ENERGIE
ȘI BIOMASĂ
Resurse energetice alternative pentru Moldova

Market survey on affordable rural biomass household heating solutions

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This paper can be used as didactical material in schools and university to study relevant technical disciplines.

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Contents

Executive summary

This report presents results of the survey on affordable rural biomass household heating solutions in the Republic of Moldova. One of main objectives of the survey is to provide sufficient and relevant information concerning the feasibility of implementation and promotion of affordable biomass- based heating systems in rural areas, in the context of the entire value chain.

In accordance with terms of reference, survey can be divided into part that describes current demand for heating solutions, description of existing supply of heating systems and promotional part that would make a connection between supply and demand.

For proper understanding of heating habits in rural area of RM was conducted a public opinion survey where 1300 respondents were questioned. Methodology used in the survey provided +/- 2,7% error margin.

During the survey, household owners were asked about certain aspects of their habits that are connected with heating systems, these are:

- **Rural household characteristics.** Most of households (82%) in rural area were built more than 20 years ago. Main building materials are loam brick (56%) and sand-lime brick (27%). Only 8% of households are thermo-insulated. Residence surface area ranging from 41-150 m^2, and average surface of rural household is 82 m^2.
- **Agricultural lands and their cultivation as a potential source of biomass fuel.** Average surface of arable land, owned, per household is 1.56 are. Most popular crop cultivated is corn. Up to 46 % of households do not exploit agricultural wastes.
- **Heating solutions characteristics.** Only 18% of households heat entire house. Average heating area is 38 m^2. Brick stove is the most popular heating solution (84%). The most used fuel is wood (90% of cases) and coal (34%) or combination of these. Reason for using this kind of fuel is that household owner considers it cheaper (34%) and more efficient. Average cost of heating in rural area is 6000MDL.

- **Propensity to acquire biomass based heating systems.** There is a little willingness to acquire biomass based heating system among households ("definitely" only 8%). However this is a result of lack of information concerning heating systems that work on biomass.

Further analysis and calculations made on the basis of conducted public opinion survey identified a set of characteristics of heating systems that would be attractive both to final customer and are economically feasible. These characteristics are:

1. Efficiency rate of heating systems 88-93%.
2. Investment in heating system begins to be feasible if heating area is not less than 75m^2
3. Biomass fuel form factor: pellets or briquettes
4. Heating systems type. Boiler or stove1
5. Affordable price of heating system:
    a. Stoves
        i. **Pellet stoves.** Affordable price varies from **660 to 1100 Euro** depending on the income of the household.
        ii. **Briquette stoves.** Range of the affordable price is from **360 up to 600 Euro** depending on the level of the income.
    b. Boilers
        i. **Pellet boilers** Affordable price range is **810 – 1600 Euro** depending on the level of the income
        ii. **Briquette boilers.** Affordable price range is **533-888 Euro** on the level of household's income.

Stated above information was used as a base for elaboration of a decision tool that can be used both by the household owner when selecting the heating system and by potential local heating system producer when designing heating systems and establishing price for the final consumer. This tool takes into consideration criteria like:

- Availability of biomass fuel by type

[1] Some of customers showed equal interest in both heating systems

- Surface of the household
- Heating necessity e.g. Air heating alone, both air and water heating.

At the moment of elaboration of the survey 8 major importers of biomass based heating systems were identified. Important feature that was noted is that there was no differentiation in added value services provided by distributors. Each distributor provided services related to elaboration of the project, installation of equipment and its maintenance.

Mentioned above distributors, had in their product portfolio 11 brands from 8 countries (Poland, Italy, Germany, Ukraine, Czech Republic, Greece and Romania).

For analysis purposes were selected 41 models of biomass based heating systems. A main criterion of preliminary selection was the ability of heating system to heat households with the surface up to 150m^2. From selected models (41), several solutions were selected for the range of typical households, in order to make economic and financial calculations. As a result it can be stated that:

- Biomass based heating systems, at the moment of the study, are found to be more efficient than any other combination of fuel and heating systems used in rural area.
- Efficiency of heating system is one of the most important criteria that gives competitive advantage **Heating systems with efficiency of 88% and higher are considered to be most feasible ones.**
- Intensity of use of the heating system plays an important role in terms of investment repayment and price of one GJ. Thus investment in heating systems that are used to heat bigger surfaces and heating water will be recovered faster.

Production of biomass based heating systems in RM is possible, as at the moment of elaboration of survey 7 companies demonstrated their willingness to produce stated heating systems. However none of the companies expressed desire to produce heating systems to deposit with further sales. All of potential producers stated that they would produce heating systems only if 100% of the production batch will be sold (pull system). This demonstrates that yet having a capacity to produce local manufacturers are not willing to market biomass-based heating systems.

Foreign producers of biomass based heating systems, which were not present on Moldovan market at the moment of the study, demonstrated little interest in Moldovan market as a place for business extension.

Public opinion survey demonstrated that household owners do not have sufficient information about biomass based heating systems. Thus making this type of heating systems an innovative product which can be promoted using law of distribution of innovation. In accordance with this law, any group of people[2], can be divided into: innovators/ navigators (most progressive layer of society), early adopters (people that will change heating systems only if they saw it already working), early majority, late majority and laggards.

[2] - Village, administrative region, community

Introduction

Project identification

Project designation: "Market survey on affordable rural biomass household heating solutions"

Client: UNDP Moldova

Contractor: "ProEra Grup" LTD

Contractor's team:

1. Project Manager: Artiom Cociu
2. Consultant: Sergiu Uzun
3. Junior Consultant: Pavel Moraru
4. External Consultant: Vlad Raileanu
5. External Consultant: Mihai Bostan
6. External Consultant: Vitalie Gangur
7. CEO ProEra Grup: Gheorghe Efros
8. Vice CEO ProEra Grup: Ion Casian

Place of Public Opinion Research: Rural area of Republic of Moldova

Project objective: The general objective of the requested consultancy services is to conduct an in-depth survey of current systems in use and an analysis of biomass based energy efficient domestic heating systems, available equipment domestically and internationally and the potential for application in the RM.

To determine the suitable range of equipment subject to analysis, development of equipment, performance criteria, such as price, energy source, technical specifications, etc. based on the survey of equipment currently in use and consumer preferences and demand. Based on the developed criteria, the service provider will assess the potential of local producers and importers to supply and deliver and service quality efficient biomass heating stoves.

Methodology

Public opinion survey:

In order to achieve the objectives set for the present study, it is proposed to carry out a quantitative research on a sample of 1 300 households, which will ensure data representativeness throughout the entire country, with a ±2.7% error margin and a confidence level of 95%.

For securing territorial representativeness, the sample used shall be segmented based on regions (a total of 10 regions). Besides, the rural localities shall be grouped in accordance to the size of the locality: small-sized (<1 500), medium-sized (between 1 501-3 000) and large-sized (>3 000). For detailed information about public opinion please refers to Annex 1: Public opinion survey methodology.

Research scenarios:

The performance of a heating system depends on different variables (e.g. heated area, fuel used etc.). Below are scenarios that were used in our calculations.

Household Area: (Based on survey)

- 40m^2
- 75m^2
- 90m^2
- 110m^2
- 150m^2

Household height *– 268cm (average height of a household under survey)*

Hot water: *Not available / Available*

Members of the household: 4.1 *– (average number of family members in rural areas according to the National Bureau of Statistics of RM)*

Average amount of hot water per family member in 24h. *– 85l*[3]

[3] Decision #191 of Gouvernement of The Republic of Moldova as of 19.02.2002

Hot water temperature: *50°C*[1]

Initial water temperature: *5°C*[1]

Average duration of heating season: *166 days*[4]

Average air temperature during heating season: *0.6°C*[2]

Target air temperature inside the house: *18°C*[2]

Average temperature of the rural household during heating season: *14°C*

Outside air temperature for the coldest period: *-16°C*[5]

Fuel and heating solution used:

For biomass based solutions, efficiency rates have been applied in accordance with the information provided by official distributors in the RM. The main criterion for choosing heating solutions was the ability to cover peck load (power of heating solutions), after which the most affordable heating solution was taken.

Pellet Boiler / Stove	Rate depends on scenario	
Straw pellets-	15 MJ/kg	Price: 1800 MDL/t.
Briquette Boiler / Stove	Rate depends on scenario	
Straw briquettes-	15 MJ/kg	Price: 1800 MDL/t.
Low Rate Brick Stove (LRBS)	Rate= 35%	
Coal-	25MJ/kg	Price: 3000 MDL/t.
Wood (log wood) -	12 MJ/kg .	Price: 940 MDL/t
Wood chips -	10.2MJ/kg	Price: 940 MDL/t.
Wheat (straw) -	15.9MJ/kg	
Sunflower (straw) -	14.9MJ/kg	
Sunflower (husk) -	20.5MJ/kg	

Combination:

Wood (80%) *12 MJ/kg*

Coal (20%) *25MJ/kg*

[4] СНиП 2.01.01-82, Moscow 1983

[5] СНиП 2.01.01-82, Moscow 1983

High Rate Brick Stove (HRBS) Rate= 75% for coal (70% other fuels)

Coal-	25MJ/kg	Price: 3000 MDL/t.
Wood (log wood) -	12 MJ/kg	Price: 940 MDL/t
Wood chips -	10.4MJ/kg	Price: 940 MDL/t.
Wheat (straw) -	15MJ/kg	Price: 940 MDL/t.
Sunflower (straw) -	14.9MJ/kg	
Sunflower (husk) -	20.5MJ/kg	

Combination:

Wood (80%) 12 MJ/kg

Coal (20%) 25MJ/kg

Natural gas Boiler Rate=90%

Natural Gas - 48Mj/m^3 Price:6.6 MDL/m^3

An additional adjustment will be taken into consideration if people use their own biomass as a fuel. The adjustment will take into consideration an average amount of biomass available in the household and it will be assumed that a household owner will use pelletizing services[6].

Economic calculations:

During the elaboration of economic calculations several approaches were used. These are:

Comparative analysis of investment costs for installation of biomass-based heating systems with next best heating solution available on the market, in particular in the case of a heating system that works on natural gas.

Future Discounted Cash flow (FDC) method was used for an estimation of the feasibility of investment in biomass-based heating systems. For this purpose scenarios with 8% and 14% discount rate were used. For a proper understanding of the feasibility of investments in biomass based heating systems, different variables were taken into account, e.g.

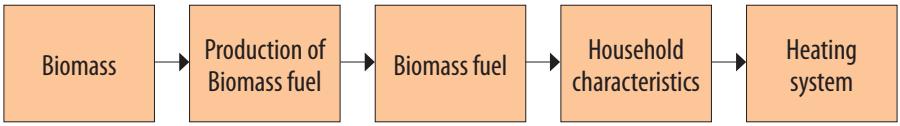
[6] - ProEra Team is convinced that this type of services can be very rapidly implemented in rural areas in order to cover biomass fuel necessities.

surface of heated area, water heating (available/not available), type of fuel used etc. (for results of calculations please see Table 21 and Table 21. For details in methodology of calculation please refer to Annex 7.

Calculation of cost for one GJ of heat here should be mentioned that depreciation charge for most used heating system in rural areas can be considered fully depreciated. For details please refer to Annex 6

For a proper understanding of the affordability of biomass-based heating systems it is very important to have an integrated approach in analyzing the entire value chain.

Figure 1: **Supply chain of biomass-based heating**



The supply chain of biomass-based heating can be characterized by different variables, both financial (price of the equipment, price of fuel, repayment period) and non-financial (heat rate of the fuel, power of the heating system, availability of biomass based fuel etc.). Different combinations of the above variables can influence the perception of affordability of the heating system by the final consumer. Proper analysis of value chain variables and the final consumer's preferences related to heating systems will give necessary information about the feasibility of using biomass-based heating systems in rural areas.

Critical variables of the supply chain:

1. Biomass
   a. Availability of biomass necessary for production of fuel in the vicinity of the community
   b. Availability of biomass in the household
2. Production of biomass fuel
   a. Availability of briquetting / pelleting services
   b. Flexibility in delivery and packaging
3. Biomass fuel
   a. Shape of fuel (briquettes /pellets)

b. Price for fuel
c. Price for briquetting / pelleting services

4. House characteristics
   a. Surface of the house
   b. Heating area of the house
   c. Thermal insulation
   d. Age of the house
   e. Other

5. Heating system
   a. Characteristics of heating system (efficiency, power etc.)
   b. Fuel used
   c. Purpose of utilization (air heating, air and hot water heating)
   d. Efficiency of the investment
   e. Price for one GJ
   f. Other

A holistic approach towards that analysis of the supply chain will provide necessary information related to the affordability of biomass-based heating systems, and contribute to the elaboration of an efficient and effective sequence of actions for the promotion of affordable biomass-based heating in rural areas.

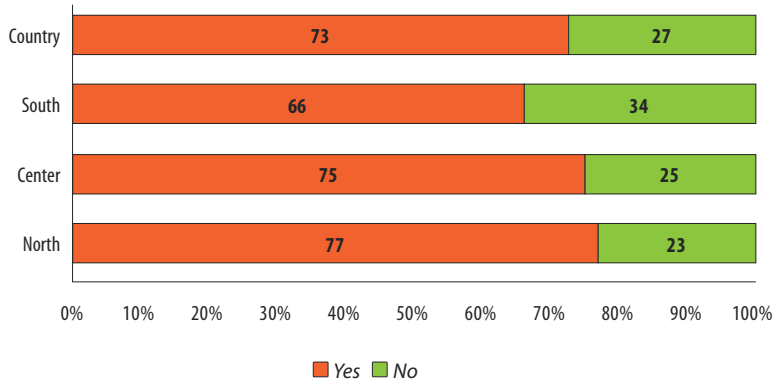
Availability of Biomass

One of the most important factors that can influence the quality of life of a community is availability of energy within its reach. The European Commission documents describe biomass as *"the biodegradable fraction of waste products and residues from agriculture (including vegetal and animal substances), forestry and related industry, as well as biodegradable fraction of municipal and industrial waste"*[7]. In the present survey the notion of biomass will be attributed only to agricultural residues and their waste/by-products. The present market study has been carried out in the rural areas of the RM and has been aimed at analysing and offering information regarding biomass sources that include agricultural residues and their wastes/by-products resulting from the agricultural activities in which both agribusiness enterprises and rural households are involved. Furthermore, the present study is focused on identification of the potential of using biomass in rural areas for heating solutions. The goal here is to find out if rural households, through their agricultural activity (formal or informal), generate sufficient volume of biomass so as to be considered feasible (with certain potential) for heating in the cold season, as well as to specify technical and economic criteria of affordable heating solutions for typical households in the rural areas of the RM.

During the study it has been established that, landowners who currently cultivate (agricultural activity) their own or leased lands make up **73% of the total rural population of the RM (Figure 2)**. Also it has been revealed that landowners from the southern part of the RM are less inclined to cultivate their land than their counterparts in other regions.

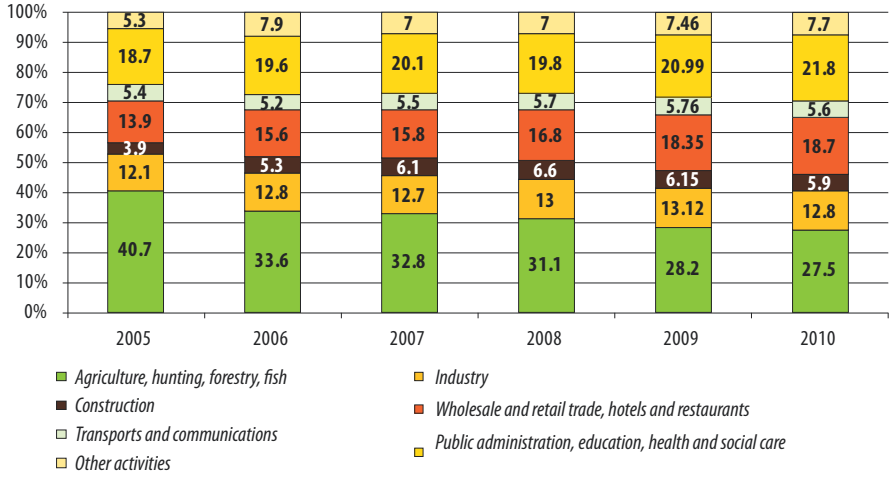
[7] EUROPEAN COMMISSION - EUR 21350 – BIOMASS - Green energy for Europe, Luxembourg: Office for Official Publications of the European Communities, 2005, http://publications.eu.int.

Figure 2: **Land cultivation**



According to the data of the National Bureau of Statistics of the RM, involvement of people in agricultural activities is declining (Figure 3). The number of the Moldovans working in agriculture decreased from 40.7 % in 2005 to 27.5 % in 2010. In the long run this negative trend, if not compensated with efficient methods of conducting agricultural activity, can bring to significant fluctuations in quantities of biomass available as a fuel.

Figure 3: **Distribution of employed population by type of economic activity (%)**



The data described above and the fact that income from agricultural activity for rural population represents on average 19.1% of their monthly incomes[8], clearly shows that the profitability of agricultural activity is quite important for the wealth of Moldova's rural population. The quantity of biomass is directly dependent on the territory-surface area where biomass is produced and the types of cultivated crops. The purpose of usage depends on population level of awareness about the value of biomass and methods of its sustainable utilization.

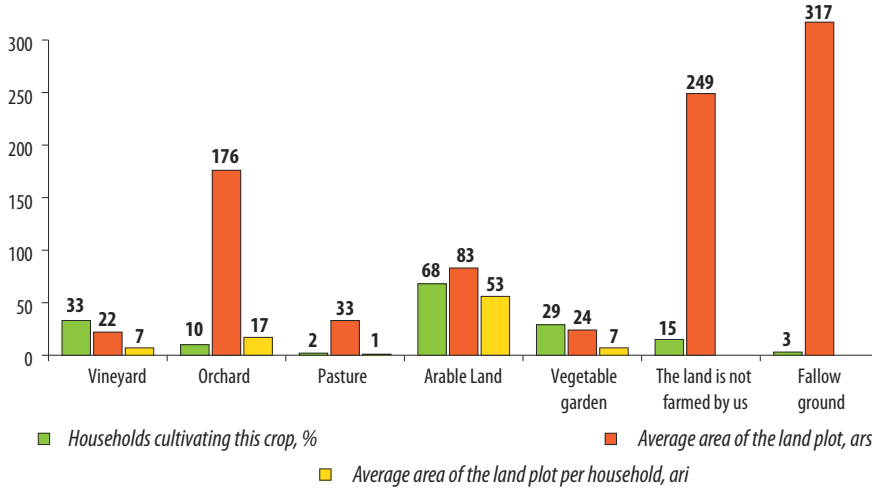
The results of the study has showed that the average surface of agricultural lands per household is 1.64 ha, out of which 1.59 ha are privately-owned lands and 0.04 ha are rented lands. The distribution of land in different regions is also different. In the Central and Northern regions of the RM, households own a larger area than in the South (South 1.16 ha < North 1.61 ha < Centre 1.81 ha). Also, as less arable land is available in the south of the country, this makes households from this region less likely to lease their land compared with other regions.

The households with their own land or leasehold property in 68% of the cases are using land for arable purposes: for growing cereals, corn, sunflower and other plants, 33% –for vineyards, 29% –as vegetable gardens, 10% – as orchards, and only 2% – as pastures. However, there are 15% of households that choose not to cultivate the land by themselves while 3% of households are leaving the land as fallow (Figure 4). In 2010, 63% of the rural households did not have any specialization regarding the usage of land, thus a combination of agricultural activities mentioned above would be dealt with by the majority[9].

