Market uptake of small modular renewable district heating and cooling grids for communities

Project No: 691679

CoolHeating.eu

Survey on the energy consumption and attitudes towards renewable heating and cooling in the CoolHeating target communities

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Authors: Tomislav Pukšec, UNIZAG FSB, Croatia
Neven Duić, UNIZAG FSB, Croatia
Rok Sunko, SKUP, Slovenia
Milada Mataradžija, VISOKO, Bosnia and Herzegovina
Emir Fejzović, VISOKO, Bosnia and Herzegovina
Amira Babić, VISOKO, Bosnia and Herzegovina
Vladimir Gjorgievski, SDEWES-Skopje, Macedonia
Ljupco Dimov, SDEWES-Skopje, Macedonia
Vasil Bozhikaliev, SDEWES-Skopje, Macedonia
Natasa Markovska, SDEWES-Skopje, Macedonia
Slobodan Jerotić, ŠABAC, Serbia

Editors: Tomislav Pukšec, UNIZAG FSB, Croatia

Contact: University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture
Dr.sc. Tomislav Pukšec
E-mail: tomislav.puksec@fsb.hr, phone: +385 1 6168 242
Ivana Lučića 5.
10000 Zagreb, Croatia
www.fsb.hr

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1 Introduction

As a part of Workpackage 3 in the CoolHeating project, this report on the survey with citizens of the target communities provides analysis of the results from surveys and general conclusions that can be drawn from these results. The main goal of this Workpackage is to ensure sustained public acceptance of renewable district heating projects by involving citizens of target communities to project activities and by gathering their opinion.

In Task 3.4, the aim is to gather ideas, suggestions and energy data from the citizens in order to plan small district heating systems in a participatory way, that way increasing the public acceptance. Therefore, a questionnaire was developed by UNIZAG FSB which was translated and adapted by partners in target communities. Analyses of the results were also made by partners in target communities. Questionnaires were distributed to citizens in form of a hard copy and in form of an online questionnaire. However, only a small amount of online questionnaires were filled. Target communities which were surveyed in this task are: city of Ozalj (Croatia), municipality of Cven (Slovenia), Municipality of Visoko (Bosnia and Herzegovina), municipality of Karposh (Macedonia) and city of Šabac (Serbia). The objective was to collect 2,500 questionnaires overall, which would mean 500 questionnaires per target community. Some target communities could not gather that much questionnaires due to their size (e.g. Ozalj and Cven), but other, larger target communities gathered more than needed 500 questionnaires, so the overall objective was almost reached. Technical data gathered in questionnaires will be further used in Workpackage 4 to asses heating/cooling demand of target communities.

The questionnaire can be divided into four main parts: information on building stock, information on the heating system in the household, information on energy consumption and information on public opinion. This report includes analyses of questionnaires gathered form all five target communities. Results from each part of the questionnaire will be presented in forms of graphs and will be followed by the analysis of results as well as brief conclusion.

In order to receive more accurate data on energy consumption, questionnaire contained one extra question about personal information of the interviewed household/citizen, which included name, address and contact information. This data will not be shown in the results of the survey and this question was optional. The questionnaire also included the disclaimer about the data protection, as follows: "*The following information of question on your personal data are optional. Your address would be helpful to better assess the potential for setting up a small renewable district heating network in your community. These data will be received by the CoolHeating partner responsible for the survey, as shown below. The data will serve only for the purposes of the CoolHeating project. By filling the name and address below (optional), I confirm that the data collected in this questionnaire can be used for the CoolHeating project in order to support small renewable district heating networks. I am aware that I can revoke these data at any time. In this case, my personal data will be deleted. Existing results of the anonymous analysis will not be affected by the revocation"*. This was discussed with CoolHeating project ethical advisor who confirmed that this questionnaire is acceptable from ethical and data protection viewpoint.

2 Results of the survey in the target community in Croatia

Target community in Croatia is city of Ozalj which has 2,283 households (2011 census). As a part of Task 3.4, 390 questionnaires were gathered from the citizens of Ozalj, which accounts for 17 % of the total amount of households in the city. Only 10 questionnaires (2.5 %) were gathered online, while the rest was gathered on a hard copy.

Hard copies were distributed among citizens during the first CoolHeating info event in the city, but most of the questionnaires were gathered by door-to-door interviewing. During door-to-door interviewing, citizens were also given promotional material in form of project flyers and pencils. Due to relatively small number of households in Ozalj, less than 500 questionnaires were gathered and it would be highly unlikely to successfully gather more questionnaires in this city. Parts of the city which were surveyed in this task are shown in Figure 1 in form of red dots. Results of the questionnaires are presented in next subchapters.

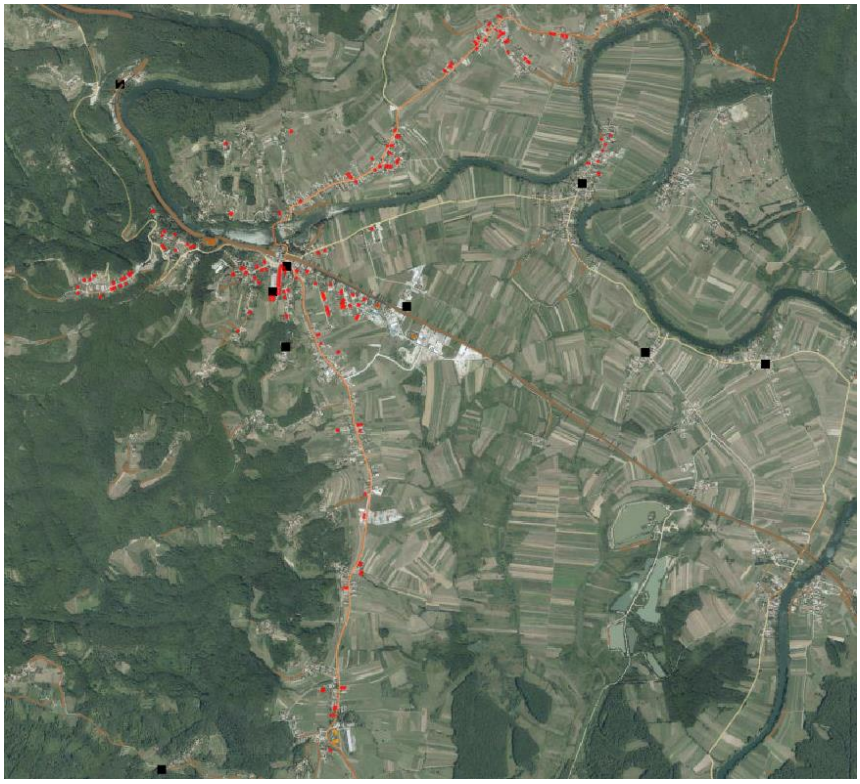

Figure 1. Parts of the city (red dots) included in the survey

2.1 Information on building stock

There are 9 questions and 2 sub-questions in the questionnaires, which provide information on building stock in Ozalj. Questions concern type of household, build period, period of last refurbishment, number of people living in the household, floor area of the household, number of rooms in the household and insulation level of outer walls and roof. 2 sub-questions concern type and thickness of insulation for the outer walls and roof.

The majority of people in Ozalj live in houses, as shown in Figure 2. These results were actually expected since the city is situated in a rural part of Croatia. This is characteristic for small rural towns and cities in Croatia. This will result in lower heat demand densities in most of the city. Nevertheless, centre of the city is expected to have higher heat demands since all of the apartment buildings are situated there, as well as some big heat consumers like primary school, supermarket, city hall, etc.

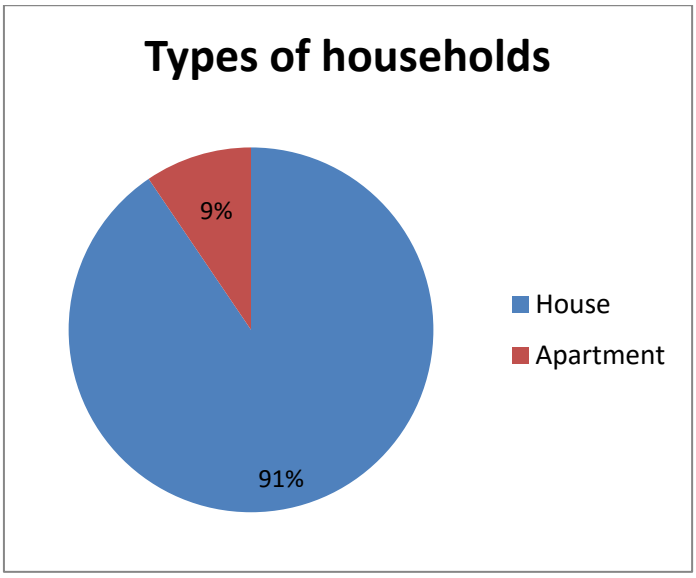

Figure 2. Type of households in the city of Ozalj

Concerning the age of buildings in Ozalj, it can be seen that most buildings were built in the period 1961 – 1980. This means that the average age of buildings in Ozalj is 40 years, as shown in Figure 3. This follows the general trend in Croatia, where most of the buildings have been built in the middle of previous century. Average age of buildings and the lack of adequate heating insulation result in high heat demands of buildings in Croatia, which in turn results in high distribution temperatures in district heating systems.

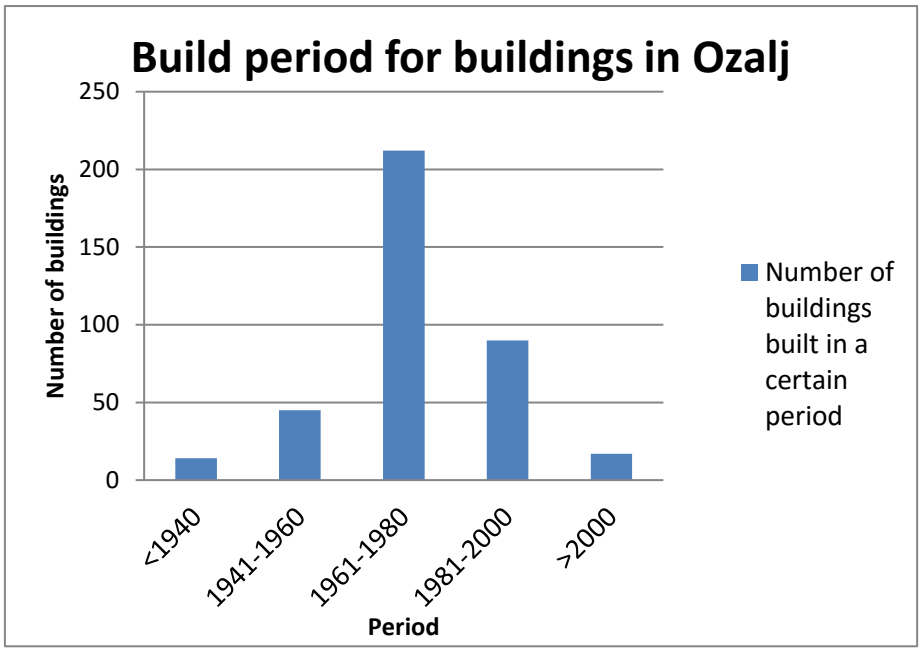

Figure 3. Build period for buildings in Ozalj

Overall, around 64 % of surveyed households in Ozalj were refurbished to some extent since they have been built. It can be seen in Figure 4 that refurbishments mostly took place in the last 6 years, which would mean that higher standard insulation or windows were used. Due to high average age of buildings in Ozalj, the share of refurbished buildings is still rather low

and should be improved in the future in order to achieve lower heat demands of the buildings.

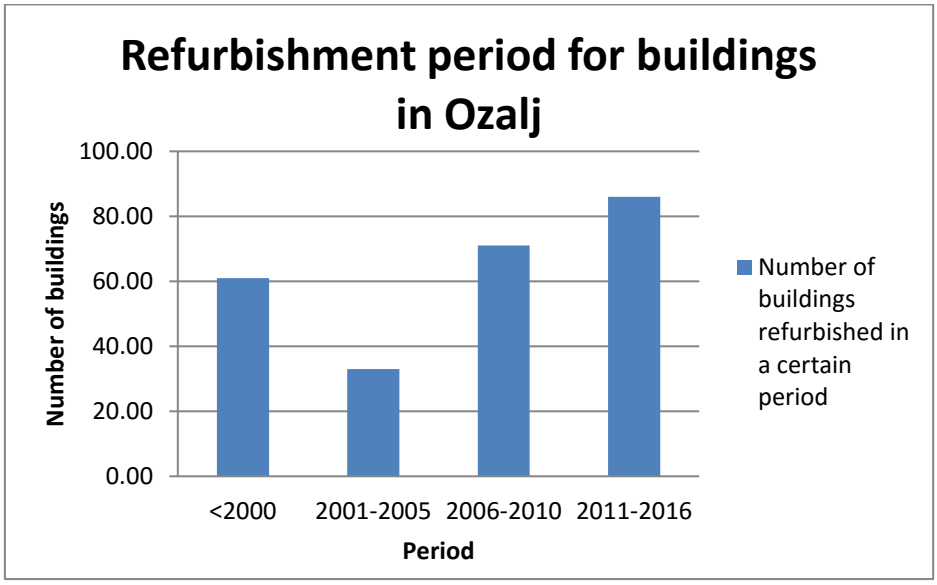

Figure 4. Refurbishment period for buildings in Ozalj

In average, 3-5 people are living in a certain household, which fits well with the data from Croatian Bureau of Statistics for Ozalj. Results on a number of people living in a certain household are presented in Figure 5. As can be seen, in just 28 % of surveyed households there are less than 3 people living in the household. This is probably due to the fact that most of the people in Ozalj live in houses, which have larger floor areas than apartments and can therefore accommodate more people.

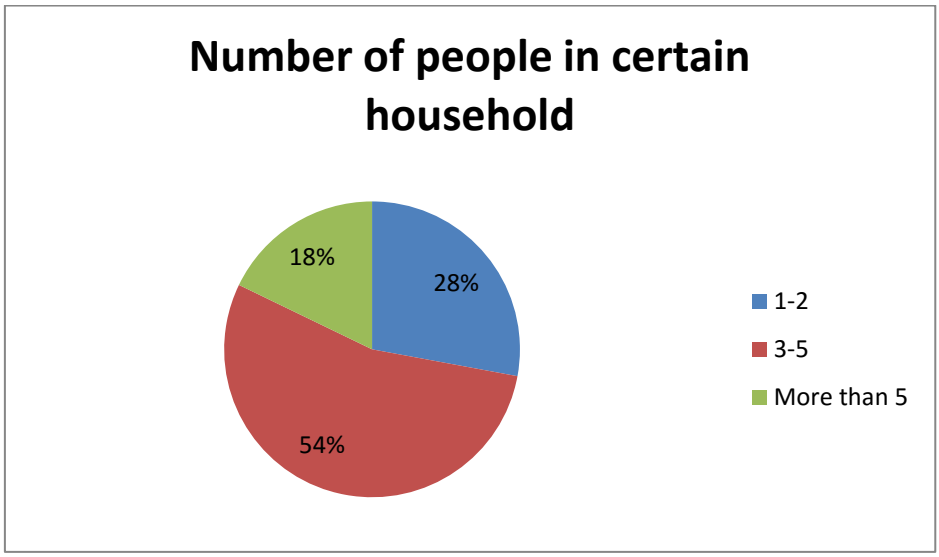

Figure 5. Number of people living in a certain household in Ozalj

As shown in Figure 6, around 4 % of surveyed households have a floor area of less than 50 m^2, which supports the previous claim. Average floor area of households in Ozalj is much higher, at 180 m^2. This is also connected to a number of rooms in households, with around 2/3 of interviewed citizens having more than 6 rooms in their household. Households with

less than 4 rooms are practically negligible, as can be seen in Figure 7. All these facts should results in higher heat demands of the households.

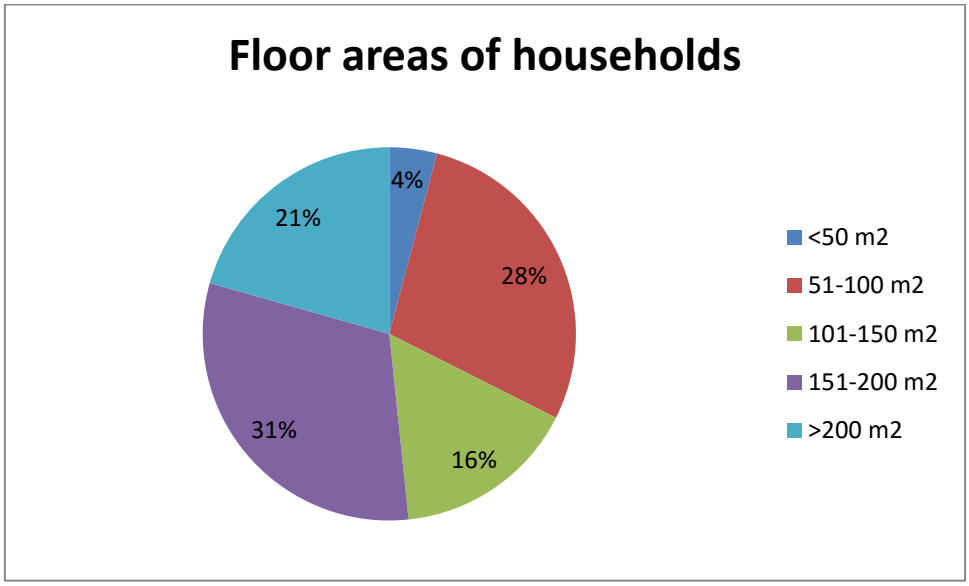

Figure 6. Range of floor areas of surveyed households in Ozalj

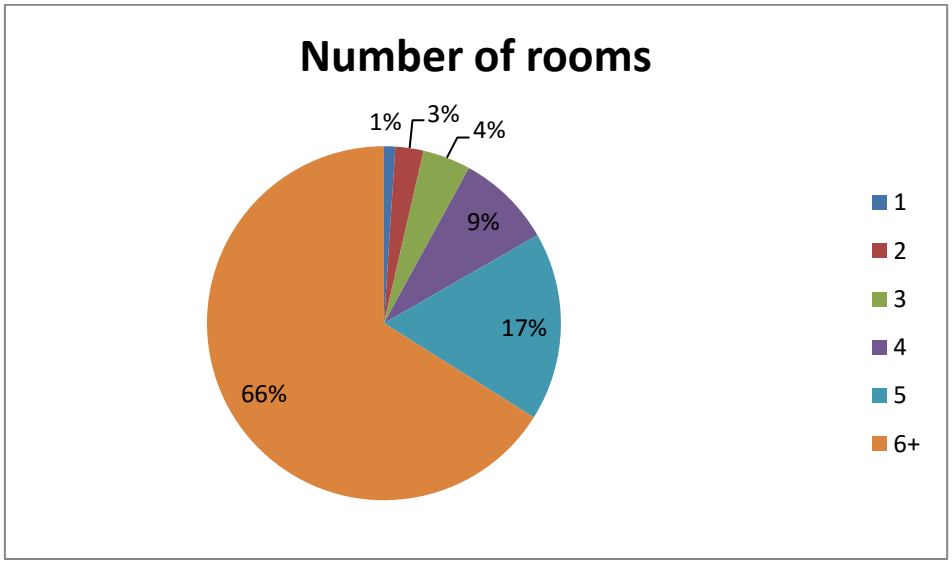

Figure 7. Number of rooms in surveyed households in Ozalj

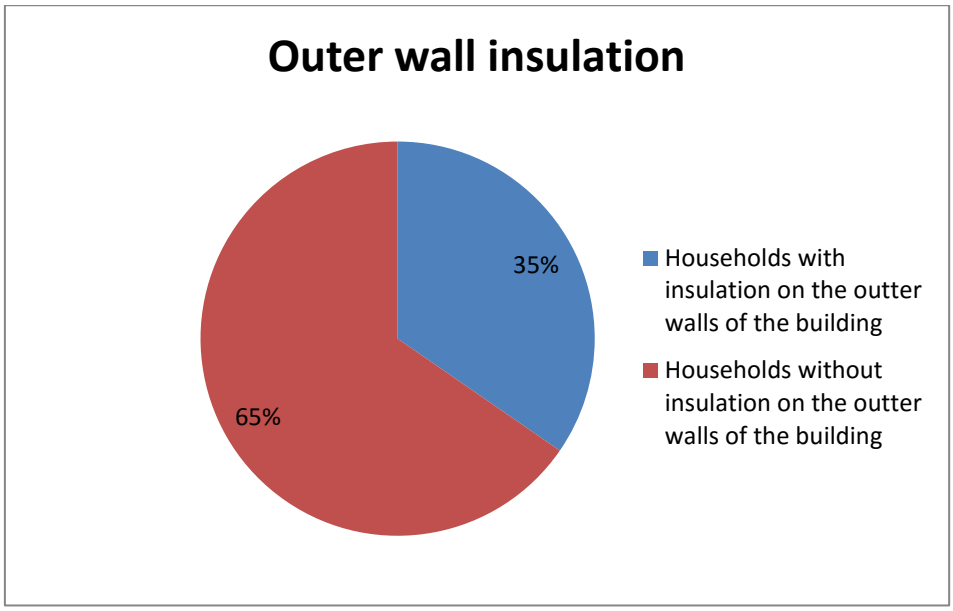

Figure 8. Share of households that have insulation on the outer walls – results for Ozalj

Concerning the condition of buildings in Ozalj, only 35 % of buildings have insulation on the outer walls. The situation is practically the same when it comes to roof insulation. These results can be seen in Figure 8 and Figure 9. Insulation material that is mostly used for outer walls insulation is polystyrene (Styrofoam) with average thickness 5 – 10 cm. On the other hand, mostly used material for roof insulation is glass wool with average thickness 10-20 cm. The results show that it is necessary to promote insulation of buildings in this area, since most citizens do not have insulation on their buildings and therefore have significantly high heat losses.

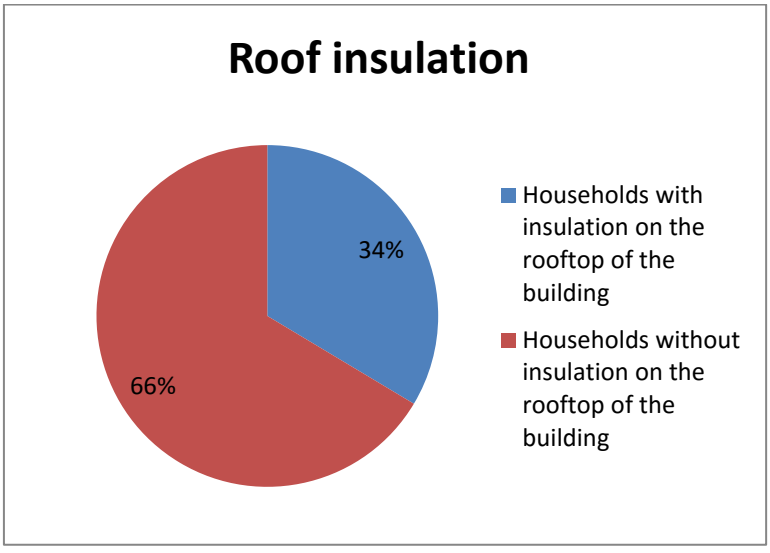

Figure 9. Share of households that have insulation on the roof – results for Ozalj

This situation is slightly better when it comes to windows that are being used on buildings. Almost half of the interviewed citizens have PVC windows, while 43 % have wooden windows. It has to be noted here that some of the wooden windows have been refurbished and therefore have high energy performance. It can be concluded that, even though much more window refurbishments can be done, current situation is rather satisfactory.

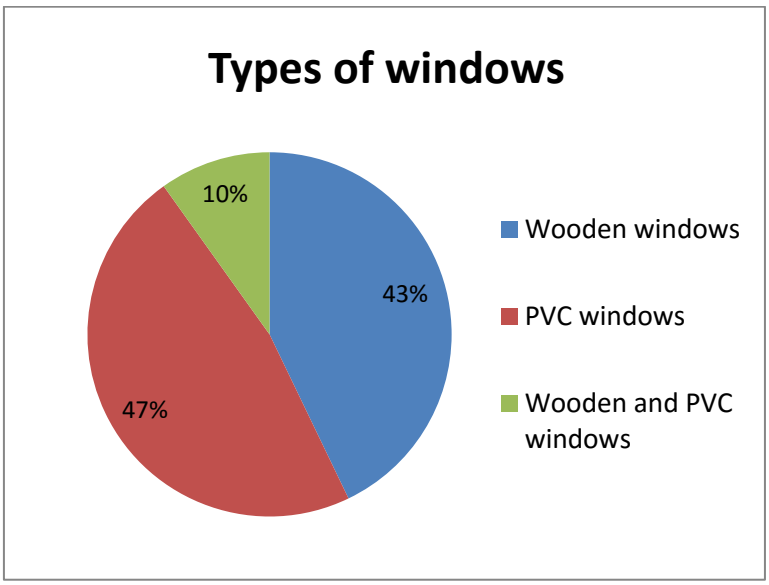

Figure 10. Types of windows that are used on buildings in Ozalj

2.2 Information on the heating and cooling system in households

When it comes to heating and cooling system in households, there are 4 questions that require input on this topic in the questionnaire. They concern type of the heating system, energy source used in the heating system, energy source used for domestic hot water preparation and type of cooling system, i.e. energy source used for cooling.

Very high share of interviewed citizens have a centralised radiator heating system, on the dwelling/apartment level. Only 16 % of interviewed citizens have individual stoves in rooms, as seen in Figure 11. This provides a great opportunity since most of the citizens already have needed infrastructure for district heating in their dwelling. Therefore, those citizens would only have to pay for connection to district heating network and not for complete refurbishment of their heating system.

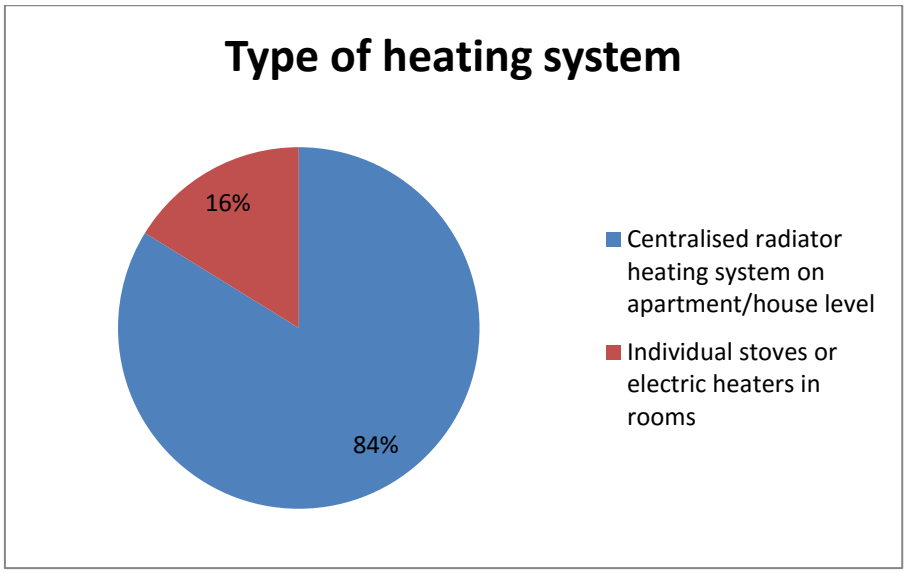

Figure 11. Type of heating system used in households in Ozalj

Concerning the energy source that is being used for heating in households in Ozalj, results show that biomass has the highest share, with logwood being the mostly used form of biomass (Figure 12). These results are expected since the surrounding area of the surveyed city is covered with forests.

Another reason is that there is no city wide natural gas grid. Almost 15 % of interviewed citizens own a part of the forest so they supply the fuel themselves and therefore pay only transportation costs. This can present both the advantage and disadvantage for district heating systems. Since they currently have no costs, those citizens will not want to connect to a district heating system and pay for connection and heat. On the other hand, this can be tackled by enabling citizens to provide their biomass to the district heating system in exchange for lower heating bills.

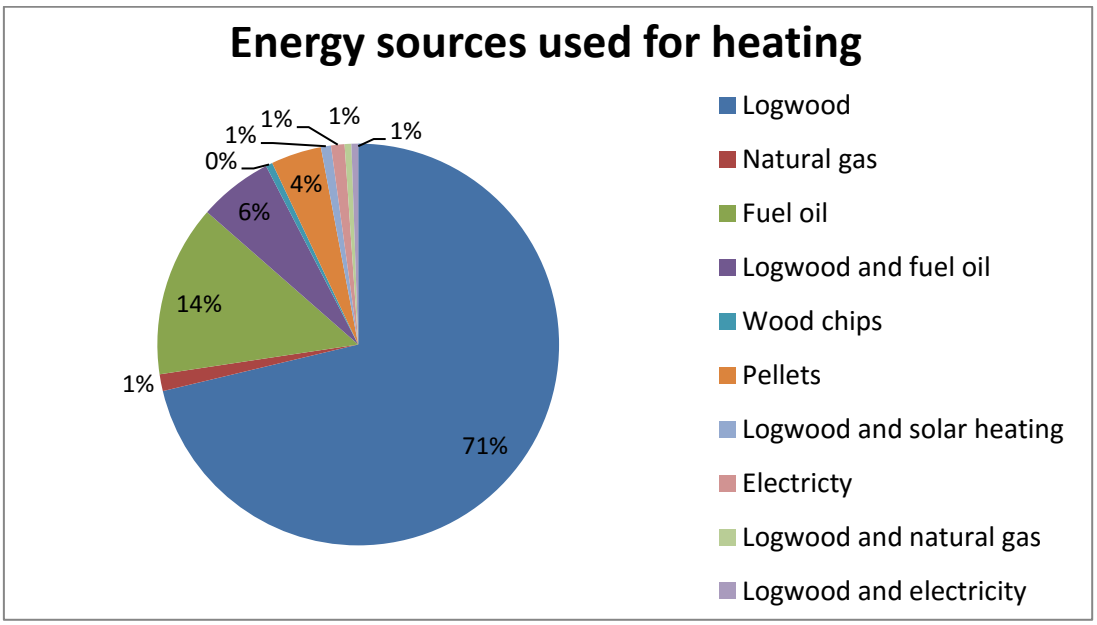

Figure 12. Energy sources used for heating of households in Ozalj

Logwood is still the main energy source when it comes to domestic hot water preparation, but electricity has a high share as well (Figure 13). It can also be seen that citizens of Ozalj are starting to acknowledge solar energy as a good, environmentally friendly energy source for domestic hot water in combination with some other source, mostly logwood.

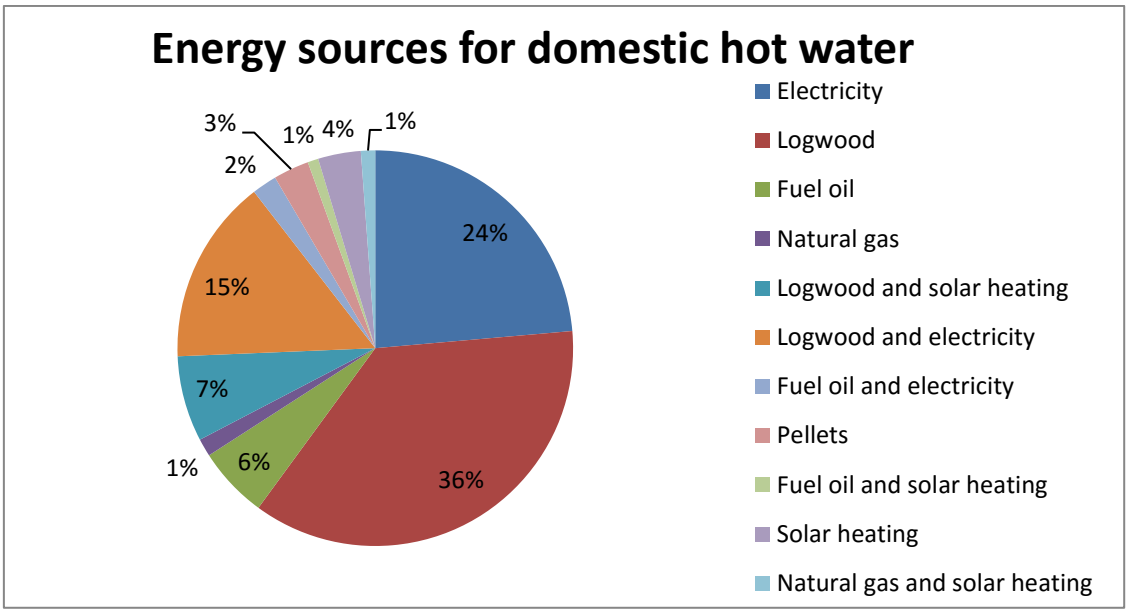

Figure 13. Energy sources used for domestic hot water preparation in households in Ozalj

When it comes to cooling, only around 34 % of interviewed citizens use cooling systems. Mostly used cooling systems are split system air conditioning units. Therefore, the only energy source used for cooling is electricity.

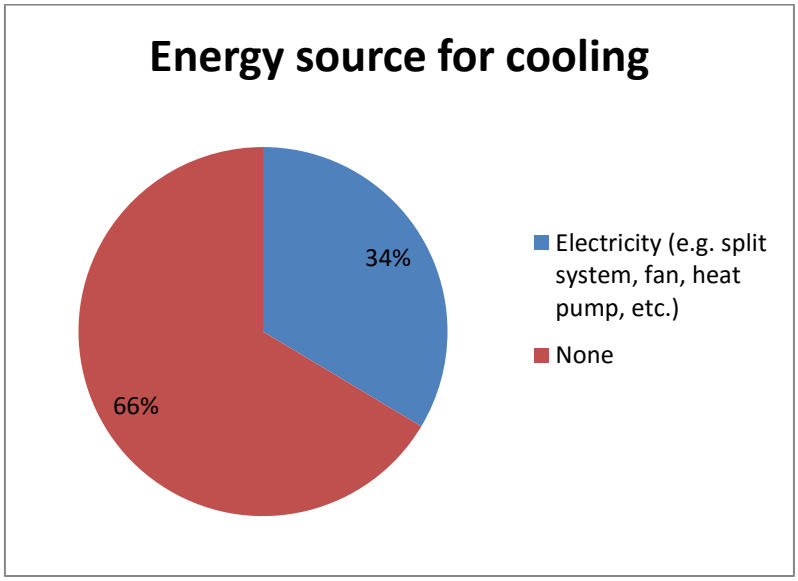

Figure 14. Energy source used for cooling in households in Ozalj

2.3 Information on energy consumption

This part of the questionnaire includes 5 questions and 3 sub-questions. They concern final energy consumption for heating, final energy consumption for domestic hot water preparation, number of rooms that are being heated, number of rooms that are being cooled, energy certificate of the household and yearly expenses for heating purposes.

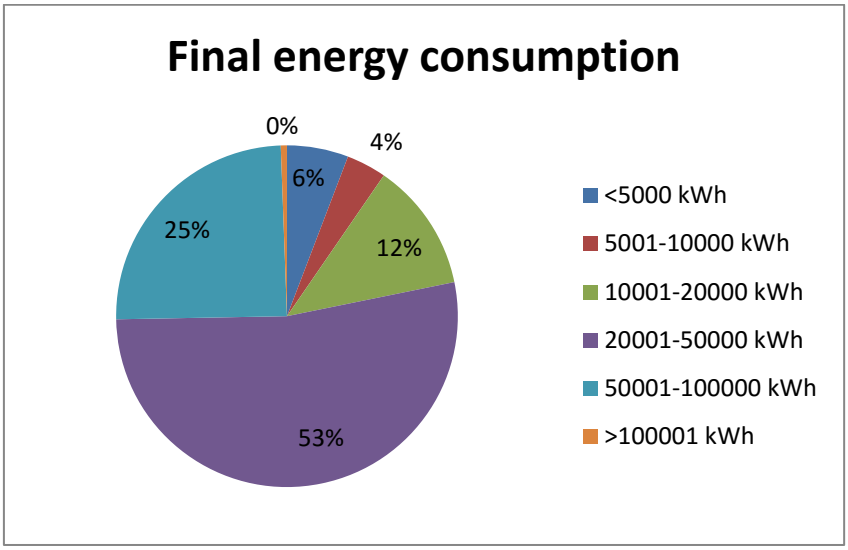

Figure 15. Range of final energy consumption for interviewed citizens of Ozalj

Depending on the different energy source used for heating, citizens used different units to express their energy consumption. Therefore, to express consumption of logwood, citizens used cubic meters, for fuel oil they used litres, for pellets tonnes and for electricity kilowatt hours. In order to unify this, all data on energy consumption was transformed to kilowatt hours. Values shown in the graphs are yearly values of energy consumption. Figure 15 shows final energy consumption of surveyed households in Ozalj. It can be seen that more than ¾ of surveyed households consume more than 20 000 kWh, mostly in the range 20 001 – 50 000 kWh. Presented results show high average heat consumption of households in Ozalj, which corresponds with previous results that showed low insulation standards, low rate of refurbishment and relatively high average age of buildings in this city.

It has to be noted that almost no data on energy consumption for domestic hot water has been received. This is mostly because people use the same energy source for domestic hot water and other purposes and therefore do not specifically measure energy consumption for domestic hot water. Consequently, data on final energy consumption for heating includes data on final energy consumption for domestic hot water as well.

Regarding the number of rooms that are being heated in a certain household, Figure 16 shows that numbers practically correspond to results shown in Figure 7 (number of rooms in households), which means that people mostly heat all of the rooms in their households. This is also due to the fact that most people have centralised radiator systems on the apartment/dwelling level.

