy prices, rising domestic energy demand, and climate change, increasing Armenia's renewable energy capacity and energy efficiency would help lower energy prices and improve energy security. Additionally, such improvements would also relieve pressure on ecosystems that provide essential ecosystem services and important habitat for endangered species. There is also potential to also address gender inequality exacerbated through energy systems by targeted interventions.

3.1.4 Armenian appreciation of nature and ecosystem services

Given Armenia's important role in maintaining global biodiversity as a part of the Caucasus biodiversity hotspot (Zazanashvili & Mallon, 2009), ensuring Armenia's forests continue to provide ecosystem services for the people who rely on them can also protect an important global resource.

From a recent report investigating environmental knowledge, attitudes, and practices, Armenians feel that the environment is degrading (*Environmental Knowledge, Attitudes and Practices*, 2020). There is very strong support for the protection of nature for future generations (98%). The report notes significant support of the idea that nature must be 'tamed to serve humankind', especially in rural villages (41%). Biodiversity loss in forests, rivers and lakes was a very or mostly concerning topic for most respondents (90%). More than half of respondents would be considered technological optimists who agree that future technology will make up for current environmental damage. From these data, the authors conclude there are conflicting ideologies concerning nature, but overall a positive perspective on environmental protection (*Environmental Knowledge, Attitudes and Practices*, 2020). From the same report, the top ecosystem services were noted as provisioning of fresh water, food and fresh air. Interestingly, this survey did not include provisioning of fuel as an option. Recreation has also been a historically important ecosystem service in Armenia (Sayadyan and Moreno-Sanchez, 2006).

3.1.5 Gender roles in Armenia

Although the literature on gender roles in Armenia is limited, a study by Beukian (2014) examines the role of femininity in the Armenian national identity. The study finds that while women actively participated in the 1988 nationalist movement and subsequent Karabakh war, women have since returned to "traditional" roles of household caretakers. With schools closed, women were responsible for educating the children, feeding the family, and providing emotional support for husbands who were unable to find work in the post-independence time (Beukian, 2014). The author argues that that expectation still exists today, and influences modern gender roles. Gender was not found to play a role in environmental perspectives in a previous study in Armenia (*Environmental Knowledge, Attitudes and Practices*, 2020).

3.1.6 Study Communities

The study area included five pre-selected community clusters in the Shirak, Lori and Kotayk marzes in Armenia (Fig.3). In total, 31 distinct settlements participated.

The Lori Berd and Gyulagarak clusters lie primarily in low and middle mountain forest and steppe, from 800-2300 meters above sea level. The Akhuryan cluster is primarily middle mountain steppe and middle mountain meadow steppe, from 1400 – 2600 meters above sea level. The Saralanj cluster is primarily middle mountain meadow steppe, while the Yeghvard cluster is middle mountain steppe.

These study regions were selected by partner organisation Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Armenia.The regions were selected based on distance to local forests and alternative fuel type availability (i.e., straw briquettes), in order to examine communities where fuelwood is not readily available. In the Shirak and Kotayk marzes, the forests are located far away from the communities. In both the Yeghvard and Akhuryan clusters, straw briquetting equipment is available (as of August 2020). The communities in the Shirak province are close to the briquetting equipment as well.

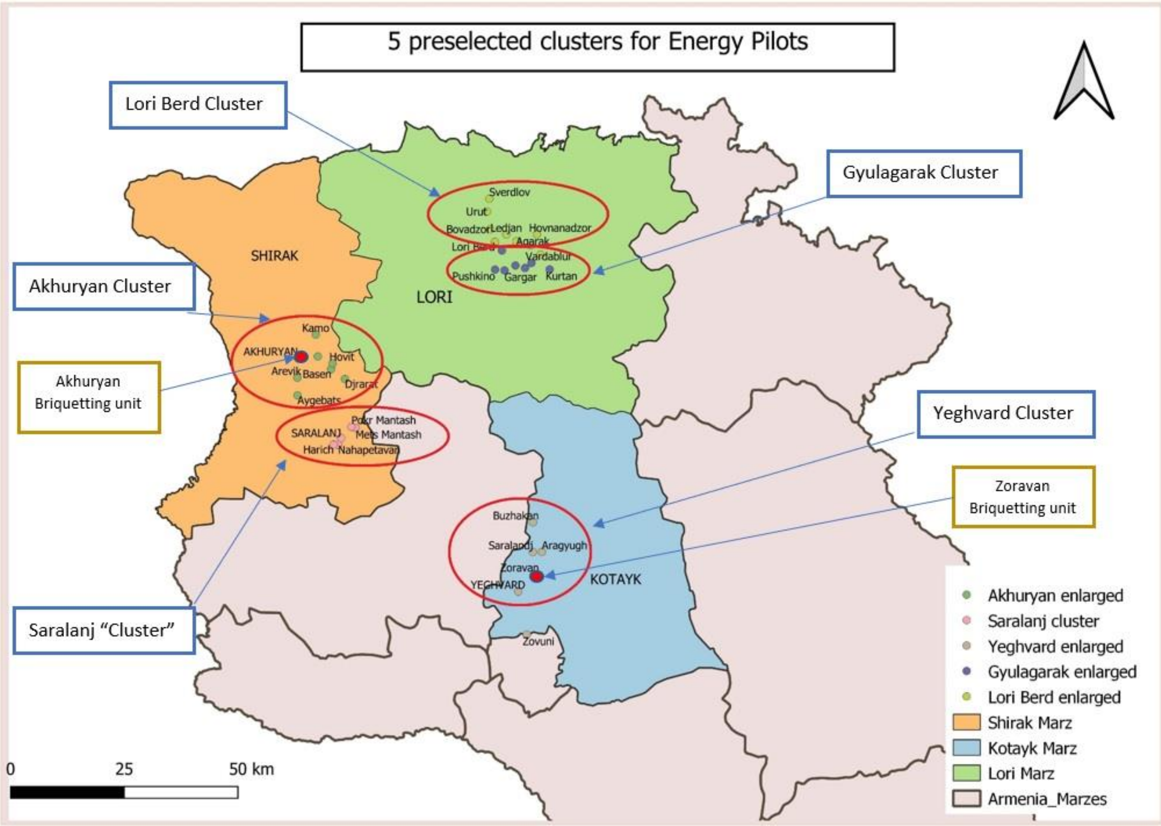


Figure 3 - Map of pre-selected communities involved in the survey (GIZ Armenia, 2020)

Table 3 - Population of communities surveyed (Armenian Ministry of Territorial Administration and Infrastructure)

Marz	Community	Population
Shirak	Akhuryan (enlarged)	17520
	Saralanj	1037
	Mets Mantash	2320
	Poqr Mantash	2320
	Nahapetavan	830
	Harich	1930
Lori	Gyulagarak (enlarged)	8332
	Lori Berd (enlarged)	5369
Kotayk	Yeghvard (enlarged)	25708

Four of the settlements (Saralani, Bujakan, Basen, and Jrarat) do not have a natural gas connection, while one (Porq Mantash) has only a partial supply of natural gas. All other settlements have a natural gas supply.

3.2 Study Design

The data collection was done using individual surveys and focus group discussions. The combined methodology was done in part since qualitative data is more useful for determining certain aspects of energy cultures such as norms and daily behaviours, which are difficult to capture with quantitative data. Additionally, since I was not able to travel to Armenia to gather information due to the COVID-19 pandemic, it was useful to have focus group quotes to gain a better understanding of the situation. Additionally, most other works utilising the ECF have chosen to use interviews or surveys. Alternative methods of data collection may have been through a literature review, but there is very limited peer-reviewed literature available on energy and society in Armenia.

3.3 Literature Review

For the literature review, I used the search engines Scopus and Google Scholar. I also utilised ResearchGate to access some research. The search terms used included the terms ‘energy cultures framework’, ‘gender and energy’ ‘gender and fuel’ ‘sustainability transitions and energy’, ‘theories in energy and society research’, ‘Armenia’, ‘energy and Armenia’, and ‘sustainability transitions AND (energy or heating or fuel or energy access)’, among others. I reviewed all available literature that used the ECF directly in their analysis.

3.4 Survey Design and Implementation

The entire survey design was done in collaboration with experts on the Armenian context, including representatives from the non-governmental organisation ESAC, which had previously conducted similar field work in the area, as well as GIZ Armenia. This was done to ensure survey questions were adapted to the local context and culturally appropriate. The survey was developed in English, and then was translated into Armenian. The survey was reviewed after translation for cultural appropriateness, and was edited by local experts to fit the local context.

The data collection comprised a mixture of written-answer questions and focus group questions. First, respondents answered the paper-based survey questions and then were invited to join a focus group discussion with a maximum of four other participants (Tables 4 and 5).

Table 4 – Individual Questionnaire ECF Indicators

Demographic	
Age	
Gender	
Education Level	
Main income sources	Options: animal husbandry, cultivation of fruits and berries, cultivation of potato, cultivation of grain/forage/corn, cultivation of vegetables, construction, community/state employee, other
Household income	
# Occupants	
Material Culture	
Total House Area	Area of the entire home
Heated Area	Area of the home that is heated
House type	Type of home: stone home, temporary cottage, or apartment
Heating fuels used	First, second, and third most used heating fuels for heating the home
Cooking fuels used	First, second, and third most used cooking fuels, distinguished both by heating and non-heating season
Water heating fuels used	First, second, and third most used water heating fuels, distinguished both by heating and non-heating season
Volume of fuelwood used	Approximated amount of fuelwood used per year in cubic meters
Volume of dung used	Approximated amount of dung used per year in cubic meters
Heating devices	Primary, secondary, and tertiary heating devices used
Insulation	Options: Ceiling, walls, windows, doors, other
Norms	
Reason for fuels used	Options: affordable, easy to access, traditional, easy to use, secure supply, no alternatives, I don't use, or other
Efficient stove price	Amount respondents are willing to pay for an energy efficient stove
Physical work	"I am ready to do additional physical work to reduce my energy / fuel consumption": 1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Heating fuel health impact	"The fuel I use for heating my home affects my health": 1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Cooking fuel health impact	"The fuel I use for cooking in my home affects my health" :1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Listed fuel health impacts	Mark which health impacts on you or your family occur from fuels used: breathing problems, respiratory illnesses, skin irritation, eye irritation, other
Ranked health impact	Rank the severity of the health impact of wood, dung, briquettes, gas and solar energy: 0 (I don't know), 1 (No impact) to 5 (Very large impact)
Family decision participation	"I participate in the energy-related decisions made in our family": 1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Technological interest	"I am interested in new technologies in the field of energy" :1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Early technology adoption	"I am usually among the first to try the new technologies in the field of energy" :1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Opinion sharing – neighbour	"I often share my opinion on energy issues with my neighbours" :1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Opinion sharing – community	"I often share my opinion during community gatherings" :1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Thermal comfort	"My home is always warm enough": 1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Heating fuel usage rate	"I am satisfied with the amount of fuel used by my heating system": 1 (totally disagree), 2 (somewhat disagree), 3 (somewhat agree), 4 (totally agree)
Ecosystem services	Rank your top three benefits and services provided by nature. Options: recreation and leisure, provisioning of fuels, provisioning of food, air, water, provisioning of housing materials, provisioning of medicinal plants, soil formation and fertility, spiritual, other
Planned heating changes	Options: None, energy efficient stove, biomass boiler, centralized gas heating system, solar water heater/solar panels, change fuel to straw briquettes directly paid for, change fuel to straw briquettes bartered for, other
Future energy discussions	Options: Yes, no, maybe/need more information
Ranked environmental impact	Rank the severity of the environmental impact of wood, dung, briquettes, gas and solar energy: 0 (I don't know), 1 (No impact) to 5 (Very large impact)
Practices	
Fuel payment method	Immediate cash, postponed cash, immediate agriproduct barter, postponed agriproduct barter, immediate agricultural service barter, postponed agricultural service barter, obtain without payment, Other/use own
Cooking management	Amount of time spent daily on cooking tasks
Heat management	Amount of time spent daily keeping the home warm
Hot water management	Amount of time spent daily heating water
Fuel management	Amount of time per year (in days) spent obtaining firewood, dung, or briquettes

Table 5 – Group discussion ECF indicators

Material Culture	
Fuels used - community	Approximately what percentage of the households in your community/settlement use firewood, gas or dung for heating?
Norms	
Access to energy info	Is it easy to access information about household energy conservation or energy efficiency?
Purchasing habits	Would you buy energy efficient devices? Why or why not?
Future energy perspectives	Are you concerned about the future supply of any fuel sources? Why or why not?
Barriers to device uptake	Assuming that a new way of heating costs the same or cheaper to use, are there any other reasons you wouldn't use it?
Future natural environment	Are you concerned about the future of your natural environment?
Suggested changes	How would you want to improve the situation of energy in your community if you were given a chance? By 'situation of energy' we mean use habits/patterns or sources of energy.
Health impacts	Do you think that the heating and cooking fuels affect your or your family's health? If yes, how might it be possible to reduce that impact?
Briquette acceptability	How acceptable are straw briquettes for your community?
Solar acceptability	How acceptable are solar energies for your community, including photovoltaic and solar thermal?
Biogas acceptability	How acceptable is biogas for your community?
Practices	
Energy Information sources	Where do you obtain information about energy conservation or energy efficiency?"
Energy conservation practices	Do you conserve energy? If yes, why and how, and if no, why not?"
Fuel efficiency practices	What do you do to make the fuel you use more efficient?"
Burning	Do you burn plastic, rubber, or other materials in your stove? If yes, for what purpose and how often?"
External Influences	
Sources for energy info	Where do you obtain information about energy conservation or energy efficiency?

Given the collaborative nature of the research being carried out, respondents were pre-selected on three criteria. To ensure I could analyze the date by gender, the stipulation was made that at least 50% of the respondents were women. Additionally, given the focus on heating fuels, only households that used firewood, dung or briquettes for heating were surveyed. Households that principally relied on gas were not included. Given the possibility that income type could influence results, the short list of pre-selected respondents included households whose primary income source were animal husbandry (at least 20%), cultivation of staple crops (corn, potato and forage) (at least 20%), and cultivation of berries, fruit or vegetables (at least 20%). There were no parameters on age set, although the survey was targeted towards adults.

To check the appropriateness of the survey questions as well as the survey length, the survey was first trialed on a group of seven women in the Gyulagarak community on 12 August 2020, and on a group of five men in the Gyulagarak community on 15 August 2020.

Initial lists of potential survey participants were obtained from local community administrations, and participant lists were then finalized using the criteria named above. The surveying was done from August to September 2020. In total, 380 individual survey responses were collected by the field teams in Armenia. Each individual survey participant was then randomly assigned to a focus group, usually of five people. Both the focus groups and surveys were conducted in the Armenian language. The focus groups were conducted separately for each gender. The focus group discussions lasted approximately 60 – 90 minutes. Focus group data was collected in small group discussions. Interviews were not done individually, partially due to time constraints, and partially because we were interested in hearing the discussion between community members. Given the COVID-19 pandemic, the surveys were conducted in small groups in open spaces. Hygiene precautions such as two-meter distance and nose and mouth masks were included. Individual surveys were distributed as paper copies and answers were recorded with pens. Focus group discussions were recorded on a recording device for later analysis.

3.5 Data Analysis

All data was analyzed using SPSS 27 (IBM, 2020). Data was translated from Armenian to English by local experts familiar with the survey context and local regions.

3.5.1 Individual survey data

First, I analyzed the survey questions. For each survey question, I performed a qualitative analysis using frequencies. For questions that were relevant to gender, I examined the responses first by all respondents and then separately by gender. I used chi-squared tests to analyze the Likert scale data from the individual surveys.

In order to facilitate correlation of the responses, I developed five scores: 'energy time', 'energy engagement', 'energy satisfaction', 'perceived health impact', and 'energy efficiency'. I analyzed the energy scores using frequencies, and also by examining Pearson's correlations between the different energy scores as well as with other scale variables such as age. I used a one-way ANOVA test to test for significant differences for the energy scores.

3.5.1.1 Energy time score

In order to give a rough score of the time an individual spends in their day and gathering fuel, I quantified responses on the amount of time spent on heating tasks in addition to the amount of time spent storing fuels (see Appendix for detailed table of questions used for energy scores). Since the data for time spent storing fuels was count data, I transformed it to categorical data using the following (Table 6):

Table 6 – Points awarded for energy time score

Category	**Number of days spent per year storing fuel (wood, dung, and briquettes)**
1	1-10
2	11-30
3	31-60
4	61-119
5	120+

Once time spent storing each type of fuel was entered as categorical data, I added the time spent for each different fuel type to obtain a total storage score, ranging from 0-15. I then added the (already) categorical data on amount of time spent per day on various heating tasks, again yielding a possible score of 0-15. I then added both together to yield the final energy time score with a possible range of 0-30.

3.5.1.2 Energy engagement score

To calculate the energy engagement score, I included questions around interest in energy, participation in household energy decisions and in discussions with the community on energy, and on plans to make energy upgrades on the home. Six of the eight included questions involved in the scoring were answered on a scale of 1-4, with 1 representing 'strongly disagree' and 4 representing 'strongly agree'.

One question included in this score was related to plans to make any energy efficiency upgrades to the home. If the respondent answered 'none', I gave a categorical score of 0, whereas if they noted any planned improvement, I gave them a score of 4.

I also included a question on whether participants would be interested in participating in future community discussions around energy. If they answered 'yes', I gave them a score of 4. If they answered 'maybe, I need more information', I gave them a score of 2. If they answered 'no', I gave them a score of zero for that question.

Once all eight questions had responses from 0-4, I added all scores together, yielding a range of possible scores from 6 – 40.

3.5.1.3 Energy satisfaction score

I calculated the energy satisfaction score by adding the responses to two questions using the scale of 1-4, with 1 representing ‘strongly disagree’ and 4 representing ‘strongly agree’. The possible range for this score is 2-8.

3.5.1.4 Perceived health impact score

I calculated the perceived health impact score with three questions, two of which used the agreement scale where 1 represented ‘strongly disagree’ and 4 represented ‘strongly agree’. The other question asked respondents to select any ways they felt their health is impacted by the heating or cooking fuels they use. For each health impact selected, I added two points to the score, up to a maximum of ten points. The possible score range for this question was 2-18.

3.5.1.5 Energy efficiency score

For the energy efficiency score, I included two questions on the volume of wood and dung used annually by the household, which were categorised from 0 (none) – 5 (more than 20 m^3). I also included the respondent’s primary household heating device. I scored the primary heating device in the following method: for a wood stove, I assigned zero points; for a wood boiler heating system, I assigned two points; for a gas stove, I assigned four points; for a gas boiler heating system, I assigned six points; for an electric heater, I assigned eight points; for responses of ‘other’, I assigned zero points. In addition, for each part of the home that respondents said were insulated, I assigned two points, up to a maximum of ten points. There was a total possible score range of 0 – 28.

3.5.2 Focus group data

The different focus group discussions were summarized in English for each community and gender. I began the analysis by reading each focus group summary. Then, for each question, I performed a key word analysis and coded the summaries to determine the frequency of different answer types. I also utilized a narrative approach, utilizing quotes from focus group respondents to provide evidence and support for their various answers.

3.6 Ethical Considerations

All participants' names were removed for the analysis to ensure anonymity and data protection. All participation was voluntary, and respondents were allowed to leave at any time, or leave questions blank if they did not feel comfortable answering them. The purpose, involved parties, and background information of this study and of the projects of the partner organizations in Armenia were explained in a short paragraph at the beginning of the individual survey to ensure respondents were aware of how the data would be used. The best hygiene practices possible were maintained with regards to the COVID-19 pandemic to protect respondents' health.

Chapter 4: Results

4.1 Respondent Demographics

The median age of the 380 respondents was 45 years old, and ranged from 17 to 74 years of age. The gender of respondents was balanced, with 49.2% male and 50.8% female. The education levels of respondents were relatively evenly spread between secondary (42.6%), college (24.2%), and higher (33.2%). Most respondents belonged to households with four family members, closely followed by household sizes of five and six.

The primary income source was animal husbandry (Table 7). The most-reported secondary and tertiary income sources included cultivation of potato, cultivation of grain, corn or forage, and animal husbandry.

Table 7– Primary income sources of respondents (n=380)

Primary Household Income Source	Percentage of Respondents
Animal Husbandry	47.4
Cultivation of Fruits and Berries	2.6
Cultivation of Potato	11.1
Cultivation of Grain, Corn or Forage	4.2
Cultivation of Vegetables	0.5
Construction	3.4
Community / State Employee	19.7
Other	11.1

Household annual income ranged from 500 000 AMD to 6 000 000 AMD, with most respondents earning between 500 000 AMD and 3 000 000 (Table 8). The average household annual income varied by community.