[8] National Bureau of Statistics of the Republic of Moldova – "Average monthly disposable income per person in rural areas(2010)"

[9] National Bureau of Statistics of RM "Agricultural activity of small agricultural producers (2010)"

Figure 4: **Use of agricultural lands by purpose of use (%)**

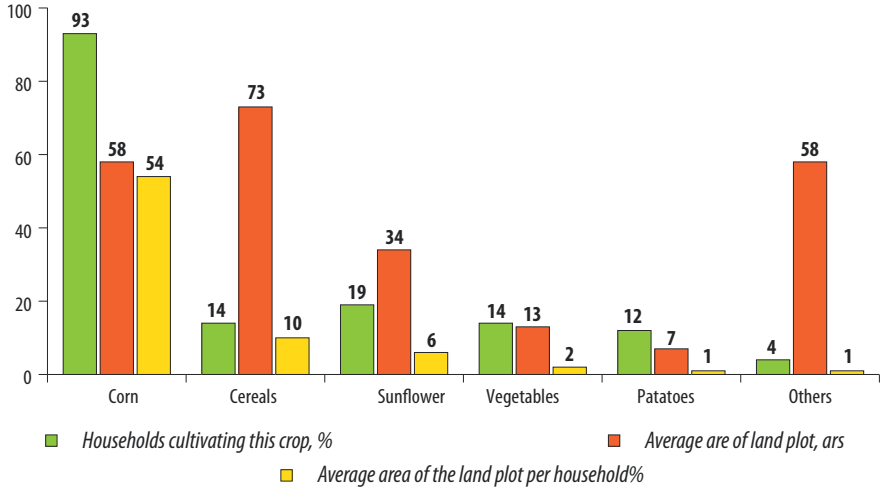


On the grounds that arable lands are the most common destinations of land usage in the RM and that the biomass produced by these types of agricultural activity has a significant energetic potential as an energy source, focus on analysing the biomass potential that can be generated from these agricultural activities was made. It can be seen that vegetable gardens are very popular among the rural inhabitants of Moldova (29%), but due to the fact that the biomass produced during this agricultural activity is less energetically potent and that it has a high value as compost, it was not taken into account in calculations.

Table 1: **Area of the cultivated arable lands by crop (%)**

	Average surface of a parcel per household, ha
Corn	0.58
Cereals	0.73
Sunflower	0.34
Vegetables	0.13
Potatoes	0.07
Other	0.58

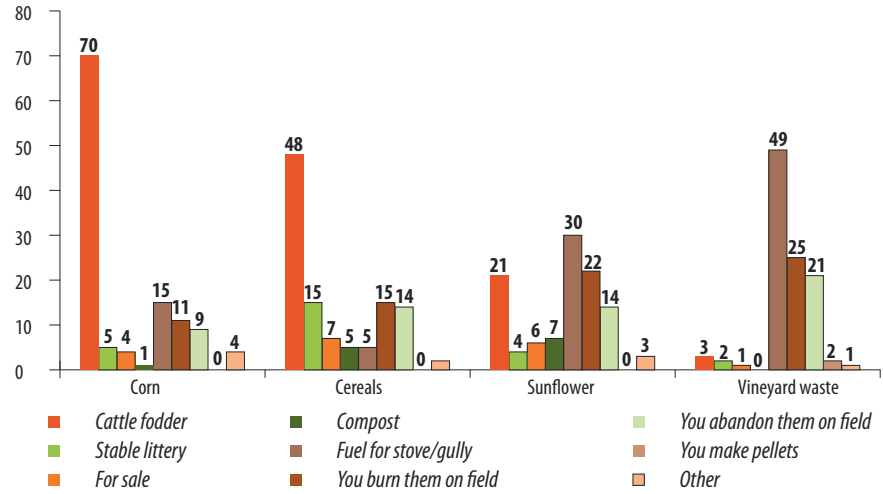
Figure 5: **Range of most cultivated crops (%)**



Since corn, sunflower and cereals are the most popular cultures grown by households (Figure 5), these cultures will be taken in to account in making calculations of available biomass.

Based on the tradition of the region and on the type of biomass available, the scope of its usage slightly varies. Figure 6

Figure 6: **Utilization of biomass (%)**



Fuel price is one of the most important variables that determine whether the heating solution is affordable and if the investment in changing the current heating solution to a biomass based one, is feasible. Fuel price determines how much money a household will save during the heating season and what benefits this brings in terms of quality of life.

Since biomass is generated by households as a result of their agricultural activity, it is very important to estimate the volumes that can be collected and used as fuel for biomass heating solutions. Table 2 shows that an average household produces **≈3t./year** of biomass suitable for energy production purposes. This valuable source of fuel can be obtained without sacrificing biomass used by the household for purposes such as: cattle fodder, bedding for animals, compost. It is important to mention that the estimated ≈3t./year does not include the amount of biomass already used for warming up a stove/gully.

This volume of biomass, suitable for energy production, is also a market niche for potential biomass fuel producers that could provide briquetting/pelleting services to households willing to switch to biomass based heating solutions. The provision of this type of service will decrease the price for the final product (briquettes/pellets) and will increase the energy security of households in rural areas of Moldova. Further in the study this indicator (3t/year) will be used as one of the scenarios in the calculation of biomass-based heating systems price. (Table 16)

Table 2: **Calculation of average amount of biomass available in household**

Culture	Average surface of a parcel (ha)	Average surface of a parcel (ha)	Avg. harvest (t/ha)	Biomass product	Avg. biomass per 1 t. of harvest (t.)	Amount of biomass (kg)	Aje.*	Amount of available biomass (kg)
Corn	0.58	0.58	3.64	Stalk	1.85	3,906	50	1,953
Wheat and Barley	0.73	0.50	2.54	Straw	1.4	1,791	29	519
		0.28	1.86	Straw	1.65	874	29	253

Culture	Average surface of a parcel (ha)	Average surface of a parcel (ha)	Avg. harvest (t/ha)	Biomass product	Avg. biomass per 1 t. of harvest (t.)	Amount of biomass (kg)	Aje.*	Amount of availa-ble biomass (kg)
Sunflower	0.34	0.34	1.67	Straw	2.55	1,448	36	521
				Husk	0.315	179	36	64
Total:						8,197		3,311

*- adjustment represents share of biomass products that were not used by household (abandoned and burned on the field, left after feeding cattle) For details please see Annex 2: Methodology of calculation of the amount of adjustment for biomass available within the household

The households can also prioritize the type of collected biomass in terms of its energetic potential. As shown in Table 3, sunflower husk and corn stalks are the energy "champions" in this case. This particular type of biomass can be recommended to households as a fuel for heating.

Table 3: **Energetic potential of available biomass**

Culture	Biomass product	Amount of avai-lable biomass (kg)	Caloric Power (MJ/kg)1	Total energy (MJ)
Corn	Stalk	1,953	17.5	34,175
Wheat	Straw	519	15.9	8,259
Barley	Straw	253	15.9	4,029
Sunflower	Straw	521	14.5	7,558
	Husk	64	20.5	1,320
Total:		3,311	Total:	55,341

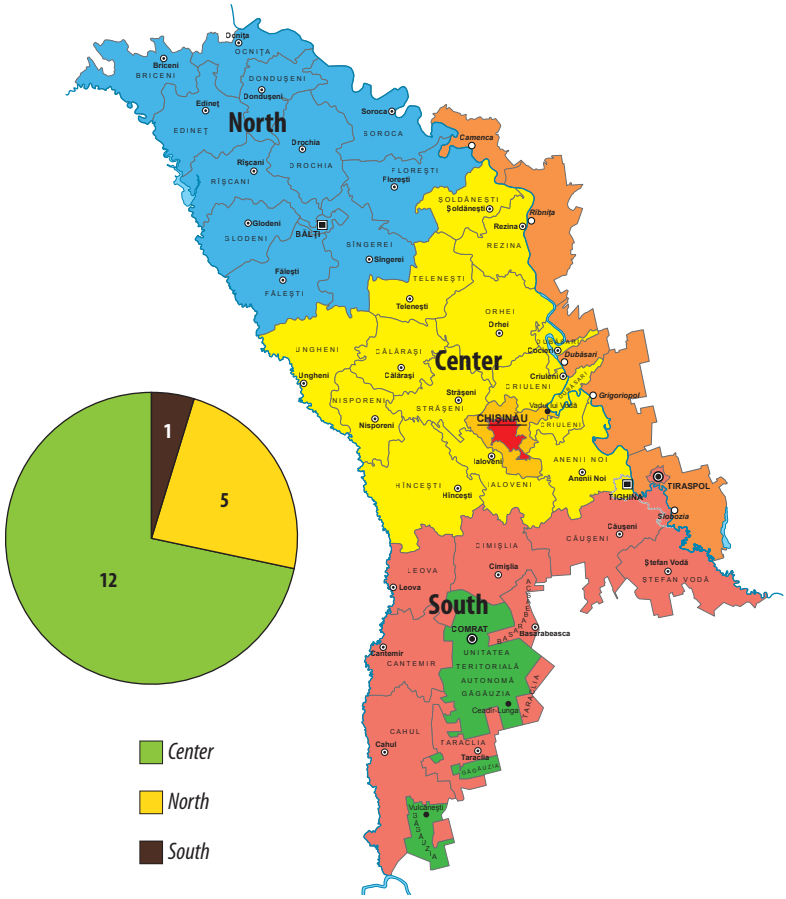
Based on the energy potential of "no-use biomass" (55,342 MJ) and the average energy consumption by size of household, Table 4 simulates scenarios of biomass based heating potential per size of household. By utilising this possibility of collecting and processing available "waste biomass" a household of 15m^2 can save up to 50% of heating and hot water production costs.

Table 4: **Amount of energy consumption for air and water heating covered by available biomass**

Surface of house (m^2)	Annual energy consumption for heating (MJ)	Annual energy consumption for hot water (MJ)	Total energy consumption (MJ)	Energy potential owned by the household (MJ)	Coverage of heating necessities with biomass (%)
A	1	2	3=1+2	4	5=4/3
40	28,100	24,000	52,100	55,341	106%
75	52,700	24,000	76,600	55,341	72%
90	63,200	24,000	87,200	55,341	63%
110	77,200	24,000	101,200	55,341	55%
150	92,000	24,000	116,000	55,341	48%

Biomass fuel production in RM

Figure 7: **Geographical allocation of pellet and briquette producers**



Pellet and briquette production in the Republic of Moldova is a practice in its incipient phase. The branch is involved in a sporadically developing process which is characterized by a high motivation of producers to learn the technology of production and to evaluate the profit generation potential that this activity might have. Also, the branch is characterized

by a lack of homogeneity in terms of technology used by the producers, the geographical allocation and the biomass used for production.

In total, in the Republic of Moldova there are more than 40 pellet and briquette producers. As showed in Figure 7 the highest concentration of producers is in the centre of the country, especially Chisinau. From 18 pellet producers from this region, 10 of them are in Chisinau and two more are in Anenii Noi district. 15 producers are located in the north of the country. In the south of the country there are 7 producers of biomass fuel. For details, please refer to Annex 11.

There are two distinct types of pellet producers in the RM. These are very different in terms of the business strategy and value proposition that they provide on the market of solid fuels. These differences will be discussed as follows.

The first group, which is also the largest one, is composed of those producers which have a larger portfolio of products. Thus their main business activity is not to produce pellets. These are companies which mainly produce sunflower seed oil and consider producing pellets as a by-product (further on these producers will be called By-product Producers). These producers, when considering the amount of the initial investment needed for producing pellets, are in an advantageous position in comparison with the second type of producers identified.

Table 5, the equipment and the technology to start producing pellets is a real business opportunity for the By-Product producers because of their main activity (producing oil from sunflower seeds). The product development (pellets and briquettes) is a process of experimentation by the employees. That is why the technology of production and the recipe are kept secret by each producer. The equipment used, is assembled from self-made machines and parts bought from international producers. The value chain of production under this scenario is both easier to understand and easier to implement for a producer of sunflower seed oil.

Table 5: **Current reality value chain of producers which consider pellets and briquettes as by-products**

	By-product Producer's Value Chain	Value Chain
1	• The biomass is obtained as a residual from the main activity • The biomass used is mainly husk alone or in combination with cereals straw and sawdust • There is no preparatory operations in which biomass is involved	 Biomass from main activity
2	• The storage conditions for biomass are similar to those of the sunflower seeds thus there is no necessity of additional investments • The biomass is pelletized after a rather small period of time thus there is no necessity in additional storage area besides the one used for the main activity	 Storage of biomass
3	• The technology of pelletizing, applied in this scenario is similar to the one applied to produce sunflower meal • The equipment for drying, grinding and pressing in order to produce pellets is rather similar to the one used in producing sunflower meal. The only difference is the cooling system applied • The packaging can be in 3 forms: a) bags for 2-25 kg b) 50 - 500 c) piles • An installation with a capacity of 10 t per 24 h requires 20 - 45 m2 surface	 Production and packaging
4	• Storage conditions of final product, pellets and briquettes, are similar to those applied for sunflower meal thus there is no necessity for additional investments to fulfil those conditions	 Storage of pellets
5	• Transportation is required from the factory to a terminal of freight trains or can be outsourced to an international freight company	 Transportation
6	• The sales method is mainly B2B directly with international customers or by placing offers on international trade portals	 Sale

It is important to underline that producers of pellets from the category described above are mainly selling their product on the European market and this implies 2 methods: a) Business to Business sales or b) trading through on-line trading portals. In both cases however, Moldovan producers must demonstrate the quality of their product by offering a sample to the potential buyer. As the local market of pellets is not yet developed thus there is insignificant demand for pellets and briquettes in Moldova. The low level of awareness of local population about the heating potential of biomass fuel creates no incentives for producers to orientate their efforts towards selling on the local market. Moreover, the price given for pellets and briquettes abroad is attractive for Moldovan producers. Therefore at present they are focused on convincing international customers of the quality of their products and capability of conducting business at an international level.

The second group of pellets and briquettes producers is composed of those who build a business only on the production of biomass fuel and are the first entrepreneurs who foresee the feasibility of this branch in the RM (further on called Main Product Producers).

Table 6: **Current reality value chain of the specialized pellet and briquettes producers**

	Main Product Producer's Value Chain	Value Chain
1	• The raw material (biomass) is collected either from land under public administration management or from privately owned agricultural land • The biomass used is mainly straw of cereals, stalks of sunflower and corn and sawdust • The biomass is collected and prepared for the next phase on the field	 Biomass processing
2	• Transportation has to be organised by the pellet producer and this involves additional equipment and human resources • As a source of raw material (biomass) in this case, only land not further than 35-50 km from the factory is considered.	 Transportation

3	• The storage conditions for biomass are rather simple to fulfil but very important for the quality and amount of the final product • The biomass is pelletized after a rather small period of time thus there is a big turnover of biomass in the storage area	 Storage of biomass
4	• The technology of pelletizing is developed on the basis of the production solutions available on the international market • The equipment is both self-made and parts are bought internationally. • The packaging can be in 3 forms: a) bags for 2-25 kg b) 50 - 500 c) piles • An installation with a capacity of 10 t per 24 h requires 20 - 45 m2 surface	 Production and packaging
5	• Storage conditions of final product, pellets and briquettes require only a rather affordable initial investment • The final product can be stored for periods from 1 day to 4 months	 Storage of pellets
6	• Transportation services are developed for different types of customers and, unless there are special requirements, provided at no additional charge	 Transportation
7	• The product is sold, mainly, through three channels: a) B2B; b) online trading portals; c) local solid fuel distributors (coal, wood etc.)	 Sale

Given another business approach, in comparison with producers from the first group, the value chain and the structure of the business in the second scenario (Table 6), are more complex. These producers are more willingly to invest in human resource development not only the experiential aspects of learning but also by providing training and theoretical preparation. One of the differences that distinguishes these producers from By-product ones, is that these producers are making pellets and briquettes from more types of biomass with more heating potential.

For instance, they use not only the seed shells, as By-product producers mostly do, but focus on cereals straw, corn stalks, canes of vineyards and sawdust.

These producers use as raw material for pellets and briquettes, biomass which is more available in the RM. A few of the Main Product producers even mentioned that they experimented and produced pellets from dry leaves, collected from land under public administration management, thus exempting the administration from spending money for gathering those leaves (Annex 3). Even if this was a one-time collaboration, the producers say that it can be transformed into an established service which would add value to both the company and the community. Also, they are mainly focused on developing long term relationships through B2B sales especially with local administrations of villages, with schools, hospitals and other public institutions which, if installing a heating solution based on biomass solid fuel, can be also the promoters in their communities of this type of fuel.

Based on experience and business models developed by pellet and briquette producers from abroad, Moldovan Main Product producers are in their incipient phase of developing complex services which would contain not only the supply of fuel for the heating solution. In Ukraine and Romania, for example, there are companies which once having established long term partnerships with their clients, changed the business structure and strategy from selling only biomass fuel to offering complex heating solutions. This means the customer would buy the comfort and commodity which would be called "heating" and would not have to bother with choosing the stove, selecting the biomass fuel supplier, managing the fuel acquisition and managing the stove itself for generating enough heat for different weather conditions. The customer, in this case, buys the Giga Calories (Gcal) but not the quantities of pellets.

However, already Moldovan producers are producing pellets and briquettes and estimating their capacity in tons when selling on the European market, through on-line trading portals. They already adjust their production quantities to the heating power that their product has. For instance, when selling to an international customer, a Moldovan producer provides samples of its product to the potential customer, and after testing the heating potential, the customer makes a bid for the amount of Giga Calories (Gcal) it needs but not for the quantities (tons). This

implies a very rigorous quality control from the side of producer and a vital necessity of profound knowledge of the production technology. For more information regarding the quality standards which Moldovan producers must to conform to if selling in European Union, please see Annex 4.

Legal framework and certification of biomass fuel in the Republic of Moldova

Because in the RM laws and regulations for biomass fuel production are in the development stage, the quality of the final product is hard to evaluate. The producers, if selling only on the territory of Moldova, are not obliged to demonstrate the quality of their product and the type of raw material used (biomass). However, this market research shows that the majority of producers are aware of the importance of the product quality and develop self-made laboratories where they test their products. Also, as stated above, local producers provide samples for international clients who give them feedback.

The only public institution in the RM that can evaluate the characteristics of biomass fuel is the National Institute of Standardization and Metrology. This institution can analyse and evaluate biomass fuel on three aspects: a) humidity; b) ash left after burning; c) Caloric power (Gcal). The test of one sample can last from 2 to 3 weeks and costs 1758[10] MDL without VAT. It is important to highlight that the evaluation given by the National Institute of Standardization and Metrology, Department of fuel certification does not represent an official certification of the biomass fuel quality. As stated above there are no quality conditions and technological framework imposed by any law or regulation in the RM, thus the results of the analysis of this institution can be considered as an informative document rather than a proof of quality.

[10] The information was provided by Mr. Victor Cuhal in October 2011

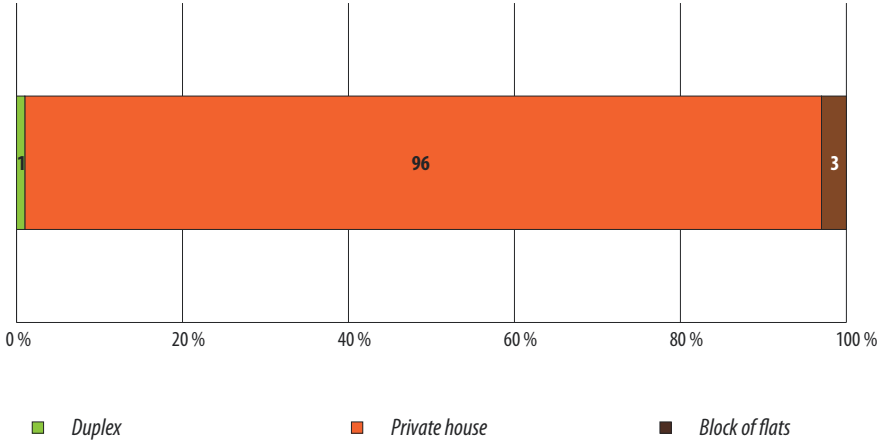
Customer preferences

For proper selection of criteria of affordable heating solutions it is necessary to have a good understanding of the current state of rural households in the RM. Statistical data below, if not specified, is based on the results of a public survey.