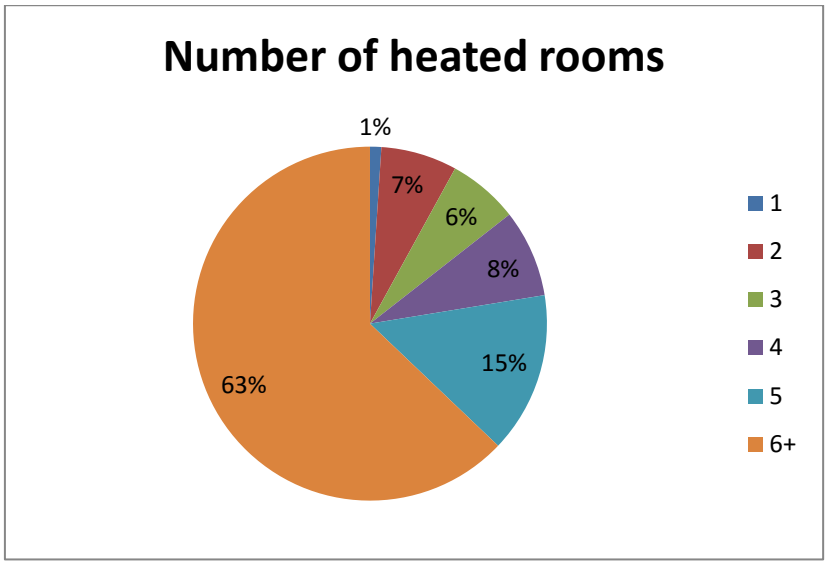

Figure 16. Number of rooms that are being heated in households in Ozalj

When it comes to a number of rooms that are being cooled in a certain household, the situation is different as expected. Since people mostly use split system air conditioners, number of rooms that are being cooled is mostly up to 3, as seen in Figure 17

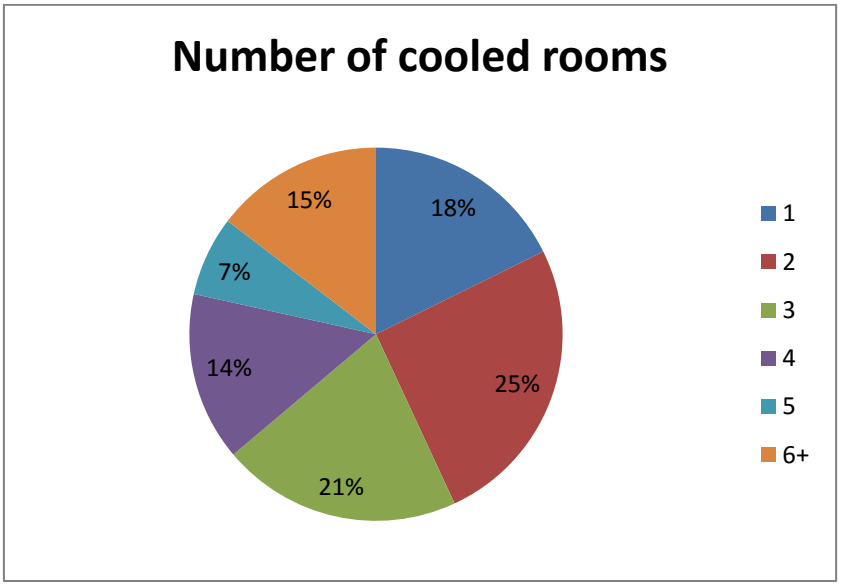

Figure 17. Number of rooms that are being cooled in households in Ozalj

Majority of interviewed citizens do not have an energy certificate for their household. Only 4 % of interviewed citizens actually have an energy certificate, but they are not aware of the energy category that has been assigned to their household. Therefore, energy certification should be promoted in Ozalj in order to indicate to citizens the level of energy consumption of their households and ways to improve its energy performance.

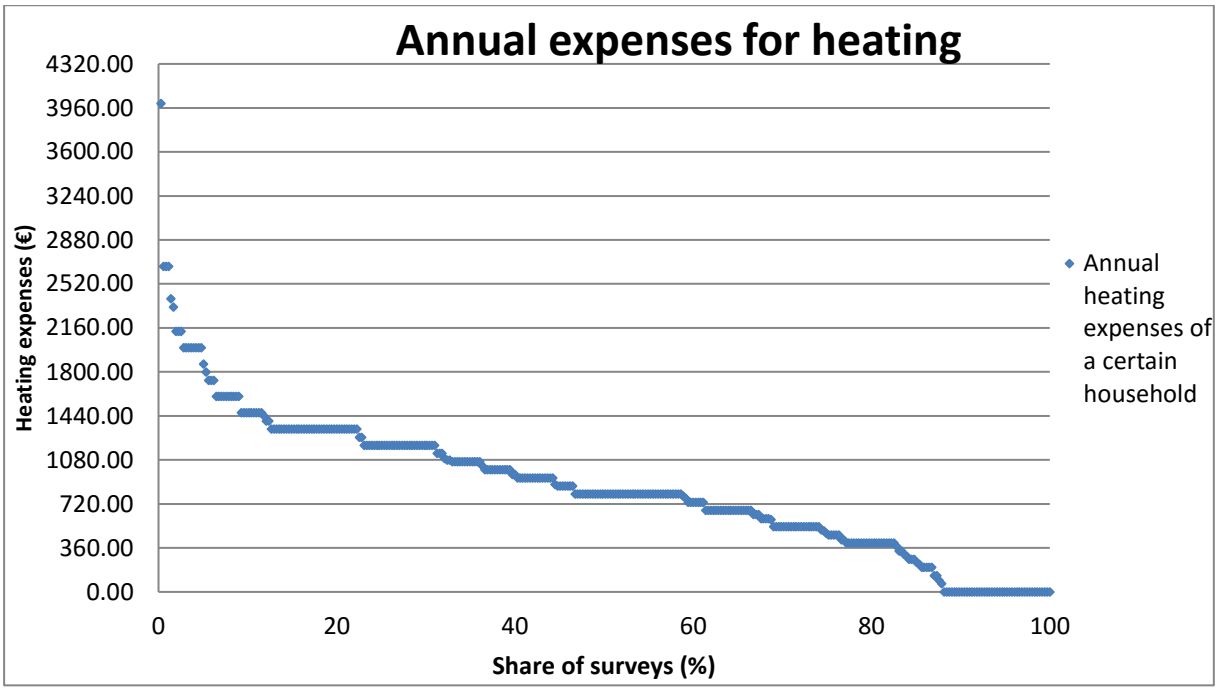

Figure 18. Sorted annual expenses for heating of households in Ozalj

From citizens' perspective, the most important parameter is the amount of money they spend each year for heating purposes. For that reason, their annual expenses for heating have also been analysed in the survey. Figure 18 shows that expenses are distributed rather evenly. Citizens who own a part of the forest have low expenses but the ones who use fuel oil or have to buy logwood have much higher expenses, with 6 % having annual expenses of more than 1600 € which is rather high for Croatian standards.

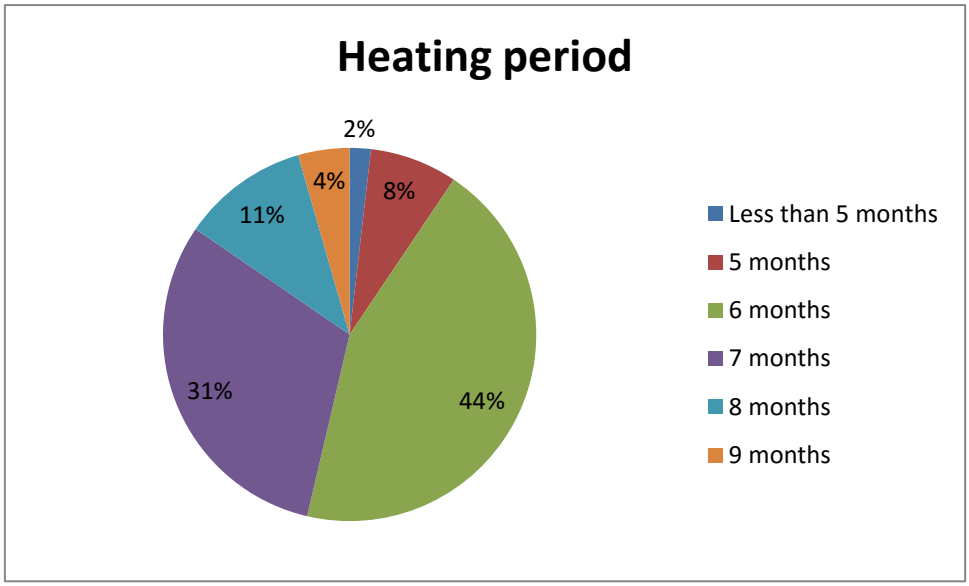

Figure 19. Annual heating period for households in Ozalj

Figure 19 shows that most of the people in Ozalj heat their dwellings 6 to 7 months. This is an average for the continental part of Croatia.

2.4 Information on public opinion

Information on public opinion on small modular renewable district heating systems is the last set of information provided by the questionnaire. This part of the questionnaire also contains information on dissemination of the CoolHeating project activities. Figure 20 shows that almost 20 % of people have already heard about the CoolHeating project when they were interviewed. These results are actually very good since only one information event has been held in Ozalj before the survey was carried out. The main source of information about the project was the flyer about the project and information from media, but also oral communication between citizens, which is very important.

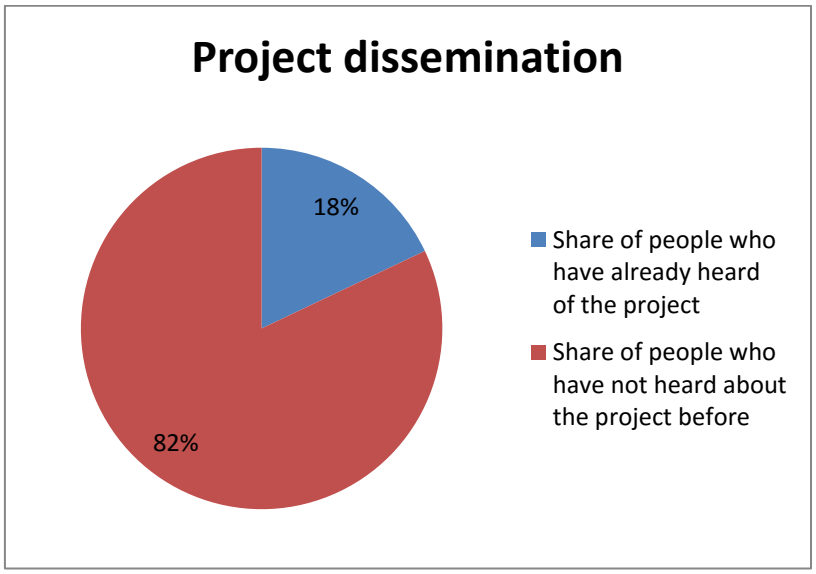

Figure 20. Results of the project dissemination in the city of Ozalj

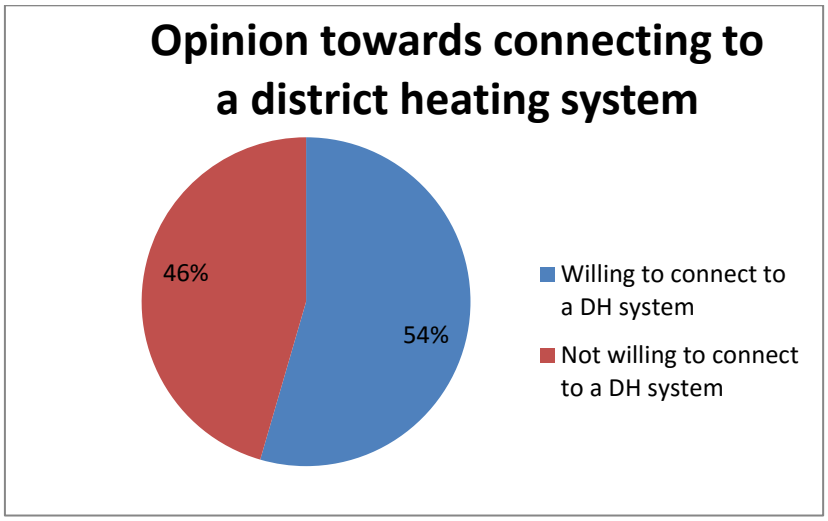

Figure 21. Opinion of citizens of Ozalj towards connecting to a district heating system

Survey also wanted to check willingness of people to connect to a district heating system. Figure 21 shows that 54 % of interviewed citizens would be willing to connect to a district heating system, which is a good result since district heating systems in Croatia have a rather

negative picture in the public. Nevertheless, there are 2 main reasons why people would not want to connect to a district heating system, as seen in Figure 22.

The fact that people lack knowledge of such systems can be tackled by implementing information events in communities or by setting up information panels in different parts of community, which would also promote energy efficiency measures, different renewable energy technologies, etc.

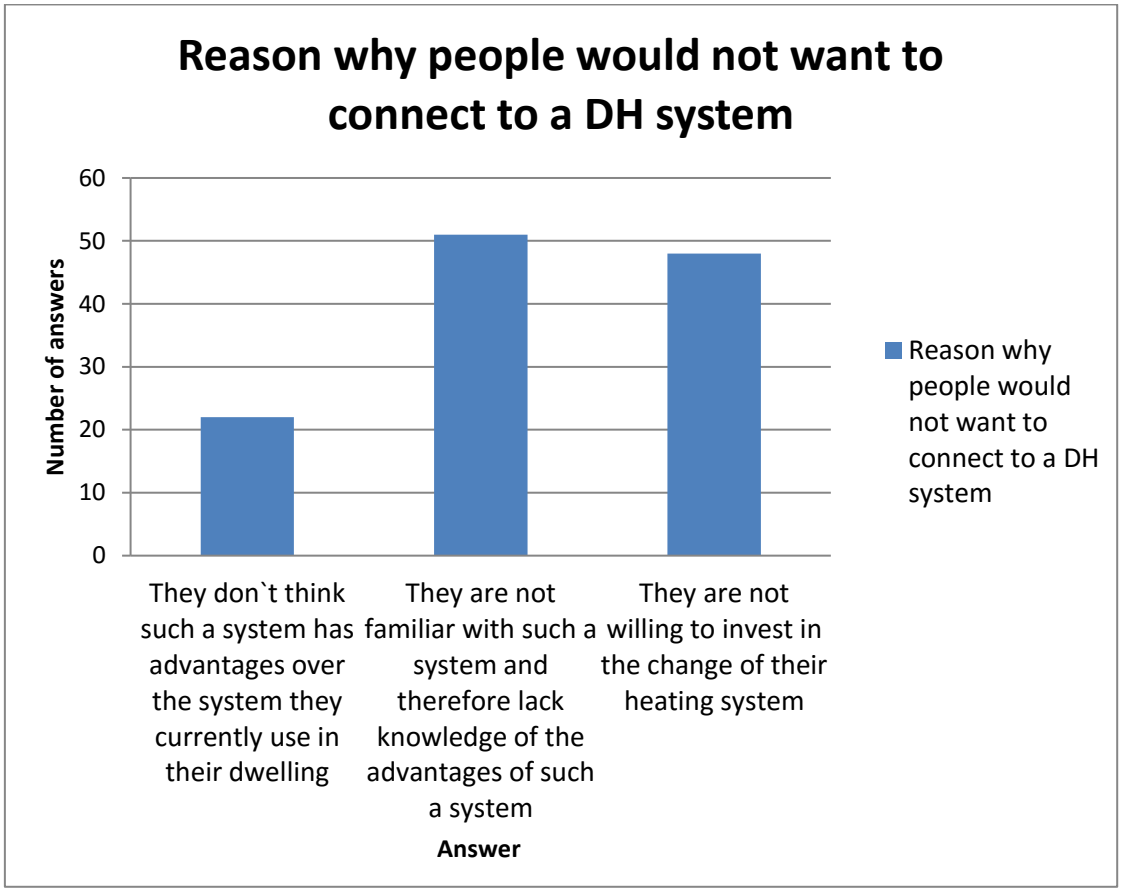

Figure 22. Main reasons why people would not want to connect to a district heating system – results for Ozalj

The fact that people are not willing to invest in the change of their heating system is specific for the rural small cities in Croatia since older, retired citizens prevail and the standard is low. This problem is unfortunately much harder to tackle.

At last, the idea of the survey was also to promote the benefits of small modular renewable district heating systems and to check which of these benefits are most attractive to the citizens. The results can be seen in Figure 23. It is shown that citizens found benefits related to the economy the most important ones i.e. that economic feasibility for the user is much better than for individual heating systems and that these systems increase local economy and enhance local employment and security of supply.

On the other hand, the least important advantages were defined by citizens as elimination of security risks due to fuel combustion in dwellings and increased comfort for the users. Therefore, these results show which benefits should be in focus when organising information events in Ozalj and on the other hand, which benefits should be less focused on.

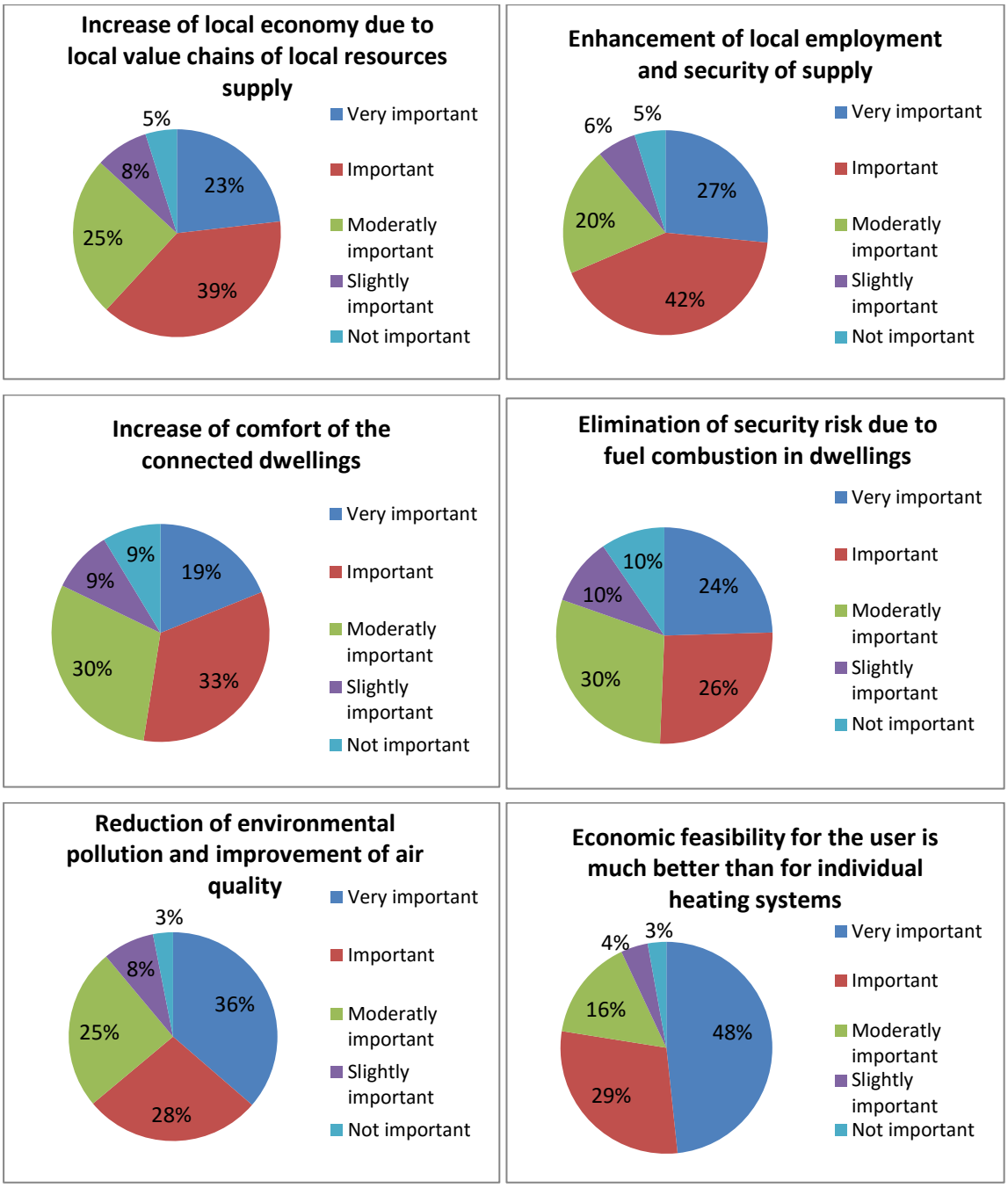

Figure 23. Opinion of interviewed citizens on benefits of small modular renewable district heating systems – results for Ozalj

2.5 Concluding remarks for target community in Croatia

Results of the survey in Ozalj are able to effectively approximate the situation in the entire city since the survey was conducted on a large enough sample. It has been shown that building stock in Ozalj is rather old and inefficient (leading to high energy consumption) and therefore a higher refurbishment rate is needed to achieve lower heat demands of the buildings.

The most used energy source for heating in Ozalj is logwood due to the large amounts of locally available biomass. This could present both the barrier and opportunity to implementation of district heating systems, which requires detailed planning on business models. Heating systems in households are mostly centralised radiator heating systems on apartment/dwelling level, which provides great opportunity for lower district heating connection costs for citizens. Regarding the costs for heating in Ozalj, they depend on energy source in use, with people who own parts of the forest having low costs and people who buy logwoods or use fuel oil having much higher costs.

It was also concluded from the results that a decent amount of people have already heard about CoolHeating project, mostly from flyers and media announcement, but also from oral communication from citizens. An interesting conclusion is that the public opinion towards small modular renewable district heating systems is rather positive, with more than half of the interviewed citizens who would be willing to connect to a district heating system in Ozalj. Main reasons for people not to connect to district heating were ignorance and inertness of citizens which have to be tackled by appropriate actions.

Finally, benefits of small modular renewable district heating systems were presented to citizens in order to receive their feedback. Most important benefits were the ones related to the economy, i.e. higher economic feasibility for the user and increased local economy, local employment and security of supply. This will be taken into account in planning of future information and promotional activities in Ozalj.

3 Results of the survey in target community in Slovenia

Target community in Slovenia is city of Ljutomer, which has 4,523 households (STAT 2015). The Municipality of Ljutomer chose the settlement of Cven as the most perspective location for developing a district heating project. Therefore, the survey was focused in that location. The settlement of Cven has 226 households (Statistical office of Slovenia). As a part of Task 3.4, 98 questionnaires were gathered from the households of Cven, which accounts for 43 % of all households in the Cven settlement. All questionnaires were collected as a hard copy, so none of them were collected online.

Some of the questionnaires were collected among citizens within the CoolHeating event during the Municipality celebration in August 2016. But most of the questionnaires were distributed and gathered by door-to-door surveying. During both steps within the data collection, citizens also received information about the project CoolHeating and received the CoolHeating project flyer. Due to the limited size of the Cven settlement it was not possible to gather 500 interviews as the total amount of households, amounts to less than half of that number (226 households). The response rate in the Cven settlement was very high due to well-educated and motivated interviewers.

Parts of the city, which were surveyed in this task, are shown in Figure 24.

Figure 24. Parts of the settlement of Cven (red circle) included in the survey

3.1 Information on building stock

There are 9 questions and 2 sub-questions in the questionnaire, which provide information on building stock in Cven. Questions concern type of household, build period, period of last refurbishment, number of people living in the household, floor area of the household, number of rooms in the household and insulation level of outer walls and roof. 2 sub-questions concern type and thickness of insulation for the outer walls and roof.

The majority of people in Cven live in houses, as shown in Figure 25. These results were expected, as the settlement is relatively small and located in the rural environment. Type and scatteredness of households result in rather low heat demand densities for Cven. A positive aspect is that the settlement is oriented in an “X” shape, with a centre of the settlement. Therefore, the distances between households are not very large. There are only a few larger energy consumers – a city hall, a school and a shop and no consumers that would require technological heat.

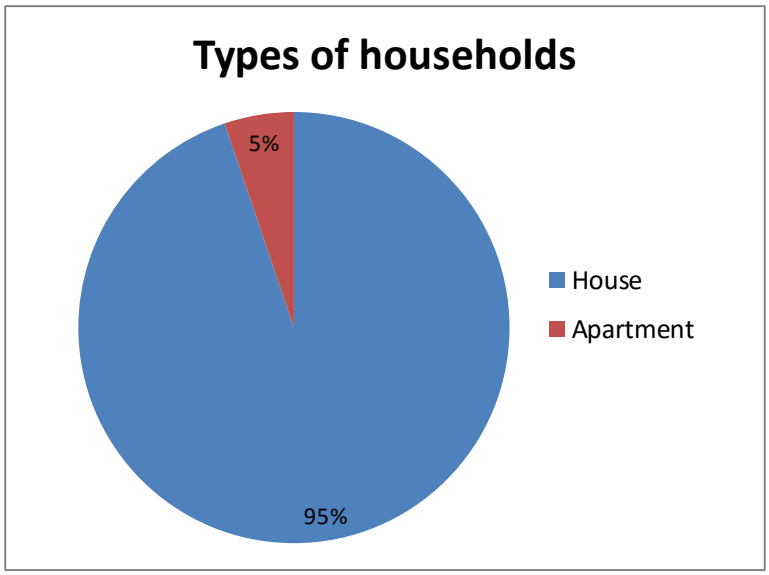

Figure 25. Types of households in the town of Cven

Average age of the buildings in Cven is around 43 years. More than one third of the interviewed buildings in Cven were built during the period from 1961 to 1980, and almost one quarter of the buildings were built in the period from 1981 to 2000. This can be seen in the Figure 26. Relatively high average age of buildings in Cven is also connected to the lack of proper heating insulation of roofs and walls. Therefore, high heat demand of buildings and relatively high heating costs for citizens are not surprising.

In Figure 27 it can be seen that the most refurbishments of buildings in Cven were done in the last six years, so it can be assumed that better insulation materials were used. Around 63 % of interviewed households in Cvens refurbished their buildings to some extent since they have been built. Still there is a significant number of not refurbished buildings which should represent a focus of development in Cven in near future – to improve energy efficiency with refurbishing old and poorly insulated buildings.

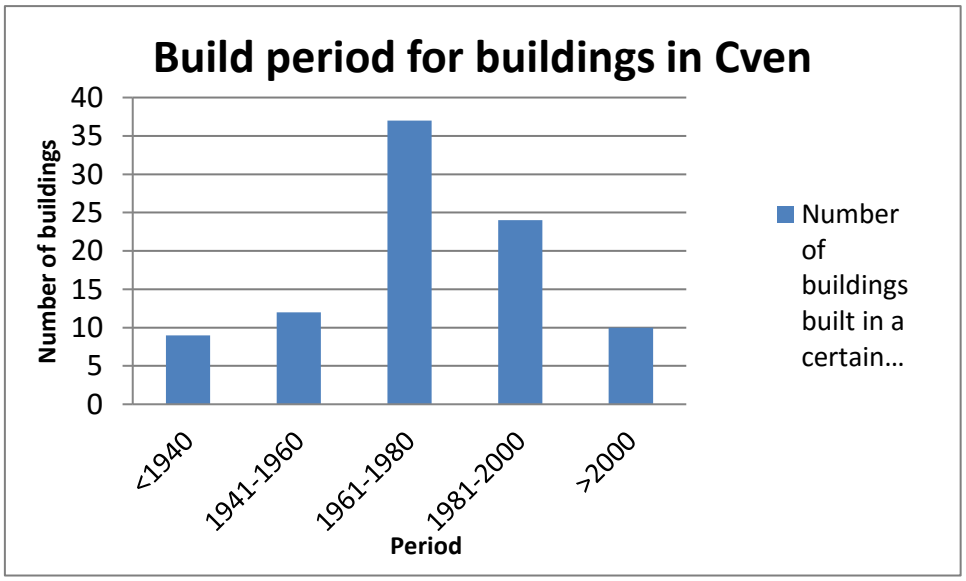

Figure 26. Build period for buildings in Cven

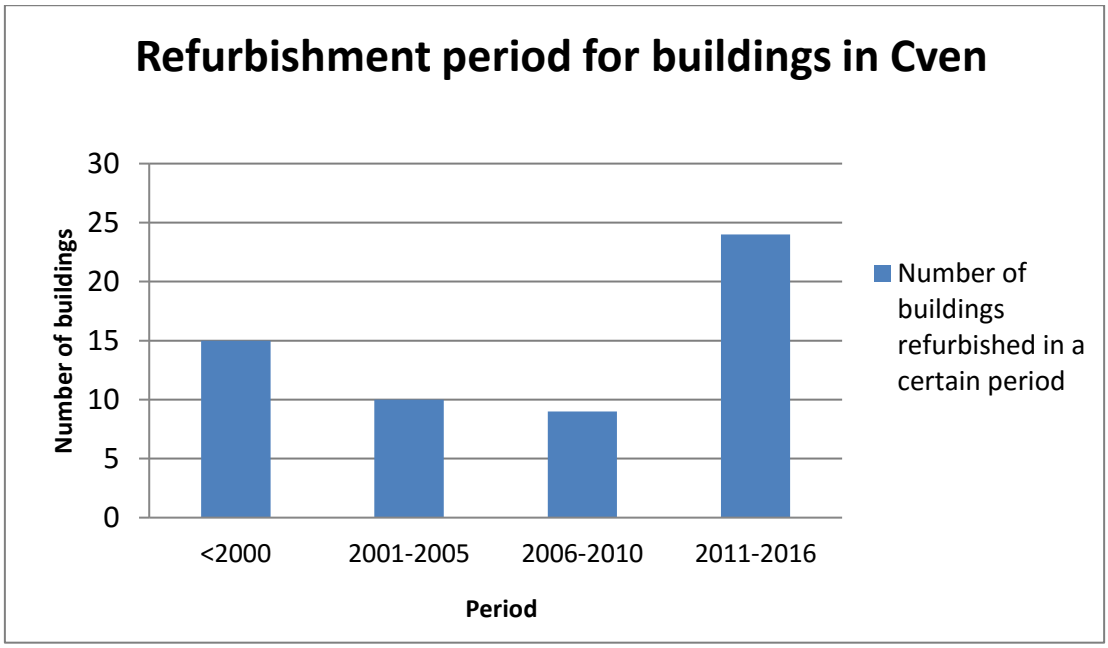

Figure 27. Refurbishment period for buildings in Cven

In almost two thirds of households in Cven, 3-5 household members are living. This information can be observed in Figure 28 and matches well with national statistical data for Cven, which shows that the average household has three members. In 27 % of interviewed households, less than 3 members live and just 12 % of the households hold more than five members. Almost all people in interviewed households live in houses, which is associated with larger floor areas and more members in each household. Nevertheless, there is a significant amount of households with only few residents, living in individual houses.

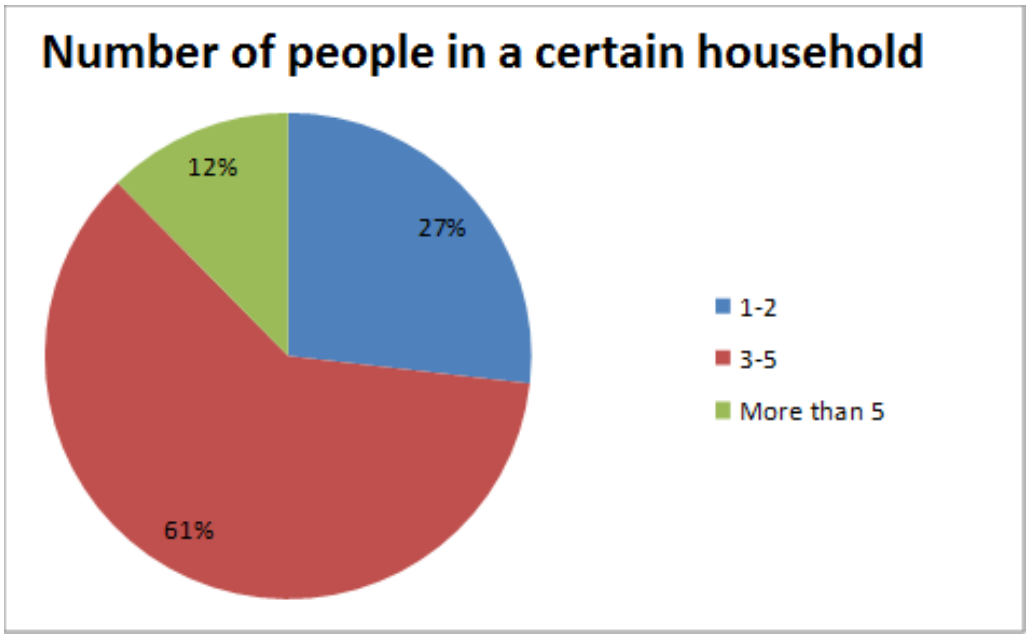

Figure 28. Number of people living in a certain household in Cven

Average floor area of households amounts to 139 m^2. None of them have floor area less than 50 m^2, which can be seen in Figure 29. This matches well with information from Figure 30 (number of rooms in households) and it shows that the most common are relatively large households with six or more rooms. Households with three or less rooms are rare (16 %). Again, this information shows relatively inefficient heating situation in Cven, with large heating areas of the households with relatively small amount of residents.

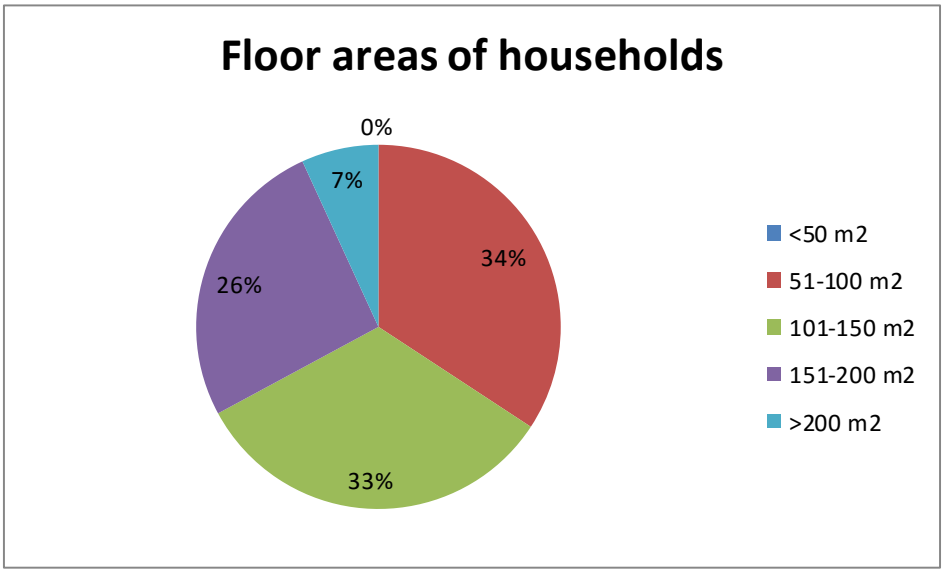

Figure 29. Range of floor areas of surveyed households in Cven

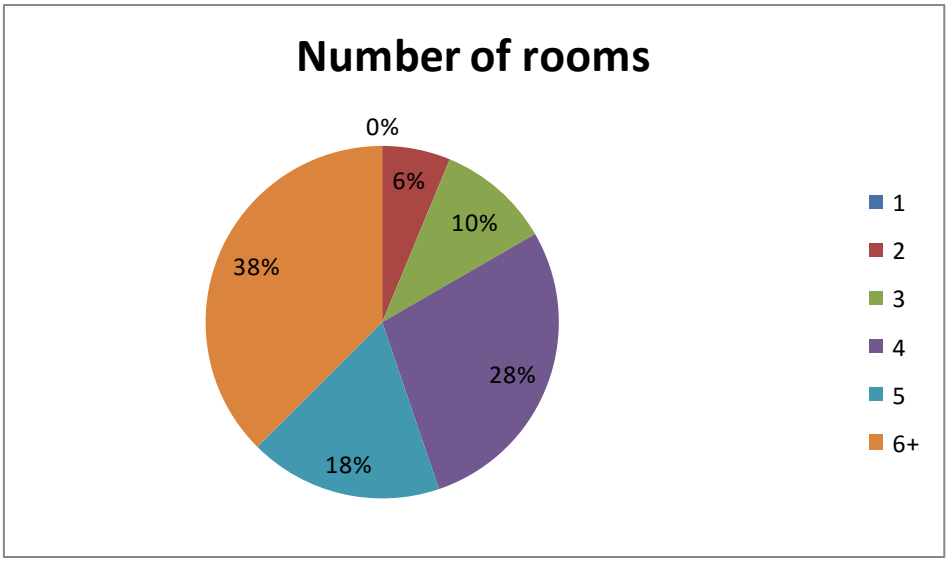

Figure 30. Number of rooms in surveyed households in Cven

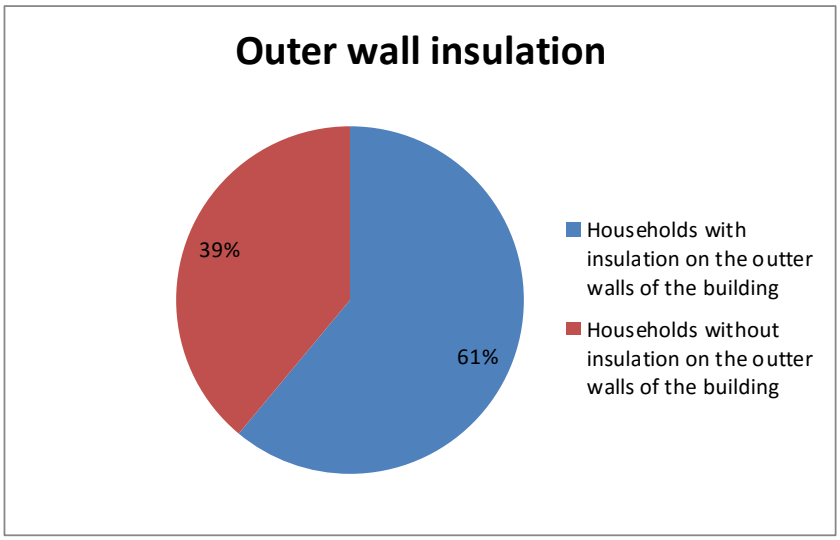

Figure 31. Share of households that have insulation on the outer walls – results for Cven

Concerning the condition of buildings in Cven, 61 % of buildings have insulation on the external walls. The situation is worse when it comes to roof insulation with 48 % of buildings with the proper roof insulation. These results can be seen in Figure 31 and Figure 32. Insulation material that is mostly used for external walls insulation is polystyrene (Styrofoam) with average thickness more than 12 cm. On the other hand, mostly used material for roof insulation is glass wool with average thickness around 16 cm. The results show that it is recommended to promote insulation of buildings - outer wall and especially roof insulation in Cven, since a rather large share of households do not have a proper insulation on their buildings, resulting in significant heat losses.

