Republic of North Macedonia

Ministry of Environment and Physical Planning

VULNERABLE GROUPS (HOUSEHOLDS) EXPOSED TO CLIMATE CHANGE IMPACTS AND AIR POLLUTION IN SKOPJE

- Additional analysis of household heating survey data in Skopje –

https://www.skopjesezagreva.mk
https://www.skopjesezagreva.mk/all-data-on-fire/

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Vulnerable groups (households) exposed to climate change impacts

Introduction

The climate is changing due to the change in the nature. Human activities, especially the use of fossil fuels, are the main reasons for the recent increase of the global warming and increasing rainfall. The use of firewood as a source of heating, is one of the activities with which man disturbs the natural balance. There are many definitions of climate change, but the main distinction in determining climate change concerns the involvement of human activity alone and of natural variability. According to the Intergovernmental Panel on Climate Changes (IPCC), climate change refers to any climate change over time, whether due to natural change or as a result of human activity.[1] According to the UN Framework Convention on Climate Change (UNECCC),[2] climate change imply that is directly or indirectly caused by human activity that changes the composition of the global atmosphere and is complementary to natural climate variability in time periods.
Whatever definition it is accept, the undeniable fact is that the man with their activities directly or indirectly affect climate change. The use of firewood as a source of heating, is one of the activities with which man disturbs the natural balance. Particularly worrying is the more frequent unplanned cutting of trees, which reduces the forest fund and disables the process of photosynthesis and air purification. Soil becomes porous and susceptible to erosion from rainfall. The use of firewood as a way of heating the households, during the combustion process, pollutes the air that we all breathe. In this way, by focusing only on measures and recommendations that reduce the use of firewood as a source of heat, a major step will be taken in decreasing the negative aspects that affect climate change.
Climate changes related to energy use have influence to all citizen. However, the purpose of this report is to distinguish and define the most vulnerable groups of households living in the Skopje Valley. The main source of data is the Conducted Survey on the method of heating households in the Skopje Valley, realized in January 2017 (https://www.skopjesezagreva.mk/). The data allow defining groups of more features, primarily by sex, age, whether they live in urban or rural areas in a house or apartment building, residence, education, monthly income. Using the Microsoft Power Bi software tool[3] enables easy grouping of features and definition of specific groups. When defining these groups of vulnerable categories, the demographic and socio-economic characteristics of the surveyed households are taken into account.
The air pollution in Skopje and all the negative aspects on people's health produce cumulative adverse effects on climate changes. This is primarily due to the urbanization process in the City of Skopje and the extensive energy consumption.

The groups that are determined in this report are defined as vulnerable categories, primarily due to their economic disability. The most affordable for these households are coal or firewood. Therefore, they choose to use them for heating. A large portion of the actual monthly income

[1] https://www.ipcc.ch/about/

[2] https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_science.pdf

[3] https://www.skopjesezagreva.mk/otvoreni-podatoci-site/

of these vulnerable groups, is intended to cover the cost of heating. Limited monthly income and living conditions determine these households as socially disadvantaged and vulnerable to adverse impacts of climate change related to energy use. Involvement of these households as priority groups in the implementation of the proposed measures to reduce pollution of Skopje should contribute to improving the living conditions of these households and to enable the realization of the objectives defined in Skopje breathe https://zivotnasredina.skopje.gov.mk/proekti/skopje-dishe-utopija-ili-realnost/.

1. Single mothers living in houses with children under the age of 18, using firewood

The single mothers with children under the age of 18 are daily faced with the battle of everyday life. Taking care for the home and the family of a single parent is one of the most difficult roles. Especially, that the care of children and their health are the highest priority for any parent. Women who are involved in the labor force, in most cases due to socio-economic status are faced with the problem of inequality in earnings. Women do not have the highest paid professions, and if some are realized in senior and management jobs position, they are less paid by men in the same jobs. The care for children and the need for absence from work, contribute, mothers harder to progress in their career. The struggle of single mothers with young children is even more pronounced. Traditional attitudes and beliefs that women should take care of home and family are still present. Women's responsibilities for cooking and cleaning at home exposes women to major health risks and diseases that are transmitted through water and burning firewood. Especially women in rural areas are mostly housewives or are engaged in work in agriculture, in unpaid agricultural activities in the field or stored goods. Insufficient information about the harmfulness of the use of firewood is one of the reasons why these households still opt for such a heating system at home. But much more important factor is the lack of funds or economic powerlessness of these households, so they cannot choose another way of heating the home.

Therefore, these households stands out as the most vulnerable category of climate change. The group takes into account single mothers (divorced and widowed) with children younger than 18, who live in houses and use firewood. Mostly these households use exclusively electric water heaters to provide hot sanitary water in the home. Those who use another system other than electricity in the home, use the firewood for food preparation.

The largest percentage of those surveyed in this group of households consider the cost of the monthly expense as a determining factor when choosing the method of heating the home. Also, for the majority of them, the price of the investment is also a significant criterion.

Single mothers with young children living in a house who use firewood for heating the home according to the calculations from the survey and the approximation made for the Skopje Valley are **0.5%** of the total number of households or a total of **746 households**.

Municipalities	%
Arachinovo	1%
Butel	1,3%
Gazi Baba	0,4%
Gjorche Petrov	0,3%
Karposh	0,2%
Saraj	0,3%
Studenichani	4,2%
Center	0,2%
Shuto Orizari	2,8%

Source: own calculations

1.1 Single mothers living in houses with children under the age of 18, from municipality Chair, using alternatively harmful fuels

Specific group that derives from the data is the single mothers that lives in houses with children younger than 18, from Chair using the alternatively harmful fuels such as: plastic boxes, straw, burned oil, lacquered or coloured wood, wooden floors, windows etc. According to the data analysis of the survey, these households are vulnerable and exposed to negative impact from the harmful fuels. In the municipality of Chair, **0,54%** from the households are determined in this group. 2/3 of them state that they use another source except electricity, to obtain sanitary hot water. In the surroundings where these households live, there are households that heat on alternative harmful fuels or use them as an additive to firewood. According to the answers, every third in their environment uses harmful fuels.
The calculation shows that a hundred of these households (97 in total), are obligatory to change the way of heating the home.

1.2 Single mothers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use

According to the surveyed, **1,85%** of the citizens of Karposh, are single mothers with children younger than 18 years. Of these, **60%** live in houses and can improve the utilization of energy in the home.
More than half reported that they heat 1/2 or the whole house, and 50% said that their home is without additional insulation and also have no thermal insulation roof (concrete, beam system, roof tiles, etc.). Also, 100% of households in this group use an electric heater to provide sanitary hot water in the household. For half of them, the price of the investment is a decisive factor for the choice of heating the home.
According to these listed characteristics, families can improve the utilization of heat energy and reduce losses. Investments in thermal insulated facade and roof of the house, will decrease energy loses. Installing solar thermal collectors for providing hot sanitary water is another opportunity for an energy efficient home. Estimates are that it is 195 households in the Karposh that belong to this specific group.

2. Single fathers living in houses with children under the age of 18, using firewood

This group of households is comprised of families with under aged children with one parent, in this case the father, which are divorced or widowed, they live in a house and uses firewood. The difference between the single mothers and single fathers is in the financial earnings. Men have better position on the labour market, which means that they can earn more money. It is

due to the existing gender inequality of wages. It is surprising that unlike the group of single mothers, in this group, 50% of those surveyed use firewood for preparing food for the family. The fact that the difference between the group of only mothers, in this group 50% of the surveyed, they use firewood to prepare meals for the family. The undeniable truth is that everyone simple uses an electric boiler for security on clean hot water. The cost of the monthly bill for heating up the home is the key for choosing heating system. Indisputably, everyone uses only electric boilers or heater to provide sanitary hot water.
The amount of the monthly heating bill, is a crucial factor for the decision which heating system to choose.

Municipalities	%
Aerodrom	0,2%
Butel	0,6%
Gazi Baba	0,3%
Gjorche Petrov	0,3%
Ilinden	0,8%
Kisela Voda	0,4%
Petrovec	3,3%
Saraj	1%
Studenichani	2,8%
Chucher Sandevo	1,7%
Shuto Orizari	4,5%

Source: own calculations

In total, we are talking about a group of **876 single-parent households**, fathers of children under the age of 18 who live in a house and use firewood. It is desirable, all these households to be covered by measures to change the heating method, as well as other recommendations for better energy use in the home. Thus, it would reduce the impacts of climate change and improve the quality of life of these families.

