

# Document 1

## **Analysis of household heating practices in the Skopje Valley**

**- Research Report -**

January - September 2017

Prepared for: United Nations Development Programme (UNDP)

With financial Ministry of Finance of the Republic of Slovakia  
The City of Skopje  
Global Environmental Facility (GEF)

and technical support by: United Nations Development Programme (UNDP)  
Persons responsible:  
Anita Kodzoman  
Jasmina Belchovska Tasevska  
Pavlina Zdraveva

in cooperation with The City of Skopje  
Ministry of Environment and Physical Planning  
Research Center for Energy and Sustainable Development -  
Macedonian Academy of Science and Arts  
Dr. Dejan Mirkakovski, PhD  
Aleksandar Dedinec, MSc

The Report was prepared on the basis of the  
social and economic analysis

The field research was made by:

The survey was made with the use of the tool  
developed by

Dr. Dame Dimitrovski  
Dr. Elizabeta Dzambaska

TIM Institute  
Persons responsible:  
Ivana Todevska, PhD  
Elena Ognenovska, MSc  
Jelena Kjetkovikj Janeva, MSc  
Ana Vasilevska

Placeformer  
PrymApps  
Persons responsible:  
Ilijancho Gagovski  
Ilija Jovanovski

Since January 2017, the UNDP Office has been analyzing the local pollution and the GHG emissions from the household heating in the Skopje Valley and has been designing and testing local actions for their reduction. These activities are being implemented as part of three complementary ongoing UNDP projects, funded by the Ministry of Finance of the Republic of Slovakia, the City of Skopje and the Global Environment Facility.

First in the series of outputs is this Report, prepared by Dr. Dame Dimitrovski with the amendments on social and economic analysis prepared by Dr. Elizabeta Dzambaska.

The opinions expressed in this document are the opinions of the authors and they do not represent the opinions of the United Nations, including UNDP or UN Member States.

## Table of Contents

1. Introduction .....	2
2. Survey Methodology.....	4
3. Results and Interpretation of the Survey Results.....	6
3.1. LOCATION OF THE HOUSEHOLD.....	6
3.2. STRUCTURE OF DWELLINGS .....	16
3.3. THERMAL CHARACTERISTICS OF THE BUILDINGS.....	20
3.4. ENERGY FOR HEATING.....	25
3.5. COST OF HEATING .....	41
3.6. HEATING SYSTEMS.....	42
3.7. SECONDARY (AUXILIARY) HEATING SYSTEM .....	44
3.8. ADDITIONAL ENERGY.....	46
3.9. SELECTION OF THE HEATING SYSTEM AND FUEL .....	47
3.10 HARMFUL PHENOMENA .....	54
4. Conclusions .....	59
Annexes.....	60
1. Survey questionnaire .....	60

## 1. Introduction

This report is prepared on the basis of latest data obtained from the field survey conducted in January 2017, in order to provide recommendations for taking reduction measures for air pollution and to reduce GHG emissions caused by the household heating practices. The report was prepared by Dame Dimitrovski, PhD and the socio-economic analysis was prepared by Elizabeta Dzambaska, PhD. The field survey was conducted by TIM Institute with the Placeformer tool, developed by PrymApps.

The objective of this report is to present the findings of this analysis and of the data obtained from the survey on the household heating practices in the Skopje Valley. The survey provided data with geo-locations which can be further used for modelling, designing and forecasting emissions generated by household heating practices. Additionally, this data-base will make it possible to model various emission reduction measures, and to analyze their impact on air quality, as well as to set short term and long-term development scenarios, taking into consideration the users choice. Additionally, the measures designed might impact the choice of the heating practices and cause emission reduction with the so-called soft measures.

**Why household heating practices?** Skopje faces intensive air pollution especially in winter. The analysis of the Ministry of Environment and Physical Planning shows that: „Based on the results from the measuring conducted in 2015, the limit values of the key polluting substances were not violated, apart from PM10 emissions. Namely, similarly to previous years, the most critical polluting substances are the suspended particles. So, the violation of the limit values for particulate matter up to 10 micrometers are recorded on all measuring points especially in winter when they are several times higher than the mid-day limit value...<sup>1</sup>“.

The study prepared by the Finnish Meteorological Institute under the Twinning Project implemented with the Ministry of Environment and Physical Planning, in which the data from the metering station in Karposh, Skopje were analyzed, presents the following finding: "Factor 4 clearly indicates the source which is biomass burning. This factor contributes to one third (32%) of the total PM10 pollution which is caused in the vicinity of the measuring station in Karposh, and it is caused by using heavy oil for heating"<sup>2</sup>.

However, it is important to underline that there are other reasons for having increased concentrations of solid particles in the Skopje air. Most important are <sup>3,4</sup>:

---

<sup>1</sup> Environmental Quality in the Republic of Macedonia — Annual Report 2015, MOEPP

<sup>2</sup> MOEPP - Finish Meteorological Institute Study 2016, Skopje

<sup>3</sup> Dame Dimitrovski & M. Vilarova, Review of Air Quality in Tetovo, EuropeAid/134079/D/SER/MK, RAMBOLL, 2015

- Atmospheric conditions - the atmospheric inversion taking place in winter;
- Urban planning factors – the plans and the sites of constructed buildings; some of the biggest polluters are in the urban area, and finally the position of buildings does not facilitate easy air cleaning and wind penetration;
- Traffic – this is one of the big polluters throughout the whole year;
- Lack of public hygiene – re-emission of solid particles several times in the ambient air, as well as other reasons.

---

<sup>4</sup> STUDY ON DEFINING TECHNOLOGICALLY AND ECONOMICALLY OPTIMAL AND ENVIRONMENTALLY SUSTAINABLE SYSTEM FOR HEATING AND INTRODUCTION OF CENTRALIZED SANITARY HOT WATER SUPPLY IN SKOPJE, D. Tashevski, R. Filkoski, I. Shesho, D.Dimitrovski, S.Armenski and others, Skopje, 2017

## 2. Survey Methodology

The field survey was conducted with the use of a structured questionnaire, completed with the use of the innovative tool [Placeformer](#) during face to face interviews. Initially the population of the Skopje Region was divided against two criteria: ethnicity and level of urbanization. After that, the planned number of questionnaires (5000), was proportionally divided into the municipalities in the Skopje Region (17) according to the number of citizens in them. At the end of the survey, 5044 questionnaires were collected in total, and the distribution in the municipalities is presented in Table 1.

### Development of the questionnaire

During the implementation of the project it was necessary to collect data for several purposes. By consulting all stakeholders of the project (participants and implementors), the following was determined:

- Which and what data need to be collected in order successfully to model the GHG emissions generated from the households heating practices;
- Which and what data are needed to project possible development scenarios;
- Which and what data could be collected concerning burning illegal fuels;
- Which and what data could be collected concerning similar phenomena near the households;
- Which and what demographic data are necessary to determine trends and multidimensional statistic correlations.

The questions listed in the survey questionnaire, were improved in consultations with the experts on emissions and concentrations modelling contracted by the project, with the experts on surveys as well as with the experts on data base development as well as with the UNDP project managers. The complete questionnaire, in the form as it was used, is presented in Annex 1 to this document.

### Conducting the survey

The field survey was conducted between 3 and 31 of January, on a sample of 5044 completed questionnaires, and there were only 70 households which rejected the survey. The survey was implemented by 23 previously trained interviewers. Table 1 presents the number of questionnaires completed in each of the municipalities.

Skopje Region		Urban settlements	Rural settlements	Total
1	Aerodrom	584	26	610
2	Arachinovo	0	102	102
3	Butel	201	116	317
4	Gazi Baba	460	227	687
5	Gjorche Petrov	213	148	361
6	Zelenikovo	1	35	36
7	Ilinden	0	119	119
8	Karposh	525	9	534
9	Kisela Voda	443	46	489
10	Petrovec	0	61	61
11	Saray	4	306	310
12	Sopishte	0	56	56
13	Studenichani	0	142	142
14	Center	423	0	423
15	Chair	559	0	559
16	Chucher Sandevo	0	60	60
17	Shuto Orizari	178	0	178
Total		3591	1453	5044

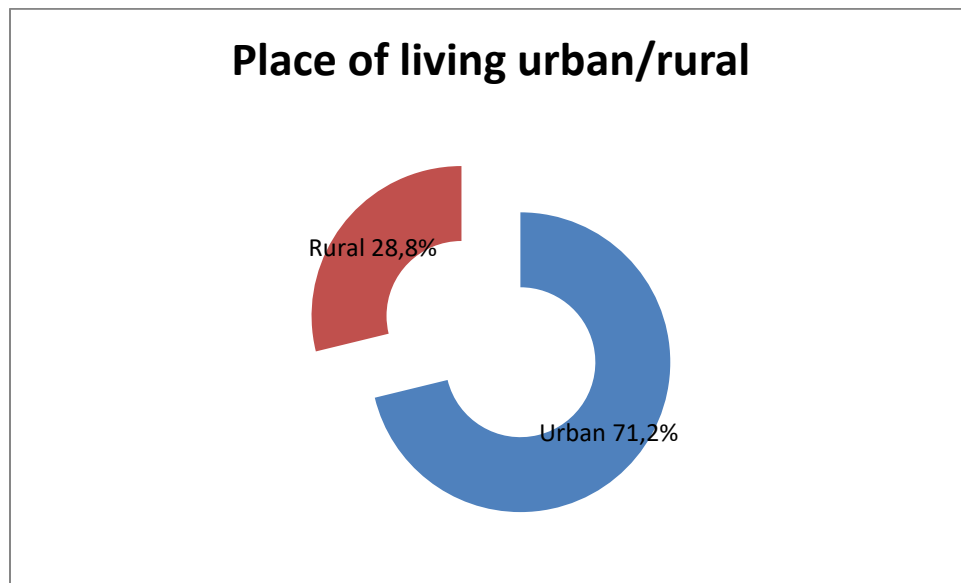
Table 1. Number of questionnaires completed per municipality



### 3. Results and Interpretation of the Survey Results

#### 3.1. LOCATION OF THE HOUSEHOLD

**Place of residence:**



Graph No. 1 Place of residence

Out of 5044 households surveyed, 71.1% are in urban settlements, and 28.8% live in villages near Skopje<sup>5</sup>.

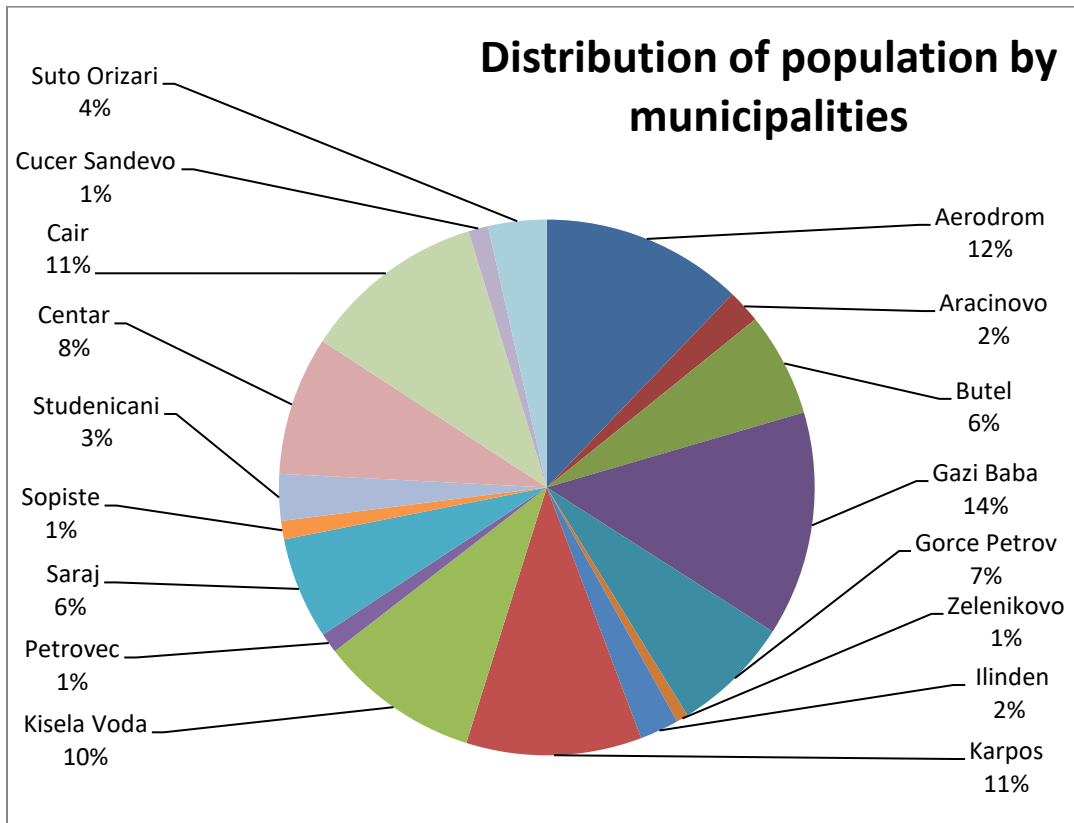
Completely urban municipalities in the Skopje Valley are Center, Chair and Shuto Orizari. Partially urban and partially rural are Aerodrom, Butel, Gazi Baba, Gjorche Petrov, Karposh, Kisela Voda and Saraj. Completely rural municipalities are Arachinovo, Zelenikovo, Ilinden, Petrovec, Sopishte, Studenichani and Chucher Sandevo.

In continuation throughout the text, instead of using the full expressions "rural settlements" and "urban settlements", we will use the terms "urban" and "rural".

---

<sup>5</sup> The division of the questionnaires in urban and rural areas was made in accordance with the Law on Territorial Division of the Local Self Government Units of 2004, (Official Gazette of the Republic of Macedonia, No. 55/2004).

## Distribution of population by municipalities

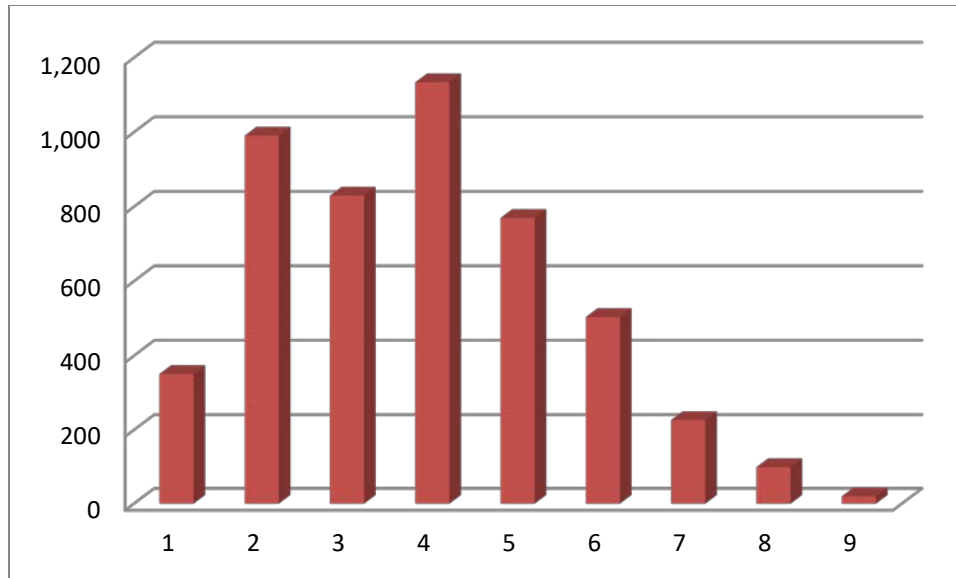


Graph No. 2 Municipality of residence

The distribution of the number of surveyed households is proportional to the number of households in every municipality in the Skopje Valley. It should be underlined, that besides the citizens in the municipalities in Skopje and Skopje Valley, due to daily and weekly migration it is estimated that there are up to 1 million of people in Skopje in certain days, and they are included in the survey by random selection.

### Q3. Number of persons in the household

**In average one household is composed of 3.73 persons.** The distribution of the number of persons living in one household is presented on the following graph.



Graph No. 3 Number of persons in the household

By cross-analyzing the data obtained with this question (place of residence: urban/rural), we obtain the following information:

- In the urban parts of the city, 8.4% are single person families, while in the rural areas only 3.3% are single person families.
- 21.8% of the families in urban areas are two-person families, while 14.4% are two-person families in rural areas.
- 18.3% are three-person households in urban areas, while there are 12% in rural areas.
- There are 22.9% three-person households in urban settlements, while 21,5% in rural.
- 13.1% are five-person households in urban areas, while there are 20.7% in rural areas.
- 7.9% are six-person households in urban areas, while there are 15.1% in rural areas.
- 3.2% are seven-person households in urban areas, while there are 7.6% in rural areas.
- 1.8% of the households have eight or more persons in urban areas, while there are 3.7% such families in rural areas.

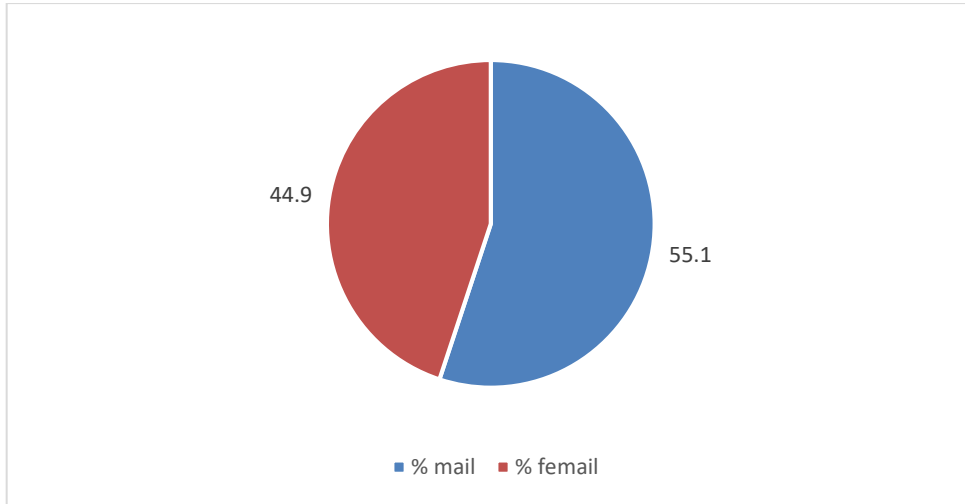
This leads to the conclusion that [urban households have in average less persons compared to rural households.](#)

### Social and Economic Issues

The part of the questionnaire relating to demographics and socio-economic features of the households, mostly contains questions on sex and age structure, ethnicity, education, marital status, as well as whether households have children under 18 which live with them and what is the monthly income of the household.

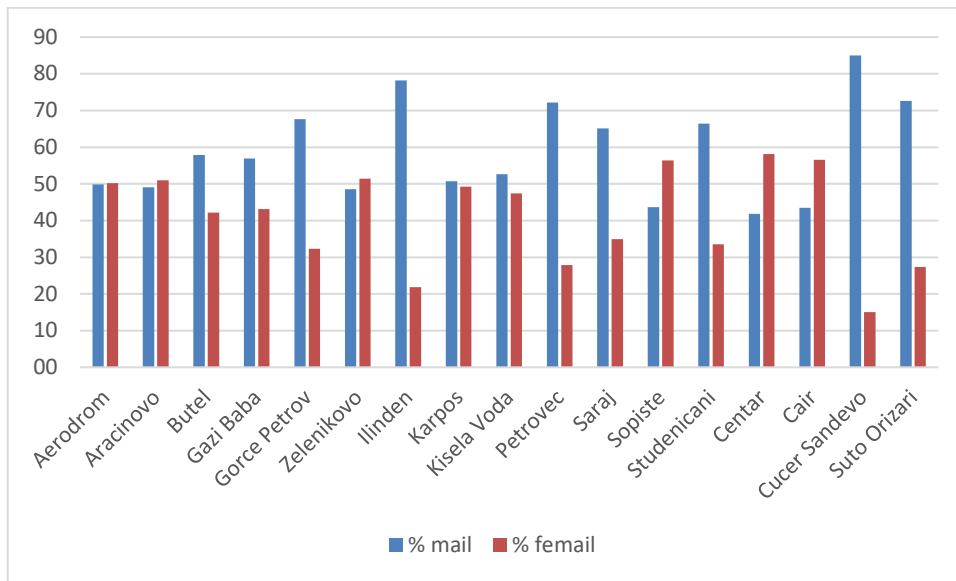
### Sex structure of the respondents

The sex structure of the surveyed respondents from the households is as follows: 55.1% are men and 44.9% are women.



**Graph No. 4 Sex structure in the Skopje Region**

The sex structure of each municipality is presented in Graph no. 5.

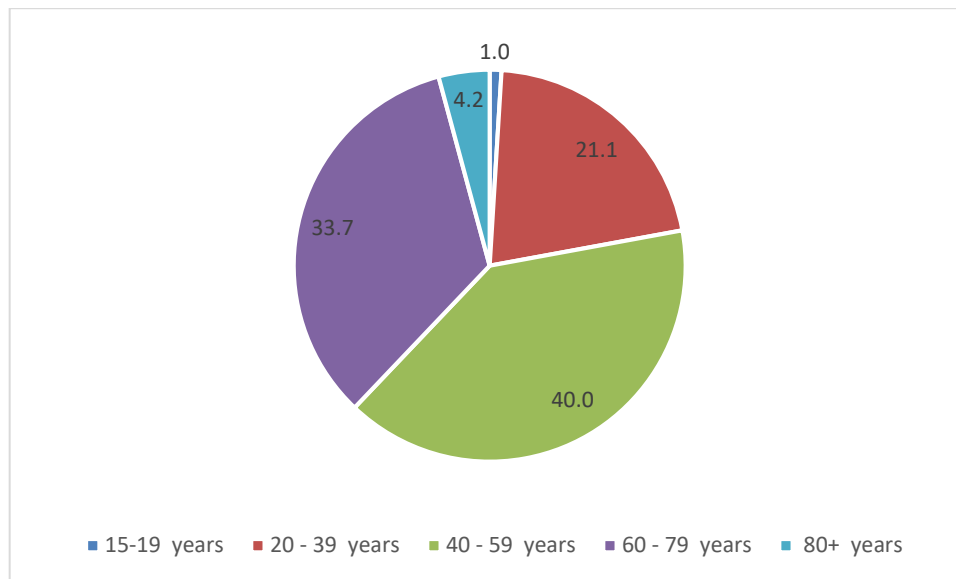


**Graph No. 5 Sex structure in the municipalities (in %)**

### Age structure of the respondents

There is variety in the answers given by respondents concerning their age. To get a better overview of the age groups the answers were grouped in five (5) age categories. The data collected on the age groups in the municipalities in the Skopje Region show the following:

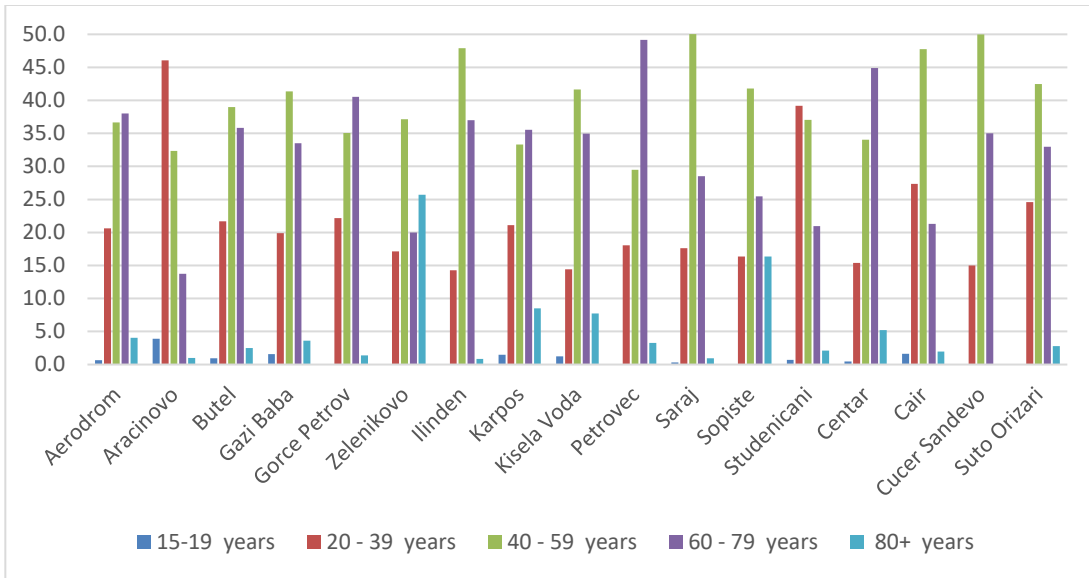
- The highest percentage (40%) of the respondents have between 40-59 years, which means they are active and working age population;
- Also, high percent (33.7%) have between 60 – 79;
- 21.1% have between 20 and 39;
- 4.2% have more than 80 years of age, and
- only 1% are young persons aged between 15-19.