Table 8 – Annual household income per year (n=380)

Income Level	Percentage of Respondents
Up to 500 000 AMD	32.9
500 000 – 1 000 000 AMD	28.7
1 000 000 – 3 000 0000 AMD	32.7

3 000 000 – 6 000 000 AMD	5.5

4.2 Material Culture

4.2.1 Building stock & heating devices

Most respondents resided in private houses made from stone (90.3%), while 6.1% lived in a temporary cottage, 2.6% in 'other' types, and 1.1% in apartment buildings. Living area of respondents' homes ranged from 25 m^2 to 500 m^2, whereas the median percentage of area of the home that was heated was 74%, although this ranged from 10.8% to 100%.

Wood stove was the most noted heating device, with 74.5% of households having one. The second most common heating device was a gas boiler heating system (4.7%), but most respondents didn't list a second heating device. Only 1.1% of respondents indicated they used straw briquettes, and just 3.7% indicated they used solar as their primary heating method. There was significant difference in energy efficiency scores between the genders ($F(1, 378) = 9.780$, $p=.002$).

4.2.2 Fuels used

The most commonly used fuels for heating the house were fuelwood (67.3%) followed by dung and electricity (Fig.4). For cooking and heating water, gas was the most common.

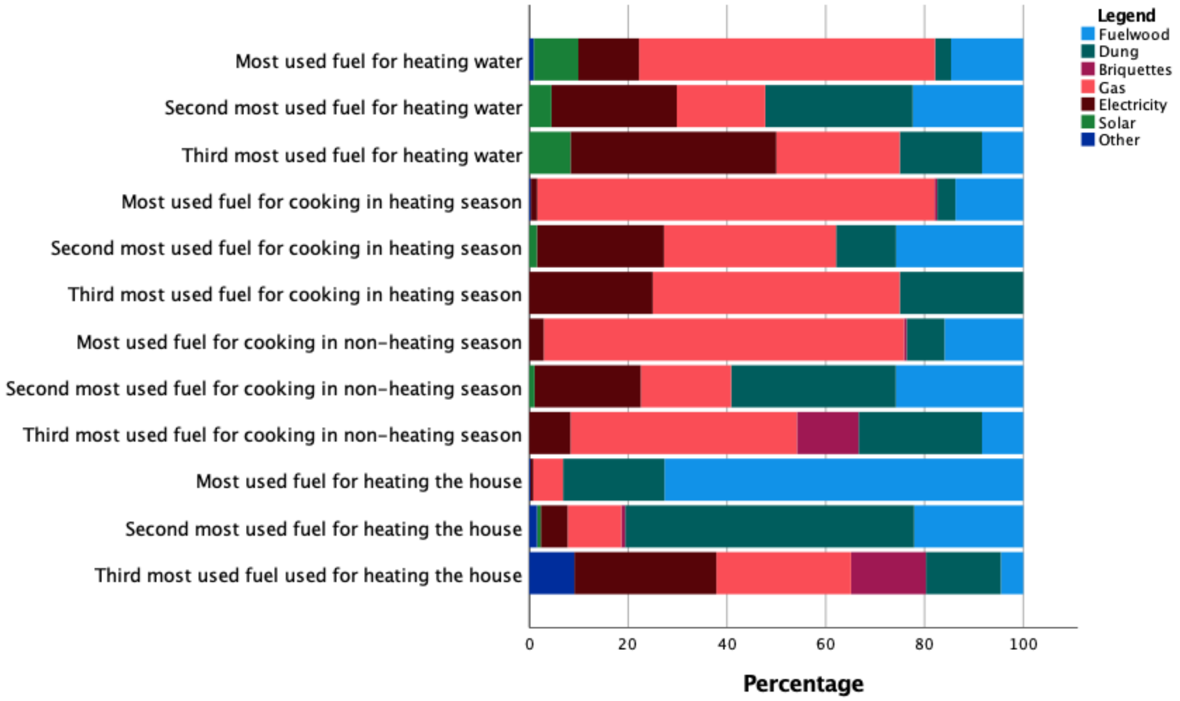


Figure 4 – Top three most commonly used fuels for different energy tasks (n=380)

Most respondents (46.3%) used between 5 and 10 m^3 of fuelwood per year, with 77.5% using less than 10 m^3 per year (Table 9).

Table 9 – Volume of wood and dung used annually per household (n=380)

Volume of Wood Used	Percentage of Respondents	Volume of Dung Used	Percentage of Respondents
0	4.5	**0**	33.4
Up to 5 m^3	27.1	**Up to 5 m^3**	25.3
5-10 m^3	46.3	**5-10 m^3**	22.6
10-15 m^3	17.4	**10-15 m^3**	11.3
15-20 m^3	3.2	**15-20 m^3**	4.7
More than 20 m^3	1.6	**More than 20 m^3**	2.6

4.3 Energy Practices

4.3.1 Obtaining fuels

To obtain fuelwood, 72.4% of respondents paid cash immediately, and 11.6% used delayed cash payment. Just 6.8% of respondents collect fuelwood themselves. For dung, 28.4% said they used dung from their own livestock, while 26.8% of respondents stated that they didn't pay. A combined 13% of respondents paid for dung, either by immediate cash payment (4.5%) or delayed cash payment (8.4%). Most people did not use briquettes (96.1%), but those who did either paid cash immediately (1.3%), paid cash later on (0.5%), bartered with an agricultural product (0.5%), used their own straw (0.8%), or didn't pay for briquettes (0.8%).

4.3.2 Time spent on energy management

There was a significant difference in energy time scores between genders ($F(1,378) =21.506$, $p<.001$), with women generally scoring higher (i.e., more time spent on energy tasks). For the three energy management tasks, there were significant differences between the genders. Women spent much more time cooking ($x^2(3) = 207.103$, $p<.001$) (Fig.5), managing the heating ($x^2(4) = 19.872$, $p<.001$) (Fig.6), and heating water per day ($x^2(4) = 40.307$, $p<.001$) (Fig.7).

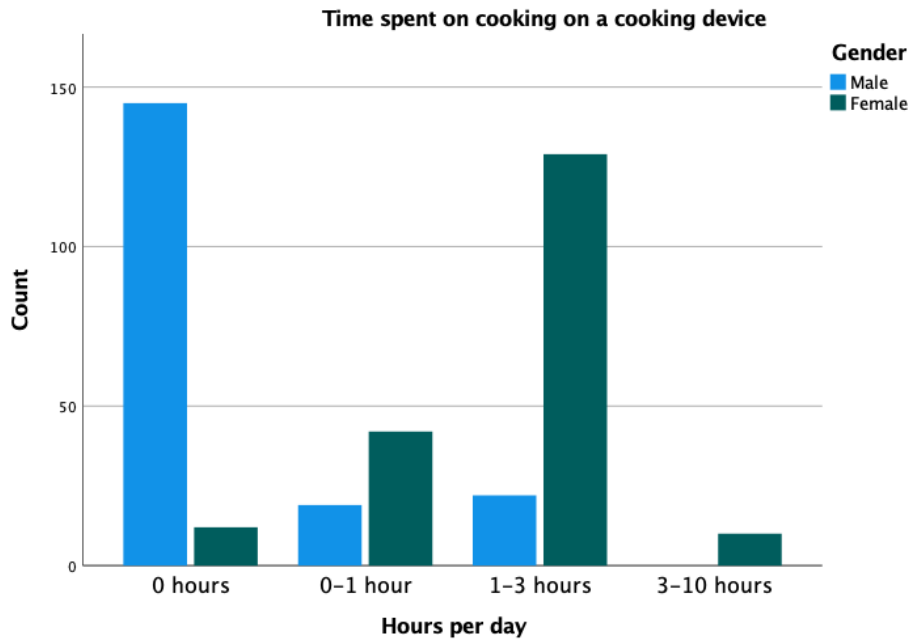


Figure 5 – Women spend much more time cooking than men per day (n=380)

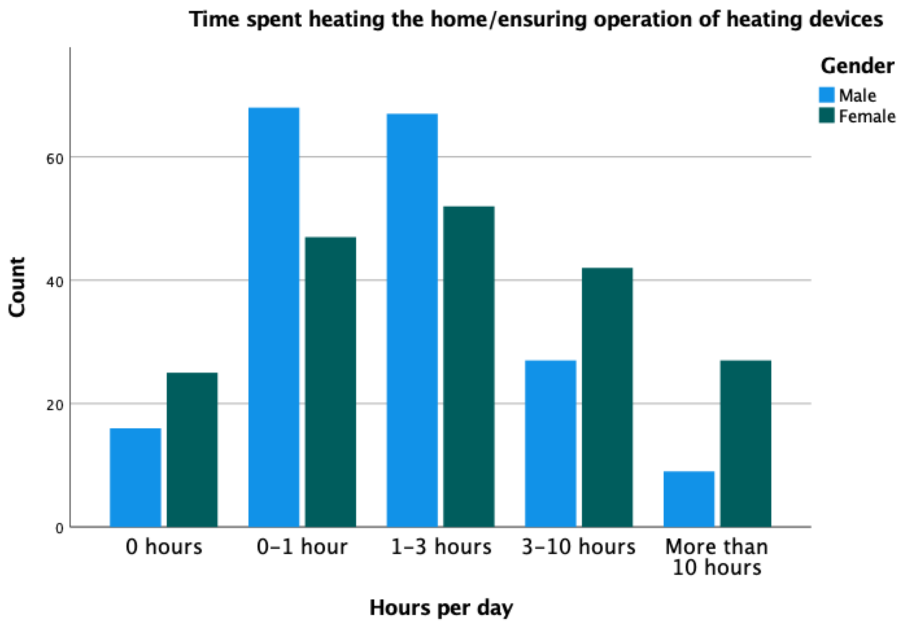


Figure 6 – Women spend much more time heating the home than me (n=380)

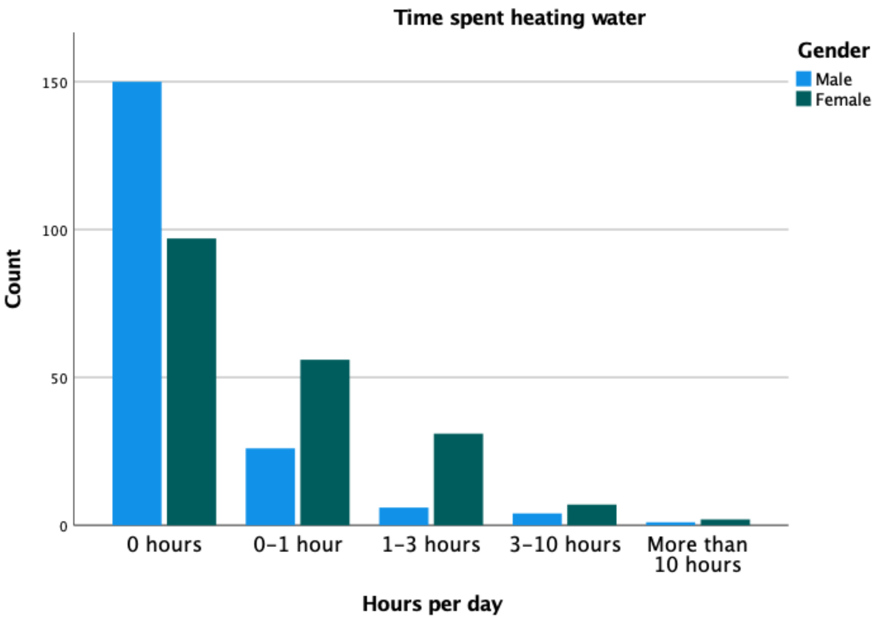


Figure 7 – Women spend much more time heating water than men (n=380)

On the other hand, men spent slightly more time on average collecting and storing heating fuels than women did (Table 10). Fuelwood storage took less time than dung storage, with a median value of just ten days per year, whereas dung was stored a median of fifty days per year.

Table 10– Time difference on heating fuel collection and storage by gender (n=380)

Gender	Mean number of days per year spent storing firewood	Mean number of days per year spent storing manure
Women	7.47 +/- 16.66	42.41 +/- 49.9
Men	11.48 +/- 23.4	56.4 +/- 61.35

4.3.3 Fuel saving practices

Most focus groups stated that everyone or most people try to save fuel (n=52), while other focus groups stated that only some people tried to save fuel (n=8). In just two villages, no one tries to save fuel. Respondents occasionally noted that households with young children are not able to save fuel as they need to keep the house warm enough so that the children do not get sick, as explained in this focus group quote:

“We use two stoves. We have three rooms. We need to heat two of them, in the third, the kitchen, we use a gas stove, let's say we cook something, and so we heat it that way too. We can not save because we have children, if there is no heat, they will get sick, etc. And the house is not in such a

good condition either, it is a small, low house, it is damp, it is necessary to heat constantly. We light it till around eleven, twelve o'clock at night, and in the morning, we light it again." – F, Amrakits

Respondents noted many different methods of saving fuel. In many focus groups, respondents stated that heating fewer rooms was common (n=29). Other commonly mentioned methods of saving fuel included turning off the heating stove whenever possible, such as at night, in the afternoon, or when no one was home (n=27). Roughly 25% of focus groups stated that some residents had installed thermal insulation (n=17) or energy efficient windows or doors (n=15). Less common methods of conserving fuels were wearing warm clothes (n=5), going to bed early or waking up late (n=7), and using an energy efficient stove (n=5). Some respondents simply stated they tried to burn less fuel (n=11) or mixed in cheaper / less efficient fuels to reduce the amount of wood used (n=5), sometimes overnight. This quote highlights what respondents do to save fuel:

"We do not use the room, we close it, we just do not heat it."
"Or we use those mattresses, or there are electric sheets. For example, if the room is not close to the stove, we turn on the electric sheets." – F, Lori Berd

Focus group respondents gave twenty-five different methods of making heating fuel usage more efficient, while just two groups didn't provide any. To make dung more efficient, the most commonly mentioned were compressing dung by hand (n=18), compressing dung with a tractor (n=19), most often also followed by cutting and drying out the dung. Other groups only noted drying dung out (n=6), using sheep dung when possible (n=3), or mixing dung with straw or sawdust (n=4). To make fuelwood use more efficient, many mentioned breaking down the wood (n=28), letting wood dry out (n=27), sometimes mentioning a particular way of lining up the wood for improved air flow, as this quote highlights:

"Well, during the summer we break down, line it up under the stairs… When we break the wood down, we leave it for a week or two to dry. As soon as we see it is dried out, we take it, line it up on the left and right so that air can pass through. It dries out in this way." – F, Bovadzor

The different practices noted were sometimes conflicting. Others preferred neither wet nor dry wood, but something in between (n=3). Some Some groups said that some people preferred damp or wet wood (n=5), while some said they used wet and dry wood together to slow the burn down (n=2), as explained in these quotes:

“In case you cut and arrange it immediately, it dries out and will be consumed at once. If you break it before using, it burns quietly and this way you seem to save a little more.” – M, Saralanj

“It is better to leave the wood in the rain. In general, there are poisonous things in it and when those oils go away with the rain, it already burns well. The more [the rain] comes (several times), the better it dries.” – M, Urut

Some respondents gathered dried branches, pinecones, or sawdust to burn (n=7). A few respondents stated that they used particular kinds of wood (n=2), such as hornbeam. A couple groups (n=2) said they use fuelwood and dung together to improve efficiency. Just one group mentioned installing energy efficient windows. Six groups mentioned cleaning chimneys or stoves regularly to improve fuel efficiency.

Another conflicting practice was whether to keep the heating stove going all the time, or whether to let it die out, as explained in this quote:

“For example, if you leave the stove fire to fade away, you will have to fill it constantly with wood so that it keeps the same temperature. You have to keep filling the wood . If you see you need the stove, you should fill it and that's it. If you save, it's the same thing, the fire will fade away, your house will get cold again, you have to burn it a lot to heat it.” – F, Jrarat

Women more frequently noted compressing dung by hand as an energy efficiency measure (n=12) compared to men (n=6). On the other hand, men more frequently noted breaking down wood (n=16) and letting wood dry (n=18) compared to women (n=11, n=8).

4.4 Energy Norms

4.4.1 Engagement in energy

Most people totally or somewhat agreed that they participate in energy-related decisions, often share energy-related opinions with their neighbours, and are interested in new energy technologies (Fig. 8). On the other hand, most respondents disagreed totally or to some extent that they usually tried new energy technologies. Most people totally or somewhat agreed that they would be willing to do additional physical work if it meant lower energy consumption. When asked about participating in further group discussions, 79% of respondents indicated they would like to, whereas 12.2% did not wish to, and 8.6% wanted more information.

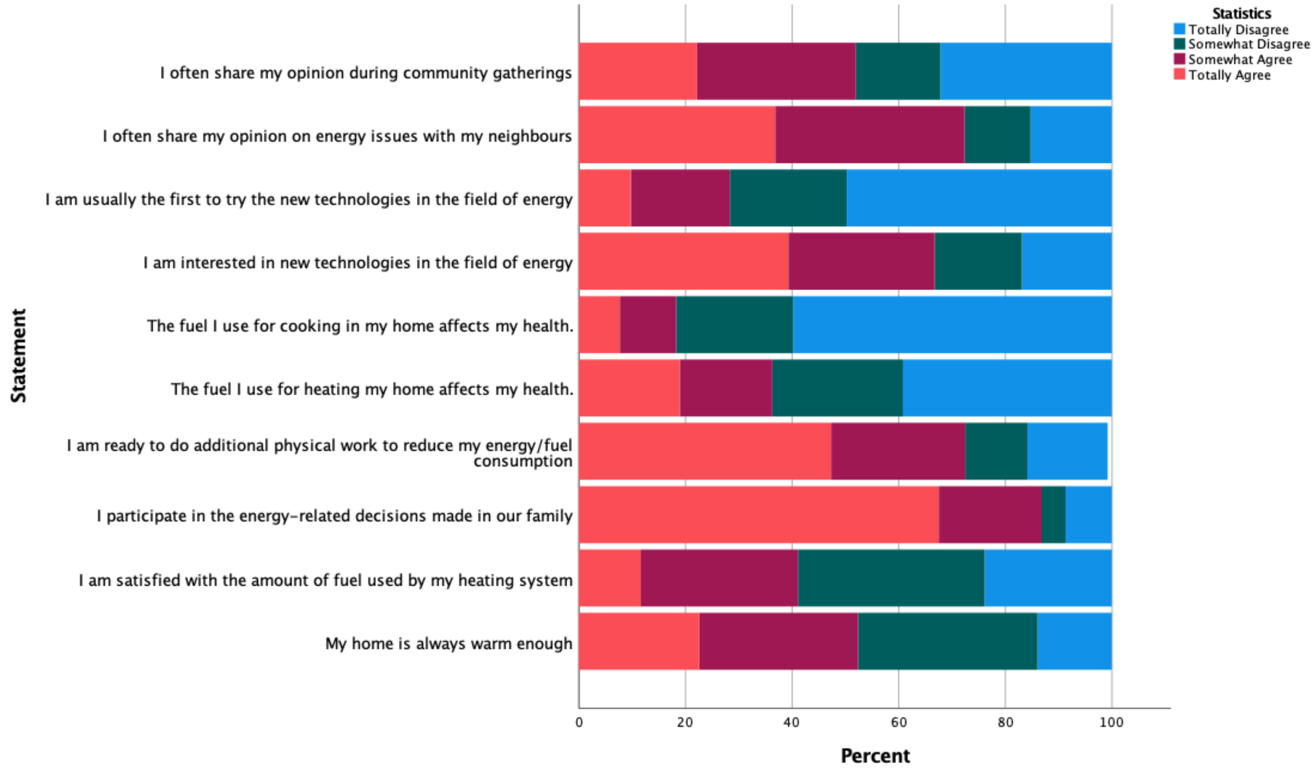


Figure 8 - Non-differentiated responses to ten statements on social innovation, energy behaviours and norms (n=380)

There was a significant difference between the genders for the energy engagement score ($F(1,378)=19.307$, $p<.001$). Men and women differed significantly in response to participation in energy-related decisions ($x^2(2) = 29.754$, $p<.001$) (Fig.9).