2.1 Single fathers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use

This group of households is identical with the group 1.2., single mothers from Karposh. In the municipality of Karposh, **0.37%** are single fathers with children younger than 18, who are living in the house, and can improve the use of energy in the home. According to this percentage of respondents in the municipality of Karposh, this group involve about **65 households.**

3. Women 65+ age, with monthly income beyond 12.000 denars single, divorced or widower and live alone

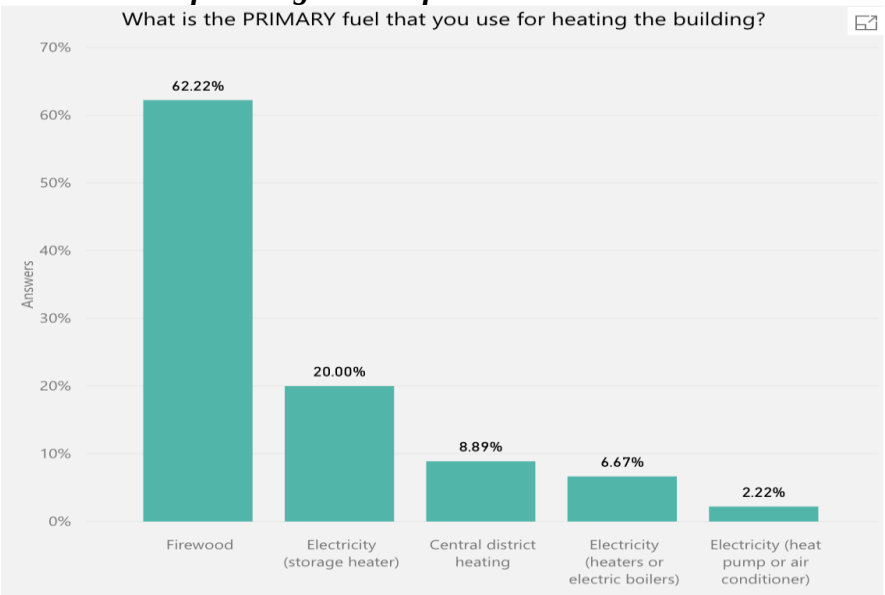
The most vulnerable category exposed to climate change are the elderly, excluding children. Among them there are chronically ill, with low-income, living in rural areas and other. This group refers to women who, according to their age (65 years old and older), have the right to old age pension, live alone in their home, i.e. they are single, divorced or widowed, and use family pensions with monthly income up to 12.000 denars.
Why women 65+ who live alone and have low monthly income?
Women, unlike men, in the Republic of North Macedonia, are more exposed to poverty. At the time of working age, women who are involved in the labor force, in most cases due to socio-

economic status are faced with the problem of inequality in earnings. Women do not have the highest paid professions, and if some are realized in high and responsible jobs, they are less paid by men in the same jobs. They look after their children and often have a need for work absence, therefore mother's harder progress in their career. Traditional attitudes and beliefs that women should take care of home and family are still present. Women's responsibilities for cooking and cleaning at home exposes women to major health risks and diseases that are transmitted through water and burning firewood. Especially women in rural areas are mostly housewives or are occupied with agriculture work, in unpaid agricultural activities in the field or stored goods.

Age and their little physical activity, make them more susceptible to negative impacts of climate change. Muscle strain in these women often leads to injuries that are particularly emphasized in winter periods, as well as viral and bacterial respiratory infections (pneumonia), chronic diseases including arthritis or osteoporosis. Often, due to poor physical activity and the fear of injuries when moving in winter snow conditions, they spend time alone at home. Loneliness increases the possibility of depression, Alzheimer's and other types of dementia. Home premises is heated more than 12 hours a day, throughout the week, whether it's working day or weekends and holidays.

The largest percentage of these, **62.22% use firewood as the primary mean for heating the home.**

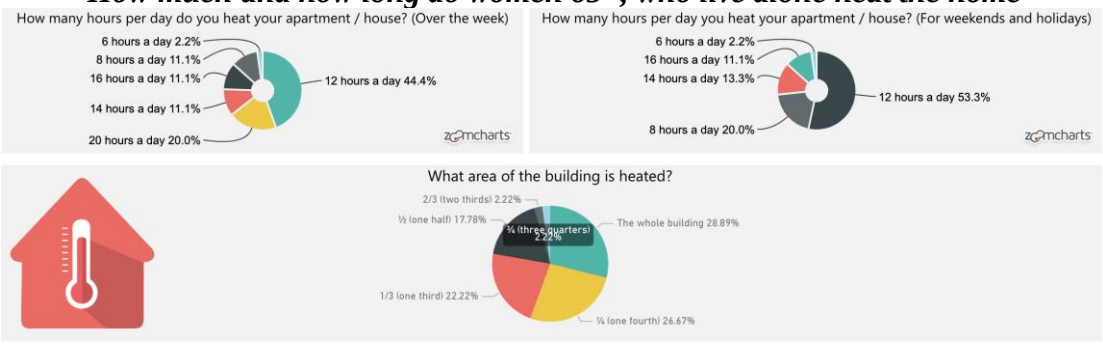
Method of heating a home for women 65+ who live alone



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

In that, 28.89% heat the entire home, 26.67% heat up ¼ of the home and more than half of these households heat the home 12 hours a day. The worrying fact is that those who use firewood as a way of heating the home use old wood stoves and at **85.71% of this group, the wood stoves are older than 20 years.**

How much and how long do women 65+, who live alone heat the home



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

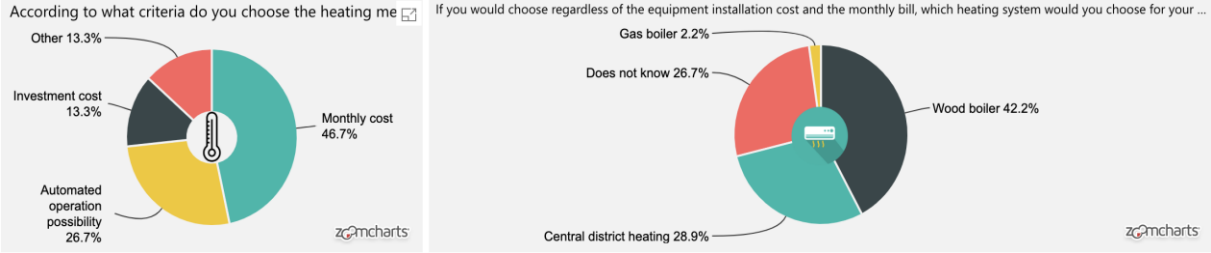
Thus, women have long been exposed to the negative effects of burning firewood that has a long-term impact on their health.
If they have offspring, according to the traditional family relations, it is assumed that they often need to help the younger ones as an unwritten rule. Above all, support and assistance in raising grandchildren, active participation in care and upbringing of the youngest is noble, but also function with too many obligations for the "grannies". In this way they overlook themselves and their needs. In doing these things, very often in their homes there are small children. On the other hand, the help and support of these women from their children is present and mutual. The health and well-being of women older than 65 years, as a vulnerable group, is among the generational priority and necessity for a society.

The insufficient awareness of these households about the harmfulness of using firewood in their homes as a way of heating is one of the factors why these households still use such a heating system at home. But, much more important factor is the lack of funds or economic powerlessness of these households, so they could have an opportunity to choose another way of heating the home.

Increased awareness and knowledge about the harmful consequences for the health, physical and psychological development of themselves, as well as on the children who occasionally stay with them in the home, will educated them and they will easier make the decision to change the heating. Also, the appropriate financial relief program, will help them to change the heating system in their homes.

The most important criteria for selection of heating, the women surveyed from this group, **46,7% highlight the monthly cost**, 26,7% possibility for automatic operation of the heating system, 13,3% investment price and 13,3% specify other criteria. Especially interesting are the answers, if they neglect the cost of installation of equipment and monthly expense, most of these households would choose wood boiler (42,2%). **However, 26.7% do not know what they would choose.**

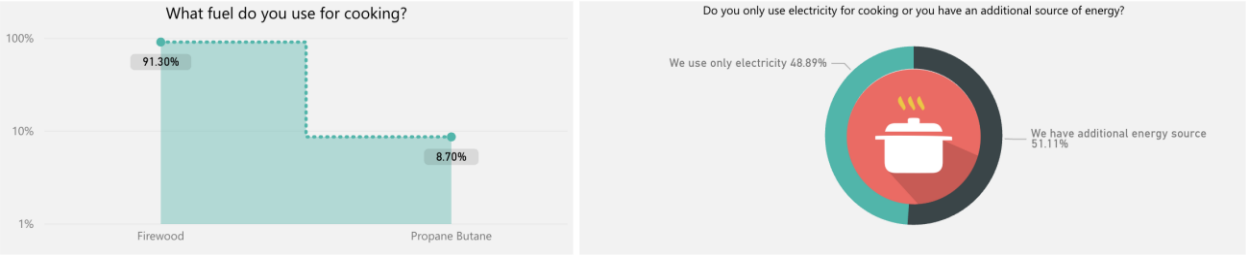
Criteria for choosing heating method for women 65+ who live alone



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

These housewives, **91,3% of respondents use firewood for cooking**, and 8,7% use LPG for preparing meals.

Are women 65+ who live alone use only electricity for cooking at home



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

Focusing on safety measures and recommendations that will reduce the use of firewood as a source of heat, would be a major step towards reducing the negative impacts of climate change. The percentage of this group by municipalities is given in the following table:

Municipalities	%
Butel	0,3%
Gazi Baba	0,9%
Gjorce Petrov	0,5%
Zelenikovo	5,7%
Karposh	0,6%
Kisela Voda	2,6%
Saraj	1%
Sopishte	5,5%
Center	0,5%
Chair	1,6%
Chucher Sandevo	1,7%

Source: own calculations

The most desirable scenario is proposed changes to cover all households in this group, regardless of the municipality they belong to. According to the characteristics indicated for each municipality, for those households that use firewood, it is first necessary to be properly informed and to offer them appropriate assistance when calculating with the heating cost calculator (http://heatcalculator.manu.edu.mk/). Pollution mitigation measures for the City of Skopje should provide professional and financial assistance to these households to make it easier to change the way of heating homes or the possibility of replacing firewood stoves with newer and more energy efficient ones.