**Graph No. 6 Age structure in the Skopje Region**

The analysis shows that dominant age group in every municipality is the one having between 40 and 59 years of age, while most of the respondents of the age group between 60 and 79 (40.5%) are in Gjorche Petrov, 35.6% are in Karposh, 49.2% are in Petrovec and 44.9% in Center. But, having in mind which are the biggest municipalities according to the number of households in the Skopje Region, some municipalities have high percentage of households in this age group. They are as follows:

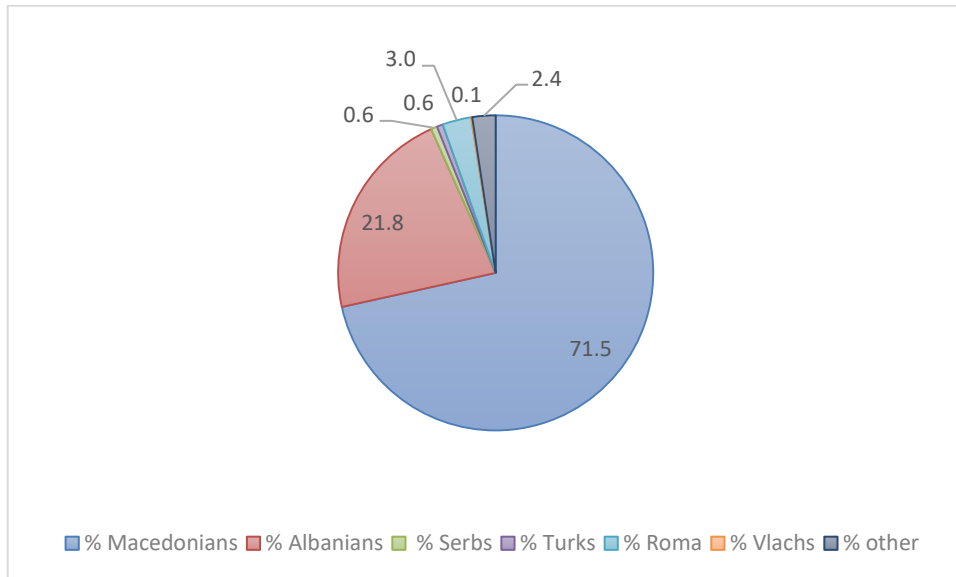
- 38% in Aerodrom;
- 35% in Kisela Voda;
- 33.5% in Gazi Baba and
- 21.3% in Chair.



**Graph No. 7 Age structure of the municipalities**

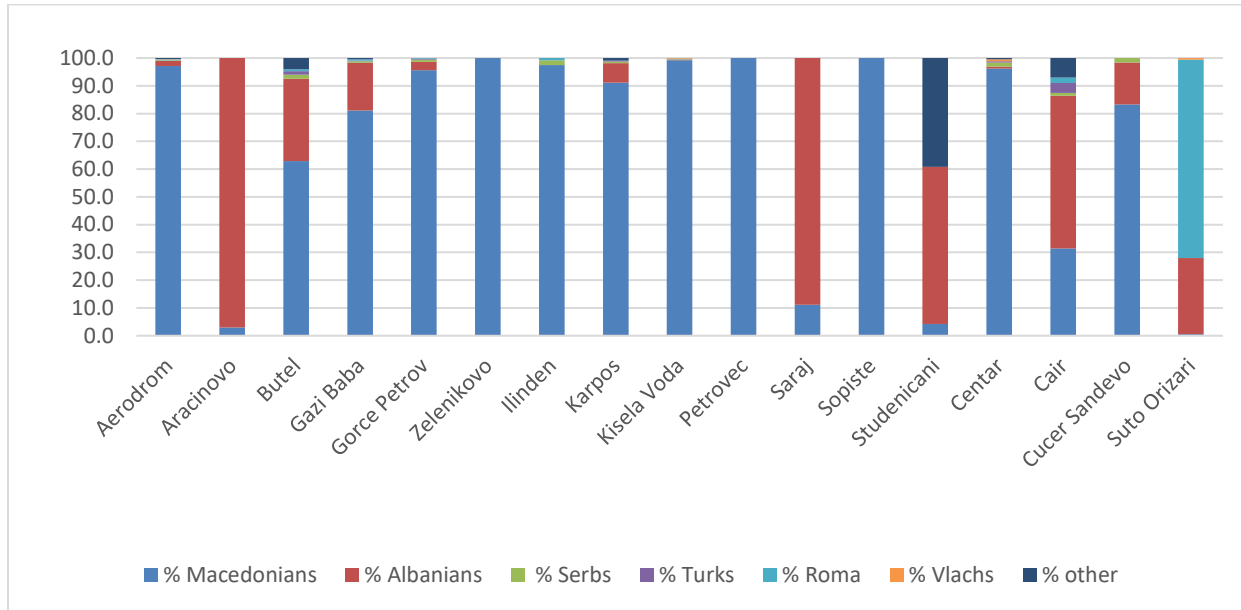
**Ethnicity**

The households in the Skopje Region have various ethnicity. The highest percentage of the surveyed households, 71.5% are Macedonians, 21.8% are Albanians, 3% are Roma, 0.6 % are Serbs; 0.6% are Turks, 0.1% are Vlachs and the other 2.4% are others.



**Graph No. 8 Ethnicity of the households in the Skopje Region**

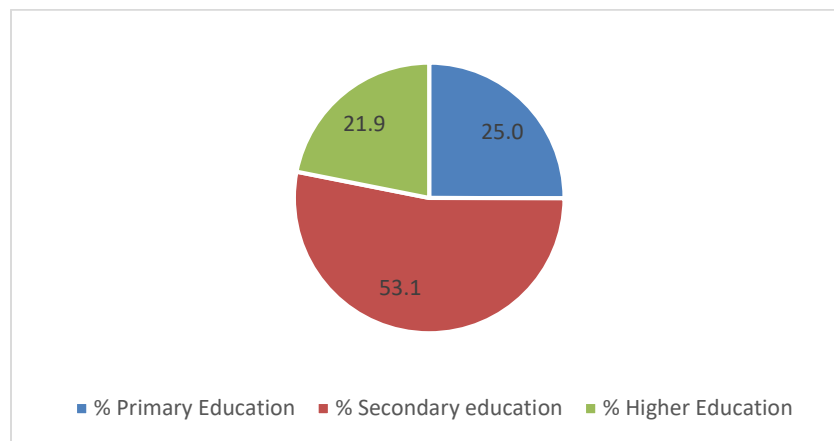
The analysis shows several municipalities with dominantly Albanian households, such as Arachinovo 97.1% , Saraj 88,8%, Studenicani 56,6% and Chair 54,9%. The municipality of Shuto Orizari has mostly households of Roma ethnicity (71.5%).



Graph No. 9 Ethnicity of households against municipalities

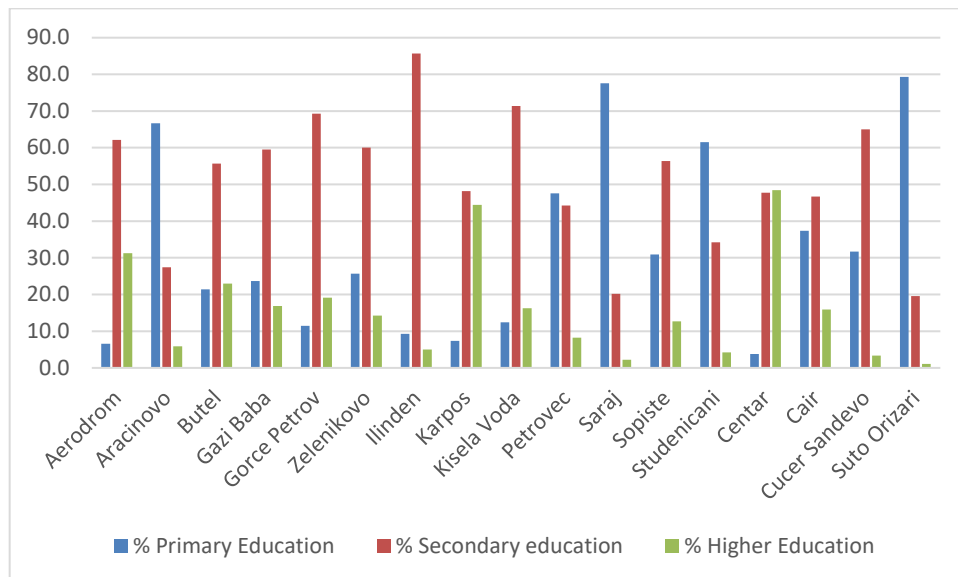
### Education Structure

The analysis of the education structure of the households in the Skopje Region shows that 53.1% have finished secondary vocational or grammar education, 25% have primary education and 21.9% have some degree of higher education.



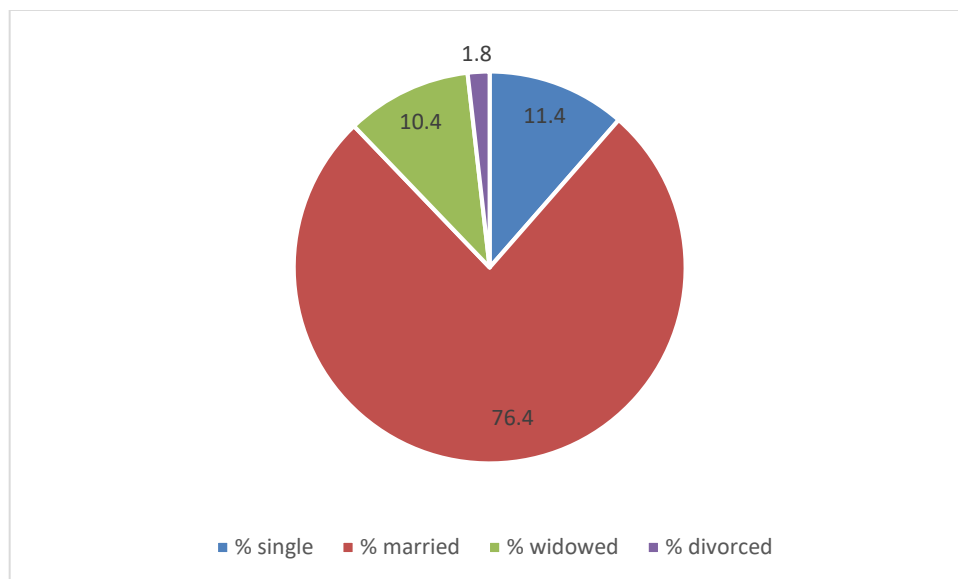
Graph No. 10 Education structure of households in Skopje Region

Municipalities with highest percentage of households with primary education are: 79.3% in Shuto Orizari, 77.6 % in the municipality of Saraj, 66.7% in Arachinovo and 61.5% in Studenicani. On the other hand, most of the households with higher education, master of PhD degree are in the municipality of Centar 48.5% and 44.4% in the municipality of Karposh.



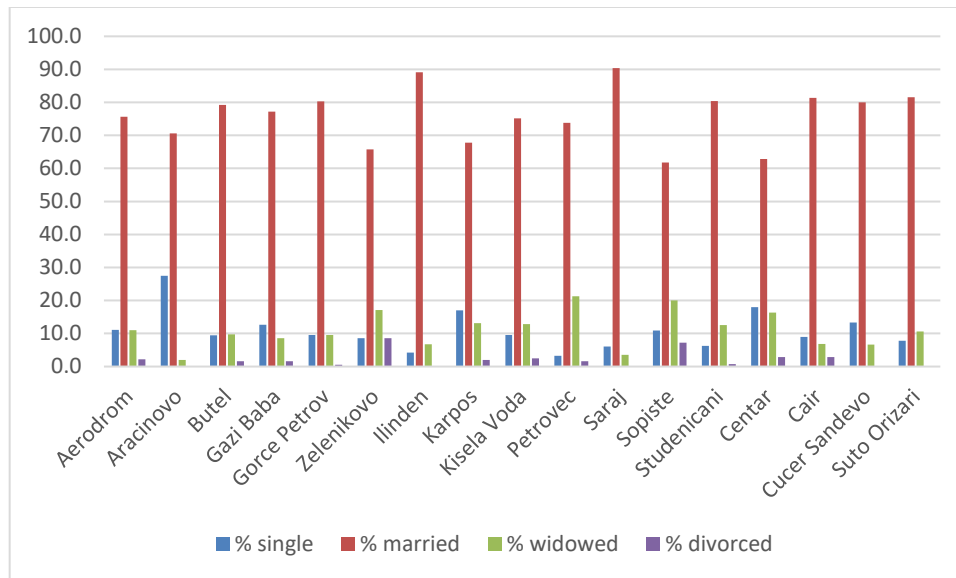
Graph No. 11 Education structure of households

**Marital status:** According to the marital status, most of the respondents from the Skopje Region were married, and this was the case in each of the individual municipalities as well. Out of the respondents surveyed in the Skopje Region, 76.4% were married, 11.4% single, 10.4% widowed and 1.8% were divorced.



Graph No. 12 Marital status of households in Skopje Region

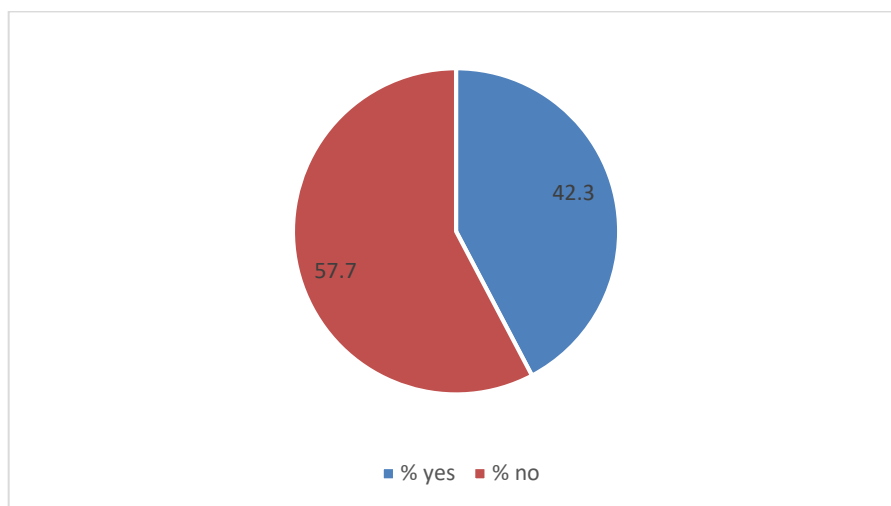




Graph No. 13 Marital status of households in Skopje Region

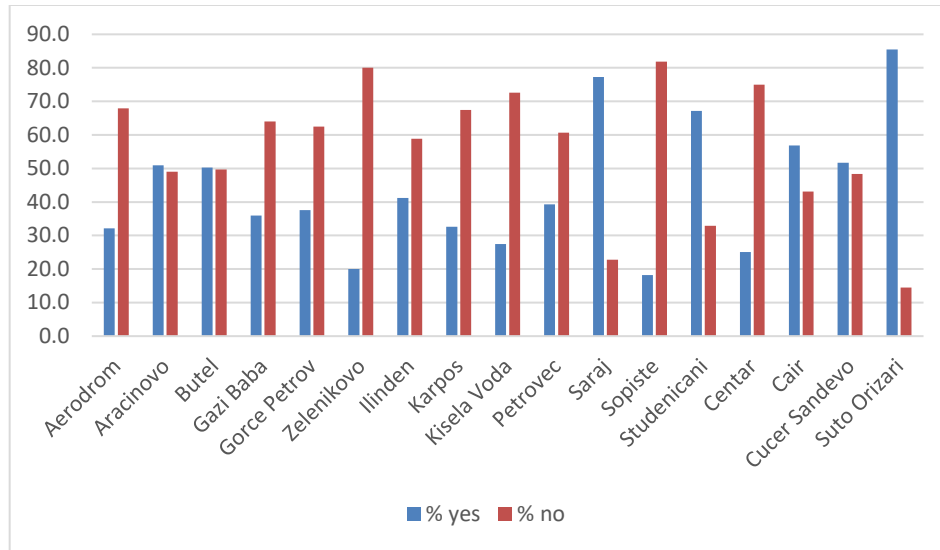
**D6. Do you have children under 18 who live in your household?**

57.7 % of the total number of surveyed households in the Skopje Region have answered positively to this question, while 42.3% said no.



Graph No. 14 Households in Skopje Region with children under 18

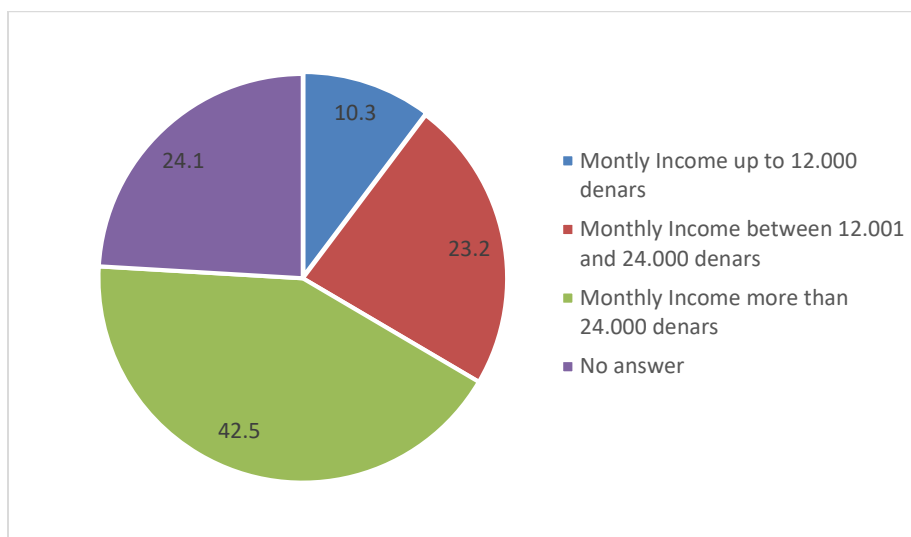
The highest percentage of households having children under 18 are in Shuto Orizari (85.5%), 77.2% are in Saraj, 67.1% in Studenichani, 56.9% in Chair, 51.7% in Chicher Sandevo, 51% in Arachinovo and 50.3% in Butel.



Graph No. 15 Households having children under 18

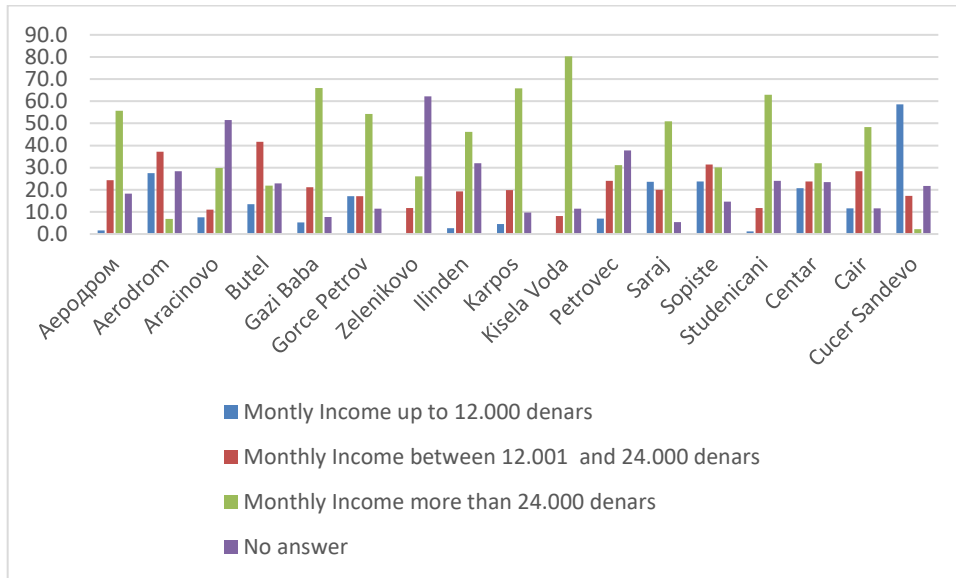
### Monthly income of households

The answers to this question are grouped in three groups. The first group covers households with monthly income of up to 12,000 MKD, the second group includes households with monthly income between 12,001 and 24,000 MKD and the third group includes every household having more than 24,001 MKD. Higher percentage of respondents did not want to answer this question or answered with "I don't know". According to the answers obtained, 42.5% of the households have more than 24,001 MKD, 23.2% have income between 12.001 and 24,000 MKD, 10.3% have less than 12,000 MKD. 24.1% of the respondents did not answer this question.



Graph No. 16 Income of households in the Skopje Region

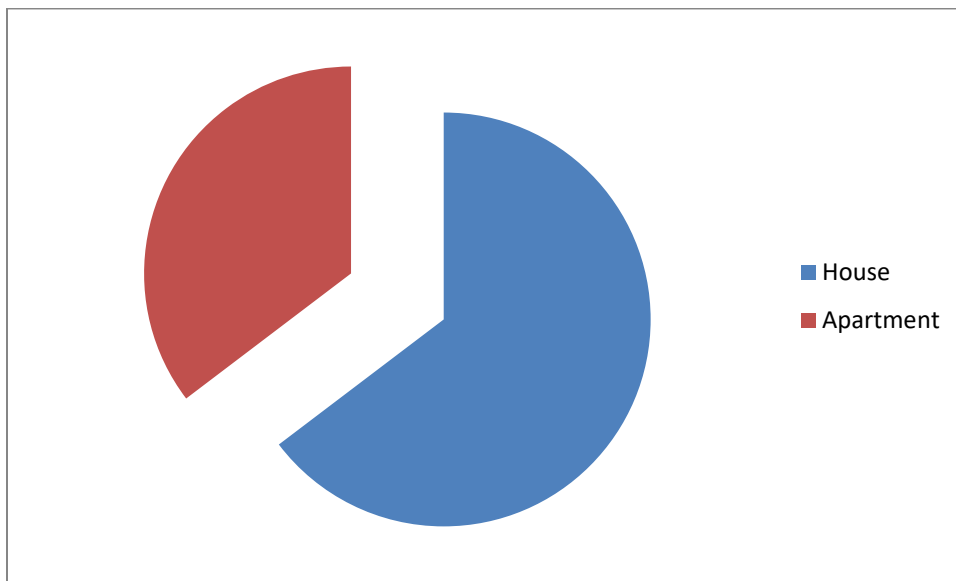
The analysis of the municipalities shows that Shuto Orizari has the highest percentage of households with monthly income of less than 12,000 MKD (58.7%).



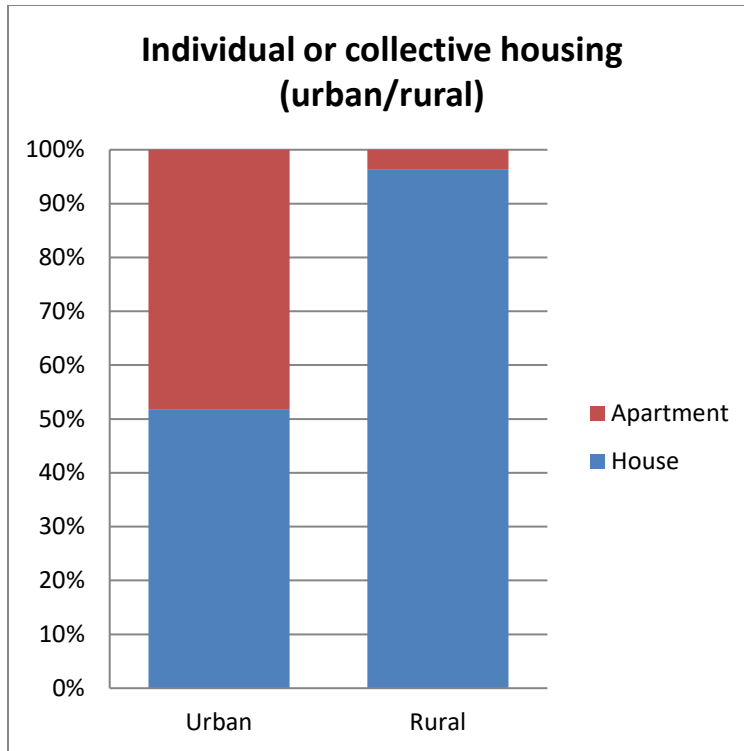
Graph No. 17 Monthly income of households in the Skopje Region

### 3.2. STRUCTURE OF DWELLINGS

**Q2a: Is your dwelling a house or an apartment?**



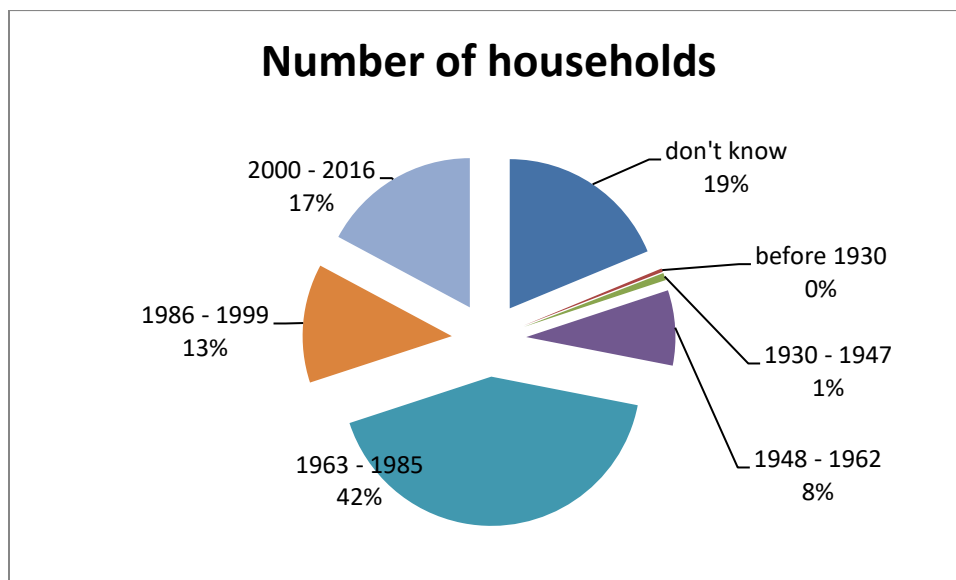
Graph No. 18 Is your dwelling a house or an apartment?