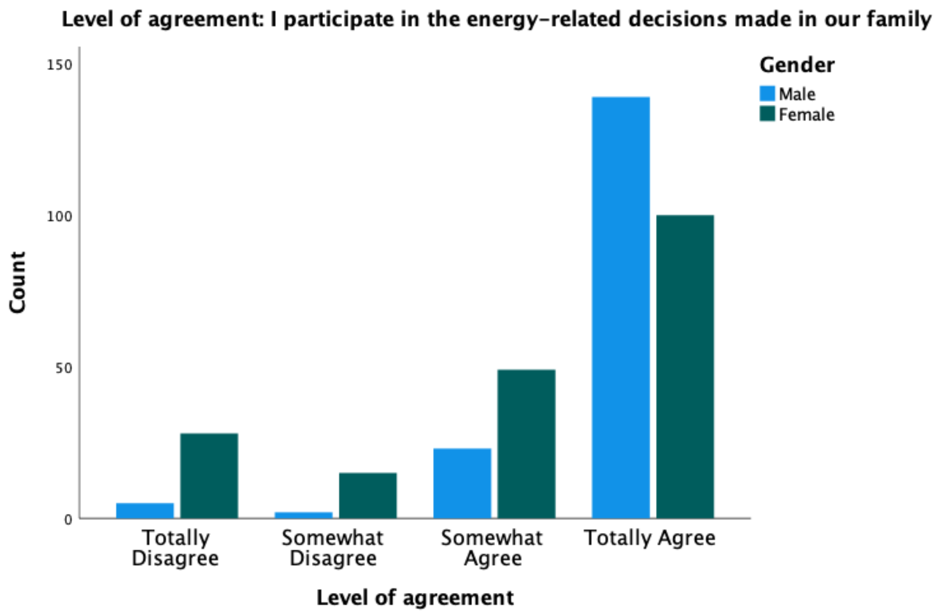


Figure 9 – Men totally agree more frequently that they participate in energy-related decisions in the family (n=380)

Responses also differed significantly between genders to the statement “I often share my opinion on energy issues with neighbours” ($x^2(1)$ =18.356, p<.001) (Fig. 10).

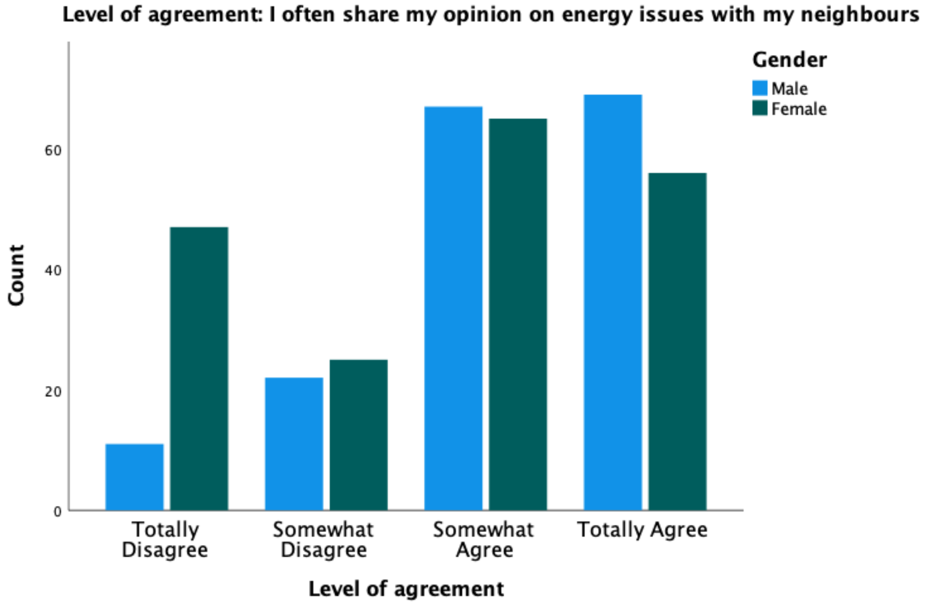


Figure 10 – Women more strongly disagree that they their opinions with neighbours on energy topics (n=380)

For an energy efficient stove which costs 80 000 AMD at market price, most respondents said they would be willing to pay 0 – 5 000 AMD (Fig.11).

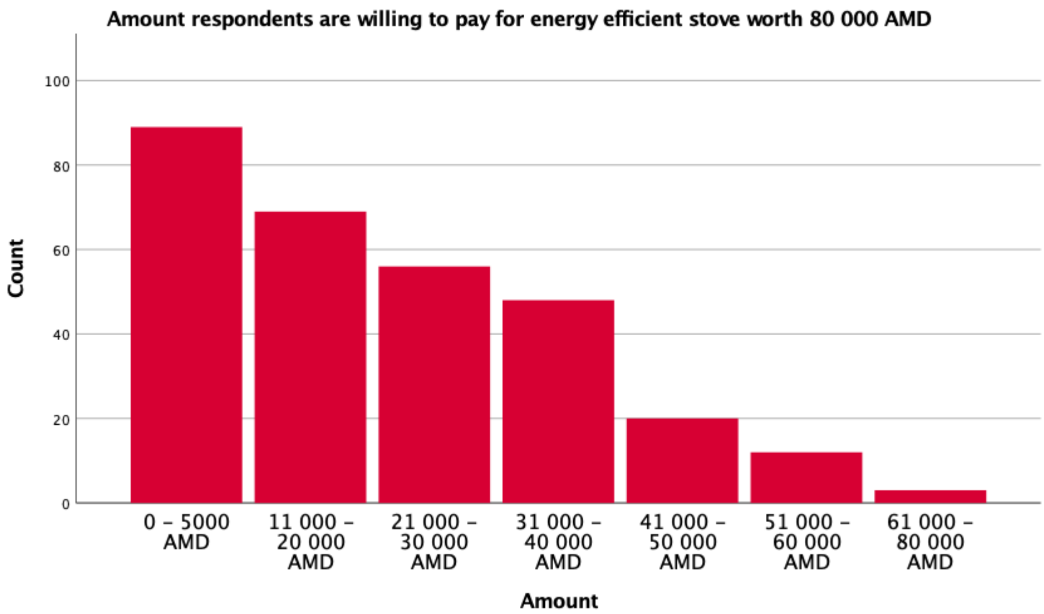


Figure 11 - Amount respondents would pay for energy efficient stove (n=380)

Roughly half of respondents stated that they had plans to make changes to their heating system (Table 11).

Table 11 – Percentage of respondents with plans to change their heating system (n=380)

1. I don't plan to change anything my current heating system	46.5%
2. I plan obtain a energy efficient stove	19.9%
3. I plan to obtain boiler working on biomass (wood, briquette)	11.6%
4. I plan to obtain centralized heating system with gas boiler	9.7%
5. I plan to obtain solar water heater or solar panels	9.4%
6. I plan to change my fuel and shift to straw briquettes obtained from the market with direct payment	0.6%
7. I plan to change my fuel and shift to straw briquettes obtained by bartering my straw with briquettes	1.4%
8. Other activity aimed at energy efficiency (please mention)	0.8%

4.4.2 Energy system satisfaction

Respondents displayed low satisfaction with the amount of fuel used by heating systems or whether their homes were always warm enough. Most people either somewhat disagreed (33.7%) or somewhat agreed (29.7%) that their home was warm enough. Only 22.6% totally agreed that their home was always warm enough. Very few respondents totally agreed (11.6%) that they were satisfied with the amount of fuel used by their heating systems, whereas 23.7% totally disagreed, 34.7% somewhat disagreed, and 29.2% somewhat agreed.

4.4.3 Motivations for fuel choice

When asked about reasons for using different types of fuels, most respondents noted affordability and ease of use as the top reasons. Few people responded on reasons for using briquettes, electricity, or solar (Table 12).

Table 12– Reasons for using different types of fuel for heating the home (n=380)

	Fuelwood	**Dung**	**Briquettes**	**Gas**	**Electricity**	**Solar**
First Reason	Affordable (36.3%)	Affordable (40.8%)	Easy to use (1.1%)	Easy to use (53.7%)	Easy to use (5.3%)	Affordable (1.8%)
Second Reason	I have no alternative (9.2%)	Easy to access (17.6%)	-	Secure supply (1.8%)	Traditional (0.8%)	-

Third Reason	Easy to use / I have no alternative (1.6% each)	Traditional (2.6%)	-	-	-	-

4.4.4 Acceptability of alternative heating fuels

Solar energy is considered the most acceptable energy source across the communities surveyed, as almost all focus groups (n=58) said that many residents of their communities already used solar and/or that it was acceptable, as this quote demonstrates:

"*In the last one year, about fifty percent have installed solar water heaters. Well, it saves a lot of electricity."* - M, Aragyugh

A few communities were not certain but considered solar as a possibility (n=3). Just one community considered it to be unacceptable because of the high investment required, and because of a lack of water to use solar water heaters, as seen in this quote:

"It is just inaccessible for us, because it is very expensive and we will definitely not be able to afford it.
"They also gave us those things to heat water with the sun, but they didn't work."
(Facilitator)"Why didn't they work?"
"Because there is no such strong sun, we did not have water, this year it rained a little, but it is not enough. Now we buy water and bring water from a few kilometers away to drink or to use. It is not available to us. The World Vision provided a tank with it, but it did not work. We used to fill it with water, but I don't know, it didn't work here." -F, Sverdlov

The acceptability of straw briquettes was mixed. Some communities considered them to be unacceptable, as they had negative experiences with straw briquettes in the past and considered them to be inefficient at heating (n=14) or stated that they did not have enough straw to produce them locally (n=7). Some communities gave other reasons including expense, a lack of straw, inefficiency, or that they produced a bad smell (n=4), as illustrated in these focus group quotes:

"Do you know what a briquette is like? For example, I brought a one… one year. Other guys also bought it. We tried two different stoves, sat down, set a timer and came up with the idea that there

could be two options: Either the quality of the briquette is not good or our stoves are not meant for this. In a word, we tried it in five different houses and no where it burnt properly. Do you know what happened? It made dust and vanished." -M, Zoravan

"We live in the mountains; our winter is severe. Go to the Ararat valley, [briquettes] will be burnt there and heat up very well, but it will not heat us up." - F, Mets Mantsh

Many communities were unsure about briquettes because they had not had experience with them in the past (n=22). In many cases, residents of those communities had no or little experience with straw briquettes and said they would need to see them proven to be efficient and affordable before trying them. The lowest share of communities said that straw briquettes were acceptable (n=19), but reiterated they would need to be affordable and accessible, as explained in this quote:

"It is acceptable but not available. It is an expensive pleasure today. One ton costs from eighty to one hundred thousand drams, and ninety percent of the village is not able to pay or buy the given prices. Besides it is far from the village for example, it must be brought from Spitak, from Kirovakan. We don't have a chance." – M, Hobardzi

Very few communities considered biogas from dung to be acceptable (n=4), although most communities were unsure or had no experience with biogas (n=37), whereas twenty-one communities found biogas was unacceptable due to the importance of manure for other uses such as fertilization, or thought the amount of dung they use for heating would not produce enough biogas. A few stated that the process of making biogas is too labour intensive, as one respondent explained:

"That is what we tried to do during the earthquake. We filled the dung, acidified it and got gas."
(Facilitator) "And then why not use it?"
"Because that dung will be used both for fertilization and the so-called dung will be thrown into the stove to burn. In addition, for example, we have a fifty percent decline in livestock. People do not keep many animals, it is not profitable. If pork costs two thousand drams today, why should he keep that pig?" -M, Mets Mantsh

When asked about burning plastic waste and other household materials, respondents noted it was a common practice particularly in winter (n=13), and by poorer households (n=21). Many noted, however, that these items are generally used in homemade boilers outside the home, for example in outbuildings (n=13). Roughly a quarter of communities said these items were rarely or never used for heating (n=15), while nine communities said they were burned to get rid of household waste rather than for heating. The following quotes illustrate conflicting opinions about the practice:

"When we are running out of wood, we have to burn it. We burn whatever we find. That has a negative effect on one's health."
"For example, our neighbours burn the cloth waste as well. They have no wood, no fuel, and they burn the cloth waste." – F, Yaghdan

"No, [no one burns plastic] here. There is no need. Let me say that here you can find a rare house where no one works, as Yerevan is close and there are at least a hundred people from our village who work in the city." – M, Zorovan

4.4.5 Barriers to Efficient Heating Fuels

Most communities agreed that people wanted to buy energy efficient devices (n=55), and many noted already having energy-saving lamps installed (n=21). However, the price of such devices was noted as being too high, or difficult to afford (n=16). Communities were interested in energy efficient stoves (n=10) and solar products (n=2), as this quote illustrates:

"We live in such a zone, where we have winter for six months. That is, we think about heating for half a year. For sure we are interested in saving. All of us are interested, it is not just one person. The one who burns the stove for six months will think about it, won't they? The fact that the stove burns half a cube less during the season does help for sure. -M, Saralanj

When asked about any reason they wouldn't switch to a different fuel that was as affordable or more affordable, most communities answered 'none' (n=35), as these quotes highlight:

"Everything depends on finances, which causes a big problem for any villager. Any villager who has money will go and bring coal and bring wood. Everything will burn. Middle-class people like us burn manure to survive. We do not live, we survive." – F, Urut

"Before we make that dung and turn it into fuel, we do a lot of physical work. If there is an affordable alternative, we will work that much, we will burn it. We will use our dung as fertilizer for our lands and get heating at an affordable price." – F, Zorovan

Many groups (n=11) reiterated that affordability was the most important consideration. Other groups stated the alternative heating fuel must be comfortable to use (n=14), 'clean' (i.e., the fuel must not damage the home) (n=8), and should be safe for health (n=5), as one respondent explained:

"Of course, comfort matters. We won't burn anything which makes smoke and dirt in the house just to heat it. It won't work this way. For example, our village is not so underdeveloped. People can repair anything, they try, they want to get heating with normal conditions so that they won't renovate their houses every two year. It is better to have some fuel type with the good conditions in the house." -F, Kurtan

A few other lesser-mentioned reasons include heating efficiency (n=6), availability/accessibility (n=4), convenience (n=4), and minimal ecological impact (n=2).

Focus groups with female participants noted that alternative fuels must heat efficiently to be acceptable (n=4) whereas this was not mentioned in any male focus groups. More male focus groups mentioned fuel cleanliness (n=6) compared to female focus groups (n=2). Male focus groups also noted comfortable use of the potential alternative fuel as a concern (n=10), whereas just five female groups noted comfort.

When asked how respondents would change their energy situation, many groups mentioned solar – either generally (n=41) or as a solar power plant (n=7). Total community gasification was also mentioned frequently (n=17), as was a more affordable and efficient heating device (n=10), and a more affordable fuel option (n=11). Fewer communities mentioned switching to briquettes (n=6), coal (n=4), or wind (n=4). A few groups wanted to fully insulate homes (n=2). Electricity was noted as being unreliable, so the alternative should be dependable, as this quote explains:

"For example, we would like to have a panel system so that they give it to us, but it does not happen that way. Our electricity is in a very bad condition. It is cut off every now and then. It is cut off during wind, it is cut off during rain, it is cut off during sunny weather. And we are all dissatisfied with it. For example, in the farm, a milking machine works, [but] because of the electricity we can not work many times." – M, Yaghdan

4.4.6 Health impacts of fuels

On the individual surveys, 301 respondents completely disagreed that fuel for heating or cooking affected their health, although heating fuels were perceived as having stronger effects than cooking fuels. Dung was considered the most impactful fuel on health, with

26.7% of respondents stating it has a very large impact (Fig.12). Gas followed, with 10.8% of respondents stating it had a very large impact on health.

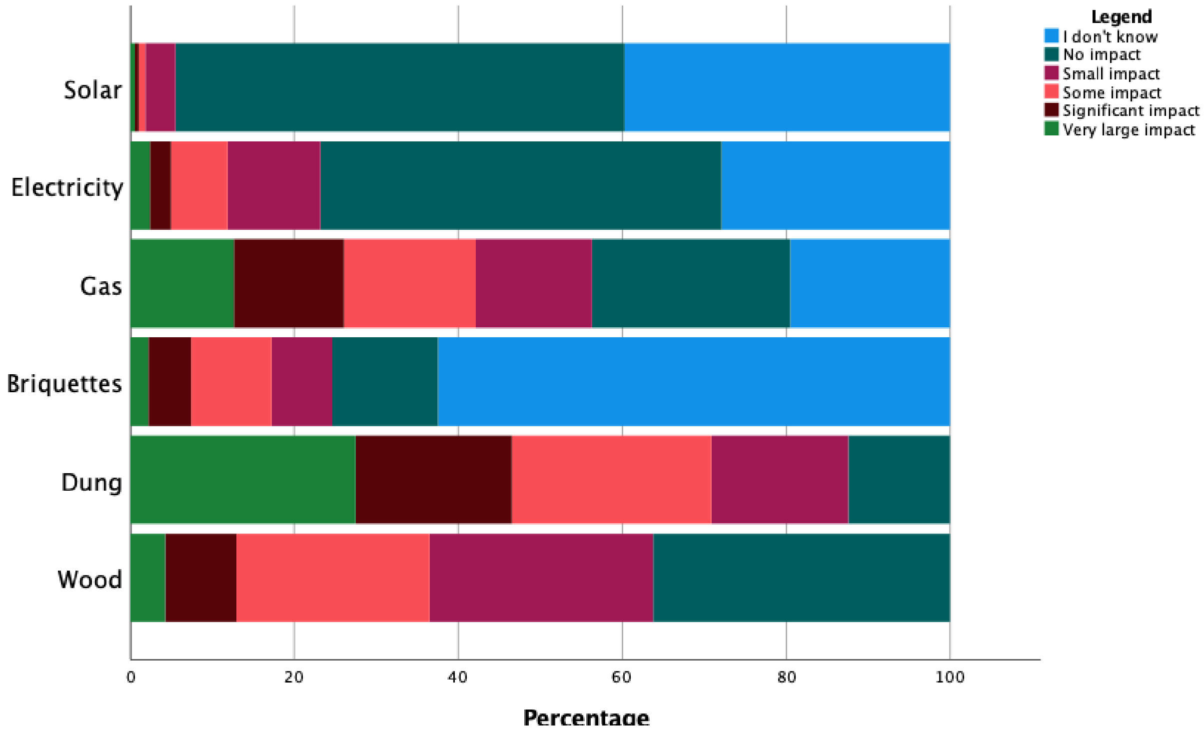


Figure 12 – Perceived health impacts by heating fuel type (n=380)

From the focus group discussions, most communities considered smoke from wood (n=23) and from dung (n=17) to be detrimental to their health. Dust from dung (n=15) and from smoke (n=7) were also a concern. Many groups said gas could be dangerous, so safety rules had to be followed carefully (n=16). These quotes highlight peoples' opinions on health impacts:

"Basically, 99% of the population in our village now has gas, but they do not use gas fully for heating, they use natural gas for cooking, and I do not think it will harm anyone."
(Facilitator) "Does the gas or dung have a negative effect on your health?"
"Yes, of course. Well, that smoke and fumes always affect [health] negatively. If there is a stove in the house, it will affect [health] for sure." – M, Arevik

"There was such an unpleasant smell from dung, my [blood] pressure was rising, and I was sick, but I was burning it, as there is no way and no money." – F, Gyulagarak

Some groups said smoke was not dangerous unless it appeared in the home (n=7). Eight groups did not consider there to be any health impacts associated with heating fuels. These quotes from the Agarak focus group demonstrates conflicting opinions on health impacts:

"Wood and dung are ecologically clean fuels and if the stove burns normally and does not smoke, there is nothing harmful. Only the smell is a little unpleasant and that's all."
"And I think if something burns, it definitely hurts. Now these new baxis are good because the smoke does not appear in the house." – M, Agarak

Women differed significantly in their perceived health impact of fuelwood ($x^2(4) = 16.798$, $p=.002$), more frequently stating that fuelwood has no health impact than men. Similarly, perceived health impact of dung was also significantly different between the genders ($x^2(4) = 19.504$, $p<.001$), with men stating dung as having a very large or significant impact more frequently than women. On the other hand, women were more concerned about the health impact of electricity, which significantly differed from men, who mostly stated there was no impact ($x^2(5) = 26.178$, $p<.001$).

When asked how the health of respondents and /or their families were affected by the fuels used at home, the top impacts were breathing problems (38.3%), eye irritation (4.9%), and respiratory illnesses (3.6%) (Fig.13). 48% of respondents did not note any health impacts. The second ways health was impacted were respiratory illnesses (8.6%), skin irritation (6.5%), and eye irritation (5.7%).