Features of households

The vast majority of rural household live in private houses (96%), therefore they are the final decision makers in terms of which type of heating solution to use. This fact presumes a development of a marketing campaign prioritizing this type of households. Another type of residences present in rural area of RM is the duplex (1%) and block of flats (3%). For these households, one should consider more customized marketing campaigns focused on heating solutions with bigger capacities.

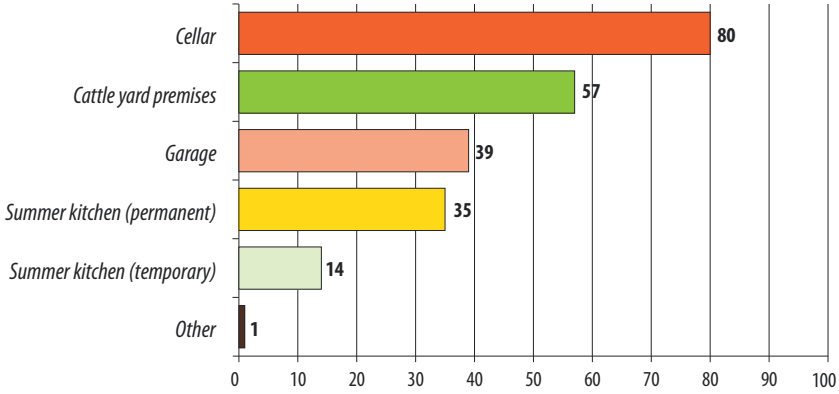
Figure 8: **Type of residence, %**



Albeit the fact that, as mentioned above, the number of population involved in agriculture is diminishing, the traditions of breeding cattle, growing different types of crops around the house and storing a part of harvest is still strong. These factors define some specifics of a normal

household structure in terms of buildings present on its territory. As one can observe in Figure 9 below, cellars, stables and garages are present in the majority of households.

Figure 9: **Adjoining properties within households, %**



Nearly every household has certain premises or at least some space where fuel is kept. Usually this space is in the adjoining constructions within the dwelling. Dimensions of these constructions can vary from one household to another; however the space of the construction is usually sufficient to store enough fuel for the entire heating season. These spaces can be used for the storage of biomass fuel. It is an important matter because the capacity to store considerable volumes of biomass (fuel) can influence the value of proposals/offers from supplier of fuels. Thus in case of inability to store biomass in the quantity sufficient for the entire heating season, a household owner will be forced to acquire fuels in smaller lots, and if a supplier will not be able to deliver fuel in accordance with the demand, then it can determine whether the end user decides against using biomass as heating fuel. This is why suppliers of biomass as fuel, along with production and/or services of briquetting and pelleting, should consider packaging and delivery terms in order to make a competitive edge versus suppliers of traditional fuels.

Figure 10: **Level types of the rural residences, %**

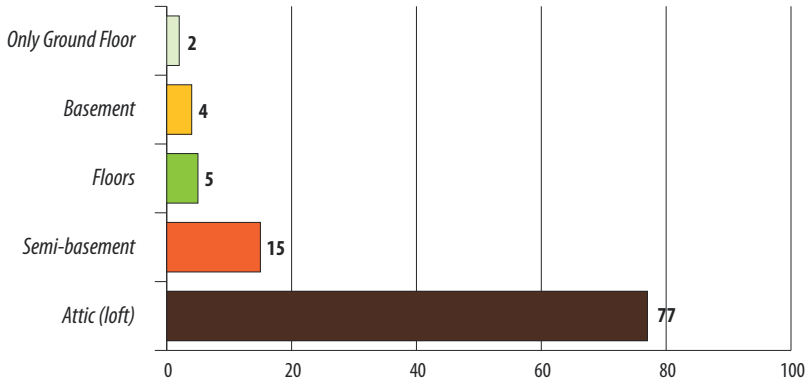


Figure 10 demonstrates that the prevailing majority of households (77%) have only a one floor building. This gives the opportunity for more flexibility when choosing a heating solution as many heating solutions are suitable for buildings with more floors. For multi-floor houses the heating solutions must be a pre-designed technical solution connecting it to pipe-line based heating system which would heat the entire house.

Based on the type of heating conductor used, the biomass based heating systems can be divided in two groups: boilers (water as conductor of heat) and stoves (air as conductor of heat). The peculiarity of boilers is that heat is distributed with the help of water through system of pipes and heaters. Stoves on biomass heat air around them. In some cases for distant rooms, heated air can be delivered with the help of special air ducts. Yet, even though in rural households from the RM such solutions are not observed, within the framework of the project, both types of heating systems were taken into account. However in order to exclude unpredictable elements related to the creation of necessary infrastructure (heaters, pipes and air ducts), the concept of replacement was used. This assumes that for biomass based boilers the necessary heating infrastructure has already been installed, and biomass based stoves have all the necessary conditions to work. Costs related to dismantling of old equipment and connection of new one were taken into consideration.

However, in order to achieve the true heating potential of any heating solution it is important to install it in a house that is conserving the heat. For this, the construction technology, building itself and insolation materials should be energy efficient. In case when after acquisition of biomass-based heating systems, household owner will decide to thermo isolate the house, additional benefit will be gained in the form of heating capacity of the heating solution, meaning that with the same heating solution the household would be able to heat a bigger surface. Thus isolation or other energy saving activities made before or after acquisition of biomass based heating system will bring additional comfort without deteriorating repayment of the investment.

Figure 11: **Age of residences, %**

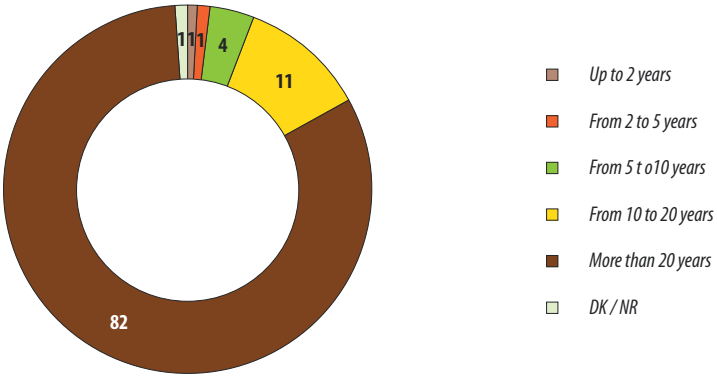
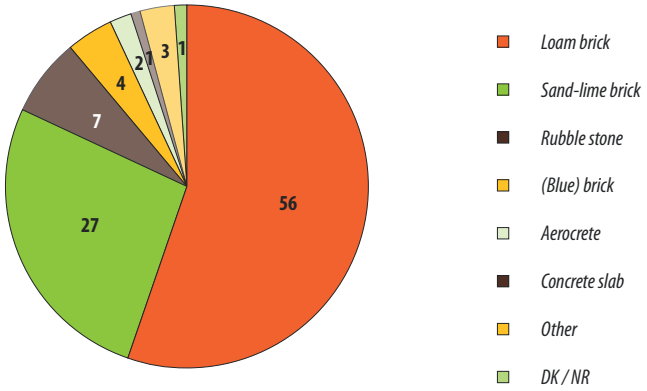


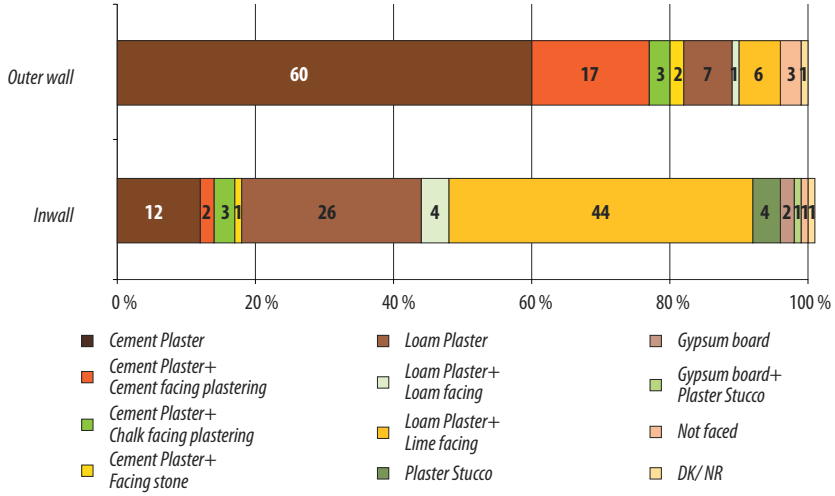
Figure 11 and Figure 12 shows that the prevailing majority of houses in rural areas are older than 20 years (82%) and are constructed mainly from Loam Brick and Sand-Lime Brick. An insignificant amount of houses in rural areas use modern building materials. The largest majority of houses were built from materials that were traditionally used in rural areas i.e. loam brick and sand-loam brick.

Figure 12: **Building material, %**



Rural households are just starting to consider the opportunities to insulate their houses. That is why the majority of households in rural area do not have thermo efficient insulation, yet. The insulation that is being used bears more esthetical significance than thermo efficient significance. Figure 13

Figure 13: **Wall facing material, %**



Only 7% of households have thermo insulation (entire house or partially). The main material that has been used is polystyrene boards. Almost all thermo insulation has been installed in the past 5 years thus one can conclude that in recent years the rural population is getting more thermal efficiency aware. As stated above, the insulation of the house plays a big role in estimating the overall efficiency of a heating solution. It is advisable, during the marketing campaign for biomass-based heating solutions, not to provide information only regarding the stove or boiler itself but as a component of a complex change that a rural household must make in order to achieve maximum thermo efficiency. The complex improvement of the thermal efficiency of the household must include the walls insulation as well as the perspective of installing thermo-efficient doors and windows, that best fits the rural exploitation conditions.

Figure 14: **Share of the thermo-insulated residences, %**

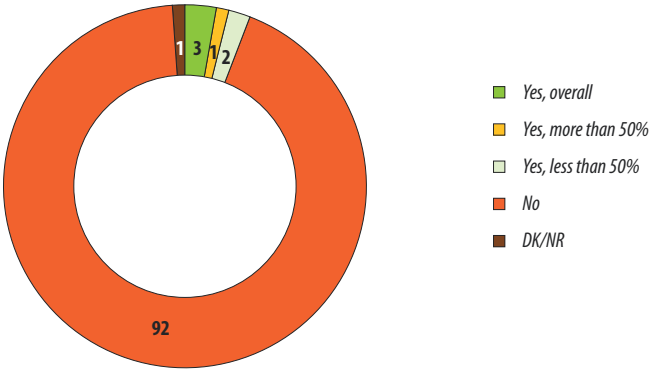
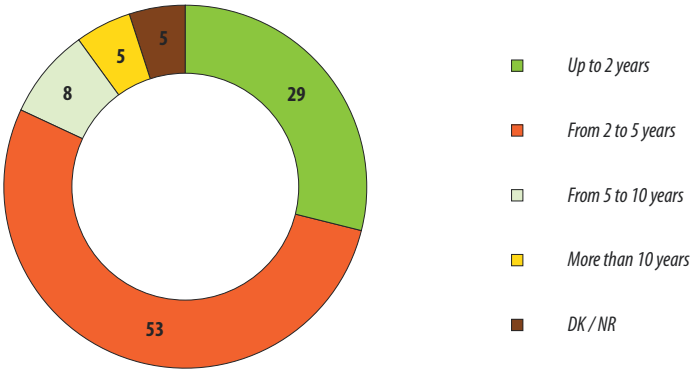
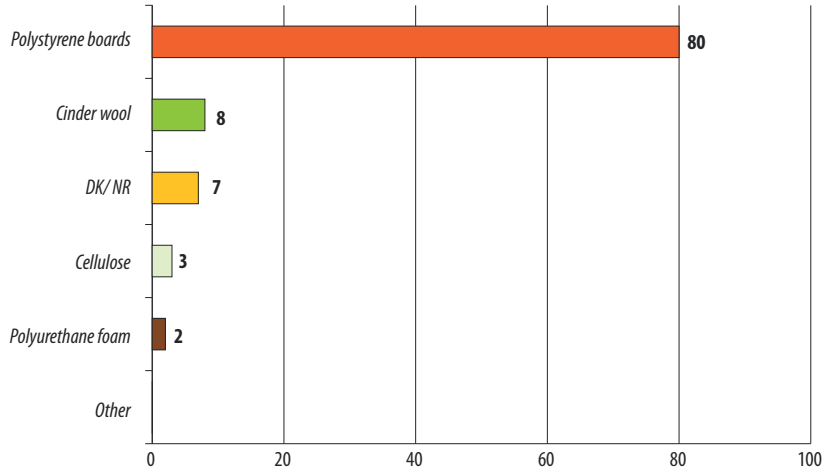


Figure 15: **Age of thermo-insulation, %**



The most used isolating material, from those available on local market in the RM, is polystyrene boards with 80% popularity among those who insulated their houses (Figure 16). Most thermo-insulating works (82%) were performed over the last 5 years (Figure 15). Thermal insulation with polystyrene board is relatively easy to install and require the minimum of knowledge, thus in most of the cases stated above insulation was carried out by the owner of the house.

Figure 16: **Thermo-insulation material, %**



One of the most important criteria for the identification of heating solutions is the area of a household that is being heated. It is worth mentioning that the larger the heated area the bigger will be the total costs for heating, however the price of one GJ of heat energy is lower. Further in the study this statement is described in detail.

The surface area of the majority of dwellings ranges between 41 m^2 and 110 m^2 (72% in Figure 17). The average surface area of a house in rural area is 82 m^2, the average room height is 268 cm (Table 7). For calculations, scenarios were selected representing different strata of the rural population. In this way, the affordability of a heating solution can be calculated more accurately, thus providing the necessary range of parameters that vary depending on the heated area and the specific necessities of the household. Further on in this study we present the results for calculations for different scenarios and the influence of the size of a heated area on the choice of the heating solution.

Figure 17: **Surface area of the residences, %**

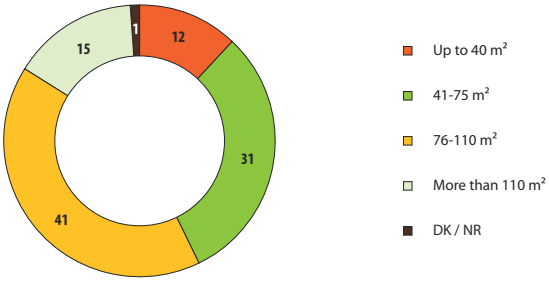


Table 7: **Average surface, height and volume of the residences, m2**

	Measure	N	Mean
Surface area	m^2	1284	82
Room height	cm	1300	268
Volume	m^3	1267	212

Already at this point of the study, some very important aspects that need to be considered when selecting the biomass-based heating solution have been highlighted.

- The type of residences i.e. private houses, apartments or duplex, indicates the type of incentives needed to choose the appropriate heating solution. In private owned houses, the decision rests with the households. A marketing campaign and message must focus on the incentives of changing heating systems for this specific group.
- The household configuration i.e. the number of floors of the house and area, the type and number of other buildings on the territory of the household offers valuable information regarding the heating capacity needed and the availability of storage place for biomass-based fuel.

- The characteristics of the heated building i.e. the material from which is built and the presence of insulation, provides information regarding the amount of extra capacity that a heating solution must have in order to cover the heat loses that houses from rural area suffer. This indicates the necessity of increasing the awareness of the rural population concerning the thermo efficiency of their houses.

Table 8: **Comparison of current and optimal heat load (GJ)**

		Current heat load of rural households2	Optimal heat load of rural households3	Difference
Residence surface (m^2)	Up to 40	20,74	28,08	-7,34
	41-75	50,51	52,66	-2,15
	75-110	43,26	63,19	-19,93
	More than 110	65,00	77,23	-12,23

The current heat load of households in rural areas is lower than the optimal heat load calculated on the bases of requirements imposed by the legislation of the RM. This is another reflection of the fact that rural households do not heat up the entire living space available, thus affecting, indirectly, their level of comfort during the heating season. This observation is especially valuable for highlighting the advantages of using biomass heating solutions in rural areas. Calculations made by ProEra team project, regarding the feasible biomass-based heating solution are made entirely according to the requirements imposed by the legislation of the RM and, which is more important, consider heating the entire living space available not only some restricted area as it is currently practised by the majority of rural households. Thus heating the entire living space with smaller costs for fuel inevitably will increase the comfort level of the target segment of population.

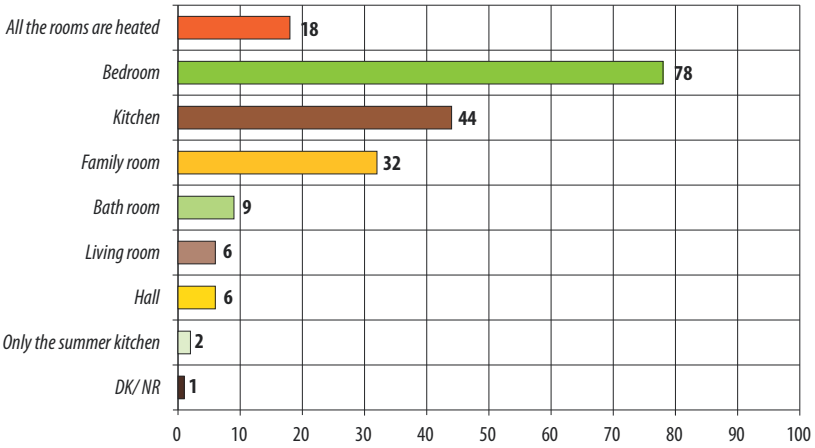
Characteristics of heating solutions used

In order to develop a proper marketing concept for promoting the best affordable biomass-based heating solutions it is necessary to have a detailed analysis of heating habits of the households. Further on, the results of the analysis of the heated areas, types of currently heating solutions used, the fuel used and others, is described.

The survey, made in the rural areas of the RM, states that only 18% of all households are heating the entire house during the cold season. The majority of households heat only parts of the house where they spend most of their time (Figure 18). Taking this into account, it can be stated that for promotional purposes it will be extremely important to emphasize that biomass-based heating systems can also be used to heat water for domestic purposes.