Graph No. 19 Is your dwelling a house or an apartment in urban or in a rural settlement

In the urban part of the city, the number of households living in apartments or houses is almost equal, while in the rural areas of the city, only 3% live in apartments and 97% in houses.

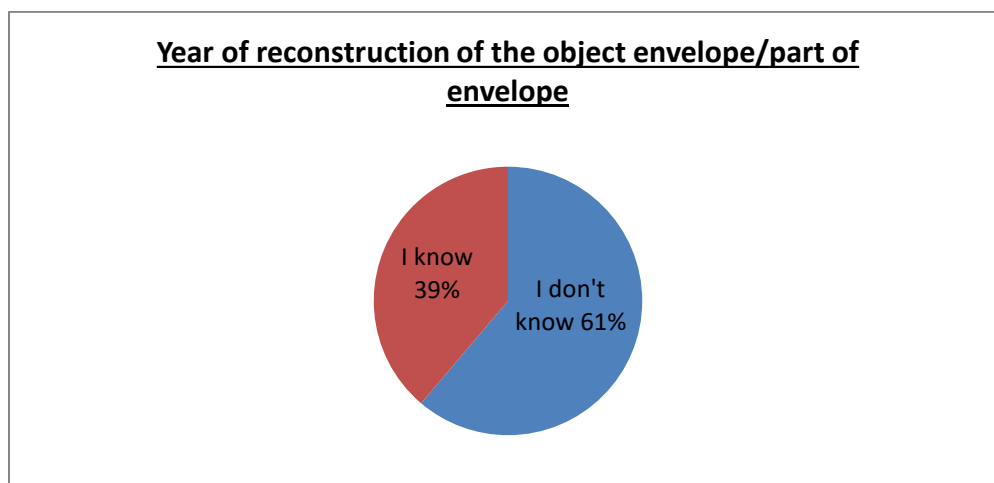
**Q2b 1. Year of construction?**



Graph No. 20 Year of construction of the building?

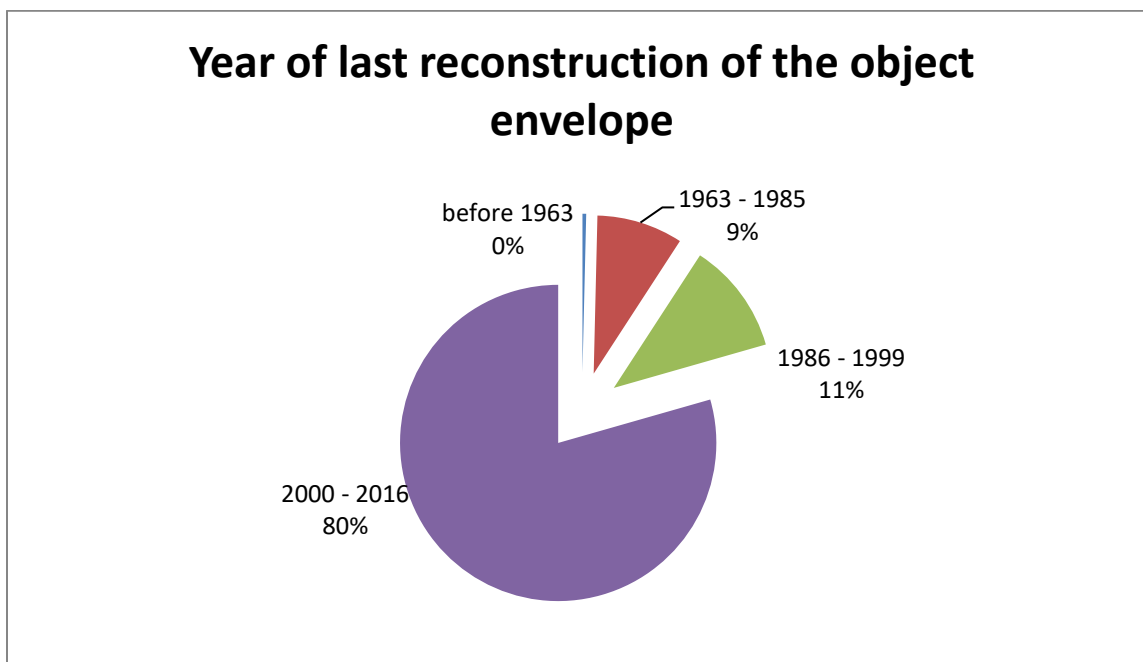
Very small number of buildings (about 1%) were constructed before 1947. 8% of the buildings were constructed before the earthquake, in the period 1948 – 1962. 42% of the buildings were constructed in the period of high growth of Skopje, between 1963 and 1985. 13% of the buildings were constructed in the period from 1986 to 1999, and 17% of the buildings in Skopje Valley were built in the last 17 years, from 2000 to 2017.

**Q2b 2. Year of most recent facade renovation or change of windows?**



Graph No. 21 Year of most recent renovation of part of the building envelope?

It is interesting that high number of respondents (61%) do not know when the last reconstruction of any part of the building envelope was made.



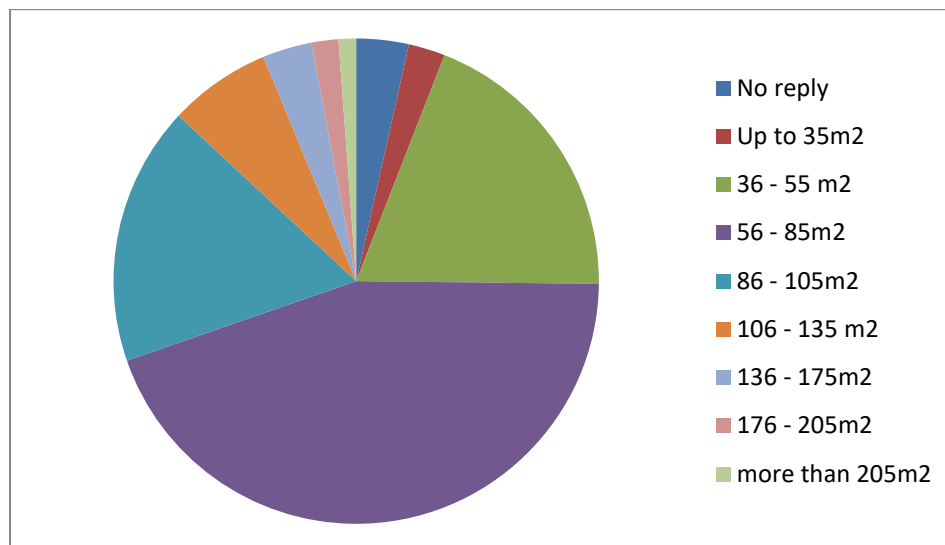
Graph No. 22 Year of most recent renovation of part of the building envelope? (without answer: I don't know)

Out of those 39% who know when the most recent reconstruction of some or of all elements of the building envelope was performed:

- even 80% responded that it was done in the period 2000 – 2016.
- 11% responded that it was done in the period 1986 - 1999,
- and 9% in the period 1963 – 1985.

There is no special connection between the manner of heating and the year of construction or the most recent reconstruction of part of the facade.

### Q2c. Total area of the apartment / house?



Graph No. 23 Total area of the apartment / house

Among the dwellings in Skopje Valley dominant are buildings having an area from 56 to 85 m<sup>2</sup>. 46.1% of the surveyed households live in dwellings like this. Almost 20% of the population lives in dwellings sized 36-55m<sup>2</sup>, and only 2% in dwellings smaller than that. 18% of dwellings have 86-105m<sup>2</sup>, 7.1% - from 106 to 135m<sup>2</sup>, and 6.4% of the households live in dwellings bigger than that.

- The average size of dwellings in Skopje Valley is 79.9m<sup>2</sup>.
- The average size of houses is 88m<sup>2</sup>, and of apartments - 65 m<sup>2</sup>.
- The average size of dwellings in urban areas is: 75m<sup>2</sup>, while in rural it is 90m<sup>2</sup>.

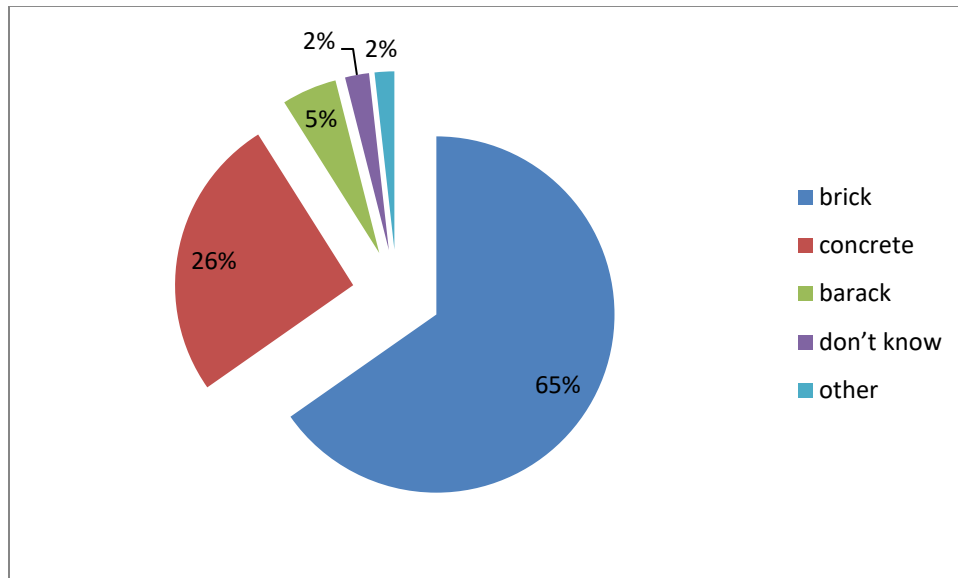
An important aspect for energy consumption for heating and for the habits of the residents is the area of the building that is heated.

### 3.3. THERMAL CHARACTERISTICS OF THE BUILDINGS

The following questions define the features of the thermal envelope of the buildings in Skopje Valley. These data should show which parts of the buildings are most often insulated by their users, and which are not. This information will facilitate designing and defining measures for motivating the users of the buildings to insulate building parts which are insufficiently insulated.

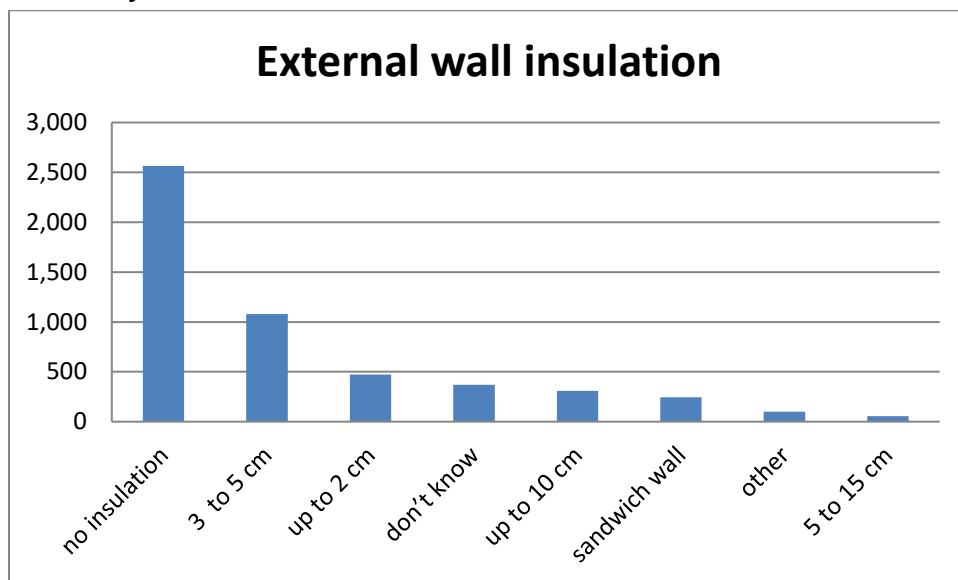
#### Q4: Building envelope:

*External walls:*



Graph No. 24 External walls of the building

*Thermal insulation of external walls*



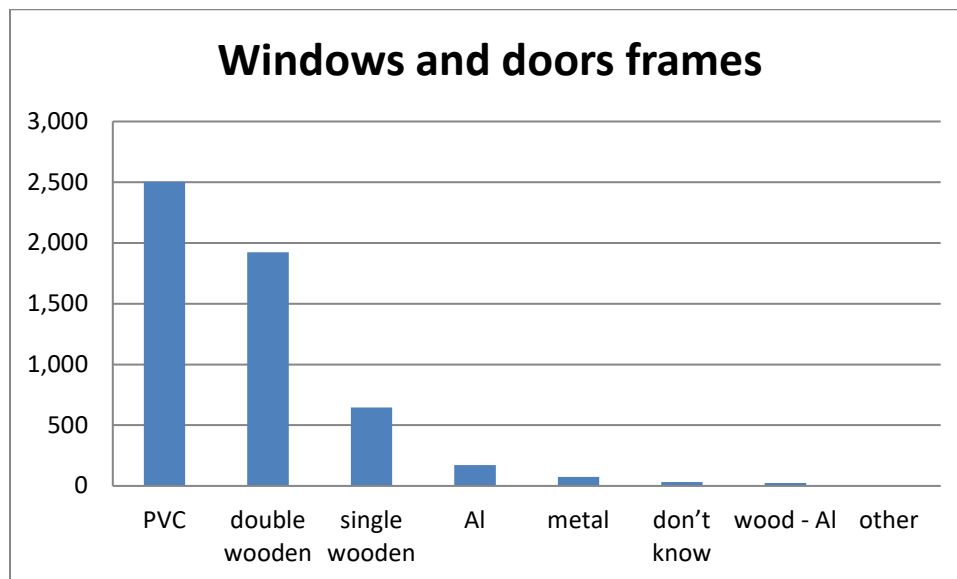
Graph No. 25 Thermal insulation of external walls of the building

The external walls of the buildings are mainly constructed from hollow and solid bricks. More than 50% of buildings have walls which are not thermally insulated. The most recent legal changes require the buildings to have a heat transmission coefficient to external walls lower than  $u=0,35 \text{ W/m}^2\text{K}$ <sup>6</sup>. The calculations show that, if the building is mainly constructed of bricks, at least 8-10cm of thermal insulation is needed in order to achieve this, and it is advised to have 10-12 cm of insulation material. Only 7.2% of the surveyed households live in such buildings.

50.8% of the buildings do not have any insulation, and 42% have thermal insulation below the requirement of the Rulebook regulating the construction of new buildings, adopted in 2013.

**These data point to possible measures** which could contribute to improve thermal insulation of buildings, reduce the energy needed for heating and reduce emissions caused by heating of buildings.

#### *Windows and door frames*



Graph No. 26 Windows and door frames

The analysis of the answers given shows the following:

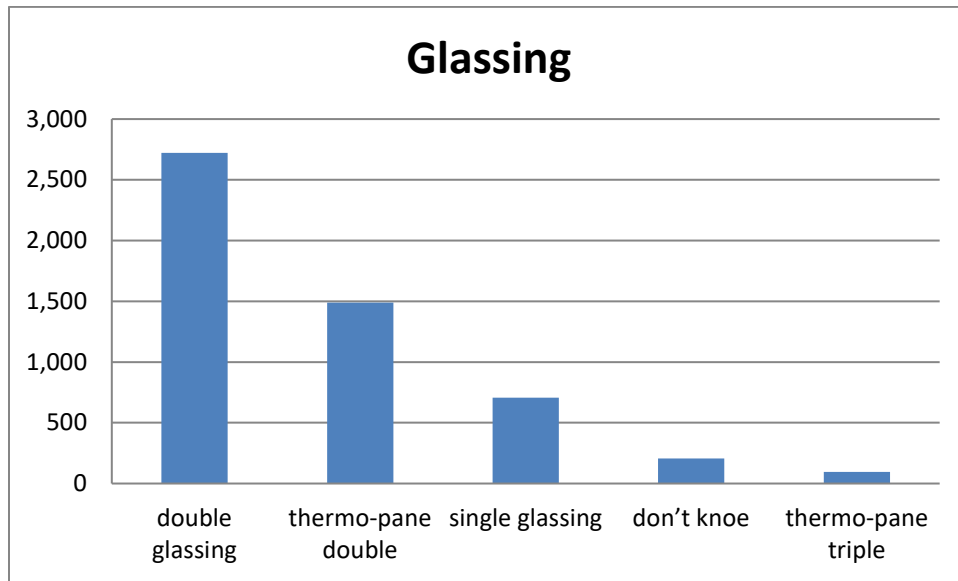
- 49.6% of the respondents have installed PVC frames on windows,
- 38.1% have double wooden window frames,
- 12.8% have single wooden frames,
- 1.4% have metal (steel) frames,

<sup>6</sup>Rulebook on Energy Performance of Buildings, 2013/2015



- and the other 1.2% have other type of window frames.

**Glazing**

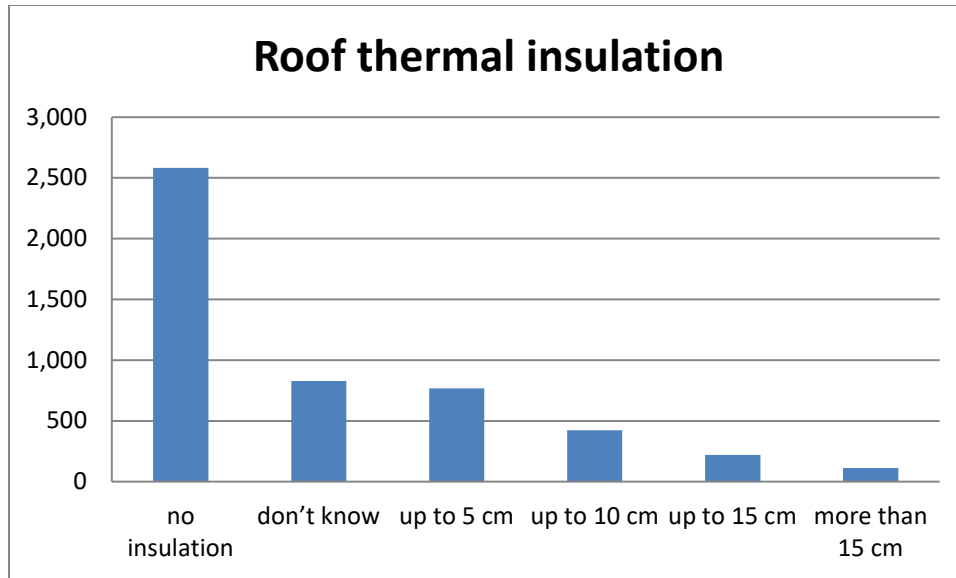


Graph No. 27 Glazing

- 85.4% of the households have double glazing, or double-glazing pane, or triple glazing pane.
- Only 14% of the respondents have single glazing windows.

The upper two graphs (26 and 27) show that **the windows have better performance compared to the external envelope of the buildings**, and that most of the buildings have new windows installed in the last 10 to 15 years.

*Roof thermal insulation*



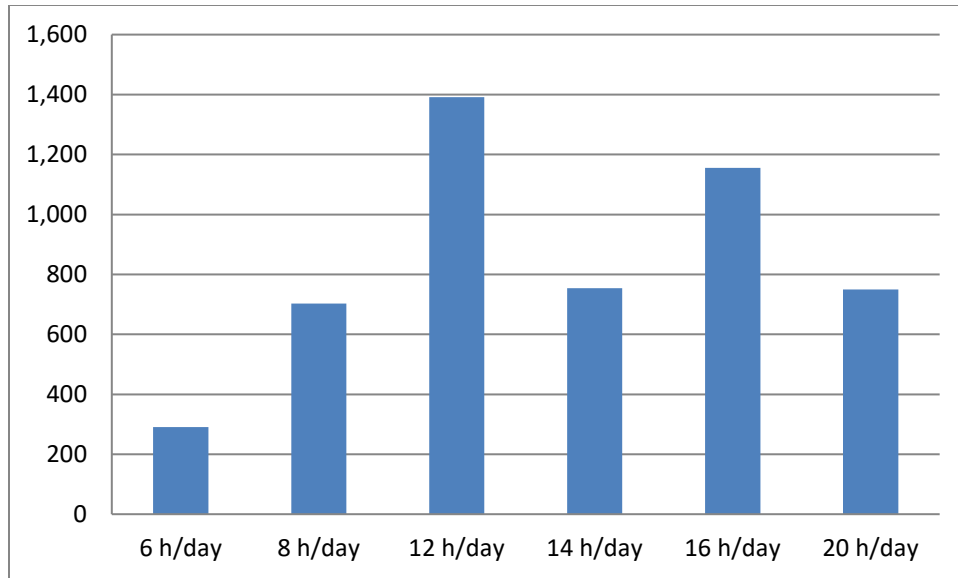
Graph No. 28 Roof thermal insulation

Most of the buildings have thermally uninsulated roof. Having in mind the fact that regulations in the Republic of Macedonia require roofs to have at least  $u$  coefficient of  $=0,20W/m^2K$ , or  $u=0,25W/m^2K$  depending on the construction, if a classical thermal insulation is used it is necessary to have at least 15cm of thermal insulation on the roof.

Only 7.4% of the buildings have such insulation, while 57.8% of the buildings have no additional insulation on the roof, and the rest 26.7% have insufficient insulation. High number of respondents 18.6%, do not know whether and how much thermal insulation they have on the roof.

These information about insulation of buildings should be the basis for defining measures which would help reduce the energy needed to heat the buildings, and which would lead to reducing the pollution caused by heating. Special attention should be paid to roof constructions, which, it seems, have the lowest level of insulation. This presents considerable loss of energy.

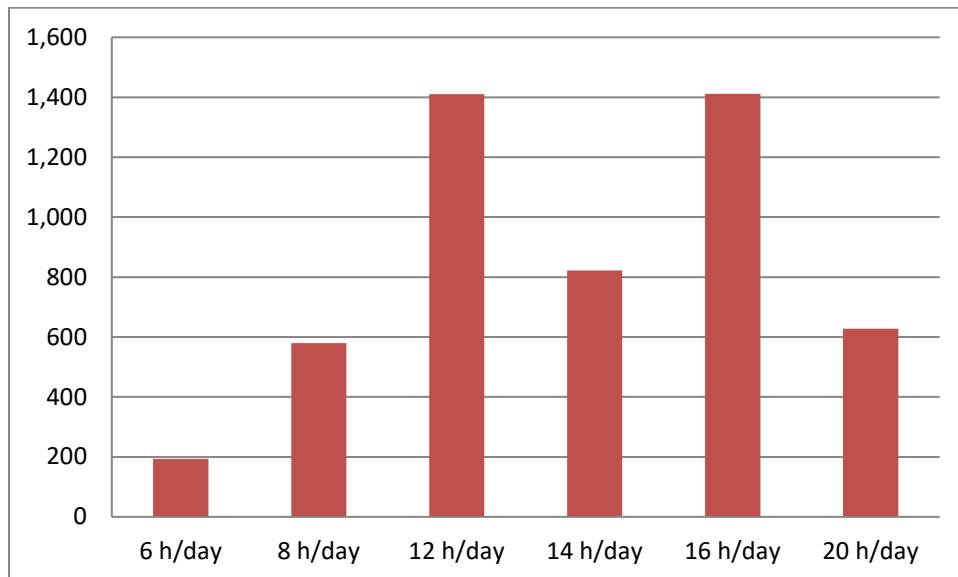
**Q5. How many hours per day do you use the heating system?**



Graph No. 29 How many hours per day do you use the heating system (working days)

In average the heating systems operate 13.5 hours a day in working days and during the heating season.