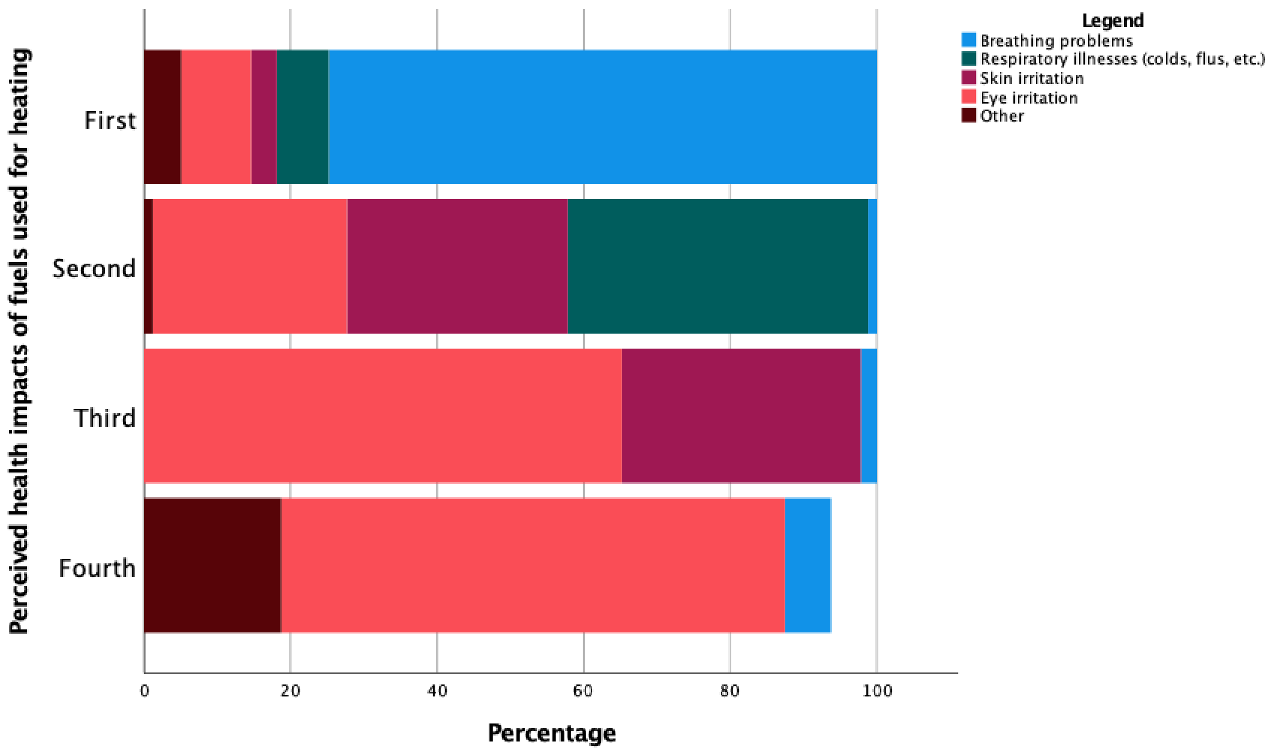


Figure 13 – First, second, third, and fourth perceived health impacts of heating fuels (not ranked) (n=380)

Respondents most frequently noted respiratory health concerns associated with their fuel usage such as coughing and shortness of breath (n=12). Allergies (n=5) and headaches (n=2) were also a concern, as were high blood pressure (n=2), colds resulting from inability to keep indoor temperature stable (n=2), and eye irritation (n=4).

In total, more female focus groups named more perceived health impacts and problems than men (n=20 and n=9, respectively). Respiratory problems (n=9), allergies (n=4) and higher blood pressure (n=2) were more frequently noted by female focus groups. Male and female groups did not differ significantly in the frequency heating fuels causing health impacts were noted.

4.4.7 Ecosystem services & environmental impacts of fuels

4.4.7.1 Ecosystem services

Provisioning of food was identified as the most important benefit or service provided by nature (24.6%), followed by provisioning of fresh air and fuel (17.8% and 17%, respectively) (Table 13). The second most important benefit was provisioning of fuels with 18.8%. Provisioning of food and fresh water were most often listed as second and third most important benefits.

Table 13- Benefits and services provided by nature (n=380)

	Most Named	**Second Most Named**
Top benefit or service provided by nature	Provisioning of food (24.6%)	Provisioning of fuel (18.8%)
Second most important benefit or service provided by nature	Provisioning of food (24.3%)	Provisioning of fresh water (22.5%)
Third most important benefit or service provided my nature	Provisioning of fresh water (20.8%)	Provisioning of food (14.9%)

The top ecosystem services also differed significantly by gender ($x^2(9) = 29.276$, $p<.001$) (Table 14). Women noted ‘provisioning of fuels’ and ‘spiritual’ more frequently, whereas men noted ‘recreation and leisure’ and ‘fresh water’ more frequently.

Table 14– Difference in first benefit or service provided by nature by gender (n=380)

Benefit or Service	Respondents - Male	Respondents - Female
Recreation and Leisure	17.6%	8.8%
Provisioning of fuels	10.7%	23.3%
Provisioning of foods	25.7%	27.5%
Fresh air	18.2%	19.2%
Fresh water	19.3%	11.4%
Provisioning of housing material	1%	0
Provisioning of medicinal plants	0	.05%
Soil formation and fertility	6.4%	4.1%
Spiritual	1%	5.7%
Other	0	.05%

4.4.7.2 Perceived environmental impact of heating and cooking fuels

Dung, gas, and wood were perceived as having the largest environmental impact (Fig.14). Solar and electricity were perceived as having no impact or a small impact, although a significant share of respondents felt they weren't sure about the impact. People were most uncertain about briquettes and solar.

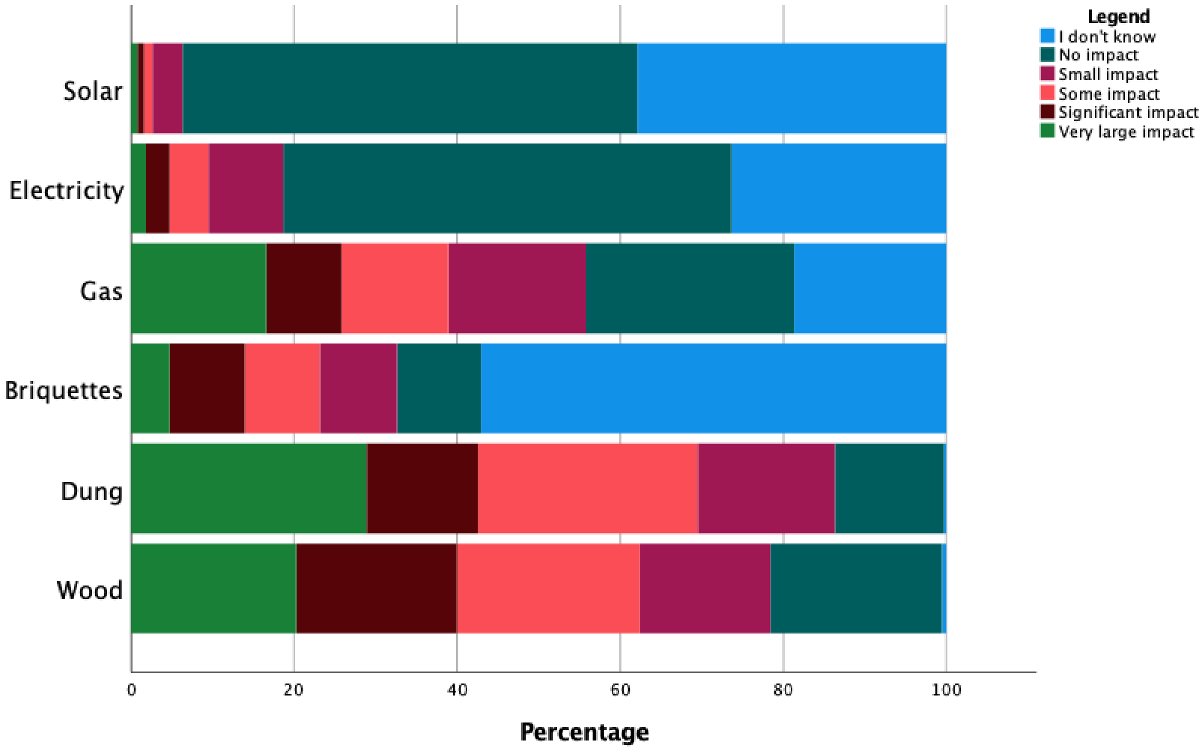


Figure 14 – Perceived local environmental impact of heating fuels (n=380)

Local environmental impact of fuelwood differed significantly by gender ($x^2(5) = 26.9$, $p<.001$), with women more frequently noting no local impact. Similarly, women and men differed significantly in their assessment of local environmental impact of solar energy ($x^2(5) = 31.537$, $p<.001$), as women more frequently responded that they didn't know, whereas men more often stated there was no impact.

Deforestation was also a major environmental concern of respondents (n=29). Some groups were also concerned with forest health, noting trees drying out and/or turning yellow (n=9). Access to clean water, water health, and drought were also common concerns (n=20). The following quotes highlight these concerns:

"The condition of our forests is very bad. They are barren forests. The trees are being cut and are not being planted instead. But there is nothing to blame. How can [homes] be heated unless they cut a tree? It is winter. This is something to worry about."
(Facilitator) "And besides forests, what other reasons for concern are related to the environment?"
"Everything. Due to the lack of forests, the ecosystem is completely disrupted."
"We do not have irrigation water for the lands."
"Well, the lands are salinizing. In a few years we may not even harvest from that land." – M, Pushkino

“So, the village is located on the network that feeds the Karnut reservoir. It gets polluted year to year to unspeakable amounts. Every year the reservoir and canal become more polluted. Dead animals, any type of industrial waste. There is a stench in the area, the Karnut reservoir is filled with garbage. From the upper villages, from where the Karnut reservoir was fed, that household garbage is simply thrown into the canal. This is a parallel problem. In addition, we have four mining enterprises. Won't speak even about dust: that they are obliged to cover that dust with soil, which is excluded and not done. Every day I tell my students not to throw away the paper of chewing gum or the ones of candies, but that culture is completely absent from our people” – M, Karnut

“Frankly speaking, we are very sad about the fact that the forests are being damaged for the fuel…It hurts a lot, but let there be so much fuel, let the gas or something else get cheaper so that we do not touch the forests. Let there be fuel available to us, we will not have to take such steps. So that we can all warm up, without harming nature.” – F, Gargar

Air pollution (n=14), soil health and farming yields (n=13) we also frequently mentioned. A few groups were concerned with the amount of garbage dumped into the environment (n=4). Eleven groups said they had no environmental concerns. These quotes from one focus group discussion show differing opinions:

“In the past, for example, they burned coal. If it will be possible, we will burn coal with pleasure. Right, the air is spoiled somehow, but we will burn.”
“I do not agree; do you know why? People renovate the house, then burn it for a season, and all that work becomes in vain, that's why we want solar energy so that the house will be clean, let’s make progress, rather than regress.” -F, Agarak

When asked about future concerns with the local environment, many more female focus groups mentioned air pollution (n=12) compared to men (n=2); otherwise, there was little difference in responses between genders.

4.4.8 Future availability of fuels

The issue of deforestation and fuelwood availability came up in almost every focus group survey (n=58). The participants said they thought fuelwood would not be available in the future (n=14), that fuelwood was already too expensive (n=12), and that fuelwood is already difficult to find (n=16), as seen in these focus group quotes:

There is a concern because it is already difficult to find wood. We have to wait now. Last year, they gave us permission to collect wood too late.”

"Because there is no forest. Nature is already disappearing. It has turned into a desert. If the state does not take any measures, at least natural gas. We do not even have gas, the pipes are far away, and there is no money to gasify the village and heat with it." -F, Gyulagarak

"Well, naturally in a few years that wood will not be available either. But there is no other option. There is no gas, either. Half of the village is gasified, about thirty percent."
"In a few years there will be no wood. We will have no gas, no wood, no light. In the evenings they turn off the lights. We sit in the dark place." – F, Pushkino

"Well, we are not allowed bring the wood. Wood is always available, it is the matter of price. Last year it was ten, this year is fifteen, next year it will be twenty-five. If many people are allowed to [harvest] it, it will naturally become cheaper. In case nobody [harvests] it, it will naturally become more expensive." - M, Hobardzi

Some thought fuelwood harvesting could be banned (n=3). A few focus groups stated fuelwood is already unavailable (n=3), or that they were already not allowed to cut down trees (n=8). Of less concern was availability of dung, but some focus groups said the number of livestock could or is dropping (n=6), mainly due to scarcity of grass and fodder, as this quote states:

"One hundred, one hundred and fifty cattle are missing from our village in a year. There is no pasture, no food." – M, Buzhakan

Gas availability was a concern in nine of the focus group discussions, particularly due to the cost and potential for rising prices in the future, as seen in these quotes:

"Yes, we definitely already think about [future heating fuel availability]. We also use gas, but at the end of the month we get 40.000, 50.000, or 60.000AMD fees to pay. It happens, you owe 1000AMD and they simply cut off the gas. That's why we burn wood."
"Well, the price of wood is getting more and more expensive. They say whatever price they want. If the wood was brought up to the house, the price will be mind-blowing. Well, they know that we are sitting in the cold. They give us a chance to pay it in parts." – F, Lori Berd

4.5 External Influences on Energy Culture – information sources

Most focus groups considered energy-related information to be accessible (n=39), while 20 focus groups considered such information to be limited. Just three focus groups stated that such information was not available or very limited. The most common source of information was word of mouth, both from acquaintances (n=39) and relatives (n=11), closely followed by the internet (n=47) (Table 15).

Table 15 - Sources of energy-related information (n=62)

Source of Information	**Response Frequency**
Internet	47
Word of mouth (acquaintances)	39
Word of mouth (relatives)	11
TV	20
Radio	1
Energy-related equipment suppliers	19
Solar organization	8
Local expert	3
Money-lending organization	2
Community meeting	1
Working abroad	1
Flyers	1
NGO	1

These quotes highlight the different sources of information people use, and how they would like to receive information:

"Well, let's say they mainly use not the experts, but from those who have brought and installed it, after a while, we may ask 'Are you satisfied with it or not, how much water do you use, is it enough or not and so on'." - F, Hobardzi

"My neighbor installed it 3 years ago, I saw that and installed it myself." – M, Hovit

"For example, water heater contractors come and say that in order to save energy we should install solar heaters." – F, Aragyugh

"It would be good if there were more advertisements, let's say, special informative brochures, so that in case they want to introduce something new, we would know about it. If there were small information booklets, for example, such a seminar is helpful now, but it'd be better to have booklets for further examination." – F, Gargar

4.6 Energy Scores

The average, median, minimum and maximum for each calculated score are listed in Table 16.

Table 16– Energy Scores (n=380)

Score	Average and Standard Deviation	Minimum	Maximum	25% Percentile	75% Percentile
Energy Efficiency	6.66 +/- 3.05	1	18	4	9
Energy engagement	22.12 +/- 5.03	6	32	19	26
Energy Time	9.674 +/- 3.07	4	18	7	12
Energy Satisfaction	4.88 +/- 1.62	1	8	4	6
Perceived Health Impact	5.62 +/- 3.48	2	16	2	8

There is a moderate positive correlation between energy time score and perceived health impact ($r(378)=.225$, $p<.001$) meaning those who are spend more time on energy activities tend to perceive greater effects on their health. There is also a moderate positive correlation between energy engagement score and perceived health impact, ($r(378)=.321$, $p<.001$) indicating those who are more engaged in energy topics perceive greater effects on their health.

There is a weak negative correlation between energy time and energy satisfaction ($r(378)=-.114$, $p=.027$), indicating those that spend more time on energy tasks are less satisfied with their energy situation. There is a weak negative correlation between energy satisfaction score and perceived health impact scores ($r(378)=-.318$, $p<.001$).

There were no significant correlations between energy efficiency scores and any other scores. Energy efficiency scores were significantly different between different annual household income groups ($F(2)=7.755$, $p<.001$), however the average difference in energy scores between the highest income group and the lowest income group was only 1.5.

Chapter 5: Discussion

5.1 Energy Cultures in Rural Armenia

An overview of the factors shaping the energy culture in rural Armenia as found in the present study is displayed in Figure 15.

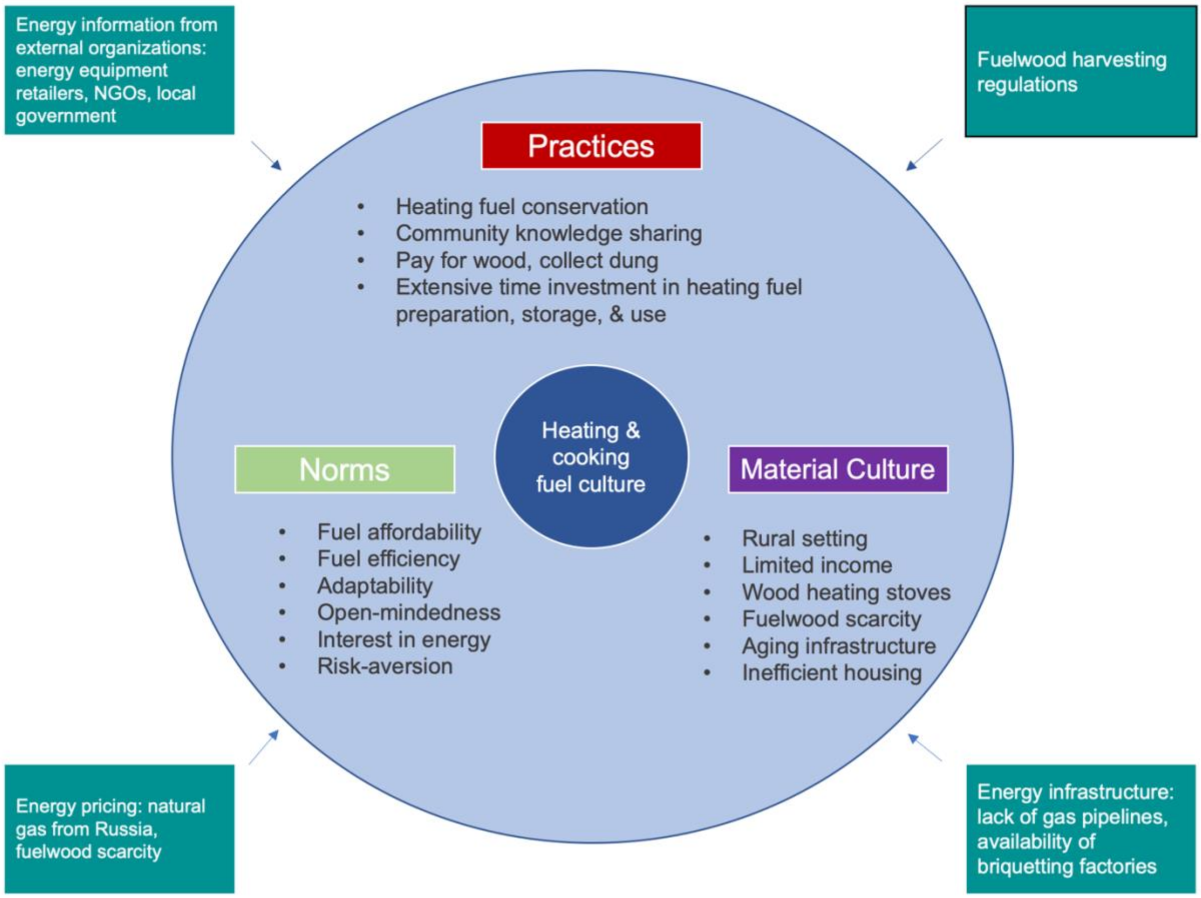


Figure 15 – Norms, practices, material culture, and external influences shaping rural Armenian energy cultures

5.1.1. Material culture: traditional, but changing

5.1.1.1 Preferred heating fuels and devices

The material culture in the communities surveyed is shaped strongly by the available heating fuels. Infrastructure was less thoroughly examined in this study, but certainly plays a role in shaping the material culture. In all surveyed communities, dung and fuelwood were the most commonly used heating fuels, which was expected, are the most available and cost-effective fuels, and was also found in other studies on energy usage in Armenia (Moreno-Sanchez &

Sayadyan, 2005; Harutyunyan et al, 2019). Most people used between five and ten cubic meters of fuelwood per year, which is is less than what other studies have found in households relying on fuelwood (Lee et al, 2015). Wood heating stoves were, as expected, the most common heating device.