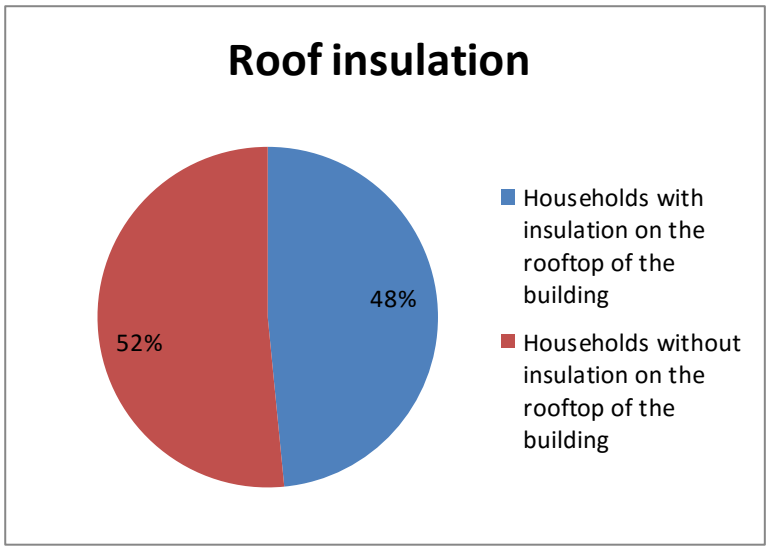

Figure 32. Share of households that have insulation on the roof – results for Cven

Obtained data about types of windows can be seen in Figure 33. The most common are households with PVC windows, also frequent are wooden windows. From Figure 27 (period of refurbishment of buildings) it can be assumed that some of windows were refurbished, which leads to better use of energy.

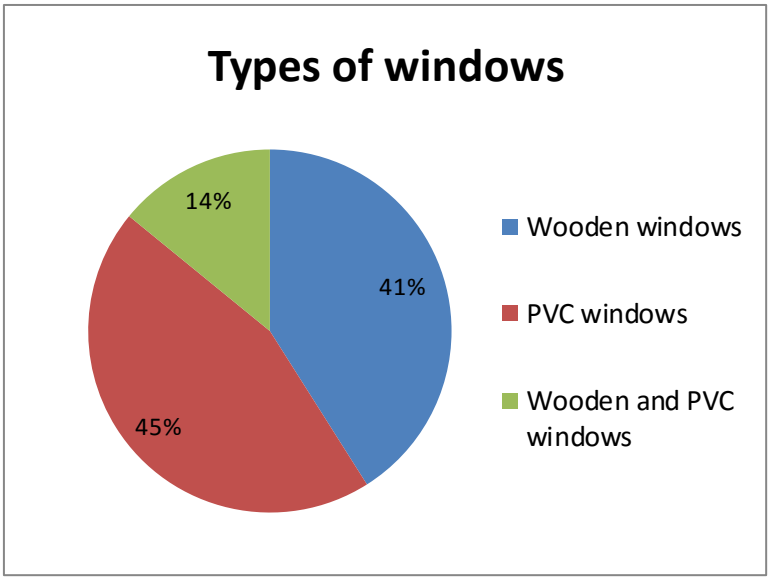

Figure 33. Types of windows that are used on buildings in Cven

3.2 Information on the heating system in the household

When it comes to heating and cooling system in households, there are 4 questions that require input on this topic in the questionnaire. They concern type of the heating system, energy source used in the heating system, energy source used for domestic hot water preparation and users of cooling system.

Almost all interviewed citizens have a centralised radiator heating system, on the dwelling/apartment level. Only 4 % of interviewed citizens have individual stoves or electric heaters in rooms, as seen in Figure 34. Centralised radiator heating system contribute to easier establishment of connection to district heating in individual households. Those households would have less costs to connect to the district heating, because they would need to pay just for connection to district heating network.

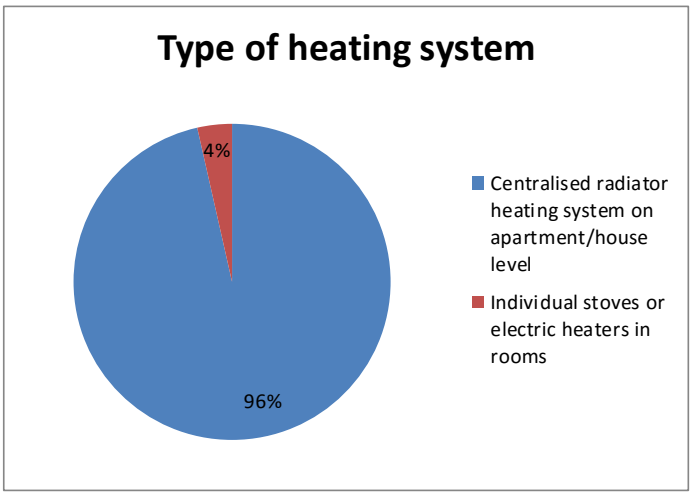

Figure 34. Type of heating system used in households in Cven

The most households use biomass for heating, in this context specifically logwood is the most popular form of it, that can be seen in Figure 35. As expected because of the extensive forest areas in the Ljutomer municipality.

On the second place, interviewed citizens use natural gas and different combination of energy sources used for heating, for example the most used combination of logwood and fuel oil. It can be observed from the heating oil and combinations of energy sources used in addition to heating oil, that use of heating oil is high in Cven. Around $^{1}/_{3}$ interviewed citizens are using other energy sources, which are shown in figure below.

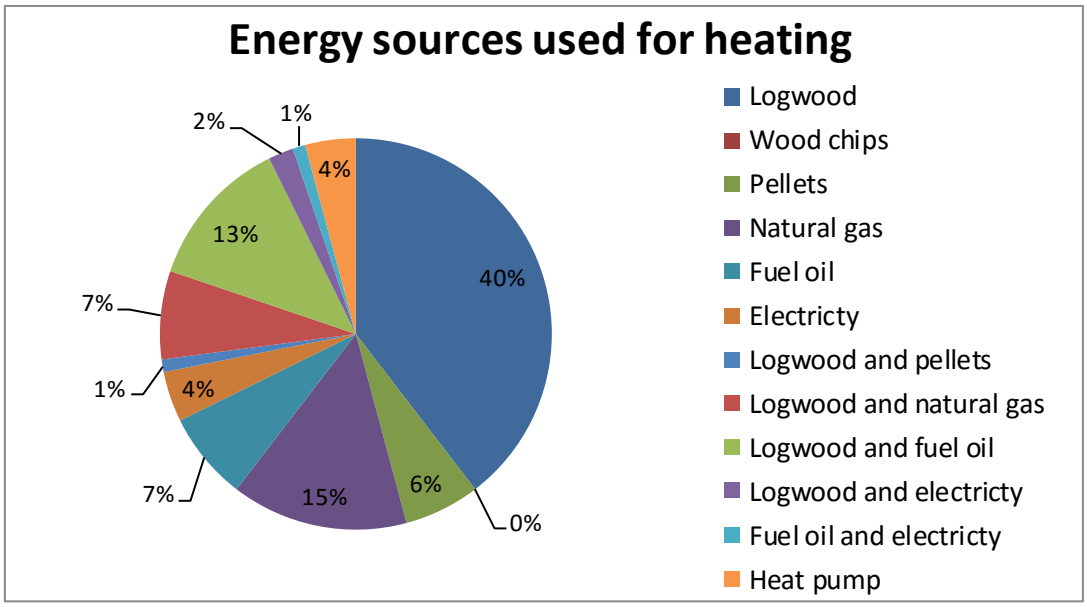

Figure 35. Energy sources used for heating of households in Cven

Logwood and electricity have each almost quarter users for hot water preparation (Figure 36). Even 19 % of interviewed citizens are using natural gas. Only 2 % of the households in Cven are using solar heating and additional 6 % use solar heating of domestic hot water in addition to other sources (fuel oil and logwood). These results have shown that citizens of Cven are only starting to acknowledge natural gas, solar energy and heat pump as a good, environmentally friendly energy source for domestic hot water. Many citizens use other combinations, especially with logwood.

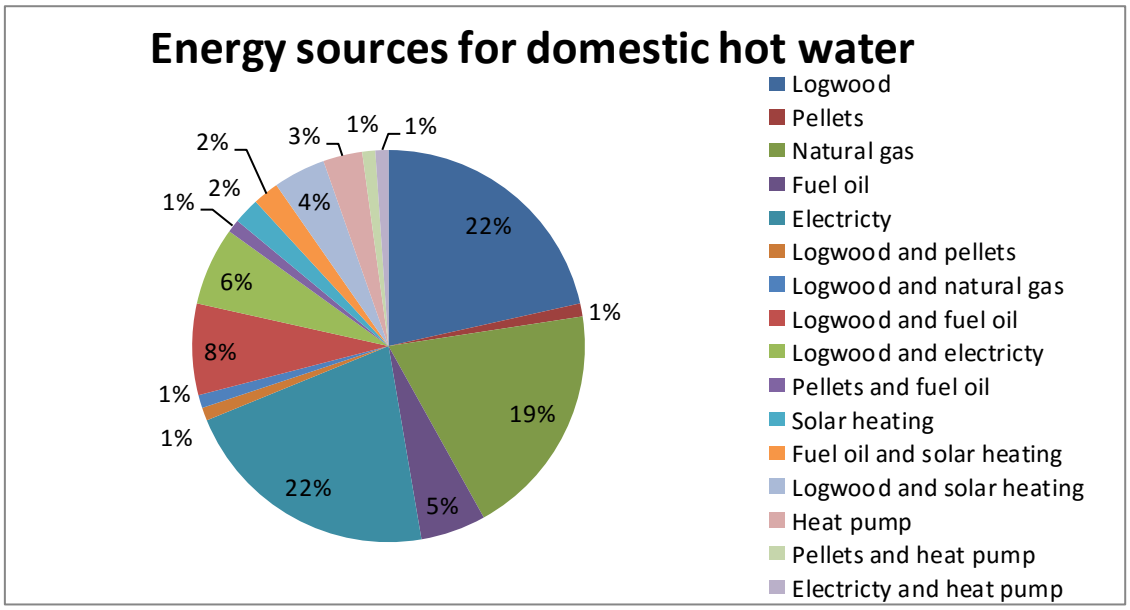

Figure 36. Energy sources used for domestic hot water preparation in households in Cven

When it comes to cooling, only 35 % of interviewed citizens use cooling. Energy source for cooling is mainly electricity (e. g. split system, fan, heat pump, etc.).

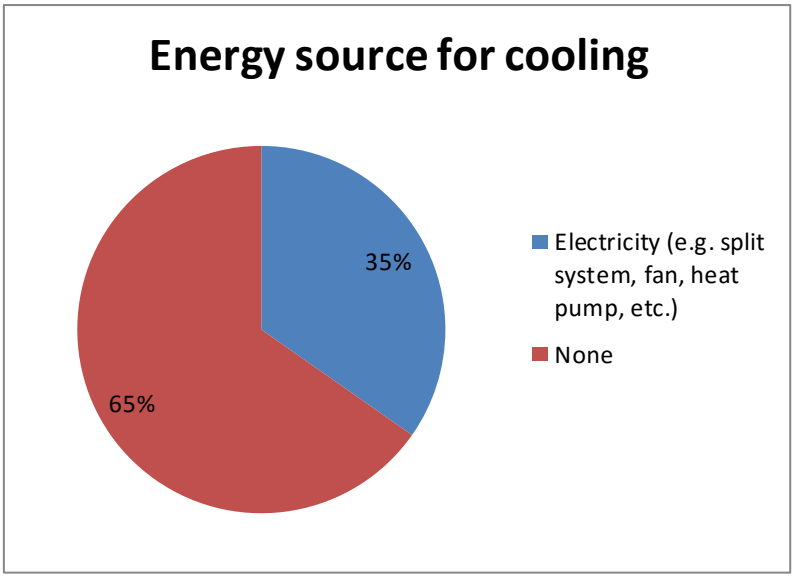

Figure 37. Energy source used for cooling in households in Cven

3.3 Information on energy consumption

This part of the questionnaire includes 5 questions and 3 sub-questions. They concern final energy consumption for heating, final energy consumption for domestic hot water preparation, number of rooms that are being heated, number of rooms that are being cooled, energy certificate of the household and yearly expenses for heating purposes.

Concerning the energy consumption, it should be noted that because of different energy sources people use, different units describing consumption of individual energy sources were

transformed to kilowatt-hours, in order to be able to compare energy consumption of households. Final energy consumption of interviewed households in Cven at the annual level can be seen in Figure 38.

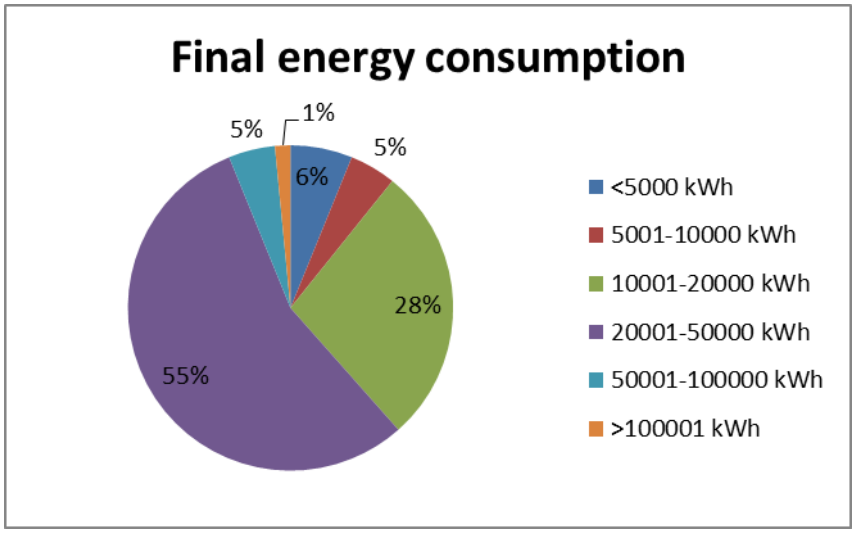

Figure 38. Range of final energy consumption for interviewed citizens of Cven

Usually people use the same energy source for domestic hot water and heating, so they do not separately measure energy consumption for domestic hot water. This leads to common data about final energy consumption, which includes both heating and preparation of sanitary hot water.

Concerning the number of heated rooms in a certain household (Figure 39), it can be practically seen comparable results with data results in Figure 30 (number of rooms in households). This means that households that participated in the survey mostly heat all of the rooms in their homes and this is also related with predominantly existing centralised radiator systems in the objects/dwellings.

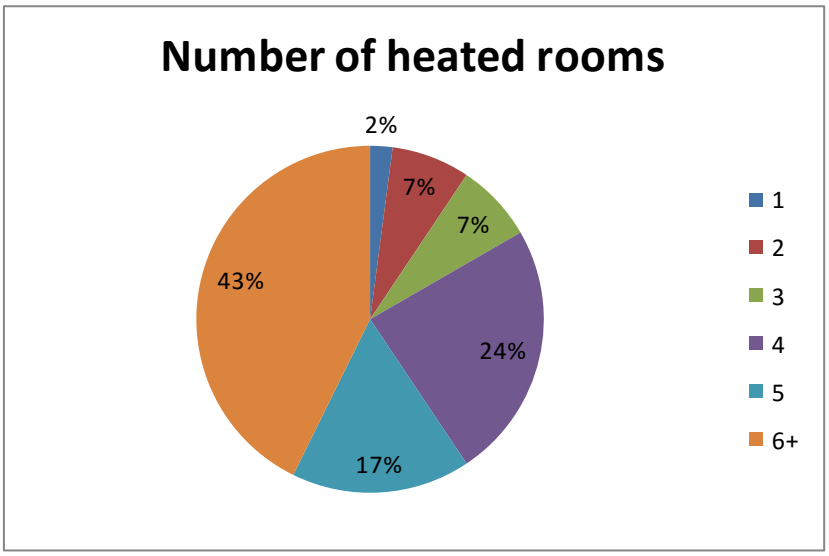

Figure 39. Number of rooms that are being heated in households in Cven

When it comes to a number of rooms that are being cooled in a certain household, the situation is different, because they mostly cool less rooms than they have in their homes, number of rooms that are being cooled is mostly 4 or less, as seen in Figure 40.

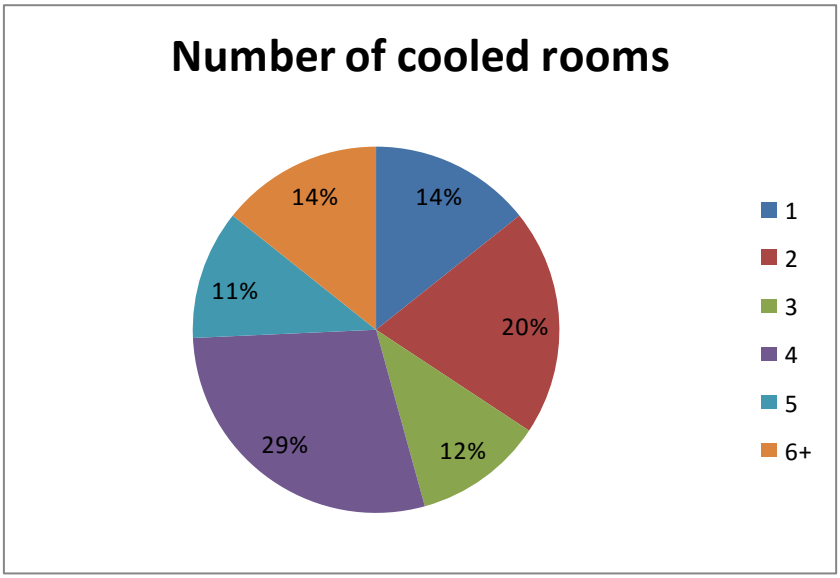

Figure 40. Number of rooms that are being cooled in households in Cven

Approximately 4 % of interviewed citizens have an energy certificate for their household. This is a very low share of the households. It is important to promote use of the energy certificates in Cven, in order to raise awareness of residents and ways to improve energy performance.

For people, usually the most important information is what expenses do they have with heating on annual basis. In Figure 41 it can be seen that the annual expenses for heating amount from around 3.000 € to almost no costs. Households who also own forests usually have very low expenses. But the ones who have to buy energy source for heating have higher expenses. Around 12 % of interviewed households have annual expenses of more than 1600 €.

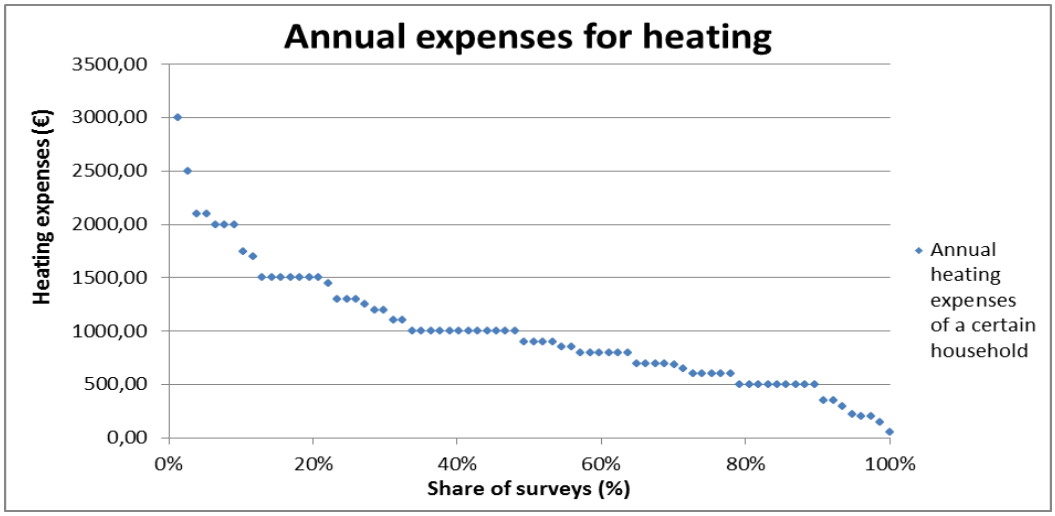

Figure 41. Sorted annual expenses for heating of households in Cven

Figure 42 shows that most of the people in Cven heat their dwellings 6 to 7 months.

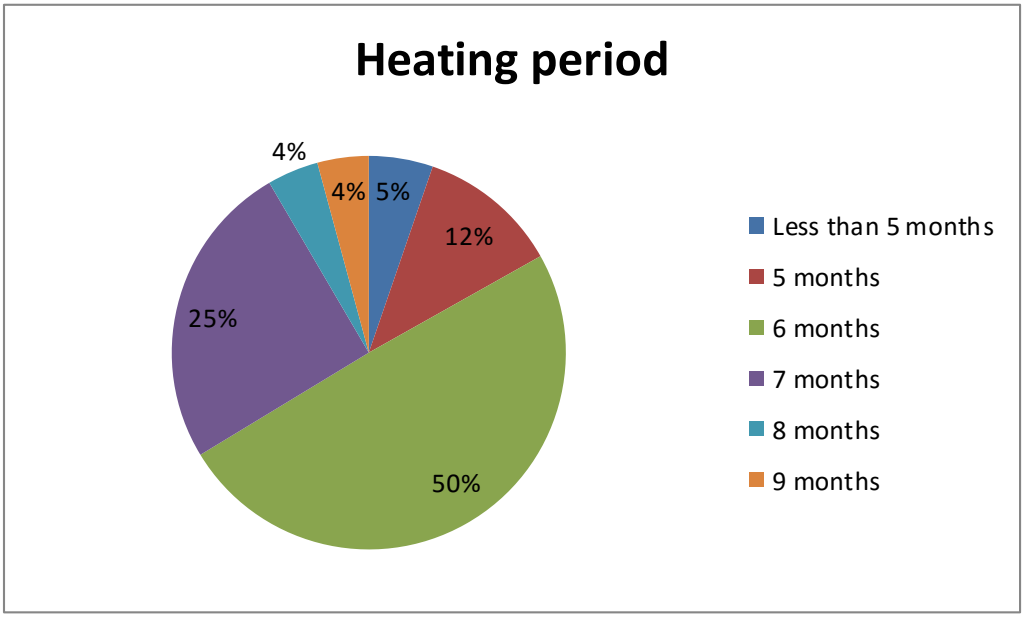

Figure 42. Annual heating period for households in Cven

3.4 Information on public opinion

Information on public opinion on small modular renewable district heating systems is the last set of information provided by the questionnaire. This part of the questionnaire also contains information on dissemination of the CoolHeating project activities.

Figure 43 shows that 20 % of people have already heard about the CoolHeating project when they were interviewed. The main source of information about the project was the flyer about the project and information from media and very important oral communication between citizens.

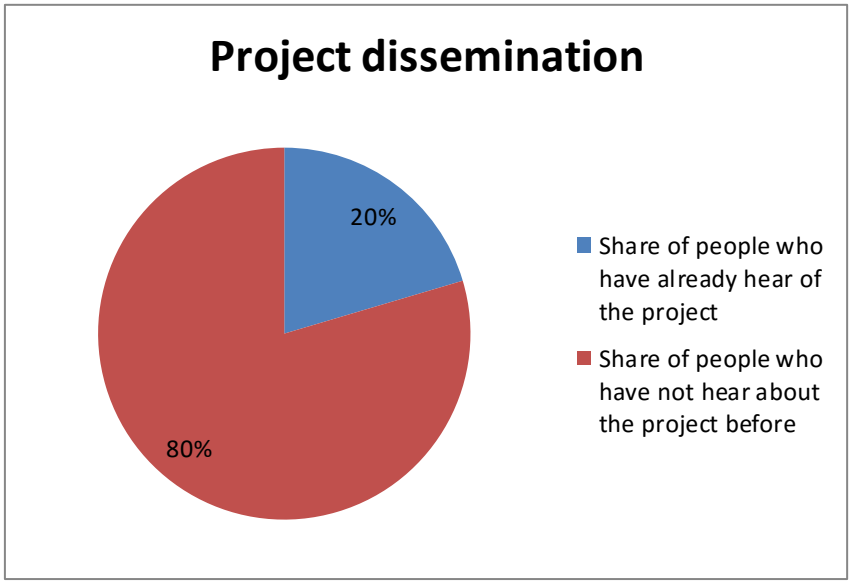

Figure 43. Results of the project dissemination in Cven

Despite no experiences and a low level of awareness about these systems with district heating systems, almost half of the interviewed citizens would be willing to connect to a district heating system. Opinions towards connecting to a district heating system is shown in Figure 43. There are two essential reasons why interviewed people would not want to connect to a district heating system, both can be seen in Figure 45.

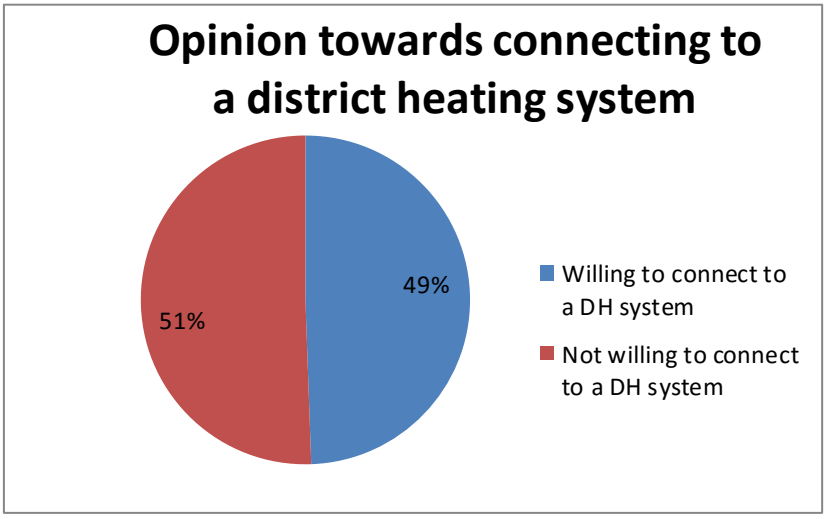

Figure 44. Opinion of citizens of Cven towards connecting to a district heating system

People are not familiar with such a system and therefore lack knowledge of the advantages of such a system and other reason, they are not willing to invest in their change of their heating system. Both barriers can be addressed by raising awareness with events and information's leaflets.

On the other hand, it is harder to convince households that are not willing to invest into the change of the heating system. Some households have recently refurbished their energy production and will not be willing to connect to a district heating even if it meant a lower cost as their investment is paying off. But there are mechanisms how to address also this barrier. First of all it is important to inform residents that in case their central heating system is in operation the costs of connecting to district hating is relatively low. And it is important to develop business models for new district heating systems where investor covers the cost of connecting individual consumers and coverts this cost into charged heating cost.

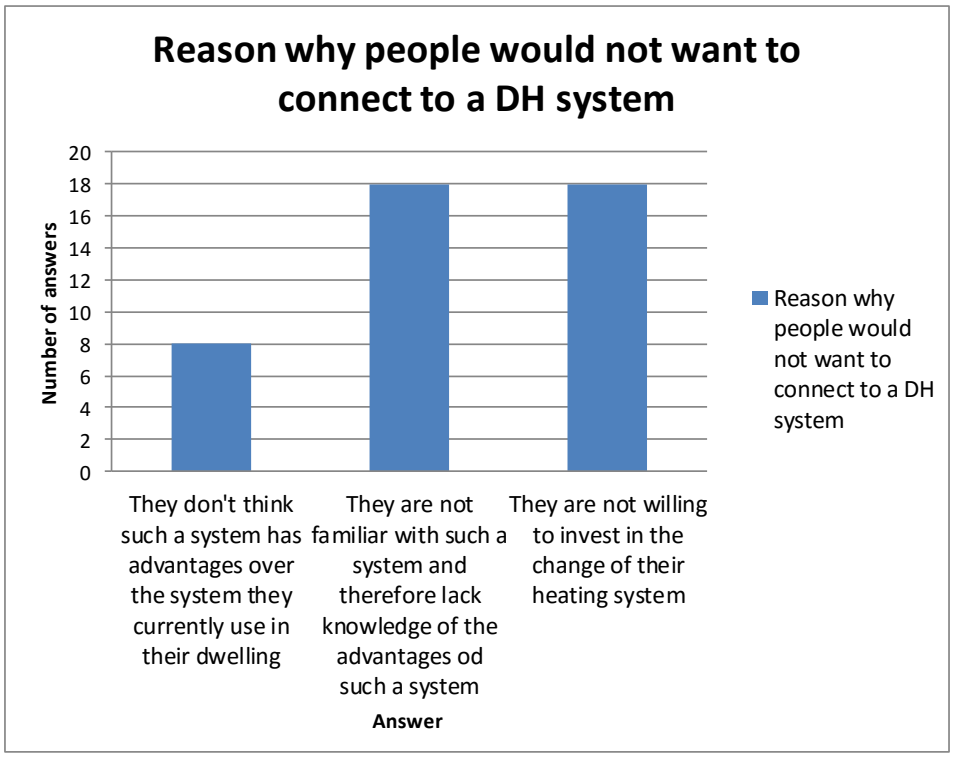

Figure 45. Main reasons why people would not want to connect to a district heating system – results for Cven

Last but not the least important area was to analyse the attitude of households in the survey regarding the six listed benefits of small modular renewable district heating systems in the questionnaire. More about respondent attitudes can be seen in Figure 46.

For around ¾ citizens all written benefits are important or very important, so all benefits are valuated as relevant. The most important for them is that increased comfort for the users and elimination of security risks due to fuel combustion in dwellings. On the other hand, the least important advantages were defined by citizens as enhancement of local employment and security of supply.

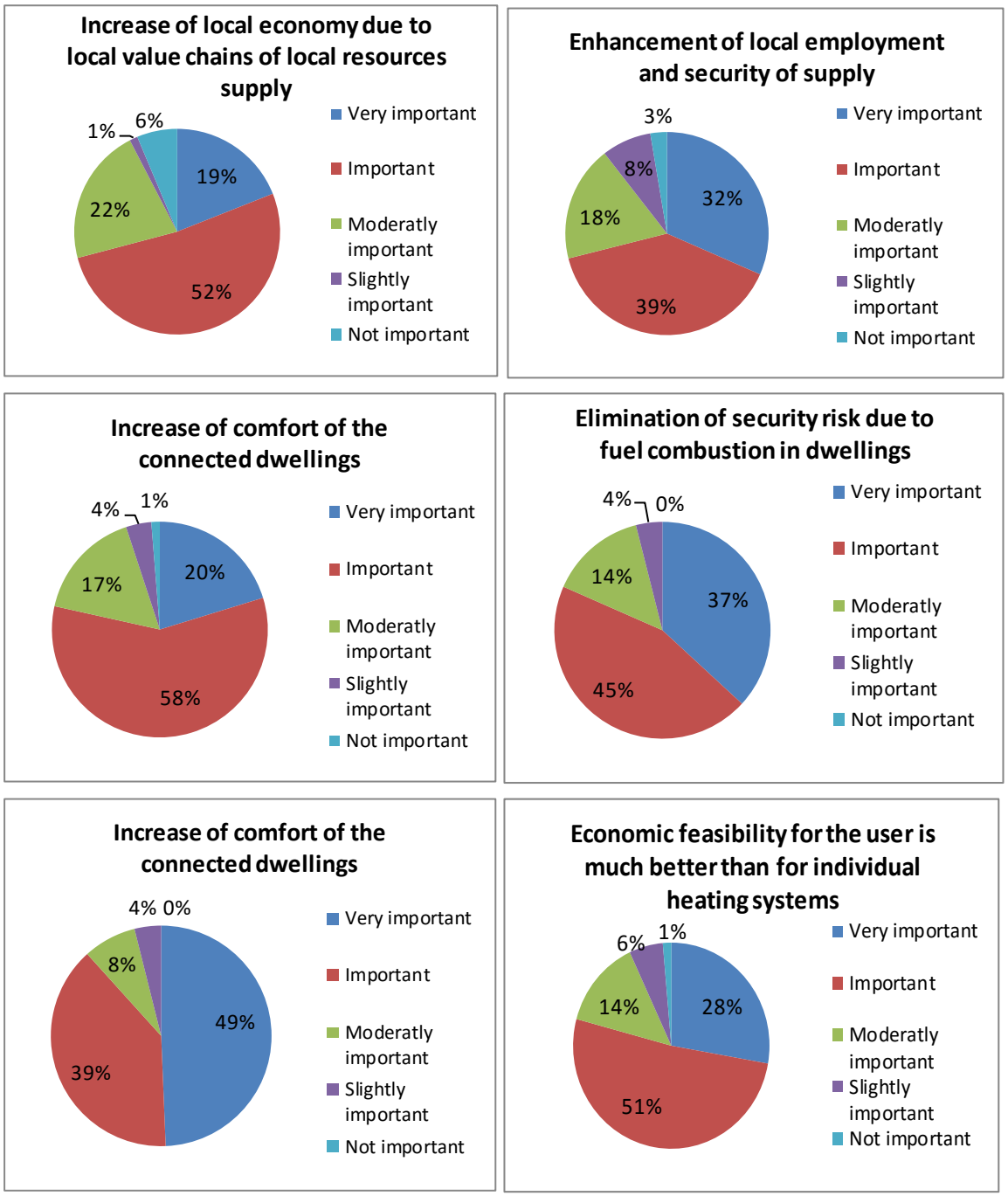

Figure 46. Opinion of interviewed citizens on benefits of small modular renewable district heating systems – results for Cven

3.5 Concluding remarks for target community in Slovenia

Results of the survey in Cven are able to effectively reflect the situation in majority of smaller decentralised settlements in northeastern Slovenia. It has been shown that building stock in Cven is rather old and that additional efforts are needed for better energy efficiency such as refurbishment of household, especially rooftop insulation.

The most used energy source for heating in Cven is logwood probably due to the large amounts of locally available biomass and spread forest ownership. This means that households have access to low cost energy which is not favourable to development of district

heating. On the other hand the abundance of energy wood can also represent an opportunity for a small local district heating system. Situation is the same for heating with oil, which is widely used in Cven and represents a relatively expensive energy source. A decrease of annual costs related to heating and comfortable energy source supply for heating can be important fact for members of households. Heating systems in households are mostly centralised radiator heating systems on apartment/dwelling level, which provides great opportunity for lower district heating connection costs for citizens.

From obtained data it is apparent that some of interviewed citizens have already heard about the CoolHeating project. The most of them received information from flyers, then from local media..

It is important to note that respondents have positive opinion towards small modular renewable district heating systems. From results it can be concluded that almost half of them would be willing to connect to a district heating system in Cven. Essential reasons for participants not to connect is predominantly lack of knowledge and information about benefits of district heating and because of expected costs related to change of the heating system.

All presented benefits of small modular renewable district heating systems were rated high. The highest ratings were related to the increased comfort and elimination of security risks due to fuel combustion in dwellings. This data should be used in planning future possible district heating projects in this area - in Cven.

4 Results of the survey in target community in Bosnia and Herzegovina

Target community in Bosnia and Herzegovina is Municipality of Visoko which has 12.900 households (2013 census). As a part of Task 3.4, 512 questionnaires were gathered from the citizens of Visoko, which accounts for 4 % of the total amount of households in the city. All of the questionnaires were gathered by door-to-door interviewing. During door-to-door interviewing, citizens were also given promotional material in form of project flyers.

Figure 47 represents parts of the municipality, which were surveyed in this task in form of red line. Results of the survey are presented in next subchapters.

Figure 47. Parts of the municipality of Visoko included in the survey

4.1 Information on building stock

There are 9 questions and 2 sub-questions in the questionnaire, which provide information on building stock in Visoko. Questions concern type of household, build period, period of last refurbishment, number of people living in the household, floor area of the household, number of rooms in the household and insulation level of outer walls and roof. 2 sub-questions concern type and thickness of insulation for the outer walls and roof. Municipality of Visoko has 41 500 citizens according to the last population census. The questionnaire was performed for collective housing and narrow urban centre old town as it is presented in Figure 47. Result has shown that in the area that was surveyed, there is a higher percentage of people who live in apartments.

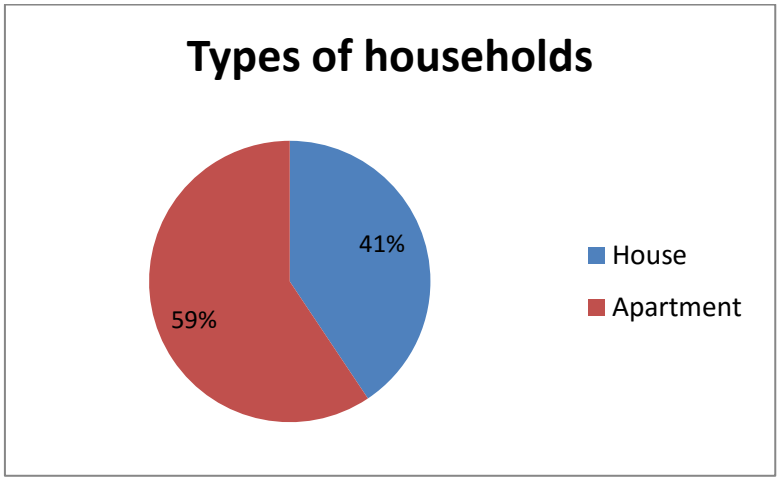

Figure 48. Type of households in the municipality of Visoko

From the Figure 49 it can be seen that most of collective housing is built in the period 1960-1980 and most of individual housing is built in the period 1950 – 1990. Construction of new buildings mostly in the period 1992-1995 and continued from 1995-2000. This means that the average age of collective housing in Visoko is 35 years and individual housing is more than 40 years.

Most of the buildings in Bosnia and Herzegovina have been built in the middle of previous century. Average age of buildings and the lack of adequate heating insulation result in high heat demands of buildings in Bosnia and Herzegovina.

The refurbishments, which in general include replacement of old windows and insulation of the facade, mostly took place in the last 15 years as can be seen in Figure 50. Due to high average age of individual and collective housing in Visoko, the share of refurbished buildings is still rather low and should be improved in the future in order to achieve lower heat demands of the buildings.