Figure 18: **Type of heated rooms, %**

The average heated area during the cold season of the year is 38 m^2. It



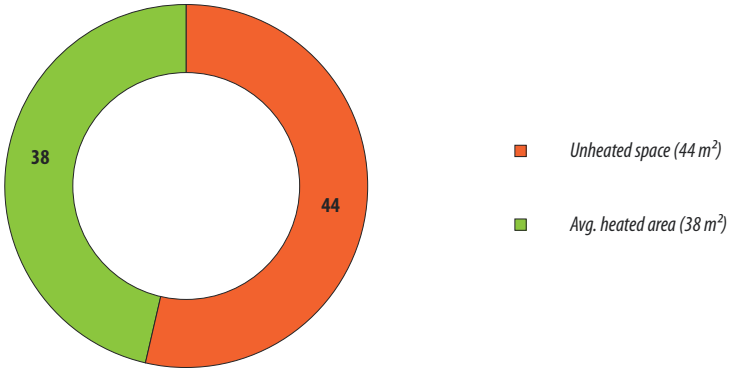
represents an average of 47% of the total residence area under survey. Another important aspect related to the promotion of biomass-based heating systems is the opportunity of heating the entire household area at lower costs in comparison to existing traditional heating systems. Switching from the concept of "survival"[11] during cold season to "comfortable life"[12] with smart low-cost heating should be the core message of an informational campaign. If offering an affordable heating solution

[11] Under "survival" is considered to be the approach when the members of the household, during the cold period of year, gather in one or two rooms of the house so as to economize the heating expenses or/and due to the technical incapability of the stove to heat the entire house.

[12] Under "comfortable life" is considered the approach when members of household, by using an efficient heating solution and ensuring comfortable conditions of living (Annex 6) do not consider the heating itself as an issue that can influence the usage of different spaces (rooms) of the house during the cold period of the year.

that will allow rural households to heat up not only the rooms of primary importance (78% bedroom, 44% kitchen) but other rooms as well at the same or lower expenses on fuel that they have nowadays, this could be highly appreciated.

Figure 19: **Share of average heated space in average living space, %**



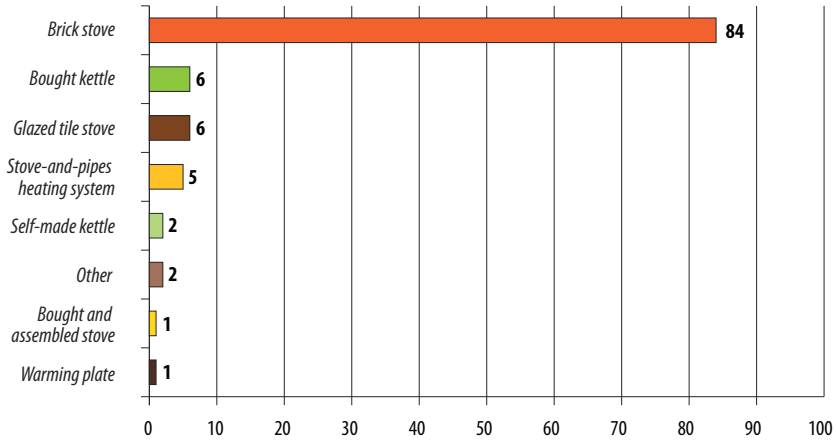
The majority of the dwellings are heated during the cold season of the year using a brick stove. 8% of the households also have a furnace (bought or self-made) (Figure 20). Two main types of brick stoves can be identified: Brick stoves without fire grate (Efficiency rate 35% for Coal and Wood), and Brick stoves with fire grate (Efficiency rate 75% for Coal and 70% for Wood)[13]. While burning, oxygen in a Brick stove without fire grate is provided through the same opening through which fuel is loaded in the stove. Usually these stoves are used for cooking in rural areas. Nevertheless, preliminary cost simulations for Brick stoves without fire grate have shown extremely high consumption of fuel, so no reasonable-thinking household owner would use this kind of system for heating. Annex 5

A brick stove with fire grate, due to its construction specifics, provides access of oxygen through a special opening usually under the fuel compartment. This kind of stove provides higher rates of burning, however,

[13] - "Heating" V.N. Bogoslovschi, A.N. Scanavi, Moscow, 1991

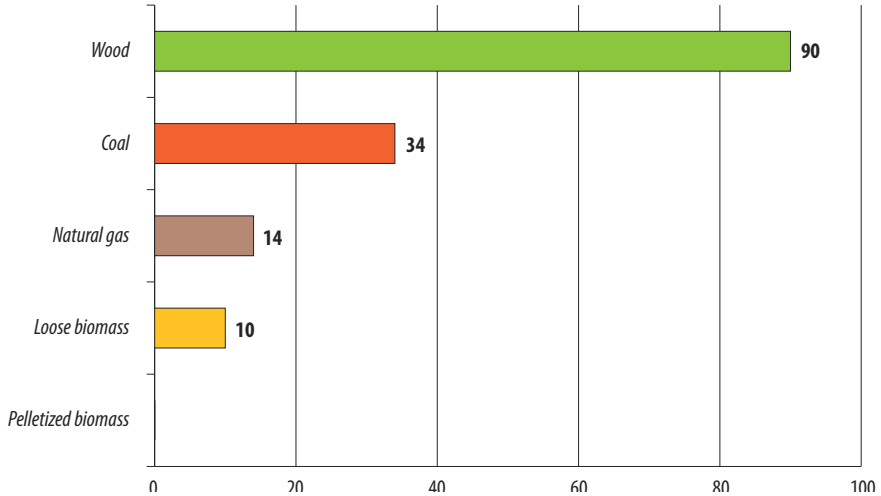
in many cases the rate depends on the construction of a stove especially the dimensions of the burning compartment where volatile particles should burn. For further calculations, two types of rates for brick stoves will be taken: a) low rate brick stove (**LRBS**) 35% and b) high rate brick stove (**HRBS**), 75% for coal and 70% for wood. The real rate of existing brick stoves considered is between these two proposed scenarios.

Figure 20: **Type of the heating installation used for heating, %**



For questions related to what type of fuel is being used for heating (multiple answer question) 25.7% of the respondents answered that they heat their houses using different combinations of fuels. This observation gives incentives to conclude that flexibility of households in using different fuels is present.

Figure 21: **Fuel used for heating, %**



An important observation for future considerations can be the popularity of heating solutions based on gas fuel (9%).Yet 99% of heating equipment imports to the RM consist of heating systems that use natural gas as a fuel. This discrepancy can be explained by the fact that for installation of these systems in rural areas, the household owner should bear additional costs related to development of infrastructure (gas pipe until house), and coordinate it with all the neighbours that are between house and the central gas pipe. This means additional extra investments and red tape stress. This kind of inconvenience is not present in urban areas, where in majority of cases household owner has a pipeline in the flat and pays only for the heating system and its installation, thus most heating systems that work on natural gas are used in urban area

Households that use natural gas as a fuel are of interest for this study because these households have some characteristics in common i.e. they have the heating infrastructure installed (pipes, ventilation etc.) which with small adjustments can be modified for biomass-based stoves/boilers, they are more likely to pay more for their comfort (they installed a heating infrastructure inside the house, paid fees for connection to gas network and are paying for gas which is more expensive than wood and coal) and they have a bigger purchasing power. Please find more on this in the next chapters of the study.

Multi-criteria analysis (Table 9) demonstrates that people with lower incomes more often use loose biomass, but their number is insignificant. Bigger households use more coal, however, the ratio coal / wood remains within boundaries of 1 tone of a coal to 3.5-4 tons of wood. This ratio will be used for further calculation of scenarios.

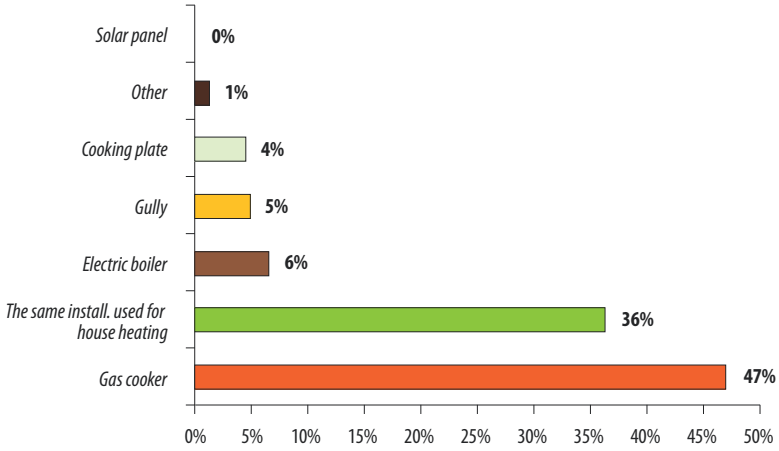
Table 10: **Usage of fuel per residence surface and income (Market survey results)**

		Coal	Wood	Loose biomass	Natural gas
	Measure	tones	m3	tones	m3
Residence surface	Up to 40 m	0.9	5.8	1.1	430
	41-75 m	0.8	6.1	1.6	1050
	75-110	1	6.1	1.3	899
	More than 110 m	1.2	6.8	0.6	1352
	DK/ NR	2.7	7.2	-	.
Household income	Up to 500 MDL	0.8	5.4	1.6	595
	501-1000 MDL	0.9	6.3	1.3	702
	1001-1500 MDL	1.1	6.4	1.5	1003
	1501-2000 MDL	1	6.1	0.8	703
	2001-2500 MDL	1	6	-	1054
	2501-3000 MDL	0.9	6.7	-	598
	3001-4000 MDL	1	5.6	1.1	1411
	4001-5000 MDL	1.1	7	-	1330
	5001-6000 MDL	1.1	6.7	-	1467
	More than 6000 MDL	1.5	7.8	-	1644
	DK/ NR	1.2	6.3	-	1492

Water heating in villages in the RM is mostly done through different methods, not through a centralized heating system installed in each house. In the majority of cases, people in rural areas heat water on a gas cooker (Figure 22). From this perspective, the biomass-based heating

systems have a significant advantage comparing to most popular heating systems used at the moment in rural area (brick stove), with their ability to heat water in necessary quantities and without extra effort. By describing for households the opportunity of having hot water at affordable price, this demonstrates the quality of their life can significantly increase. This feature should be included in informational campaign.

Figure 22: **Installations used for water heating, %**



In Table 10 it can be seen that in rural areas, the majority of household owners that have a brick stove as heating systems consider it a very efficient one and fuel for this heating system is cheaper. These statements are relative and are not based on proper scientific reasoning. Further research into the efficiency and price of one GJ of heat is required.

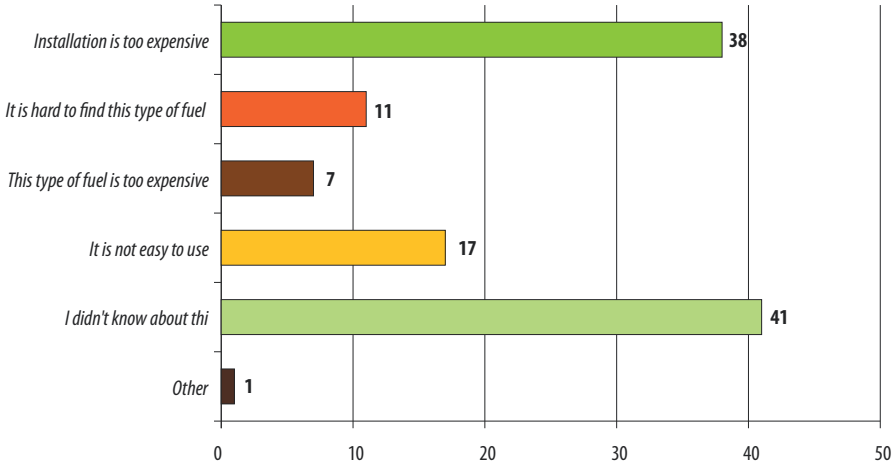
The table above demonstrates the fact that in rural areas in the RM, decisions concerning the selection of a heating system are not made on the basis of calculations and analysis of practical advantages and benefits but on the basis of local traditions and advice of neighbours. Thus, there is evidence that the "what people say" effect is strong in rural area showing that people can be influenced by others opinion. This finding can be used effectively as well during the marketing campaign.

Table 10: **Reasons for using the current heating system depending on heating system used, %**

	Bought kettle	Self-made kettle	Brick stove	Glazed tile stove	Stove-and-pipes heating system
It is more efficient	2	1	24	3	1
Fuel is cheaper	1	0	30	2	1
The installation is cheaper	1	0	13	1	1
It is easy to use	3	1	21	1	1
It was recommended to me	1	0	4	0	0
There was no other choice, when I built my house	0	1	15	1	1
Many people from my village installed this kind of solution	0	0	5	1	1
It is more ecological	0	0	3	0	0

Figure 23 shows that majority of households in rural area do not know about biomass based heating systems. This give an incentive to conduct an informational campaign in rural areas about the existence of biomass based heating systems. The second biggest group of respondents consider biomass based heating systems to be expensive. Further in the study, calculations related to economic feasibility of this investment will be provided. From this perspective, as stated above, the informational campaign should include information concerning the efficiency of biomass based heating system, and a comparison of prices for one GJ of heat energy.

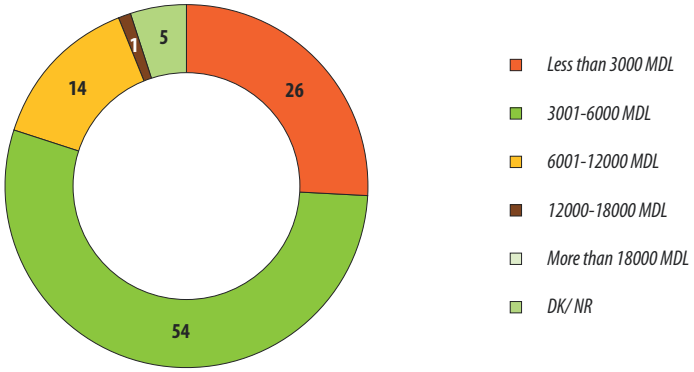
Figure 23: **Limitations regarding the use of heating equipment based on biomass, %**



The study showed that the average quantities used for house heating, by type of fuel are: 1.0t. of coal, 6.2m^2 of wood, 1024 m^3 of natural gas and 1.4t of loose biomass.

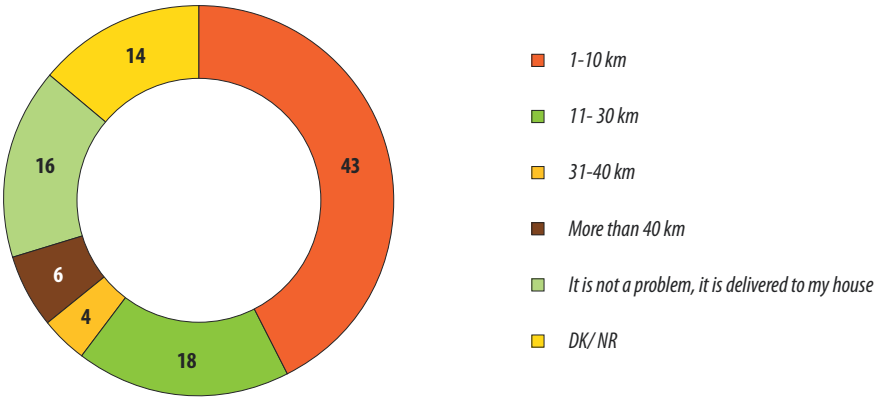
Figure 23 provides valuable data related to existing perceptions of affordable heating solutions. It can be stated that household owners are more inclined to make decisions on changing the heating system, if costs related to heating will be reduced. Thus an affordable heating system can be considered not only the cheapest one but also that one that will induce heating savings, as a result will reduce investment repayment period.

Figure 24: **Expenses for heating during the cold season, %**



One of most important factors that influence selection of heating systems is the price of fuel on which it works. Figure 24 shows that, using heating solutions with low efficiency, make majority household owners spend not more than 6000 Mdl per heating season. Result of cross check calculation based on the averaged consumption of all fuels, an average household would spend around 5000 Mdl per heating season in the RM. Based on this information comparative promotion campaign can be made, where expenses for traditional and biomass-based heating systems will be compared.

Figure 25: **Distance to the nearest fuelling station, %**



As was stated earlier one of the triggers for changing a heating system is availability of fuel. Figure 25 provides insight related to current situation of the delivery of fuel to the final consumer. For future producers of biomass based fuel, it will be very important to provide the necessary flexibility in delivery of fuel and services. From the figure above can be stated that 61% of household owners acquire fuel that has to be delivered from distances up to 30km. Thus point of sale of biomass fuel should be situated not further than 30 km to final consumer, and in ideal case delivered on the demand of the customer. Proper analysis of added value services (e.g. delivery, packing) provided to final consumer will give the necessary competitive edge and will contribute to the development of the biomass heating market.

Heating Solutions Market in Moldova[14]

Most popular heating solutions in the RM

According to the National Bureau of Statistics of the RM, the prevailing majority of imports of heating solutions are those based on gasified fuels. The market share is presented in Figure 26.

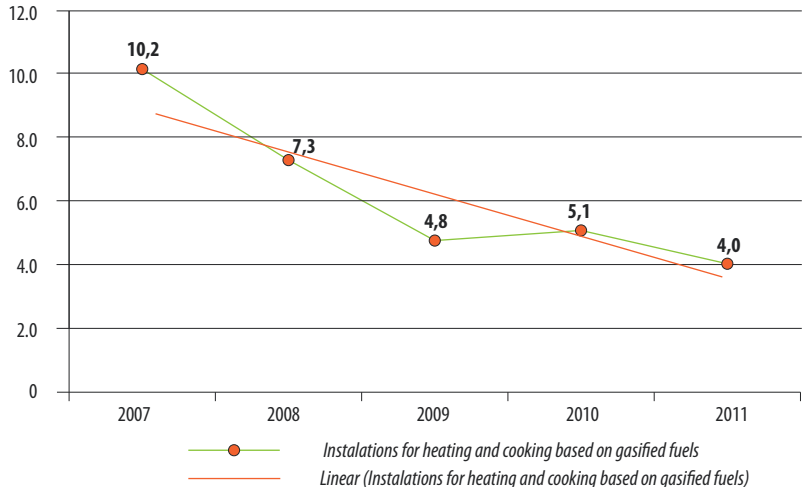
Figure 26: **Imports of heating solutions in the RM**

Imports of heating solutions that are working on gasified fuels show a negative trend (imports are diminishing). This can signal that the market of heating solutions is near its saturation. However from the public opinion survey, it can be seen that most rural households use self-made brick stoves for heating and gas cookers for cooking. Therefore, it can be concluded that most heating solutions on gasified fuels are used in urban areas because they provide the necessary flexibility and ease of use in block of flats (Figure 27)

[14] - Analyzed product positions are 732111 and 732119 in accordance with Integrated Custom Tariff. Information on imports of positions mentioned was presented by the National Bureau of Statistics of the RM.

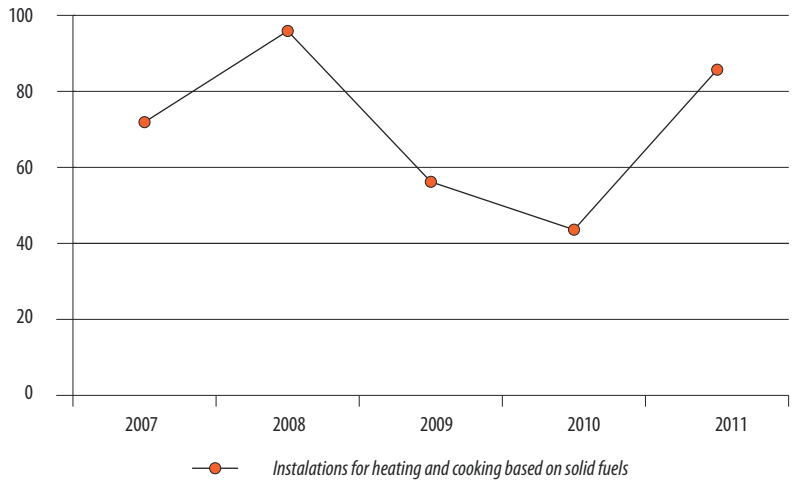
As stated earlier, imports of heating solutions that work on solid fuels make up only 1% of heating solution imports. However, as can be seen in Figure 28 the market for this type of solutions is currently developing. The market of the heating systems mentioned above will continue to grow together with understanding among the population of the affordability and advantages of biomass-based heating solutions.