The material culture appears to be undergoing a shift, as many communities noted in their focus group responses that availability of fuelwood is major concern. Many noted that in recent years, new rules around fuelwood harvesting have been introduced to reduce deforestation. Due to this, many residents consider fuelwood to be already difficult to obtain, and/or stated that it probably won't be available in the future. Residents in some communities also highlighted concerns on the availability of dung, as cattle are decreasing in some regions due to a lack of fodder. The lack of fodder was thought to be due to drought and irrigation water scarcity, although causes were not always given by respondents. In addition, that almost half of residents have plans to change their heating system indicates that changes are underway – particularly, people are looking to more efficient stoves and boiler systems.

5.1.1.2 Infrastructure

It is challenging to determine the role of domestic infrastructure within this study, as most of the respondents lived in similar housing types, namely individual homes made from stone. Generally, most housing lacked insulation or other energy efficiency measures such as double-pane windows. This definitely influences the material culture, as inefficient buildings will require more heating fuel to maintain the desired temperature compared to housing with energy efficient improvements (Zhu et al, 2018). In addition to higher financial cost and/or labor for the additional heating fuel, health impacts may be worse in these homes (Zhu et al, 2018).

There was no detectable pattern to the energy efficiency scores across the communities, nor any correlation with any other energy score, which indicates that such upgrades are probably made on an individual household basis. Annual household income did have a slight impact on energy efficiency scores, as wealthier households had slightly higher average scores, but not to an extreme extent. There may be additional factors that influence energy efficiency upgrades in homes, and further investigation is necessary.

There was a clear impact of public infrastructure on the material culture, namely fuels used.

Those villages closer to a briquetting factory were more accepting of briquettes as possible energy sources, or already used them. In addition, the lack of gas pipelines to every house strongly influences the number of households using gas. Some respondents noted poor roads near their community. This could also influence the energy culture, if materials are difficult to obtain due to challenges travelling to other regions. This can also make it more difficult to rely on external energy sources – for example, if a briquetting factory is located far away, there is a potential risk that they will not be accessible in all weather conditions. Rather, as some respondents noted, one would need to make a large purchase and pick them all up at once, or have them delivered, both of which would require a large financial commitment. Lower market access has also been correlated with "traditional" fuel (dung and fuelwood) usage in other studies (van der Kroon et al, 2014).

5.1.2. Energy practices

5.1.2.1 Fuel collection and preparation

The practices around fuelwood collection largely reflect the restrictions on fuelwood harvesting imposed on the communities. Fuelwood is most commonly purchased with direct cash payment or delayed payment; very few respondents collect their own wood. On the other hand, most people use dung produced by their livestock, with no payment involved. Dung preparation is a large undertaking that many respondents considered to be a very difficult and time-consuming process, which is also often done in advance. Wood also is usually broken down to dry out far in advance. There is clearly a significant time investment in improving the efficiency of heating fuels, indicating potential for new heating fuels that do not require as much time.

There are conflicting opinions about a few practices meant to make fuel use more efficient. First, there were some communities that prefer to use wet or moist fuelwood. Primarily, the reason for this was to keep the wood burning longer. Some respondents who preferred wet wood even stated that they knew it was less efficient, but ultimately thought it was better for their circumstances. Leaving fuelwood out in the rain removed certain compounds and helped the wood dry more effectively, according to one respondent. Most respondents, though, thought using dry wood was much more efficient. Another, less often mentioned difference in practice is whether to keep the stove going at all times versus turning it off periodically, when it isn't as needed. The discrepancies found in energy practices were clearest between communities, highlighting how important community is for knowledge-sharing and development of energy practices.

5.1.2.2 Fuel conservation practices and impacts

There are many practices related to conservation of fuel in the study area. Winter is very harsh in some regions, and conserving heating fuel to last the entire season is considered essential. Many focus groups stated that everyone in the community conserves energy out of necessity. Many of the fuel conservation practices described by respondents are associated with (severe) energy poverty (Herrero, 2020; Pachauri and Spreng, 2011), as does the large share of respondents indicating their home isn't always warm enough. One of the most frequently mentioned conservation practices of simply using less fuel whenever possible, done by shutting off the heating device when it isn't essential such as at night or when people aren't home, heating just part of the home, putting on warm clothes or altering the sleep schedule to require less heating (i.e., going to bed early or getting up late) is a strong indicator of energy poverty in particular. Such practices are common in households where energy is too expensive to keep the home heated to an adequate temperature (i.e. those in energy poverty), which can have serious impacts on physical, mental and social well-being (Liddell and Moris, 2010; Howden-Chapman et al, 2011). Therefore, it can be concluded that energy poverty affects a significant portion of rural Armenians, which further raises concerns about health impacts of the current energy culture beyond indoor air pollution from fuelwood and dung. To make matters worse, the conditions are largely permanent rather than temporary – i.e., chronic – and therefore more strongly impact the health through life-long effects (Jessel et al, 2019). The practices described in this study are confirmed by a wider report on the energy situation in Armenia (Tumasyan et al, 2015).

5.1.3. Norms

5.1.3.1 Cultural norms: curiosity, community, engagement, and readiness for change

Respondents in this study demonstrated willingness to try innovative methods of heating, and showed curiosity about innovations. Unlike some other literature, there did not appear to be a lack of public acceptance for new renewable technologies (Liu and Pistorius, 2012). Community knowledge-sharing was also demonstrated to be a key norm across the regions, which reflects the extensive body of literature on peer effects and social networks as important information channels (Wilson and Dowlatabadi, 2007; Noll et al, 2014). In this study, people are much more likely to implement new technologies when their neighbours do, which makes sense, as they more or less know the technology will also work in their situation.

Overall, respondents were overwhelmingly interested in joining in later discussions on energy efficiency, indicating most people are engaged in energy and willing to learn more. Respondents are strongly engaged in energy-related decisions within families. That most respondents share their energy opinions with neighbours also reinforces the high energy engagement. People are less inclined to share opinions at community gatherings, but this could be due to other factors such as hesitancy in front of larger groups. That people are engaged in energy and open to new possibilities is key, as willingness to change behaviour is essential in furthering rapid and clean energy transitions (Murphy, 2001).

While responses were mixed, more than half of respondents were dissatisfied with their heating systems, which demonstrates an opportunity for change. If people were satisfied, then it would create additional challenges with introducing more efficient fuels and devices (Sovacool et al, 2021). A similar number of respondents have plans to change the heating system, which further supports a readiness for change.

There was also strong willingness to do additional physical work to reduce fuel consumption, despite busy schedules and the extensive time already required to prepare fuels. This highlights the importance of heating fuels to the communities, and the lengths respondents are willing to go to reduce fuel consumption.

5.1.3.2 Main drivers of heating fuel acceptability: affordability, effectiveness, and comfort

Most respondents are interested in new energy technologies, but few stated that they were among the first to try them. This indicates that the culture of innovation and trying new things is already existent, but that the material culture is a barrier – namely, pricing. This can also be inferred from the fact few people would be willing to pay more than 10 000 AMD ($19 USD) for an energy efficient stove. When asked if they would buy energy efficient devices, many already had energy saving light bulbs, and many said they would like to buy more if they were affordable or financially able to. Additionally, a strong majority stated affordability was the reason for using a fuel. Indeed, household income level was correlated with a higher energy efficiency score. That affordability plays a key role is not surprising. Extensive literature on energy transitions notes affordability as crucial (Ma et al, 2019; Vigolo et al, 2018; Rahut et al, 2014; Mondal et al, 2010). There is definitely a wealth gap between different communities. Those that are closer to Yerevan have greater opportunity to find work, indicating that a community-specific approach could be more beneficial when examining potential policy interventions.

Effectiveness or heating efficiency was also a key aspect of an acceptable heating fuel. Some respondents said that a hypothetical alternative fuel should ‘heat as well as wood’. Cleanliness and comfort of a hypothetical alternative fuel was also key, which relates to affordability, as dirty or polluting fuels have a negative impact on the condition of homes.

While there is a culture of openness to new options, there is a clear requirement in many communities that heating fuels must be both effective and affordable for them to be considered acceptable. These are very practical requirements, and reflect a focus on fuel utility, which was apparent in both individual and focus group surveys.

Respondents’ ideal changes for their energy situation also largely reflect the requirements of efficiency and affordability, with introduction or broadening of solar energy the most preferred change. The uptake of solar, being generally recognized as efficient, is only hampered by affordability, and shows that most communities would like to transition to clean energy if possible. Gasification was also mentioned frequently as a change that respondents would like to make, which again corresponds to the efficiency/affordability requirements. Gas is considered efficient, but unaffordable. A more affordable fuel or heating device, mentioned by one-third of focus groups as the way they would change their energy situation, also reinforces the importance of affordability.

There appears to be very limited cultural preference for any particular heating fuel. Very few mentioned traditional usage as a reason for using fuelwood in the individual surveys, and only as their second reason for using it. There were no mentions in the focus group discussions of any cultural preference. There is evidence of a cultural preference for certain cooking fuels in the literature such as charcoal (Jürisoo et al, 2019; Shrestha et al, 2019), but to date there is very limited literature on cultural preferences for heating fuels. Heating fuels are not often linked to cultural practices in the way cooking fuels are linked to food and cuisine, and so may not play as much of a role in determining acceptability. Environmental concerns were also not a major factor in peoples’ choice of heating or cooking fuels in this study, or if they were a concern, they were by far out shadowed by efficiency and affordability. Further examination of this topic would be prudent, as energy projects that do not account for cultural preferences often fail (Mondal et al, 2010).

Alternative types of heating or cooking energy that were generally considered acceptable were solar photovoltaic and solar thermal (water heaters), although it was often said that subsidies or other forms of funding were necessary to obtain them. In additional, a few communities did not think their area was well-suited due to climatic or infrastructure conditions, which is important to consider (Mondal et al, 2010). While this study did not investigate wind energy, it was mentioned in a few different focus groups as a potential energy source, indicating that it may be acceptable. In many cases, briquettes were not commonly thought of acceptable. Respondents often said they had heard negative things about briquettes, and some had tried them out with lackluster results. Since briquettes are relatively expensive, respondents perceive them as violating both the affordability and efficiency requirements.

Biogas from dung was also generally not considered acceptable by those who had tried it before. People either thought it was not available, as dung was already used for heating, or because they preferred to use dung as a fertilizer.

5.1.3.3 Perceived heating and cooking fuel health concerns

There is some conflicting evidence in this study on the level of concern people in rural Armenia have for heating fuels. In the individual surveys, just 79 respondents agreed somewhat or totally that heating fuels affect their health, yet later on in the survey, 198 respondents selected at least one way their health is impacted by heating fuels. Additionally, when ranking health impacts of different fuels, respondents showed greater concern - 176 respondents considered dung to have a very large or significant impact, for example. This discrepancy could be explained simply by the additional time respondents had to consider whether fuels have health impacts while they were filling out the individual surveys, as the ranked health impacts of different fuels were asked later on in the survey. It could also be that respondents are aware of the health impacts, but are not very concerned about them. When it comes to the health impact of briquettes, gas, electricity, and solar, a large share of respondents said they didn't know, which indicates a need for education and outreach. While there are health concerns, primarily about the traditional heating fuels fuelwood and dung, affordability and efficiency outweigh them when making choices on energy. The one exception to this is plastic waste, which is only burned in the poorest households, due to the severe health impacts that people were largely aware of.

5.1.4. External influences on heating fuel choice

5.1.4.1 Energy information sources

There is a clear influence from external agencies on respondents' energy knowledge, particularly from solar equipment distributors and other NGOs, although the role they play appears to be less significant than the word of mouth or the internet. There is also a clear thirst for more information, that also reflects curiosity and interest in energy, and demonstrates the opportunity for improving energy education in the region. It would be interesting to examine the actual information being shared by external organizations to determine how it is influencing heating choices.

5.1.4.2 Fuel supply

A clear theme throughout both individual and focus group surveys was the uncertainty around various heating fuel supply, particularly fuelwood and gas. I consider heating fuel supply an external influence because government is mainly responsible for policy around fuelwood harvesting, and gasification relies on government and/or gas company infrastructure. Concern for fuelwood availability was almost unanimous across the focus group discussions, which shows that essentially all communities are affected, regardless of income disparity or other factors that differentiate the communities or individuals. Multiple focus groups thought it might be possible that gas would become unavailable, or that prices would drop. There is also uncertainty at the household level, because as one respondent noted, the gas company may simply shut off the gas due to overdue bills. This is probably also a deterrent to using gas, as people would be hesitant if they were unsure they could always afford the bill coming at the end of the month.

Few communities were concerned about the availability of dung, which is partly likely due to the fact that not all communities use it, but also partly because animals and livestock are considered to be steady sources of manure for fuel. However, decreasing yields and inadequate fodder have led to some communities to lower the number of livestock. This could in part be due to localized environmental degradation affecting soil quality, but this may also be related to drought and weather fluctuation as a result of climate change (*Fifth National Report of the Republic of Armenia to the Convention on Biological Diversity, 2014)*. These effects could be exacerbated by climate change in the coming year, which could further reduce the number of livestock, and thereby also reduce energy security and endanger livelihoods (Melkonyan and Asadoorian, 2014; Escarcha et al, 2018).

The uncertainty in fuel supply could be driving or reinforcing the curiosity and interest in energy technologies. If people were satisfied with their heating systems and felt secure in heating fuel supply, they would probably be less curious and interested in changing their system. Indeed, I did find evidence for this hypothesis in one recent study that found satisfaction with fossil-fuel based heating systems was a significant barrier to decarbonization (Sovacool et al, 2021). I did not find any strong evidence for this hypothesis within this study as most respondents were at least somewhat dissatisfied with their heating system, but it would be interesting to investigate this potential correlation further.

5.2 Energy Cultures Through a Gendered Lens

5.2.1 Gender impacts on heating and cooking fuels used and energy management practices

The results of the study did not indicate there were any strong differences between the genders in heating fuel management practices or perceptions. That there was no significant difference in reasons for using various heating fuels between genders isn't unexpected, since this decision is likely made at the household level, rather than the individual level. Similarly, household level decision making would also explain why there was also no significant difference in which fuels were used. However, I hypothesized differences in energy management practices. That there were no significant differences conflicts with existing literature (Shrestha et al, 2020; Permana et al, 2014; Petrova and Simcock, 2019). It has also been demonstrated that women are likelier to choose clean energy over 'dirty' options (Rahut et al, 2014; Dawit, 2020), but in this study, women appeared to be less concerned with the health impacts of fuelwood, for example. To examine this in more detail, it would be useful to conduct a similar study on energy practices with both the male and female household heads. In this way, one could study whether there are differences between the genders at the household level. There was a small but statistically significant difference in energy efficiency scores between genders, with women having on average lower scores. This is unexpected, because energy efficiency decisions (fuels used, energy devices, insulation, etc.) are likely made at the household level, rather than an individual basis. The difference may simply be because women did not participate in installing energy efficient equipment or materials, and therefore were not aware / did not think to include it in their response.

Interestingly, women and men had significantly different energy engagement scores, with women being less likely to participate in energy-related decisions, share opinions about energy or to engage with new energy technologies. This fits with other literature that found men tend to be more engaged in energy topics (Shrestha et al, 2020). In contrast, women do the bulk of fuel-related tasks, particularly cooking and heating the home, although men tend to do slightly more fuelwood and manure storage. The pattern of women performing more energy-related tasks while men ‘manage’ the energy has been found in other literature (Petrova and Simcock, 2019). In the rural Armenian context, women appear to be more involved with management of dung, while men more often do work related to fuelwood. Other literature found women were more interested in energy technology than men, explained by the fact that women are the direct beneficiaries of such technology while men are responsible for maintenance (Liu and Pistorius, 2012), but was not found in this study.

5.2.2 Differing impacts of energy behaviours on women and men

5.2.2.1 Time investment

This study was able to clearly demonstrate evidence of unequal impacts of heating fuel management in the communities surveyed, specifically that women are responsible for energy management within the home through cooking and heating, whereas men and women are jointly responsible for fuel preparation and storage. One focus group even explicitly stated that women do much more energy work than men, and would therefore be more interested in saving than men. It is unsurprising that women and men spent significantly different amounts of time on various heating tasks, as women often spend more time on heating and energy-related tasks (Shrestha et al, 2020: Oparaocha and Dutta, 2011). Women performing the bulk of the energy-related tasks impacts other areas of life, including recreation time and income generation potential (Wodon and de la Briere, 2018).

5.2.2.2 Health impacts

This study demonstrated that in the rural Armenian context, women perceive fuelwood and dung as less problematic for the health than men, which is contrary to my hypothesis that women would perceive the impacts more strongly because of their increased exposure. These results could be explained by the fact that women have become accustomed to fuelwood and dung use, whereas men do not spend as much time managing the heating, and therefore notice the impacts to a larger degree. On the other hand, in the focus groups, women did note more health concerns than men. The lack of concern or identification of health issues may also be due to the necessity to use them. It is clear that many people in the communities surveyed are aware of and concerned about the health impacts of heating fuels, but in order to more strongly correlate health impacts and gender, further study is required.

5.3 Interlinkages Between Ecosystem Services and Energy Behaviours

This study was not clearly able to demonstrate any concrete linkages between environmental concerns and energy behaviours, as respondents were mixed in their perceived environmental impact of different fuels. In particular, peoples' opinions on the environmental impact of fuelwood were very mixed. When it came to the focus group discussions, opinions were also mixed - however, many groups mentioned deforestation as a major concern for the future of the local environment, which also links to the concern for fuelwood in the future. Some people discussed the impact that harvesting fuelwood has on the environment, and even went into depth on the larger implications such as ecosystem collapse. The apparently conflicting knowledge about environmental degradation caused by fuelwood harvesting and the practice of fuelwood use can be explained by the necessity of its use. From other focus group quotes, it can be inferred that most respondents do not consider forest management to be their responsibility, which relates to how historical and present-day forest management is done by the state (Sayadyan and Moreno-Sanchez, 2006). Communities may not consider themselves forest caretakers, despite their reliance on them. There is a clear influence of community on environmental concern, which indicates that different communities are probably facing different environmental challenges.

I did not find strong evidence of differences in environmental attitudes between men and women, which corresponds to some literature (Arabatzis and Malesios, 2013). In a recent Polish study, however, the authors found that women were significantly more concerned about the environment (Żuk & Pacześniak, 2020). The authors of the Polish study found that a similar share of men and women roughly equal support for renewable energy, but had different ideas of which energy types specifically should be pursued to take in decarbonizing the economy. This could also be the case in Armenia, as women and men did display different opinions about top ecosystem services, and while the group discussions did ask for the ways people would change their energy situation, it was not possible to examine this on an individual basis. To examine this further, it would be beneficial to develop an environmental concern score via other environmentally-focused questions.

That most respondents considered provisioning of food a top ecosystem service is expected, as other studies have found similar results (*Environmental Knowledge, Attitudes and Practices*, 2020). In this study, however, the provisioning of fuel was the second-most selected top ecosystem service, which reinforces the importance of heating and cooking fuels in the communities studied. This also explains to the strong concern from respondents about deforestation and fuelwood availability. One study on charcoal production in

Mozambique found that provisioning of fuels such as charcoal and firewood was the top ecosystem service provided by woodland (Woollen et al, 2016). Interestingly, fewer ecosystem services were described as a function of length of time a village had been producing charcoal. It would be interesting to examine the perceived ecosystem services in greater depth, and to examine any local environmental degradation, for example forest health. Few other studies have investigated provisioning of fuel as an ecosystem service in depth. Most other studies examining ecosystem services and energy examine biofuel production. One study by Lupp et al (2014) which examined the perceptions of energy crop production in farmers and non-farmers in the Görlitz region of Germany found that provisioning of energy crops was not considered an important ecosystem service. Rather, provisioning of water and food as well as biodiversity and pollination were the most valued services. An important difference to Lupp et al (2014) is that in the respondents there grew fuel crops for income rather than heating. Gasparatos et al (2011) found that biofuel production generally resulted in a trade-off between ecosystem services, where fuel provisioning increased but food provisioning and other provisioning and regulating services decreased.

5.4 Shifting Energy Cultures

5.4.1 Potential impacts of fuelwood scarcity

It is clear that residents in the areas surveyed are, for the most part, ready and willing to join the energy transition, particularly in impoverished communities and in communities where traditional fuel sources such as fuelwood are becoming – or already are – scarce for various reasons, such as government regulation. The evidence of fuelwood scarcity from respondents in this study is very strong, and with three-quarters of residents relying on fuelwood as their primary heating fuel, it appears something will have to change.