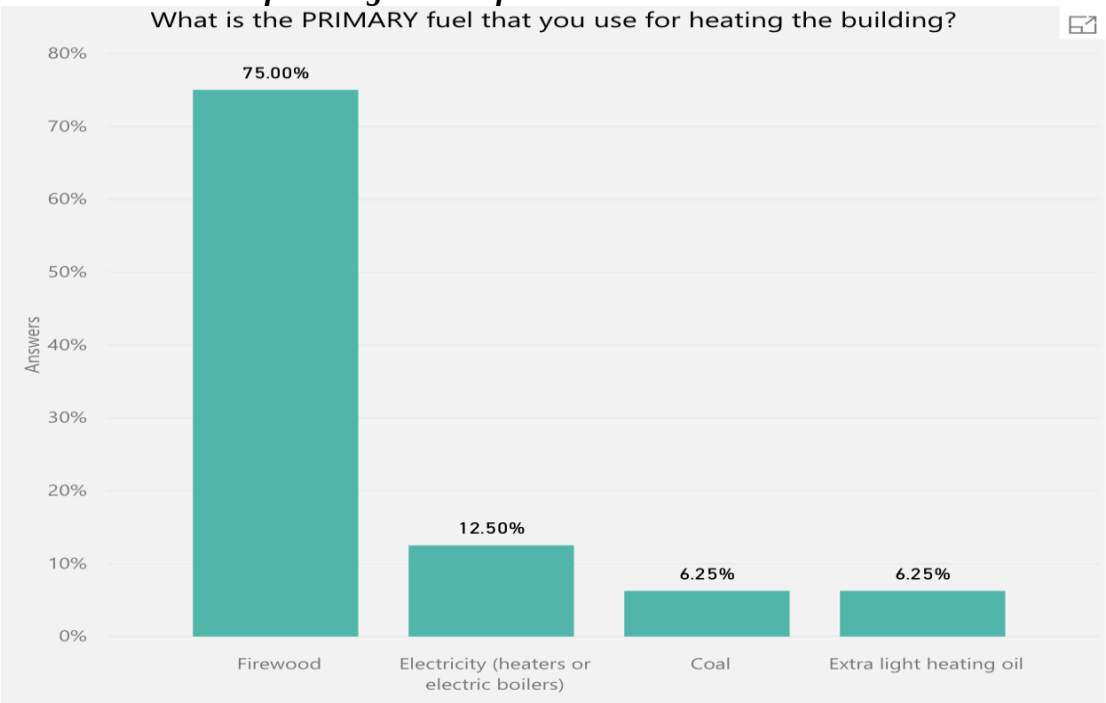
According to the analysis, it is about **0,89%** of all surveyed households, or around **1.460 households** (extrapolated with the official data from the States statistical office, from the 2002 census).

4. Men 65+ age, with monthly income beyond 12.000 denars, single, divorced or widower and live alone

Second defined group is men aged 65 and over 65 years and over who live alone in the home are single, divorced or widowed and have pensions up to 12,000 denars. This group is regarded as vulnerable category, primarily due to the different physical and psychological nature of men and women. Women are more flexible and from birth they grow up and are prepared for their roles of housewives in the family. Unlike them, men in traditionally background, are prepared for the role head of the family and it is emphasized thru their growing. Hence, they are less ready for the challenges of single life and have more obstacles to adapt to a single life. Overall unequal gender participation in the labor market, as well as wage differentials between women and men, is reflected in the differences in pensions between them. Since, it is considered the low monthly income as a limiting factor in the definition of this group of households, the number of these households is lower. Probably, if we abstract from the amount of monthly income, this group would be bigger.
The basic common characteristics of 65+ men who live alone and who have low monthly income is that **75%** of the respondents in this group use firewood and stoves older than 20 years. They rely on the monthly expense bill for heating and the price of the investment when deciding which heating system to choose.

- **6.25%** of this group use coal as a source of energy

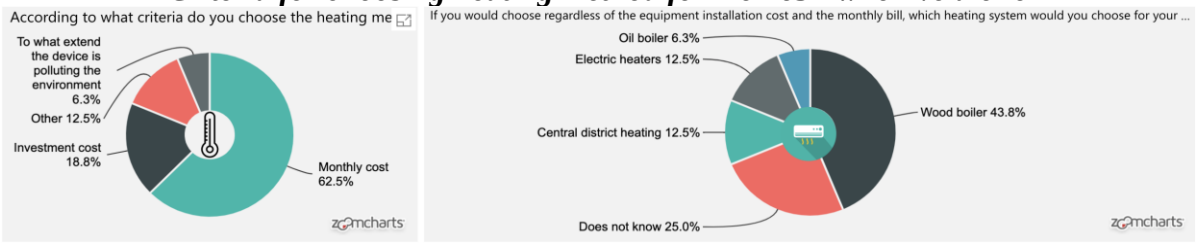
Method of heating a home for men 65+ who live alone



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

For 62.5% of this group, the price of the monthly expense is the most important criterion for choosing the heating system of the home. If they need to change the heating system, 43.8% said they would like to have a wood boiler, but a high percentage (25%) do not know what to choose.

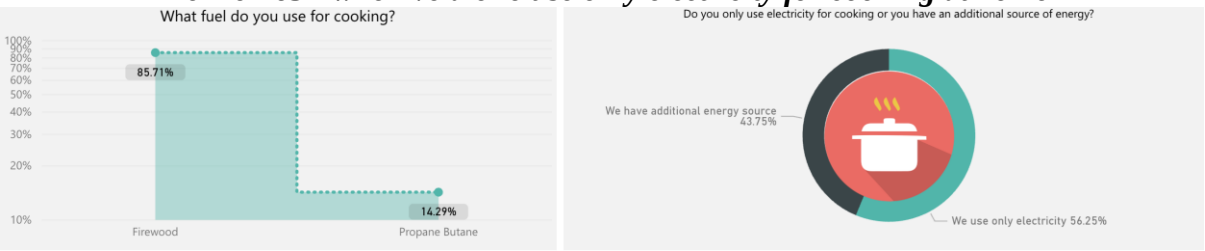
Criteria for choosing heating method for men 65+ who live alone



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

43.75% of respondents, confirmed that besides electricity used additional energy for cooking, so, 85.71% use firewood and 14.29% LPG.

Are men 65+ who live alone use only electricity for cooking at home



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

The distribution according to the municipalities is as follows:

Municipalities	%
Aerodrom	0,2%
Gazi Baba	1,5%
Kisela Voda	0,4%
Sopishte	5,5%

Source: own calculations

In the Skopje Valley, a total of 0.3% of the surveyed households are from this vulnerable group, or **519 households** are men 65+, who live alone and have low monthly incomes. Recommendations are the same as for the previous category of women 65+.

4.1. Men 65+ age, from Gazi Baba, with monthly income beyond 12.000 denars, uses coal and live alone

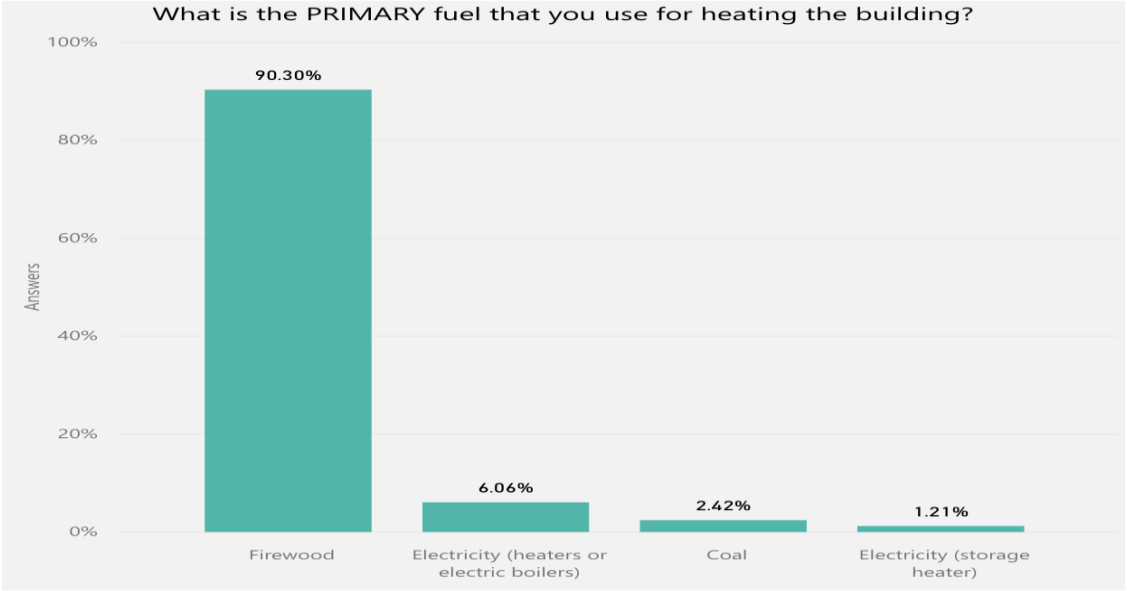
There are households in the municipality of Gazi Baba, who are 65 years of age and older, who live alone, with monthly income of up to 12,000 denars and for heating the house using coal. According to the surveyed 0.15% in Gazi Baba use coal and according this they belong to this vulnerable group. According to the calculations, there are about 83 of these households and they have to change the heating source. As such, it should be proposed to the municipality off Gazi Baba measures that should prioritized these households to use other sources of energy.

5. Households living in a rural environment in a house with monthly income of up to 12.000 denars

Households that lives in house in rural with monthly income with monthly income up to 12.000 denars. First of all, the definition of these households as vulnerable categories susceptible to climate change is the result of the fact that the largest percentage of them use firewood. According to the low monthly income they declared they could hardly make drastic changes in the way of heating the home. It is essential to offered them the opportunity to change the way of heating.

- 90.3% use firewood, only 6.06% use electricity and 2.42% use coal. Of those who use firewood, 87.16% have a wood stove, and 25.5% have wood stove from 2-5 years old and 24.83% from 5-10 years old.