Figure 27: **Imports of Installations for heating and cooking based on gasified fuels**[15]



[15] - for visual purposes year 2011 was obtained through extrapolation of results for first 8 months

Figure 28: **Imports of installations for heating and cooking based on solid fuels[16]**



At the moment of elaboration of survey 8 distributors of foreign brands of biomass-based heating systems were identified. Total number of brands represented on Moldovan market is equal to 10. (for details please see Annex 8)

Additional services offered by distributors are in most of the cases the same; all distributors offer installation services, maintenance etc. As to warranty period two producers offer extended warranty (36 moths) instead of standard 24 moths. Maintenance services for all brands wary from 30 – 40 euro/year, except one brand (Koteko) that is positioned as a cheap heating system producer. (for details please see Table 11).

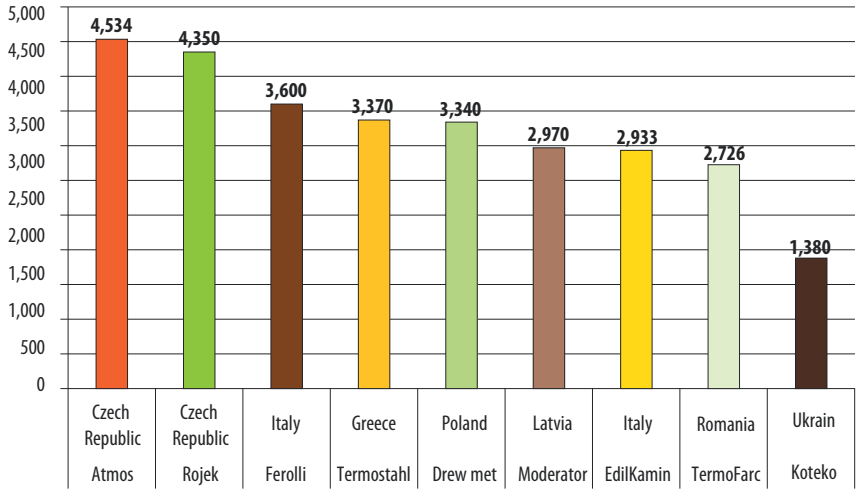
Table 11: **Brands available on the Moldovan market with average price and conditions of services**

#	Distributor	Producer	Origin	Typical services	Post warranty services	Average Price (Euro)
				Warranty	(euro/year)	

[16] for visual purposes year 2011 was obtained through extrapolation of results for first 8 months

#	Distributor	Producer	Origin	Typical services	Post warranty services	Average Price (Euro)
1	Bioterm	Atmos	Czech Republic	24 months	30 - 40	4 534
2	Casa The	Rojek	Czech Republic	36 months	30 - 40	4 350
3	Termostal	Ferroli	Italy	24 months	30 - 40	3 600
4	Solaraterm	Thermostahl	Greece	24 months	30 - 40	3 370
5	Solaraterm	Drew met	Poland			3 340
6	Politerm Grup	Moderator	Latvia	36 months	30 - 40	2 970
7	Bioterm	EdilKamin	Italy	24 months	30 - 40	2 933
8	Systemebasa	TermoFarc	Romania	24 months	25 - 40	2 726
9	Bioterm	Koteko	Ukrain	24 months	15 - 20	1 380

Figure 29: **Average price of biomass-based heating systems available on Moldovan market by brand (MDL)**

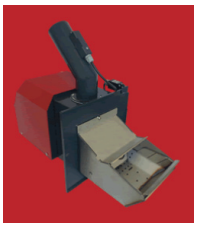


Price range of heating systems can be divided into three tiers: Top tier – expensive heating systems (3 500 euro and higher), Middle tier – mainstream, middle price range (2 000 – 3500 Euro), Low tier – cheapest heating solutions on biomass (less than 2 000 Euro). From table above can be seen that most of brands available on the market enter into middle tier price range (yellow bars on the chart). Only one brand is in the low price range.

Brief description of analyzed brands is presented below. For detailed information about models and prices for stated above brands please refer to Annex 8 and Annex 9.

Top Tier

Atmos (Czech Republic)



Provides large variety of heating systems both on biomass and traditional fuel. Variety of biomass-based heating systems present on the RM market is narrowed to pellet burners and universal systems able to work on pellets and briquettes.

Rojek (Czech Republic)

Brand that is present in industry for 90 years. Specialises on production of boilers that work on wood pellets and solid fuels. Combined fuel heating systems can be a suitable solution for initial stages of project implementation. Until stable supply of biomass fuel can be attained, final consumer can use biomass fuel along with traditional fuels.

Ferroli (Italy)

Brand is specialized on vast model line of heating systems and additional equipment both for domestic and industrial heating. On Moldovan market this brand is represented by Termostal company. Almost all models are able to operate both on pellets and briquettes. It is worth mentioning that

some of the models have low heating rate (65-71%) comparing to models of competitors.

Middle price tier

Thermostahl (Greece)

Company is specialized on production of heating systems that work on pellets and solar heating solutions. On Moldovan market present with biomass based heating systems that have considerable heat rate (89%).

Drew Met (Poland)

Brand is positioned on Moldovan market as producer of big household heating systems (17-24kW). Information concerning warranty and price of maintenance does not differs from market's mainstream.

Moderator (Latvia)

On Moldovan market company is present with several universal heating systems that can work on several types of fuels. Among all brands present on the market, Moderator provides 36 months of warranty comparing to standard 24 moths.

EdilKamin (Italy)

Practically single producer, at the moment of elaboration of survey, that provided small heating solutions 3 kW along with pretty significant heat rate (90%). Practically significant difference of this brand is design stoves can be easily included in interior of the room.

TermoFarc (România)

On Moldovan market brand is present with high power (14–25kW) biomass based heating systems, in most of the models biomass fuel can be combined with conventional fuel. Heat rate of presented solutions is up to 87%.

Low price tier

KotEco (Ukraine)

The company Bioterm represents brand in RM market. Heating systems of this brand are the cheapest ones on the market, let alone considerable heat rate 85-88%. This can be an example that

Vaillant (Germany)

One of the biggest brands in household heating in the world. On Moldovan market, there were two official distributors of this brand. However there were no offers of biomass-based heating systems at the moment of survey. Official distributors declared that in nearest future offers would arrive on the market, and they will be able to provide, all necessary information. Presence of big brand on the market like Vaillant should be monitored, as it can bring wide range of biomass-based heating systems suitable for different households and level of income.

Willingness to enter Moldavian market by foreign producers

During the study 92 companies were contacted concerning information about biomass-based heating systems for rural areas, and the possibility to export it to the RM. As a result 7 producers exposed interest in the Moldovan market, out of which only 4 transmitted relevant information about their products. 8 producers replied that they do not have in their plans a market extension to the RM in nearest future. The rest of the producers did not answer.

Regardless the answer rate on the request letter, potential entrance of 7 more producers in Moldavian market can mean significant shift in the price towards affordability.

Conclusions

Moldavian market of biomass based heating systems is at its initial stage of development. Some representatives of heating systems on biomass are already present. In the nearest future we can expect appearance of new international brands on Moldovan market.

Current price offers for biomass-based heating systems, is mainly situated within the range of 1 200 – 5 300 Euro. Brands differentiate themselves by price, design, fuel type used and heat rate. Yet price for heating systems offered by most of brands is considerably bigger than that affordable, there are brands on the market that offer price which can be considered as very attractive and close to that affordable[17].

Propensity to change heating solution (multi-criteria analysis)

One of the most important aspects of the feasibility study concerning affordable heating solutions for households in rural areas is the propensity of population to acquire those. Table 11 presents a multi-criteria analysis that demonstrates the willingness of the household owner to acquire a biomass-based heating system.

[17] - Amount of affordable price will be discussed further in text.

Table 12: **Propensity of the household to acquire heating systems on biomass depending on the type of fuel currently used**

Type of fuel used:	Intentions to buy heating installation on biomass					Total answers
	I will definitely buy	I would rather buy	I would rather not buy	I will certainly not buy	Don't know / Didn't answer	
Coal	11%	22%	17%	24%	26%	441
Wood	11%	17%	19%	32%	21%	1,175
Natural Gas	13%	23%	18%	24%	22%	181
Loose biomass	8%	13%	15%	39%	25%	134
Biomass Pellets	0	0	0	0	0	0

As a result of analysis it can be stated that people who use natural gas are more likely to change their heating solution to a biomass-based one. This can be a signal that household owners are concerned about their heating costs, more than ease of utilization. Since gas heating systems comparing to a homemade brick stove can be considered a new technology, owners of this kind of heating systems should be addressed during an informational campaign, as they can be treated as innovators. However, the price for biomass based heating system should not exceed the price that was paid for heating system on gas, including costs of connection to the gas network.

Another important point is the relatively high propensity to acquire biomass-based heating system demonstrated by household owners who use coal. A major driver for changing the heating system for this group is the price for coal. A conclusion drawn from this table is that the information campaign should be at the first stage at the level of community and first of all households using gas and coal as a fuel for heating.

Table 12 presents multi-criteria analysis that shows the propensity to acquire biomass based heating solution depending on the monthly income of the household.

Table 13: **Propensity of the household to acquire heating system on biomass depending on monthly income**

Monthly income (MDL)	Intentions to buy heating installation on biomass					Total answers
	I will definitely buy	I would rather buy	I would rather not buy	I will certainly not buy	Don't know / Didn't answer	
< 500	14%	9%	21%	38%	19%	149
501-1000	9%	14%	22%	36%	19%	360
1001-1500	9%	15%	20%	40%	16%	232
1501-2000	15%	22%	19%	22%	22%	147
2001-2500	11%	18%	20%	24%	28%	80
2501-3000	11%	24%	15%	25%	24%	79
3001-4000	10%	27%	12%	14%	37%	51
4001-5000	24%	21%	18%	24%	15%	34
5001-6000	8%	25%	21%	21%	25%	24
> 6000	15%	25%	15%	25%	20%	20
Ns/NR	9%	20%	13%	30%	28%	124
	144	222	248	411	275	1300

From the above table can be seen that the number of those who expressed their willingness to acquire a heating system based on biomass rises with the level of income. Households with monthly income higher than 2500MDL can be approached during the information campaign, as this target group would have enough purchasing power in order to be considered as innovators, early adopters and potential owners planning to build a house.

In previous chapters it was noted the fact that majority of household owners do not have relevant and sufficient information concerning biomass-based heating systems. These factors can explain the non-willing-

ness of household owners to acquire heating systems based on biomass presented in the above tables. In order to effect a shift of public opinion towards willingness to acquire heating systems based on biomass, the information campaign must provide relevant information about the benefits of the new heating systems comparing to conventional ones including using real life examples along with on-sight visits and best-case practices.

In order to make a more precise estimate of people's willingness to acquire biomass-based heating systems, ProEra Grup included in the survey a series of additional questions concerning willingness to invest in a new heating system. The first question concerned the price of a heating system that can be considered an average price on the market. The second question was about the household's share of participation in acquisition of a biomass based heating system.

During the survey of rural households, 12.38% expressed their willingness to acquire biomass based heating systems. This indicator presents very valuable information that practically determines the success of the entire project. Taking into consideration the fact that biomass-bases heating can be considered as a new technology, thus it is subject to Everett M.Rogers "Diffusion of Innovations" theory used by the expert team in the present study for the development of a promotional campaign, (for details please see Chapter **Conclusions and recommendations**). In accordance with the theory, for successful implementation of any innovation, it is vital to attain a point where 14-16% of consumers in certain market start using the innovative technology. As was mentioned earlier for rural areas, in the Republic of Moldova this indicator is very high (12.38%). This could mean that with a properly designed incentive program both for producers of heating systems and biomass fuel, biomass-heating can become the most preferable heating solution in rural areas.

In order to determine the price of an affordable biomass-based heating system, ProEra Team analyzed in detail the structure of households that are willing to acquire biomass-based heating system, (12.38%). Further in the chapter, multi-criteria analysis will be presented, relative (%) values, if not specified, should be considered as shares of the total of household that manifested willingness to acquire biomass based heating systems.

During the survey concerning household owners willing to acquire heating system based on biomass, there was a question about the amount of subsidy owners would like to have for purchasing a biomass-based heating system.

Table 14: **Multi-criteria analysis of distribution of households in accordance with household surface, level of income, and share of participation in heating system acquisition**

Area of house hold	Income per month	Amount of subsidy				Total
		up to 70 %	50% > <70%	less then 50%	Don't know/ Didn't answer	
< 75 m2	< 2000	17%	9%	1%	2%	28%
	2000 - 4000	1%	0%	1%	1%	3%
	4000 >	1%	0%	0%	1%	1%
> 75 m2	< 2000	23%	13%	1%	4%	41%
	2000 - 4000	5%	4%	3%	5%	17%
	4000 >	4%	3%	0%	2%	9%
Total:		51%	28%	5%	15%	100%

Analysis of Table 13:

1	From totals "Amount of subsidy" required by households in order to by biomass-based heating solutions it can be seen that the vast majority (circa 79%) of the respondents are expressing their willingness to acquire these solutions only if the amount of the subsidy will represent more than 50% of the price.

2	Even if the respondents expressed their general willingness to acquire biomass-based heating solutions, circa 15 % of them are still undecided regarding the share of the price they are willing to pay thus did not express a clear range of subsidy they would accept as feasible for them.
3	67% of households that are willing to acquire heating system based on biomass have houses with surface bigger than 75m2. Also, considering the fact that feasibility of biomass-based heating solutions is increasing according to the heated surface of the household (Table 16) this group of households should be contacted during the information campaign in the first place.
4	The majority (circa 40%) of analyzed households willing to buy heating system are those with income lower than 2000 MDL/month and who can afford a share of the price not bigger than 30%. This of course means that for this segment of the households the amount of subsidy that needs to be considered represents 70% of the price of the heating solution.
5	For households with surface less than 75m2 and income higher than 2000 MDL/month because of uniformity of data 0-1%, it will be difficult to attribute the amount of subsidy other than 70% of the market price for the heating system.
6	Due to the fact that: a) the feasibility of a biomass-based heating solution is increasing together with the increase of the heated surface (Table 16) and b) in order to acquire the heating solution a household needs a certain purchase power which is doubtful in cases when the household has a low income (less than 2000 MDL/month), the group of respondents which is the most suitable for a first phase campaign is suggested to be the one that comprises circa 19% of the respondents who all have incomes higher than 2000 MDL/month and are heating houses with surface bigger than 75m2.

The value of Table 15 is mainly in the presentation of behavior that could be expected from households that are willing to change their heating system to biomass based one. Further development of the program can depend on behavior of "navigators" among final consumers.

Results of adjustments of heating systems that work on biomass process are presented in tables below both for stoves and boilers.

Table 15: **Adjustment of heating systems (Stoves – air heating) market price in accordance of perception of affordability**

Area of house hold	Income per month	Share of household's participation	Hating system on:			
			Pellets		Briquettes	
			Market price (Euro)	Affordable price (Euro)	Market price (Euro)	Affordable price (Euro)
< 75 m²	< 2000	30%	2200	660	1200	360
	2000 - 4000					
	4000 >					
> 75 m²	< 2000	30%	2200	660	1200	360
	2000 - 4000	50%	2200	1100	1200	600
	4000 >					

Table 16: **Adjustment of heating systems (Boilers – air and water heating) market price in accordance of perception of affordability**

Area of house hold	Income per month	Share of household's participation	Hating system on:			
			Pellets		Briquettes	
			Market price (Euro)	Affordable price (Euro)	Market price (Euro)	Affordable price (Euro)
< 75 m²	< 2000	30%	2700	810	1775	533
	2000 - 4000					
	4000 >					
> 75 m²	< 2000	30%	3200	960	1775	533
	2000 - 4000	50%	3200	1600	1775	888
	4000 >					

Economic analysis

In addition to the behavioural aspect of rural households concerning acquisition of biomass based heating systems; other important aspects of the feasibility study are the economic and financial effectiveness of the investment. Notion of financial and economic efficiency of biomass based heating systems can be analysed through several aspects. The primary criterion is the price for heating system, second is the investment efficiency. These two notions are interconnected and can influence the entire result of the feasibility study. A third aspect of affordability is the operational costs of heating system, or to be more specific, price for one GJ of energy generated by heating system on biomass compared to other heating systems and fuel combinations.

Proper understanding of the above stated aspects of affordability will give necessary information that should be delivered to the final consumer and will be related to the financial benefits of using a biomass heating system.

The methodology and logic of the economic calculations are presented in Annex 7

Comparison analysis on gas and biomass-based heating solutions installation costs.

Based on the observations that emerged from the propensity of households to buy a biomass-based heating solution, the necessity to analyze the economical reasoning of this propensity, arises. As stated above (Table 13), those respondents who use gas are the most numerous from those who would like to change their current heating solution for a modern biomass-based one. They are those who appreciate the comfort offered by a gas fueled solution and have the necessary purchasing power to afford it. Further on, the comparison analysis between initial costs for installing a gas fueled solution and a biomass fueled one is presented.

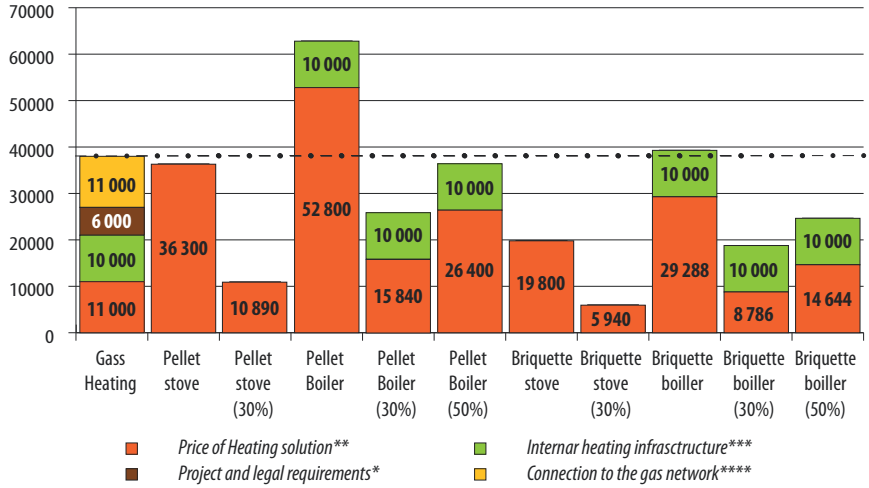
When talking about affordability of a heating system, the question of price probably is the most important. Figure 30 shows a comparative analysis of acquisition and installation costs for heating systems that work on natural gas and those on biomass fuel. Along with market price for biomass based heating systems were included several scenarios related to perception of affordability described earlier. Real market prices were adjusted in order to comply with results of public opinion survey.

Analysis of Figure 30

1. Boiler types of heating systems are more expensive than stoves, however further in the study are presented facts that demonstrate that intensity of utilization of a heating system will result in lower cost of 1GJ. Using boilers on biomass is more convenient in the long the run.
2. Heating systems that work on briquetted biofuel are cheaper than those on pellets, and their installation price is equal or less than the installation of a natural gas heating system.