**Q5a: How many hours per day do you use the heating system (weekend)?**



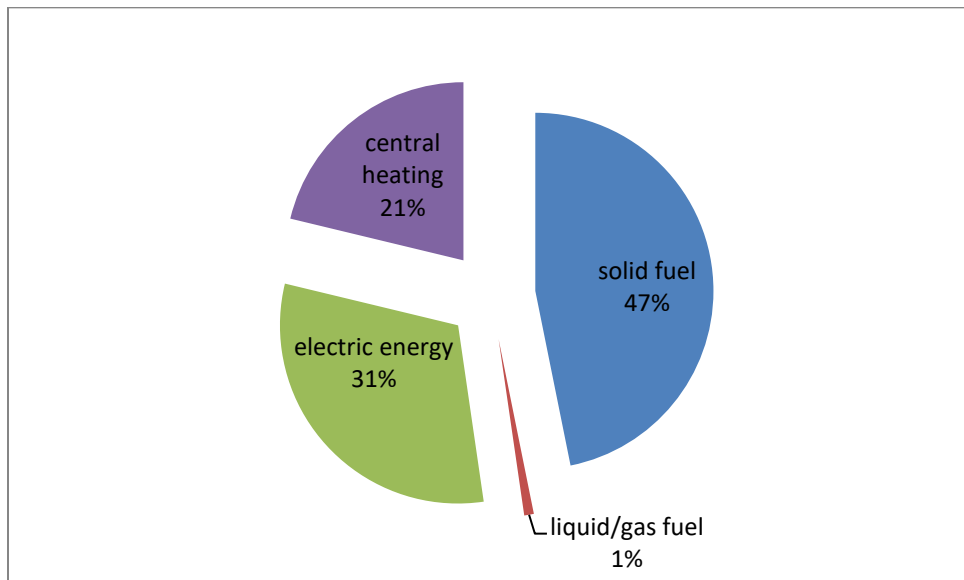
Graph No. 30 How many hours per day do you use the heating system (weekends)

During weekends and holidays, the heating systems in average work for 13.75 hours.

Hence, we can conclude that the **heating time of the buildings is the same time as the one provided by the central heating systems**. Quite surprising is the answer that the number of hours in which the buildings are heated on working days and on weekends is almost the same.

### 3.4. ENERGY FOR HEATING

#### Q1: What is the PRIMARY fuel you use for heating?



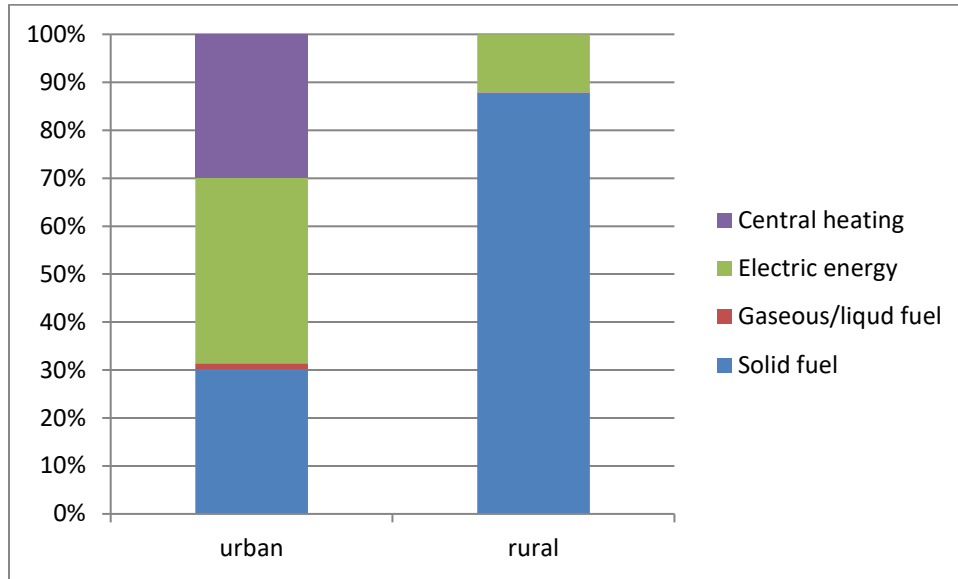
Graph No. 31 What is the PRIMARY fuel you use for heating?

If we analyze the answers of the households concerning what is the primary fuel they use for heating, and we group the answers according to the main types of fuel we can see that:

- 21% of the households are connected to one of the central heating or water distribution systems available in Skopje. We should have in mind that these systems are available only in some of the urban areas of the city (see the map below).
- 31% of the households use electricity for heating (regardless of the system they are using). Skopje and the municipalities in the Skopje Valley are completely covered by the electricity distribution grid, which currently satisfies the demand. Pollution caused by the use of electricity, as well as the GHG emissions are not caused on the site where the fuel is used, but on the site of transformation (electrical power plant) and they depend on the energy mix at the time of analysis. The systems using electricity generate small or no local pollution.
- **47% of the households use solid fuel in their own combustion system for household heating purposes** (one of the fuels offered in the questionnaire: firewood, coal, briquettes or other solid fuel).

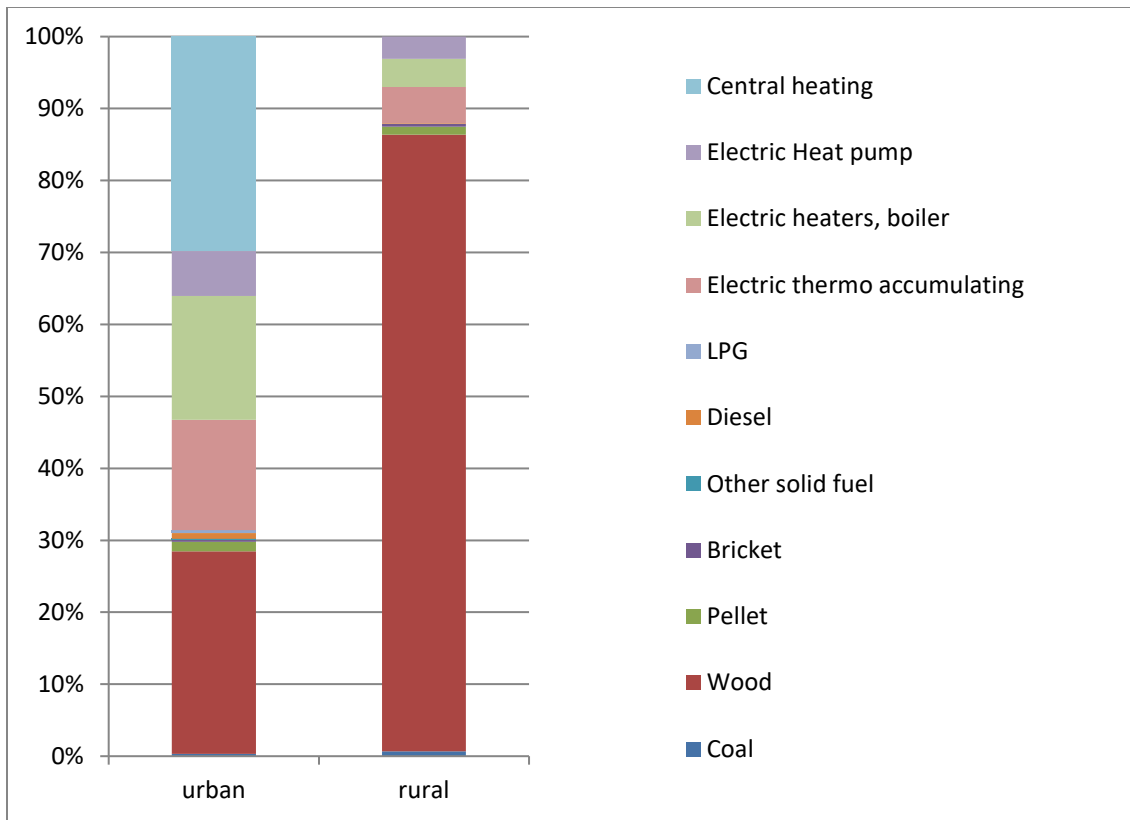
- 1% of the respondents use liquid or gaseous fuels available on the heating market.

If we analyze the energy source used for heating the buildings in urban or in rural part of the city, we can see that there is a significant difference in the choice of the energy source (see Graph 32).



Graph No. 32 Cross-section analysis: What is the primary fuel they use for heating depending on the location?

Taking into consideration the fact that central heating systems are available only in urban parts of the valley, it is logical that there are no households in rural areas which use this system.



Graph No. 33 Intersection analysis: What is the primary fuel you use for heating the building (urban/rural)

The analysis of the connection between the households on central heating shows the following results: 29.8% of the respondents in the urban part of the city and 0% of those in rural areas are connected to the central heating system.

These systems use natural gas as a primary fuel (although there are options for other replacement fuels as well). Partially energy is obtained by energy transformation in heating power plants, and partially by cogeneration thus obtaining electricity and heat. This manner of generating heat in the central heating systems in Skopje, although their main energy source is fossil fuel (natural gas) generates very low emissions of solid particles in the ambient air.

For comparison, in the most recent statistical overview on consumption of energy sources in households in 2014, prepared by the State Statistical Office of the Republic of Macedonia in December 2015 <sup>7</sup>, there are some data on the presence of certain heating systems in the households in the Skopje Region, the quantity of different fuels spent as well as the quantity of various types of energy spent. These data are presented in Table 3.1. These data show that most households in Skopje Region use electricity (38.1%) and firewood combustion systems (32.32%), then central heating system (28.79%), while the rest of the heating systems are present in very low percentage.

**Table 31. Number of households and type of heating practice in the households in Skopje Region in 2014.**

Type of heating practice	Number of households	Share of households %
Central heating system	46.590	28,79
Electricity	61.662	38,10
Firewood	52.312	32,32
Briquettes, pellets	860	0,53
Wood and agricultural waste	-	
Coal	149	0,09
Light heating oil	15	0,01
Liquified Petroleum Gas	253	0,16
Natural gas	-	-
<b>Total</b>	<b>161.841</b>	-

This research done in 2014 shows that firewood is very much present as a heat source. This is confirmed with the number of heating devices in the households in the Skopje Region, since the number of furnaces using solid and liquid fuels is 64,373, or about 40% of the households in the Skopje Region have a furnace on solid or liquid fuel. According to these statistics low number of households use fuel oil (15 households in the whole region). Because of this data and because the statistical database of the State Statistical Office is made by surveying 0.45% of the households, we have reservations concerning the accuracy of the data, although there are some correlations between the two surveys. Such is for example the increase in the number of households using solid fuel and reduction of those which use the central heating system or electricity.

At this moment the total heat demand for all households connected to the central heating system is about 500 MW. Without additional extension of the network, only by connecting all households for which the system is available, the demand will increase to 600 MW, and the existing heating capacities may satisfy this demand. In such a scenario, it is expected the

<sup>7</sup> Use of energy sources in the households in 2014 - State Statistics Office, 2015

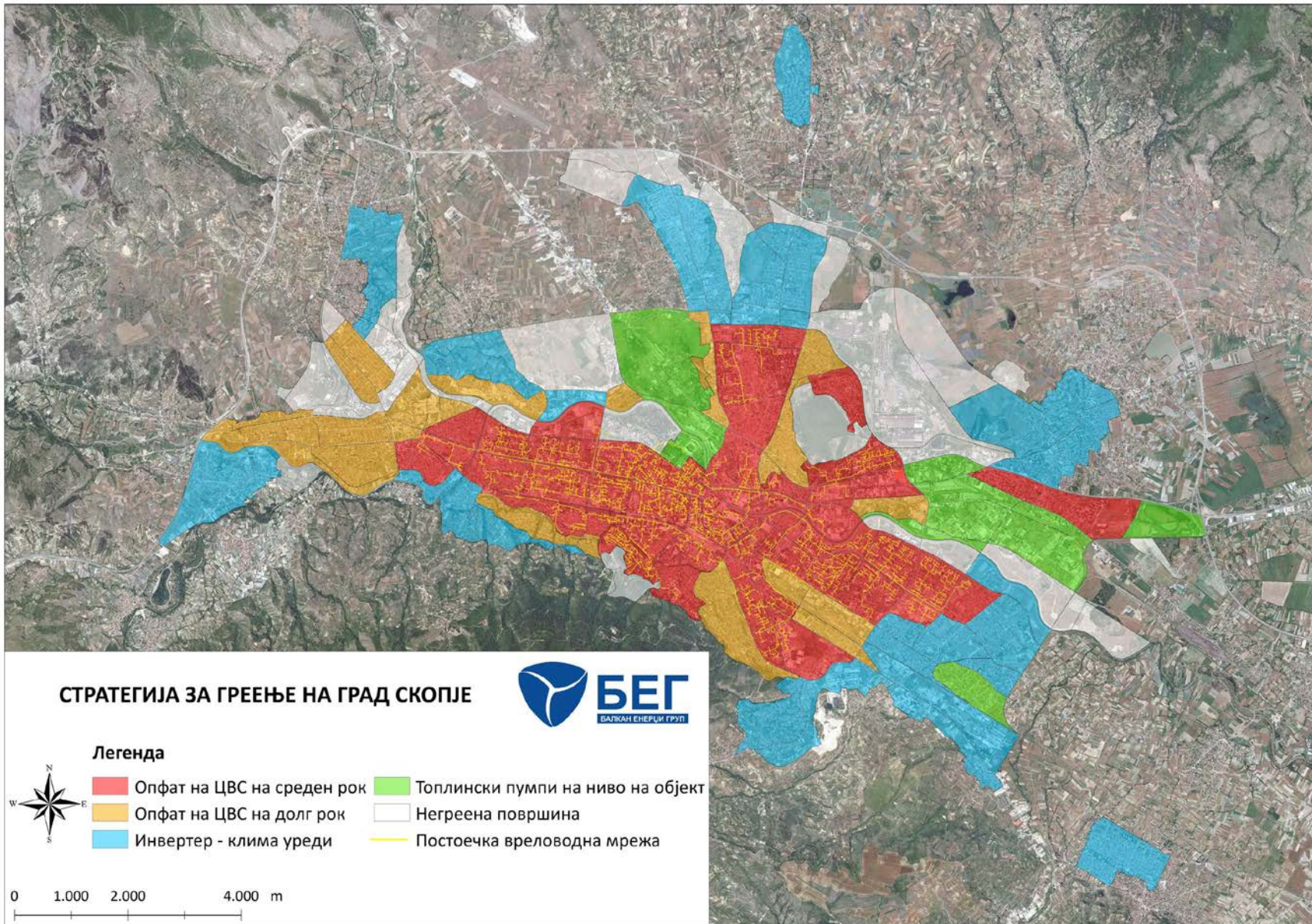
heating cost to be reduced for 10%. The assessment of the distribution companies is that only by connecting the customers who have disconnected themselves from the network, and which already have complete infrastructure, the number of apartments connected to central heating will grow for additional 15,000 units.

In their development plans, the heating systems operators plan for extension of the network until 2020 and until a capacity of 1000 MW is reached. This also plans for connecting all interested entities in urban settlements having more than 25,000 inhabitants per km<sup>2</sup>. The existing production capacities can satisfy this demand, and it is expected this to reduce the price of heating for 25%.<sup>8</sup> The figure bellow presents the development strategy of the biggest central heating operator in Skopje.

---

<sup>8</sup> STUDY ON DEFINING THE TECHNOLOGICALLY AND ECONOMICALLY OPTIMAL AND ENVIRONMENTALLY SUSTAINABLE SYSTEM FOR HEATING AND INTRODUCING CENTRALIZED SANITARY HOT WATER SUPPLY IN SKOPJE, Developed by the Faculty of Mechanical Engineering and MACEF D. Tashevski, R. Filkoski, I. Shesho, D.Dimitrovski, S.Armenski and others, Skopje, 2017





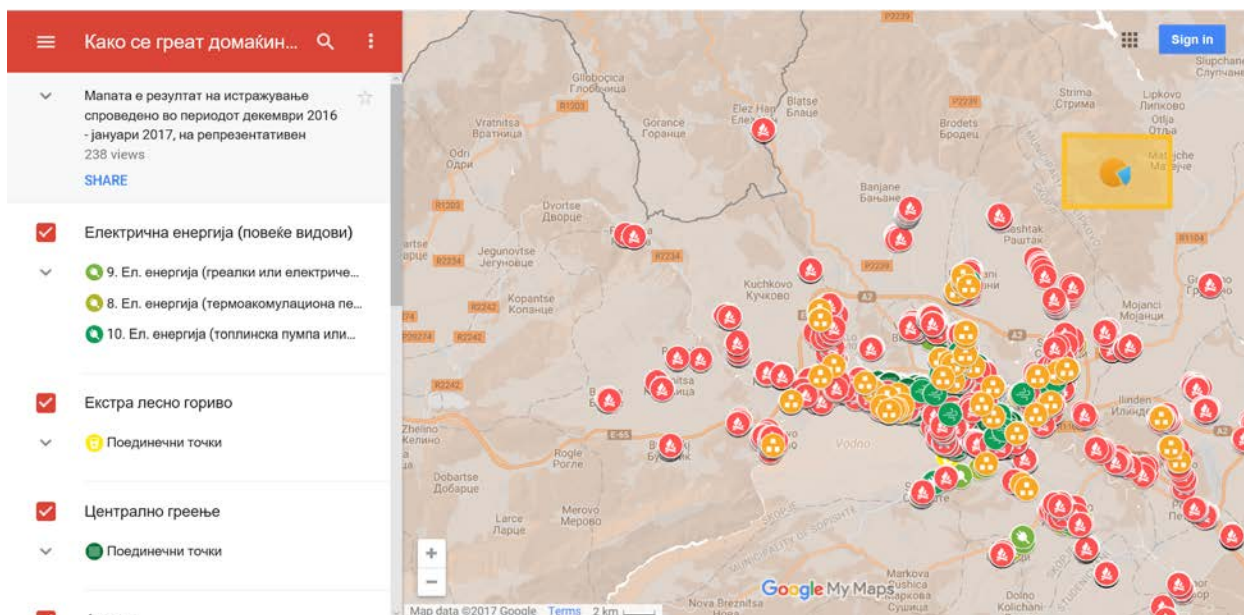
If we look at the results from the survey on households which use electricity for heating, we can determine the following:

- 6.2% of the households in urban areas and 3.1% in rural areas use electricity for powering a heat pump (including air conditioners) as a primary heating system. These systems usually have higher level of utilization of electricity when they transform it into heat. During the heating season, it is expected the transformation coefficient to be between 2 and 3.5 or 1kWh electricity from the system should be used to emit 2 to 3.5 kWh heat in the building.
- 17.2% in urban areas and 3.9% in rural areas use electricity for electric heaters and electric boilers in order to distribute heat in the building. These electricity systems transform electricity into heat with coefficient close to 1. It is necessary these systems to be used in the time when the user wants to heat the building (usually, during the day). This also means use of electricity from the system when it is most burdened and when the electricity is most expensive.
- 15.3% of the households in urban areas and 5.0% in rural areas use electricity for storage heaters. These systems have transformation capacity close to 1. The users mainly accumulate energy from the grid (charge the heaters) when electricity is cheap (during night) and use the heat during the day. This manner of using the surplus of electricity produced by the system in the late-night hours or early in the morning may be very beneficial for additional controlled balancing of the grid and for reducing peaks throughout the cold days. The use of such controlled regime systems, is expected partially to reduce the import of electricity.

Concerning the use of firewood as the main energy source for heating the buildings, **28.2% of the households in urban areas and 85.7% in rural areas use firewood.**

The geographic distribution of households which use various fuels and heating systems is presented on the following [link](#):





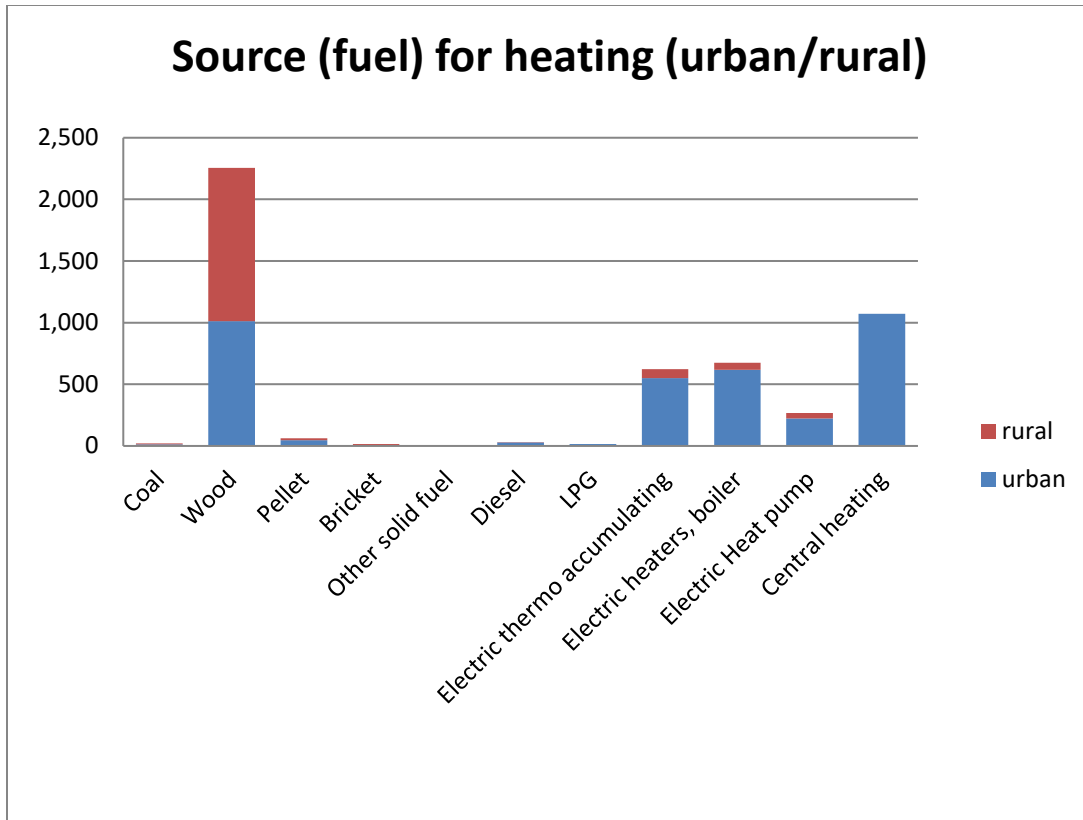
Very low number of households use other fuels:

Table 3.2 Fuels used on low quantities in the Skopje Valley

Energy source	Urban	Rural
Coal	0.3%	0.7%
Pellets	1.3%	1.1%
Briquettes	0.3%	0.4%
Other solid fuels	0.2%	0.0%
Heating oil	0.8%	0.1%
Propane Butane	0.4%	0.0%

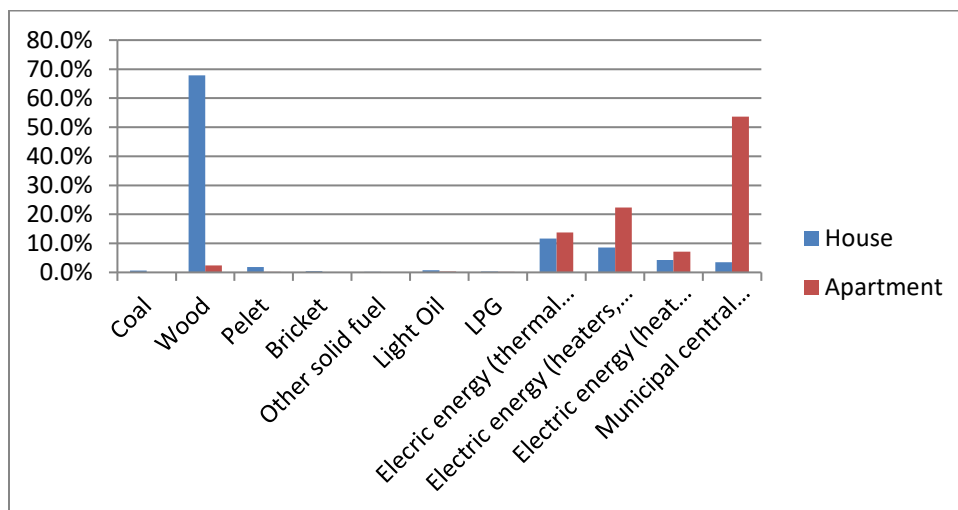
The results of the analysis on the use of heating systems in urban and rural areas, point to two main conclusions:

- In rural areas, firewood is dominantly used for heating and more than 85% of the households use it. The others mainly use electricity for storage heaters, regular heaters and electric boilers and in smaller percentage for thermal pumps.
- In urban areas 38.7% of the households use electricity (more or less efficient, depending on the system); 29.8% are connected to the central heating system; 28.2% use firewood and small part use other fuels.