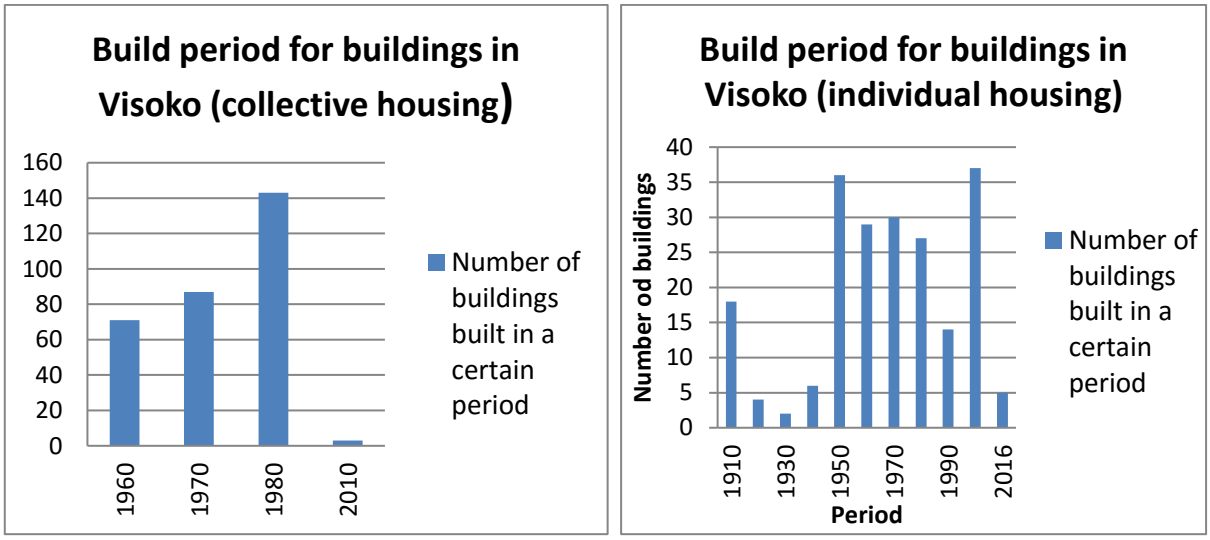

Figure 49. Build period for buildings in Visoko

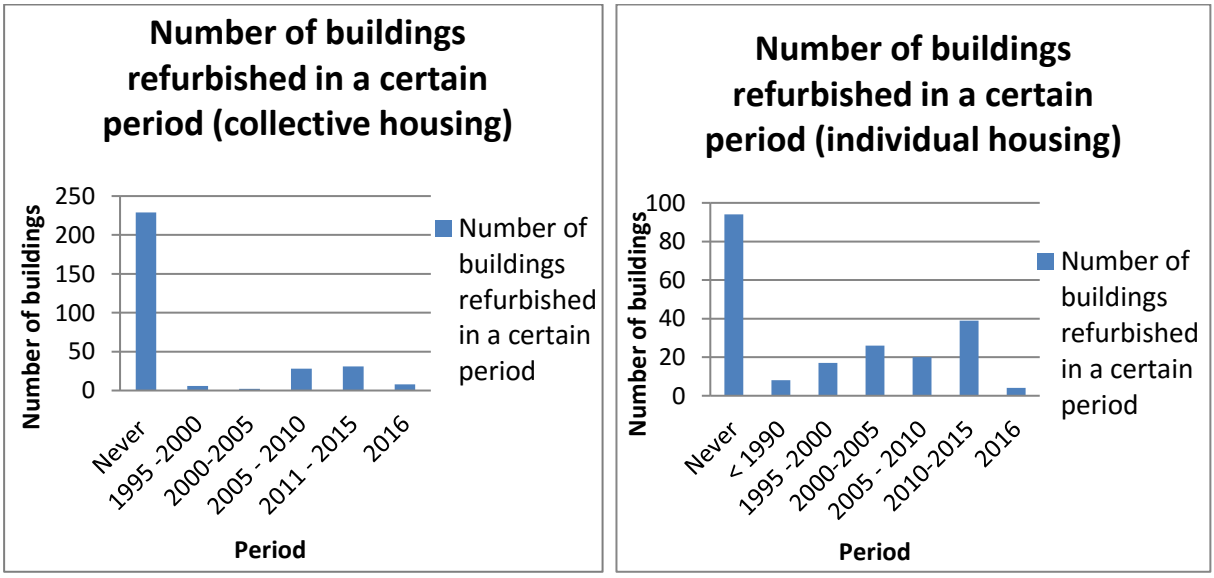

Figure 50. Refurbishment period for buildings in Visoko

According to Figure 51, results have shown that mostly 1-2 people live in collective households, which is more than 50% of the total number of surveyed collective households

with small difference compared to results for 3-5 people. For individual housing, mostly 3-5 people live in the dwelling (59 % of interviewed citizens). Average number of people that live in a certain dwelling for collective and individual housing is 3-5. According to Figure 52, around 27 % of surveyed collective housing have a floor area of 60 m^2 and for individual housing floor area is from 70-100m^2. This is also connected to a number of rooms in a certain household, which is 4 for individual housing and 2 for collective housing. This is shown in Figure 53. All these facts should result in higher heat demands of the individual households.

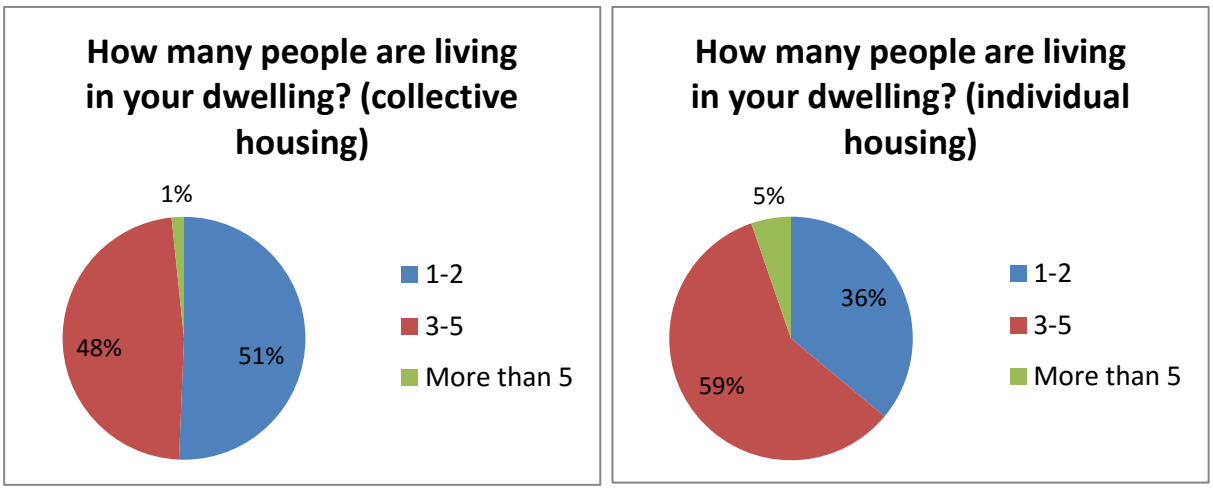

Figure 51. Number of people living in a certain household in Visoko

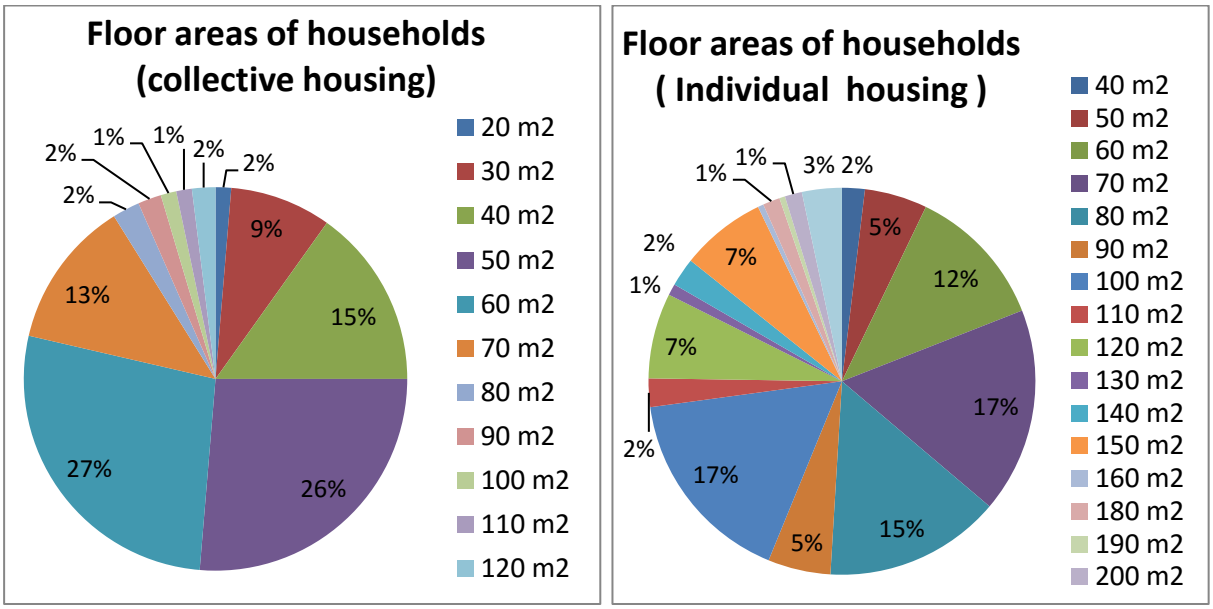

Figure 52. Range of floor areas of surveyed households in Visoko

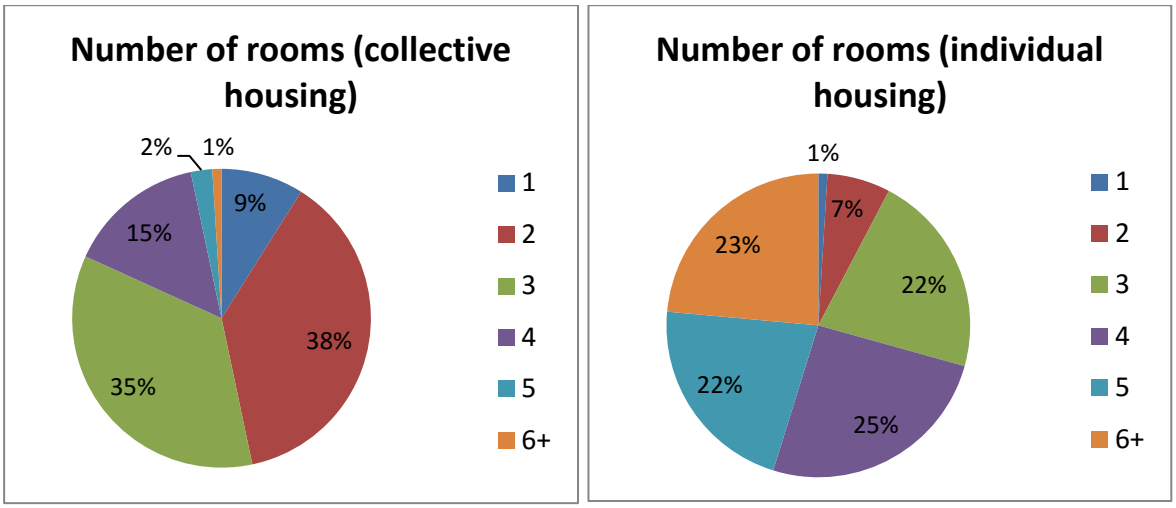

Figure 53. Number of rooms in surveyed households in Visoko

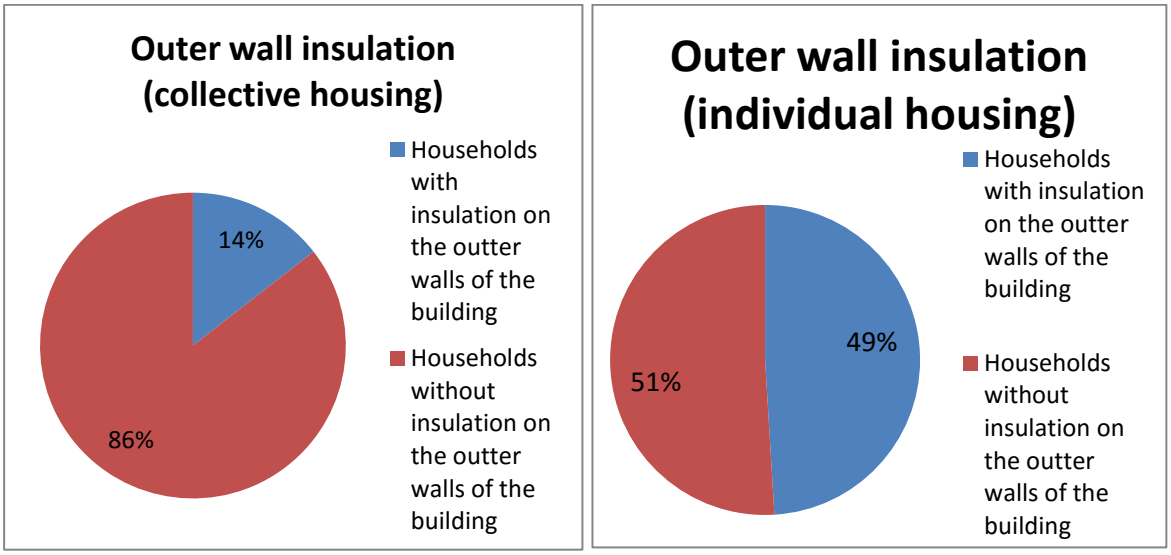

Figure 54. Share of households that have insulation on the outer wall – results for Visoko

Figure 54 has shown that for collective housing only 14% incorporates outer wall insulation but for individual housing this share is much higher, at 49%. Average result is 32% for collective and individual housing. Difference in percentage from collective and individual housing is in the fact that individual housing is much bigger than collective, and in the fact that since 1995 people constantly invested in outer insulation because of high heat expenses. Insulation material that is mostly used for outer wall insulation is polystyrene (Styrofoam) with average thickness 5 – 10 cm.

Figure 55 has shown that only 27% of collective housing and 35% of individual housing has roof insulation, with an average being 31%. This means that there are very high heat losses present in the community. Because of the lack of outer wall and roof insulation, it is necessary to promote insulation of buildings in Visoko.

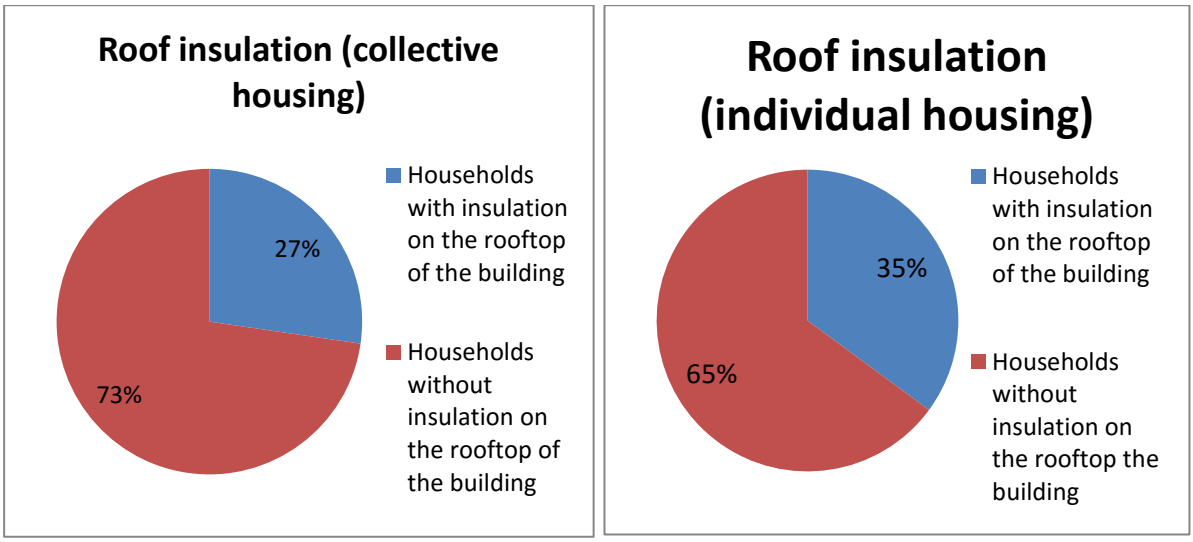

Figure 55. Share of households that have insulation on the roof – results for Visoko

Figure 56 has shown slightly better situation when it comes to windows that are being used on buildings. Average result for collective and individual housing is 37% for PVC type of windows and 60% for wooden types of windows. Some of the wooden windows have been refurbished and therefore have high energy performance. Conclusion is that situation in this field is satisfactory.

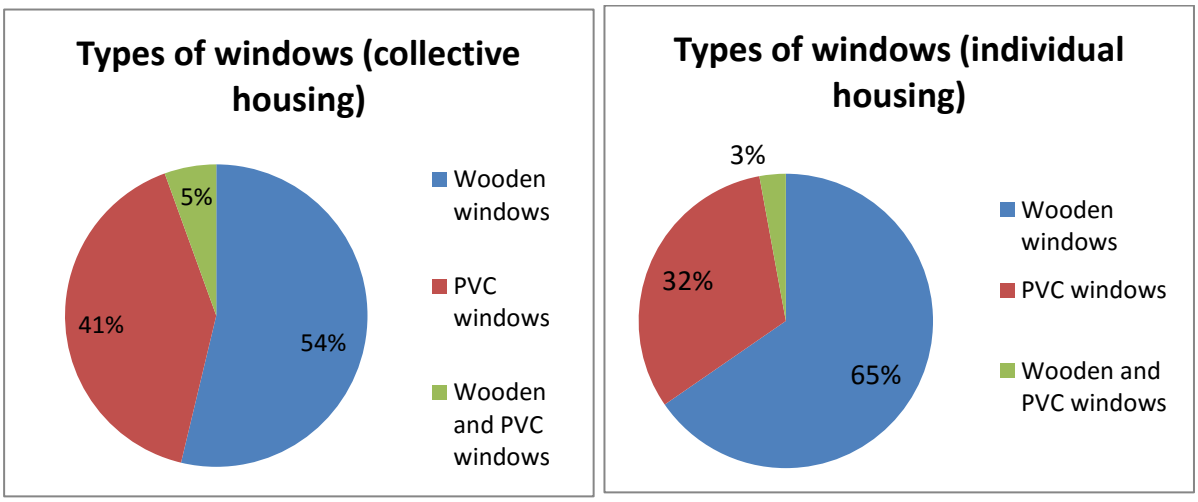

Figure 56. Types of windows that are used on buildings in Visoko

4.2 Information on the heating system in the household

When it comes to heating and cooling system in households, there are 4 questions that require input on this topic in the questionnaire. They concern type of the heating system, energy source used in the heating system, energy source used for domestic hot water preparation and type of cooling system, i.e. energy source used for cooling.

More than 50% of interviewed citizens in collective and individual housing have individual stoves, on the dwelling/apartment level, and more than 40% of interviewed citizens a centralised radiator heating system in rooms, as seen in Figure 57. This information is important because most of the citizens do not have needed infrastructure for district heating

in their dwelling. Those citizens would have to pay connection to district heating network and also complete refurbishment of their heating system.

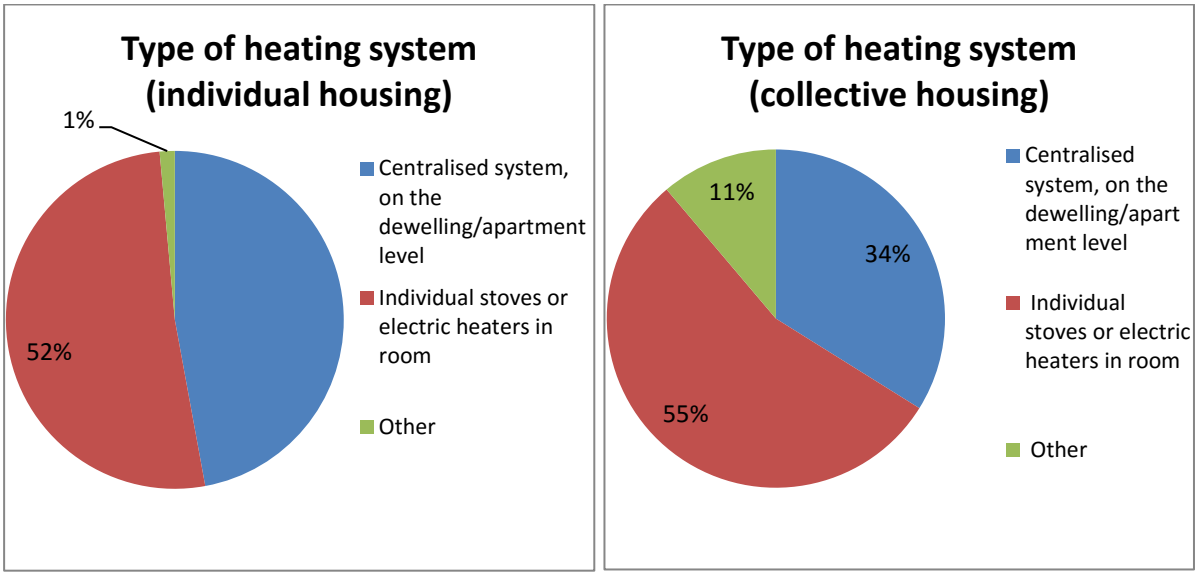

Figure 57. Type of heating system used in households in Visoko

Concerning the energy source that is being used for heating in collective housing, results have shown that electricity and natural gas are mostly used, while for individual housing, brown coal is mostly used, as shown in Figure 58.

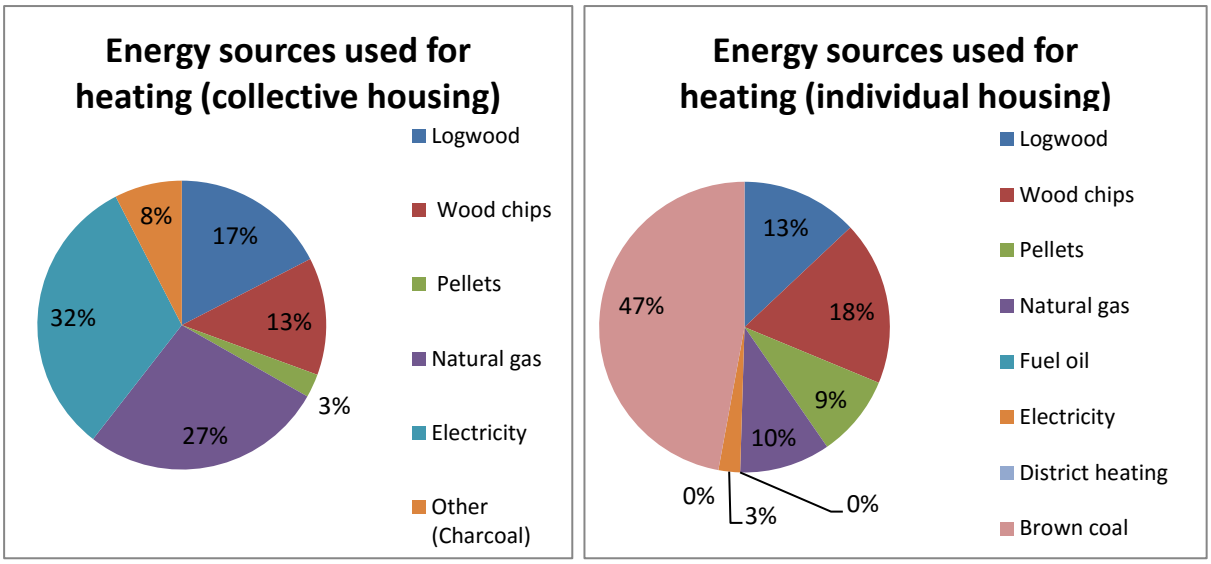

Figure 58. Energy sources used for heating of households in Visoko

Electricity is still the main energy source when it comes to domestic hot water preparation as it is shown on Figure 59.

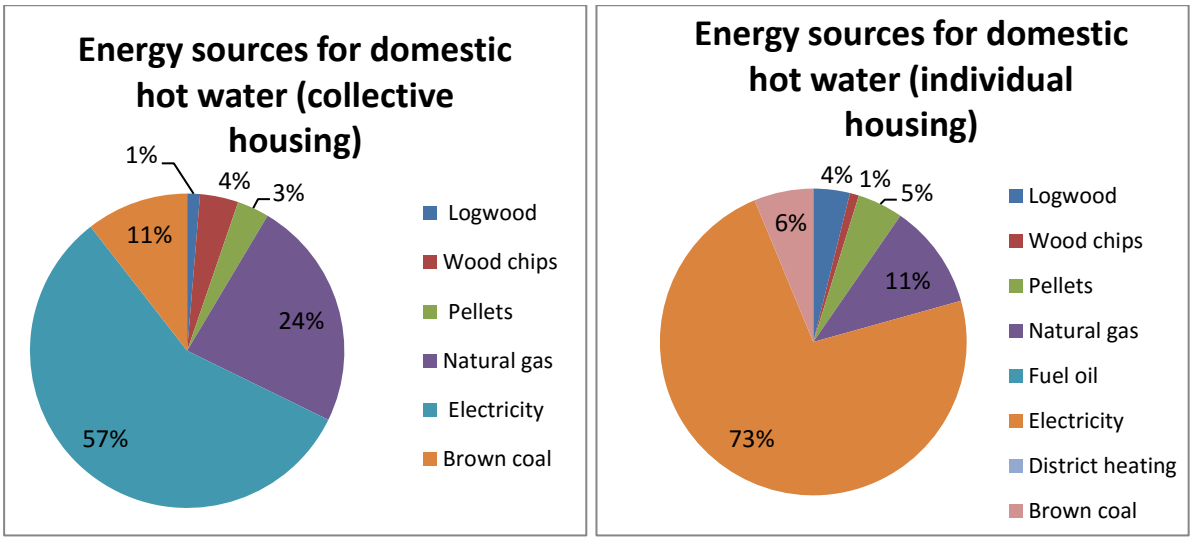

Figure 59. Energy sources used for domestic hot water preparation in households in Visoko

When it comes to cooling, only around 20 % of interviewed citizens use cooling systems. Mostly used cooling systems are split-system air conditioning units. Therefore, the only energy source used for cooling is electricity. This is shown on Figure 60.

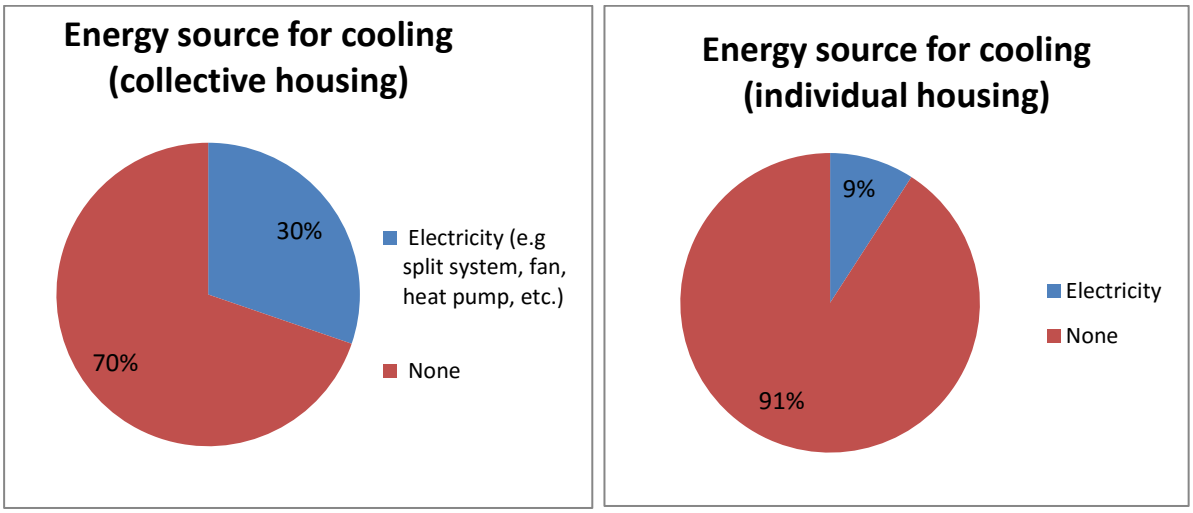

Figure 60. Energy source used for cooling in households in Visoko

4.3 Information on energy consumption

This part of the questionnaire includes 5 questions and 3 sub-questions. They concern final energy consumption for heating, final energy consumption for domestic hot water preparation, number of rooms that are being heated, number of rooms that are being cooled, energy certificate of the household and yearly expenses for heating purposes.

In order to express consumption of logwood citizens used cubic meters, for fuel oil they used litres, for pellets tonnes and for electricity kilowatt hours. In order to unify this, all data on energy consumption was transformed to kilowatt hours. Values shown in the graphs are yearly values of energy consumption.

Figure 61 has shown final energy consumption of surveyed households in Municipality of Visoko (collective and individual housing) and it can be seen that almost equal percentage is present for different energy consumptions of surveyed households. This can be explained also with a fact that most of interviewed citizen were from collective housing who mostly use natural gas and electricity as heating source and individual housing consume brown coal and wood.

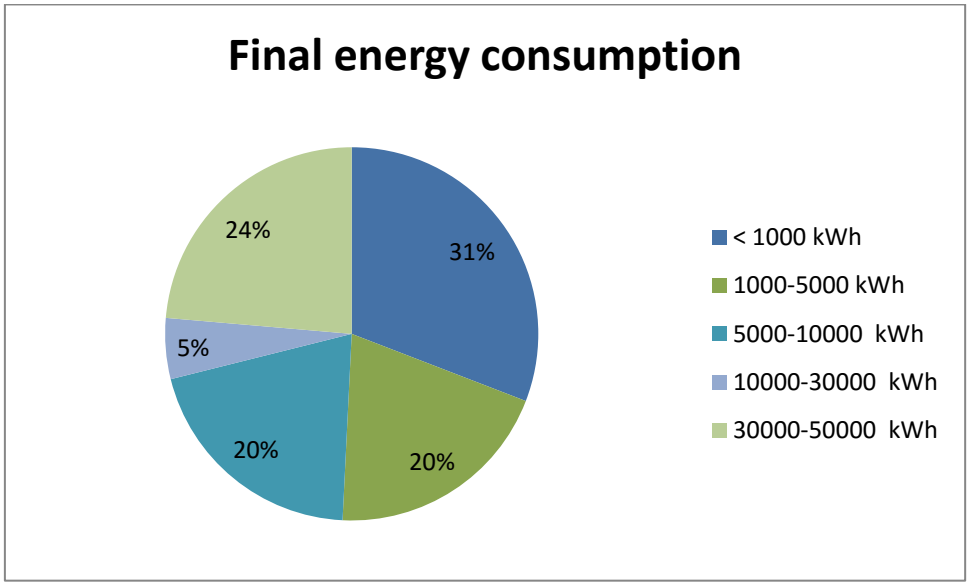

Figure 61. Range of final energy consumption for interviewed citizens of Visoko

Figure 62 shows that number of heated rooms for collective housing is 2 and for individual housing the result is 3. This corresponds to results shown in Figure 53.

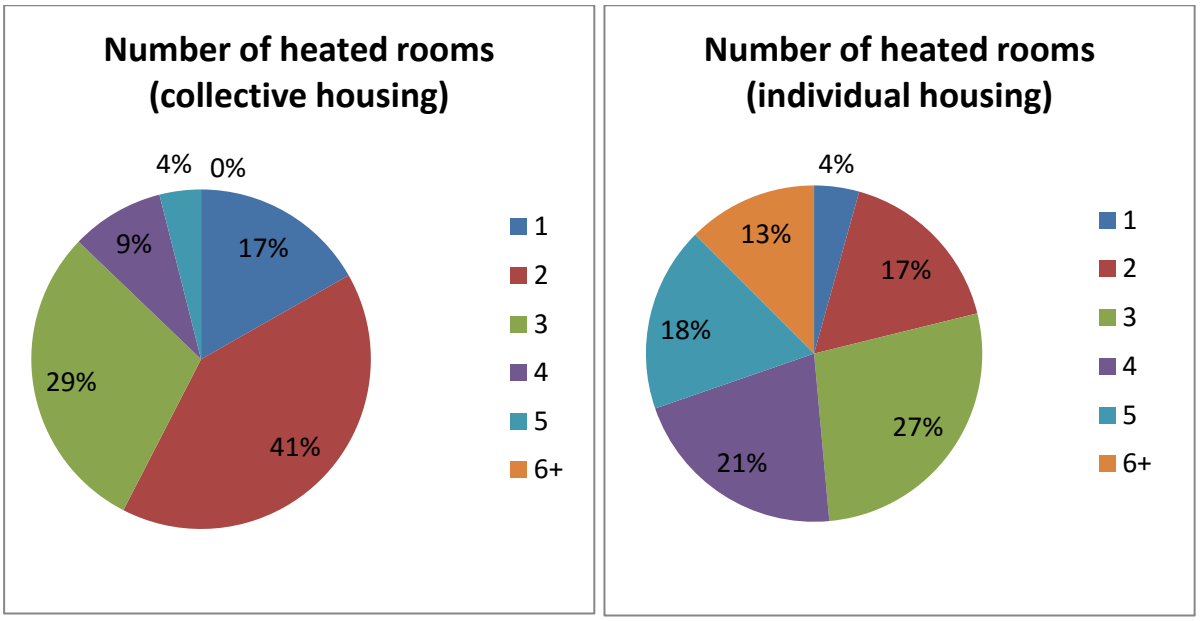

Figure 62. Number of rooms that are being heated in households in Visoko

Figure 63 shows that number of rooms that are being cooled in a certain household is one because people mostly use split system air conditioners.

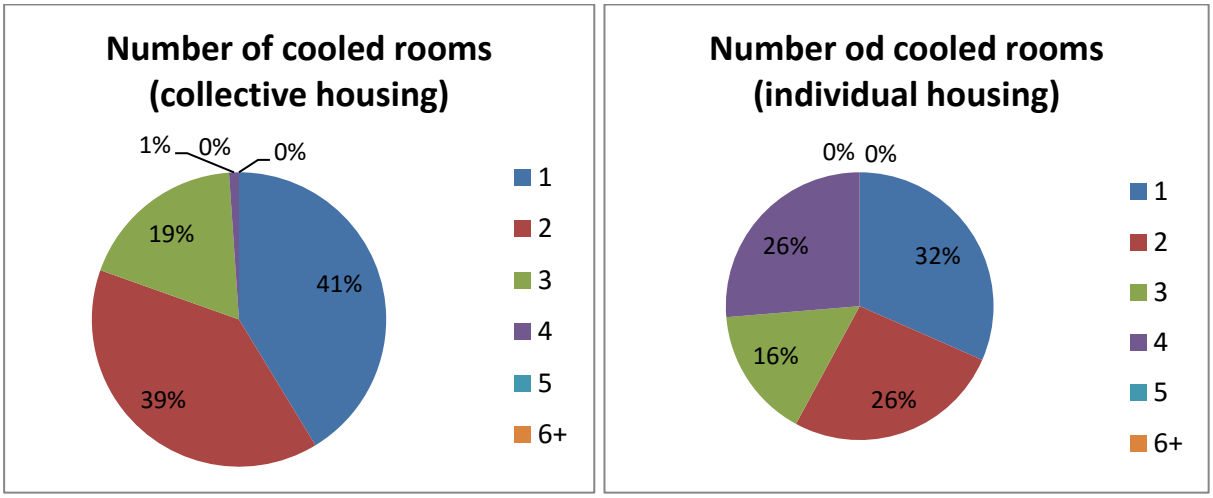

Figure 63. Number of rooms that are being cooled in households in Visoko

interviewed citizens do not have an energy certificate for their household and therefore, energy certification should be promoted in Municipality of Visoko. Citizens need to be informed about the level of energy consumption of their households and ways to improve its energy performance, which is exactly what an energy certificate represents.

From citizens' perspective, the most important parameter is the amount of money they spend each year for heating purposes. For that reason, one of the most important questions in the questionnaire was the one on annual expenses for heating. Analyses of these results is shown below.

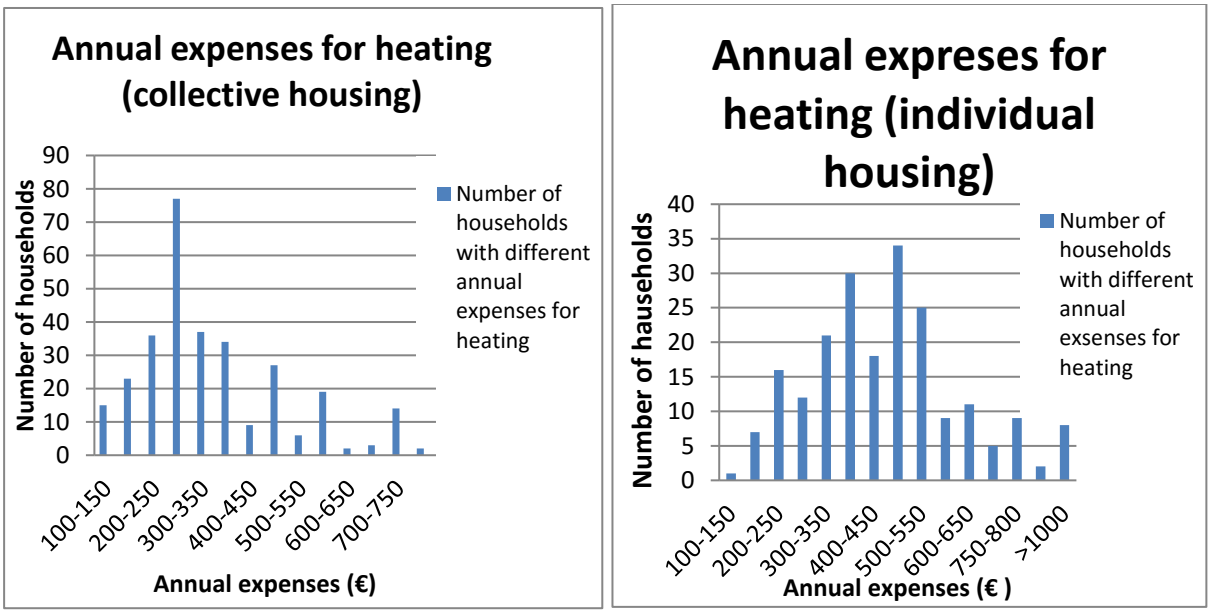

Figure 64. Annual expenses for heating of households in Municipality of Visoko

Figure 64 has shown that heating expenses for collective households are in the range 250-300 € and for individual housing 500-550 €, because the average size of individual

households is much higher than for collective households. Figure 65 shows that expenses of heating for housing (average collective and individual houses) in most cases is more than 400 €.