Besides the fact that a biomass-based heating solution offers almost the same level of comfort as the gas fueled ones for lower initial costs, it has other advantages as well. Some of these are: the household does not depend on the willingness of his neighbors for the supply of fuel (in order to connect to a gas network it is necessary to develop and sign the project with the regional gas distributor, a project which in the majority of cases is beyond the income level of an individual household), the household spends less time on installation of the solution due to the fact that the legal framework is less strict for biomass-based solutions, thus requires less time to meet the conditions, the operational costs are lower as well (Table 19). However an installed heating system on natural gas provides more comfort as it provides the necessary flexibility of heating (easy to regulate, possibility to automate the heating process) and there is no need to manually add fuel.

Figure 30: **Costs for installation of the heating solution (MDL)**



* - it includes the expenses, usually divided between a few households interested in being connected to network of gas, for projecting the network and paying all the fees for the documentation of the connection itself.

** - The price for biomass-based solution is taken the one considered feasible according to our calculations (The price for gas fuelled solution is taken as it is from those available on Moldavian market.

*** - it includes the costs for pipes, radiators and other components of an in-house heating infrastructure and the costs for installation itself. Technically the infrastructure with the water heating approach is the same for gas or biomass-based solutions thus the costs are the same.

****- it includes the expenses that are related to the physical connection to the network of gas (pipes, installation etc.)

This calculation applies to households situated at a distance from the central natural gas pipeline. Households situated near the pipeline would have lower investment costs related to connection to the gas network.

It is worth mentioning that a biomass based heating system has more options related to the way the household is heated. It can be connected to the in-house heating infrastructure (pipeline and radiator system) or it can heat directly the air around it. The second option excludes the necessity of investment in internal heating infrastructure, that lowers installation costs and makes biomass based heating systems more affordable and attractive. If talking about heating systems that work on natural gas then those should be connected to an internal heating infrastructure, which implies additional costs.

All these observations are of great value when developing the marketing campaign because it helps to define more precise market segmentation for each phase of the campaign.

Investment appraisal for the affordability of biomass based heating solutions

The financial efficiency of the project in terms of discounted future cash flows and net present value (NPV) provides information whether it is feasible to invest in biomass based heating systems or not. One of the most important criteria of evaluation of heating system is **the efficiency rate**. Efficiency demonstrates how much of household owner's money is being transformed into heat and how much is going up the chimney.

From this perspective ProEra team along with a group of experts calculated an economically justified price for biomass-based heating systems, depending on several variables:

- Heating system type boiler/stove
- Household surface
- Heating system burning efficiency rate

In order to demonstrate how proposed economically feasible price depends on efficiency of heating system, from identified range of heating systems available on the market, were identified three groups of heating systems in accordance with their efficiency (heat rate). These rates are 71%, 88%, 93%[18].

For the methodology of calculation, please see Annex 6.

[18] - It can be mentioned that there are heating systems, on the market, with heating rates that differ from those stated above, the purpose of calculation below is to demonstrate feasibility range, rather that to calculate proposed price for every particular heating system.

Table 17: Economically justified prices for heating solutions at 8 and 14% discount rate

Scenario		Efficiency Rate (%)	4Proposed price (Euro)	Efficiency Rate (%)	5Proposed price (Euro)	Efficiency Rate (%)	6Proposed price (Euro)
Discount rate 8%	40 m^2	71	-89	88	236	93	309
	75 m^2	71	227	88	837	93	974
	90 m^2	71	362	88	1094	93	1258
	110 m^2	71	542	88	1437	93	1638
	150 m^2	71	732	88	1798	93	2037
Discount rate 14%	40 m^2	71	-151	88	119	93	179
	75 m^2	71	111	88	616	93	730
	90 m^2	71	223	88	830	93	966
	110 m^2	71	372	88	1114	93	1280
	150 m^2	71	530	88	1413	93	1611

* - in red are indicated prices that are below the amount of money that household owner is willing to pay for heating system (affordable price was obtained during the survey)

Conclusions to table:

1. Households with small heat requirements are less likely to repay investment into a biomass based heating system. Small heated areas do not provide necessary savings. Thus household that are willing to heat area round 40m^2 will less likely to find heating systems on the market with the price that will be considered a **justified investment**. For households with area 40m^2 justified price, for heating systems with 93% heat rate, will be round 309 Euro. At the moment

of survey there were no biomass based heating systems with same characteristics and price, available on the market.

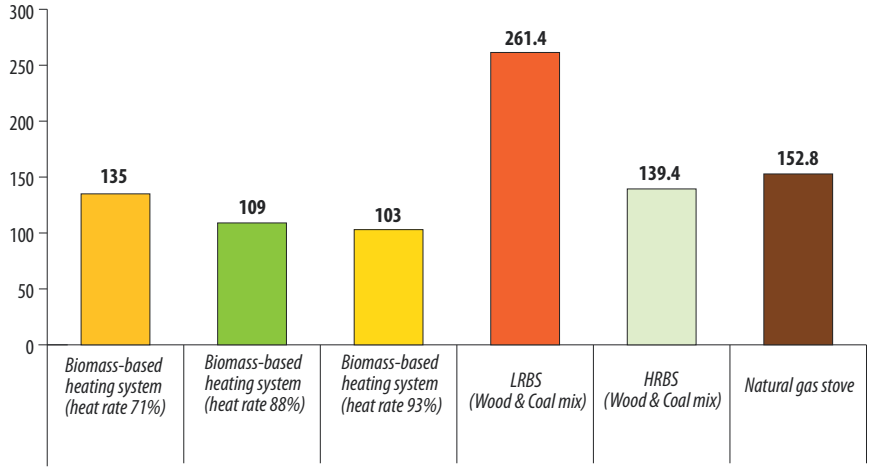
2. Heating systems with high efficiency rates (88-93%) can be considered more economically feasible if used in heated area higher than 40m^2. Calculated economically feasible price of heating systems with higher rate for households with heating surface bigger than 75m^2 can be compared and are neat to prices available on the market.
3. It also can be stated that value of money is a determining factor in the investment process. Thus scenario with 14% discount rate demonstrates that households with heating surface less than 75m^2 will not be able to have feasible return on investment.
4. In order not to decrial biomass-based heating systems at the incipient stages of biomass project, both aspects of price, affordability and economic efficiency should be taken into consideration. Thus if household owner's perception of price affordability will be higher than economically justified price, in the long term owner will realize that heating system was not an inefficient investment. This negative experience can influence public opinion about biomass-based heating systems in the long run.

Stated above conclusions provide necessary insights related to the notion of affordability. In order to induce a massive change of existing heating systems to biomass-based it is vital to **adjust prices** (in this case, decrease prices) in order to make the heating system attractive to the final consumer and efficient from a financial point of view. It goes without saying that this kind of measure is temporary but it is necessary for the initial stages of the promotion of biomass-based heating systems.

Operational cost analysis

An analysis of operational costs provides information concerning the utility of heating systems that can be used for comparing advantages of heating systems during an information campaign. The price of one GJ of specific fuel and heating system combination can be influenced by the following factors: calorific value of the fuel, price for the fuel, efficiency of heating system.

Figure 31: **Comparison of price for one GJ from different heating systems and fuels**[19]



From the table above it can be seen that if comparing only variable costs of heating, the price for one GJ is significantly lower compared to traditional fuels and heating systems.

Another important fact is that heating systems with higher efficiency provides lower cost of on GJ.

In this scenario, for calculation was taken gas stove with 93% heat rate, as to be compared with biomass-based heating system of the same rate. As a result cost of one GJ produced by biomass heating system is 103 Mdl when cost of one GJ produced by gas stove is 153 Mdl. As a conclusion we can state that besides heat rate of heating system another important criterion is price of a fuel. Thus biomass-based heating systems combine higher efficiency of burning and relatively cheap fuel.

[19] HRBS – High Rate Brick Stove (heat rate 70%); LRBS – Low Rate Brick Stove (Heat rate 35%)

Selecting affordable biomass based heating solution

The following chapter was considered as important from the perspective of ethical appreciation of affordability. During the public opinion survey ProEra team has managed to identify the price for an affordable heating solution (Table 14 and Table 15), however the price that the final consumer is willing to pay for a heating system can differ from the economically justified price of a particular heating system. In other words after analyzing a heating system as an investment and revealing the financial benefits that this system brings to households, the economically justified price can be calculated. Comparing affordable price and economically justified price of heating system can lead to several scenarios.

1. Affordable Price > economically justified price. Household owner will be willing to pay more for heating system however the investment will not be repaid within a reasonable period. As a result, the household owner will be disappointed with his investment, and this will lead to the creation of a negative reputation for biomass-based heating systems.
2. Affordable price ≤ economically justified price. Household owner will see all the benefits of using biomass based heating systems.

When selecting a proper heating solution many aspects should be taken into account. Two groups of characteristics of heating system should be analysed in order to make a proper selection and to benefit from functions that the heating system provides. The first group of characteristics are technical ones, here identified: **Technical characteristics** (heating capacity of the equipment, efficiency rate, type of loading of fuel etc.) and **optional features**. The second group of characteristics are financial ones (Net present value of the investment (NPV), price for heating system).

Technical characteristics can change depending on household configuration, heating requirements etc.

Optional features are those characteristics that bring added value to the final customer hence the price for this kind of heating system will be higher. Some of the features available on the market of biomass-based heating solutions are: remote control (mobile telephone), automatic fuel loading controlled by the fluctuations of air temperature etc.

In order to make the process of biomass-based heating system selection easier and more efficient the heating solution matrix was elaborated.

It comprises variables that are crucial for efficient selection of a heating system, and combines both financial and non-financial variables. It is worth mentioning that for some scenarios the suggested (calculated) price for heating system is very low. In the current market situation no distributor and producer of biomass based heating systems would agree to sell them at this price. From another point of view if the price will be higher than the calculated one, the investment in a heating system will not be feasible.

Examples using the Selection matrix:

Goal: to find out technical characteristics (efficiency, power, type) and economically justified price for heating system that works on biomass.

Beginning at the top of the table, ask the following questions:

Q.: What type of biomass fuel is available in the area?

A.: Pellets or Woodchips

Action: working with left-hand side of the table

Q.: Is there willingness to have an automated loading system for biomass fuel?

A.: Yes

Action: working with left part of the table that contains "yes" in the second row

Q.: Will the water be heated by the selected system?

A.: Yes

Action: working with the column that contains "yes" in the third row of the table.

From this process the following information about the future heating system can be determined:

Pellet boiler with automated loading system with heat rate 88-93%.

Q.: What is the surface area that will be heated?

A.: Approximately 80m^2

Action: Selecting intersection of column identified above with row "76-90m^2"

Result: Power of future heating system should be around 12,9kW

Q.: Will the owner of the house use biomass generated within his dwelling as a fuel?

A.: Yes

Action: Proceeding to group of rows "Proposed price with own biomass fuel in dependence of household surface (euro)" selecting row "76-90m2"

Selection result:

Pellet /wood chip boiler with automated loading system

Heat rate 88-93%,

Power: 12,9kW

Recommended price: 1299 Euro

Table 21: **Heating solutions (93% efficiency rate) selection matrix**

Available biomass fuel	Pellets/Wood chips				Briquettes/Wood Logs			
Willingness to have automated loading system*	yes		no		yes		no	
Water heating	yes	no	yes	no	yes	no	yes	no
Description of heating system	Pellet and/ or Wood chip Boiler with automated loading system	Pellet and/ or Wood chip Stove with automated loading system	Pellet and/ or Wood chip Boiler with manual loading system	Pellet and/ or Wood chip Stove with manual loading system	Briquette and/or Wood Logs Boiler with automated loading system	Briquette and/or Wood Logs Stove with automated loading system	Briquette and/or Wood Logs Boiler with manual loading system	Briquette and/or Wood Logs Stove with manual loading system
Rate of heating solution	93%	93%	93%	93%	93%	93%	93%	93%
Necessary power of heating solution in dependence of household surface (kW)								
Up to 40 m^2	8,20	3,7	8,20	3,7	8,20	3,7	8,20	3,7
41-75 m^2	11,50	7,0	11,50	7,0	11,50	7,0	11,50	7,0
76-90 m^2	12,90	8,4	12,90	8,4	12,90	8,4	12,90	8,4
91-110 m^2	14,70	10,2	14,70	10,2	14,70	10,2	14,70	10,2
more than 110 m^2	16,60	12,2	16,60	12,2	16,60	12,2	16,60	12,2
Economically justified price (euro)								
Up to 40 m^2	308		308		308		308	
41-75 m^2	638	252	638	252	638	252	638	252
76-90 m^2	778	392	778	392	778	392	778	392
91-110 m^2	965	579	965	579	965	579	965	579
more than 110 m^2	1162	776	1162	776	1162	776	1162	776

Table 21: **Heating solutions (88% efficiency rate) selection matrix**

Available biomass fuel	Pellets/Wood chips				Briquettes/Wood Logs			
Willingness to have automated loading system*	yes		no		yes		no	
Water heating	yes	no	yes	no	yes	no	yes	no
Description of heating system	Pellet and/ or Wood chip Boiler with automated loading system	Pellet and/or Wood chip Stove with automated loading system	Pellet and/ or Wood chip Boiler with manual loading system	Pellet and/ or Wood chip Stove with manual loading system	Briquette and/ or Wood Logs Boiler with automated loading system	Briquette and/ or Wood Logs Stove with automated loading system	Briquette and/ or Wood Logs Boiler with manual loading system	Briquette and/ or Wood Logs Stove with manual loading system
Rate of heating solution	88%	88%	88%	88%	88%	88%	88%	88%
Necessary power of heating solution in dependence of household surface (kW)								
Up to 40 m^2	8,20	3,7	8,20	3,7	8,20	3,7	8,20	3,7
41-75 m^2	11,50	7,0	11,50	7,0	11,50	7,0	11,50	7,0
76-90 m^2	12,90	8,4	12,90	8,4	12,90	8,4	12,90	8,4
91-110 m^2	14,70	10,2	14,70	10,2	14,70	10,2	14,70	10,2
more than 110 m^2	16,60	12,2	16,60	12,2	16,60	12,2	16,60	12,2
Economically justified price (euro)								
Up to 40 m^2	208		208		208		208	
41-75 m^2	520	171	520	171	520	171	520	171
76-90 m^2	644	295	644	295	644	295	644	295
91-110 m^2	810	461	810	461	810	461	810	461
more than 110 m^2	984	635	984	635	984	635	984	635

* If selecting an automated loading system, one should be aware that for this feature it is necessary to have additional free space for storing the biomass fuel and for installing the system to the stove itself. The team project suggests two possible situations: 1) the household has the storage space available (this is usually the case because in the RM, the rural population is willing to buy/store the entire amount of fuel needed for the cold season before the season itself. This is due to both tradition as well as the practicability of roads during the winter season) and does not consider the opportunity to use it for other purposes. In this case the household can install a tank connected directly to the stove which presumes additional costs but increase the level of comfort as well; 2) the household does not have the necessary space or has decided to use the space for some other activities rather than for storing fuel thus the household has to be sure that the biomass-based fuel would be available for the entire cold season (gradually produced or delivered by the fuel producer or the household itself).

The information stated above can be used as a decision tool that can be used both by the household owner when selecting the heating system and by potential local heating system producer when designing heating systems and establishing price for the final consumer. This tool takes into consideration criteria like:

- Availability of biomass fuel by type
- Surface of the household
- Heating necessity e.g. Air heating alone, both air and water heating.

It is worth mentioning that the table above provides only guiding information concerning certain scenarios, thus every heating system installation should be analysed individually.

Companies capable of producing heating solutions in the RM

Before analyzing companies a certain set of notions, as follows, should be clarified.

- Companies able to produce heating systems can be divided to: producers, assemblers and mixed type of previous two.
- Producers of heating systems - companies that are able to create any part of the heating system
- Assemblers of heating systems – companies that import parts of heating systems and assemble them.
- Third categories of producers acquire certain elements of heating systems and produce other parts within their plant.

Biomass-based heating systems is a complex engineered device, that contains a set of sophisticated components e.g. burner, thermal sensor and programing unit. This is one of the reasons because biomass-based heating systems have higher price comparing to conventional heating systems. For current Moldovan conditions in engineering and production most easy and fast direction in development of biomass-based heating systems production, are assembling and mixed production. In long term with accumulation of knowledge and experience companies would be able to be become full cycle producers of heating systems.

During the survey, 22 companies were identified as those that are able to produce biomass-based heating systems. (Annex 8)

Findings of the survey on local potential and existing producers:

- Only one company has real experience in production of biomass based heating systems. This company can be referred to third type of producer (mixed).
- Rest of the companies work at the project basis, and are not willing to produce heating systems to stock at the constant rate. This can bring the risk of not consistent production.

- Almost all companies demonstrated interest in production of heating systems only if customer would have provided necessary blueprints.
- Currently in Moldovan market, companies, capable to produce biomass-based heating systems, can be considered as sellers of their production capacities. If customer comes with all the necessary documentation and will pay for production, company will be able to fulfill the order. This reduces risk of not selling the final product. This is a very important insight that must be taken into consideration while selecting

Comparison of program implementation scenarios (co-financing local producers or acquisition of heating systems available on the RM market)

In the context of the current market survey ProEra Grup Ltd. requested information regarding biomass based heating solutions from producers from 11 countries. Even though 92 foreign producers were contacted, only 5 producers offered complex information regarding their biomass based heating solutions while the vast majority declined to participate in the survey. The following analysis was made based on the information obtained from those foreign producers which responded. For a comparison analysis of feasibility to produce locally biomass based heating solutions, further on, the comparison between available, locally produced, biomass based heating solutions costs of production and prices of similar foreign heating solutions, is made. In order to choose properly the comparable heating solutions available from local producers, local dealers and foreign producers, further on, the heating solutions analyzed will be evaluated based on the following characteristics:

1. Heating Power
2. Efficiency of burning
3. Components of the heating solution

According to the portfolio of biomass based heating solutions available from local producers at the moment of the study, the heating power starts from 22 Kw. However local producers highlighted that the issue of producing heating solutions with lower capacity is not due to their know-how or technology but rather the demand on the market. It is important to be mentioned that the cost of production for local potential producers would diminish not much (not more than 25%) in case of considering the production of lower heating capacity heating solutions.

The fact that local producers did not start to market the biomass-based heating solutions can be considered as an indirect demonstration that rural households with a living area lower than 150m^2, currently, do not

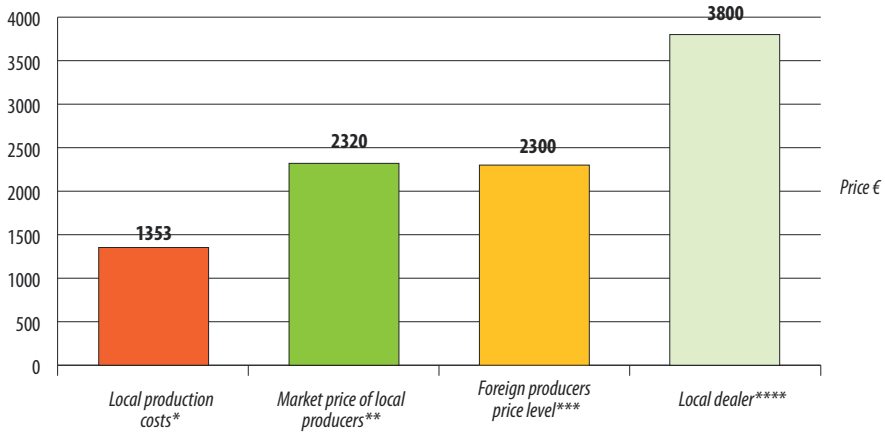
express their willingness to acquire biomass based heating solutions. Although local producers expressed their capability to produce heating solutions with lower heating power, for further analysis ProEra Grup experts considered the costs of production of current available biomass based heating solution with the smallest heating power (22Kw).