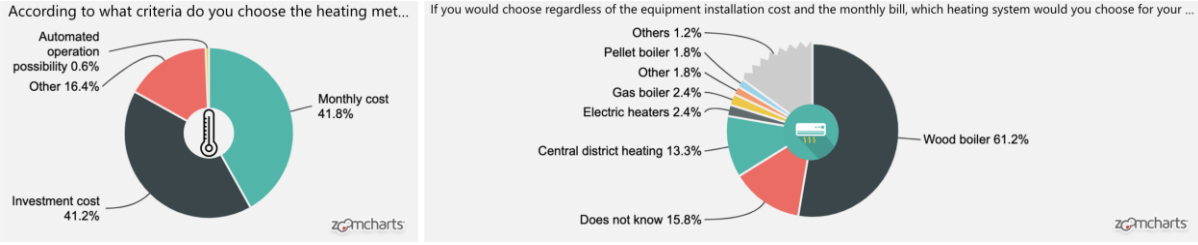
Method of heating a home for households in rural with low monthly income



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

- 79.39% warm the whole season with the same system and heat ¼ of the house (28.18%). It is quite expected that by more than 80% heating costs are the decisive factor for the decision that will heat the home, with 41.8% being the monthly cost and 41.2% of the investment cost.

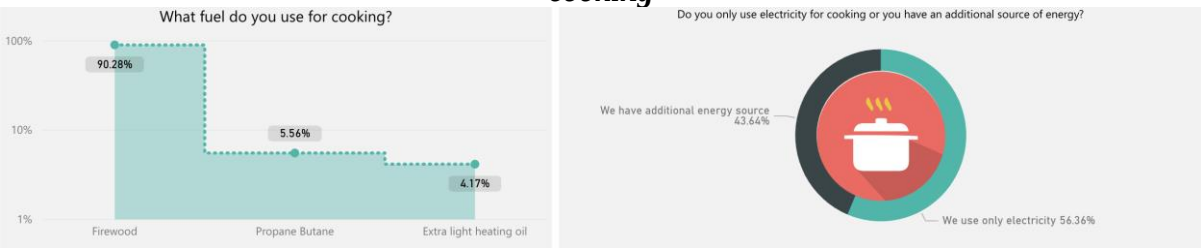
Criteria for choosing heating method for households in rural area with low monthly income



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

Regardless of the price of the investment and the price of the monthly expenses, if they need to change the heating system, 61.2% of the respondents answered that they would choose wood boilers, 15.8% do not know what they would choose.
These households, 43.64%, confirmed that they use additional source of energy except electricity for preparing food. Hence, **90.28% use firewood for cooking**, 5.56% propane butane and 4.17% extra light heating oil.

Are households living in houses in rural with low monthly income use only electricity for cooking



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

According to the responses to the issues of providing sanitary hot water, **12.95% of respondents with wood boiler provides hot water.** The potential of solar energy can also be used by placing the solar heat collectors that provide hot water. The decision for this, depends exclusively on the households, and therefore one of the recommendations is through joint coordination of the municipalities and the companies that set up these collectors, also with the appropriate financial model for this investment, these households would place solar collectors in their homes.

Municipalities	%
Arachinovo	27,5%
Butel	1,3%
Gazi Baba	5,5%
Gjorce Petrov	3,0%
Zelenikovo	17,1%
Karposh	0,2%
Kisela Voda	0,2%
Saraj	7,1%
Sopishte	23,6%

Studenichani	23,8%
Chucher Sandevo	11,7%

Source: own calculations

The desirable scenario is if all these households are covered by measures and activities for changing the heating mode and the possibility of installing solar thermal collectors. It is about **3.27%** of the total number of households **(5.353 households)** living in the Skopje Valley. However, the households from **Gazi Baba** who are most influenced by the assessment **(1.233 households)**, then the households from **Studenichani (1.103 households)** are particularly specific. Studenichani is a municipality that of the 4.639 households, about ¼ are households in these group defined as vulnerable category. These are households that are in rural areas and have low monthly income. Therefore, the change in the way home heating should be subsidized.

5.1. Households from the municipality of Studenichani living in a rural area, in houses, with low monthly income and use coal for heating

In the municipality of Studenichani it is obligatory, in the program for changing the method of heating to be included those households that use coal. It should be replaced by an appropriate way of heating, and special attention should be made to those with primary education who use coal. Training and education about the harmful impacts and the negative consequences for the environment, as well as the health of people followed by an appropriate financial plan for subsidizing should enable these households to make the change easier.
The analysis of the respondents shows that of the 34 households that were separated from the survey that belong to this group, 11.76% use coal. According to the calculation in the total number of households, it is about **130 households** that need to change coal as a home heating method.

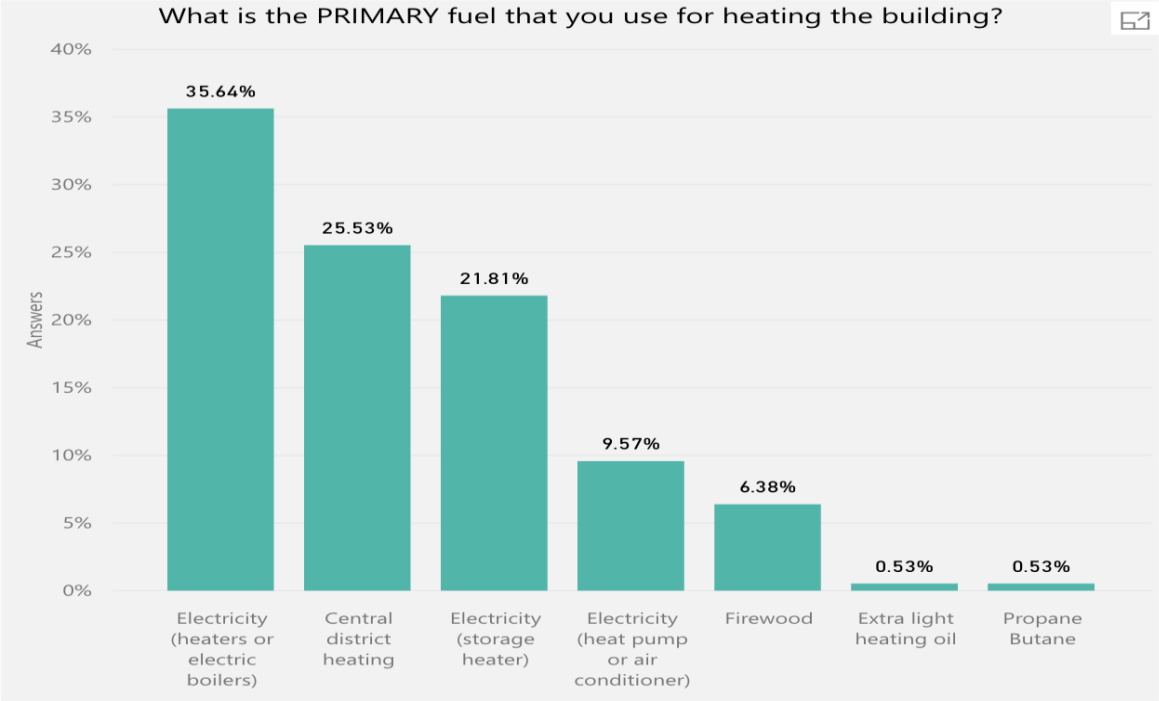
6. Households living in an urban area in the Skopje Valley, in buildings built up to 1963 or whose last renovation was at the latest until that year, have thermal insulated roof and insulation of a facade of up to 2cm

Old settlements in Skopje have buildings that were built in the period before the great earthquake in 1963 that struck the Skopje region. These are old buildings that have not been renovated since then and are facing the ravages of time. They have an uninsulated facade or the insulation of the facade is up to 2cm, as well as thermal insulated roofs (concrete, beam system, roof tiles, etc.). This state leads to a large exposure of households living in them to the impacts of climate change in urban living. Above all, regardless of the heating system used by these households, there is a great loss of heat in the heating season, and also they are exposed to high temperatures in the summer days. With this there is a great loss of energy and the quality of life of members of these households is low.
These households living in apartments in an urban environment mostly for heating their home use electricity, and 35.64% use electricity (heaters or electric boilers), 25.53% are connected to central city heating, 21.81% use electric heat accumulator oven, 9.57% heat pumps or air conditioners, 6.38% firewood, 0.53% extra light heating oil and 0.53% propane butane.

- Those households that use firewood in this group, 91.67% have wood stoves. From them the largest percentage of 33.33%, are aged 5 to 10 years.

- Small percentage of this group, 7.98% said that the home also has another source of energy for preparing food. Therefore, 73.33% use propane butane, and 26.67% firewood.

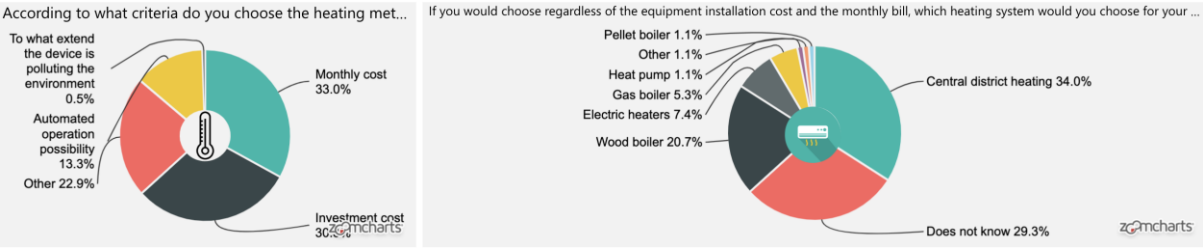
Method of heating a home for households in urban area that live in old buildings that have thermal insulated roof and insulation of the facade beyond the necessary



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

In this group, there is a diversity of answers received to the question which criteria they used when choosing the method of heating. Thus, by 33%, crucial is the price of the monthly cost, for the 30.3% the price of the investment and 22.9% relay on the completely other factors. For the 13.3% the possibility for automatic operation of the system of heating is relevant. Only, 0.5% relay the decision on how much the device pollutes.

Criteria for choosing heating method for households in urban area that live in old buildings that have thermal insulated roof and insulation of the facade beyond the necessary



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

If they are offered to change the heating mode, the largest percentage of 34% would like the change to be for central heating, but a large percentage of this household group, 29.35 does not know what to decide.