Across other parts of the world, extensive literature exists on how communities have coped with fuelwood scarcity, and could provide insight as to other ways rural Armenian communities may deal with a lack of fuelwood. In Ethiopia, an interview-based study (Scheid et al, 2018) identified twenty-three coping strategies. Some of the coping strategies which were also mentioned by respondents in Armenia include using private trees instead of those from shared land, using smaller branches and twigs, using wet fuelwood, eating meals cold, and using dung instead of fuelwood. Scheid et al (2018) noted that a few households had adopted preventative strategies, such as uptake of energy efficient stoves or on-farm tree planting, which could provide some relief in communities with no viable heating fuel alternative to fuelwood, but I did not find significant evidence of the preventative strategies. Other coping strategies found by Scheid et al (2018) which were not explicitly stated by respondents in this study include increased time spent collecting fuelwood, walking distance, or frequency of forest visitation. Additionally, other studies found that respondents utilized ‘human resources’, i.e., borrowing from a friend or neighbour, which did not present as a coping mechanism in this study.

A major difference to the existing literature is the reason for fuelwood scarcity, which would clearly impact the coping mechanisms employed. In many communities included in this study, harvesting fuelwood is no longer allowed, compared to other regions studied, where the scarcity is due to deforestation or increase in pricing. Interestingly, however, Palmer and MacGregor (2008) did not find a correlation between awareness of local harvesting restrictions and amount of fuelwood used – indicating that restrictions may not prevent harvesting in all instances.

In terms of other effects of fuelwood scarcity, a review by Cooke et al (2008) examined a variety of concerns – although, whose concerns they are is less certain - about fuelwood scarcity commonly found in the literature, namely lowered dung application on farmland, increased crop residue burning, reallocation of agricultural labor, or increased farmland usage for fuelwood. Cooke et al (2008) found evidence of reduced dung application, which does appear to mirror what many respondents said about preferring to use dung as a fertilizer if they didn’t have to use it as a heating fuel. In a study in on the effects of fuelwood scarcity in Ethiopia (Guta, 2014), the author found that increasing fuelwood scarcity did not result in significant uptake in agricultural fuels such as dung and crop residues, which also corresponds with what Palmer and McGregor (2008) found in South Africa. Many respondents noted, however, that the amount of dung their community has been using had increased in recent years, contrary to what the literature suggests in times of fuelwood shortage. This could be explained by the different communities, where some have increased the number of livestock, while others have reduced them. Cooke et al (2008) found mixed evidence of labor reallocation – in just one study, people spent more time on fuelwood collection due to its scarcity, and therefore less time on agricultural tasks, whereas two other studies found no significant impact. If agricultural production time was lowered in the Armenian context, it could impact food security or reduce agricultural output in the region, which is a concern. Conversion of farmland to fuelwood production could similarly impact the study communities, and has support as an impact of fuelwood shortage in the literature (Cooke et al, 2008). Tree planting on farmland can also provide benefits including erosion control, however (Cook et al, 2008). I did not find evidence of either of these consequences in this study, but since some communities still have access to fuelwood, either by gathering or purchasing, respondents may not need to go to such lengths to secure their fuel supply.

Another concern is decreased health and nutrition due to fewer cooked meals or meals cooked inadequately (Cooke et al, 2008), which did find support across three studies based in Nepal and Malawi, specifically lower consumption of cooked food and in cooking time, as well as lower height and weight in preschool children. While this study did not examine childhood health specifically, children are heavily impacted by energy poverty, and it would not be unexpected to see such impacts in the most vulnerable households. If homes are not able to be heated adequately due to unavailability of fuelwood, this further impacts health, particularly through increased susceptibility to infectious diseases and respiratory issues (Jessel et al, 2019).

Fuelwood scarcity may have a larger impact on the most vulnerable households in general, as wealthier residents may be able to afford more expensive alternatives such as briquettes or natural gas. While Cooke et al (2008) did not find support for this across three studies, the most vulnerable in those studies were still able to collect fuelwood from a common access area, which is not possible in many of the communities surveyed in this study.

The literature also examined concerns about an increase in time spent on energy tasks by women, connected to the additional time necessary to find fuelwood when it is scarce. While women perform generally more time on heating tasks in the communities surveyed, it is hard to predict what effect, if any, the fuelwood shortage will have as it is not clear from the data if there are gender roles around fuelwood collection. With potential increase in dung usage, there may indeed be a greater workload for women.

When fuelwood prices are high enough, households may decide to move to private fuelwood resources – i.e., use their own trees or plant trees on their property (Cooke et al, 2008) which can help common use areas regenerate. The scope of this study did not include local logging regulations, so further examination of how communities, logging companies and government manage forested areas would help develop an understanding of potential forest impacts. A few respondents mentioned that they were no longer concerned with the condition of the forests since new restrictions on logging and harvesting came into effect, but others said deforestation was still a problem, occasionally mentioning illegal logging.

If fuelwood is to be used in the future, different management tactics will be necessary to improve access. If fuelwood could be managed by community organizations, it may have a much wider, positive effect on the community, as people work together to maintain the area (Rogers et al, 2012). Community-based forest management was shown to be effective for forest health and socio-economic improvement in Malawi, a country which also has had fuelwood usage restricted, although transparency and accountability were noted as key challenges (Zulu, 2010), and also highlights the importance of community-specific interventions.

5.4.2 Other challenges and opportunities for a new energy culture

5.4.2.1 Alternative heating and cooking fuels: briquettes and solar energy

Based on the willingness of respondents to try new heating fuels and the fuelwood shortage facing most rural Armenians, there is a clear opportunity to improve the energy situation. Briquettes are considered a potential solution by some respondents, and are one proposed energy efficiency intervention by local NGOs. However, there was hesitancy around the efficiency of briquettes, as well as the cost. In Kampala, Uganda, an extensive study on briquette acceptability (Mugabe and Kisakye, 2020) found that sustainability and low cost were key drivers to their use, while excessive amounts of ash, crushing, and inaccessibility made them unappealing to some. If the benefits of briquettes – namely, sustainability, convenience, and lessened health impact, could be proven to residents in the study area, they may be more receptive to their usage.

Solar energy, particularly for heating water is another acceptable choice, but the price is a barrier to its uptake. An additional challenge is the necessary infrastructure, i.e. stable roofs and a steady fresh water supply, which some households indicated they did not have. Both of those challenges will need to be addressed before solar water heaters can be installed. Heating the home with solar energy would prove to be much more challenging, requiring electrification of household heating devices, which would be costly. It is challenging to find examples of where this has been successful, as most literature on rural solar uptake focuses on electrification, which is not a challenge in the present study area. Renovation of homes at high altitudes in China to more effectively capture solar radiation passively (i.e. – increased surface area on south-facing walls, added insulation materials, and graphite and concrete walls) was shown to improve the thermal comfort of homes and decrease the amount of coal needed for heating by almost half (Liu et al, 2019). Renovation of homes in rural Armenia to these specifications could greatly reduce the amount of fuel needed, and thereby reduce the economic and health impacts of heating fuel usage. These types of renovations can also reduce humidity in the home (Ji et al, 2015), which can ultimately help reduce damage to the home from dampness. Funding for these renovations would still be a barrier, but could help in areas without adequate infrastructure for solar water heaters or solar photovoltaic panels. The present study did not examine the acceptability of passive house renovations, so this would need to be investigated further. Another potential use of solar would be in district heating projects, where centralized facilities generate heat for communities. This has been shown to be effective in different countries around the world, for communities ranging in size, and has the twin benefits of household control over indoor temperatures and reduced heating costs (Li and Xu, 2019). If funding for such a project could be secured, it may also be an option for improved quality of life and lower cost. Community solar plants were mentioned in some focus groups, indicating they would be acceptable, at least in some communities.

5.4.2.2 Supporting a clean energy transition in rural Armenia

The obvious barrier to a clean energy transition in rural Armenia is funding. With most respondents living below the poverty line, access to funding to invest in new technologies is very limited. This reflects the consensus in the literature that income is an important driver, if not the most important driver, in uptake of clean energy technology (Mugabe and Kisakye, 2020; Ma et al, 2019; Vigolo et al, 2018; Murphy, 2001; Dawit, 2020). Given the limited income levels of many rural Armenians, strong subsidies would be an option to encourage households to invest in more efficient and/or clean technologies. Access to credit to help with the upfront cost is also a significant influence in renewable and efficient energy technologies (Dawit, 2020). It is important to ensure that any financial programs provide a strong incentive to implement energy efficient or clean energy technology, as weak incentives may not sufficiently compensate for direct and indirect benefits of 'free' fuels. One study found ecosystem payment programs targeted at reducing fuelwood usage in rural China have not been effective because they did not actually compensate people enough to stop their use of fuelwood (Song et al, 2018).

Beyond funding, there are other factors that help to drive the switch to improved energy sources. At the moment, the market supply of alternative energy technologies is limited, particularly with regard to fuelwood, but also to gas, briquettes, and solar energy. When people have access to improved markets and supply, they are more likely to move to more efficient fuels (van der Kroon et al, 2014).

Education on available technologies, their installation, and operation is critical to the success of clean energy projects (Mondal et al, 2010). Although many respondents felt knowledge was available, community-specific information based on local context and climatic conditions would be most beneficial. Even if information is available, some residents may be uncomfortable with learning via the internet or word of mouth, and may prefer in-person training. Some people appeared to be interested in seminars, information booklets, and other types of training sessions.

Given the strong evidence of community co-operation and knowledge sharing, different community-based initiatives could catalyze the clean energy transition in rural Armenia. Co-operatives function as education and communication hubs (Viardot, 2013). Interestingly, co-operatives most often utilise word-of-mouth and networking as educational tools (Viardot, 2013), which coincides with how most Armenians receive their information about renewable and energy efficiency technology. This indicates co-operatives would likely be an acceptable community institution in most communities. Co-operatives can also help reduce skepticism of renewable energy projects (Viardot, 2013; Liu and Pistorius, 2012). Local co-operatives could play a role in helping low-income residents afford energy efficiency upgrades by sharing the upfront cost burden (Guta, 2020), addressing the concerns Armenians have about affordability. Co-operatives lower the upfront cost of accessing energy technology in a few different ways, namely through differing investment levels in community energy projects, preferential rates of goods and services through partner vendors, and volume discounts through inter-cooperative partnerships (Viardot, 2013). They can also make accessing energy and daily life easier for its members by doing the technical calculations and cost-benefit analyses for them (Viardot, 2013). Community organizations, like co-operatives, can also reduce barriers to clean energy uptake by boosting awareness and lobbying for better governmental support for clean energy (Noll et al, 2014). Identifying and supporting individuals who are particularly passionate about clean and/or efficient energy technologies would be one way to begin a co-operative (Kaphengst and Velten, 2014). Financial support from government plays a key role in ensuring the success of new energy co-operatives (Wierling et al, 2018) and will likely be necessary in the Armenian context.

Access to community services such as employment opportunities and schools has also been shown to positively correlate with alternative fuel use (Link et al, 2012). Developing the social infrastructure in rural communities could also provide more opportunities for networking, education, and community development. Improved livelihoods have been found as the main driver of fuelwood substitution (Wang et al, 2012), underscoring the need for economic development. Access to work in Yerevan, for example, was noted in focus groups as a key provider of improved livelihoods, and thereby also reduced tolerance for uncomfortable or dirty fuels.

5.4.3 Energy transitions in rural Armenia: fuel stacking or energy ladder?

In this study, the energy ladder theory of energy transitions was not applicable, as most people relied on a variety of energy types for heating and cooking that ranged from ‘traditional’ (such as dung and wood) to modern (such as solar energy). This correlates with recent works (Rahut et al, 2017; Yadav et al, 2021; van der Kroon et al, 2013) that found the energy ladder was too simplistic to sufficiently describe the energy situation of communities.

The fuel stacking theory better describes the situation in rural Armenia, however, under the theory, people would switch to electricity as their ultimate energy source, which isn’t the case. Electricity was noted as being unreliable. In addition, there doesn’t appear to be a strong material culture around electric heating, with the exception of heating blankets. Future theories should factor in other important determinants of energy use such as pricing, subsidies, and reliability. The ECF does a better job of including these factors, but it provides more of a snapshot in time, rather than a transition theory. Future works could explore ways of combining energy cultures and fuel usage theories.

5.4.4 Empowering women to join Armenia’s energy transition

Importantly, women must empower themselves, but external organizations can help by facilitating empowerment (Skutsch, 2005; de Groot et al, 2017). That women hold valuable information and experience around energy, and that women are essential to the energy transition as agents of change must be recognized, as they (in this study) spend more time around energy than men. Ensuring women can engage in the decision-making process around energy will help realize change that empowers women and improves the status of women in society (Lieu et al, 2020; de Groot et al, 2017). When women are able to engage in energy transitions fully (i.e. - with adequate income and time), they tend to choose cleaner fuels (Choudhuri and Desai, 2019). Therefore, it will be important to reduce poverty in the area through economic opportunities. In the Armenian context, income and time are clearly barriers for both women and men to engage, but even more so for women in this study. With some women involved in cooking and heating tasks for more than twelve hours a day, finding the time to engage in energy decision making or community initiatives may not be feasible. This creates something of a cycle, as there is no time to engage, and therefore the voices of women are not heard.

In order to target the barriers facing women in rural Armenia, easily accessible information that can be delivered quickly would be one option. Another option would be outreach that is during the time women spend on domestic tasks – i.e. in-home consultations. In addition, initiatives like women's renewable energy co-operatives would help spread information through existing social networks. Gender-specific information and educational outreach could be an effective way to improve women's participation. Workshops for women, for example, could be implemented to reduce hesitancy to participate. Some initiatives aimed at improving energy efficient or clean energy technologies such as co-operatives have been found to be male-dominated (Kaphengst and Velten, 2014), which highlights a need for gender-inclusive programs. If renewable energy businesses were to set up in the rural area, they could also support women's engagement in the energy transition. One effective program initiated by geothermal company LaGeo in El Salvador supported women in developing a chapter of Women in Geothermal, for example, and offers equal wages for women and men (Mang-Benza, 2021). In another instance, women from Kenya were invited to travel to India to train as solar engineers, which resulted in far-reaching community transformation including improved status of women (Mang-Benza, 2021). While neither of these examples may be perfectly well-suited to the Armenian context, they highlight innovative ways women can empower themselves when opportunities are presented.

5.5 Study Limitations

5.5.1 Methodological limitations

The qualitative nature of the study makes strong statements difficult to make. I attempted to use a quantitative proxy using the energy scores, but since they themselves were based off of qualitative information, they are also limited in their use. It would be beneficial to develop energy scores that could be applied across studies, which still include flexibility for local conditions. Deeper analysis on a community or marz basis would have provided valuable insights and could have helped to mitigate confounding factors such as climate and community income level, but due to the qualitative analysis and limited sample size within communities, particularly when segregating by gender, it was not possible within the scope of this study. Overall, the large sample size does allow for some conclusions to be drawn, however.

In looking to more clearly understand differences by gender, it may have been useful to ensure that for each household, both the male and female household heads took part in the surveys, and that the data was then paired. Paired data might have made it easier to make stronger inferences about the differences in energy culture and the perceived health and environmental impacts of the various heating fuels.

As a researcher, a major limitation of this study was the inability to be present in Armenia during the data collection due to the COVID-19 pandemic. While I was fortunate to partner with dedicated and knowledgeable experts in Armenia, I was not able to gain as strong of an understanding of the study context as if I had been able to conduct in-person research. I was not, for example, able to clarify things with respondents or observe the various conditions in different communities. If there had been information online about the various communities, it may have been more successful, but there is very little available (at least in English). The lack of in-depth context also makes it difficult to draw conclusions about external factors which were not included in the survey or focus group questions.

5.5.2 Scope limitations

The scope of this study was rather wide, which made it difficult to gain a deep understanding of any one topic in particular. For that, however, it was very useful to provide a general overview of the energy culture and provide an example of how the ECF can be used to examine multiple factors such as gender, health, and ecosystem services. A major feature of the ECF is the external factors, which were not a main focus of this study. Therefore, the overall ECF presented in the discussion may not be comprehensive. Additional external factors that would have been interesting to examine include political influences on energy, historical influences such as the Soviet era regime, and potentially the current event situation at the time of data collection (the COVID-19 pandemic). An in-depth examination of access to forest may have been useful, but due to study limitations, it was not possible. It would have been beneficial to include a comprehensive overview of fuelwood harvesting regulations to better understand which communities are facing scarcities, and therefore may be more open to transitioning to new fuel types. It would be interesting to examine where the purchased wood is obtained and the implications of its harvesting, but was not possible in this study. In order to gain a stronger understanding of perceived environmental impacts of heating use, more questions around concerns for the environment within the individual surveys would have been useful. Additionally, one research goal of this study was to suggest energy interventions, but without community-specific analysis, it is difficult to do so, as each community is different and has its own norms and resources. Therefore, any recommendations made are only useful generally, and further study will be required before implementing changes in communities.

Chapter 6: Conclusion and Outlook

The study adds to the body of literature emphasizing the importance of social and cultural aspects in societal transitions. This study was able to provide a comprehensive overview of the heating and cooking fuel energy culture in rural Armenia, which is shaped by limited fuel options and access, low financial resources to invest in clean and/or energy efficient technology, and inefficient housing infrastructure. The energy practices are based around improved heating fuel efficiency and fuel conservation, and affordability and efficiency are key traits that alternative fuels should have. The study also highlights the importance of community knowledge sharing for energy transitions. Rural Armenian communities are generally open and eager to participate in the energy transition, but without financial resources to do so, can not. Based on the material culture, norms, practices, and external influences, rural Armenians generally find solar energy acceptable, whereas other alternatives such as biogas are not.

The role of gender is also examined, and although this study was not able to differentiate energy behaviours or norms by gender, it made clear the fact that gender plays a strong role in determining how much time is spent on heating and cooking tasks. This study demonstrated that women in rural Armenia spend much more time on heating and cooking tasks than men. While men are more engaged in energy than women, many women are interested in energy topics, indicating potential for women to become a driving force in the energy transition. This study also demonstrated that people in rural Armenia are concerned with the health impacts of traditional heating fuels, but are unable to choose devices or fuels that do not harm the health due to lack of funding.

This study shows that the communities surveyed are deeply concerned with deforestation and forest degradation, in part because the forests provide essential ecosystem services – namely, fuelwood. The study was not able to strongly link gender, community, or other demographic characteristics to environmental attitudes, probably due to the limited number of environmental attitude questions asked.

With a population heavily reliant on stocks of traditional heating fuels and dung that are increasingly at risk due to a number of factors, some of which include government policy, illegal harvesting, and climate change, there is a clear need for immediate interventions that ensure rural communities across Armenia have access to efficient, safe, and affordable energy. Energy interventions could include extensive energy efficiency upgrades for heating devices and for building stock to reduce the demand for heating fuels, and could also examine establishing community facilities for alternative heating fuels such as district solar or briquetting factories in those communities that find them acceptable. To date, there is very little literature on rural energy transitions in Armenia, and future study is necessary to examine the perceptions and energy cultures in other regions of the country. Future studies could also more deeply examine how initiatives such as co-operatives or passive house renovations would be accepted. In addition, an examination of forest access, both in regards to physical distance as well as due to government restrictions would be useful to help determine which communities are most in need of immediate replacements for fuelwood.

References

Aghababyan, K., Khanamirian, G.G., Ananyan, V. & Kalashyan, M. (2010). Analysis of forest pests and pestholes exacerbated by climate change and climate variability in Syunik Marz of Armenia and to identification of the most applicable prevention measures.

Arabatzis, G. & Malesios, C. (2013). Pro-environmental attitudes of users and non-users of fuelwood in a rural area of Greece. *Renewable and Sustainable Energy Reviews*, 22, 621–630.

Ceceiski, E. (1995). From Rio to Beijing Engendering the energy debate. (1995). *Energy Policy*, 23, 561-575.

Environmental Knowledge, Attitudes and Practices Survey in Armenia. (2020). ACT Assist GmBH.

Babajanian, B.V. (2008). Social Capital and Community Participation in Post-Soviet Armenia: Implications for Policy and Practice. *Europe-Asia Studies*, 60, 1299–1319.

Beukian, S. (2014). Motherhood as Armenianness: Expressions of Femininity in the Making of Armenian National Identity: Motherhood as Armenianness. *Stud Ethn Nation*, 14, 247–269.

Bezemer, D.J. & Lerman, Z. (2004). Rural livelihoods in Armenia. *Post-Communist Economies*, 16, 333–348.

Bouzarovski, S. & Petrova, S. (2015). A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science*, 10, 31–40.