Graph No. 34 What is the primary fuel you use for heating depending on the location?

In continuation we present the interrelatedness between the type of fuel used for heating of households in individual or collective housing (Graph 35).



Graph No. 35 What kind of fuel is used if the dwelling is a house or an apartment?

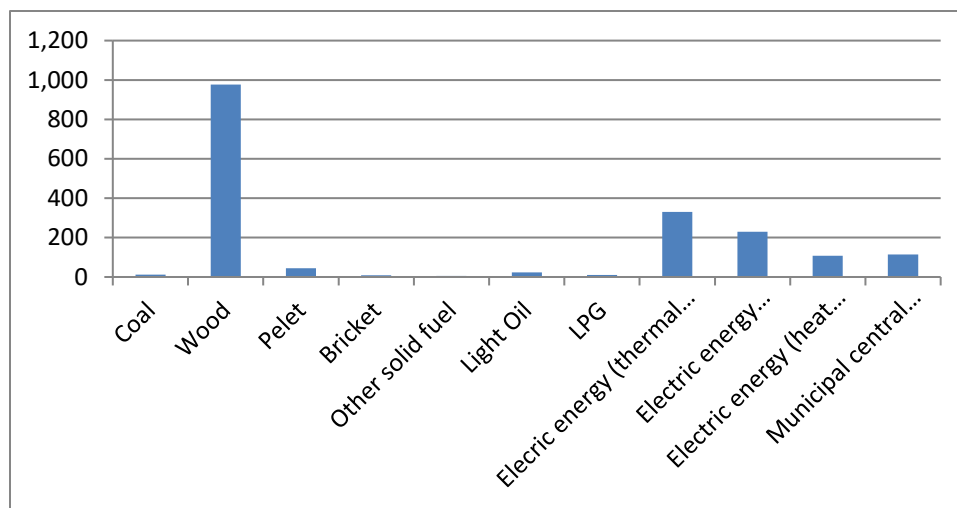
The households living in **collective housing buildings** have the following types of heating:

- 53.7% of the households are connected to central district heating;
- 22.3% use electricity for electric boilers or heaters;
- 13.7% use electricity for storage heaters;
- 7.2% use electricity for heat pumps and air conditioners;
- 2.4% use firewood and
- 0.7% use pellets, liquid or gaseous fuels.

The households living in **individual buildings – houses**:

- 67.9% use firewood;
- 11.6% use electricity for electric boilers or heaters;
- 8.5% use electricity for storage heaters;
- 4.3% use electricity for heat pumps;
- 3.5% are connected to central district heating;
- 1.8% use pellets and
- 2.4% are households which use coal or briquettes, propane-butane, extra light heating fuel or other solid fuel.

The heating practices of households living in individual houses in urban areas were also analyzed, and the results are presented in Graph 36:



Graph No. 36 Cross-section: (only urban)/ (only houses) what do you use for heating?

If we review households living in individual buildings in urban areas, we can see that lower percentage use firewood compared to households in rural areas. However, **almost 50% of the population in urban part of the valley which live in individual houses use firewood systems.**

According to the geographical distribution, the houses in the urban settlements on the periphery of the city, in higher percentage use firewood compared to the houses in urban areas concentrated in the central core of the city.

Typical representatives of these groups are: urban settlement (for e.g. the settlement Radishani where electricity is dominantly used for heating individual houses), figure 3.1.

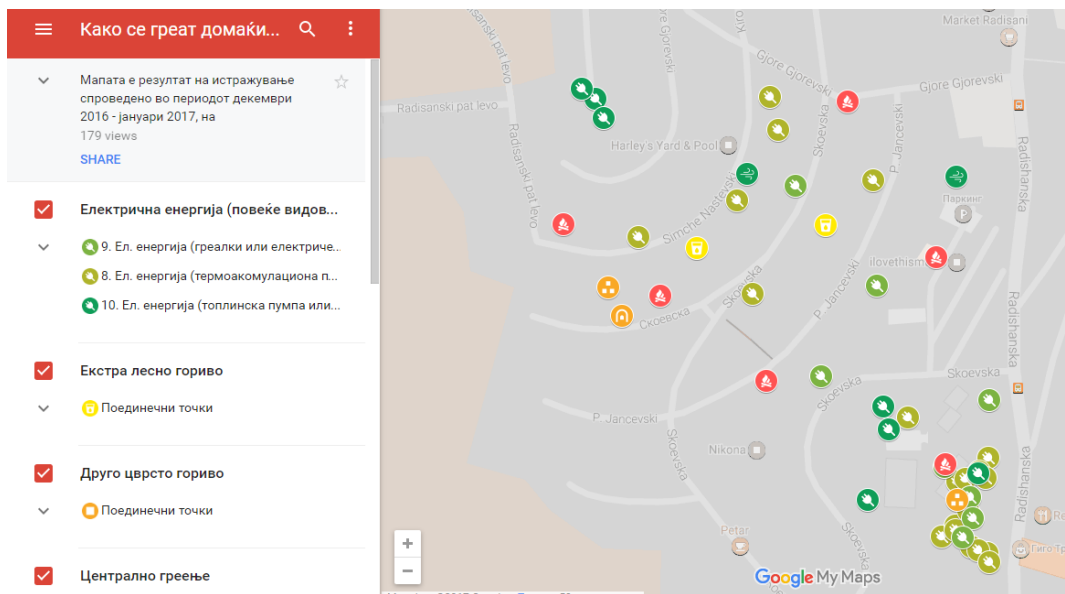


Figure 3.1

Typical settlement with individual houses, for e.g. Vizbegovo, close to the urban core of Skopje with dominant firewood heating, figure 3.2.

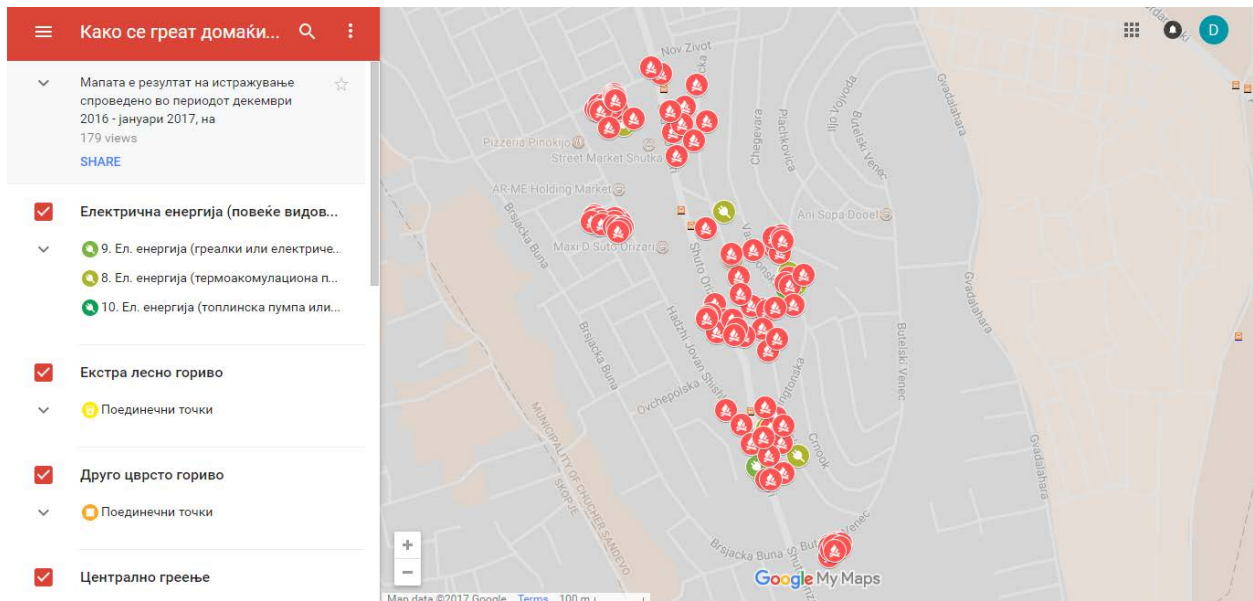


Figure 3.2

Settlement of individual and small collective residential buildings, dominantly heated by central heating (for e.g. the settlement Zhelezara), figure 3.3.

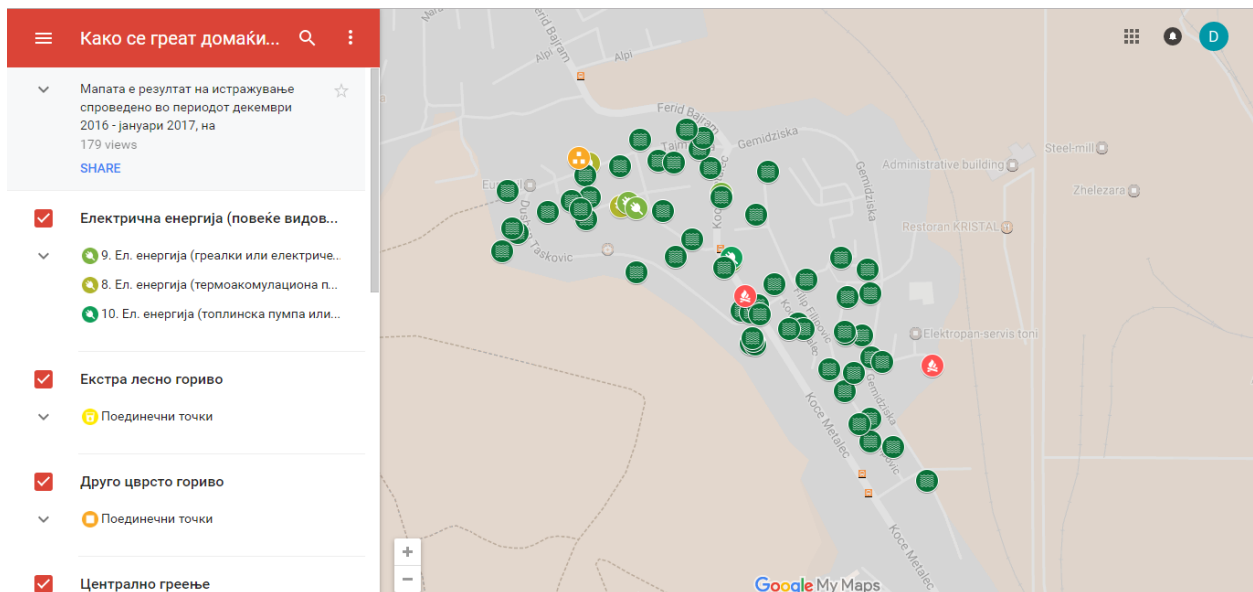


Figure 3.3

Completely urban settlement with individual buildings in the core of the city, dominantly heated with firewood (for e.g. settlement of 11 Oktomvri, Kisela Voda), figure 3.4.

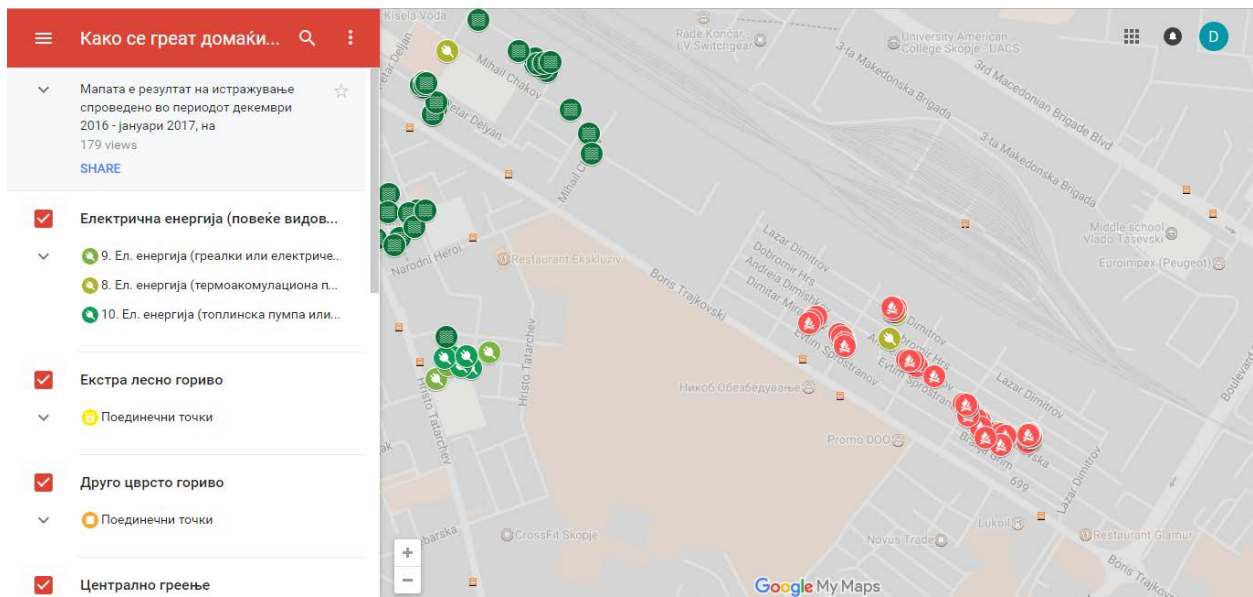


Figure 3.4

Mixed urban settlement with large collective residential buildings and family houses, dominantly heated by central heating and electricity (for e.g. settlement of Bunjakovec - Debar Maalo, Centar), figure 3.5.

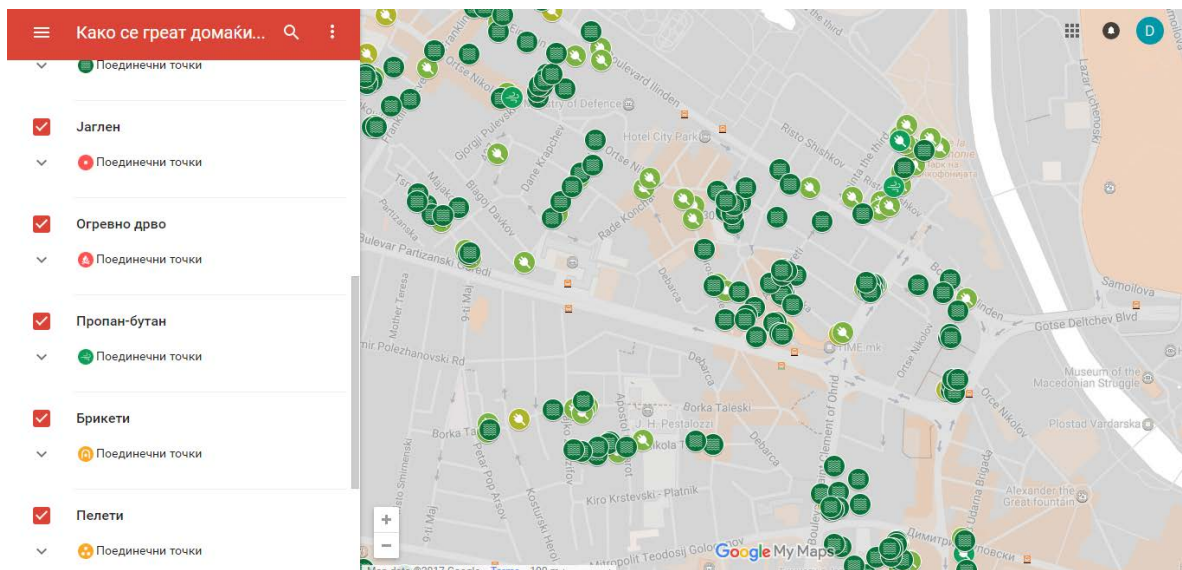
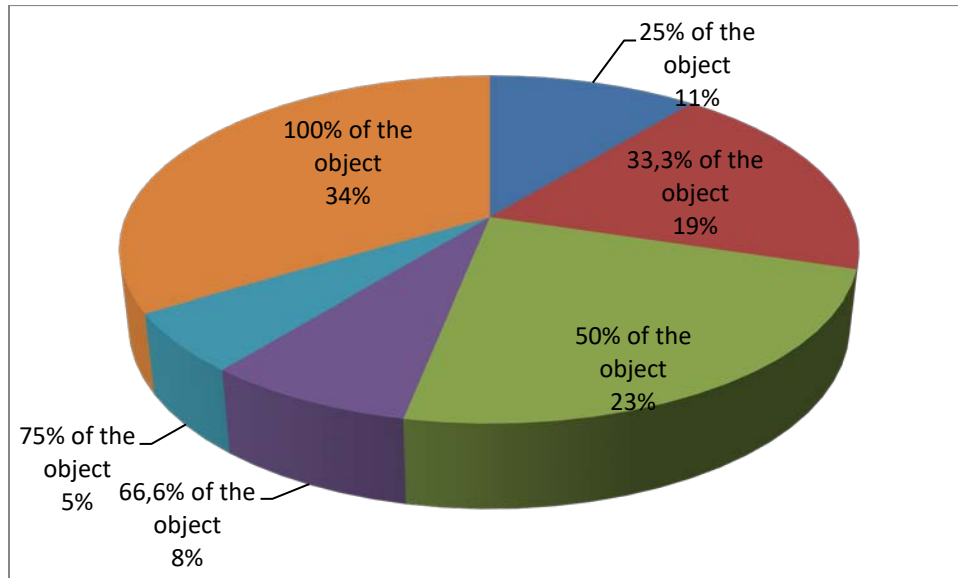


Figure 3.5



These categories of cases show in which places and settlements we need to focus additional attention when developing measures aimed at reducing firewood induced pollution.

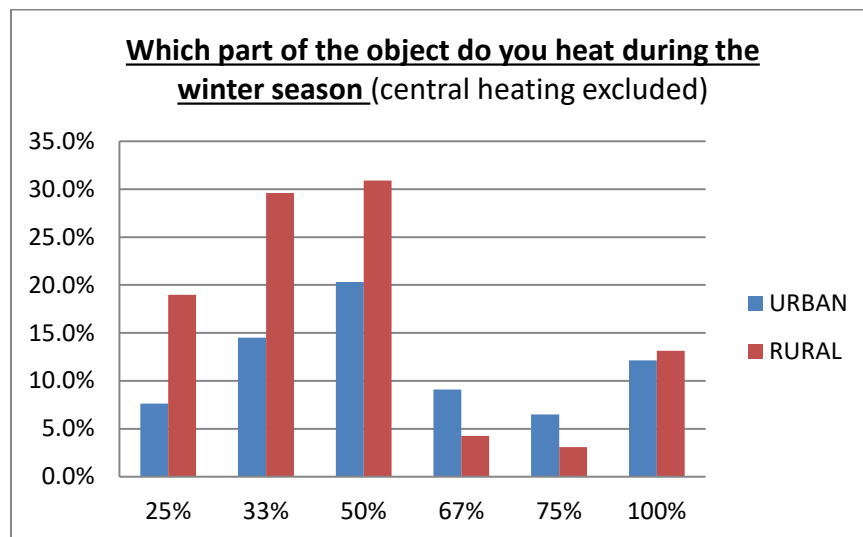
**Q2d. What area of the building is heated?**



Graph No. 37 What part of the building is heated in the heating season

In average households heat 63.5% of the building surface, which means that more than 1/3 of the buildings is heated during winter.

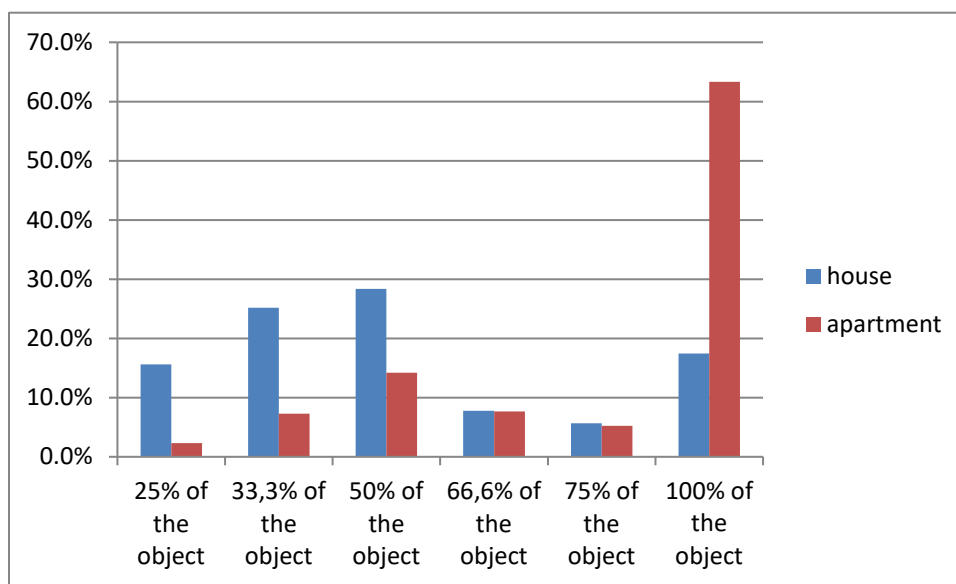
If from this picture we take out the households using central heating, then dominant are the households which heat up to 50% of their area during the heating season.



Graph No. 38 What area of the building is heated in the heating season (without the households using central district heating)

If we exclude the households connected to the central heating system, we have trackability of data concerning what is the area heated in winter. In rural parts of the city, the households heat lesser areas from the buildings, compared to buildings in the urban part of the Skopje Valley.

Specifically, the households using firewood, heat in average 49.2% of the facility during the heating season.



Graph No. 39 What area in the house is heated depending on whether it is a house or an apartment

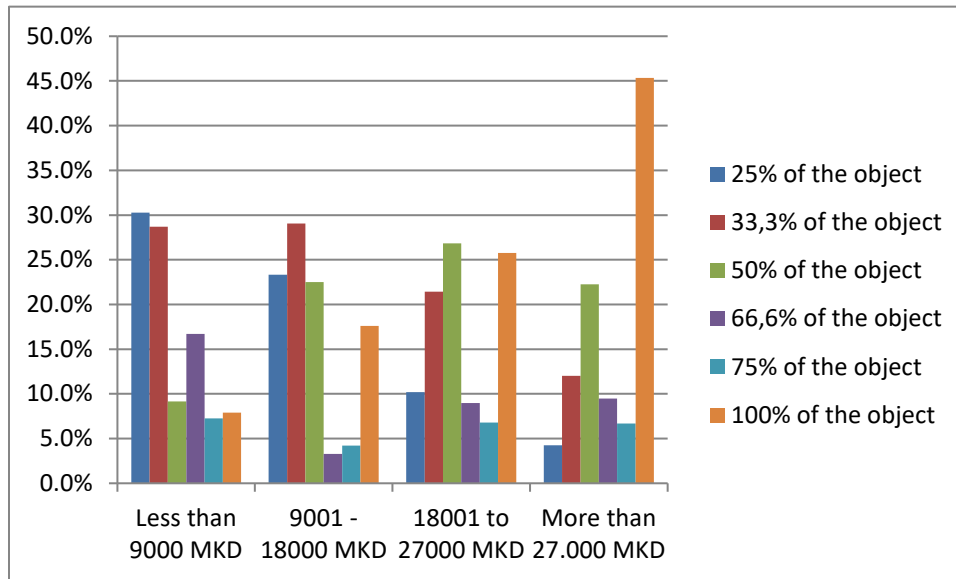
The graph bellow shows data on the size of the heated part of the building depending whether it is a house or an apartment.

If we analyze the heated area of the building depending on the fuel/the system they use for heating, we can see the following results:

- More than 76% of the households using firewood heat half or less of the building during the heating season.
- More than 73% of the households using coal heat half or less of the building in which they live during the heating season.
- 67% of the households using storage heaters heat less than half of the area (25 – 50%) in the building during the heating season.
- 67% of the households using electric boilers or electric heaters heat from 33 to 66% of the building.

- More than 50% of the families using pellets during the heating season heat the whole building.
- 86% of the households using heat pumps heat half or more of the area of the building and 40% heat the whole building.
- Almost all households using central heating during winter heat the whole building.