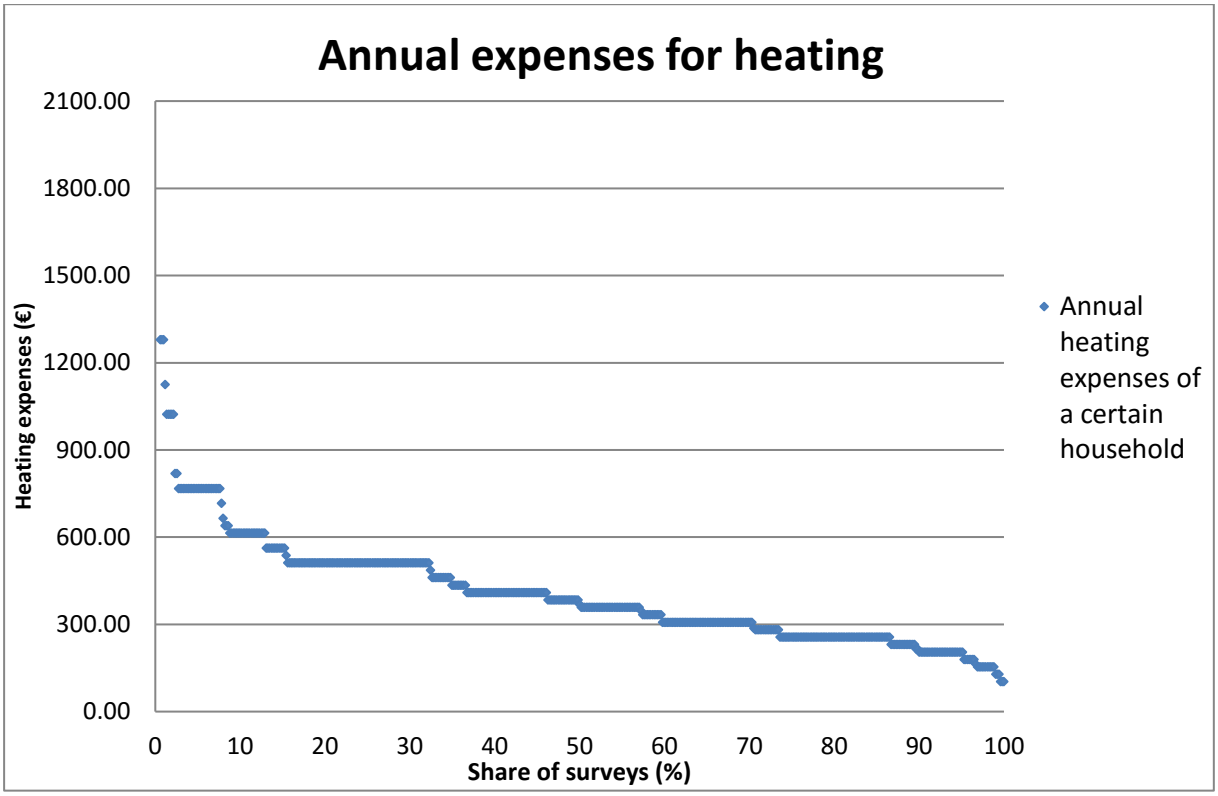

Figure 65. Sorted annual expenses for heating of households in Municipality of Visoko

Figure 66 shows that most of the people in Visoko heat their dwellings 6 to 7 months. This is an average for the continental part of Bosnia and Herzegovina.

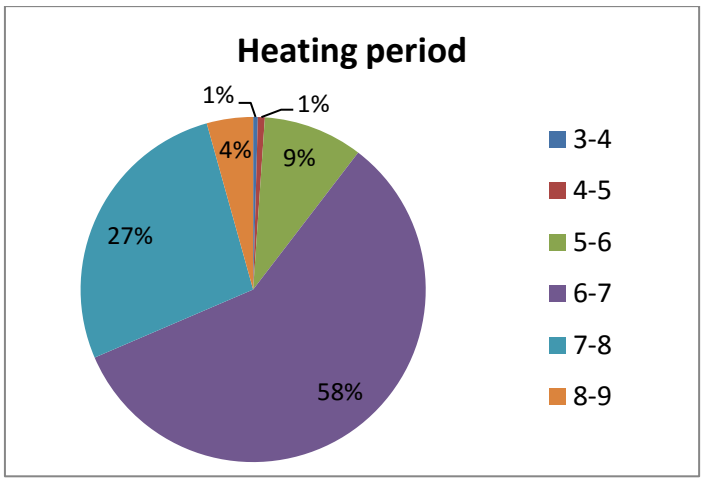

Figure 66. Annual heating period for households in Visoko

4.4 Information on public opinion

Figure 67 shows that almost 63 % of people have already heard about the CoolHeating project when they were interviewed. These results are actually very good since only one information was on the website of the Municipality of Visoko before the survey was carried out.

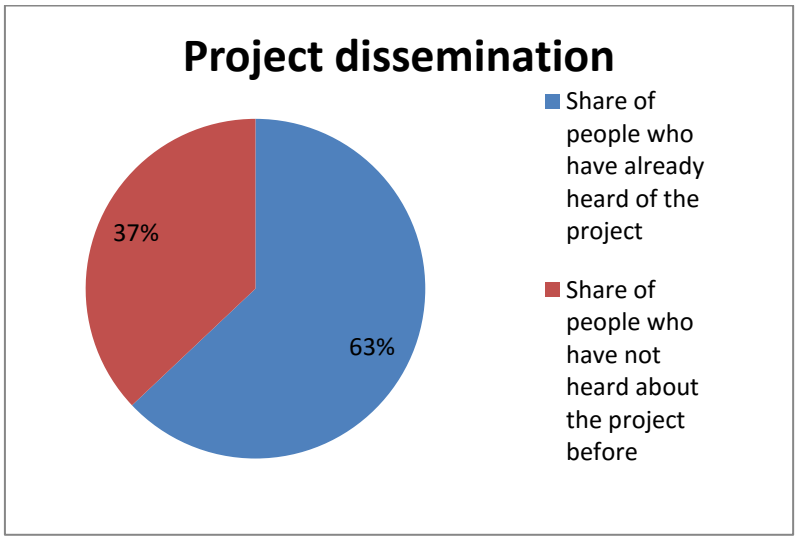

Figure 67. Results of the project dissemination in the Municipality of Visoko

Questionnaire also wanted to check the willingness of people to connect to a district heating system. Figure 68 shows that 86 % of interviewed citizens would be willing to connect to a district heating system. The main reason why people would not want to connect to a district heating system is necessary investment in infrastructure for this heating system because of low life standard, as seen in Figure 69.

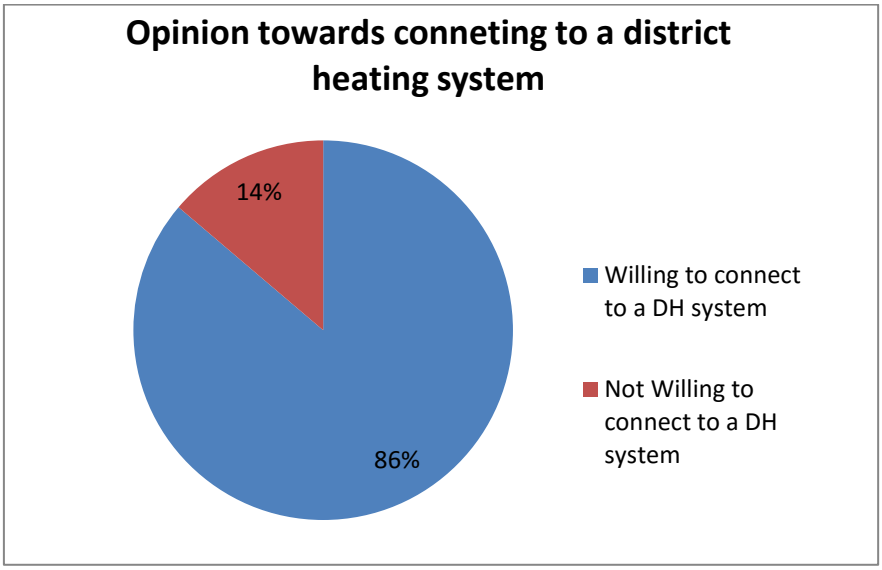

Figure 68. Opinion of citizens of Visoko towards connecting to a district heating system

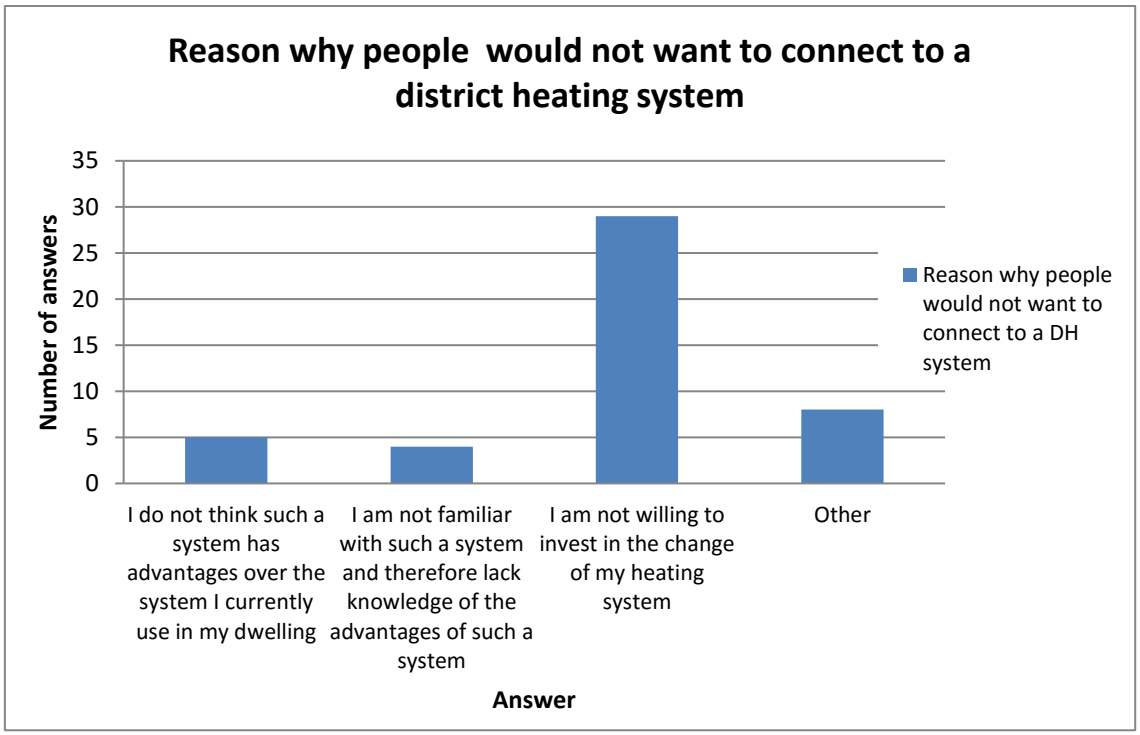

Figure 69. Main reasons why people would not want to connect to a district heating system – results for Visoko

The idea of the survey was also to promote the benefits of small modular renewable district heating systems and to check which of these benefits are most attractive to the citizens.

According to Figure 70, citizens of Visoko found that the two most important benefits of small modular renewable district heating systems are reduction of environmental pollution/improvement of air quality and the fact that economic feasibility for the user is much better than for individual heating system. These results show which benefits should be in focus when organising information events in Visoko.

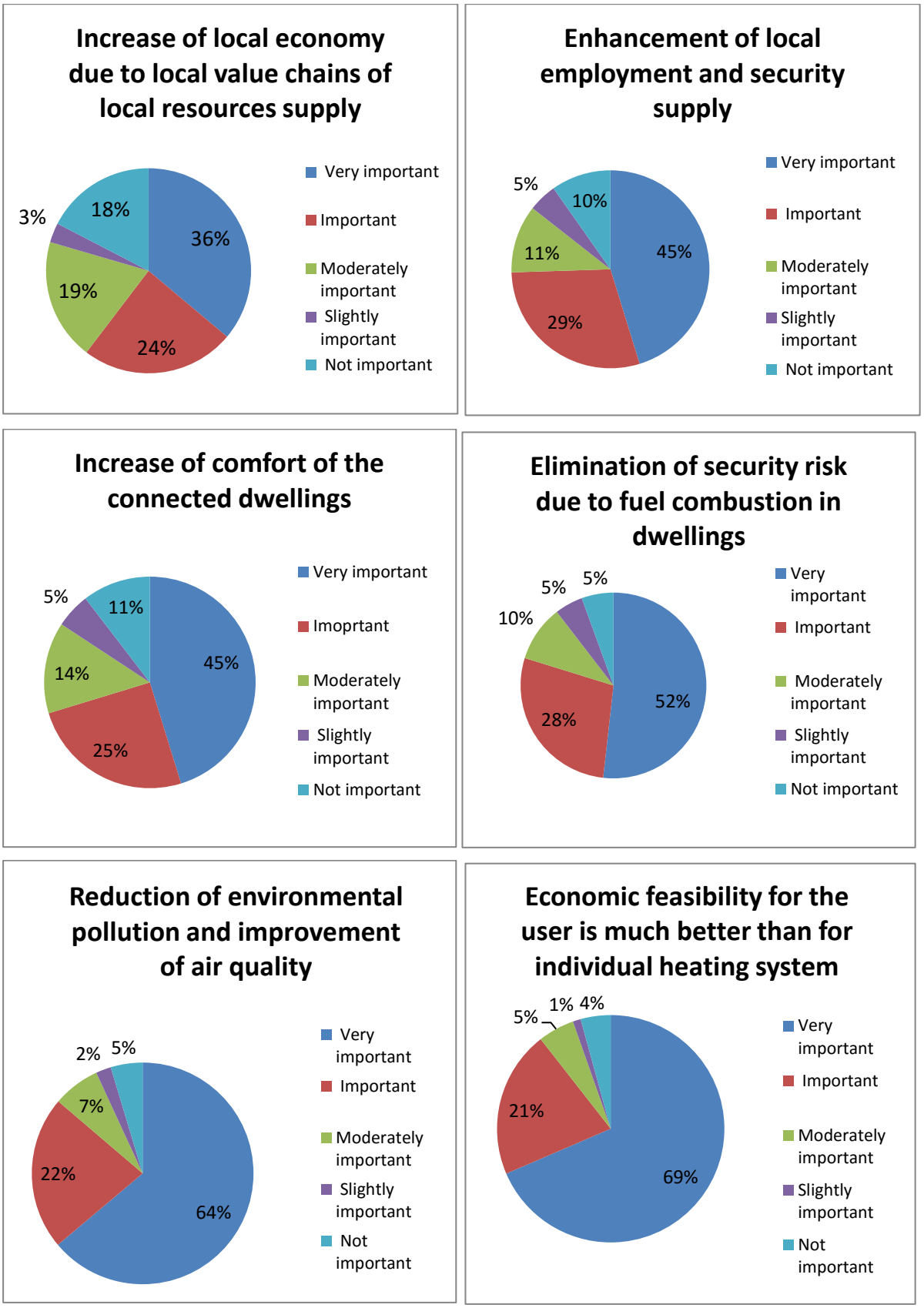

Figure 70. Opinion of interviewed citizens on benefits of small modular renewable district heating systems – results for Visoko

4.5 Concluding remarks for target community in Bosnia and Herzegovina

According to overall data of the interviewed citizens 86% of the respondents are interested into connecting to a district heating system.

This analysis shown that most of the exisiting housing is old and with high energy consumption. The most used energy source is brown coal for individual housing and eletricity and natural gas for collective housing.

Annual expenses for heating of collective housing in most cases is 250-300 € and for individual housing in most cases is 500-550 €. Most of the people in Visoko heat their dwellings 6 to 7 months. This is an average for the continental part of Bosnia and Herzegovina.

By using solid fuels for heating system will result in a series od negative impacts. Solid fuels are not renewable energy sources. Reduced availability od these energy sources will results insignificant increase in energy prices. During the combustion of brown coal, each heating system emits CO_2 gas that directly contributes climate changes.

The purpose of this („use of renewable energy“) project implementation is much higher than the economic benefits. Numerous positive effects are realized, such as rational waste management, retention of existing jobs and creating new jobs, increaseing the competetiveness of domestic industry. The project has a positive socio-economic and enviromental impact, increasing the circulation od money in the local community and in the state. It is also atracting new investments which is the biggest adventage of using renewable energy sources.

Developed countries have recognized the benefits of using renewable energy sources and they are giving then a great adventage and support.

5 Results of the survey in target community in Macedonia

Official data from the Municipality of Karposh website states that the number of residents in the municipality had been 59 666 in 2008, out of which 28 460 are male and 31 206 are female residents. The number of households estimated in the Municipality is 19 680, which results in an average number of just above three residents per household. A point should be made that this information is outdated. However, it can be assumed that the statistics have not changed significantly over the past years. More present data from the State Statistical Office shows that the number of residents in Karposh had been 60 625 in 2015.

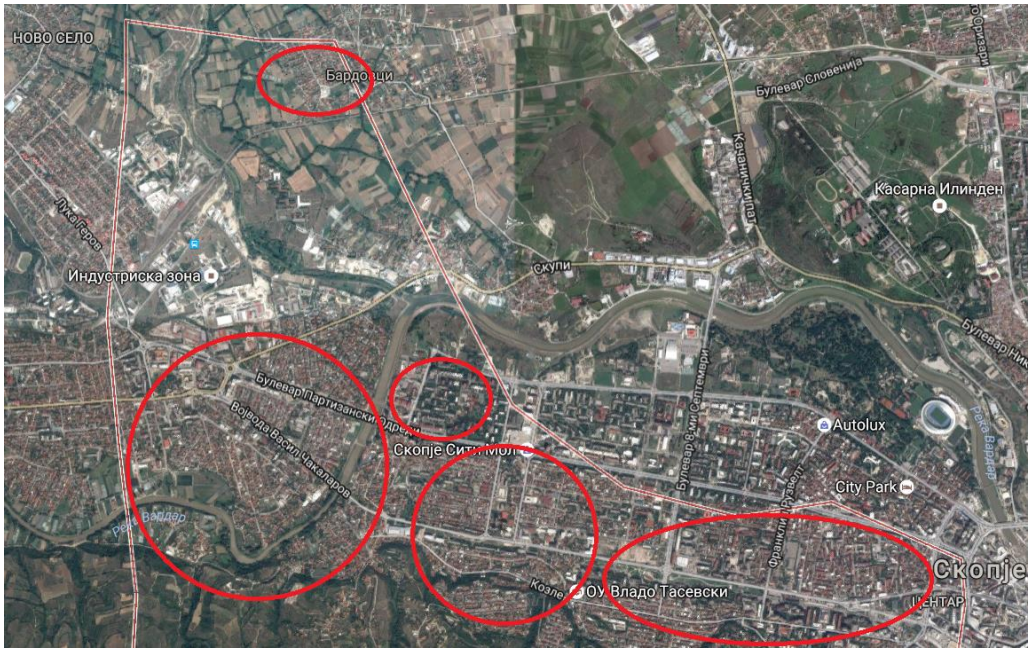

Figure 71. Areas of the Municipality of Karposh included in the survey

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As part of the CoolHeating's Task 3.4 Survey of the citizens of the target communities, the goal of obtaining 500 questionnaires had been set for the Municipality of Karposh. However, the fact that Karposh is organized in 14 local communities facilitated the survey conduction and allowed the target of filling out 500 questionnaires to be met and exceeded. Before the start of this process, a training session for the surveyors of all 14 local communities had been held. The aim of the training session was to acquaint the surveyors with the questions and the possible obstacles that may occur in the process. Then, 50 copies of the questionnaire were handed to each local community's surveyor, i.e. 700 hard copies were handed out in total. Additionally, an online questionnaire was conducted and results from 39 people were obtained, which gives a total number of gathered questionnaires of 739. Nevertheless, not every interviewed citizen answered all of the questions. This may be a consequence of the lack of knowledge and interest.

5.1 Information on building stock

There are 9 questions and 2 sub-questions in the questionnaire, which provide information on building stock in Karposh. Questions concern type of dwelling, build period, period of last refurbishment, number of people living in the dwelling, floor area of the dwelling, number of rooms in the dwelling and insulation level of outer walls and roof. 2 sub-questions concern type and thickness of insulation for the outer walls and roof.

When addressing the topic of types of dwellings in Karposh, it appears that the percentage of houses (56%) is only slightly higher than the percentage of apartments (44%), as shown on

Figure 72. However, each of the local communities in the municipality has a distinct house/apartment ratio. This data, along with other factors may be relevant when determining the feasibility of a certain project. The information on the types of dwellings in each local community in Karposh is given in Figure 73.

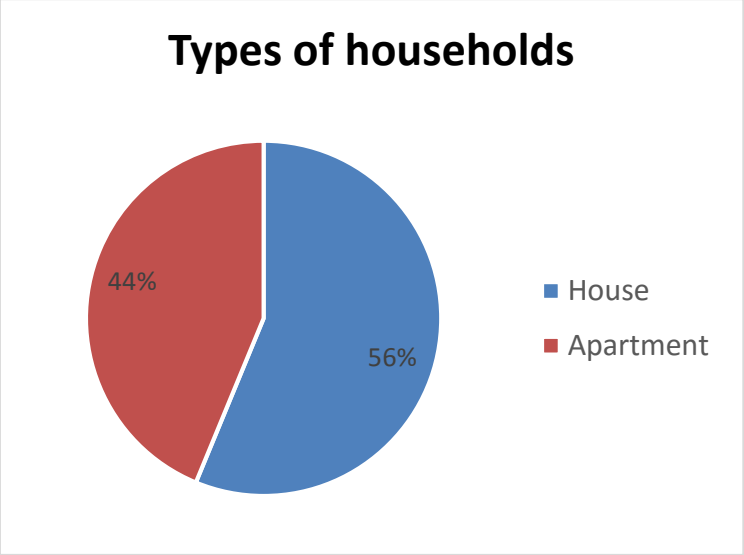

Figure 72. Type of households in the Municipality of Karposh

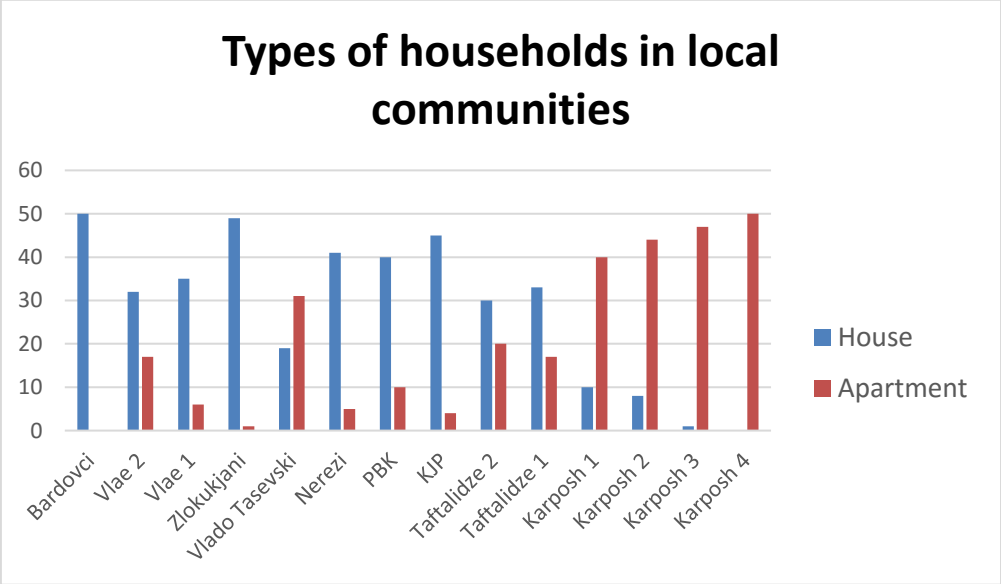

Figure 73. Type of households in the local communities of Karposh

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For instance, all of the interviewed citizens which reside in Bardovci live a house, while all of the citizens from Karposh 4 live in an apartment. The disaggregated approach toward the classification of types of dwellings provides a certain geographical mapping of this information which can later be correlated with the heating solutions and expenses of each community.

The dwellings in Karposh have mostly been built in the period 1960 - 1980. It should, however, be addressed that there is a difference in the construction technology in buildings before and after the earthquake in 1963. Just above 150 of the interviewed citizens had their

dwellings built in the time frame of 1980 – 2000. This generalisation does not, however, apply to the case of Bardovci, Vlae 2 and Nerezi, as the majority of the interviewed citizens from these local communities stated having their dwellings built after 1980. This is clearly portrayed on Figure 75.

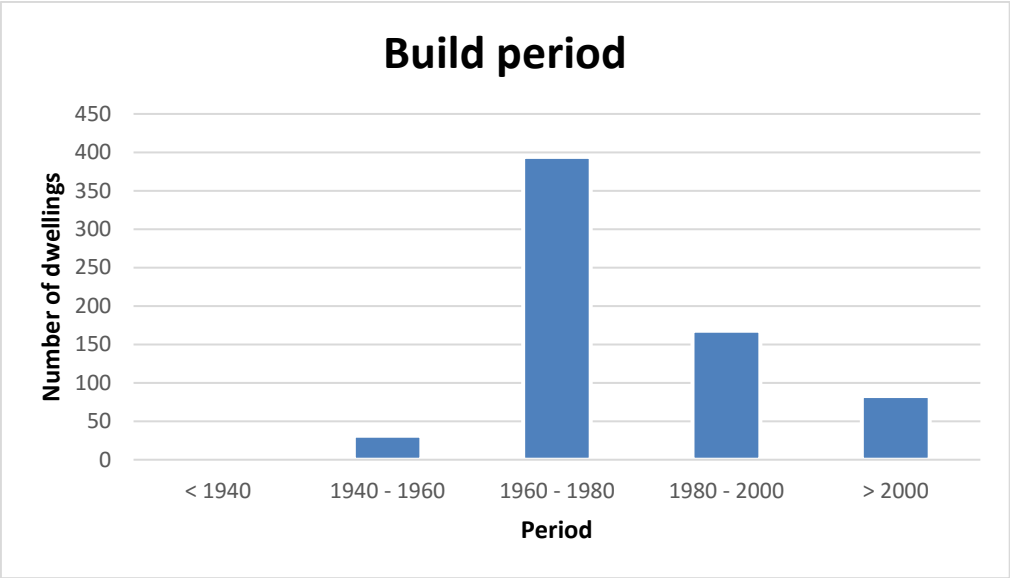

Figure 74. Build period of dwellings in the Municipality of Karposh

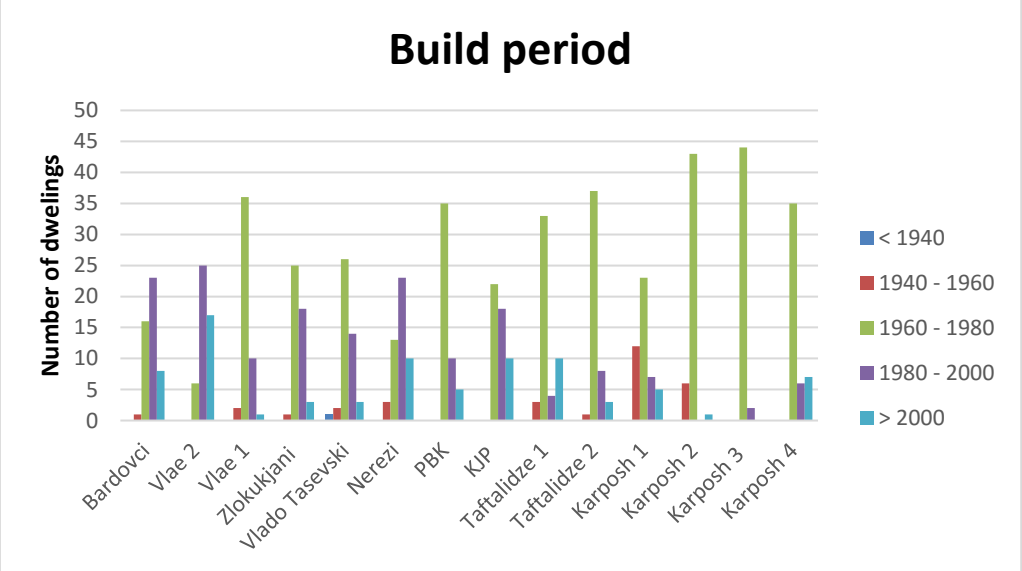

Figure 75. Build period of dwellings in local communities in the Municipality of Karposh

Naturally some kind of refurbishment, which may not necessarily include improvement of the dwellings' energy characteristics, has taken place in part of the dwellings. Out of the 715 citizens who answered the question of build period, 447 stated that they have refurbished their dwellings at some point. As shown on Figure 76, most of the dwellings have been refurbished after 2000, while a smaller portion of the citizens have refurbished their dwellings in the period 1980 – 2000 and even less in the period 1960 – 1980. None of the interviewed citizens have made refurbishments previous to 1960 since most of the dwellings had been built in the period 1960 – 1980.

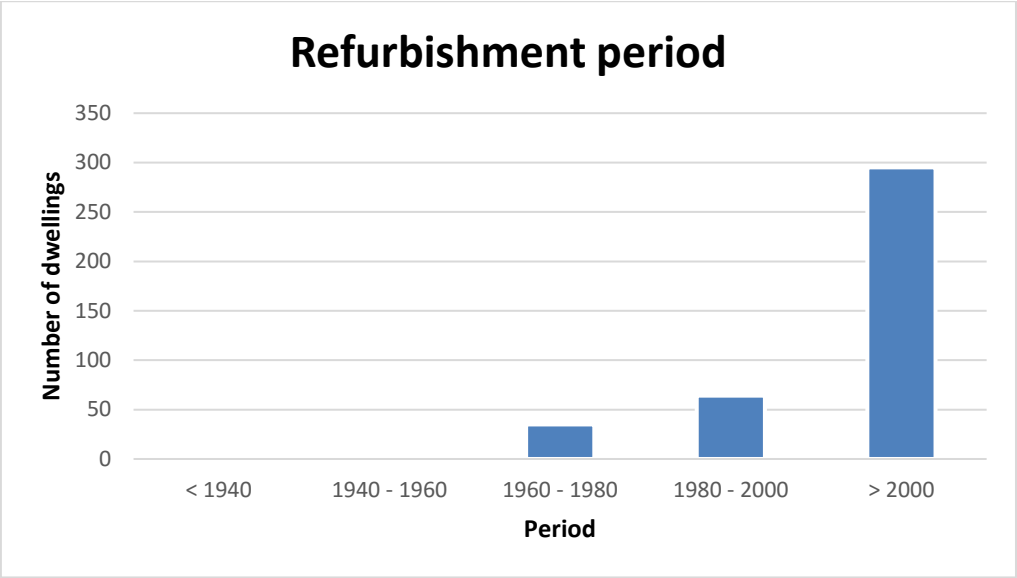

Figure 76. Refurbishment period of dwellings in the Municipality of Karposh

A more detailed view of this information is shown on Figure 77 where the statistics are separately shown for each local community.

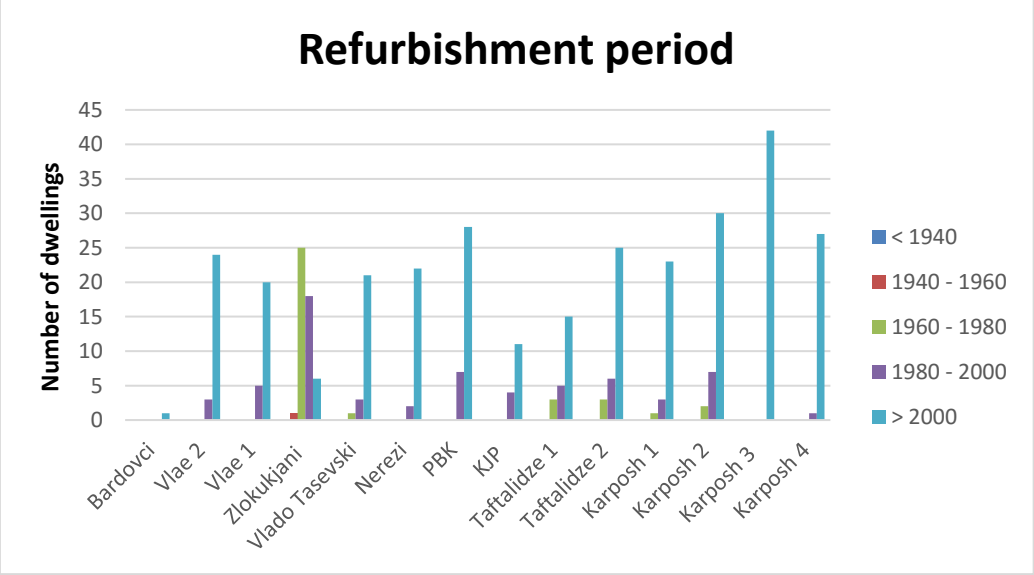

Figure 77. Refurbishment period of dwellings in the Municipality of Karposh

As Figure 78 shows, 3 to 5 people live in 56% of the households, which correlates well with the above-mentioned estimate of average number of people per household. Furthermore, the number of household in which 1-2 residents live accounts for 30%.

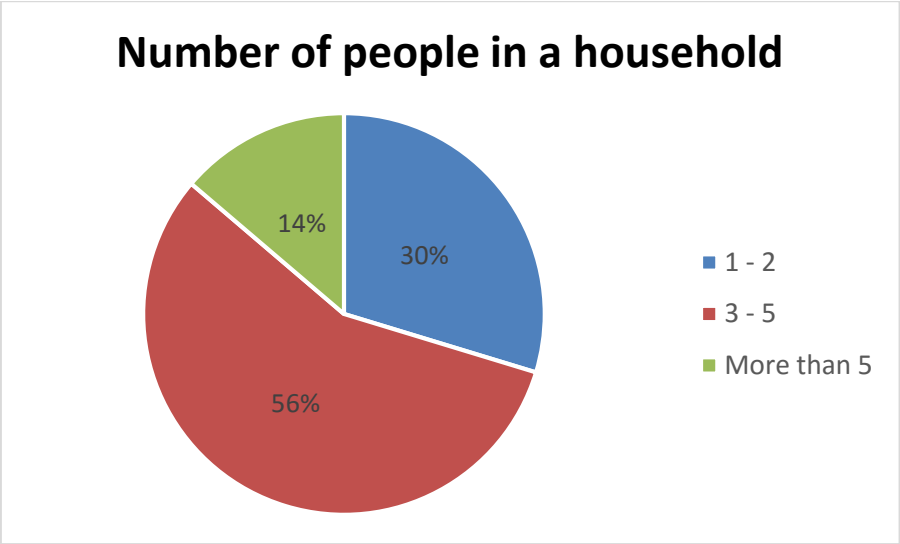

Figure 78. Number of people living in a certain household in Karposh

Another important information on the building stock is the floor area of the dwellings and the number of rooms in each of them. Firstly, more than half of the interviewed citizens live in dwellings with a floor area between 50 m^2 and 100 m^2. Then second largest category relates to floor areas of 100 m^2 to 150 m^2. Only 10% of the dwellings are smaller than 50 m^2. Furthermore, smaller shares of citizens live in dwellings with floor areas of 150 m^2 to 200 m^2, respectively.

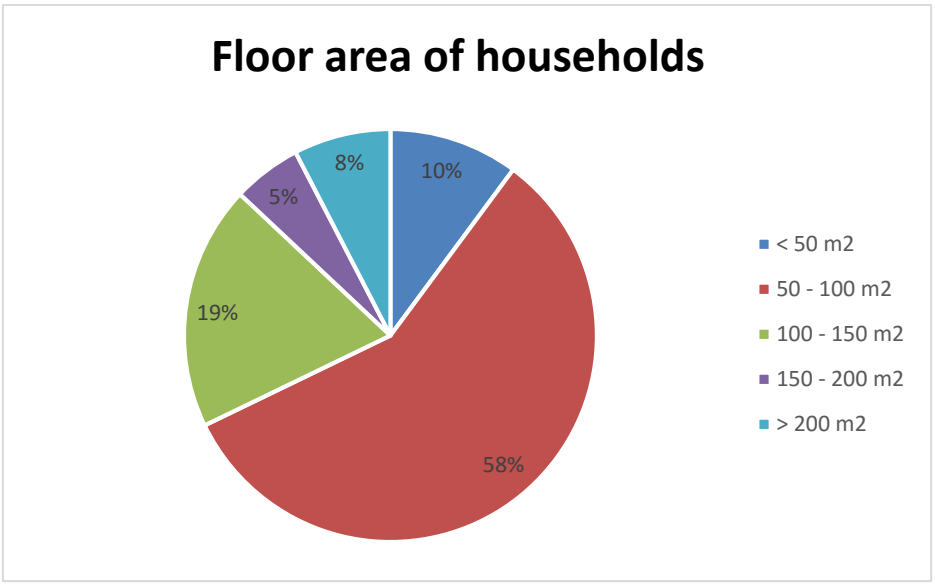

Figure 79. Range of floor areas of surveyed households in the Municipality of Karposh

The disaggregation of the data from Figure 79 gives the representation shown on Figure 80. The number of dwellings represented with a green column is most emphasized in Bardovci, Vlae 2, Nerezi, PBK and KJP. This should not come as a surprise because most of these communities have larger shares of houses as opposed to apartments. On the other hand, just above 28% of the citizens from Karposh 1 and Karposh 2 live in dwellings with a floor area of less than 50 m^2. These are mainly citizens living in apartment buildings.