Table 22: **Characteristics of the heating solutions based on which the selection for comparison is done**

	Local Production	Foreign Production	Local Dealers
Heating power (Kw)	22	22	22
Combustion efficiency (%)	Up to 84	Up to 92	Up to 92
Components of the heating solution	Incorporated: Burner Pellet feeding system Pellet tank ($1m^3$)	External: Burner Pellet conveyor Pellet tank ($1.5m^3$)	External: Burner Pellet conveyor Pellet tank ($1.5m^3$)

In Table 25 above, are presented the evaluation characteristics based on which the heating solutions are chosen for analysis. It is important to mention that the heating solution considered in the category "Foreign Production" and "Local Dealers" is the same. This gives better understanding of the level of feasibility if selecting between different options to facilitate the development of the local market of biomass based heating solutions.

Figure 33: **Comparison analysis of local production costs and prices for similar „ready to use" imported equipment (EURO)**



* Local production costs which includes: a) material costs; b) production costs; c) electronic equipment; d) burner. The displayed production cost is obtained through backward calculations.

** Market Price of Local Producers includes the production costs and the average industry profit margin of 30 % and VAT of the RM.

*** Foreign Producers prices which include the transportation prices of a number of 20 boilers in 20ft containers from all over the European continent and do not include profit margins or VAT of the RM.

**** Local Dealers prices offered on the RM market (retail price) which includes VAT.
None of the above prices includes the installation and/or maintenance costs.

Based on these findings, one can observe that the Market Price offered by local producers is much lower than the price offered by local dealers selling foreign produced heating solutions. This leads us to acknowledge the potential of development of feasible and competitive production of biomass based heating solutions in the RM.

In order to assure that the local producers would have no trade-off between selling biomass based heating solutions on the local market and households involved in the co-financing program, it is necessary to cover the difference between the cost of production and the profit margin of the producer and the affordable price for the households. In the Table 26 below are presented the feasible prices for households willing to acquire biomass based heating solutions together with market prices offered by local dealers and local producers.

Table 23: **Comparison of Sum to be invested if considering Local Dealers Market Price and Local Producers Cost of Production**

Area of the household	Income per month	Share of household's participation	Affordable price (AP) (Euro)	Local Dealers		Local Producers	
				Market Price (Euro)	Sum to be financed (Euro)	Production Costs (PC) (Euro)	Sum to be financed* (Euro)
A	B	C	D	E	F	G	H
< 75 m2	< 2000	30%	810	2700	1890	1140	573
	2000 - 4000						
	4000 >						
> 75 m2	< 2000	30%	960	3200	2240	1350	678
	2000 - 4000	50%	1600	3200	1600	1350	155
	4000 >						

According to Table 17 the affordable price for a household would be as shown in column D from the Table 26 above in accordance with the willingness of the household to pay for the heating solution. Based on these results the amounts needed to be financed in case of acquiring biomass based heating solutions from local producers would be much lower than in the case of acquiring those from local dealers. For more detailed explanation of the "sum to be financed" see column F and H from Table above. Details of the calculations are presented in Table 27 below.

Table 24: **Calculations of Sum to be financed if considering the differences between Market Prices of Local Dealers and Cost of Production faced by Local Producers.**

Area of the household	Income per month	Share of household's participation	Affordable price (AP) (Euro)	Local Dealers		Local Producers				
				Market Price (Euro)	Sum to be financed (Euro)	Production Costs (CP) (Euro)	Compensation of CP through financing (Euro)	Non-compensated CP (Euro)	30% Profit Margin from non-compensated CP (Euro)	Sum to be financed* (Euro)
A	B	C	D	E	F	G	H=G-D	I=G-H	J=I*30%	K=H+J
< 75 m²	< 2000	30%	810	2700	1890	1140	330	810	243	573
	2000 - 4000									
	4000 >									
> 75 m²	< 2000	30%	960	3200	2240	1350	390	960	288	678
	2000 - 4000	50%	1600	3200	1600	1350	0*	1350	405	155**
	4000 >									

*the affordable price is higher than the Cost of Production thus no need for compensation.

**the Non-compensated CP (I) added to 30%Profit Margin (J) equals to 1755 Euro and if extracting the affordable price for householder (D) the result is 155 Euro

As a conclusion the following can be stated:

The most convenient option to fulfil the necessities of households interested in installing a biomass based heating solution would be the support of local production through a co-financing program. It is very important to inform local producers about conditions of the co-financing program. One of the main conditions is the timeframe of the co-financing program. Local producers should realise that incentives provided within the program are made for development of local biomass-based heating producer that will be able to make affordable heating systems even after the end of the co-financing program. Thus the producer should aim for long term benefits and sustainable development of the business, investing in research and development, and optimization of processes.

Certification of Conformity of biomass-based heating solutions produced by local entrepreneurs

The entity responsible for certification of conformity of the products in the RM is the National Institute of Standardization and Metrology (NISM). According to law No 186 "On conformity assessment of products" a local producer of biomass-based heating solutions would need to obtain a certificate of conformity in order to be able to legally sell the products he offers. The certificate is issued on the basis of the conclusion of a specialized department of NISM[20]

The procedure of obtaining the certificate of conformity or the National mark of conformity is described as follows:

1. The Producer signs the application
2. The producer submits the list of documents required (Technical description of the heating solution developed by the producer, Questionnaire of the self-evaluation of the product, Passport of the heating solution[21] developed by the producer)
3. The NISM responsible department reviews the "Request Letter" and the documents submitted by the producer
4. The NSIM responsible department emits the decision on the request (the producer will be informed if the procedure of certification will carry on)
5. The NISM emits the "Contract of services" and signs it with the applicant (producer of the biomass-based heating solution)
6. The NISM emits the invoice for the producer
7. The Producer pays the amount stated in invoice[22]

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[20] Address - 48 Lazo str./ Tel – (+37322) 208157

[21] It is a document that is developed by the producer and must contain compulsory but not exhaustive information: technical description, installation conditions and requirements, exploitation requirements, safety rules.

[22] For the situation described in this report, the price for certification of conformity would be 711 MDL

8. The NISM identifies the product and evaluates it on the bases of the "Questionnaire of the self-evaluation of the product"
9. The NISM expert team* evaluates the conformity of the technical description stated in the "Passport of the heating solution", tests the technical aspects and evaluates if the heating system is safe for private exploitation.
10. On the basis of the results presented by the expert team, the NISM issues the certificate of conformity of the National mark of conformity for a period of 3 years.

* - according to law No 186 "On conformity assessment of products", the expert teams in NISM are created according to the specifics of the product that is required to be certified. The team is created from specialists from the area of certification.

Legal Requirements related for the installation of biomass based heating systems

For a household, if changing the heating solution, the following issues arise: a) installation and exploitation of the heating solution according to technical norms imposed by the producer; b) installation and exploitation of the heating solution imposed by the national norms of prevention of fire.

The installation and exploitation requirements of the heating solution are stated by the producer and are described in the attachment of the Passport of the Stove. Also, for installation of a heating solution, some specific technical skills are required thus the stove production company or the local retailer, offer the installation service for households. The fulfillment of technical requirements, if the heating solution is installed by an authorized[23] person/company, is not an issue of concern for the household.

According to the law No. 93 from 05.04.2007 about "Service of civil protection and emergencies" the subdivision of Ministry of Internal Affairs, the Service of civil protection and emergencies (SCPE) is in charge of monitoring and supervision on implementation by the households, state institutions and economic entities of the norms and regulations related to protection and prevention of fire. The main responsibility and attributions related to prevention of fire, of the Service of civil protection and emergencies, are stated in the law mentioned above and contain:

- instructions to eliminate detected violations of the rules and regulations in civil protection and defense against fire
- carry out state supervision in the field of civil protection and defense against fire
- organize the expertise of state civil protection and defense against fire

[23] Authorization is made by the producer of the heating solution. Also, only organizations with the necessary certificated knowledge can be authorized to install a heating solution.

A more precise description of the responsibilities and actions that the Service of civil protection and emergencies can take in order to prevent fire in household area can be found in Law No. 267 about "protection against fire". The activities intended to prevent fire and inform the population about the risks of it, are held every year by the SCPE and are described in the Governmental Decision No 1159. In the RM, due to specifics, related to logistics, human resources etc., of the SCPE, there is an authorized non-governmental organization called "Fire-prevention society of the RM" (FPS), which is actually in charge of running all the activities stipulated in state documents mentioned above. This entity is monitored by the SPCE but is individual in its actions taken for achieving its responsibilities attributed by the act of authorization. It is organized in 23 Regional organizations, 7 Representatives in different regions (Annex 12).

The existing norms for prevention fire in households cover the technical specifications of chimneys used for evacuation of exhaust gas and the procedural aspects of the control itself.

The norms for prevention of fire, in Republic of Moldova, are created on the basis of a regulatory act from the Russian Federation "СНиП 41-01-2003". According to this regulation, households that plan to install a heating solution for the first time or to change the existing one on a new one are obliged to meet the following general rules:

1. The floor coverage where the heating solution is installed should be entirely, at least in the region of loading, made from fire-resistance material (minimum 0.5 m/ 0.7 m in the area of fuel loading)
2. The room (space) where the heating solution is installed must have good ventilation (windows that can be opened, fans etc.)
3. The chimney, if it passes through the roof of the house, must be built from a fire-resistant and low heat transfer rate (U-value) material.
4. The chimney should pass through the roof in a space that would permit a minimum distance of 0.25m from any other objects from roof. Also, the minimum height of the chimney part built outside the roof must be 0.5m.

5. The chimney (the ventilation channel) must be wide enough to permit all the exhaust gases to be evacuated. The necessary weight depends on the capacity (also the volume of the combustion chamber) and the type of heating solution.
6. The storage of fuel for the heating solution must be organized in another room from the one where the stove/boiler itself is installed. Only if the loading is automatized and technically developed by the producer of the heating solution then storage is allowed in the same room as the stove/boiler.

The procedure of obtaining the "Prescription for exploitation of the chimney" can be obtained as follows:

1. In the case of a first time installation of a heating solution in the house or the space allocated for it.
    i. The household should ask for a Pre-installation control of the space allocated for installation of the heating solution through a Request letter.
    ii. During two weeks an authorized specialist from SCPE will control the space and can consult the technical requirements stated in the Technical Passport of the stove in order to prescribe some suggestions of installation. The specialist can visit the venue ones or more times.
    iii. The specialist will provide comments on the peculiarities of thermal insulation of heating and ventilating equipment, piping systems of internal heating, air ducts, chimneys and flues in order to:

- Prevent burns
- To achieve a heat loss, less than the acceptable limit
- To avoid condensation of moisture
- To prevent the freezing of the coolant in the pipes, laid in unheated rooms or in an artificially cooled rooms

More details please find in СНиП 41-01-2003 document on the web site of SCPE.

After the household has finished all the installation works, the specialist from FPS will control the quality of installation according to suggestions he previously made and to norms for preventing fire in households. The "Prescription of usage of the chimney" authorizes the household to use the heating solution he chose and has to be renewed every year before the cold period of year (October – March).

2. In the case of a change of the heating solution two scenarios are observed by FPS:

    i. When the household which owns a stove fuelled by natural gas disconnects the stove from the gas pipe thus continuing to use gas only for cooking but not for heating. In this case the household has to inform also the regional gas-company distributor which will disconnect the stove according to all the requirements imposed by the Decision No 1226 "Rules of organization and execution of design works, installation and reception of gas supply systems". For the installation of the new heating solution the procedure described above (1) should be executed by the household.

    ii. When the household is renewing the existing heating solution. This is a practice highly observed in rural areas and mostly realized by the people who use brick stoves. In this case the household must, through a Request letter, inform the FPS about re-making of the stove. The procedure is simpler because the FPS specialist will give "a prescription on using the chimney" on the basis of the renewed stove which in majority of cases is built on the place of the old one and has the same heating capacity as the old one (if the heating necessities of household did not change). The main issue of control of chimney capacity is showed by the volume of the combustion chamber of the new stove.

The price of issuing the "Prescription on the using of the chimney" depends on the complexity of the case but would not exceed the rate between 138 – 275 Mdl per household.

It is important to highlight the fact that the heating solutions which are fuelled with natural gas are an issue of a much rigorous control and more strict regulations comparing with those imposed on heating solutions which are fuelled with wood bricks, coal or biomass. Also, due to a recent tragic event[24] the focus on regulating on prevention of fire is on the gas heating solution. SPCE is more concerned with the risks present in households heated by gas rather than those risks which come from houses heated with other systems. Based on this unbalanced efforts on prevention of fire, FPS is more indulgent when controlling. It must adjust its actions to the economic reality in Moldovan villages and the financial situation of households.

[24] http://apropomagazin.md/2010/10/27/trei-ani-de-la-tragedia-din-soroca-video/

Conclusions and recommendations

During the elaboration of the feasibility study on affordable biomass-based heating solutions, many aspects of the entire value chain were identified and analyzed. It is worth mentioning that perception of affordability of biomass-based heating system depends on both financial and non-financial factors. These factors can influence public opinion concerning heating systems and favorably or unfavorably and contribute to the decision-making process of the final consumer, whether to buy biomass-based heating system or not.

The main conclusion of this study is that biomass-based heating systems are a very effective and efficient solution of heating the household in rural areas, and with the fulfillment of certain conditions can be considered as feasible and affordable.

As the content of the study forms part of a very complex system, some aspects of the study are subject to additional disclosure and conclusions.

Biomass

The rural household generates on average 3t of unused biomass every year, which can be used as a fuel for biomass based heating systems. All this quantity of biomass is the result of calculations made based on data from public opinion survey and includes biomass that is not included in regular household activities (cattle feeding, using as fuel for stoves/ gully–cooking water heating, etc.). Thus, the household owner will face a tradeoff:

- On one side heating the house with traditional heating system and acquiring traditional fuel (coal, wood),
- On the other side using biomass-based heating system with higher efficiency rates, which will use biomass fuel, part of which will be produced at a lower price, from the biomass that is generated within his household (3t of biomass / year).

This will result in significant savings when heating during the cold season. However the study showed that the rural population does not have the necessary information about methods of pressing and utilization of biomass for heating purposes.

Recommendations

An information campaign related to method of utilization of generated biomass for heating purposes. The information campaign should provide real life facts about biomass and provide best-case practices that were implemented within the area.

Producers of biomass

During the research in the RM several producers of biomass fuel were identified. It is also worth mentioning that for some companies production of biomass fuel is not their main business. Other companies produce biomass fuel for export.

Recommendations

To conduct projects directed at the development of micro producers of biomass fuel at the level of village or community. These micro enterprises should produce biomass fuel and provide services of briquetting / pelleting to the population. These producers will ensure the availability of biomass fuel in the region and will promote the utilization of biomass for heating purposes. According to ProEra team's pre-feasibility study, micro enterprises that provide these services can become profitable businesses and create additional working places in rural areas.

Distribution and fuel

There is no well-developed supply chain of biomass fuel distribution. However, identified distributors of traditional fuel (coal, logwood) do not see a threat in biomass fuels. In many cases, distributors were interested in selling biomass-based fuel to the population, with the condition of maintaining their respective profit margin.

The main types of biomass fuel are biomass pellets, wood chips, biomass briquettes and wood logs. The first two as well as the last two types of fuel in many cases can be burned by the same type of heating systems.

Using combined fuel systems will provide necessary confidence for the final consumer about availability of fuel.

Recommendation

Promotion of combined biomass fuel heating systems at the early stage of the development project should be the priority until the availability of stable biomass fuel supply is developed.

Biomass based heating systems market and local producers of heating equipment

The market of biomass based heating systems in the RM is in its development stage. Nearly 99% of heating system imports in the RM are imports of heating systems that work on gas. The majority of heating systems presented are high-end models. These should be used for heating large spaces. However there exist models on the local and more often on the international market also suitable for rural areas both from a performance and from a price perspective.

From identified local companies that are capable of producing biomass-based heating systems only one company has experience in producing them.

Recommendations

In order to induce development of affordable biomass based heating systems it is important to promote the production of respective heating equipment locally. This will reduce costs related to transportation and customs clearance. Compensating part of the production costs carried by the local producer will induce the development of the market. Another opportunity for promoting biomass-based heating solutions which can be considered, albeit with a proper feasibility study required, is the promotion and ease of obtaining this type of fuel. When using briquetting/pelleting solutions available on the market, households, with some additional investments, can produce biomass-based fuel themselves.

Final Consumer

One of the most important links in the value chain is the final consumer. As it mentioned in the study, the majority of households in rural areas are using old and inefficient heating systems along with traditional and ecologically unsustainable types of fuel (coal extraction is heavily polluting the environment while wood heating presumes cutting forests which directly influences the pollution rate of the environment). Rural household owners do not have sufficient information about biomass based heating systems, or this information is distorted as our market survey shows (Figure 23). The cumulative number of rural households who have a distorted perception of biomass-based heating solutions is circa 25%. This distortion is expressed ether by the perception of comfort level offered by these solutions or by the fact that households consider the biomass fuel expensive while not using on average 3t of loose biomass annually.

Recommendations

In order to promote biomass based heating systems in rural areas, an information campaign should be held. Below are the presented steps of such a campaign.

A promotional campaign for biomass-based heating solutions should focus attention on measures of informing people about biomass potential by comparing it with traditional heating solutions. Among the advantages of the proposed heating solution should be mentioned:

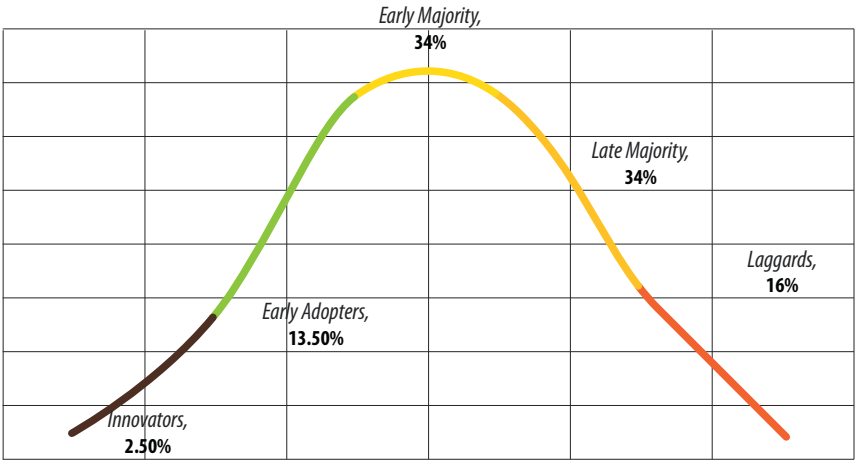
1. Competitive price for fuel (both as a price for GJ and briquetting / pelleting services)
2. Higher efficiency of heating solution
3. Possibility to regulate heat
4. Significant savings on heating costs
5. Possibility to heat water
6. Handling is easier in comparison with solutions based on coal and wood.
7. Neutral impact upon environment

8. Easiness of fuel storage
9. Short investment payback period
10. Higher quality of life

Another important aspect of the envisaged information campaign is to provide proper understanding for end-users about fuel security for biomass-based heating solutions. With this in view, it is crucial for the proposed project to be implemented in those villages where it will be possible to produce / deliver biomass fuel to final consumers at a competitive price. It is also recommended that a pilot project to be implemented in those villages where final consumers will have the possibility, i.e. available biomass and financial resources, to convert the self-produced biomass into fuel (pellets, briquettes).