The relation between this answer and the level of income is presented in Graph 40:



Graph No. 40 Heated area cross-referenced to income

From here we can clearly see that **families having income up to 9,000 MKD in most cases heat 25 to 33% of the building in which they live.**

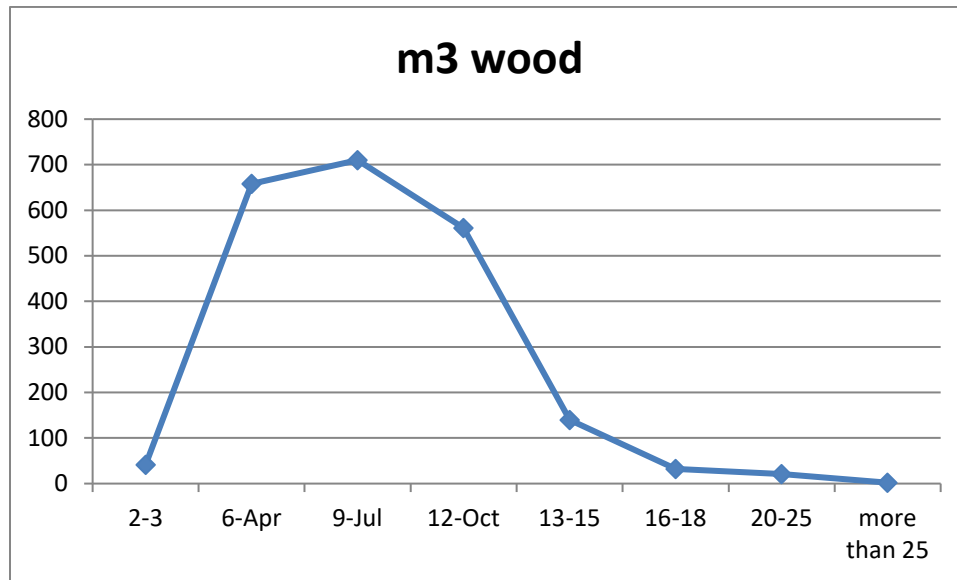
The families having income from 9000 to 18000 MKD heat 25 to 50% of the building in which they live.

More than 45% of the families having income higher than 27,000 MKD, heat the whole building.

### 3.5. COST OF HEATING

#### Q6.1 How much wood do you use for heating for one season (2015/16)?

Families using primarily firewood for heating reported to have used in average 8.38 cubic meters of wood per season.



Graph No. 41 Division of households according to their consumption of firewood

The average coal consumption per season is 3.34 t. The average consumption of pellets per household in one season is: 3.56 t. The average consumption of extra light heating oil per household in one season is: 1,299 l. In average, families using central district heating, annually pay 31,321 MKD. households using electricity, in average pay 24,876 MKD per season.

*\*These data are not comparable because the calculations have not taken into consideration the size of the building, the area heated, the hours of heating and the system used, the number of members per household, the building envelope, the system efficiency, the temperature of the heated air in the building and other elements.*

### 3.6. HEATING SYSTEMS

**Q8: What kind of heating device (firewood device) do you use?**

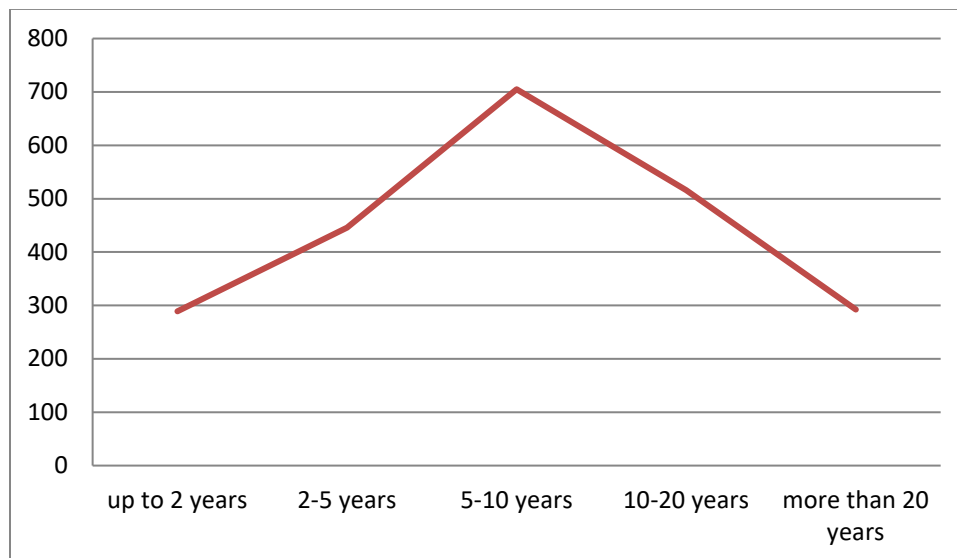


Graph No. 42 What kind of firewood device do you use

The analysis of answers shows that dominantly there are two systems used:

- 70% use firewood furnaces
- 15% closed fireplace

**Q9: How old is the heating device?**



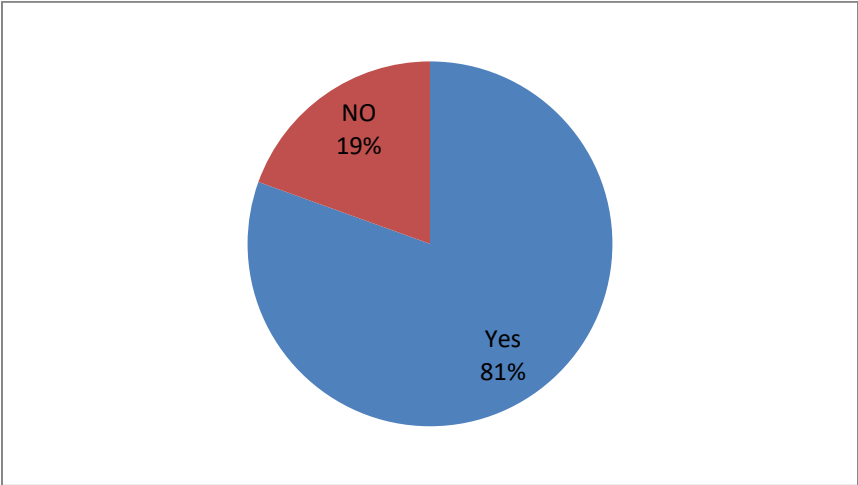
Graph No. 43 Heating device age

The previous two graphs (42 and 43) show that **most households using firewood use simple firewood heating systems**. Considering the types of the systems, it can be concluded that most of them are not sufficiently efficient. Change of fuel (lighter fuel, gaseous fuel of central heating) will mean higher efficiency of the device, which means less fuel will be needed for the same heating comfort. Even the change to another solid fuel with the application of more modern combustion devices with higher efficiency, may significantly reduce the energy consumption.

This situation with the firewood combustion systems used points to several potential improvement measures. Because of the inefficient heating devices, additional quantity of firewood is used. **If the device is changed, the fuel savings could be up to 30%**. If we also replace the fuel with a higher quality one (and use a fuel that emits less emissions), it would also reduce the quantity of the energy needed because of the more efficient boilers.

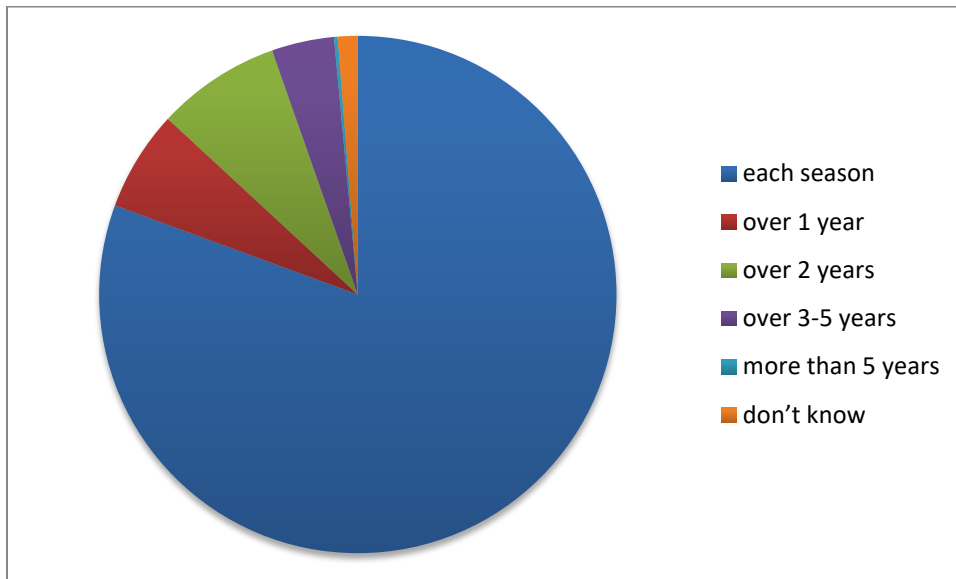
By designing measures for replacing firewood and inefficient systems with cleaner energy sources, in combination with a more efficient conversion system and additional building insulation measures, we could significantly reduce the harmful gasses emissions and have a lower monthly bill than the current one.

**Q10. Although it is not a legal obligation, do you perform maintenance (cleaning the firebox) of the fireplace, the furnace/boiler?**



Graph No. 44 Do you maintain your boiler

**Q10a. How frequently do you do that?**

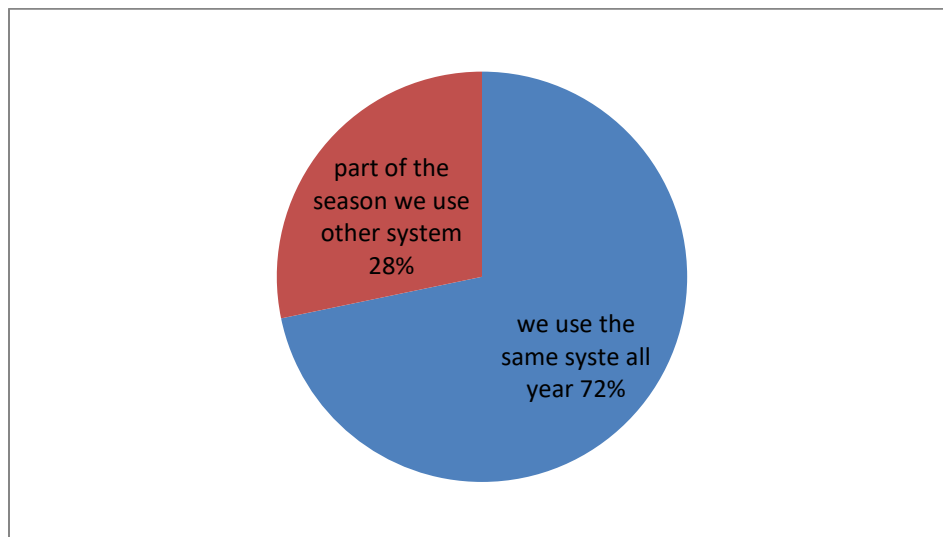


Graph No. 45 How often you clean the firebox

Most of the households have reported that regularly and every year they clean the firebox, which leads to better combustion.

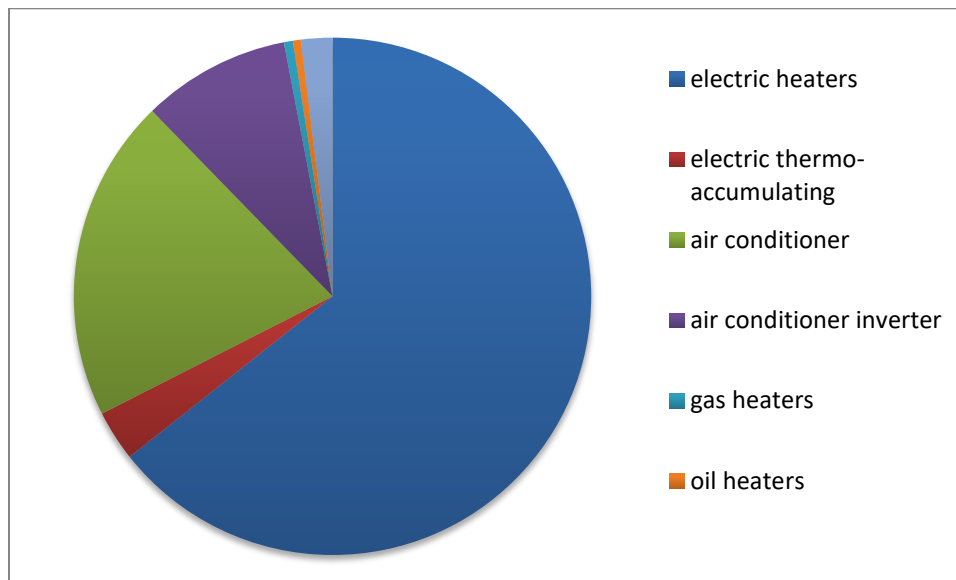
**3.7. SECONDARY (AUXILIARY) HEATING SYSTEM**

**Q11. Do you use the same system throughout the heating season, or you have another system as well?**



Graph No. 46 Do you use the same system throughout the heating season, or you have another system as well

**Q11a. What other system do you use?**



Graph No. 47 What other system do you use

Even 28% of the households at the beginning and the end of the heating season, when the temperatures are not too low, use a different heating system.

This is:

- 64.4% of them use electric heaters,
- 29.5% air conditioners
- 3.2% storage heaters and
- 3.1% other systems.

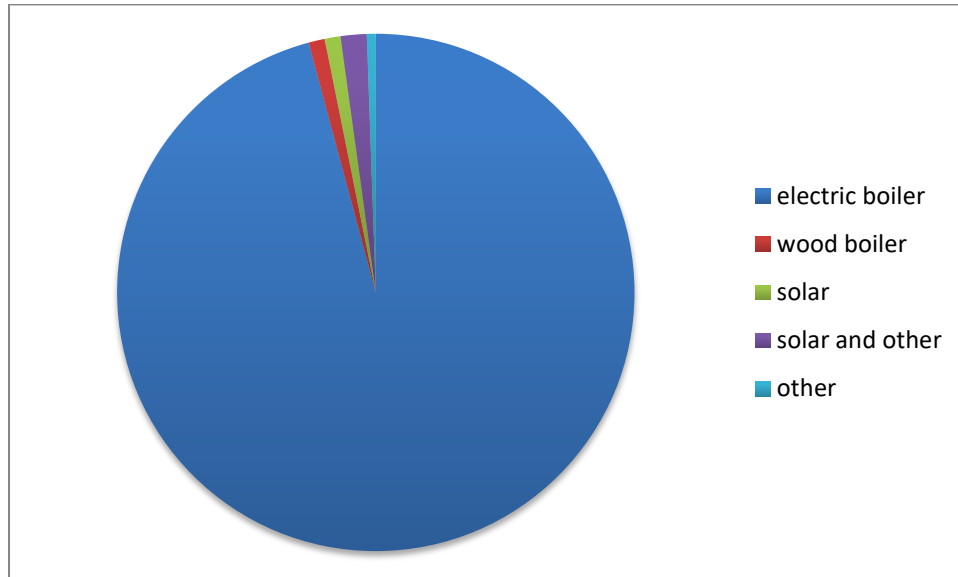
It is interesting that, although part of the households heat their buildings also in the transitional period and for this they use electricity, in the intensive heating season they use the main fuel (mostly firewood).

When developing pollution awareness raising measures, special attention may be given to those households which already have electricity systems installed (especially heat pumps) and how they can use them throughout the heating season.



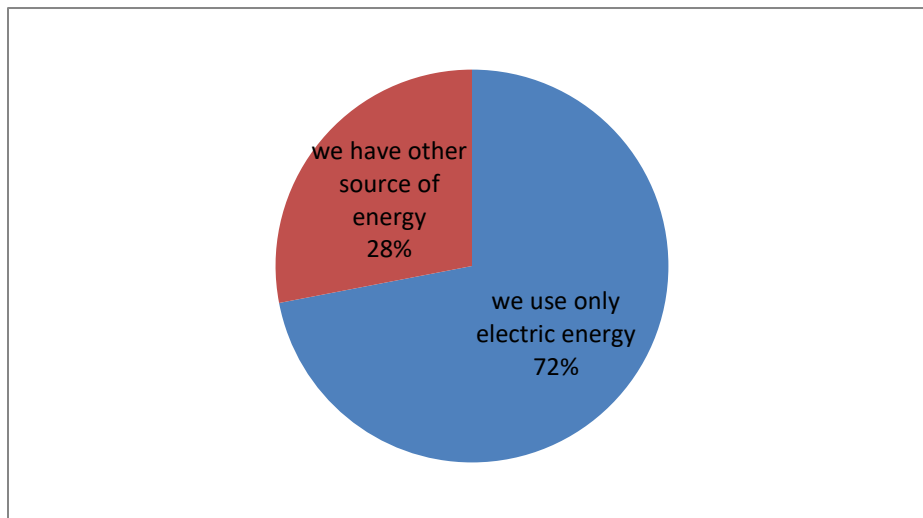
### 3.8. ADDITIONAL ENERGY

**Q12. How do you obtain sanitary hot water?**



Graph No. 48 How do you obtain sanitary heat water

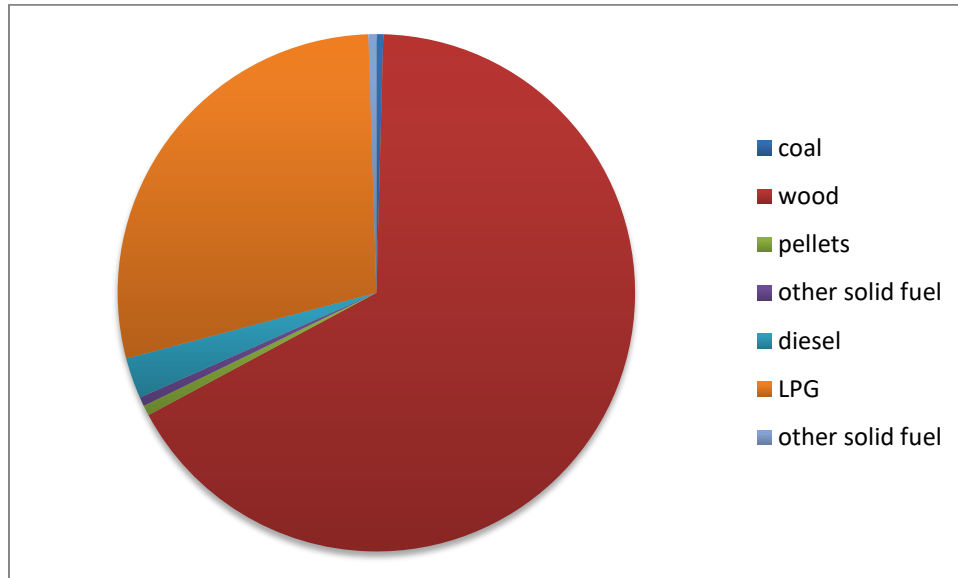
**Q13. Do you only use electricity for cooking or you have an additional source of energy?**



Graph No. 49 How do you obtain cooking energy

Even 72.2% of the households use exclusively electricity for cooking.

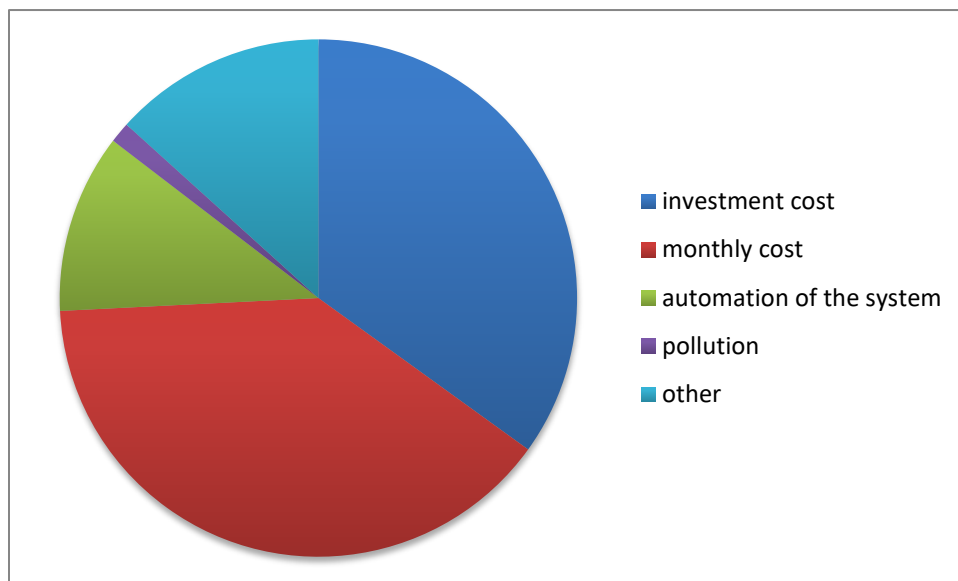
- 18.7% use firewood and
- 8% use propane-butane.



Graph No. 50 How do you obtain cooking energy (those who do not use only electricity)

### 3.9. SELECTION OF THE HEATING SYSTEM AND FUEL

**Q14. According to what criteria you choose the heating method?**



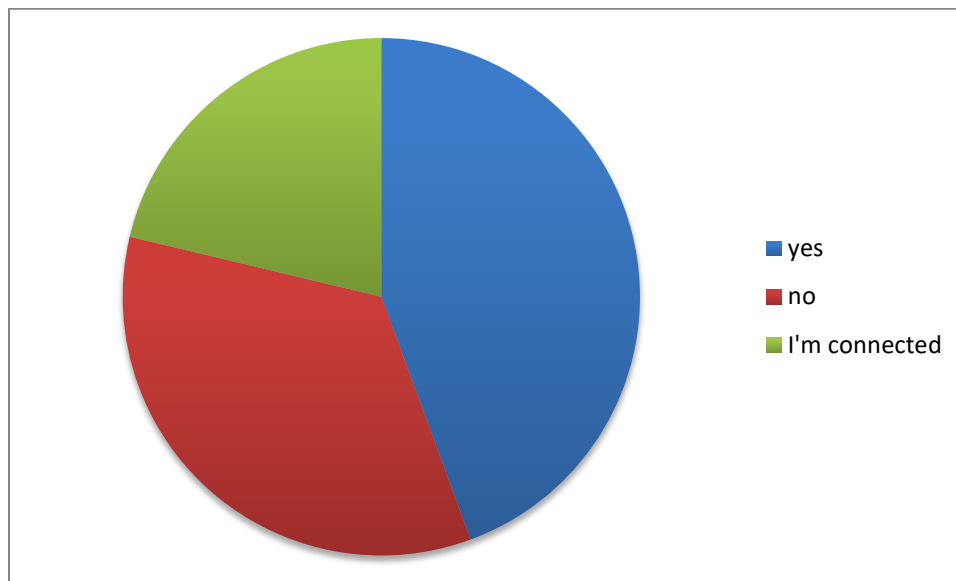
Graph No. 51 According to what criteria you choose the heating method

The following answers were given to this question:

- 35% decide according to the price of the initial investment for the system
- 39% decide according to the monthly heating bill,
- 11% decide according to the possibility to have automated operation of the system,
- **1% decide according to the environmental impact of the system and**
- 14% decide according to other criteria.

These percentages show that biggest part of the population, decides to use a system because of its cost, and lesser part because of the possibility to have greater comfort and automated operation, and very minor part decides in accordance with the pollution caused by the system. This shows that there is a very low public awareness and individual responsibility about air pollution and the impact that heating systems have on air quality.

**Q15. Would you connect your building to central heating, if it is available and if the amount of the annual cost is LITTLE higher than the current cost?**

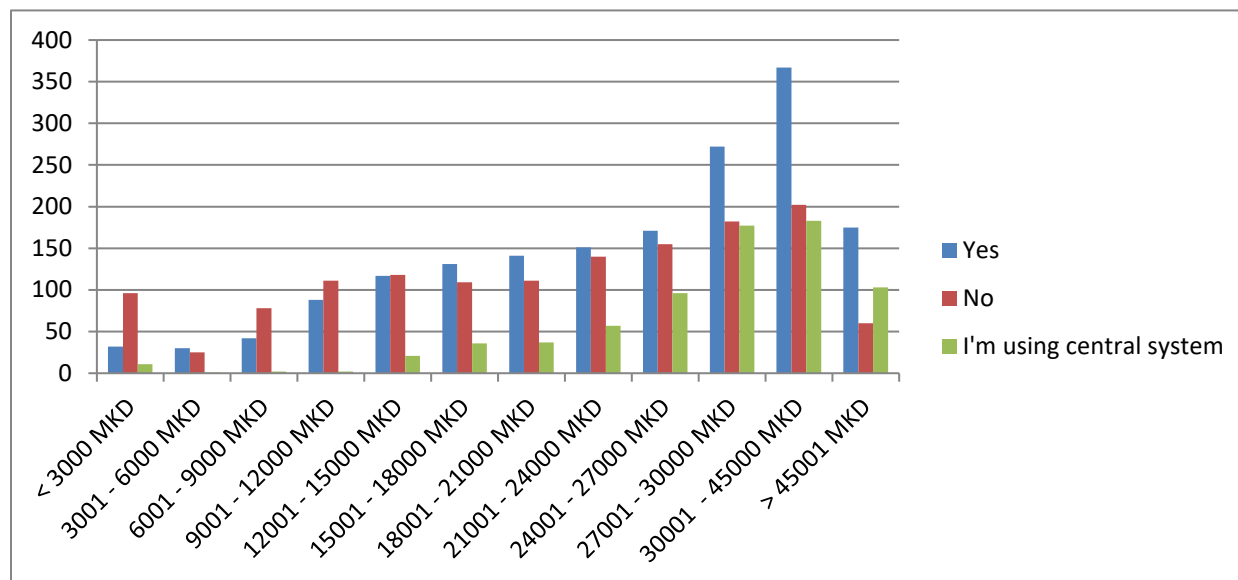


Graph No. 52 Would you connect your building to central heating, if it is available and if the cost is little higher than the current one?