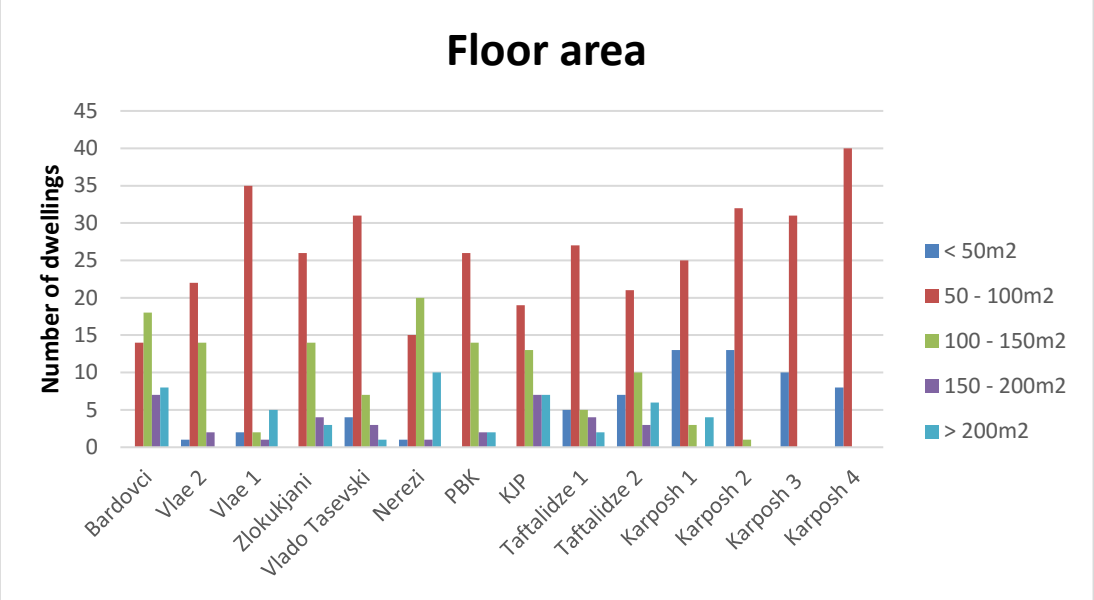

Figure 80. Range of floor areas of surveyed hoseholds in local communities of the Municipality of Karposh

As one might expect, the data on floor area of the dwellings coincides well with the information on number of rooms per dwellings. Because more than half of the citizens live in dwellings with floor areas in the range of 50 – 100 m^2, it seems logical that 61% of all surveyed households have 3 or 4 rooms. Additionally, the percentages of households living in dwellings with 1,2,5 or 6 rooms are smaller. Only 1% of the dwellings have one room – studio apartments.

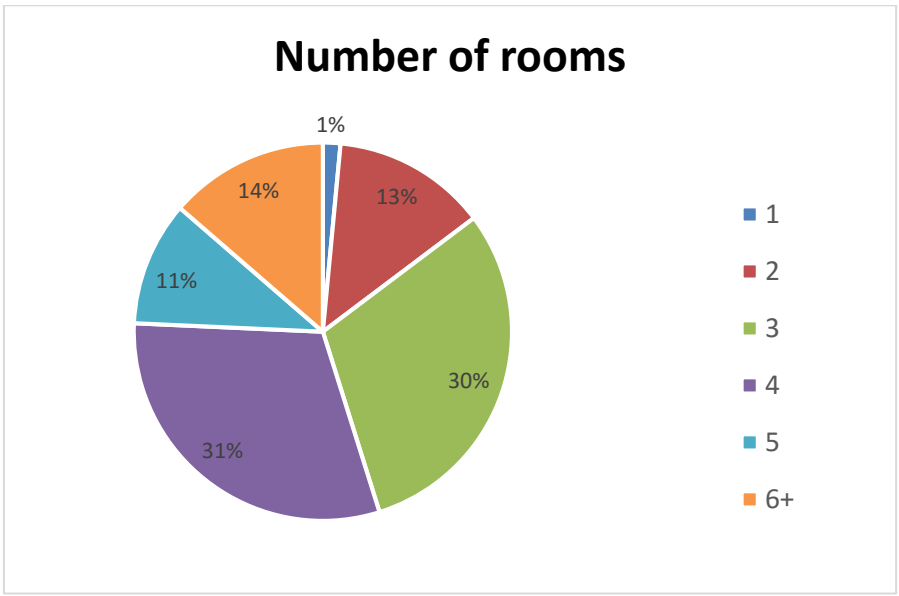

Figure 81. Number of rooms in surveyed households in the Municipality of Karposh

Two questions were provided in the questionnaire for assessment of the insulation quality of dwellings in Karposh. Consequently, the results show that only 39%, i.e. 273 households of

all that had been interviewed have some outer wall insulation. 242 out of those 273 households knew the specific thickness of the outer wall insulation. As shown on Figure 83, 137 of the interviewed dwellings' insulation width is less than 5 cm; only 19 have insulation thicker than 10 cm, while the other 86 dwellings have an outer wall insulation with thickness between 5 and 10 cm.

The topic of roof insulation had been separately addressed and the obtained results seem less promising as only 30% of the interviewed households have roof insulation. Although the majority of these roofs have insulation between 5 and 10 cm, they account for a small percentage of all households.

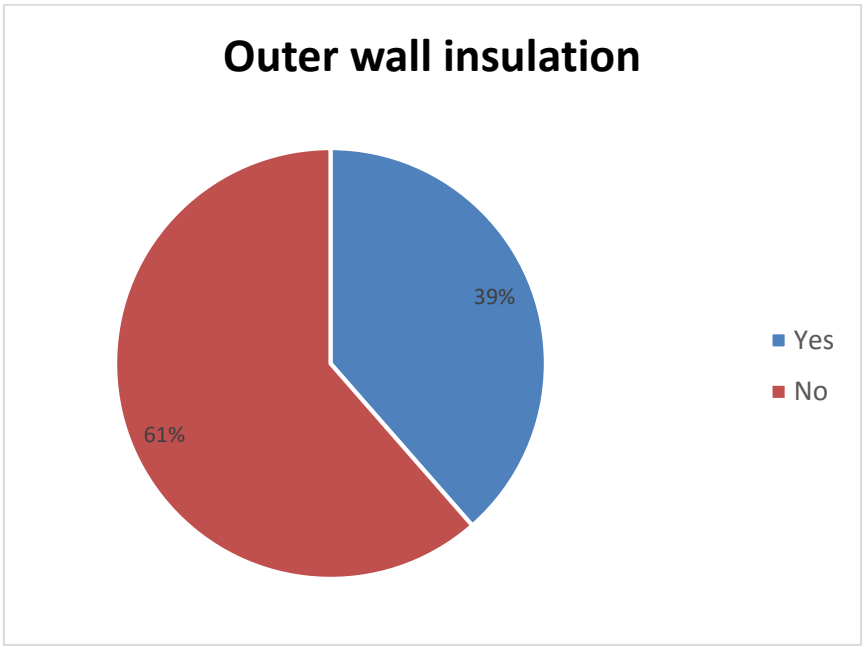

Figure 82. Share of hoseholds that have insulation on the outer walls – results for Karposh

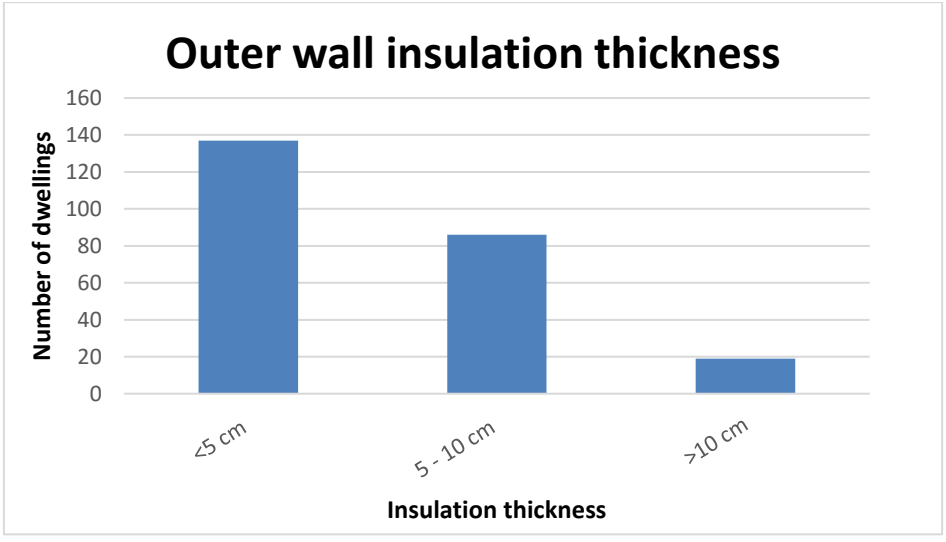

Figure 83. Thickness of outer wall insulation of insulated dwellings – results for Karposh

The conclusion drawn is that there is lots of work to be done in the field of building insulation if the full benefits of renewable district heating are to be felt. This insight is fairly intuitive,

even more so if Figure 74 - Figure 77 are taken into account. Therefore, local and national measures for insulation may facilitate the increase in percentage of insulated dwellings. Such measures (e.g. communal tax covering) have been adopted in Karposh.

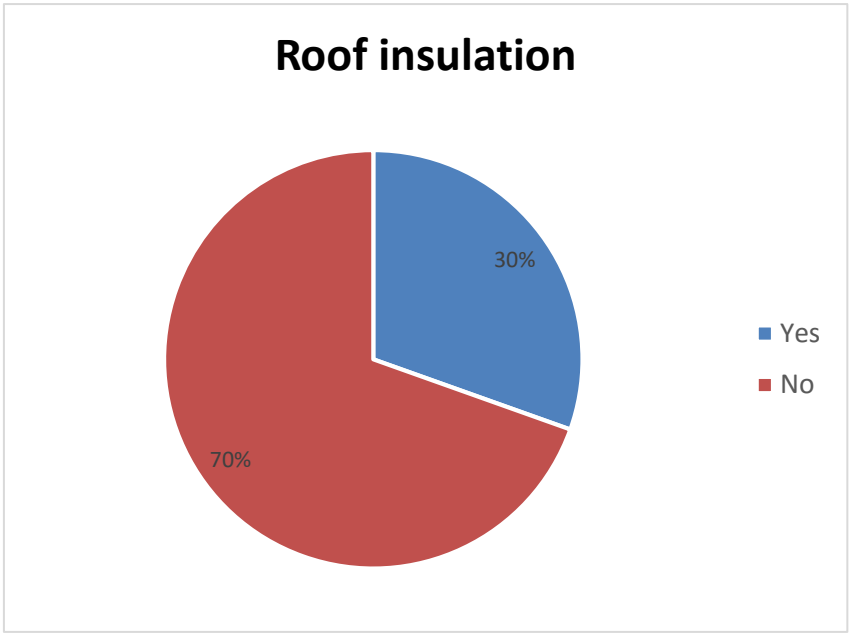

Figure 84. Share of households that have insulation on the roof – results for Karposh

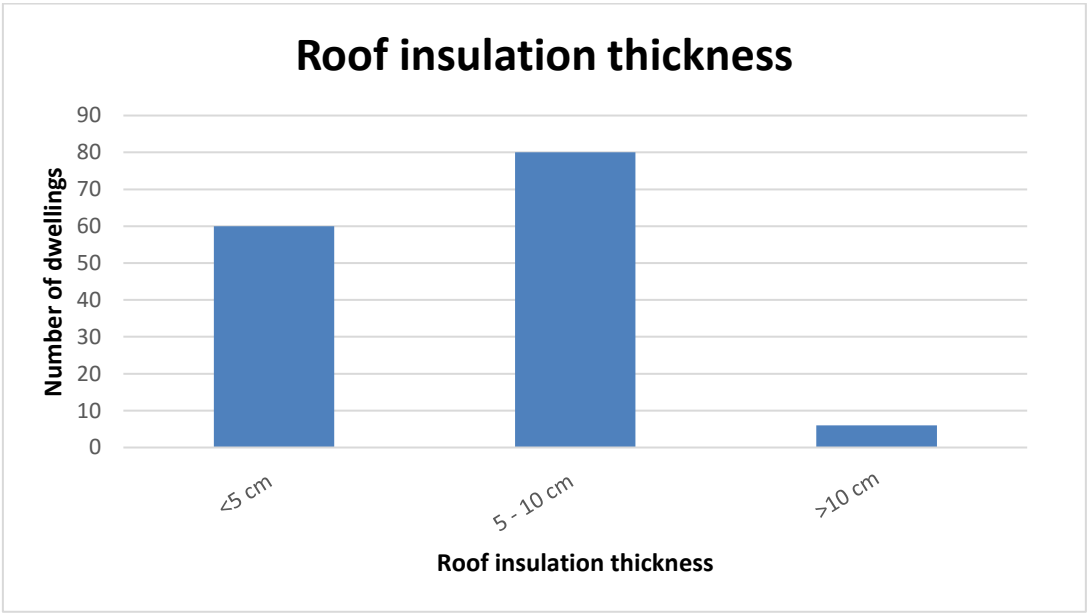

Figure 85. Thickness of roof insulation of insulated dwellings – results for Karposh

The quality of windows in dwellings is another key element in the building stock information for the Municipality of Karposh. Having in mind that the traits and U-factors of windows may vary in each window type category, pointing out that the survey provides a rough and subjective (citizens' point of view) estimation of the energy traits of the windows is worthwhile. Therefore, the answers to the question regarding types of windows were categorized in four groups ranging from extremely satisfactory energy characteristics to extremely unsatisfactory energy characteristics. The majority of answers are mostly in

between – 57% of the interviewed citizens believe that their windows have satisfactory energy characteristics (mainly PVC and good quality wooden windows), 42% believe that the windows in their dwellings have unsatisfactory energy characteristics (mainly older wooden or aluminum windows). Only 1% of citizens own windows with extremely satisfactory energy characteristics, while the 2 citizens who believe that their windows are extremely unsatisfactory appear statistically negligible on Figure 86 because they represent less than 0.3% of the interviewed citizens.

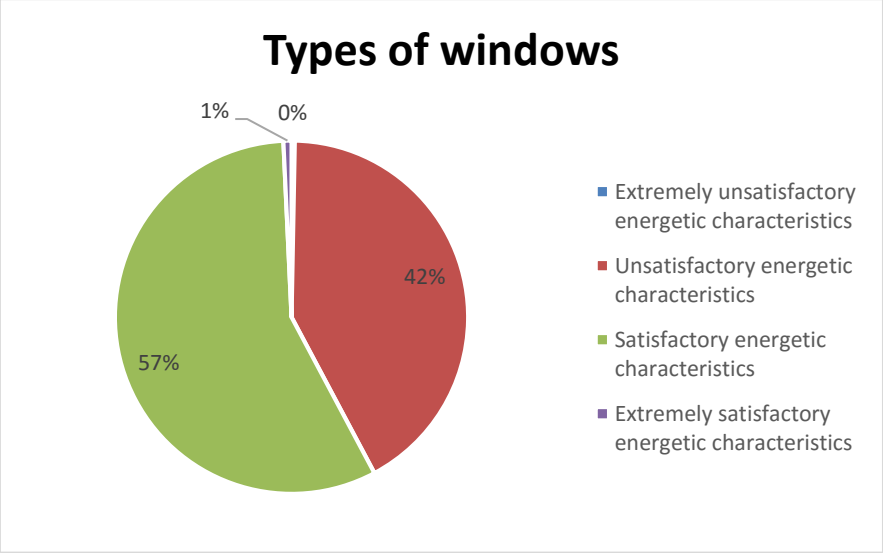

Figure 86. Types of windows that are used in dwellings in the Municipality of Karposh

5.2 Information on the heating system in the household

When it comes to heating and cooling system in households, there are 4 questions that require input on this topic in the questionnaire. They concern type of the heating system, energy source used in the heating system, energy source used for domestic hot water preparation and type of cooling system, i.e. energy source used for cooling.

Figure 87 shows the types of heating system used in dwellings in the Municipality of Karposh. It is evident that 40% of the interviewed citizens are connected to a district heating system and almost an equal share of households use individual stoves or electric heaters in rooms 37%. On the other hand, 13% have a centralised heating system on dwelling/apartment level. Various solutions apply to this category such as electric boilers, pellet stoves, residual fuel oil etc.

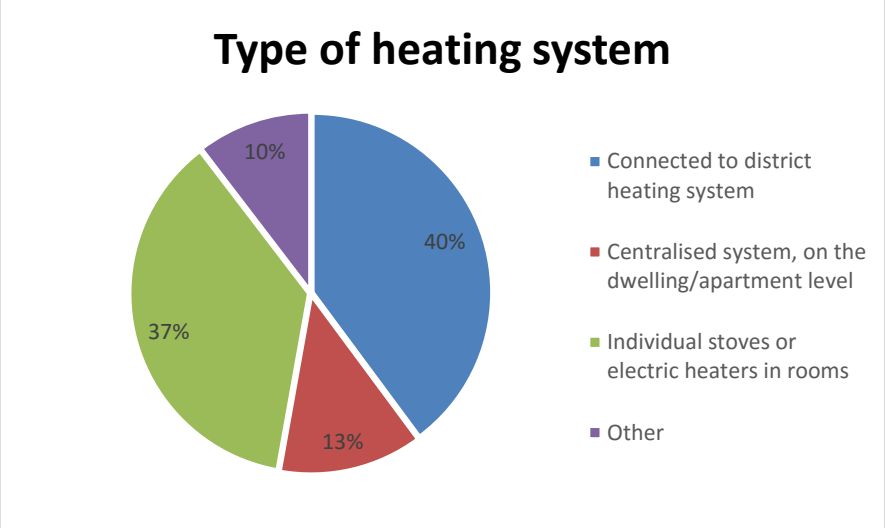

Figure 87. Type of heating systems used in households in the Municipality of Karposh

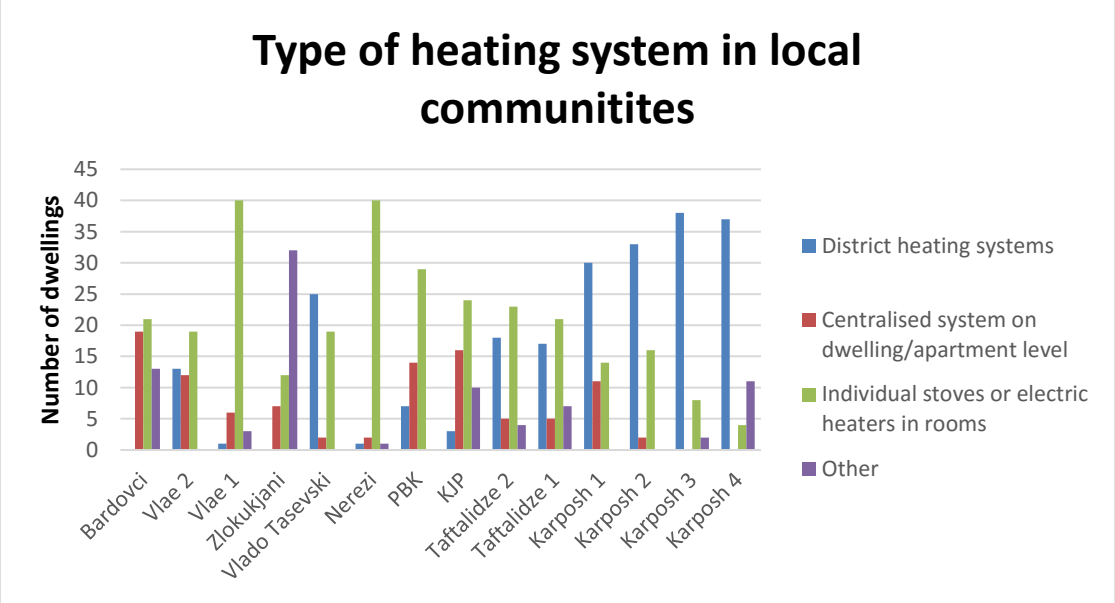

Figure 88. Type of heating systems in households in the local communities of Karposh

When correlating data from Figure 87 and Figure 89, a certain mismatch seems to appear as the percentage of district heating in Figure 89 is 28% - smaller when compared to 40% in Figure 87. However, the number of answers taken into account when compiling the pie graph in Figure 87 is 818, while the number of answers for Figure 89 is 753. This is due to the fact that some households apply more than one heating solution in their dwellings.

Figure 88 gives some information for the heating solutions in each of the local communities. It can be concluded that dwellings in most of the communities tend to use individual stoves and electric heaters. Additionally, the trend of using district heating systems in Karposh 1 – 4 is also obvious, although experience has shown that many apartments in these communities have disconnected from the district heating systems in the past. Bardovci is the only local community, which interviewed residents stated that they live in houses. Along with Zlokukjani, they are the only local communities not using district heating.

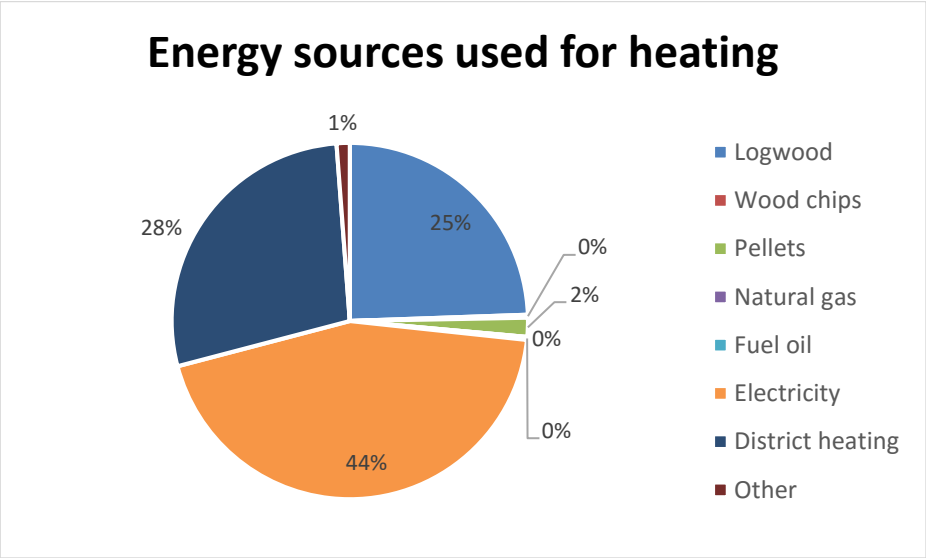

Figure 89. Energy sources used for heating of households in the Municipalty of Karposh

Figure 89 and Figure 90 show the predominant use of electricity for floor heating and hot water preparation. The low price of electricity is the incentive for these approaches. Another energy source commonly used for heating is logwood. Only 2% of households, however, use pellets - an energy source which may substitute logwood in the future. The absence of a gas network prevents the use of natural gas.

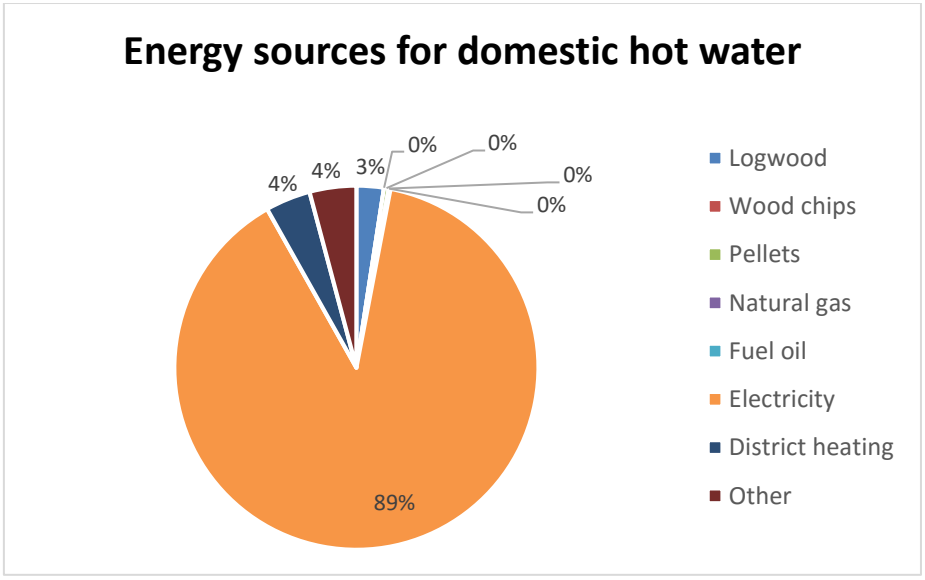

Figure 90. Energy sources used for hot water preparation in households in the Municipalty of Karposh

Electricity is the most used energy source for hot water preparation - 89% of the interviewed households stated that it is their primary and only source. Additionally, 4% of the households utilize the district heating by connecting it to the boiler – a solution feasible only during the heating season. A different energy source, mostly electricity, must be used throughout the remaining months. Another 4% of the households use other heating sources for hot water preparation. This category is mainly consisted of renewable energy solutions such as solar water heating installation.

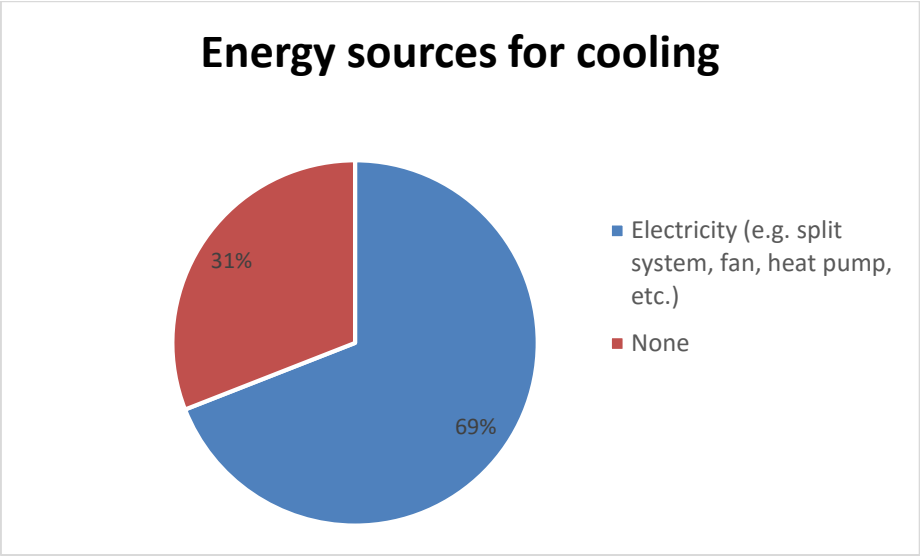

Figure 91. Energy sources used for cooling in households in the Municipalty of Karposh

For cooling purposes, 69% of the interviewed households use electricity. No other cooling systems are applied in the Municipality of Karposh. The other 31% of households don't cool their dwellings in any way.

5.3 Information on energy consumption

This part of the questionnaire includes 5 questions and 3 sub-questions. They concern final energy consumption for heating, final energy consumption for domestic hot water preparation, number of rooms that are being heated, number of rooms that are being cooled, energy certificate of the household and yearly expenses for heating purposes.

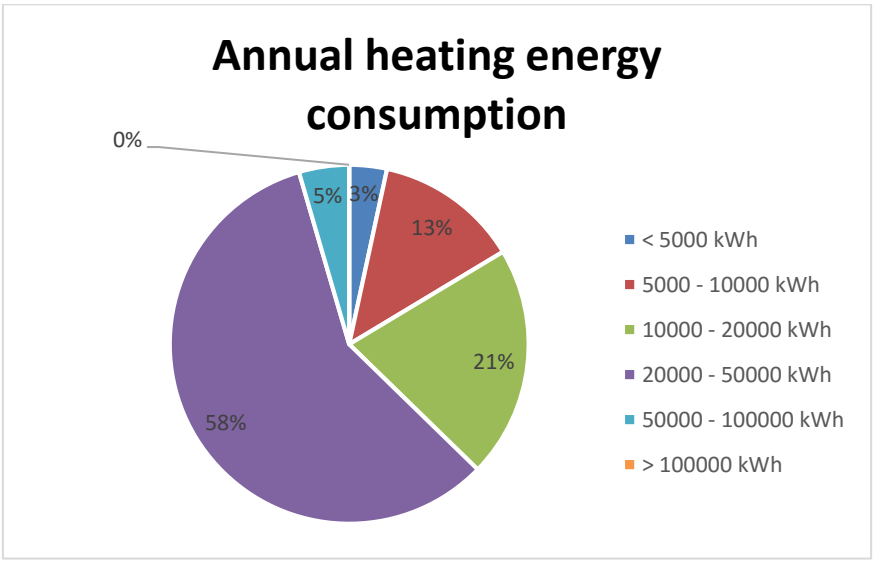

Figure 92. Range of annual heating energy consumption in dwellings in the Municipality of Karposh

Knowing the annual heat consumption of the dwellings is important in the process of mapping the heat demand of a certain municipality. All of the data on fuel consumption that

was obtained from the questionnaires has been converted to kWh allowing for Figure 92 to be created. A significant portion of the questionnaires lacked proper information on heat consumption. Some of the citizens provided information of the expenses for electricity. The information on wood consumption was obtained in m^3, while the citizens which use pellets provided their consumption in metric tons. As most of the households use oak and beech wood for heating, it was assumed that the density of the logwood is 750 kg/m^3. The assumptions for density and energy content of the fuels are subject to uncertainty and may therefore impact the outcome of the analysis. The majority of data on heat consumption from district heating was provided in kWh. The citizens which provided the amount of their heating expenses instead of energy consumption where not considered because of the two tariff system for electricity consumers and the uncertainties of the deductive process for converting district heating bills to kWh. We believed that the inclusion of these approximations would spoil the purity of the data set.

As Figure 92 shows, 58% of the interviewed citizens which provided information of the annual heat consumption use 20 000 – 50 000 kWh per year. All of them, however, fall in the category of households that use logwood as a heat source. Similarly, the 5% of households that use 50 000 – 100 000 kWh also depend on logwood. A share of 21% of the households use 10 000 – 20 000 kWh. This share may have been larger if more households which use electricity or are connected to the district heating system had provided usable information on the heat consumption. The Annual Report on the Activities of the Energy Regulatory Commission of the Republic of Macedonia states that when addressing the heat consumption, a dwelling with a floor area of 50 m^2 is considered which annual heat consumption is 7,500 kWh. If this is taken as relevant, while simultaneously referencing the floor areas of the dwellings in Karposh, the assumption that the green share of the pie may be larger seems credible.

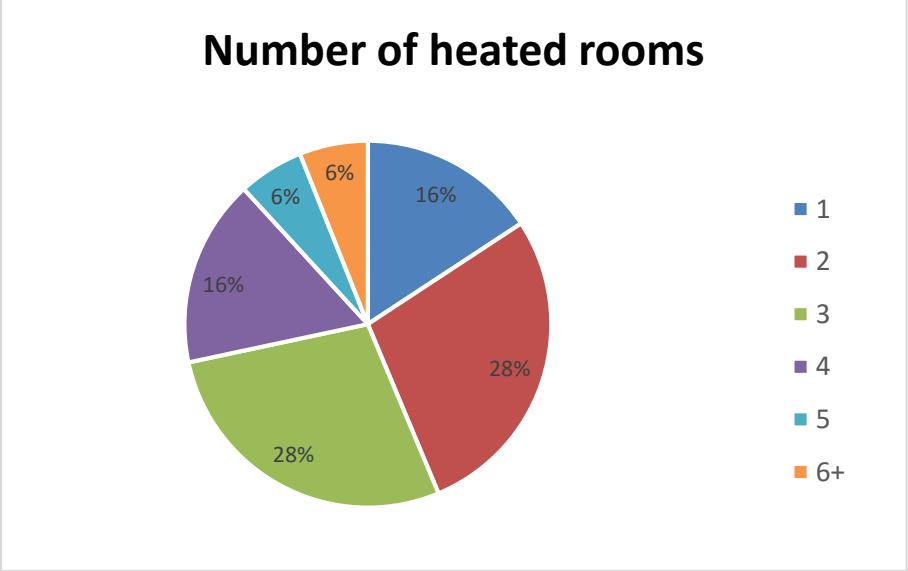

Figure 93. Number of rooms that are being heated in dwellings in the Municipality of Karposh

Out of all the surveyed households, 28% heat two rooms in their dwellings and just as many households heat three rooms. Two groups of 16% each heat one and four rooms, respectively, while the remaining 12% are also constituted of two equal shares of households. Half of them heat five rooms and the other 6% heat six rooms. Figure 94 provides a graphic representation of this data.

As opposed to the symmetry of the pie in Figure 93, Figure 94 shows that 43% of the interviewed households, which use a cooling system in their homes, cool only 1 room. A slightly smaller share of households - 34%, cool 2 rooms. The percentages decrease as the number of rooms being cooled increases. The fact that more households cool 6 rooms than the households that cool 5 rooms is surprising, but might be due to the random selection of households and is not necessarily a proper representation of the whole municipality.

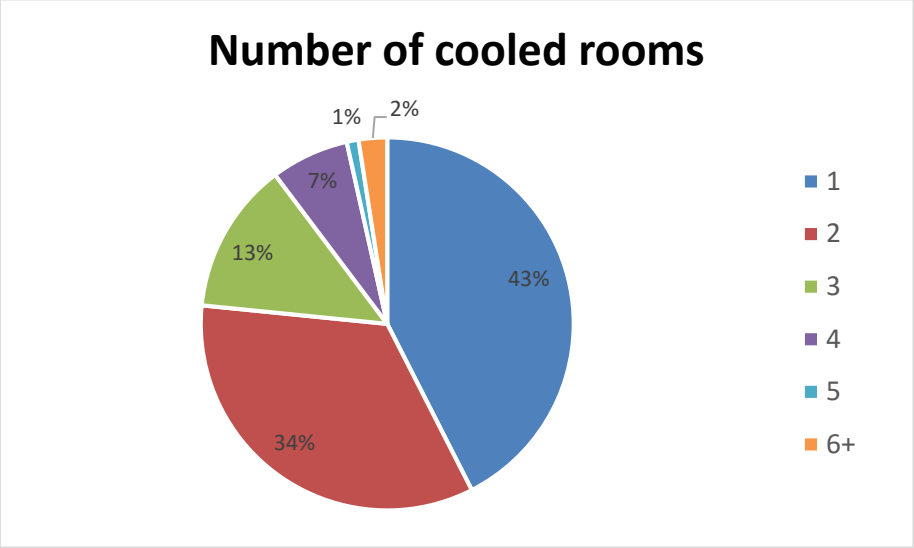

Figure 94.Number of rooms that are being cooled in dwellings in the Municipality of Karposh

The survey showed that cost and annual expenses which citizens have are among the crucial decision making factors when choosing a heating solution. For that reason, a sorted diagram has been created containing data of the annual heating expenses of the interviewed households in Karposh. This is shown on Figure 95. It is evident that 50% of the interviewed citizens have annual heating expenses larger than 500 €, while the other 50% have smaller expenses than 500 €. Around 10% of the citizens have heating expenses larger than 1000 €.

However, this chart does not provide a regional view of the expenses in the municipality, an information which may be of some value.

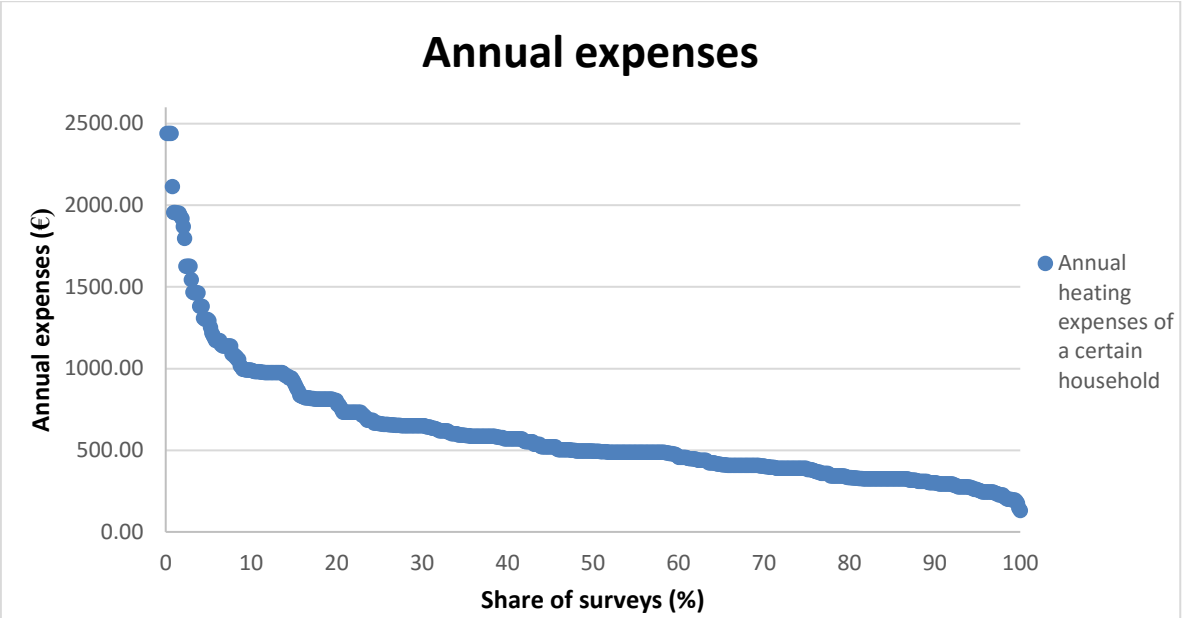

Figure 95. Sorted annual expenses for heating of households in the Municipality of Karposh

The data for the distribution of annual heating expenses among the local communities in the Municipality of Karposh is given on Figure 96. As previously elaborated, this data has been obtained from 700 samples - 50 samples of the questionnaire which were given to each of the 14 local communities. Therefore, the results may not apply to all households of the particular local community, but they depict the expenses under the current specific circumstances of the surveyed households.