It comes to the **188 surveyed households** in Skopje Valley that are living in this kind of buildings. Using the data from the locations where these buildings are exactly located in each

municipality, it is possible to define how many buildings they actually are and should be covered by a measure for their renovation and reconstruction. It is necessary to make a new energy efficient facade with adequate insulation, as well as roof reconstruction with the possibility of setting white thermal-efficient roofs. In this way, greater energy efficiency and lower temperatures will be achieved in the summer period.

The measure could be implemented as a public-private partnership, where socially responsible private companies would be hired to complete the reconstruction of the buildings, according to previously agreed terms in accordance also with the tenants of the buildings, but under the auspices of the municipalities. Socially responsible companies may also be involved in donating to make these refurbishments of buildings, which may in turn place banners on facades, painted ads, or appropriate advertising roofs for donating companies. The more specific municipalities that are obliged to be included in the implementation of this measure are the **municipalities of Chair, Center, Aerodrom, Kisela Voda, Gazi Baba.**
According to the estimation, taking into account the percentage of households living in this type of buildings and surveyed, it is about **6.100 households** that live in urban areas in Skopje Valley. Chair is one of the specific municipality, with estimate of **3.212 households**, then **519 households in Center, 389 in Gazi Baba, 389 in Karposh and 292 in Butel.**

6.1. Households living in an urban area in Gjorche Petrov, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood

In Gjorche Petrov out of 365 households surveyed, according to the set criteria, one household stated that they live in a building built until 1963 in an urban area that has not been renovated yet and has a thermal insulated roof and facade. They using firewood and according to this they are vulnerable group. Since it is one household, it is best to locate this building by GPS address and additionally survey all the households that are living there to determine how they all heat their home. They can be offered to change the heating system, to reconstruct the roof and facade. According to estimates, this group may include about **32 households in Gjorche Petrov**.

6.2. Households living in an urban area in Kisela Voda, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood

In the municipality of Kisela Voda, according to previously defined criteria, it is 16,67%. According to the calculations for the total number of households in Kisela Voda there are about **44 households.**

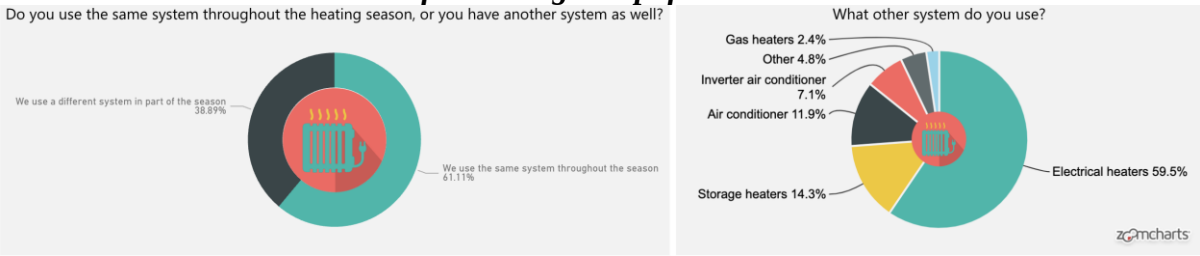
6.3. Households living in an urban area in Chair, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood

In the municipality of Chair, 10,10% of this group say that they use firewood. As such they stand out as a separate group that need to change the way of heating, except that the building in which these households live needs to be renovated to the facade and roof. This group in the municipality of Chair should include **324 households.**

7. Households living in houses in urban areas, are highly educated and use firewood as a way of heating their homes

Households living in urban areas, with at least a high level of education, that use firewood, stand out as a specific group. An interesting finding is that these households 38.89% in the heating season except firewood used another system to heat their homes. This is an argument that if they are informed in detail about the harmful effects on the health of family members and their contribution to air pollution in the environment in which they live, it is expected that they will change heating system.

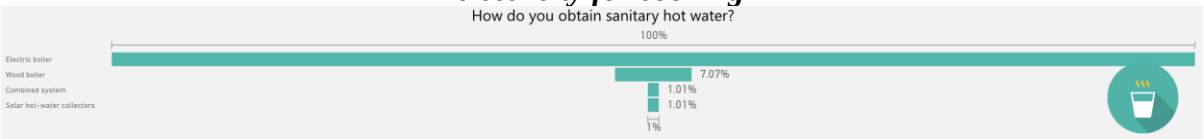
Are households living in houses in urban areas, with at least high level of education, use another source for heating except firewood and which one



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

A potential for greater energy efficiency for this group of households is setting up solar heat collectors. A very small percentage (8.33%) of these households have so far used other sources of energy to provide thermal sanitation in their homes. Most use only electric water heaters. In Butel only one household of the respondents from this group confirmed that they use solar collector, while in the municipality of Gazi Baba (6 households) and Kisela Voda (1 household) have a boiler using wood for sanitary hot water. One household in Karposh using a combined system.

Are households living in houses in urban area, with at least high education, use only electricity for cooking



Source: https://www.skopjesezagreva.mk/all-data-on-fire/

Municipalities	%
Aerodrom	1,4%
Butel	4,4%
Gazi Baba	2,8%
Gjorche Petrov	3,3%
Karposh	3,9%
Kisela Voda	3%
Center	0,5%
Chair	2,7%
Shuto Orizari	1,1%

Source: own calculations

This group of households accounts for **2.1% or 3.504 households** out of the total number of households in the Skopje Valley.

Conclusion and recommendations

The availability of data obtained from a survey of household heating in the Skopje Valley in January 2017, as well as the use of Microsoft Power Bi software tool offers the possibility of cross-referencing more data and identifying different groups. In this report, the demographic and socio-economic characteristics of the surveyed households, as well as the underlying motive for defining vulnerable categories of households in the Skopje Valley exposed to climate change, are the criteria for creating these target groups.
The report identifies 7 (seven) different groups of households, and several specifically specified groups that originate from the primary ones.

1. Single mothers living in houses with children under the age of 18, using firewood
1.1. Single mothers living in houses with children under the age of 18, from municipality Chair, using alternatively harmful fuels
1.2. Single mothers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use
2. Single fathers living in houses with children under the age of 18, using firewood
2.1. Single fathers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use
3. Women 65+ age, with monthly income beyond 12.000 denars single, divorced or widower and live alone
4. Men 65+ age, with monthly income beyond 12.000 denars, single, divorced or widower and live alone
4.1. Men 65+ age, from Gazi Baba, with monthly income beyond 12.000 denars, use coal and live alone
5. Households living in a rural environment in a house with monthly income of up to 12.000 denars
5.1. Households from the municipality of Studenichani living in a rural area, in houses, with low monthly income and use coal for heating
6. Households living in an urban area in the Skopje Valley, in buildings built up to 1963 or whose last renovation was at the latest until that year, have thermal insulated roof and insulation of a facade of up to 2cm
6.1. Households living in an urban area in Gjorche Petrov, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood
6.2. Households living in an urban area in Kisela Voda, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood
6.3. Households living in an urban area in Chair, in buildings built up to 1963, they are not renovated, have thermal insulated roof and facade and use firewood
7. Households living in houses in urban areas, are highly educated and use firewood as a way of heating their homes

The recommendations for these groups fit in and should be part of the implementation of the activities and measures of the Study on the Heating in the City of Skopje, Analysis of Policies and Measures STUGRES and Skopje is breaths, prepared in 2017. Studies have shown that firewood is the largest local air pollutant especially with PM particles. "Of the many factors

that undoubtedly have an impact on air quality and air pollution in the City of Skopje, the most dominant is household heating or 90% of total PM10 particles."
Poor thermal insulation of buildings contributes to greater energy demand for heating on the one hand, and inefficient stoves and boilers used to heat homes contribute to increased local pollution. In addition, inefficient use of energy is one of the main causes of increased greenhouse gas emissions.

According to their characteristics as vulnerable categories, measures are proposed to make certain changes. In the Skopje breathing scenario, the measures envisaged to be implemented in the period 2017-2025, contribute to reducing energy consumption from sources whose GHG emissions are high and their replacement with low-carbon sources with minimal effect on local pollution.

1. Fuel change and heating (use of more efficient technologies)

- complete shutdown of coal as a source of warming in homes;
- changing the way homes are heated by replacing fossil fuels primarily with firewood with alternative environmentally friendly sources of energy,
- replacement of firewood stoves with newer and more energy efficient ones;
- possibility to connect to central heating system.

2. Energy efficient buildings (improvement of insulation in residential buildings)

- renovation and replacement of insulated or slightly insulated facades lower than prescribed standards with a thermally efficient facade of housing structures;
- renovation and replacement of insulated roofs with thermally insulated roofs with the possibility of installing appropriate solutions for the use of solar energy;

3. Increased acceptance of central heating (existing or small central systems)

The most desirable scenario is to include all proposed groups through appropriate measures and activities that will enable the realization of the goals set in STUGRES and Skopje breath.

The planned activities, as well as the number of households to be covered by the proposed STUGRES measures are shown in the figure.