More than half of those households which are not connected to the central district heating would connect to the system if the monthly cost is little higher compared to the current one.

The structure of the heating systems in those households which are willing to connect and those which would not connect is almost the same, and even the percentages (60% willing to connect and 40% against) is almost the same for all types of heating systems. Only the

households using heat pumps in higher percentage (60%) are not willing to connect to central heating, which is an expected response since the initial installation for this system is very high.

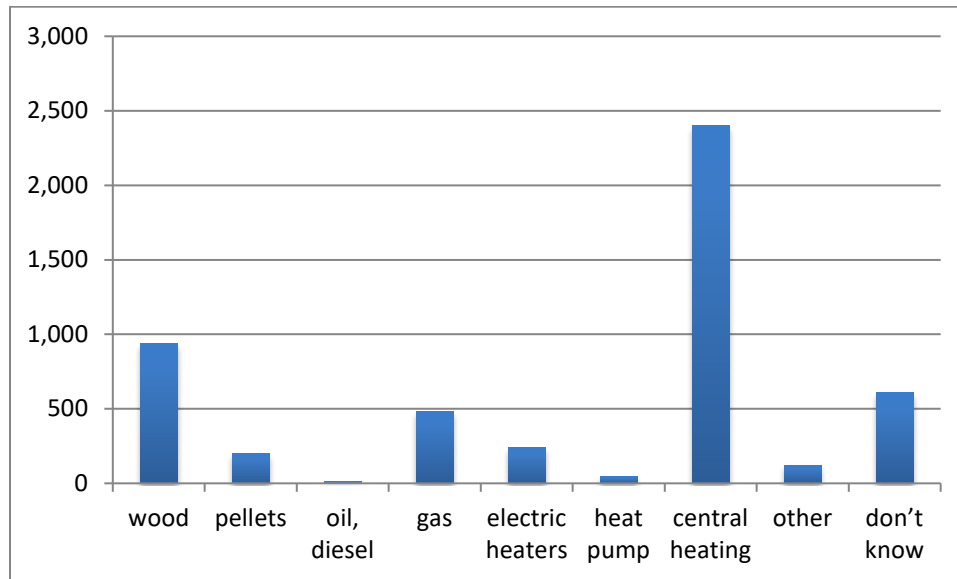


Graph No. 53 Cross-section: Would you connect your building to central heating, if it is available and if the cost is little higher than the current one/the amount of the monthly cost

Concerning the monthly income, and according to graph 53, visible is the trend that households with lower income are less willing to connect to the central heating system, while households with higher monthly income are more willing to connect to this system.

The distribution of households willing to connect to the central heating system in urban area is 1, 1:1 in relation to those who are not willing to connect. In rural areas much higher is the percentage of households which are willing to connect to the system and the ratio is 1,9:1.

**Q16. If you would choose regardless of the equipment installation cost and the monthly bill, which heating system would you choose for your apartment/house?**



Graph No. 54 Which system would you choose if it is free of charge

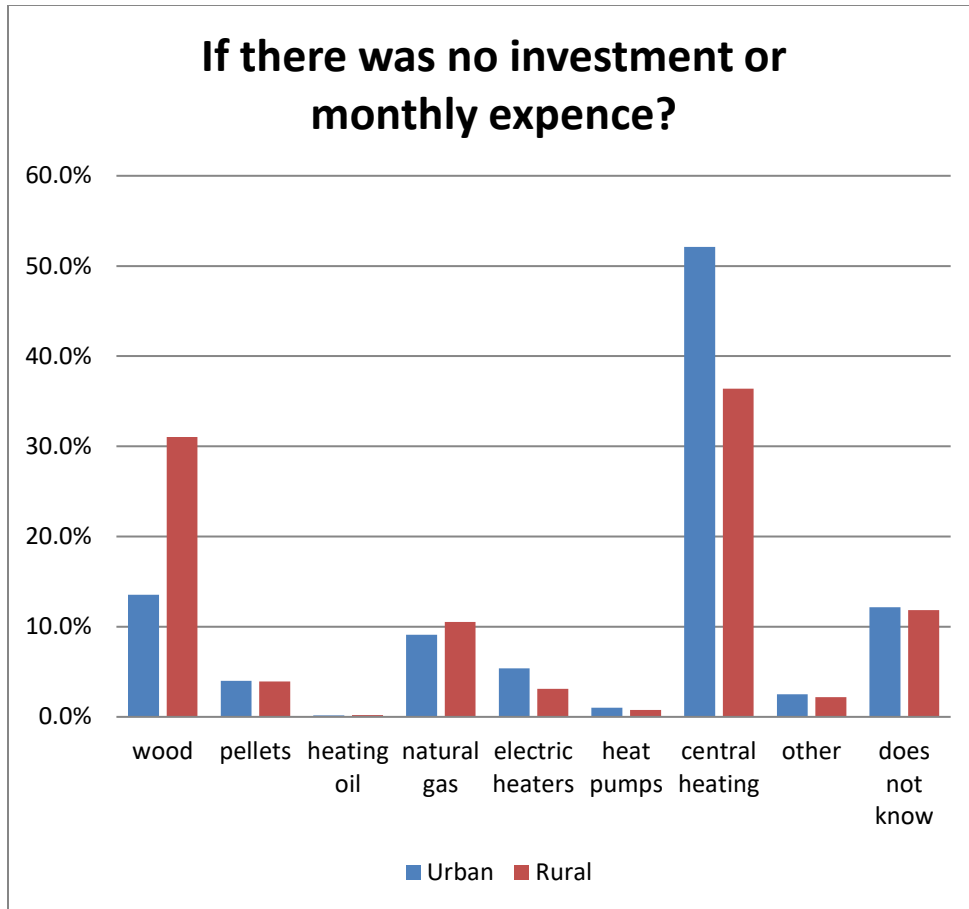
When analyzing the answers to the question, regardless of the equipment installation cost and the monthly bill, which heating system would you choose, visible are several trends:

High number of households or 47.6% of them would connect to the central system. 18.6% of all respondents, or 13.5% of the households in urban and 31% of the households in rural areas, regardless of the heating cost would like to use firewood for heating.

High number of households would like to use natural gas, almost 10%. 4.7% would like to use electrical heaters, 4% boiler with pellets and less than 1% would use heat pump.

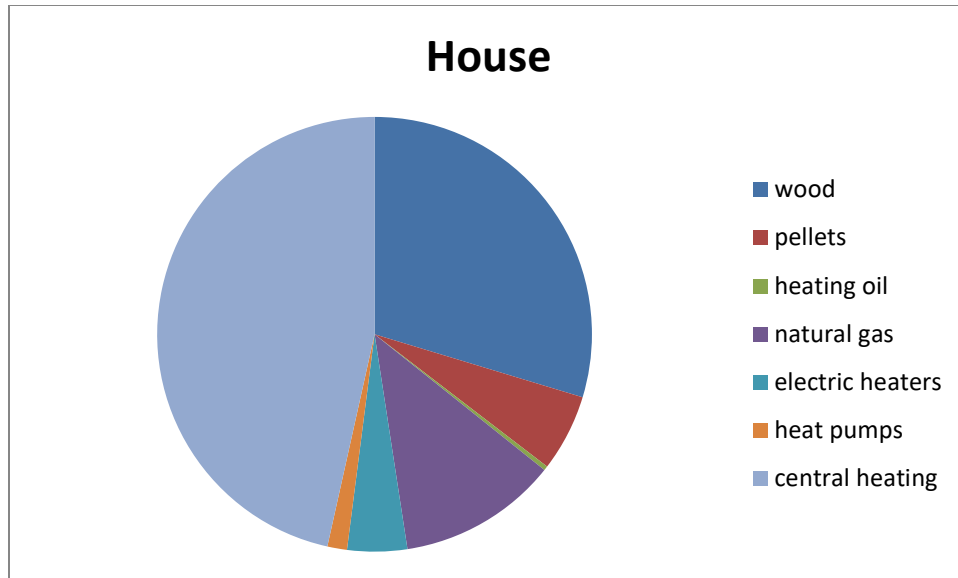
This shows that it is necessary to have strong awareness raising campaign for the citizens to improve the information they have about the possible heating systems, comparison of the monthly bill and to eliminate the myths about the domestic heating.

Especially small is the interest in heat pumps systems, which could reduce local pollution in the areas where central heating is not available.

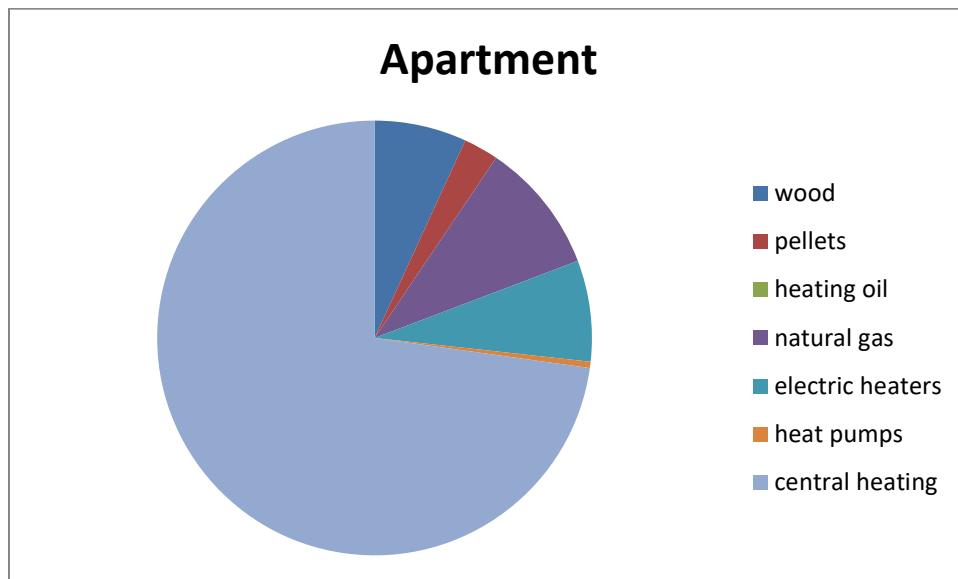


Graph No. 55 Cross-section: Which system would you choose if it is free of charge/urban or rural areas

These answers to the question what would the households use in an ideal situation depending on whether they live in a house or in an apartment, and the differences between these two situations are shown in graphs 56 and 57 below:



Graph No. 56 Cross-section: What heating system would be used by households living in houses

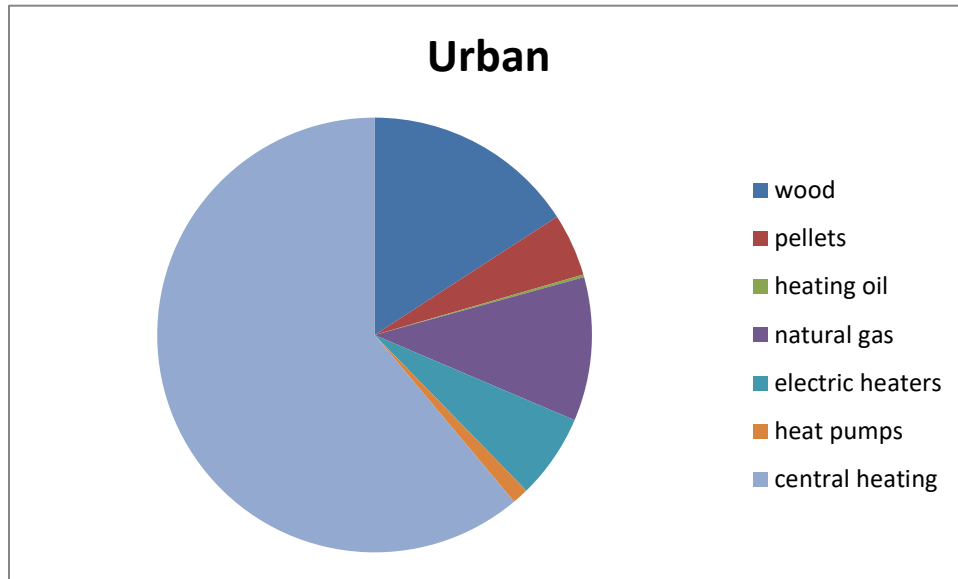


Graph No. 57 Cross-section: What heating system would be used by households living in apartments

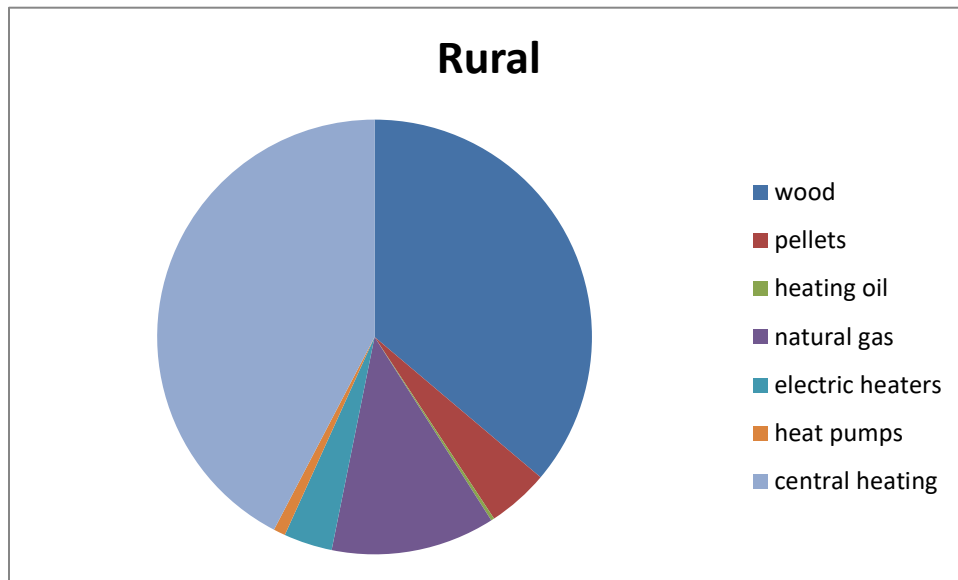
The difference between those who live in apartments or houses are visible for the households that would prefer to use firewood, and for the households that would connect to the central heating. Namely, the households living in apartments would dominantly connect to central heating, while lower number would like to use electric heaters, gas boilers and very low number would use firewood and pellets.

Contrary to this, most of the households living in houses would mostly use central heating and firewood, less would use gas boilers and very few would use electric heaters and pellets.

The answers by the households from urban and rural settlements are given in the comparative graphs 58 and 59 below:



Graph No. 58 Cross-section: What heating system would be used by households living in urban settlements

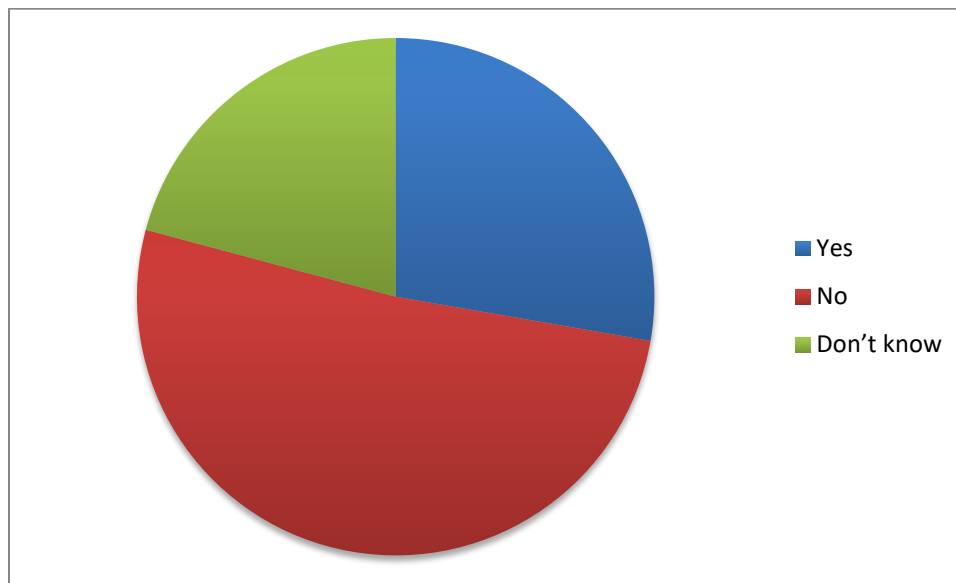


Graph No. 59 Cross-section: What heating system would be used by households living in rural settlements



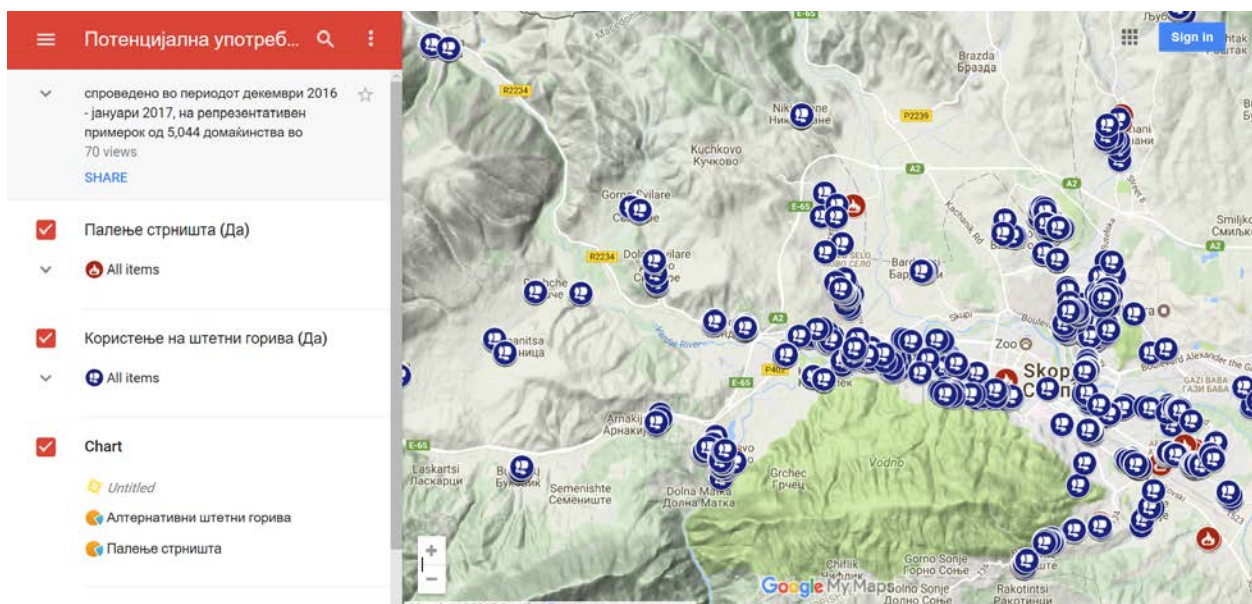
### 3.10 HARMFUL PHENOMENA

q17 Are in your vicinity households which use alternatively harmful fuels or use fuels additionally to firewood, such as: plastic boxes, straw, burned oil, lacquered or colored wood, wooden floors, windows etc.?



Graph No. 60 Is there somebody in your vicinity using harmful materials for heating

The geographic analysis of the answers to this question is presented on the following [link](#):



The graph shows some characteristic examples, mainly distributed in settlements.

For example, the rural or urban settlements in which all or more than 90% of the surveyed settlements confirmed that somebody in their vicinity is using harmful materials as an addition to firewood (figures 3.6 and 3.7).

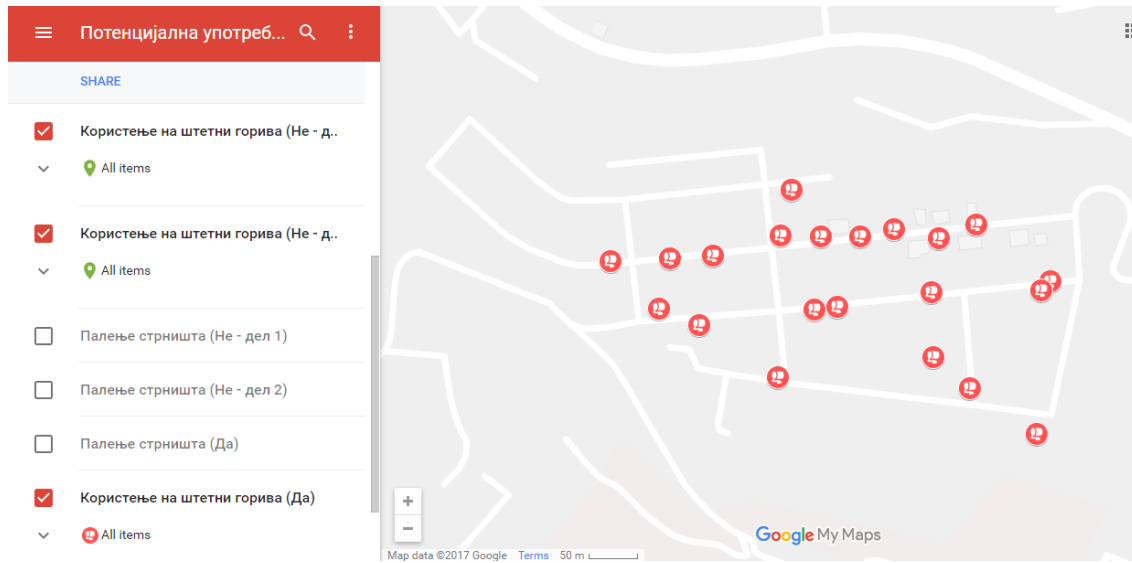


Figure 3.6 Zhdanec

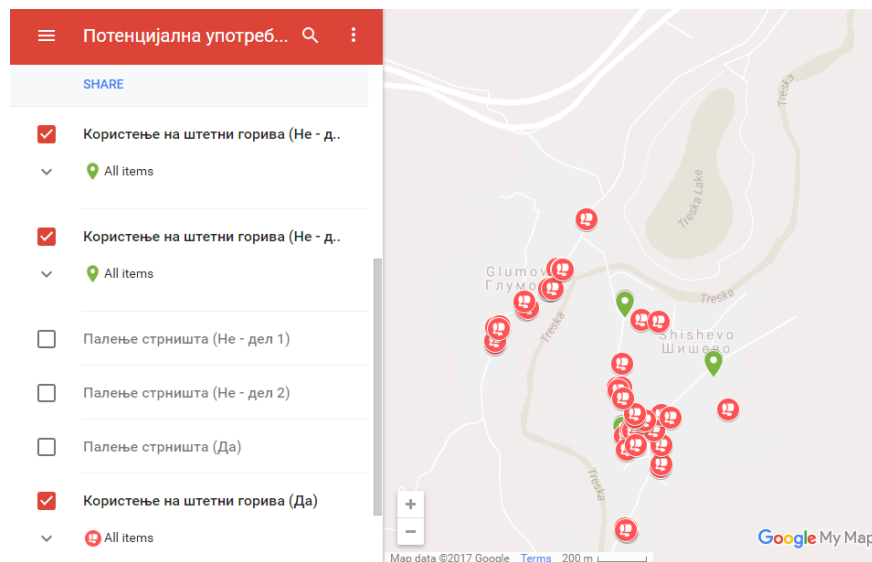


Figure 3.7 Shishevo

Settlements in which there is strict division of the households which believe that in their vicinity somebody burns harmful materials and those in which the respondents did not have that impression are presented in figures 3.8 and 3.9,