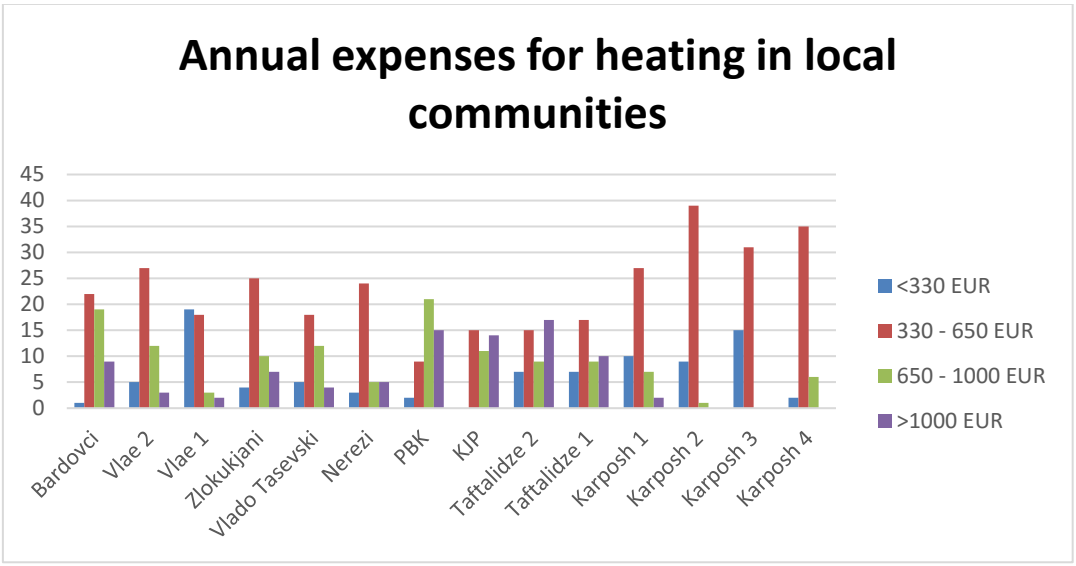

Figure 96. Annual expenses for heating of dwellings in local communities of the Municipality of Karposh

Consequently, when cross-referencing Figure 96 with Figure 88, which shows the type of heating system in the local communities, various conclusions can be drawn. As local communities whose interviewed citizens predominantly use district heating, Karposh 1 – 4 are also communities where the annual heating expenses between 330 – 650 € are the most emphasized. Figure 96 may also serve as a cause for further investigation as it shows that

the interviewed citizens from PBK, KJP and Taftalidze 2 seem to have the largest annual expenses for heating. It should be investigated if this applies to all of the dwellings in those local communities.

Most of the households in Karposh heat their homes for 6 months of the year. When referencing the data of Figure 87, it is clear that 40% of the households use district heating. Therefore, two thirds of the 66% of households whose heating period is 6 months are actually the households connected to the district heating systems. 19% of the households heat their homes for 5 months. The percentage of households which heat their homes for 7 or less than 5 months is 7% and 8%, respectively. This is presented by Figure 97

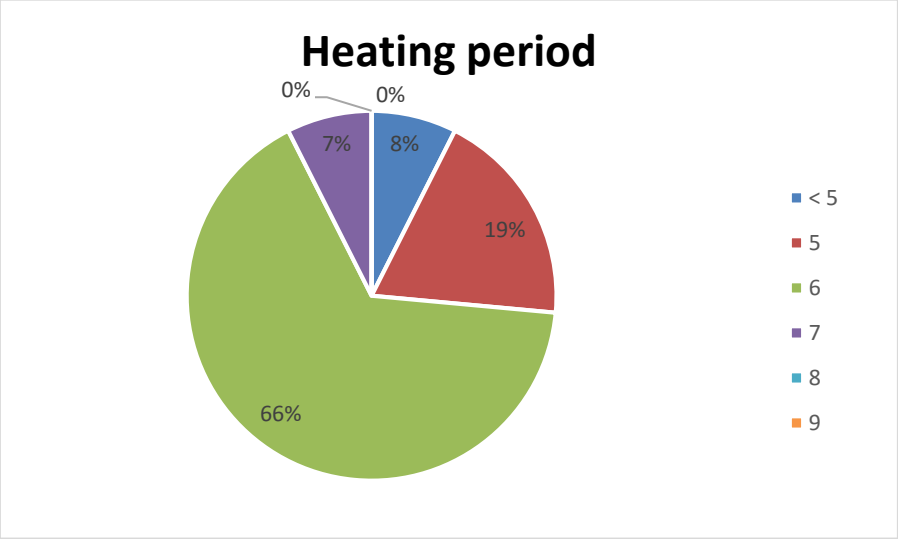

Figure 97. Annual heating period for households in the Municipalty of Karposh

Regarding the question of energy certificates, only 22 citizens stated having energy certificates. Additionally, only two of them knew the energy class of their dwellings and both of the answers were a C class.

5.4 Information on public opinion

Information on public opinion on small modular renewable district heating systems is the last set of information provided by the questionnaire. This part of the questionnaire also contains information on dissemination of the CoolHeating project activities.

Figure 98 shows the share of citizens that had been somehow informed about the CoolHeating project. The analysis shows that 62% of the interviewed citizens had heard of the project, either from the media, the dissemination material or from some other source. Most of the people who work in the Municipality's local government know of the CoolHeating project. Therefore, oral dissemination is an important dissemination channel. The fact that 38% of the citizens didn't know of the project shows room for improvement.

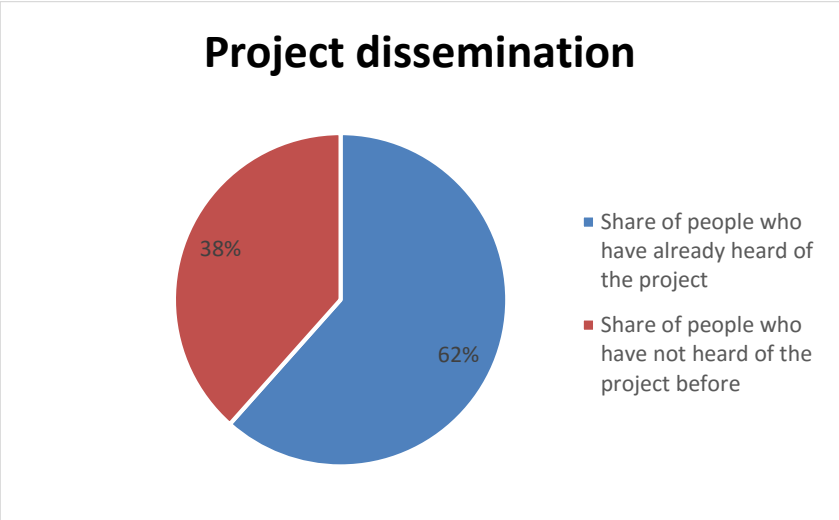

Figure 98. Results of the project dissemination in the Municipality of Karposh

The annual expenses, as well as comfort of the heating system are the most important factors for citizens when choosing a heating system, as previously mentioned. With those facts taken into consideration, 86% of the citizens stated that they are willing to connect to a district heating system. The remaining 14% of citizens didn't seem to be interested to connect to a renewable district heating system.

The reasons why they were not willing to connect to a district heating system are shown on Figure 100. It shows that more than 60 people are not familiar with small renewable district heating systems and lack the knowledge of their advantages. A group of 29 people believe that their heating system solution is better than other heating systems, while almost as many are not willing to invest in the change of their heating system.

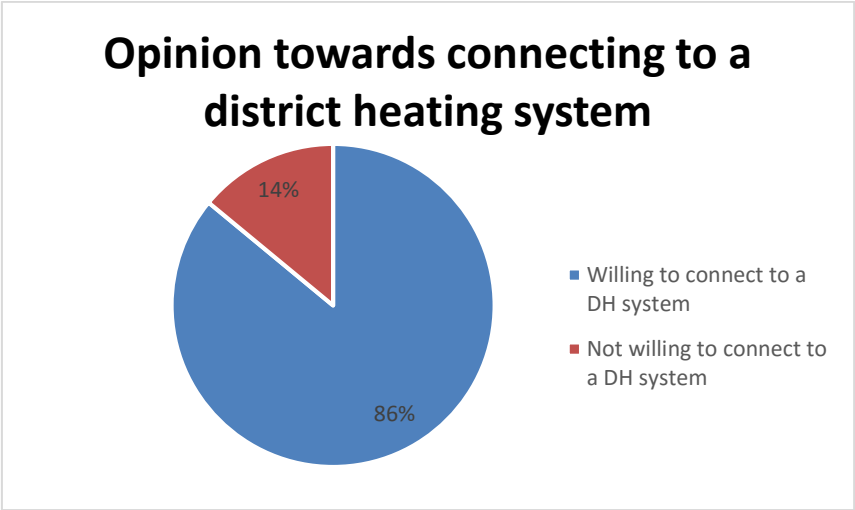

Figure 99. Opinion of citizens of Karposh towards connecting to a district heating system

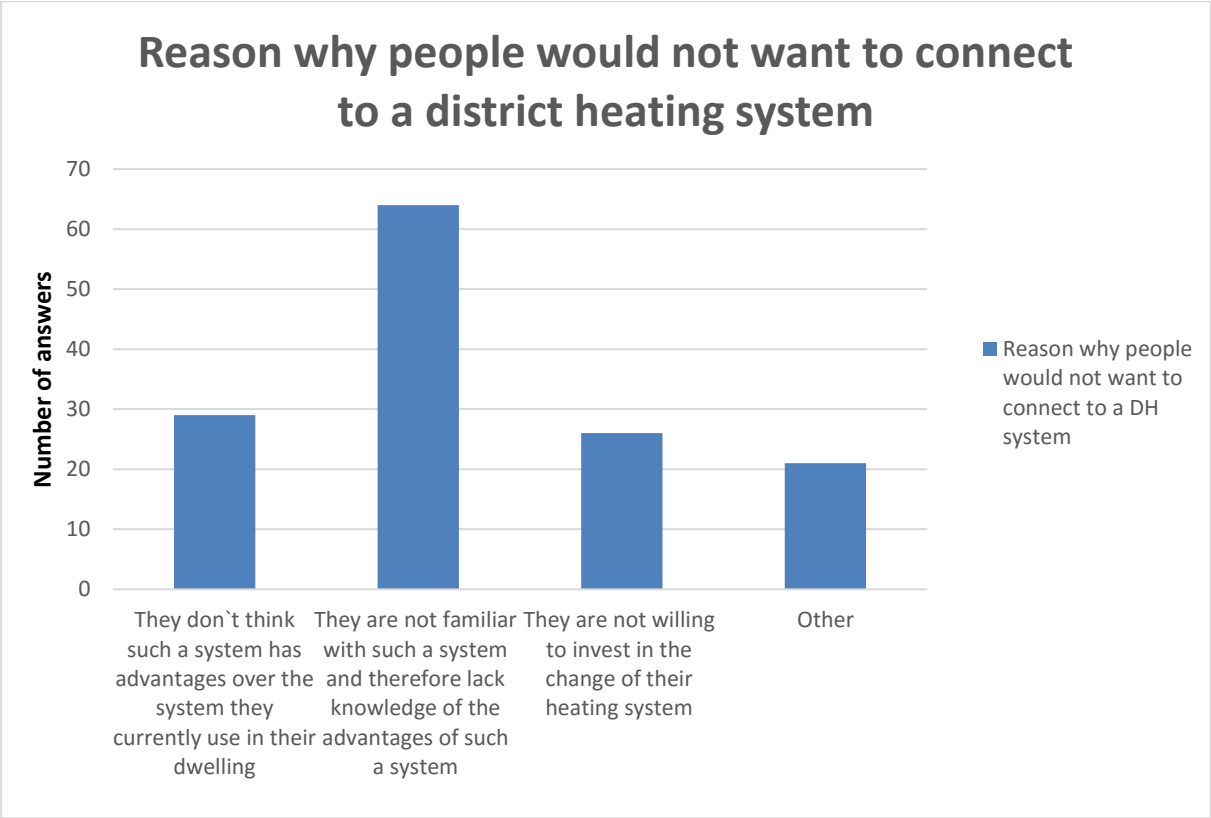

Figure 100. Main reasons why people would not want to connect to a district heating system – results for the Municipality of Karposh

Figure 101 represents the citizens' opinion towards the advantages of small, renewable district heating systems. When filling this part of the questionnaire, the citizens were additionally informed about the advantages of the systems, which is in line the objective of stimulating their interest. The results show positive feedback with a majority of households judging the advantages as highly important. Only a small percentage of households find the elaborated advantages as unimportant, most probably the ones not willing to connect to a district heating system.

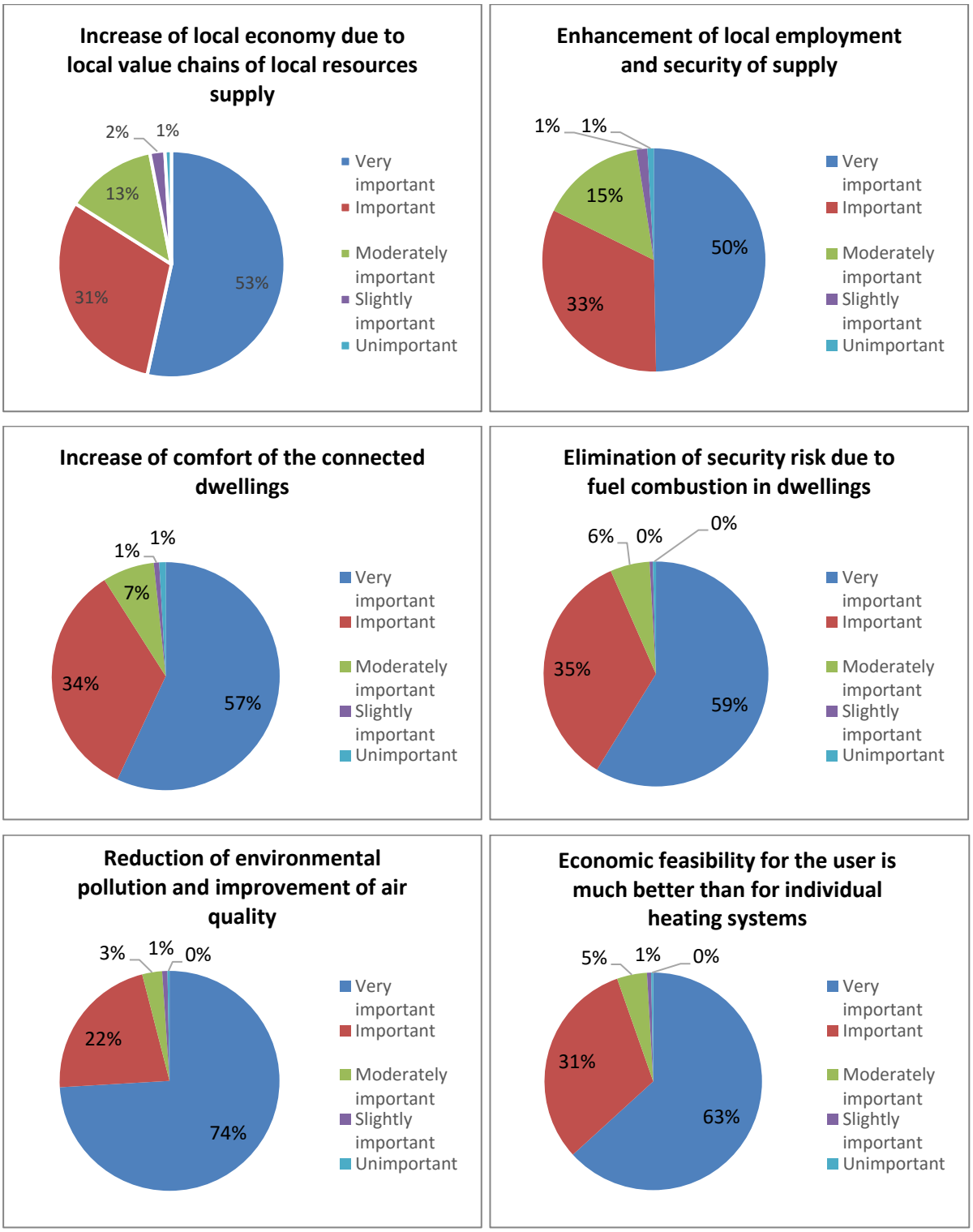

Figure 101. Opinion of interviewed citizens on benefits of small modular renewable district heating systems – results for the Municipality of Karposh

5.5 Concluding remarks for target community in Macedonia

To conclude, a survey has been conducted for the citizens of the Karposh Municipality. During the process, all 14 local communities of the municipality were involved and each of them conducted 50 questionnaires. Moreover, an online questionnaire was conducted out of which almost 40 filled questionnaires were obtained. The results have been elaborated in accordance with the template provided by UNIZAG FSB, but additional graphs are provided as well. These additional figures depict a disaggregated insight of the local communities, thus giving a regional view of some questionnaire's questions. The number of filled questionnaires per local community, however, should be taken into consideration when making judgements, simply because it is not sufficient to acknowledge the results as definite. Nevertheless, the figures containing regional data could be valuable as basis for further studies.

The survey has shown a certain balance between the number of households residing in houses and apartments, although the share of houses is slightly larger. Regionally, the house/apartment ratio differs significantly. Most of the dwellings have been built in the period of 1960-1980, while refurbishments have mostly taken place after 2000. A deficiency in outer wall and roof insulation have been recognized. This is considered an area where future improvement should take place.

The questions on types of heating systems show electricity as a dominant heating source. This is due to the low price of electricity in the Republic of Macedonia. A large share of households uses electricity as a source for their heating systems or individual stoves. This is mostly present in apartments. District heating also takes up a significant share of the households. Furthermore, because there are many houses, logwood constitutes a quarter of all the fuels used for heating.

Regarding heat consumption, Figure 92 provides information on the annual heat consumption of the interviewed households in Karposh. It seems that the majority of households use between 20 000 – 50 000 kWh annually. Experience suggests that the share of households using 10 000 – 20 000 might be larger in reality than depicted on the chart. The heating periods and number of heated and cooled rooms were analyzed as well. Additionally, another important element seems to be the annual heating expenses. Because of that, a sorted diagram of the annual heating costs of households was created. It shows the percentages of households that have a certain amount of annual heating expenses.

It has been shown that the citizens of Karposh are mostly willing to connect to a district heating network, even more so if it is based on renewable energy source. Only a small share of households was not willing to do so. Figure 100 portrays their reasons. Moreover, it can be concluded that additional education on renewable district heating systems should take place because when exposed to the advantages, citizens mostly judged them as very important.

6 Results of the survey in target community in Serbia

According to the 2011 census data the city of Šabac, target community in Serbia, is has 39,166 households. Around 1.5 percent of those households (608) have been surveyed under Task 3.4 to gather the information about their heating and cooling habits and preferences. Most of the surveys were collected as a hardcopy surveys (98.7 %), while the rest was gathered online.

Hard copies surveys printouts were distributed to the local communities and further to the citizens together with the dissemination material of the project. The online survey has been started with the media announcement at First info Day in the city, and from the city of Šabac official internet portal from 6th of June. The door-to-door hardcopy questionnaires have been distributed mostly during the August. The local communities of the city which were surveyed via hardcopy questionnaires are shown in Figure 102 with red dots. Therefore both households in suburban parts and villages but also the urban zone has been surveyed which will be presented in the following subchapters.

Figure 102. Parts of the City of Šabac included in survey

6.1 Information on building stock

There are 9 questions and 2 sub-questions in the survey, which provide information on building stock in Šabac. Questions concern type of household, build period, period of last refurbishment, number of people living in the household, floor area of the household, number of rooms in the household and insulation level of outer walls and roof. 2 sub-questions concern type and thickness of insulation for the outer walls and roof.

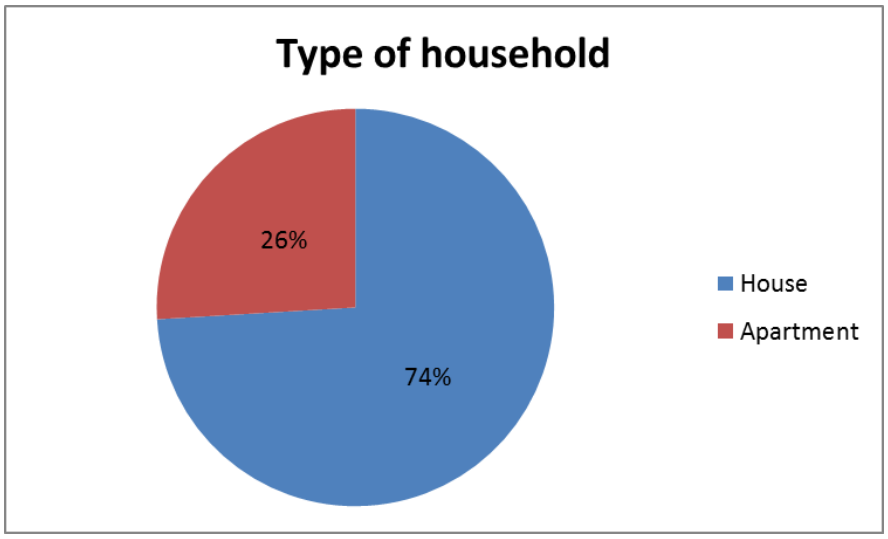

Figure 103. Type of households in the city of Šabac

Almost three quarters of surveyed households were single houses, while one quarter lives in the apartments, mostly in the city centre. According to information known before survey, around 7,500 families live in apartment buildings in centre of the town connected to district heating system. Also, it was known that 2,550 households were connected to natural gas distribution network. The other study information shows the average heat consumption in apartments connected to district heating grid is 117 kWh/m2, while households that use natural gas spend around 1,000 m3 per year. Regarding the fuel mix in district heating system, the natural gas is main fuel, heavy oil is alternative fuel in case of some disturbance of natural gas supply.

The great number of buildings were built in second half of last century. Unfortunately this period characterized lack of the strong regulations for thermal insulation of buildings. The technical rules between 1990 and 2000 did not support any energy efficiency measures. Therefore, heat consumption in buildings built in this period is very high.

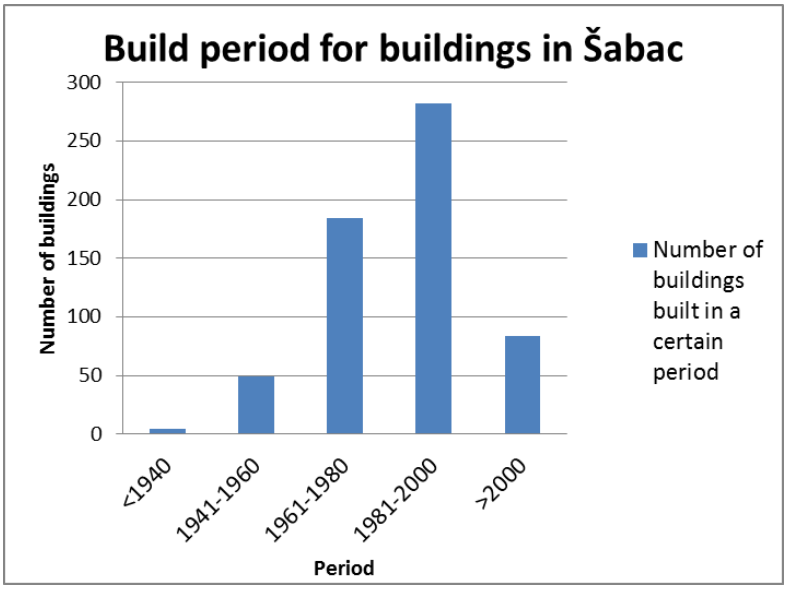

Figure 104. Build period for buildings in Šabac

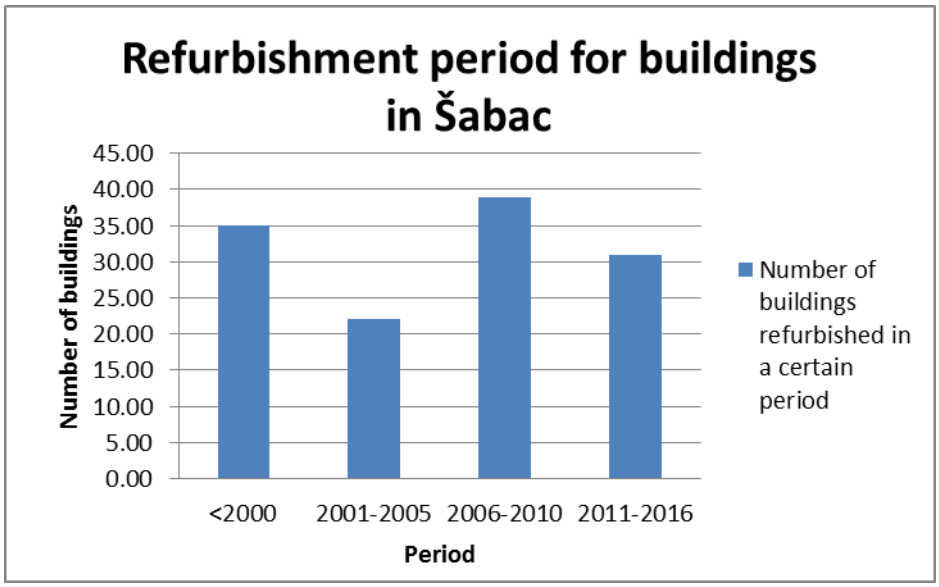

Figure 105. Refurbishment period for buildings in Šabac

According to analysis, around 25 % of surveyed households were refurbished, mostly in period between 2000 and 2011. because credit lines became available in that period. New technologies in windows production, high quality and cheaper products, contributed in lot of cases that people decided to replace existing wooden windows with new PVC with better glass package. In future, thanks to the new regulations the share of refurbished buildings will increase. Figure 105 shows present situation.

The average number of persons in families in Serbia, which is also the same for Šabac, is 3 persons. In villages and suburban settlements families have a more persons. There are 41 % of families with less than three member and those families mostly use flats, but there are a lot of examples in villages that old people live in one-family houses, without their successors.

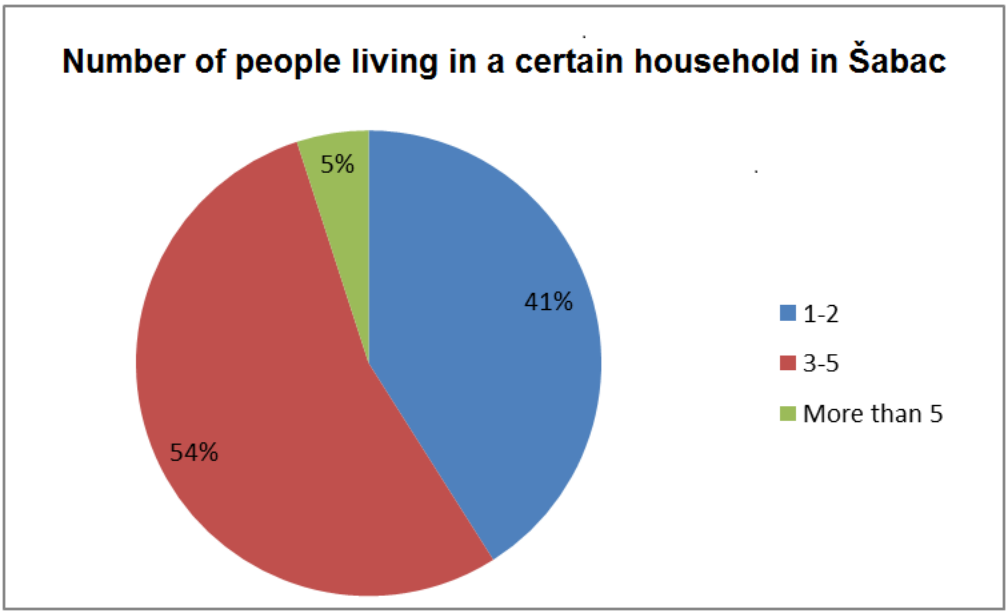

Figure 106. Number of people living in a certain household in Šabac

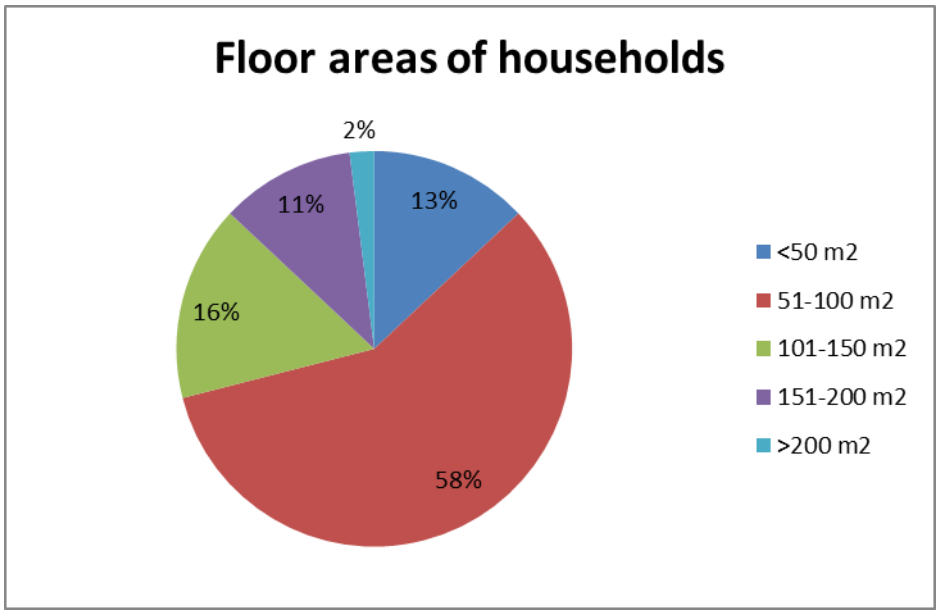

Figure 107. Range of floor areas of surveyed households in Šabac

Average floor area of households in Šabac is higher, at 72 m2 and more than 56 % families use one family houses with 6 and more rooms. Only in high buildings there are small flats with less than 4 rooms where one or two people live.

The common situation is that the whole buildings are being heated but not all the rooms are being used.

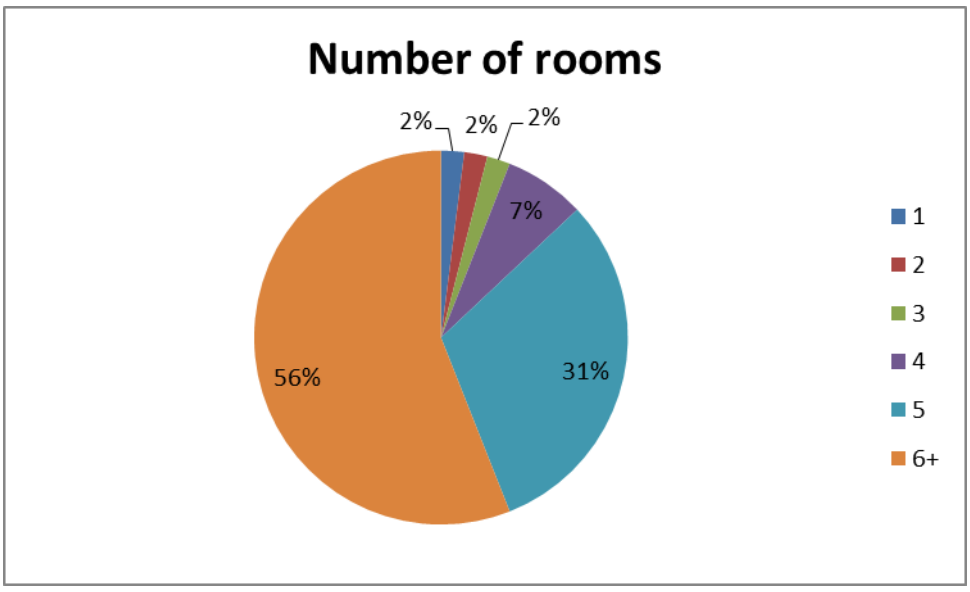

Figure 108. Number of rooms in surveyed households in Šabac

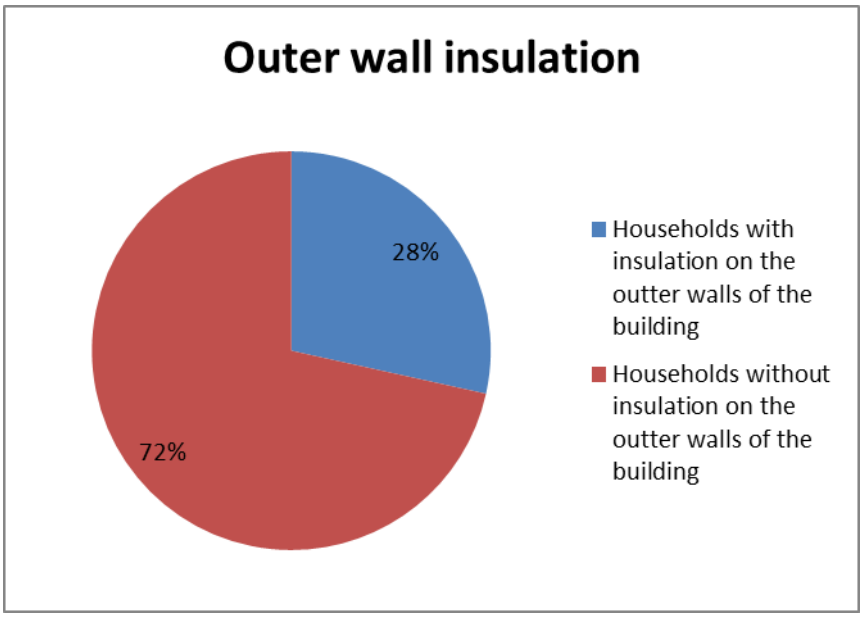

Figure 109. Share of households that have insulation on the outer walls – results for Šabac

According to analysis of questionnaires, 28 % of buildings have insulation on the outer walls. The same situation shows analysis of roof insulation. These results can be seen in Figure 109 and Figure 110.

Insulation material that is mostly used for outer walls insulation is polystyrene (Styrofoam) with thickness 5, 8 or 10 cm. Since October 2012, all new buildings must fulfill condition that maximum energy consumption do not exceed 65 kWh/m2 or have to be in Class C according to Serbian technical rules. On the other hand, mostly used material for roof insulation is mineral wool with average thickness 10-20 cm.

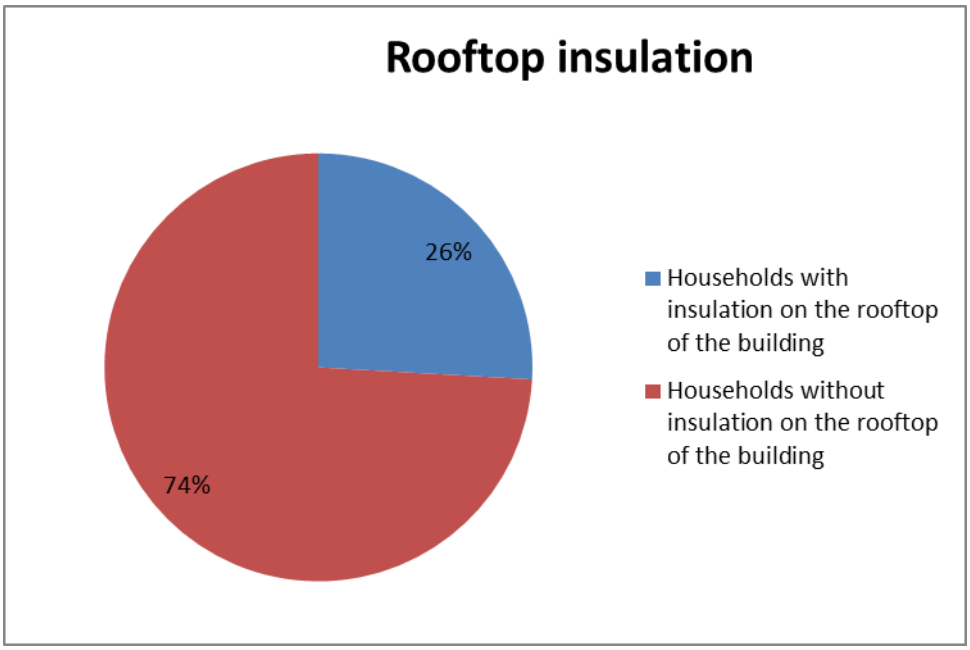

Figure 110. Share of households that have insulation on the roof – results for Šabac

Thanks to better financial situation in Serbia after 2000, a lot of people replaced the existing windows with wooden frame with PVC windows and high quality glass package. This trend clearly shows the reduction of heat demand of buildings that are connected to district heating and where heat metering is available.

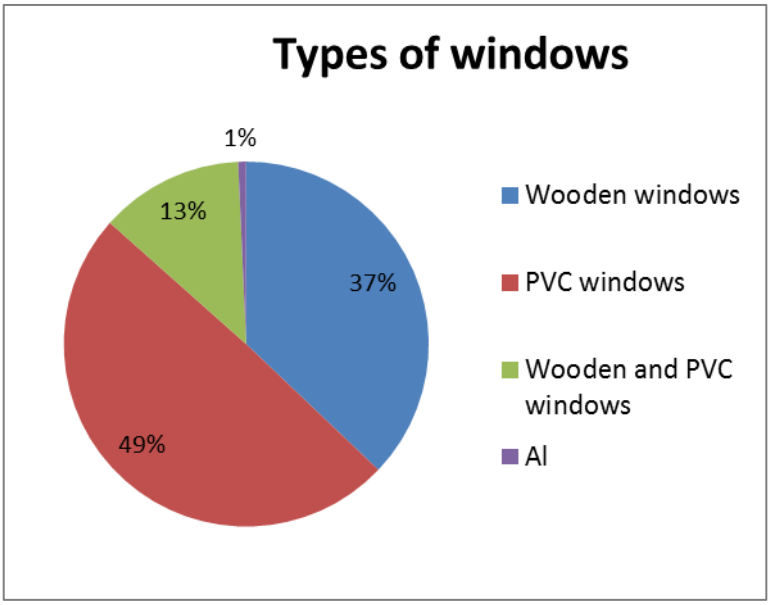

Figure 111. Types of windows that are used on buildings in Šabac

6.2 Information on the heating system in the household

When it comes to heating and cooling system in households, there are 4 questions that require input on this topic in the survey. They concern type of the heating system, energy source used in the heating system, energy source used for domestic hot water preparation and type of cooling system, i.e. energy source used for cooling.

Very high share of surveyed citizens have a centralised heating system, either within single buildings (44%) or either their buildings are connected to the district heating (21%). The rest households, around 35 % have individual stoves in rooms, as seen in Figure 112. In cases where natural gas has been used, the households could switch to biomass or the other renewables. In this case the decrease of heat price could be expected which could be favourable to the attitude of connections to district heating system.