Figure 1

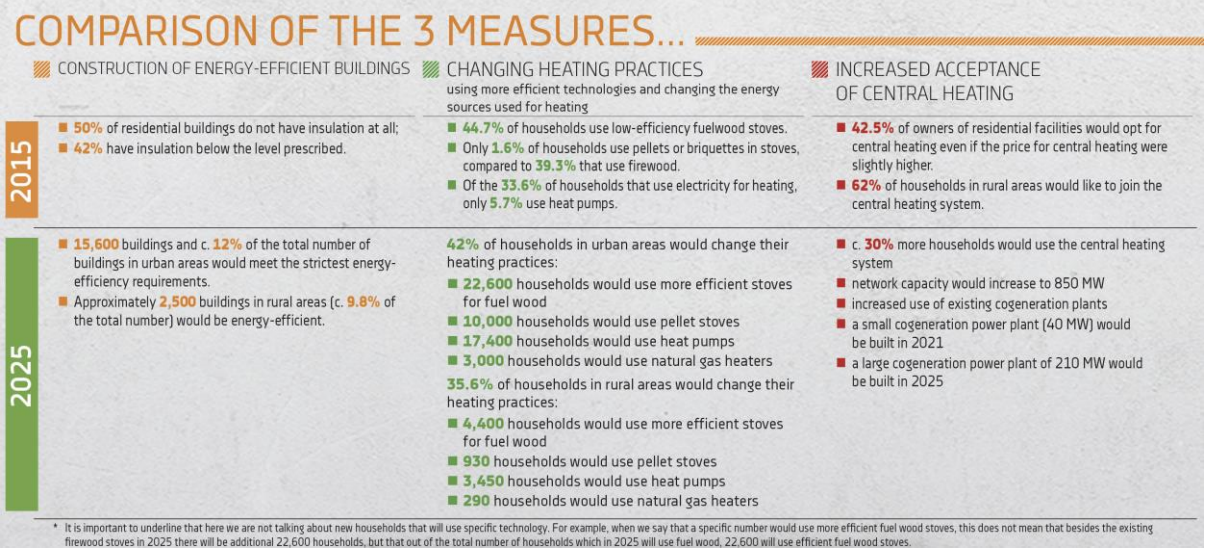
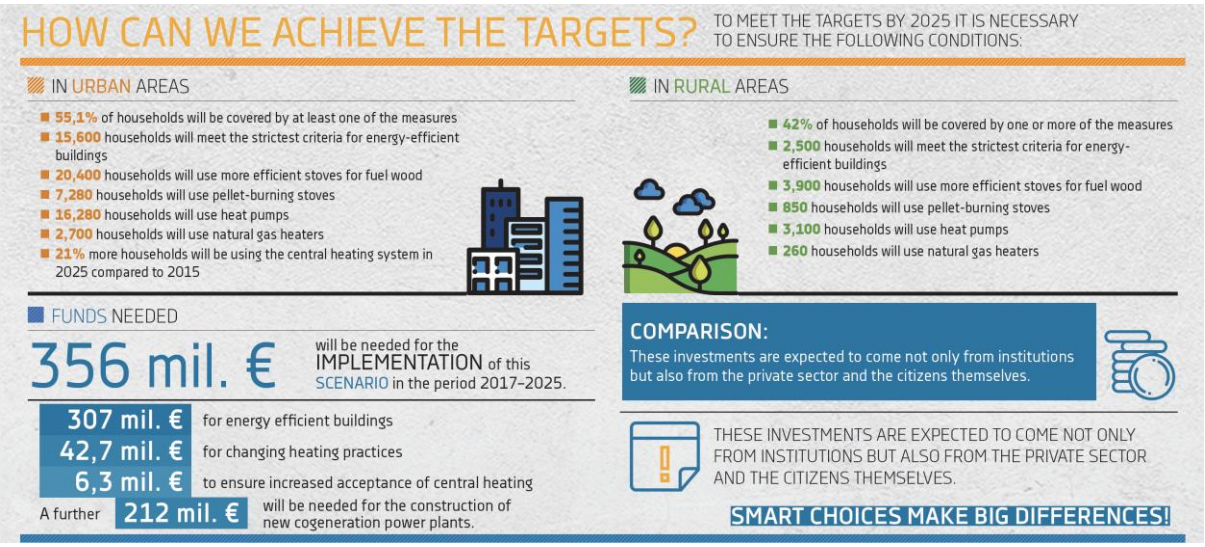


Figure 2 presents the guidelines on how to achieve the goals:

Figure 2



According to the calculations for the vulnerable groups that should be included in the STUGRES scenario, around **9.354 households** with single parents with minor children, elderly living alone and rural households with low monthly incomes should change their heating system by 2025 or replace ovens they use with more efficient pellet stoves, heat pumps or natural gas stoves.

Special category is the households that live in houses in the urban area, are highly educated and use firewood as a way of heating their homes, which should change the way of heating are **3.504 households.**

In the municipality of Chair, **97 single mothers** with children younger than 18 years, using harmful fuels, **83 Gazi Baba households** are 65+ men using coal, **34 households from Studenichani** using coal for heating, should change their heating method.

Households that need to improve the energy efficiency of their homes by renovating the facade and roof are estimated to be around **6.300 households** (6.294). The single parents in the municipality of Karposh that should be covered by this measure are about **200 households** (195 households).

Particularly interesting and certainly a category that must be part of energy efficiency improvement activities are the old buildings that were built until 1963. It is about **6.100 households** living in such buildings. Most present in Chair, about **3.212 households.**

The total data on the number of households by the defined groups of this report, by municipalities is presented in Table no. 9 in the Annex to this document.

ANNEX

The analysis and determination of the vulnerable groups for the report is based on the data from the Survey on the Warming of Households in Skopje Valley. The survey included 5044 households from all municipalities in the Skopje valley. The percentages of households covered by municipalities are as follows:

Table 1

Municipalities	Number of surveyed households	Percentage coverage of surveyed households
Aerodrom	592	**11,7%**
Arachinovo	102	**2,0%**
Butel	318	**6,3%**
Gazi Baba	689	**13,7%**
Gjorche Petrov	365	**7,2%**
Zelenikovo	35	**0,7%**
Ilinden	119	**2,4%**
Karposh	540	**10,7%**
Kisela Voda	492	**9,8%**
Petrovec	61	**1,2%**
Saraj	312	**6,2%**
Sopishte	55	**1,1%**
Studenichani	143	**2,8%**
Center	423	**8,4%**
Chair	559	**11,1%**
Chucher Sandevo	60	**1,2%**
Shuto Orizari	179	**3,5%**
Total	**5044**	**100,0%**

The household approximation was made according to the official data on the number of households in the municipalities of the Skopje valley, according to the database of the State Statistical Office of the Republic of North Macedonia (http://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__Popisi__PopisNaNaselenie__PopisOpstini/01Popis_op_02_VkNasDomSt_mk.px/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef) and the answers received from 5044 households surveyed. Thus, according to the received answers from the surveyed households, a percentage is calculated how much of the total respondents are defined in that group and then from that percentage according to the total number of households in the municipality, how much households belong to the defined group is calculated.

For example: according to the survey data, 4 households in Butel municipality are single mothers with underage children living in a house and using firewood to heat their home. This represents **1.3%** of the total number of surveyed households in Butel (318 households). According to the State Statistical Office of the Republic of North Macedonia, there are **10.316 households** registered in the municipality of Butel (according to the 2002 census). The calculation of 1.3% of this group of households shows that there are about 130 households.

The same methodology is applied in calculations for all groups of vulnerable categories of households.

The analysis of the survey data as well as the approximation by the total number of households is presented in the following tables:

1. Single mothers living in houses with children under the age of 18, using firewood
Table 2

Municipalities	Number of surveyed households	Number of households single mothers with underage children living in houses and heating their homes with firewood	Approximation of the total number of this group of households by municipality
Aerodrom	592	/	/
Arachinovo	**102**	**1**	**32**
Butel	**318**	**4**	**130**
Gazi Baba	**689**	**3**	**97**
Gjorche Petrov	**365**	**1**	**32**
Zelenikovo	35	/	/
Ilinden	119	/	/
Karposh	**540**	**1**	**32**
Kisela Voda	492	/	/
Petrovec	61	/	/
Saraj	**312**	**1**	**32**
Sopishte	55	/	/
Studenichani	**143**	**6**	**195**
Center	**423**	**1**	**32**
Chair	559	/	/
Chucher Sandevo	60	/	/
Shuto Orizari	**179**	**5**	**162**
Total	**5044**	**23**	**746**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

1.1. Single mothers living in houses with children under the age of 18, from municipality Chair, using alternatively harmful fuels

In Chair 0.54% of the surveyed households are using solid fuels that pollute the air. According to the calculations it is about 97 households.

1.2. Single mothers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use

In Karposh, 1.85% of the surveyed are single mothers with young children. From them 0.11% live in houses and can improve energy efficiency in their home. In Karposh there are 10 single mothers with children younger than 18 years. Only, 6 households live in houses and only one household uses firewood. Other 5 households use electricity to heat their homes (electric heaters, thermo-accumulators and heat pumps or air conditioners).

2. Single fathers living in houses with children under the age of 18, using firewood

According to the municipalities the following number of households is concerned:

Table 3

Municipalities	Number of surveyed households	Number of households, single fathers living in houses with children under the age of 18, using firewood	Approximation of the total number of this group of households by municipality
Aerodrom	**592**	**1**	**32**
Arachinovo	102	/	/
Butel	**318**	**2**	**65**
Gazi Baba	**689**	**2**	**65**
Gjorche Petrov	**365**	**1**	**32**
Zelenikovo	35	/	/
Ilinden	**119**	**1**	**32**
Karposh	540	/	/
Kisela Voda	**492**	**2**	**65**
Petrovec	**61**	**2**	**65**
Saraj	**312**	**3**	**97**
Sopishte	55	/	/
Studenichani	**143**	**4**	**130**
Center	423	/	/
Chair	559	/	/
Chucher Sandevo	**60**	**1**	**32**
Shuto Orizari	**179**	**8**	**260**
Total	**5044**	**27**	**876**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

2.1. Single fathers living in houses with children younger than 18, from Karposh, who can improve the efficiency of energy use

In the municipality of Karposh, 2 households are living in the houses and are with the criteria the same with the previous group of single mothers with children younger than 18 years. The same measures as for the previous group of single mothers are proposed. The number are **65 households** from this group in Karposh.