Burns, S.L., Krott, M., Sayadyan, H. & Giessen, L. (2017). The World Bank Improving Environmental and Natural Resource Policies: Power, Deregulation, and Privatization in (Post-Soviet) Armenia. *World Development*, 92, 215–224.

Choudhuri, P. & Desai, S. (2020). Gender inequalities and household fuel choice in India. *Journal of Cleaner Production*, 265, 121487.

Cooke, P., Köhlin, G. & Hyde, W.F. (2008). Fuelwood, forests and community management – evidence from household studies. *Envir. Dev. Econ.*, 13, 103–135.

Cottrell, Frank. (1955). Energy & Society The Relation Between Energy, Social Change, and Economic Development.

DeFries, R. & Pandey, D. (2010). Urbanization, the energy ladder and forest transitions in India's emerging economy. *Land Use Policy*, 27, 130–138.

de Groot, J., Mohlakoana, N., Knox, A. & Bressers, H. (2017). Fuelling women's empowerment? An exploration of the linkages between gender, entrepreneurship and access to energy in the informal food sector. *Energy Research & Social Science*, 28, 86–97.

Demirchyan, A., Petrosyan, V., Sargsyan, V. & Hekimian, K. (2016). Prevalence and determinants of anaemia among children aged 0–59 months in a rural region of Armenia: a case–control study. *Public Health Nutrition*, 19, 1260–1269.

Escarcha, J., Lassa, J. & Zander, K. (2018). Livestock Under Climate Change: A Systematic Review of Impacts and Adaptation. *Climate*, 6, 54.

Fifth National Report of the Republic of Armenia to the Convention on Biological Diversity. (2014).

Gasparatos, A., Stromberg, P. & Takeuchi, K. (2011). Biofuels, ecosystem services and human wellbeing: Putting biofuels in the ecosystem services narrative. *Agriculture, Ecosystems & Environment*, 142, 111–128.

Guta, D.D. (2014). Effect of fuelwood scarcity and socio-economic factors on household bio-based energy use and energy substitution in rural Ethiopia. *Energy Policy*, 75, 217–227.

Guta, D.D. (2020). Determinants of household use of energy-efficient and renewable energy technologies in rural Ethiopia. *Technology in Society*, 61, 101249.

Harutyunyan, A., Petrosyan, E., Pfeiffer, P. & Vardanyan, K. (2019). Energy Use and Demand of Communities in Getik Valley, Armenia, 19.

Herrero, S.T. (2017). Energy poverty indicators: A critical review of methods. *Indoor and Built Environment*, 26, 1018–1031.

Hirt, L.F., Schell, G., Sahakian, M. & Trutnevyte, E. (2020). A review of linking models and socio-technical transitions theories for energy and climate solutions. *Environmental Innovation and Societal Transitions*, 35, 162–179.

IBM Corp. Released 2020. IBM SPSS Statistics for Macintosh, Version 27.0. Armonk, NY: IBM Corp

Ibtissem, M.H. (2010). Application of Value Beliefs Norms Theory to the Energy Conservation Behaviour. *JSD*, 3.

International Energy Agency. (2020) IEA Electricity Information. Accessed from: https://www.iea.org/subscribe-to-data-services/electricity-statistics

Jessel, S., Sawyer, S. & Hernández, D. (2019). Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature. *Frontiers in Public Health*, 7.

Ji, Y., Wang, Z., Ning, H. & Zhang, X. (2015). Field Investigation on Indoor Thermal Environment at a Rural Passive Solar House in Severe Cold Area of China. *Procedia Engineering*, 121, 596–603.

Junge, N. & Fripp, E. (2011). Understanding the Forestry Sector of Armenia: Current Conditions and Choices, 58.

Jürisoo, M., Serenje, N., Mwila, F., Lambe, F. & Osborne, M. (2019). Old habits die hard: Using the energy cultures framework to understand drivers of household-level energy transitions in urban Zambia. *Energy Research & Social Science*, 53, 59–67.

Kaphengst, Timo & Velten, Eike. (2014). Energy transition and behavioural change in rural areas: The role of energy cooperatives.

Kaygusuz, K. (2011). Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews*, 15, 936–947.

Klaniecki, K., Duse, I.A., Lutz, L.M., Leventon, J. & Abson, D.J. (2020). Applying the energy cultures framework to understand energy systems in the context of rural sustainability transformation. *Energy Policy*, 137, 111092.

Köhler, J., de Haan, F., Holtz, G., Kubeczko, K., Moallemi, E., Papachristos, G., et al. (2018). Modelling Sustainability Transitions: An Assessment of Approaches and Challenges. *Journal of Artificial Societies and Social Simulation*, 21.

Köhlin, G., Sills, E.O., Pattanayak, S.K. & Wilfong, C. (2011). Energy, Gender and Development, 74.

Lee, S.M., Kim, Y.-S., Jaung, W., Latifah, S., Afifi, M. & Fisher, L.A. (2015). Forests, fuelwood and livelihoods—energy transition patterns in eastern Indonesia. *Energy Policy,* 85, 61–70.

Liddell, C. & Morris, C. (2010). Fuel poverty and human health: A review of recent evidence. *Energy Policy*, 38, 2987–2997.

Li, Z. & Xu, Y. (2019). Applicability Analysis of Solar District Heating in North Rural Areas. *IOP Conf. Ser.: Earth Environ. Sci.*, 238, 012084.

Liu, M.F.M. & Pistorius, T. (2012). Coping with the energy crisis: Impact assessment and potentials of non-traditional renewable energy in rural Kyrgyzstan. *Energy Policy*, 44, 130–139.

Liu, Z., Wu, D., He, B.-J., Wang, Q., Yu, H., Ma, W., *et al.* (2019). Evaluating potentials of passive solar heating renovation for the energy poverty alleviation of plateau areas in developing countries: A case study in rural Qinghai-Tibet Plateau, China. *Solar Energy*, 187, 95–107.

Lieu, J., Sorman, A.H., Johnson, O.W., Virla, L.D. & Resurrección, B.P. (2020). Three sides to every story: Gender perspectives in energy transition pathways in Canada, Kenya and Spain. *Energy Research & Social Science*, 68, 101550.

Link, C.F., Axinn, W.G. & Ghimire, D.J. (2012). Household energy consumption: Community context and the fuelwood transition. *Social Science Research*, 41, 598–611.

Lupp, G., Bastian, O., Syrbe, R.-U. & Steinhäußer, R. (2014). Perceptions of Energy Crop Production by Lay People and Farmers Using the Ecosystem Services Approach. *Moravian Geographical Reports*, 22, 15–25.

Ma, W., Zhou, X. & Renwick, A. (2019). Impact of off-farm income on household energy expenditures in China: Implications for rural energy transition. *Energy Policy*, 127, 248–258.

Mang-Benza, C. (2021). Many shades of pink in the energy transition: Seeing women in energy extraction, production, distribution, and consumption. *Social Science*, 9.

Melkonyan, A. & Asadoorian, M.O. (2014). Climate impact on agroeconomy in semiarid region of Armenia. *Environ Dev Sustain*, 16, 393–414.

Ministry of Energy and Natural Resources Armenia. Scaling Up Renewable Energy Program Investment Plan for Armenia. (2014).

Mkrtchyan, A. & Grigoryan, E. (2014). Forest Dependency in Rural Armenia, 52.

Moezzi, M. & Lutzenhiser, L. (2010). What's Missing in Theories of the Residential Energy User. Center for Urban Studies, Publications, and Reports, 151.

Mondal, A., Kamp, L.M. & Pachova, N.I. (2010). Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh—An innovation system analysis. *Energy Policy*, 38, 4626–4634.

Moomaw, W., Yamba, F., Kamimoto, M., Maurice, L., Nyboer, J., Urama, K., *et al.* (2012). Renewable Energy and Climate Change. *Renewable Energy and Climate Change*, 49.

Moreno-Sanchez, R. & Sayadyan, H.Y. (2005). Evolution of the forest cover in Armenia. *int. forest. rev.*, 7, 113–127.

Naumann, M. & Rudolph, D. (2020). Conceptualizing rural energy transitions: Energizing rural studies, ruralizing energy research. *Journal of Rural Studies*, 73, 97–104.

Nazif-Muñoz, J.I., Spengler, J.D., Arku, R.E. & Oulhote, Y. (2020). Solid fuel use and early child development disparities in Ghana: analyses by gender and urbanicity. *Journal of Exposure Science & Environmental Epidemiology,* 30, 698–706.

Noll, D., Dawes, C. & Rai, V. (2014). Solar Community Organizations and active peer effects in the adoption of residential PV. *Energy Policy*, 67, 330–343.

Oparaocha, S. & Dutta, S. (2011). Gender and energy for sustainable development. *Current Opinion in Environmental Sustainability*, 3, 265–271.

Palmer, C. & Macgregor, J. (2009). Fuelwood scarcity, energy substitution, and rural livelihoods in Namibia. *Envir. Dev. Econ*., 14, 693–715.

Pachauri, S. & Spreng, D. (2011). Measuring and monitoring energy poverty. *Energy Policy*, 39, 7497–7504.

Petrova, S. & Simcock, N. (2019). Gender and energy: domestic inequities reconsidered. *Social & Cultural Geography*, 1–19.

Rahut, D.B., Das, S., De Groote, H. & Behera, B. (2014). Determinants of household energy use in Bhutan. *Energy*, 69, 661–672.

Rahut, D.B., Behera, B., Ali, A. & Marenya, P. (2017). A ladder within a ladder: Understanding the factors influencing a household's domestic use of electricity in four African countries. *Energy Economics*, 66, 167–181.

Räty, R. & Carlsson-Kanyama, A. (2010). Energy consumption by gender in some European countries. *Energy Policy*, 38, 646–649.

Rogers, J.C., Simmons, E.A., Convery, I. & Weatherall, A. (2012). Social impacts of community renewable energy projects: findings from a woodfuel case study. *Energy Policy*, 42, 239–247.

Rosa, E., Machlis, G. & Keating, K. (1988). Energy And Society. *Ann. Rev. Sociol.*, 14, 149–172.

Sabyrbekov, R. & Ukueva, N. (2019). Transitions from dirty to clean energy in low-income countries: insights from Kyrgyzstan. *Central Asian Survey*, 38, 255–274.

Sayadyan, H.Y. & Moreno-Sanchez, R. (2006). Forest policies, management and conservation in Soviet (1920–1991) and post-Soviet (1991–2005) Armenia. *Envir. Conserv.*, 33, 60–72.

Scheid, A., Hafner, J., Hoffmann, H., Kächele, H., Sieber, S. & Rybak, C. (2018). Fuelwood scarcity and its adaptation measures: an assessment of coping strategies applied by small-scale farmers in Dodoma region, Tanzania. *Environ. Res. Lett.*, 13, 095004.

Seyfang, G. & Haxeltine, A. (2012). Growing Grassroots Innovations: Exploring the Role of Community-Based Initiatives in Governing Sustainable Energy Transitions. *Environment and Planning C: Government and Policy*, 30, 381–400.

Shove, E. & Walker, G. (2014). What Is Energy For? Social Practice and Energy Demand. *Theory, Culture & Society*, 31, 41–58.

Shrestha, B., Bajracharya, S.B., Keitsch, M.M. & Tiwari, S.R. (2020). Gender differences in household energy decision-making and impacts in energy saving to achieve sustainability: A case of Kathmandu. *Sustainable Development*, 28, 1049–1062.

Skutsch, M.M. (2005). Gender analysis for energy projects and programmes. *Energy for Sustainable Development*, 9, 37–52.

Song, C., Bilsborrow, R., Jagger, P., Zhang, Q., Chen, X. & Huang, Q. (2018). Rural Household Energy Use and Its Determinants in China: How Important Are Influences of Payment for Ecosystem Services vs. Other Factors? *Ecological Economics*, 145, 148–159.

Sovacool, B.K., Demski, C. & Noel, L. (2021). Beyond climate, culture and comfort in European preferences for low-carbon heat. *Global Environmental Change*, 66, 102200.

Spencer, H. (1880). *First Principles*.

Stephenson, J., Barton, B., Carrington, G., Doering, A., Hopkins, D., Lawson, R., *et al.* (2015). The Energy Cultures framework: exploring the role of norms, practices and material culture in shaping energy behaviour in New Zealand and the Pacific, 16.

Sulaiman, C., Abdul-Rahim, A.S., Chin, L. & Mohd-Shahwahid, H.O. (2017). Wood fuel consumption and mortality rates in Sub-Saharan Africa: Evidence from a dynamic panel study. *Chemosphere*, 177, 224–231.

Tumasyan, M., Harutyunyan, K., Manukyan, Y., Hakobyan, L. & Hovsepyan, A. (2015). Residential Energy Consumption Survey Analytic Report. Economic Development and Research Center.

UNDP Armenia. Fourth National Communication on Climate Change. (2020).1-213.

van der Kroon, B., Brouwer, R. & van Beukering, P.J.H. (2013). The energy ladder: Theoretical myth or empirical truth? Results from a meta-analysis. *Renewable and Sustainable Energy Reviews*, 20, 504–513.

van der Kroon, B., Brouwer, R. & van Beukering, P.J.H. (2014). The impact of the household decision environment on fuel choice behavior. *Energy Economics*, 44, 236–247.

Viardot, E. (2013). The role of cooperatives in overcoming the barriers to adoption of renewable energy. *Energy Policy*, 63, 756–764.

Vigolo, V., Sallaku, R. & Testa, F. (2018). Drivers and Barriers to Clean Cooking: A Systematic Literature Review from a Consumer Behavior Perspective. *Sustainability*, 10, 4322.

Wang, C., Yang, Y. & Zhang, Y. (2012). Rural household livelihood change, fuelwood substitution, and hilly ecosystem restoration: Evidence from China. *Renewable and Sustainable Energy Reviews*, 16, 2475–2482.

White, L.A. (1943). Energy and the evolution of culture. *American Anthropologist*, 45, 335–356.

Wierling, A., Schwanitz, V., Zeiß, J., Bout, C., Candelise, C., Gilcrease, W., *et al.* (2018). Statistical Evidence on the Role of Energy Cooperatives for the Energy Transition in European Countries. *Sustainability*, 10, 3339.

Wilson, C. & Dowlatabadi, H. (2007). Models of Decision Making and Residential Energy Use. *Annu. Rev. Environ. Resour.*, 32, 169–203.

Wodon, Q. & de la Briere, B. (2018). Unrealized potential: the high cost of gender inequality in earnings, 28.

Woollen, E., Ryan, C.M., Baumert, S., Vollmer, F., Grundy, I., Fisher, J., *et al.* (2016). Charcoal production in the Mopane woodlands of Mozambique: what are the trade-offs with other ecosystem services? *Phil. Trans. R. Soc. B*, 371, 20150315.

Yadav, P., Davies, P.J. & Asumadu-Sarkodie, S. (2021). Fuel choice and tradition: Why fuel stacking and the energy ladder are out of step? *Solar Energy*, 214, 491–501.

Nugzar Zazanashvili & David P Mallon. (2009). *Status and Protection of Globally Threatened Species in the Caucasus*. Critical Ecosystem Partnership Fund and World Wildlife Fund.

Zhu, Y., Fan, X., Wang, C. & Sang, G. (2018). Analysis of Heat Transfer and Thermal Environment in a Rural Residential Building for Addressing Energy Poverty. *Applied Sciences*, 8, 2077.

Zulu, L.C. (2010). The forbidden fuel: Charcoal, urban woodfuel demand and supply dynamics, community forest management and woodfuel policy in Malawi. *Energy Policy*, 38, 3717–3730.

Żuk, P. & Pacześniak, A. (2020). Sustainable Development, Energy Transition, and Climate Challenges in the Context of Gender: The Framework of Gender Determinants of Environmental Orientation in Poland. *Sustainability*, 12, 9214.

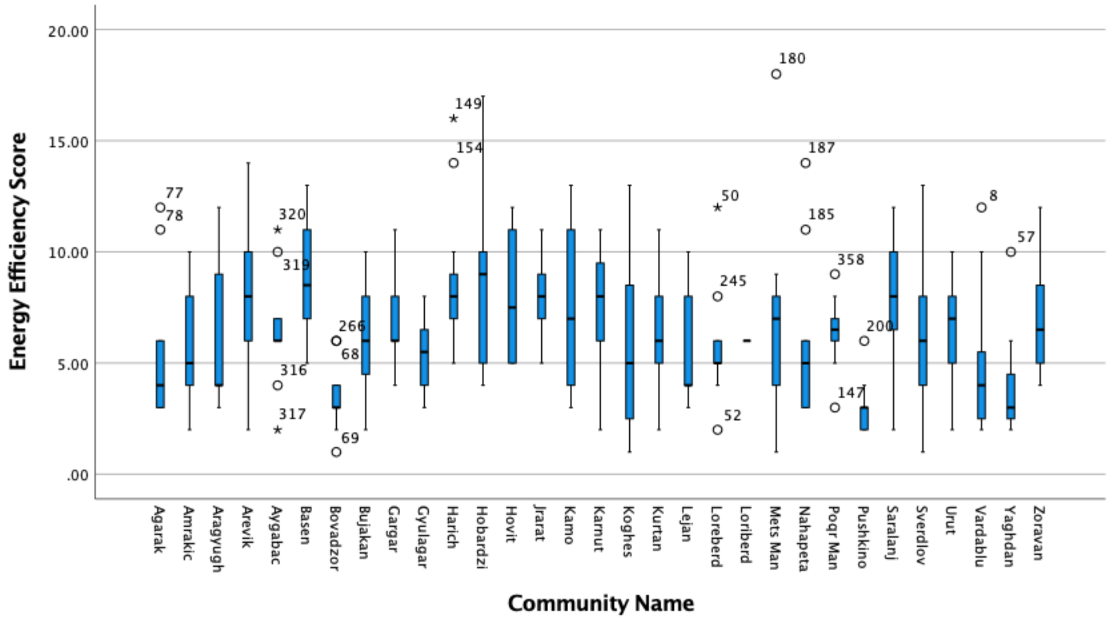
Appendices

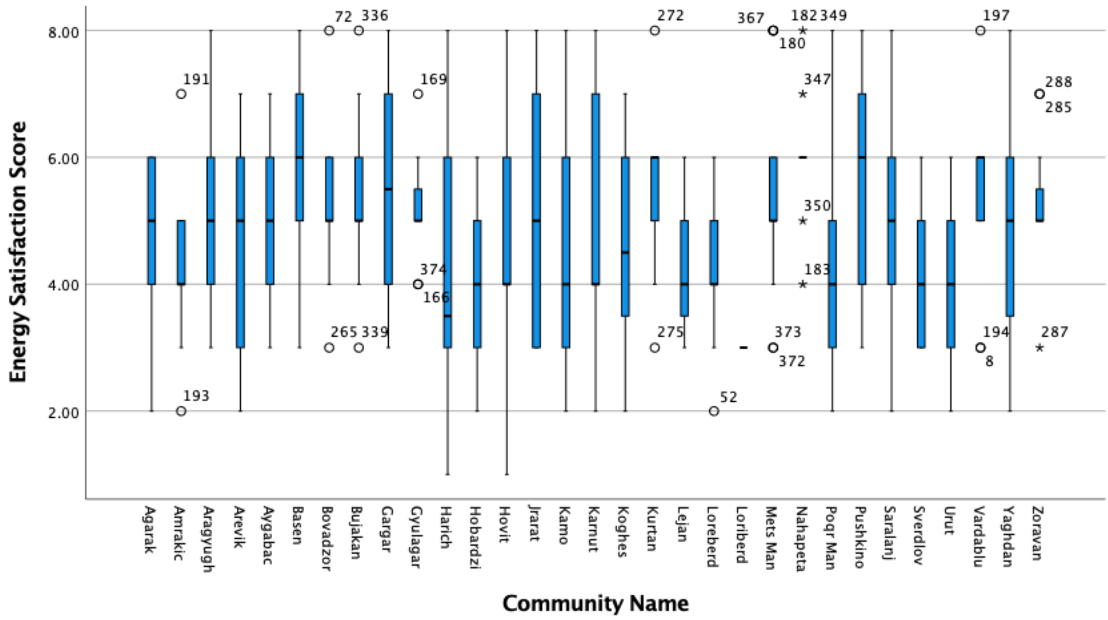
Appendix 1: Energy score questions (from individual surveys)