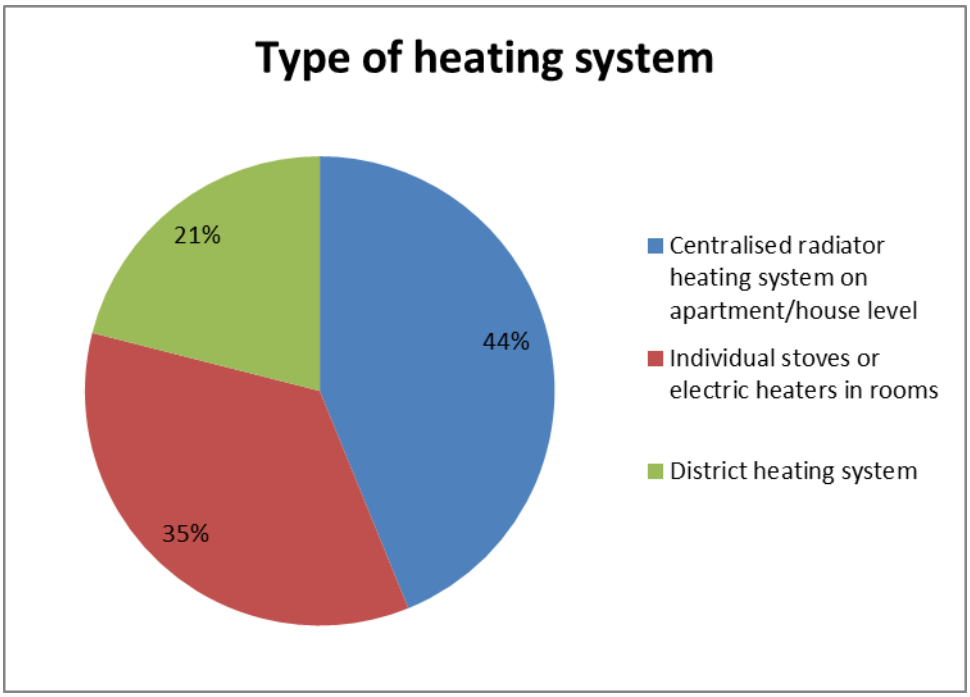

Figure 112. Type of heating system used in households in Šabac

Concerning the energy source that is being used for heating in households in Šabac, results show that biomass has the highest share, with logwood being the mostly used form of biomass (Figure 113). These results are expected because logwood is the cheapest fuel.

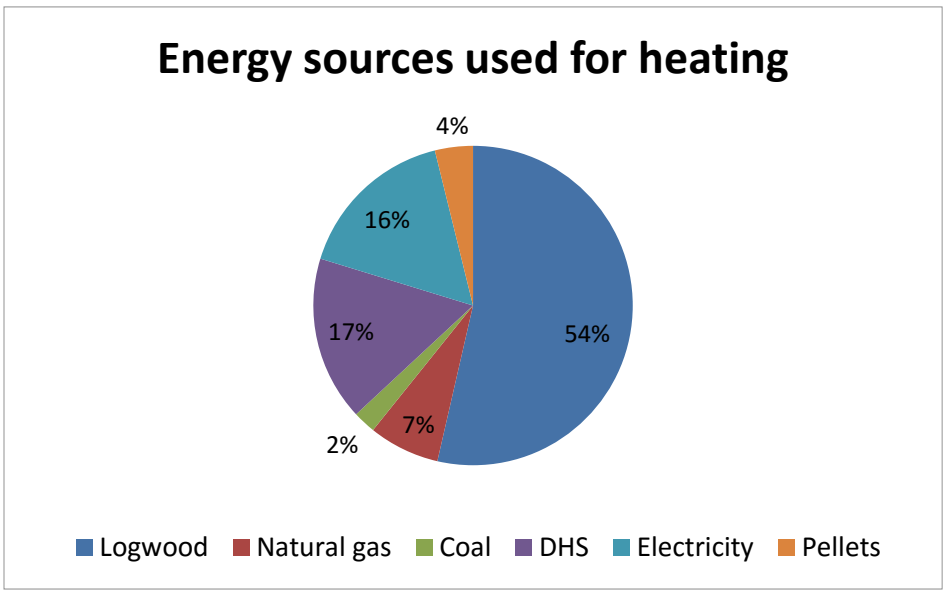

Figure 113. Energy sources used for heating of households in Šabac

The characteristic related to use of logwoods are low efficient stoves and boilers, therefore recommendation of local experts is to be replaced existing stoves and boilers with new modern and high efficient. This inefficiency may results from the fact that more than 25% of surveyed citizens owe a part of the forest so they might don't perceive the cost of fuel accurately paying only the transportation costs.

The second dominating source of heating in surveyed households is district heating. The third dominating source of heating is electricity (16%) long term policy of supporting this type of heating in households. Probably most of them are electric storage heaters, but also direct heaters may be used, including direct heaters in combination with centralised heating system. The fourth and insignificant source of heating is natural gas. The reason might be the unavailability of connections outside city centre and gas relatively high price. Just a few households are using the pellets (4%) and coal (2%) for household heating.

Regarding domestic hot water preparation, electricity is the main source. There are no solar systems used for domestic water heating.

Surveys show that around 21 % of surveyed citizens use cooling systems. Mostly used cooling systems are split system air conditioning units. Therefore, the only energy source used for cooling is electricity.

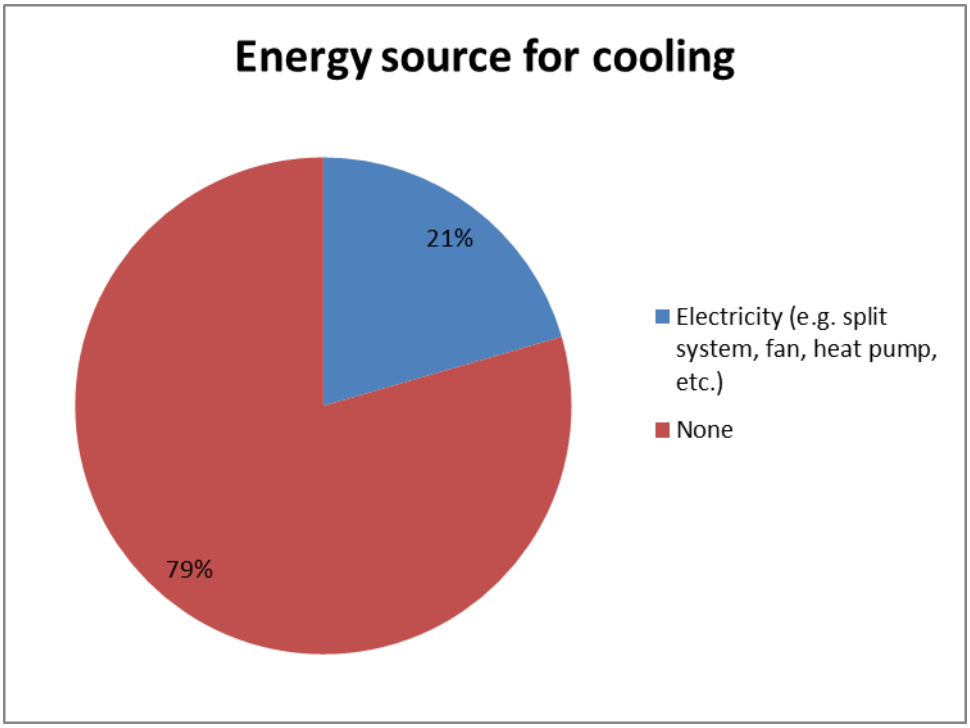

Figure 114. Energy source used for cooling in households in Šabac

6.3 Information on energy consumption

This part of the survey includes 5 questions and 3 sub-questions. They concern final energy consumption for heating, final energy consumption for domestic hot water preparation, number of rooms that are being heated, number of rooms that are being cooled, energy certificate of the household and yearly expenses for heating purposes.

The collected data on fuel consumption were explanatory, so the conversion into SI energy units was needed, and took a significant effort. Also, some citizens during the survey were asked the surveyors for help to fill requested information regarding consumption. This shows that citizens do not poses the accurate information about their energy consumption.

Information collected through conversation with citizens show high average heat consumption of households in Šabac, which corresponds with previous results that showed

low insulation standards, low rate of refurbishment and relatively high average age of buildings in this city.

It was very difficult to collect information on electricity consumption for heating of domestic hot water because there was no separate measuring of electricity for this purpose.

Energy certification has been started recently from 2012. and it mean that new houses have energy certificate or refurbished houses. This survey show that less than 1 % of surveyed citizens have energy certificate but they actually did not know what energy class of their buildings is.

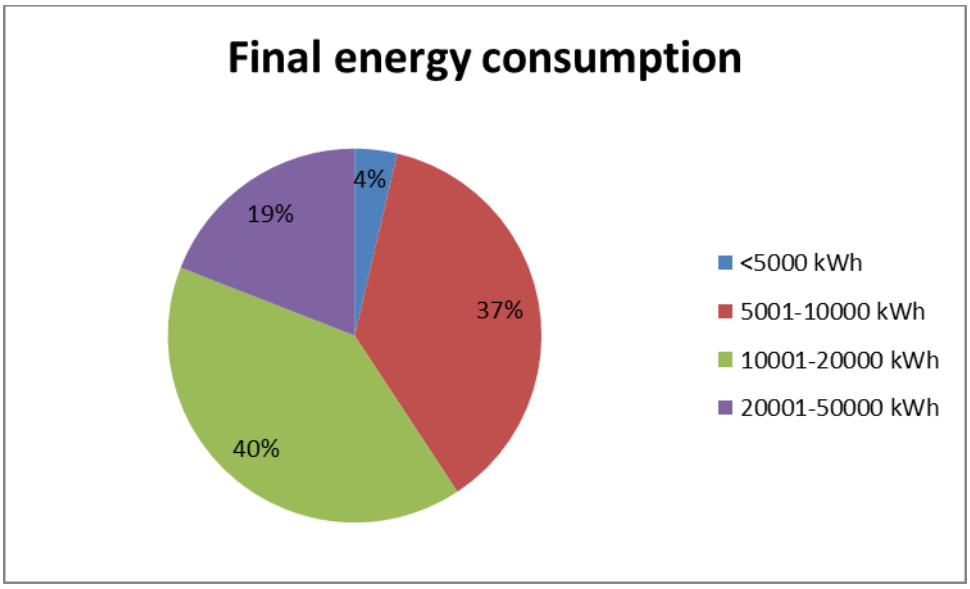

Figure 115. Range of final energy consumption for surveyed citizens of Šabac

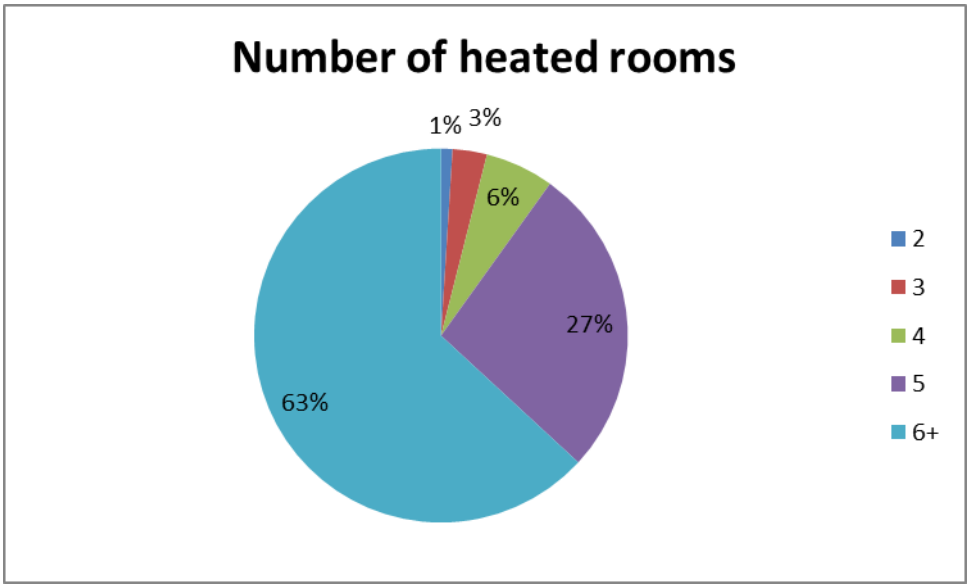

Figure 116. Number of rooms that are being heated in households in Šabac

For citizens, the most important information is amount of money they spend for heating for their houses and apartments. Generally, unit costs of fuels and electrical energy are not so

high, but energy demands are expected high, because lack of thermal insulation of outer walls and roofs of buildings and that means the annual expenses have serious share in family budgets. Figure 118 shows annual expenses for energy.

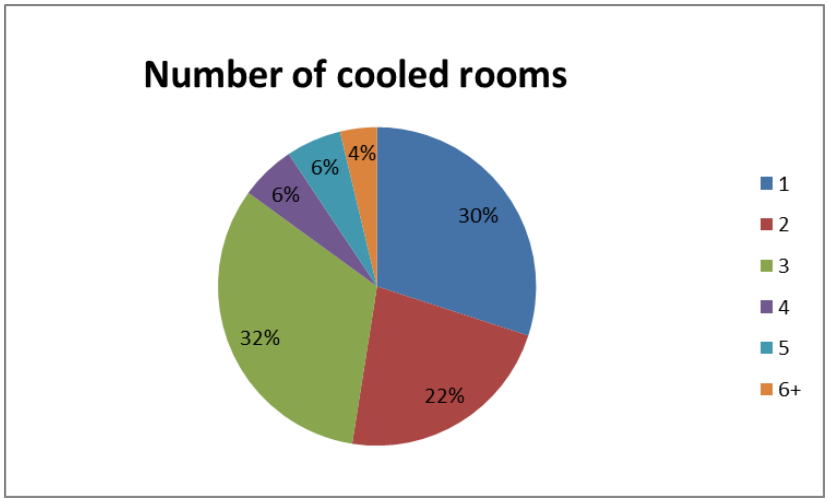

Figure 117. Number of rooms that are being cooled in households in Šabac

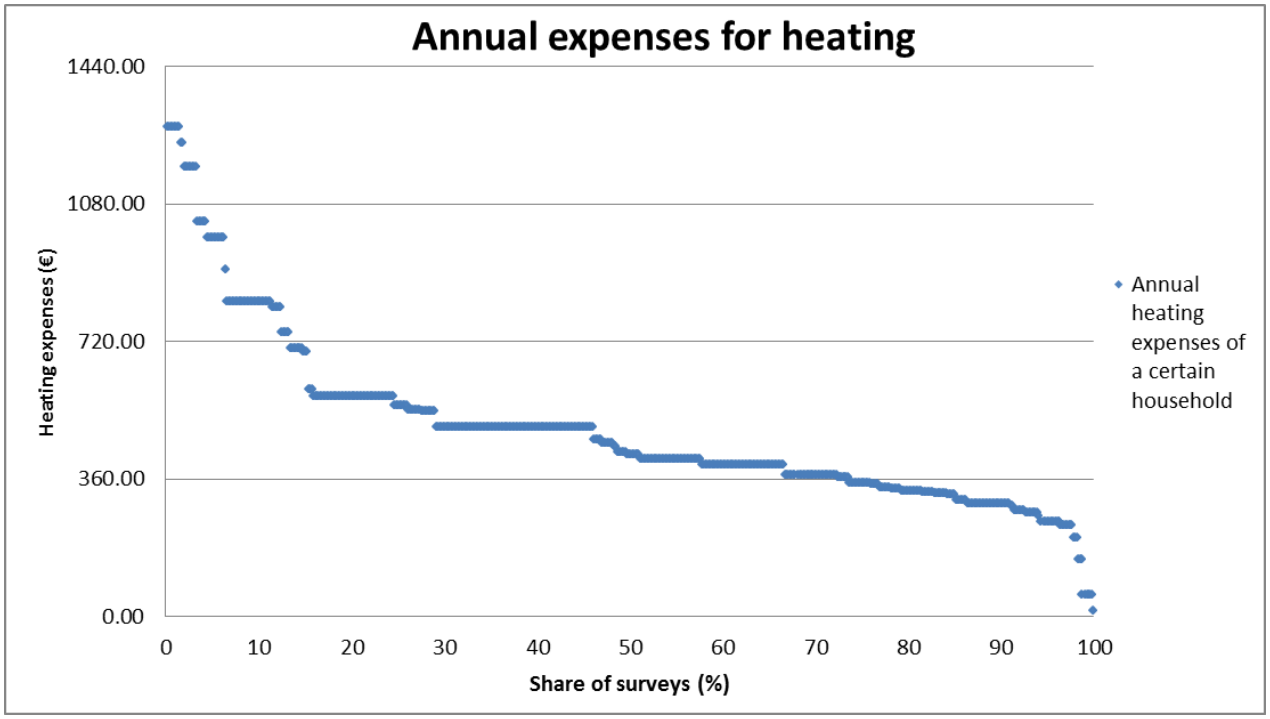

Figure 118. Annual expenses for heating of households in Šabac

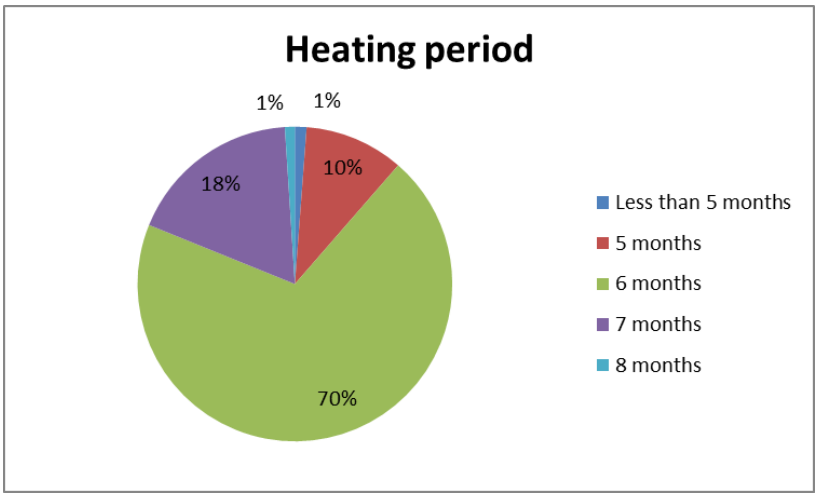

Figure 119. Annual heating period for households in Šabac

Most of the people in Šabac heat their dwellings 6 months.

6.4 Information on public opinion

Information on public opinion on small modular renewable district heating systems is the last set of information provided by the survey. This part of the survey also contains information on dissemination of the CoolHeating project activities.

It can be seen in Figure 120 that 45 % of people have already heard about the CoolHeating project when they were interviewed. It must be noted that info day has been held in Šabac before the survey was carried out. The main source of information about the project was the flyer about the project and information from media, but also oral communication between citizens, which is very important.

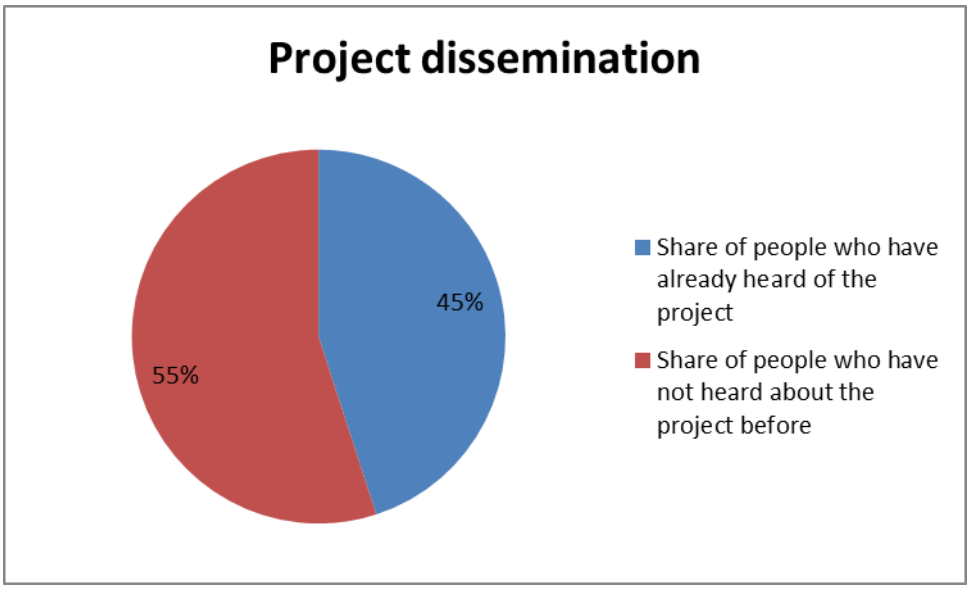

Figure 120. Results of the project dissemination in the city of Šabac

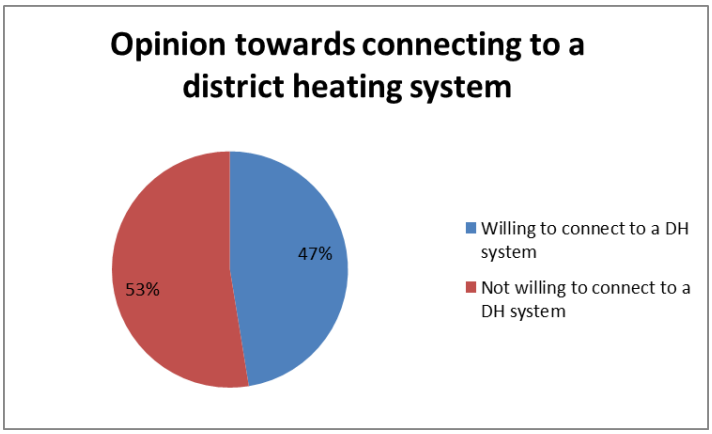

Figure 121. Opinion of citizens of Šabac towards connecting to a district heating system

The aim of the survey was to test the willingness of people to connect to a district heating system. While majority is against, it has been shown at Figure 121 that at least 47 % of surveyed citizens are willing to connect to a district heating system, which is a good result since district heating systems in Serbia recently appear negatively in the public media. The majority of surveyed households choose 3 main reasons why they are not willing to connect to a district heating system, which has been shown in Figure 122.

Analysis shows that energy experts have to spend more time to explain the benefits of small district heating system and benefit in case using renewables, especially biomass as local fuel.

The unwillingness to invest into heating system is prevails among reasons for not to connect to district heating among the city of Šabac households and it has been related to general lack of investment behaviour of the citizens in country. On the other hand the advantages of the district heating systems over the existing heating scheme are not known to many households in survey. The third reason lies on unfamiliarity of the district heating systems to the citizens.

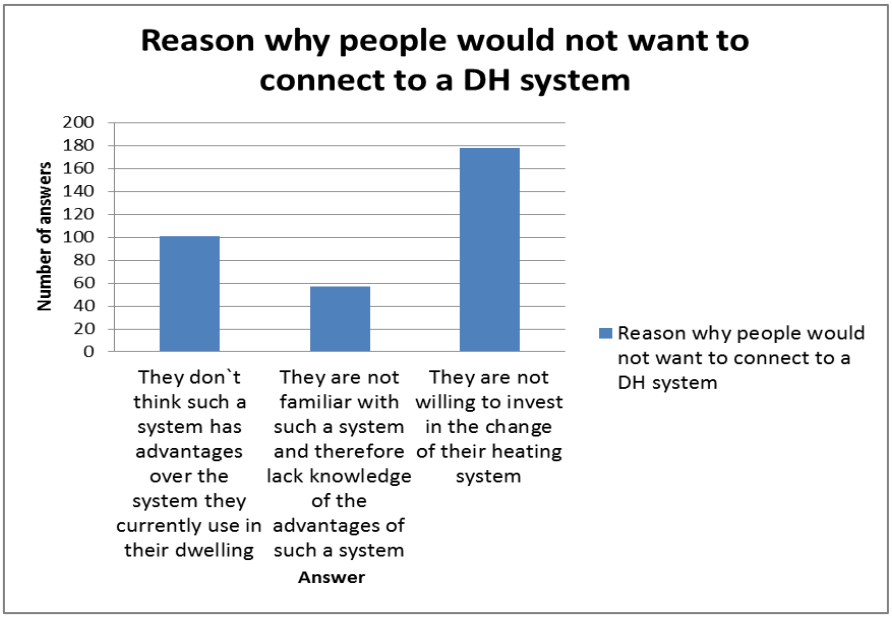

Figure 122. Main reasons why people would not want to connect to a district heating system – results for Šabac

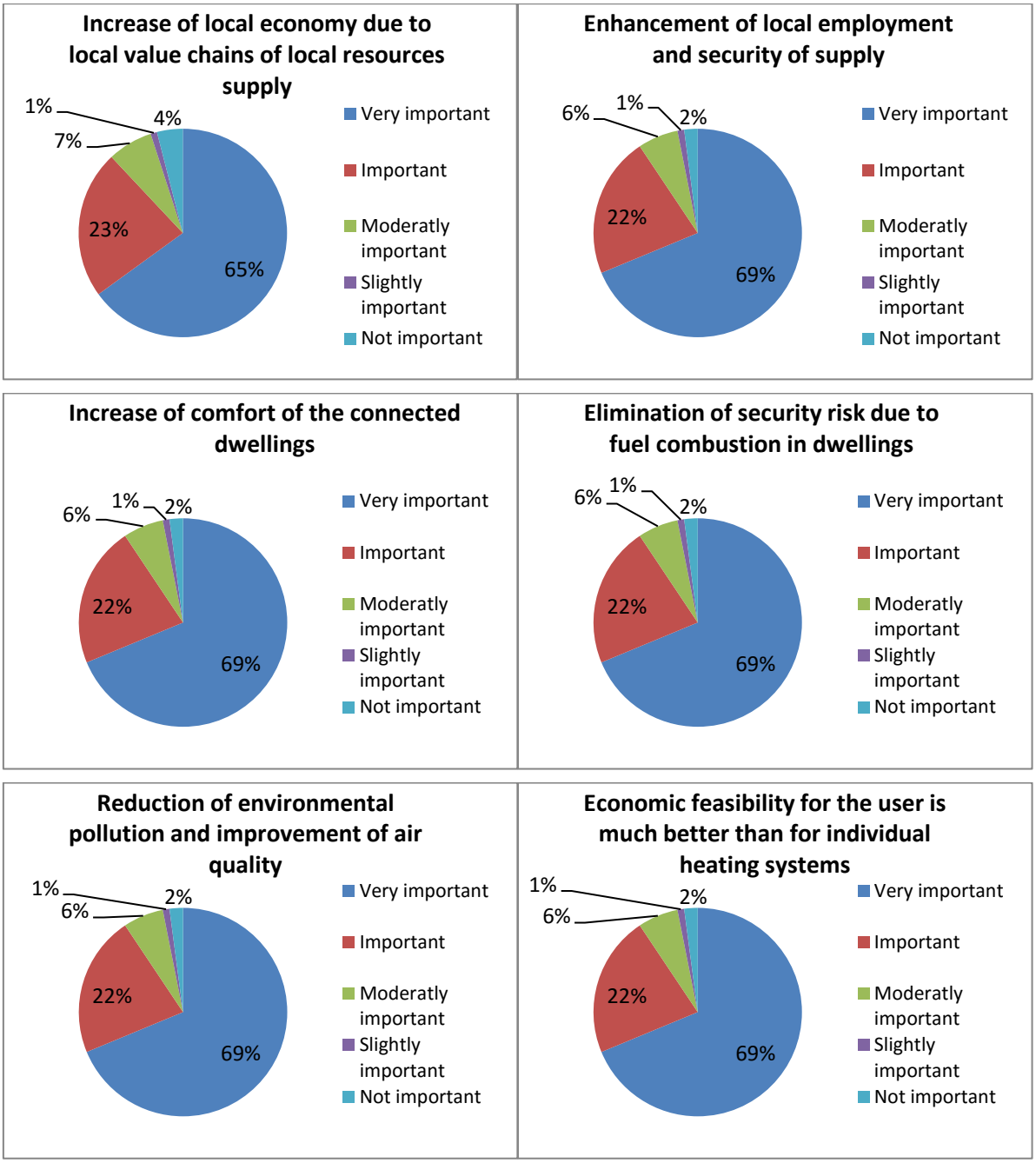

Figure 123. Opinion of surveyed citizens on benefits of small modular renewable district heating systems – results for Šabac

The most important driver for district heating systems, among six possible answers, is reduction of environmental pollution and air quality improvement (76% surveyed households see it very important), followed with security risk from the fire (71%) and increase of comfort is at third place (68%). The other three possible answers: security of supply and employment (67%), economics of scale advantage (66%) and finally the boost of local economic supply chains (65%) citizens see also very important. The only 2% of surveyed people (4% for the answer “Increase of local economy due to local value chains of local resources supply”) find the answers not important.

6.5 Concluding remarks for target community in Serbia

The fact that 605 people had took part in survey shows that this project is very interesting for local community. Renewable sources of energy, especially biomass could give a chance to citizens for better life standards and long term energy prices stability. Also, local biomass and small district heating could support local economy.

The building stock in Šabac is so old and needs high rate of refurbishment to archive lower heat demand and lower annual expenses for energy. That means a serious financial resources should be invested in thermo insulation of buildings and new heating systems.

The main energy source is logwoods and natural gas. The problem is that natural gas is imported good and long term secure of supply is not in hand of citizens, but the local biomass is used on not efficient way.

Great many of households have centralised heating system and no needs for so high expenses to be connected to district heating system.

The fact is that already people heard about CoolHeating project and public opinion towards small modular renewable district heating systems is rather positive.

7 Conclusions

As a part of Task 3.4 of the CoolHeating project, a survey was conducted in all five target communities included in the project. The results of each national survey have been presented in this report. The goal of this task was to gather 2 500 questionnaires in total, i.e. 500 questionnaires per target community. Total number of gathered questionnaires equals to 2 344. This is due to a low number of households in two target communities (Ozalj in Croatia and Cven in Slovenia), which limited potential number of gathered questionnaires from these communities. Nevertheless, in these two communities, the share of households interviewed in this process is much higher than in other target communities and therefore the overall outcome of the survey can be considered satisfactory.

The results of the survey showed that in most target communities there is a much higher share of houses than apartment buildings. The only exception here is municipality of Visoko with a much higher share of apartment buildings in the surveyed parts of municipality. These figures are connected with floor areas, number of rooms and number of people living in these households. Therefore, houses have higher floor areas, higher number of rooms and more people living in them than apartments. Age of buildings in all target communities is rather high, with most buildings built in the second part of 20th century, which was characterised with the lack of regulations for thermal insulation of buildings. This fact, combined with rather low refurbishment rates of buildings in target communities, results with rather low energy performance of buildings. This can also be seen when analysing types of windows and the share of households which have insulation on outer walls and rooftop. In most of the target communities, less than 40 % interviewed households have insulation on the outer walls and rooftop. The situation is somewhat better in target communities in Slovenia and Bosnia and Herzegovina but the results are still not satisfactory. Concerning types of windows, on average around 50 % of households have PVC windows which can be concluded as satisfactory, but the potential for improvement is still rather high.

When it comes to heating systems in households, these results differ for different target communities. Municipality of Karposh (Macedonia) and city of Šabac (Serbia) already have a district heating network, while other target communities do not have a district heating network on a city/municipality scale. Still, some major conclusions can be drawn. Mostly, more than 50 % of interviewed citizens already have needed infrastructure for connecting to a district heating system. This presents an opportunity since those citizens would not have to pay for the complete refurbishment of their heating system but only for connection. Energy sources that are currently being used for heating in target communities range from mostly biomass (logwood, pellets, woodchips) in Croatia, Slovenia and Serbia to coal in Bosnia and Herzegovina and electricity in Macedonia. It has to be noted that in all of the communities included in the survey, biomass has a relatively high share due to its low price, especially when citizens own a part of the forest. As expected, electricity has a highest share as an energy source for domestic hot water, while for cooling citizens use split-system air conditioners, i.e. electricity. It has to be noted that majority of people do not use cooling at all.

Since most of the interviewed citizens have a centralised radiator heating system on the apartment/dwelling level, they mostly heat all of their rooms. On the other hand, the number of cooled rooms mostly depends on the number of cooling units. Therefore the share of cooled rooms is much more diversified. Concerning the final energy consumption for heating of households in target communities, more than half of the interviewed citizens are in range 20 000 – 50 000 kWh in Croatia, Slovenia and Macedonia. These figures are slightly lower for Serbia and significantly lower for Bosnia and Herzegovina where 50 % of interviewed citizens have final energy consumption of up to 5000 kWh annually. Due to geographically similar positions of target communities, all the results show that majority of interviewed citizens heat their households 6 – 7 months. One of the most important questions in the questionnaire was the one concerning annual expenses for heating of households. It can be seen that the expenses are lowest in Macedonia and particularly Serbia and Bosnia and Herzegovina, where 50 % of surveyed citizens have expenses lower than 400 €. Target communities in Croatia and Slovenia have significantly higher annual expenses for heating.

For Croatia, around 50 % of interviewed citizens have expenses higher than 800 €, while for Slovenia around 50 % of surveyed citizens have expenses higher than 1000 €.

The last part of the questionnaire provided information on public opinion towards small modular renewable district heating systems. The analysis of project dissemination results showed that share of people who have already heard about the project is the highest in target communities in Macedonia and Bosnia and Herzegovina, more than 60 %. These are great results which occurred due to good dissemination strategies and the size of target communities (target communities with higher population have higher possibility to reach citizens with their dissemination activities). Dissemination results are also good for Serbia, while in Slovenia and Croatia these results are much lower. This is mostly due to the small size and high scatteredness of target communities in these countries so these results can still be considered satisfactory. Opinion of citizens of target communities towards connecting to a district heating systems can be considered satisfactory as well, since at least around 50 % of people answered that they would be willing to connect to a district heating system. Main reasons why citizens would not want to connect to a district heating system have also been analysed in the survey. Depending on the results in target communities, different ways of tackling these reasons have been identified. Finally, benefits of small modular renewable district heating systems have been introduced to the citizens in order to see which of the benefits they consider most important. The results will be taken into account in future information activities in the target communtiies.

Appendices

1. Questionnaire for citizens of target communities on energy consumption – English version

Questionnaire
for citizens of target communities
on energy consumption

Information on the survey and the CoolHeating project

This survey is carried out as a part of the EU Horizon 2020 project CoolHeating (No 691679) which aims to give support to the implementation of small modular renewable district heating and cooling grids for municipalities and smaller cities.

On the one hand, the purpose of this survey is to inform citizens about the project so that they can participate by expressing their doubts and giving ideas and suggestions. On the other hand, the purpose is also gathering energy data to be used for mapping of the energy needs, and energy planning.

Gathered data will be used for research activities of the CoolHeating project and will not be used for any other purposes.

1. **Are you already aware of the CoolHeating EU project in which your city participates?**

☐ Yes
☐ No

2. **If you answered yes to the previous question, how did you find out about the project?**

☐ Through a flyer describing the project
☐ Through local media announcement
☐ Other:_____

3. **What type of dwelling do you live in?**

☐ House
☐ Apartment in a building

4. **In which year was your dwelling built?**

_____

5. **In which year did the last refurbishment of your dwelling take place?**

_____

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6. **How many people are living in your dwelling?**

- ☐ 1-2
- ☐ 3-5
- ☐ More than 5

7. **What is the size (in m^2) of your dwelling?**

---

8. **How many rooms do you have in your dwelling?**

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6+

9. **Are the outer walls of your dwelling insulated?**

- ☐ Yes
- ☐ No

10. **If you answered yes to the previous question, what kind of insulation do your outer walls have (type, thickness)?**

---

11. **Is the roof of your dwelling insulated?**

- ☐ Yes
- ☐ No

12. **If you answered yes to the previous question, what kind of insulation does your roof have (type, thickness)?**

---

13. **What type of windows do you have installed on your dwelling?**

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14. What kind of a heating system do you have in your dwelling?

- ☐ Connected to district heating system
- ☐ Centralised system, on the dwelling/apartment level
- ☐ Individual stoves or electric heaters in rooms
- ☐ Other: _____

15. What kind of energy source and how much do you need for heating?

- ☐ Logwood _____ m³
- ☐ Wood chips _____ m³
- ☐ Pellets _____ t
- ☐ Natural gas _____ m³
- ☐ Fuel oil _____ l
- ☐ Electricity _____ kWh
- ☐ District heating _____ kWh
- ☐ Other: _____

16. What kind of energy source and how much do you use for hot water preparation?

- ☐ Logwood _____ m³
- ☐ Wood chips _____ m³
- ☐ Pellets _____ t
- ☐ Natural gas _____ m³
- ☐ Fuel oil _____ l
- ☐ Electricity _____ kWh
- ☐ District heating _____ kWh
- ☐ Other: _____

17. How many rooms do you heat in your dwelling?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6+

18. What kind of energy source do you use for cooling?

- ☐ Electricity (e.g. split system, fan, heat pump, etc.)
- ☐ None

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19. How many rooms do you cool?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6+

20. Do you have an energy certificate for your dwelling?

- ☐ Yes
- ☐ No

21. If you answered yes, please specify the category of your dwelling and/or average annual heat demand.

---

22. Please specify your annual expenses for heating purposes (in national currency)

---

23. How many months per year do you heat your dwelling?

---

24. Would you be willing to connect to a district heating system?

- ☐ Yes
- ☐ No

25. If you answered no to the previous question, please elaborate why.

- ☐ I don`t think such a system has advantages over the system I currently use in my dwelling
- ☐ I am not familiar with such a system and therefore lack knowledge of the advantages of such a system
- ☐ I am not willing to invest in the change of my heating system
- ☐ Other

26. If you chose other in the previous question please elaborate.

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27. How important do you see the following advantages of a small modular renewable energy district heating system?

	Very important	Important	Moderately important	Slightly important	Not important
It increases local economy due to local value chains of local resources supply	☐	☐	☐	☐	☐
It enhances local employment and security of supply	☐	☐	☐	☐	☐
It increases comfort of the connected dwellings	☐	☐	☐	☐	☐
It eliminates security risk due to fuel combustion in dwellings	☐	☐	☐	☐	☐
It reduces environmental pollution and improves air quality	☐	☐	☐	☐	☐
Economic feasibility for the user is much better than for individual heating systems	☐	☐	☐	☐	☐

Disclaimer – data protection

The following information of question 28 on your personnel data are optional. Your address would be helpful to better assess the potential for setting up a small renewable district heating network in your community. These data will be received by the CoolHeating partner responsible for the survey, as shown below. The data will server only for the purposes of the CoolHeating project.

By filling the name and address below (optional), I confirm that the data collected in this questionnaire can be used for the CoolHeating project in order to support small renewable district heating networks. I am aware that I can revoke these data at any time. In this case, my personnel data will be deleted. Existing results of the anonymous analysis will not be affected by the revocation.

28. Personnel data (optional)

Name: _____

Address (Street, post code): _____

Contact data: _____

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Name of the organisation implementing the survey

University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
Ivana Lučića 5, 10 002 Zagreb, Croatia

Contact person of the responsible person of the survey

Tomislav Pukšec, PhD
tomislav.puksec@fsb.hr

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