3. Women 65+ age, with monthly income beyond 12.000 denars single, divorced or widower and live alone

Of the 5.044 households surveyed in the Skopje Valley, 32 households are single women over 65 with low monthly household income living alone and 13 households living in an apartment. According to the analysis, it is about 0,89% of all surveyed households, or around **1.460 households** (extrapolated with the official data from the States statistical office, from the 2002 census).

The presence of these households in the municipalities in Skopje Valley and certain specifics, defines in more detail the behaviour of these women.

Butel – 1 household

- In Butel, all respondents use central city heating, heat ¼ from home, 6 hours a day on all days of the week, including holidays.
- The cost of investment is a key criterion for deciding how to heat their home. If they have to change the method of heating, regarding the price, everyone would use a wood-fired boiler.

Gazi Baba – 6 households

- 83.33% use firewood, 16.67% electric heaters or electric boiler
- of those who use firewood all have wood stoves, of which 60% are over 20 years old.
- for the 83.3% crucial factor for what heating system will use, is the cost of the monthly expense, and for 16.7% point out the possibility for automatic operation.
- If they have to replace the heating system, 50% do not know with what to replace, 16.7% would like the change to central city heating, 16.7% with a wood boiler and 16.7% with a boiler on gas.

Gjorche Petrov – 2 households

- 50% use firewood and 50% central city heating.
- 50% heat the home 12 hours a day throughout the heating season (including weekends and holidays), while 50% heat the home 16 hours.
- those who use firewood have a wood stove older than 20 years.
- 50% set the monthly cost as the most important criterion for choosing the heating system, while 50% consider the possibility of automatic operation.

Zelenikovo – 2 households

- all use firewood, heated ¼ from home, 12 to 16 hours a day, with wood stoves older than 20 years,
- the cost of the investment and the cost of the monthly expense are crucial for deciding which heating system to use.

Karposh – 3 households

- 33.33% use central city heating, 33.33% electric pump or air conditioner and 33.33% firewood
- heat the home from 12 hours a day 66.7%, to 16 hours a day 33.3%.
- those who use firewood have wood stoves older than 20 years, and 66.7% would change the heating system with central heating, while others do not know what to choose.
- crucial for the choice of heating are other (66.7%) and the possibility of automatic operation (33.3%)

Kisela Voda – 13 households

- 92.31% use firewood, while 7.69% use electric heaters or boiler
- 69.2% heat the home 12 hours a day
- 61.54% heat the whole home, 23.08% ½ of the home.
- 76.9% price on monthly cost and 23.1% cost on investment
- 91.67% use wood stoves older than 20 years

Saraj – 3 households

- 100% use firewood
- 66.6% heat their home from 12 to 14 hours a day including weekends and holidays, 66.7% heat 1/3 of the premises in the home.
- those who use firewood have wood stoves older than 20 years and also using fierwood for cooking
- 66.7% think that other than the stated reasons are important for the choosing the heating system, the monthly expenses is relevant for the 33.33% of the respondents and all 100% of the respondents do not know what they would choose as a system of heating if they need to replace the existing one.

Sopishte – 3 households

- all 100% use firewood and wood stoves, with 66.67% heating 1/3 of the home 12 - 14 hours a day
- for the 33.33% the cost of the investment, 33.3% think that other reasons besides the above are crucial for the choice of heating method, and 33.33% the the monthly cost. The wood stoves they use are over 20 years old and if they have to change the heating method they would replace it with a wood boiler.

Center – 2 households

- 50% use central city heating and 50% electricity with thermal accumulator
- half of the respondents heat the home 16 hours a day, and the other half 8 hours a day whether it is a weekend or holiday, heating 50% of the home or entire home.
- the cost of the monthly expense and the possibility of automatic operation of the heating system are crucial factors, with everyone declaring that if they had to change the heating system, they would choose central city heating.

Chair – 9 households

- 88.89% electricity with thermal accumulator, 11.11% (electric heaters or boiler)
- heat the home for 20 hours a day, and 66.67% heat 1/3 of the premises.
- 88.9% possibility of automatic work, 11.1% other
- 55.6% would change central heating system while 44.4% would not know what to choose

Chucher Sandevo – 1 household

- uses firewood, with a wood oven 10-20 years old, heats 16 hours daily ¼ from the premises of the home.
- the cost of the monthly expense is a crucial factor in choosing a heating system, but if it needs to change the method of heating it does not know with what it will replace.

Table 4

Municipalities	Number of surveyed households	Number of households, women 65+ age, with monthly income beyond 12.000 denars singl, divorced or widower and live alone	Approximation of the total number of this group of households by municipality
Aerodrom	592	/	/
Arachinovo	102	/	/
Butel	**318**	**1**	32
Gazi Baba	**689**	**6**	195
Gjorche Petrov	**365**	**2**	65
Zelenikovo	**35**	**2**	65
Ilinden	119	/	/
Karposh	**540**	**3**	97
Kisela Voda	**492**	**13**	422
Petrovec	61	/	/
Saraj	**312**	**3**	97
Sopishte	**55**	**3**	97
Studenichani	**143**	/	/
Center	**423**	**2**	65
Chair	559	**9**	292
Chucher Sandevo	60	**1**	32
Shuto Orizari	179	/	/
Total	**5044**	**45**	**1460**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

4. Men 65+ age, with monthly income beyond 12.000 denars, singl, divorced or widower and live alone

Analysis of the municipalities highlights the following characteristics for this group:

Aerodrom – 1 household

- Uses firewood, with a wood oven older than 20 years, heats the home 12 hours a day, heating it from the premises of the home. The cost of the monthly expense is crucial, and I would replace it for a wood boiler

Gazi Baba – 10 households

- 70% use firewood, 20% electric heaters or boiler and 10% coal
- 40% heat only 8 hours a day
- for 80% of the surveyed, the cost of the monthly expense is crucial for the choice of heating system, 10% the investment cost and 10% how much heathing system pollute the environment.
- 40% do not know what kind of system would like to replace the existing one, 20% would choose central city heating, 20% wood boiler, 20% electric heaters

- of those households who using firewood, 42.86% have ovens older than 20 years and the same percentage, 42.86% have wood stoves 10-20 years old.

Kisela Voda – 2 households

- 50% use extra light, 50% firewood, heats the whole house for 8 hours a day
- the cost of investment is a determining factor, and if they have to change, 50% would use an oil boiler and 50% a wood boiler,
- the specific for this municipality is that these households that use firewood have wood stoves that are only 2 years old.

Sopishte - 3 households

- Firewood with ovens older than 20 years,
- Respondents rate the importance of the criteria for selection of heating system as 66.7% other and 33.3% cost per month. But all 100% said they would replace the existing heating system with a wood-fired boiler.

Approximation by municipalities of this group is given in the following table:

Table 5

Municipalities	Number of surveyed households	Number of households, men 65+ age, with monthly income beyond 12.000 denars singl, divorced or widower and live alone	Approximation of the total number of this group of households by municipality
Aerodrom	592	**1**	32
Arachinovo	102	/	/
Butel	318	/	/
Gazi Baba	**689**	**10**	324
Gjorche Petrov	365	/	/
Zelenikovo	35	/	/
Ilinden	119	/	/
Karposh	540	/	/
Kisela Voda	492	**2**	65
Petrovec	61	/	/
Saraj	312	/	/
Sopishte	**55**	**3**	97
Studenichani	143	/	/
Center	423	/	/
Chair	559	/	/
Chucher Sandevo	60	/	/
Shuto Orizari	179	/	/
Total	**5044**	**16**	**519**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

4.1. Men 65+ age, from Gazi Baba, with monthly income beyond 12.000 denars, use coal and live alone

In the municipality of Gazi Baba there are households that are men 65 and older, living alone, with a monthly income of up to 12,000 denars and using coal to heat their homes. Only, one household use coal.

5. Households living in a rural environment in a house with monthly income of up to 12.000 denars

According to the municipalities the following number of households is concerned:

Table 6

Municipalities	Number of surveyed households	Number of households living in a rural area, in house with low monthly income, using firewood	Approximation of the total number of this group of households by municipality
Aerodrom	592	/	/
Arachinovo	**102**	**28**	**908**
Butel	**318**	**4**	**130**
Gazi Baba	**689**	**38**	**1233**
Gjorche Petrov	**365**	**11**	**357**
Zelenikovo	**35**	**6**	**195**
Ilinden	119	/	/
Karposh	**540**	**1**	**32**
Kisela Voda	**492**	**1**	**32**
Petrovec	61	/	/
Saraj	**312**	**22**	**714**
Sopishte	**55**	**13**	**422**
Studenichani	**143**	**34**	**1103**
Center	423	/	/
Chair	559	/	/
Chucher Sandevo	**60**	**7**	**227**
Shuto Orizari	179	/	/
Total	**5044**	**165**	**5353**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

Arachinovo – 28 households

- 75% use firewood, 25% electricity, heaters or electric kettle
- 71.43% use a wood stove, while 19.05% use a wood boiler in a separate room (boiler room)
- 42.9% criterion for choosing the heating method is the investment cost, 28.6% monthly cost and 28.6% other
- if they would change the heating system, 78.6% would choose a wood boiler

Butel – 4 households

- 100% use firewood, 75% of them use wood stoves and 25% use a fireplace, with half of them heating their homes 12 hours a day
- the selection criteria for the heating system are 50% the monthly cost and 50% the investment cost
- if they would change the heating system, 75% would choose a gas boiler and the remaining 25% a wood boiler
- provide hot water with an electric water heater

Gazi Baba – 38 households

- 94.74% use firewood, 2.63% electricity, heaters or boiler, and 2.63% electric thermal accumulator
- 80.56% use wood stove, 13.89% indoor fireplace and 5.56% open fireplace
- 71.1% the cost of the monthly expense is crucial for the choice of heating system, 23.7% the investment cost, and if the heating system should be changed 55.3% would choose a wood boiler and 15.8% % central city heating

Studenichani – 34 households

- 85.29% use firewood, 11.76% coal and 2.94% electricity
- 76.47% heat up ¼ of the house
- equally significant 44.1% are the cost of the monthly cost and 44.1% the investment cost when choosing a heating system, with 76.5% replacing a wood boiler, and 14.7% not knowing what to choose

Saraj – 22 households

- 95.45% use firewood, 4.55% electricity thermo accumulation oven
- 86.4% value the investment price as a special criterion for changing the heating system, with 40.9% replacing the existing heating system with a wood-fired boiler, while 36.4% do not know what they would choose.