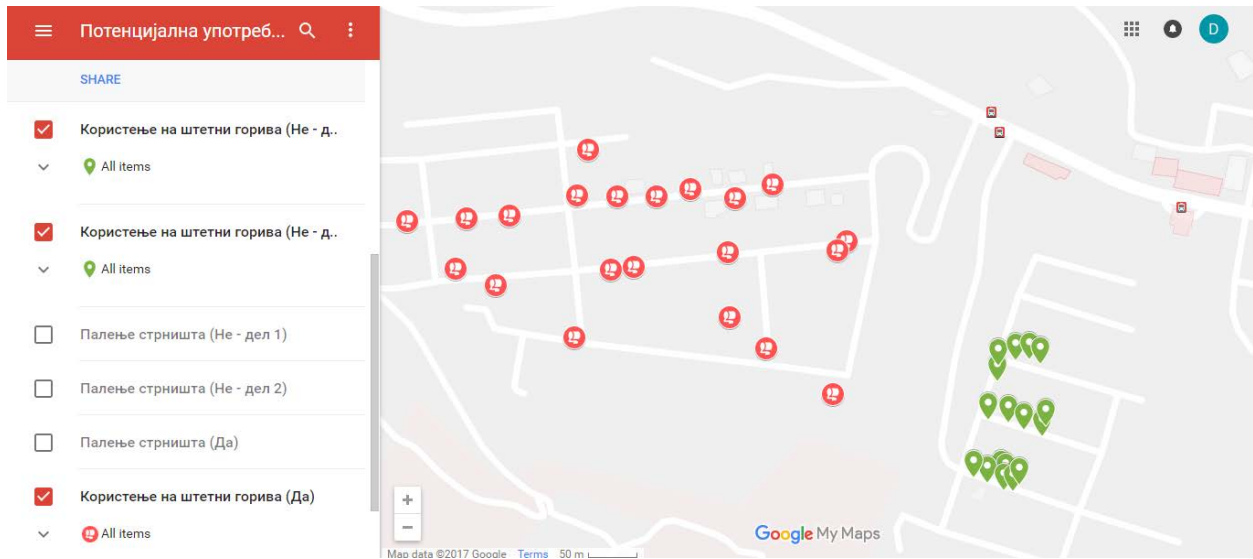


Figure 3.8 Zhdanec and Trnodol – differences

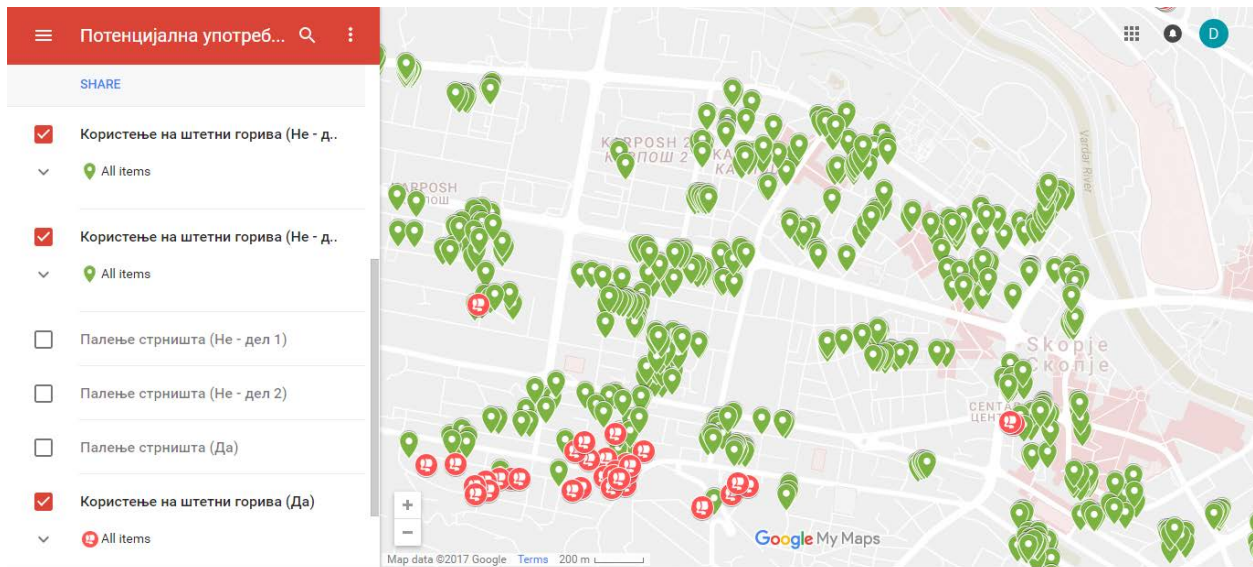
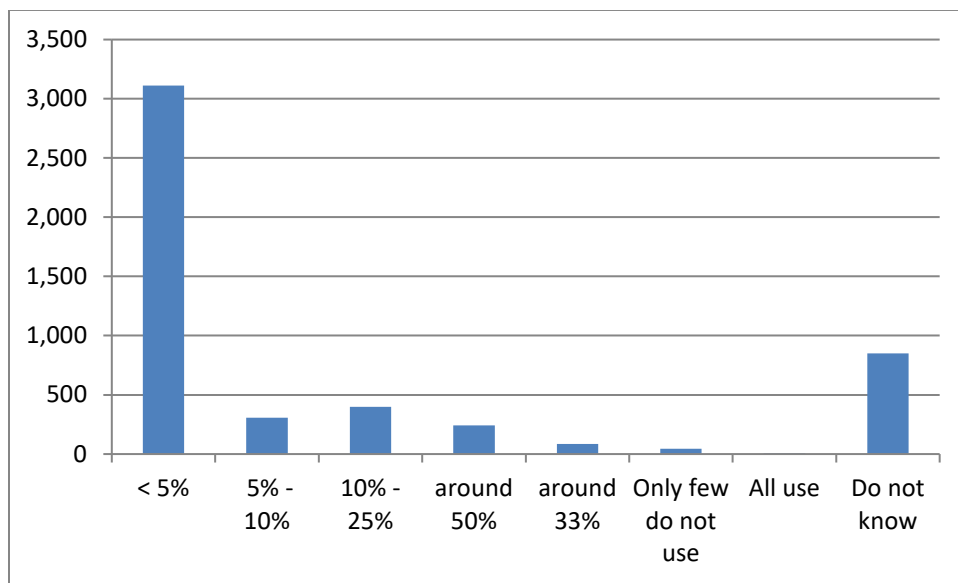


Figure 3.9 Part of urban Skopje (the Big ring and the area limited by the city park and Vodno, from Centar to Karposh)

There are also completely urban settlements, for e.g.: Settlement of 11 Oktomvri in Kisela Voda, in which 100% of the respondents believe that in their vicinity harmful fuels are used, and Shuto Orizari where more than 90% of the households have the impression that in their vicinity harmful materials are burned.

**Q17a. What percent of the households in your vicinity use harmful fuels?**

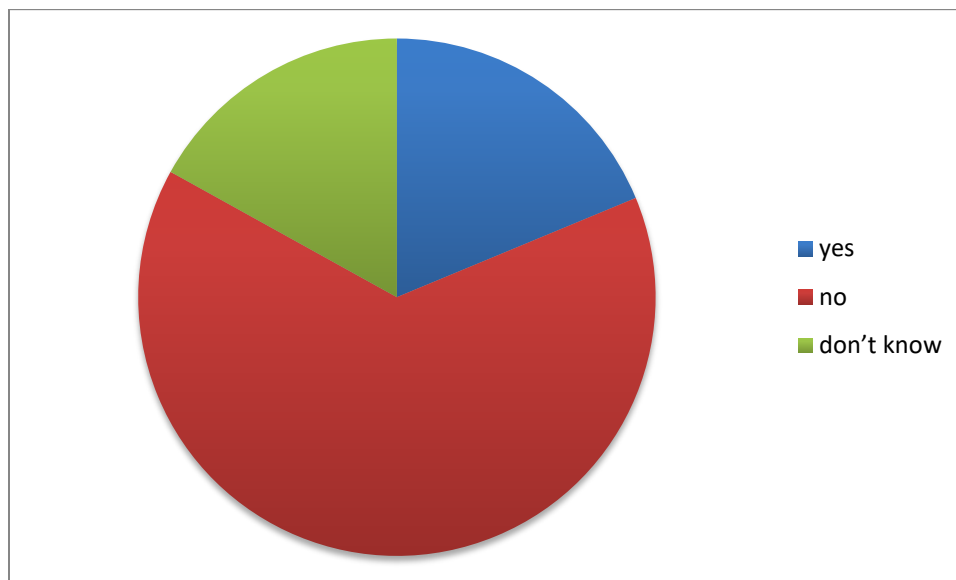
The answers of the 28% of the respondents who answered that in their vicinity somebody uses harmful materials for heating, to the question what is the percentage of households using such additions are presented in the graph 61.



Graph No. 61 What percentage of the households in your vicinity use harmful materials for heating (only those who have answered that somebody in their vicinity uses harmful materials for heating)

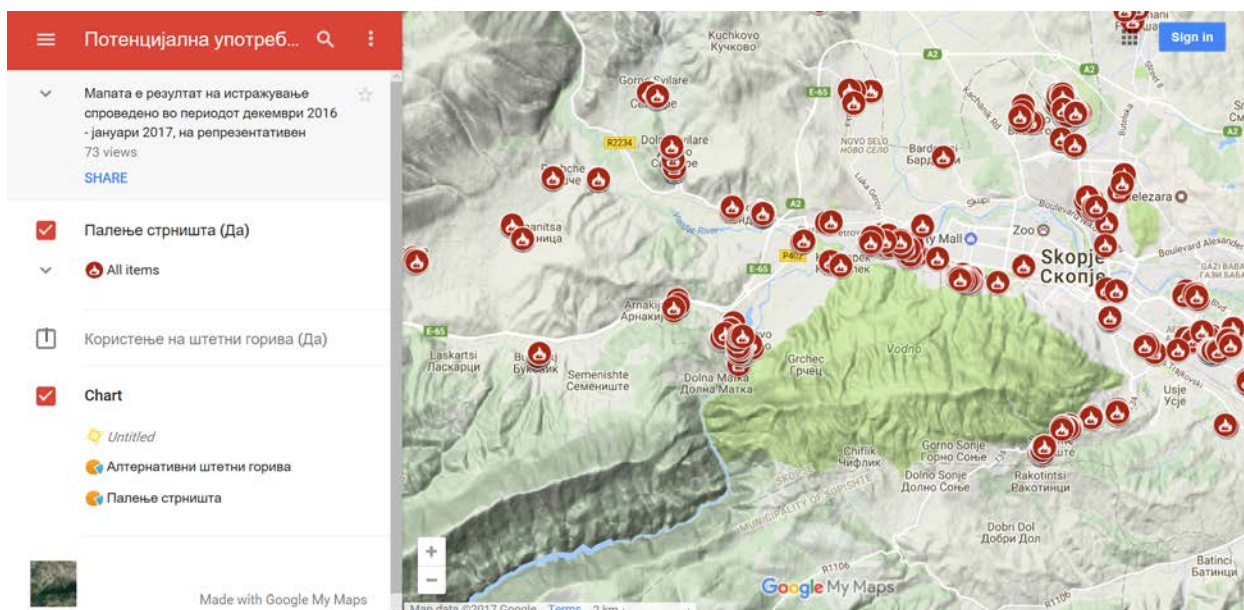
Although part of the households use harmful fuels for heating, they mainly use them as addition to the main fuel. Those who have answered that somebody in their vicinity uses such additions, have the impression that 5 to 25% of the households in their vicinity use such additions.

### Q18 Are stubbles being burned in your vicinity in the settlement where you live?



Graph No. 62 Are stubbles being burned in your vicinity in the settlement where you live?

Although in the Skopje Valley 19% of the respondents said that in their vicinity stubbles are being burned, in rural areas, this percentage is even 40.8%. The geographic distribution of this answer is presented on the following [link](#):



## 4. Conclusions

The survey showed that the inhabitants in the Skopje Valley are interested and want to be part of the solution for the air pollution problem.

The heating practices for using solid fuel should be abandoned. Since the highest percentage of those using firewood for heating use inefficient and old furnaces, efforts should be made to replace the old furnaces with new ones and to encourage the use of heat pumps and pellets and briquets stoves.

Since more than 90% of the households have none whatsoever or have poor insulation in their homes, it is necessary to define measures and actions to improve insulation thus reducing the energy needed for heating and by that reducing air pollution induced by heating. Special attention should be paid to roof constructions, which, it seems, have the lowest level of insulation.

Ways should be found on how to make more households connect to the central heating system. Even 44% of the households say that they would connect to the central heating system if it is available and if the cost is little higher compared to the cost of their current system.

Public awareness campaigns are needed, which would include all issues listed in the conclusions. It is necessary to raise public awareness about the urgency of the air pollution problem and to promote quality solutions.

## Annexes

### 1. Survey questionnaire



Mirche Acev 3/2-14, 1000 Skopje

Unique registration number 4080013539225

Gyro account: 200002638103754, Stopanska Banka AD Skopje

Tel: 02 3296619; 075325973,

mail: [office@timinstitut.eu.mk](mailto:office@timinstitut.eu.mk)

---

## 64UNH\*1216

### Presentation

1. Present yourself in the following way: "Good morning/day/evening, I am \_\_\_\_\_ an employee of TIM Institute, research quality and development. We are currently conducting a public opinion survey related to the households heating in Skopje.

**M1.** \_\_\_\_\_

**M2. Place of residence**

1. City
2. Village

**M3. Municipality**

68 Aerodrom

69 Arachinovo

70 Butel

71 Gazi Baba

72 Gjorche Petrov

73 Zelenikovo

74 Ilinden

75 Karposh

76 Kisela Voda

77 Petrovec

78 Saray

79 Sopishte

80 Studenichani

81 Centar

82 Chair

83 Chucher Sandevo

84 Shuto Orizari

**M5. Code of the interviewer:**   \_\_ \_\_ \_\_ \_\_

**M6. Date of the interview**   \_\_ \_\_ \_\_ \_\_

**M7. Time when the interview started (use 24-hour time)**\_\_ \_\_ : \_\_ \_\_

**Q1. What is the PRIMARY fuel that you use for heating the building?**

***(ONLY ONE ANSWER)***



1. Coal
2. Firewood
3. Pellets
- 4 Briquettes
5. Other solid fuel
6. Extra light heating oil
7. Propane Butane
8. Electricity (storage heater)
9. Electricity (heaters or electric boilers);
10. Electricity (heat pump or air conditioner)
11. Central district heating

**Q2a. Is your building a?**

ANSWER WITHOUT ASKING THE RESPONDENT

1. House
2. Apartment

**Q2b\_1. Year of construction?**

**(ONLY ONE ANSWER)**

(Write down) \_\_\_\_\_

9. Does not know (**ILLEGIBLE**)

**Q2b\_2. When was the most recent facade renovation or change of windows?**

**(ONLY ONE ANSWER)**

(Write down) \_\_\_\_\_

9. Does not know (**ILLEGIBLE**)

**Q2c. Total area of the apartment / house?**

**(ONLY ONE ANSWER)**

(Write down) \_\_\_\_\_m2

9. Does not know (**ILLEGIBLE**)

**Q2d. What area of the building is heated?**

**(ONLY ONE ANSWER)**

1.  $\frac{1}{4}$  (one fourth) - 25 %
2.  $\frac{1}{3}$  (one third) - 33,3 %
3.  $\frac{1}{2}$  (one half) - 50%
4.  $\frac{2}{3}$  (two thirds) - 66,6 %
5.  $\frac{3}{4}$  (three quarters) - 75 %
6. The whole building - 100 %

**Q3. How many people live in the building?**

**(ONLY ONE ANSWER)**

(Write down) \_\_\_\_\_

**Q4. What insulation do you have on your house/apartment?**

**(SEVERAL ANSWERS ARE PERMITTED)**

**Q4\_1. Basic construction:**

Q4\_1\_1. 1. Concrete

Q4\_1\_2. 2. Bricks

Q4\_1\_3. 3. Pre-assembled house

Q4\_1\_4. 4. Other (write down) \_\_\_\_\_

\_\_\_\_\_

Q4\_1\_9. 9. Does not know (**ILLEGIBLE**)

**Q4\_2. Styrofoam insulation, glass or stone wool on the walls:**

**(SEVERAL ANSWERS ARE PERMITTED)**

Q4\_2\_1. 1. Without additional insulation

Q4\_2\_2. 2. Less than 2 cm

Q4\_2\_3. 3. Less than 5 cm

Q4\_2\_4. 4. Less than 10 cm

Q4\_2\_5. 5. Less than 15 cm

Q4\_2\_6. 6. Sandwich insulated wall

Q4\_2\_7. 7. Other (write down) \_\_\_\_\_

\_\_\_\_\_

Q4\_2\_9. 9. Does not know (**ILLEGIBLE**)

**Q4\_3. Window and door frames**

**(SEVERAL ANSWERS ARE PERMITTED)**

Q4\_3\_1. 1. Single wooden frames

Q4\_3\_2. 2. Double wooden frames

Q4\_3\_3. 3. Metal (steel or iron)

Q4\_3\_4. 4. PVC

Q4\_3\_5. 5. Aluminum

Q4\_3\_6. 6. Wood/aluminum

Q4\_3\_7. 7. Other (write down) \_\_\_\_\_

\_\_\_\_\_

Q4\_3\_9. Does not know (**ILLEGIBLE**)

**Q4\_4. Windows:**

**(SEVERAL ANSWERS ARE PERMITTED)**

Q4\_4\_1. 1. Single glazed

Q4\_4\_2. 2. Double glazed

Q4\_4\_3. 3. Thermal pane windows (two glazed)

Q4\_4\_4. 4. Thermal pane windows (three glasses)

---

Q4\_4\_9. 9. Does not know (**ILLEGIBLE**)

**Q4\_5. Roof construction (for houses and lofts)**

**(SEVERAL ANSWERS ARE PERMITTED)**

Q4\_5\_1. 1. Thermally uninsulated roof (concrete, beam system, roof tiles etc.)

Q4\_5\_2. 2. Less than 5 cm of insulation

Q4\_5\_3. 3. Less than 10 cm of insulation

Q4\_5\_4. 4. Less than 15 cm of insulation

Q4\_5\_5. 5. More than 15 cm of insulation

---

Q4\_5\_9. 9. Does not know (**ILLEGIBLE**)

**Q5. How many hours per day you heat your apartment / house?**

<b>(ONE ANSWER IN EVERY COLUMN)</b>	<b>Q5a. Over the week</b>	<b>Q5b. For weekends and holidays</b>
6 hours a day	1	1
8 hours a day	2	2
12 hours a day	3	3
14 hours a day	4	4

16 hours a day	5	5
20 hours a day	6	6

**Q6. What quantity of fuel you use per heating season (2015-2016)?**

	<b>(ONE ANSWER IN EVERY COLUMN)</b>	<b>Q6a.</b>
<b>1</b>	Wood	_____ m3 (cubic meters)
<b>2</b>	Pellets and briquettes	_____ t (tons)
<b>3</b>	Coal	_____ t (tons)
<b>4</b>	Extra light heating oil	_____ l (liters)
<b>5</b>	Liquified Petroleum Gas	_____ kg (kilograms)
<b>6</b>	Others	

**Q6b. What is your heating cost per season (2015-2016)?**

	<b>(ONE ANSWER IN EVERY COLUMN)</b>	<b>Q6c.</b>
<b>1</b>	Heating (Central district heating)	_____
<b>2</b>	Electricity	_____

**IF THE HOUSEHOLD USES SOLID OR LIQUID FUEL, ASK:**

**Q7. What is the nominal power of the furnace/boiler/fireplace?**

**(ONLY ONE ANSWER)**

- 1. 5 kW
- 2. 8 kW
- 3. 11 kW

4. 15 kW
5. 20 kW
6. 25 kW
7. 35 kW
8. 50 kW
9. Other \_\_\_\_\_  
\_\_\_\_\_

99. Does not know (**ILLEGIBLE**)

**IF THE HOUSEHOLD USES FIREWOOD, ASK:**

**Q8. What kind of heating device do you use?**

**(ONLY ONE ANSWER)**

1. Open fireplace
2. Semi-open fireplace (fireplace with a protective glass or a screen)
3. Closed fireplace (fireplace with doors with a possibility to keep it closed)
4. Wood furnace (wood stove)
5. Furnace with heat exchanger (boiler) and radiator heating
6. Wood boiler (in special room - boiler room)

**IF THE HOUSEHOLD USES FIREWOOD, ASK:**

**Q9. How old is the fire place/furnace/boiler that you use?**

**(ONLY ONE ANSWER)**

1. Less than 2 years old
2. From 2 to 5 years old
3. From 5 to 10 years old
4. From 10 to 20 years old

5. More than 20 years old

**Q9a. Do you know who has manufactured the fireplace (closed type)/furnace, boiler?**

***(ONLY ONE ANSWER)***

Q9a\_1. Manufacturer \_\_\_\_\_

Q9a\_2. Product model \_\_\_\_\_

**Q10. Although it is not a legal obligation, do you perform maintenance (cleaning the firebox) of the fireplace, the furnace/boiler?**

***(ONLY ONE ANSWER)***

1. Yes
2. No

**IF YES (MAINTAINS THE HEARTH/ASH CHUTE), ASK:**

**Q10a. How frequently do you do that?**

***(ONLY ONE ANSWER)***

1. At the end of every heating season
2. Every second season
3. Every 2 years
4. In a period of 2 to 5 years
5. More than 5 years

**Q11. Do you use the same system throughout the heating season, or you have another system as well?**

***(ONLY ONE ANSWER)***

1. We use the same system throughout the season
2. We use a different system in part of the season

**IF THEY USE A DIFFERENT SYSTEM, ASK:**

**Q11a. What other system do you use?**

***(ONLY ONE ANSWER)***

1. Electrical heaters
2. Storage heaters
3. Air conditioner
4. Inverter air conditioner
5. Gas heaters
6. Oil heaters
7. Other (write down) \_\_\_\_\_

**ASK EVERYONE:**

**Q12. How do you obtain sanitary hot water?**

***(ONLY ONE ANSWER)***

1. Electric boiler
2. Wood boiler
3. Solar hot-water collectors
4. Combined system



5. Other (write down) \_\_\_\_\_

**Q13. Do you only use electricity for cooking or you have an additional source of energy?**

**(ONLY ONE ANSWER)**

1. We use only electricity
2. We have additional energy source

**IF THEY USE ADDITIONAL ENERGY SOURCE, ASK:**

**Q13a. What fuel do you use for cooking?**

**(ONLY ONE ANSWER)**

1. Coal
2. Firewood
3. Pellets and briquettes
4. Other solid fuel (write which one) \_\_\_\_\_
5. Extra light heating oil
6. Propane Butane
8. Other (write down) \_\_\_\_\_

**ASK EVERYONE:**

**Q14. According to what criteria you choose the heating method?**

**(ONLY ONE ANSWER)**

1. Investment cost
2. Monthly cost
3. Automated operation possibility
4. To what extend the device is polluting the environment
5. Other (write down) \_\_\_\_\_

**Q15. Would you connect your building to central heating, if it is available and if the amount of the annual cost is LITTLE higher than the current one?**

**(ONLY ONE ANSWER)**

1. Yes

2. No

**Q16. If you would choose regardless of the equipment installation cost and the monthly bill, which heating system would you choose for your apartment/house?**

**(ONLY ONE ANSWER)**

1. Wood boiler

2. Pellet boiler,

3. Oil boiler,

4. Gas boiler,

5. Electric heaters,

6. Heat pump,

7. Central district heating,

8. Other (write down) \_\_\_\_\_

9. Does not know (**ILLEGIBLE**)

**Q17. Are there in your vicinity households using alternatively harmful fuels or additional fuels to firewood, such as: plastic boxes, straw, burned oil, lacquered or colored wood, wooden floors, windows etc.?**

**(ONLY ONE ANSWER)**

1. Yes

2. No

\_\_\_\_\_

9. Does not know (**ILLEGIBLE**)

**Q17a. What percent of the households in your vicinity use harmful fuels?**

**(ONLY ONE ANSWER)**

1. Less than 5%
2. Between 5% and 10%
3. Between 10% and 25%
4. Every second household
5. Every third household
6. Only few do not use such fuels
7. Almost everyone uses such additions to the wood
- \_\_\_\_\_
9. Does not know **(IT IS ILLEGIBLE)**

**Q18. Are stubbles being burned in your vicinity in the settlement where you live?**

**(ONLY ONE ANSWER)**

1. Yes
2. No
- \_\_\_\_\_
9. Does not know **(ILLEGIBLE)**

## **DEMOGRAPHICS**

**D1. Sex**

ANSWER WITHOUT ASKING THE RESPONDENT

1. Female
2. Male

**D2. Age**

\_\_\_\_\_

**D3. Ethnicity**

***(ONLY ONE ANSWER)***

1. Macedonian
2. Albanian
3. Serb
4. Turk
5. Roma
6. Vlach
7. Other

**D4. Education**

***(ONLY ONE ANSWER)***

1. Primary
2. Vocational / gymnasium
3. University, MSc, PhD

**D5. Marital status**

***(ONLY ONE ANSWER)***

- 1 Single
- 2 Married
- 3 Widower
- 4 Divorced

**D6. Do you have children under 18 who live in your household?**

***(ONLY ONE ANSWER)***

1 Yes

2 No

**D7. Average monthly income of the household**

**(ONLY ONE ANSWER)**

01. Less than 3,000 MKD

02. 3,001 - 6,000 MKD

03. 6,001 -9,000 MKD

04. 9,001 -12,000 MKD

05. 12,001 -15,000 MKD

06. 15,001 -18,000 MKD

07. 18,001 -21,000 MKD

08. 21,001 -24,000 MKD

09. 24,001 -27,000 MKD

10. 27,001 -30,000 MKD

11. 30,001 - 45,000 MKD

12. 45.001+

\_\_\_\_\_

98. Refuses to answer **(ILLEGIBLE)**

99. Does not know **(ILLEGIBLE)**