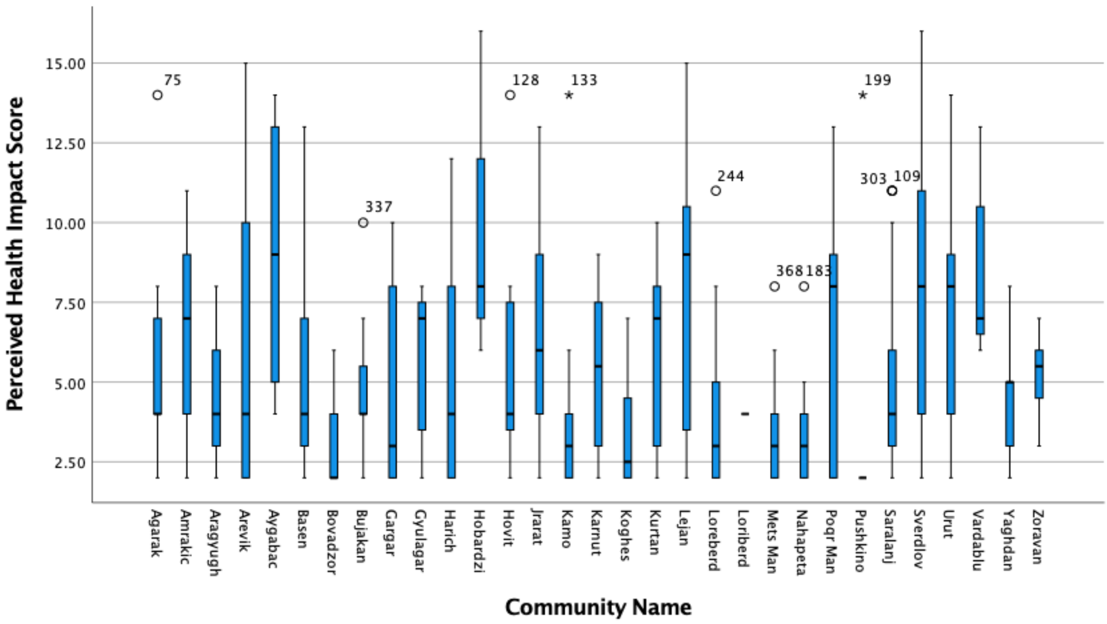
Score	Question No	Question
Energy Time	10	Amount of time spent on heating tasks
	11	Amount of time spent storing fuels
Energy Engagement	12	Please indicate if you are going to change the heating of your house in any way
	13_3	Level of agreement: I participate in the energy-related decisions made in our family
	13_4	Level of agreement: I am ready to do additional phisical work to to reduce my energy / fuel consumption
	13_7	Level of agreement: I am interested in new technologies in the field of energy
	13_8	Level of agreement: I am usually among the first to try the new technologies in the field of energy
	13_9	Level of agreement: I often share my opinion on energy issues with my neighbors
	13_10	Level of agreement: I often share my opinion during community gatherings
	19	Interest in participating in further energy discussions
Energy Satisfaction	13_1	Level of agreement: My home is always warm enough
	13_2	Level of agreement: I am satisfied with the amount of fuel used by my heating system
Health Impact	13_5	Level of agreement: The fuel I use for heating my home affects my health.
	13_6	Level of agreement: The fuel I use for cooking in my home affects my health

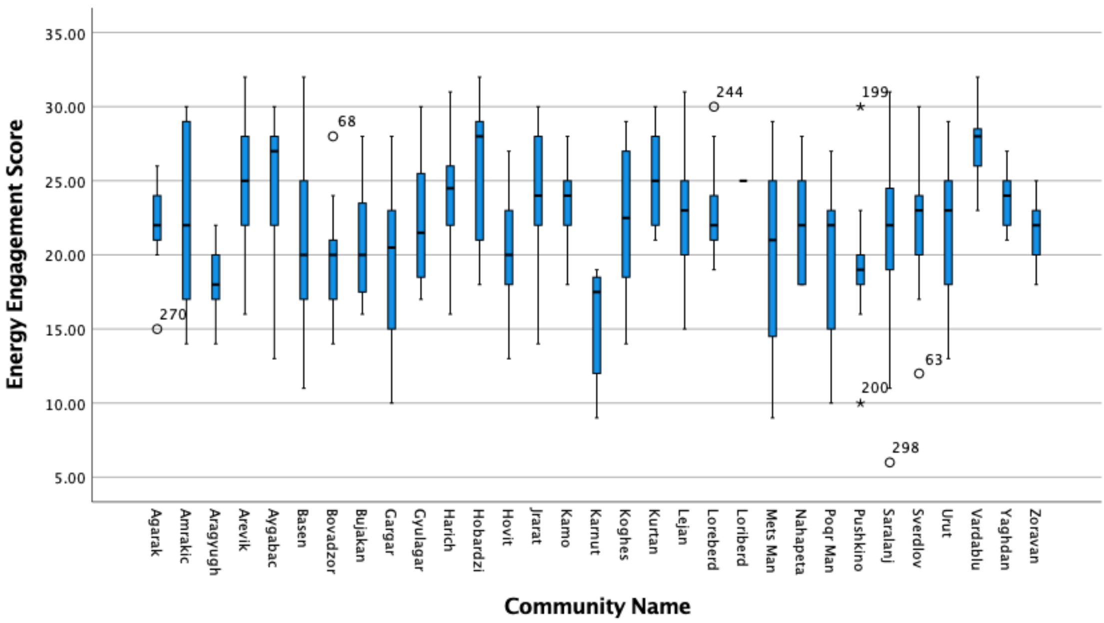
	14	Please mention how is the health of you or your family affected by the fuel you use at Your house. Please select all that apply
Energy Efficiency	Demographics	Type of home
	4	Volume of fuelwood used annually
	5	Volume of dung used annually
	8	Primary heating device
	17	Parts of home insulated

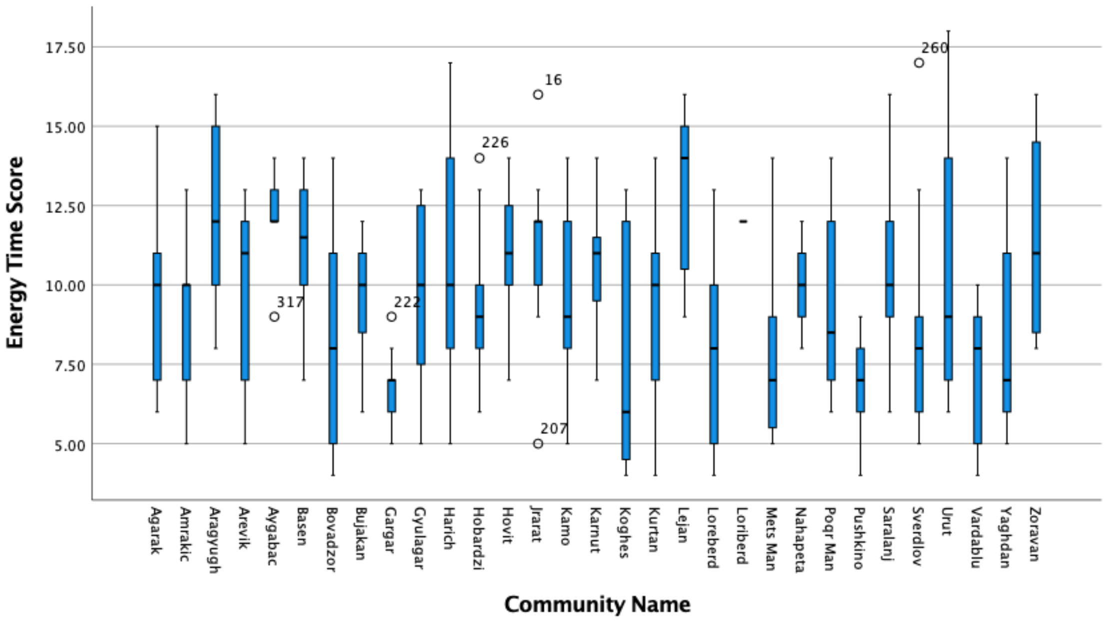
Appendix 2: Energy Scores by Community






Perceived Health Impact Score
15.00
12.50
10.00
7.50
5.00
2.50
Agarak
Amrakic
Aragyugh
Arevik
Aygabac
Basen
Bovadzor
Bujakan
Gargar
Gyulagar
Harich
Hobardzi
Hovit
Jrarat
Kamo
Karnut
Koghes
Kurtan
Lejan
Loreberd
Loriberd
Mets Man
Nahapeta
Poqr Man
Pushkino
Saralanj
Sverdlov
Urut
Vardablu
Yaghdan
Zoravan
Community Name


Energy Engagement Score
35.00
30.00
25.00
20.00
15.00
10.00
5.00
Agarak
Amrakic
Aragyugh
Arevik
Aygabac
Basen
Bovadzor
Bujakan
Gargar
Gyulagar
Harich
Hobardzi
Hovit
Jrarat
Kamo
Karnut
Koghes
Kurtan
Lejan
Loreberd
Loriberd
Mets Man
Nahapeta
Poqr Man
Pushkino
Saralanj
Sverdlov
Urut
Vardablu
Yaghdan
Zoravan
Community Name


Energy Time Score
17.50
15.00
12.50
10.00
7.50
5.00
260
16
226
317
222
207
Agarak
Amrakic
Aragyugh
Arevik
Aygabac
Basen
Bovadzor
Bujakan
Gargar
Gyulagar
Harich
Hobardzi
Hovit
Jrarat
Kamo
Karmut
Koghes
Kurtan
Lejan
Loreberd
Loriberd
Mets Man
Nahapeta
Poqr Man
Pushkino
Saralanj
Sverdlov
Urut
Vardablu
Yaghdan
Zoravan
Community Name

Appendix 3: Individual Survey

Demographics

Age	
Gender	1.Male ________ 2.Female ___________
Education	1.Secondary/ ___________ 2.College/ ___________ 3.Higher/ ___________
Number of family members	
Types of the house	1. Stone private house ___________ 2. Temporary cottage ___________ 3. Multiapartment building ___________ 4. Other
Housing size (m2)/	
Housing size (m2)/	

1. Please identify the main source of Your family income. Arrange them according to importance. For the main type of income please mention 1, for the type of income which is at the second place in volumes mention 2 and so on

1	Animal husbandry	
2	Cultivation of fruits and berries/	
3	Cultivation of potato/	
4	Cultivation of grain, corn or forage/	
5	Cultivation of vegetables/	
6	Construction/	
7	Community/ state employee/	
8	Other/ please mention	

2. From the ranges below, please identify the level of your family annual income (AMD). Please reply to the question without discussion with each other

1	Up to 500,000 /AMD	
2	500,000-1,000,000 / AMD	
3	1,000,000-3,000,000 / AMD	
4	3,000,000- 6,000,000 / AMD	
5	6,000,000 / AMD	

3. For each operation listed above, please indicate what fuel you use and how much. For each operation listed above, please indicate what fuel you use and how much. For example, if you use wood the most for heating your house, mark 1 for the wood version, if the second most used fuel after wood is manure, mark 2 for the manure version, and so on.

		For heating te house/	**For cooking in not heating season/**	**For cooking in heating season/**	**For heating of water/**
1	Fuelwood				

2	Dung				
3	Briquettes				
4	Gas				
5	Electricity				
6	Solar energy				
7	Other. Please mention				

4. Please mention the volumes of fuelwood annually used by your family m3/

0	0	
1	Up to 5 m^3	
2	5-10 մ^3/ m3	
3	10-15 m3	
4	15-20 m3	
5	more than 20 m 3	

5. Please mention the volumes of dung annually used by your family m3/ One track can transport approximately 5-6 m3 dung/

0	0	
1	Up to 5 m^3	
2	5-10 / m3	
3	10-15 m3	
4	15-20 m3	
5	more than 20 m 3	

6. Please indicate the reasons you use each of the fuels noted below. Please indicate all possible options. If you do not use any fuel, then don’t mention anything about it.

7. Please indicate the method of payment for each type of fuel used by You. If you do not use any fuel, then don’t mention anything about it.

	Wood	Manure	Briquets
0. Don’t use			
1. Immediate payment by cash			
2. Postponed payment by cash			
3. Immediate barter with agriproduct			
4. Postponed barter with agriproduct			
5. Immediate barter with agricultural services			
6. Postponed barter with agricultural services			
7. I don’t pay/ obtain without payment			
8. Other/ I use my own			

8. Please indicate the devices you use for heating in your home

1. Wood stove	
2. Wood boiler heating system	
3. Gas stove	
4. Gas boiler heating system	

5. Electric heater	
6. Other	

9. Please indicate how much you are ready to pay for obtaining an energy efficient stove, the market price of which is approximately 80.000 AMD

1	2	3	4	5	6	7	8
0-5. 000	5.000- 10.000	11.000- 20.000	21.000- 30.000	31.000- 40.000	41.000- 50.000	51.000- 60.000	61.000- 80.000

10. Approximately how much time do you personally spend on each of the following tasks per day?

	1	2	3	4	5
	0 hour	0-1 hours	1-3 hours	3-10 hours	More than 10 hours
Cooking on the device for cooking					
Heating the house, ensuring the operation of the heating device of house					
Heating water					
Other (please mention)					

11. How much time (days) do you spend storing firewood, manure or briquettes needed for your heating season in your yard?

Wood	
Manure	
Briquets	

12. Please indicate if you are going to change the heating of your house in any way

9. I don’t plan to change anything my current heating seastem	
10. I plan obtain a energy efficient stove	
11. I plan to obtain boiler working on biomass (wood, briquette)	
12. I plan to obtain centralized heating system with gas boiler	
13. I plan to obtain solar water heater or solar panels	
14. I plan to change my fuel and shift to straw briquettes obtained from the market with direct payment	
15. I plan to change my fuel and shift to straw briquettes obtained by bartering my straw with briquettes	
16. Other activity aimed at energy efficiency (please mention)	

13. **Please indicate how much you agree with the mentioned below statements.** Please indicate one of the suggested options in each question

	1	2	3	4
	Totally disagree	Somewhat disagree	Somewhat agree	Totally agree
My home is always warm enough				

I am satisfied with the amount of fuel used by my heating system				
I participate in the energy-related decisions made in our family				
I am ready to do additional phisical work to to reduce my energy / fuel consumption				
The fuel I use for heating my home affects my health.				
The fuel I use for cooking in my home affects my health.				
I am interested in new technologies in the field of energy				
I am usually among the first to try the new technologies in the field of energy				
I often share my opinion on energy issues with my neighbors				
I often share my opinion during community gatherings				

14. Please mention how is the health of you or your family affected by the fuel you use at Your house. Please select all that apply.

1	Breathing problems	
2	Respiratory illnesses (colds, flus, etc.)	
3	Skin irritation	
4	Eye irritation	
5	Other (please mention)	

15. Please rank these fuel types by negative health impact on the scale from 1 to 5:

	0- I don't know, 1-don't have any impact, 5- has very big impact
Wood	0 1 2 3 4 5
Dung	0 1 2 3 4 5
Briquettes	0 1 2 3 4 5
Gas	0 1 2 3 4 5
Electricity	0 1 2 3 4 5
Solar energy	0 1 2 3 4 5

16. Please rank these energy types by negative local environmental impact on the scale from 1 to 5

	0- I don't know, 1-doesn't have any impact, 5- has very big impact			
Wood	0 5	1	2	3	4
Dung	0 5	1	2	3	4
Briquettes	0 5	1	2	3	4
Gas	0 5	1	2	3	4
Electricity	0 5	1	2	3	4
Solar energy	0 5	1	2	3	4

17. What part(s) of your home is insulated? Choose all that apply

1. Ceiling	
2. Walls	
3. Windows	
4. Doors	
5. Other	

18. Please mention the tree most important for You benefits and services provided by nature. Arrange them according to importance for You. Mark 1 for the most important option, 2- for the second and 3 for the third important options.

1	Recreation and leisure	
2	Provisioning of fuels	
3	Provisioning of foods	
4	Fresh air	
5	Fresh water	
6	Provisioning of construction material for housing	
7	Provision of medicinal plants/	
8	Soil formation and fertility	
9	Spiritual recreation	
10	other (please write the answer here)	

19. Would you be interested in participating in more group discussions related to energy efficiency in your household and community?

Yes	No	Maybe, I need more information
1	2	3

Appendix 4: Discussion Questions

1. Is it easy to access information about household energy conservation or energy efficiency?
   Հասանելի՞ է արդյոք տեղեկատվություն տնային տնտեսություններում էներգախնայողության կամ էներգաարդյունավետության վերաբերյալ:

2. Where do you obtain information about energy conservation or energy efficiency?
   Ինչպե՞ս եք ստանում կամ գտնում տեղեկատվություն էներգախնայողության կամ էներգաարդյունավետության վերաբերյալ:

3. Արդյո՞ք դուք խնայում եք վառելիքը: Եթե այո, ապա ինչու՞և ինպե՞ս: Եթե ոչ, ապա ինչու՞:
   Do You conserve energy? If Yes, why and how, if no, why?

4. Would you purchase energy efficient devices? Why or why not?
   Կցանկանա՞ք արդյոք ձեռք բերել էներգաարդյունավետ սարքեր: Եթե այո՝ ապա ինչու: Եթե ոչ՝ ապա ինչու:

5. What do you do to make the fuel you use more efficient?
   Ի՞նչ գործողություններ եք իրականացնում ձեր վառելիքի օգտագործումն ավելի արդյունավետ դարձնելու համար:

6. Are you concerned about the future supply of any fuel sources? Why or why not?
   Արդյոք դուք մտահոգվա՞ծ եք ապագայում որևէ վառելիքի առկա և հասանելի լինելու վերաբերյալ: Եթե այո՝ ապա ինչու: Եթե ոչ՝ ապա ինչու:

7. Assuming that a new way of heating costs the same or cheaper to use, are there any other reasons you wouldn’t use it?
   Եթե լինի ջեռուցման այլընտրանքային եղանակ, որը գնային առումով ավելի մատչելի է, քան այն, ինչն օգտագործում եք հիմա, արդյոք կա՞ որևէ պատճառ դրանից չօգտվելու համար:

8. Are you concerned about the future of your natural environment? Explain your reasons.
   Արդյոք դուք մտահոգվա՞ծ եք Ձեր շրջակա միջավայրի և բնության ապագայի վերաբերյալ: Որո՞նք են Ձեր դիրքորոշման/կարծիքի պատճառները:

9. How would you want to improve the situation of energy in your community if you were given a chance? By ‘situation of energy’ we mean use habits/patterns or sources of energy.
   Հնարավորություն ունենալու դեպքում ինչպե՞ս կցանկանաք բարելավել էներգիայի հետ կապված իրավիճակը Ձեր համայնքում: Էներգիայի հետ

կապված իրավիճակ ասելով նկատի ունենք էներգիայի օգտագործման ճնաչափեր, վարքագծեր կամ աղբյուրներ:

10. Do you think that the heating and cooking fuels affect your or your family's health? If yes, how might it be possible to reduce that impact?
Արդյո՞ք ջեռուցման և սնունդ պատրաստելու համար վառելիքի օգտագործումը բացասական ազդեցություն ունի Ձեր և Ձեր ընտանիքի անդամների առողջության վրա: Եթե այո, ապա ինչպե՞ս կարող եք նվազեցնել այդ ազդեցությունը:

11. Արդյո՞ք այրում եք պլաստիկե, ռետինե կամ այլ պարագաներ Ձեր վառարանում: Եթե այո, ապա ինչու՞,ի՞նչ հաճախականությամբ և ինչ նպատակով:
Do you burn plastic, rubber or other materials in your stove? If Yes, then for what purpose and how often?

12. How acceptable are straw briquettes for your community?
Ձեր համայնքի համար որքանո՞վ է ընդունելի ծղոտե բրիկետների օգտագործումը:

13. How acceptable is solar energy for your community? Solar energy includes: a) solar thermal for heating water and b) photovoltaic for electricity
Ձեր համայնքի համար որքանո՞վ է ընդունելի արևային էներգիայի օգտագործումը: Արևային էներգիայի օգտագործումը ներառում է. ա) արևային ջրատաքացուցիչ սարքեր, և բ) արևային պանելներ՝ էլեկտրականության արտադրման համար:]

14. How acceptable is biogas energy for your community?
Ձեր համայնքի համար որքանո՞վ է ընդունելի կենսագազի օգտագործումը:

15. Ձեր համայնքի/բնակավայրի բնակիչների մոտ քանի տոկոսն է ջեռուցման համար օգտագործում փայտ, քանի տոկոսը՝ գոմաղբ և քանի տոկոսը՝ գազ:
16. Approximately what percentage of the households in your community/settlement use firewood, gas or dung for heating?