Sopishte – 13 households

- 92.31% use firewood and 7.69% electric heaters or electric kettle
- 53.8% other than the mentioned are the criteria for selection of heating system, while 38.5% is the price of the monthly expense crucial, 76.9% would replace a wood boiler

Gjorche Petrov – 11 households

- 100% use firewood
- 54.55% heat 1/3 of the home
- 63.6% investment price, 27.3% monthly cost price,
- 54.5% would change with central city heating, 36.4% with wood boiler

5.1. Households from the municipality of Studenichani living in a rural area, in houses, with low monthly income and use coal for heating

The analysis of the respondents shows that of the 34 households surveyed, 11.76% use coal. According to the calculation of the total number of households, there are about 130 households that are obliged to change the coal as a way of heating the home.

6. Households living in an urban area in the Skopje Valley, in buildings built up to 1963 or whose last renovation was at the latest until that year, have thermal insulated roof and insulation of a facade of up to 2cm

Distribution by municipality, by those parameters belonging to this group, as well as calculation of total number of households by municipality is presented in the following table.

Table 7

Municipalities	Number of surveyed households	Number of households living in an urban area in the Skopje Valley, in buildings built up to 1963 or whose last renovation was at the latest until that year, have thermal insulated roof and insulation of a facade of up to 2cm	Approximation of the total number of this group of households by municipality
Aerodrom	**592**	**28**	**908**
Arachinovo	102	/	**/**
Butel	**318**	**9**	**292**
Gazi Baba	**689**	**12**	**389**
Gjorche Petrov	**365**	**6**	**195**
Zelenikovo	35	/	**/**
Ilinden	119	/	**/**
Karposh	**540**	**12**	**389**
Kisela Voda	**492**	**6**	**195**
Petrovec	61	/	**/**
Saraj	312	/	**/**
Sopishte	55	/	**/**
Studenichani	143	/	**/**
Center	**423**	**16**	**519**
Chair	**559**	**99**	**3212**
Chucher Sandevo	60	/	**/**
Shuto Orizari	179	/	**/**
Total	**5044**	**188**	**6099**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

Aerodrom – 28 households

- Most of these households use central heating (39.29%), 32.14% electricity with thermal accumulator, 17.86% electricity with heaters or electric kettle and 7.14% electricity with heat pump or air conditioner and 3, 57% propane butane.

- More than half of the households (60.7% of those surveyed) heat their homes for more than 16 hours a day, both on weekends and on weekends and holidays, with 39.29% heating at home and as much as 39.29% they heat the whole house.
- Selection criterion of heating system according to 60.7% of this group are the monthly cost of heating.

Butel – 9 households

- 77.78% are connected to central city heating, 11.11% electricity heaters and electric kettle and 11.11% electricity thermal accumulator;
- 77.8% heat the home 8 hours a day, with 55.56% heating the home;
- 66.7% stated that the cost of investment and 22.2% of the cost of the monthly expense are the deciding factor in choosing a home heating system.

Gazi Baba – 12 households

- 41, 67% use electricity (electric heaters and boiler), 33.33% use electricity with heat pump or air conditioner, 16.67% central city heating and 8.33% thermal accumulator
- 33.33% heat the home 12 hours a day and 25% 14 hours a day. 41.7% of them heat their home 8 hours a day during weekends and holidays, with 58.33% heating their entire home;
- for 2/3 of this group of surveyed households the basic criterion for choosing the heating system is the investment cost, by 16.7% the monthly cost.

Gjorche Petrov – 6 households

- 50% use electricity with heat pump or air conditioner), 33.33% use electricity with thermal accumulator and 16.67% use firewood.
- 50% heat the home about 8 hours a day on weekdays and longer than 16 hours a day on weekends and holidays, with most warming up more than half of the premises.
- 50% decisive factor for the choice of heating is the investment cost, 33.33% the monthly cost and 16.7% of this group answered the possibility of automatic operation of the heating system.

Karposh - 12 households

- 58.33% central city heating, 16.67% electricity (electric heaters and boiler) and 16.67% electricity with thermal oven) and 8.33% extra light fuel
- 50% heat the home 6 hours on weekdays and 6-12 hours daily on weekends and holidays, with more than half of those surveyed in this group (66.67%) heating the entire surface of the home
- 50% responded that as a selection criterion the heating system respects the monthly cost, while 25% is relevant to the cost of the investment, and 16.7% to the possibility of automatic operation and 8.3% to other criteria.

Kisela Voda - 6 households

- 33.33% electricity (electric heaters and boiler), 33.33% electricity with thermal accumulators), 16.67% firewood and 16.67% central city heating.

- 50% - 12 hours a day, 33.3% 16 hours a day all week and weekend days and holidays, all warming up the whole home
- 83.3% cost per month, 16.7% opportunity for automatic work
- those who use firewood use wood stoves older than 20 years
- If they had to replace the heating system 66.7% would replace with electric heaters, 16.7% with central heating and as much as 16.7% with a wood boiler.

Center – 16 households

- 62.50% central city heating, 37.50% electricity (electric heaters and boiler),
- 37.5% 12 hours a day on weekdays, and 62.5% 12 hours a day on weekends and holidays, with 62.5% heating the entire home.
- 75% monthly cost, 12.5% investment, 6.3% automatic work capability and 6.3% other.

Chair – 99 households

- 46.46% electricity (electric heaters and boiler), 24.24% electricity with thermal accumulator, 10.10% firewood, 10.10% central city heating, 9.09% electricity heat pump or air conditioner;
- of those who use firewood 90% use a wood stove and 10% use a closed fireplace (door with fireplace with closure)
- 30% of those using firewood have stoves old between 5 - 10 years, but the same percentage 30% have stoves older than 20 years, while 20% are 2-5 years old;
- 35.4% of this group of households stated that the deciding factor in choosing a home heating system is the cost of investment, and 28% other factors, 20.2% the possibility of automatic operation. The cost of the monthly bill and the cost of the investment for this category of households in Chair is not so significant, i.e. 16.2% of this group.
- 43.4% stated that if the heating system needs to be changed they do not know what they would choose, and 31.3% would choose a wood boiler and 23.2% central city heating.

7. Households living in houses in urban areas, are highly educated and use firewood as a way of heating their homes

The distribution of these households by municipality and the calculation of the total number of this group of households by municipality is given in the following table:

Table 8

Municipalities	Number of surveyed households	Number of households living in houses in urban areas, are highly educated and use firewood as a way of heating their homes	Approximation of the total number of this group of households by municipality
Aerodrom	**592**	**8**	**260**
Arachinovo	102	/	/
Butel	**318**	**14**	**454**
Gazi Baba	**689**	**19**	**616**
Gjorche Petrov	**365**	**12**	**389**
Zelenikovo	35	/	/
Ilinden	119	/	/
Karposh	**540**	**21**	**681**
Kisela Voda	**492**	**15**	**487**
Petrovec	61	/	/
Saraj	312	/	/
Sopishte	55	/	/
Studenichani	143	/	/
Center	**423**	**2**	**65**
Chair	**559**	**15**	**487**
Chucher Sandevo	60	/	/
Shuto Orizari	**179**	**2**	**65**
Total	**5044**	**108**	**3504**

Source: https://www.skopjesezagreva.mk/all-data-on-fire/ , own calculations

Number of households included in the groups in this report by municipalities in Skopje Valley

Table 9

Municipalities	Group 1.	Group 1.1.	Group 1.2.	Group 2.	Group 2.1.	Group 3.	Group 4.	Group 4.1.	Group 5.	Group 5.1.	Group 6.	Group 6.1., 6.2 и 6.3.	Group 7.	Total
Aerodrom	/	/	/	32	/	0	32		0	/	908	/	260	1.232
Arachinovo	**32**	/	/	0	/	0	0		908	/	0	/	0	940
Butel	**130**	/	/	65	/	32	0		130	/	292	/	454	973
Gazi Baba	**97**	/	/	65	/	195	324	83	1.233	/	389	/	616	3.002
Gjorche Petrov	**32**	/	/	32	/	65	0		357	/	195	**32**	389	1.070
Zelenikovo	/	/	/	0	/	65	0		195	/	0	/	0	260
Ilinden	/	/	/	32	/	0	0		0	/	0	/	0	32
Karposh	**32**	/	**130**	0	**65**	97	**0**		32	/	389	/	681	1.426
Kisela Voda	/	/	/	65	/	422	65		32	/	195	**44**	487	1.310
Petrovec	/	/	/	65	/	0	0		0	/	0	/	0	65
Saraj	**32**	/	/	97	/	97	0		714	/	0	/	0	908
Sopishte	/	/	/	0	/	97	97		422	/	0	/	0	616
Studenichani	**195**	/	/	130	/	0	0		1.103	**34**	0	/	0	1.267
Center	**32**	/	/	0	/	65	0		0	/	519	/	65	681
Chair	/	**97**	/	0	/	292	0		0	/	3.212	**324**	487	4.315
Chucher Sandevo	/	/	/	32	/	32	0		227	/	0		0	291
Shuto Orizari	**162**	/	/	260	/	0	0		0	/	0		65	325
Total	**746**	**97**	**130**	**876**	**65**	**1.460**	**519**	**83**	**5.353**	**34**	**6.099**	**400**	**3.504**	**18.713**

Source: own calculations