Previously it has been mentioned that land owners in the RM rural areas do not have necessary and complete information about biomass-based heating solutions. As biomass-based heating solutions are new for the RM, for an information campaign to be successful it will be reasonable to take Everett M.Rogerss' "**Diffusion of Innovations"** theory as the guiding methodology. Figure 33

Figure 34: **Curve of diffusion of innovation**



"Diffusion of Innovations" theory presumes that when it comes to innovative product any particular market has five types of customers:

In order to activate massive switching of heating solution to biomass-based ones 15 % of households in a certain village should change their existing heating solutions to the biomass-based ones, thus **early majority** will be "activated".

Addressing innovators:

First of all 3.5 % of households considered to be innovators should be addressed. However, since at the early stage identification of these kind of people will be difficult, it is proposed to inform people first about the existence of biomass-based heating solutions by providing proper benchmarks and examples of efficiency of heating systems based on calculations, and best case practices, presented in booklets and posters. Next, installations for this kind of heating should appear in public institutions, village halls, kinder-gardens or schools. This will provoke discussions among the population of the village and will awaken interest. Persons responsible for operating heating solutions should go through training and should provide necessary information to interested people regarding the exploitation of the new equipment. Necessary information

concerning heating solutions on biomass presented in booklets and/ or posters/flyers should be available everywhere. Information materials should contain necessary technical information of heating solutions on biomass as compared with traditional heating solutions, outlining all the benefits of the former.

Information material should be customised for several types of households, with the areas of 75, 90, 110, 150 m^2 this will provide proper reference to conditions of living of a certain household. The proposed layout of the booklet is in Annex 13.

At this stage two or three households that are willing to produce biomass-based fuels should be identified. Candidates for this role can be farmers or land owners that have access to significant amounts of biomass. At an early stage mobile briquetting / pelleting solutions should be used. These individuals could produce and sell fuel, and provide pelleting / briquetting services for the population.

Expected outcomes from the stage:

1. The population is informed about heating solutions with biomass
2. People become aware of the benefits of the proposed heating solutions getting information from employees of institutions mentioned above.
3. People actually see benefits by visiting public places where heating solutions on biomass have been installed.

A possible risk is the following: certain concerns about heating efficiency of their stoves at home could appear among people. To prevent/avoid the risk, a wide-range promotional information campaign has to be well planned and duly implemented.

Addressing early adopters:

The next step in the information campaign will be addressing local small and medium enterprises (SMEs). Entrepreneurs are considered to be innovative, creative persons that are ready to accept changes with low

resistance particularly in cases when change promises certain financial savings.

The following features of the SMEs should be taken into consideration:

- Family business - faster decision making process
- Preferably with several employees - will induce process of informing village population outside the SMEs
- Heated space should have a form factor of the house (small shop, bar, canteen) - this criterion will help potential buyers to extrapolate all benefits of heating and delivering hot water to their own houses.
- All heating systems should be provided with promotional materials and owners of the heating solution should be willing to demonstrate it to all interested people. By this time producers of heating solutions should enter the market with different incentive schemes related to acquisition of the heating solutions on biomass.

Expected outcomes from the stage:

1. First private cases of heating with biomass.
2. Growth of confidence among population concerning efficiency of biomass-based heating solutions.
3. First acquisitions of heating systems for private households based on information provided within the framework of the campaign.

Addressing early majority:

For this stage collaboration between all participants of the supply chain is very important.

To attract the early majority, public seminars and learning courses should be organised where:

- Producers of biomass fuels should give information about the variety of services they provide to final customers, e.g. delivery, pelleting/briquetting services, as well as information about prices etc.;
- Producers and importers of heating solutions will provide information about their price range, technical characteristics of systems, payment and incentive schemes, advantages of their equipment;

- Users of biomass-based heating solutions will provide best case practices, real life information about technical performance of the equipment, tips and tricks in operation of biomass-based heating solution, benefits that were gained when switched to new heating solutions, e.g. heating entire house, possibility to regulate temperature, hot water all year around etc.

In these seminars, question and answer session will have an added value for adjusting promotional materials for future campaigns.

Expected outcomes from this stage:

1. Increased acquisition and installation of heating solutions on biomass
2. Producers and importers adjust their product range in accordance with the needs of the market
3. Proper supply of biomass fuels with variety of options is established
4. More and more good case practices appear
5. Information about benefits of heating solutions on biomass and their affordability is transmitted to other villages

Concerns related to implementation of this stage:

- All participants of the supply chain should transmit the same message
- Monopoly created by one supplier of fuel can destroy the entire initiative
- Inflexibility of producers and importers of heating solutions on biomass can provoke resistance among the population
- There will be no particular approach towards late majority and laggards. The well-established supply chain and best-case practices will keep the process going without significant efforts.

For proper selection of biomass-based heating system the consumer should be guided by an easy to understand questionnaire, which will filter unnecessary features of the equipment and will identify all characteristics that the area needs for comfortable use without significant in-

vestment. An example of this kind of questionnaire is presented in Table 21: Heating solutions (93% efficiency rate) selection matrix.

From this matrix it can be seen that with current market conditions, houses that have heating area of less than 75m^2 and intend to use only acquired biomass fuel, will not be able to find a biomass heating system that will be considered as an economically justified investment. However if the household owner will use as fuel biomass generated within his dwelling, the savings on biomass fuel will justify investment in biomass-based heating system even if the heating area of the house is 40m^2.

The financial aspect of feasibility and affordability can be considered as follows: *Investment in biomass-based heating system is feasible if the net present value of future savings provided by the system during the period of the next 8 years is positive.*

An affordable heating system can be considered one that meets the following requirements:

1. Investment reasoning is feasible
2. The price of the heating system is lower than the price for the next best (efficiency based) heating solution available on the marketing which customer is willing to buy (in particular: heating systems that work on natural gas).

Earlier in the study it was mentioned that biomass-based heating systems when taking into account non-financial benefits have in effect a lower price. This information should be presented to the final consumer in rural areas in order to induce investment in biomass based heating systems.

Annexes

Annex 1: Public opinion survey methodology

1. Methodology for the research

According to request the following methodology is considered by applicants as most suitable, thus assuring the highest reliability and geographical coverage.

1.1 Background

The project purpose is to increase the use of renewable energy technology significantly through fuel switching and energy efficiency. It primarily focuses on improving heating comfort levels in rural public sector buildings including schools and community centres by using readily available waste straw supplied from local agricultural enterprises. The project will also stimulate local markets for improved household heating; industrial cogeneration, and biomass-based briquetting, as well as raise local capacity in the biomass sector, and promote the benefits of biomass energy and the project.

1.2 Purpose and objectives

To conduct an in-depth survey of current systems in use and an analysis of biomass based energy efficient domestic heating systems. It is expected that technology solutions will be assessed and ranked based on their performance (efficiency and emissions), fuel requirements (multi-fuel), and features (cooking, baking, heating, central heating and hot water).

The major role and importance of this market research/survey is to identify the best technical solutions in household heating versus beneficiaries' needs, demand and constraints in installing new energy efficient stoves.

This market research will also lay the informational basis for potential/suitable technologies of biomass based heating solutions to be used in Moldovan households.

Objectives:

- Identify consumer needs for heating technologies;
- Identify motivations and constrains in replacing existing heating technologies;
- Determine consumer preferences regarding household heating equipment and its acceptance in terms of price range, fuel, efficiency.

1.3 Sampling

In order to achieve the objectives set for the present study, it is proposed to carry out a quantitative research on a sample of 1300 households, which will ensure data representativeness throughout the entire country, with a ±2.7% error margin and a confidence level of 95%.

For securing territorial representativeness, the sample used shall be segmented based on regions (a total of 10 regions). Besides, the rural localities shall be grouped in accordance to the size of the locality: small-sized (<1500), medium-sized (between 1501-3000) and large-sized (>3000).

The structure of the sample is presented in the table below.

Table 1: **Distribution of population**

Region	Total units N	City / sub-urb	Small villages	Medium villages	Large villages
Anenii Noi	45	1	30	10	4
Basarabeasca	10	1	5	1	3
Briceni	39	2	29	6	2
Cahul	55	1	38	13	3
Călărași	43	1	36	5	1
Cantemir	51	1	35	11	4
Căușeni	43	2	23	10	8
Cimișlia	39	1	28	8	2
Criuleni	43	1	30	9	3
Dondușeni	30	1	18	8	3
Drochia	39	1	26	10	2
Dubăsari	14	0	4	6	4
Edineț	49	2	38	7	2
Fălești	74	1	53	12	8

Region	Total units N	City / sub-urb	Small villages	Medium villages	Large villages
Florești	74	3	49	18	4
Glodeni	35	1	19	10	5
Hîncești	63	1	54	7	1
Ialoveni	34	1	26	6	1
Leova	39	2	31	3	3
Mun. Bălți	3	1	1	0	1
Mun. Chișinău	34	6	18	7	3
Nisporeni	39	1	26	9	3
Ocnița	32	3	13	12	4
Orhei	75	1	70	3	1
Rezina	41	1	22	12	6
Rîșcani	55	2	44	7	2
Sîngerei	69	2	56	8	3
Șoldănești	33	1	21	6	5
Soroca	68	1	50	11	6
Ștefan Vodă	26	1	11	12	2
Strășeni	39	2	27	6	4
Taraclia	26	1	21	2	2
Telenești	54	1	35	14	4
Ungheni	74	2	55	12	5
UTA Găgăuzia	32	3	19	7	3
Total	1519	53	1061	288	117

During the sampling stage, the main mistake of statisticians refers to the fact that only the number of inhabitants is considered. However, an extremely important issue is the inclusion of all units in the randomization process; or in other words giving a chance to all geographical regions to participate in research.

The next step in sampling will be combining some of the Regions in groups, in such a way the randomization of units will be done within each group. The tables below represent statistical repartition of the interviews.

At the same time the selection of cities and villages depend also on their size, being segmented as small, medium and large, and the number of inhabitants. Within each group, sampling points are selected randomly according to the size and number of inhabitants. For each type of sam-

pling point a minimum of interviews is set (12, 16 and 20) thus assuring the reliability of the sample.

Table 2: **Distribution of interviews by groups**

		Primary data		
		Population, ths. people	%, population	Sampling
Group 1	Briceni, Edineț, Dondușeni și Ocnița	184.2	9.0	117
Group 2	Drochia, Florești și Soroca	203.4	9.9	129
Group 3	Mun. Bălți, Fălești, Glodeni, Râșcani și Sângerei	254.7	12.4	161
Group 4	Dubăsari, Orhei, Rezina, Șoldănești și Telenești	264.4	12.9	167
Group 5	Anenii Noi, mun. Chișinău, Criuleni, Ialoveni și Strășeni	352.8	17.2	223
Group 6	Călărași, Nisporeni și Ungheni	190.8	9.3	121
Group 7	Basarabeasca, Cimișlia, Hâncești și Leova	205.5	10.0	130
Group 8	Căușeni, Ștefan Vodă	130.7	6.4	83
Group 9	UTA Găgăuzia	95.7	4.7	61
Group 10	Cahul, Cantemir și Taraclia	169.9	8.3	108
Total		2052.1	100	1300

Table 3: **Distribution of interviews by type of locality**

		No. of Interviews			No. of villages		
		Large village	Medium village	Small village	Large village	Medium village	Small village
Group 1	Briceni, Edineț, Dondușeni și Ocnița	38	66	13	2	4	1
Group 2	Drochia, Florești și Soroca	61	42	26	3	3	2
Group 3	Mun. Bălți, Fălești, Glodeni, Râșcani și Sângerei	80	64	17	4	4	2

Group 4	Dubăsari, Orhei, Rezina, Șoldănești și Telenești	80	80	7	4	5	1
Group 5	Anenii Noi, mun. Chișinău, Criuleni, Ialoveni și Strășeni	70	96	57	3	6	5
Group 6	Călărași, Nisporeni și Ungheni	60	49	12	3	3	1
Group 7	Basarabeasca, Cimișlia, Hâncești și Leova	60	52	18	3	3	2
Group 8	Căușeni, Ștefan Vodă	25	35	23	1	2	2
Group 9	UTA Găgăuzia	20	16	25	1	1	2
Group 10	Cahul, Cantemir și Taraclia	60	36	12	3	2	1
Total		554	536	210	27	33	19

The multistage randomization will be applied considering Group of Regions and households. Two randomization stages will be applied:

- Locality – selected randomly for each stratum as characterized above and using a table of random numbers,
- Household – in each locality, based on streets, routes are designed depending on number of interviews per locality. The household selection is based on a statistical step and methodology using random route technique.
- Person/respondent – when selecting the respondent according to his role in the household.

Non-quota sampling which is widely used as a methodological tool in research, will be applied. This method has proven its suitability and at the end of the research the difference between official demographic data and those interviewed is less than 1%. Consequently, when selecting the respondent the following procedure will be applied.

After the random selection of locality (depending on its size), as described above the household will be chosen from the centre of the village following a special route. Further, the respondent from the household will be selected according to his role in the household. If the respond-

ent is not present in the house three attempts will be made in order to interview him.

1.4 The questionnaire

The questionnaire will be developed according to the main objectives of the market study and the overall project. The questionnaire is translated both in Romanian and Russian languages. Our experience has proven necessity of pre-testing questionnaires and it is a mandatory step. This approach is helpful for identifying questions that may be misunderstood or misinterpreted by respondents. Consequently, the questionnaire is improved and adapted to the target. In this case the questionnaire will be tested on a dozen of respondents.

1.5 Pilot research

A pilot research will be used in order to validate the questionnaire. About 15 interviews will be performed in rural areas, 10 in Romanian and 5 in Russian languages. Respondents for pilot research will have different age and education range.

While conducting the pilot research different interviewers will be assisted by senior consultants from ProEra Grup. Thus, beside the analysis of the questionnaire, interviewers will be tested in terms of respondent selection and interviewing.

As a result the final questionnaire will be finalized with all necessary adaptations.

1.6 Interviewing and quality assurance

Interviews are performed by ProEra Grup team of interviewers who have participated in numerous projects of similar nature. Interviewers are carefully trained at the beginning of the project regarding the aim of the project and in which way this data will be analysed. Additionally, each question from the questionnaire is explained.

Interviews are conducted in the native language of the respondent. In line with interviewing, monitoring of delivered questionnaires is performed, in order to assure that gathered data corresponds to the proposed sample.

Two methods of quality assurance will be applied, though the interviewers are trustworthy. About 15% of respondents will be contacted by telephone. During the conversation random answers from the questionnaire will be analysed. Additionally, about 5% of respondents will be visited by a team of ProEra Grup consultants responsible for data collection. A second interview with a shorter questionnaire (a random set of questions from the official questionnaire) will be performed with respondents.

In order to ensure the right procedure of household selection within rural areas, all the interviewers will fill in an interview route.

1.7 Data interpretation

All questionnaires are scanned and data is exported into a SPSS database. Each topic of the questionnaire is analysed depending on the characteristics of the sample (gender, age, education). In the case of qualitative data (open questions) - an in-depth analysis is performed and codes are applied.

Annex 2: Methodology of calculation of the amount of adjustment for biomass available within the household

	Destination of use	Corn (%)	Cereals (%)	Sunflower (%)
1	Cattle fodder	70	48	21
2	You burn them on field	11	15	22
3	You abandon them on field	9	14	14

From data collected during the public opinion survey (Figure 6: Utilization of biomass (%)) data related to % of biomass that was not utilized by the household was aggregated in the table above.

For calculation of the adjustment's amount following steps were taken:

Cereals and sunflower:

1. Sum of second and third rows in the table (Cereals: 15+14=29 and Sunflower:22+14=36)
2. Amounts in cattle fodder rows were not taken into calculation because usually straws from cereals that area given to cattle are consumed almost completely. As for Sunflower stalks only leaves are consumed by the cattle. In Figure 6: Utilization of biomass (%)demonstrates that sunflower stalks are used more often by household owner as a fuel for stove / gully, thus the amount of cattle fodder leftovers from the sunflower stalks can be omitted from calculation.

Corn:

1. Sum of second and third row in the table (11+9=20)
2. As in the case of sunflower stalk, corn stalks are used as food for cattle, amount of leftovers can vary from 40-50% of total mass given to cattle. Thus the amount of biomass that is left after feeding animals can be calculated as follows: 70% (please see table above) * 45% (average quantity of leftovers)~30%
3. The amount of available biomass generated by corn growing in an average household is 20+30=50% from the total amount of corn biomass grown by the respective household.

Annex 3: Availability of biomass in the RM (Households with arable areas less than <10 ha)

Table 1: **Average total cultivated surface and total harvest in RM**

	Total cultivated surface (th. ha)					Average cultivated surface (th. ha)
	2006	2007	2008	2009	2010	
	1	2	3	4	5	6=1+2+3+4+5/No years
Wheat	76	69	104	90	71	82
Barley	29	30	29	35	32	31
Corn	185	189	152	145	152	165
Sunflower	83	63	59	57	53	63
	Total Harvest (th. t)					Average harvest (th. t)
	1	2	3	4	5	6=1+2+3+4+5/No years
Wheat	190	77	326	217	181	198
Barley	51	24	71	65	60	54
Corn	535	137	522	416	551	432
Sunflower	122	42	98	78	88	85

Table 2: **Average total available biomass**

	Average harvest t/ha	Type of Biomass	Biomass t/t of harvest		Biomass t/ha		Total Biomass available (th.t)		Average total biomass available (th. t)
			lower	upper	lower	upper	lower	upper	
	1	a	2	3	4=1*2	5=1*3	6=6 (Table 1)*4	7=6(Table 1)*5	
Wheat	2.54	paie	1	1.8	2.54	4.57	198	357	277
Barley	1.86	paie	1.5	1.8	2.79	3.35	81	98	89
Corb	3.64	coceni	1.2	2.5	4.37	9.10	519	1,080	799
Sun-flower	1.67	tulpini	1.5	3.6	2.50	6.05	128	309	219
		coji	0.3	0.33	0.50	0.55	26	28	27

Annex 4: General survey of limit values in existing national standarts for fuel pellets in European Union.

Specification	Austria ÖNORM M7135		Sweden SS 18 71 20			Germany DIN 51731 / DIN plus			Italy CTI - R 04/5				Britisch BioGen / UK Code of good practice	
	Holzpresslinge	Rindenpresslinge	Gruppe 1	Gruppe 2	Gruppe 3	5 Längenklassen sonst gleich [cm]			4 categories according origin and with or without pressing aids A no additives	A with additives	B	C	premium fuel pellets	recovered fuel pellets
Size	**- Pellets :** 4 - 20 mm ∅ max.100 mm lg.	-Briketts: 20 -120 mm ∅ max. 400 mm lg.	max. 4 mm ∅**)	max. 5 mm ∅	max. 6 mm ∅		Länge	∅	6 mm, 8 mm	6 mm, 8 mm	6 mm, 8 mm	10 -25 mm	<4mm- 20 mm	> 10mm-<20mm
						HP1	>30	>10						
						HP2	15-30	6-10						
						HP3	10-15	3-7						
						HP4	<10	1-4						
						HP5	**<5**	**0,4-1**						
Bulk density			≥ 600 kg/m³**)	≥ 500 kg/m³	≥ 500 kg/m³				620 - 720 kg/m³	620 - 720 kg/m³	620 - 720 kg/m³	≥ 550 kg/m³	>600 kg/m³**)	>500 kg/m³**)
Fines in % <3mm			≤ 0,8	≤ 1,5	≤ 1,5								<0,5 %	<0,5 %
Unit density	≥ 1,0 kg/dm³	≥ 1,0 kg/dm³				1-1,4 g/cm³								>40 pounds/cubic ft. +)
														0,527 kg/dm³
Moisture content	≤ 12 %	≤ 18 %	≤ 10 %	≤ 10 %	≤ 12 %	<12 %			≤ 10 %	≤ 10 %	≤ 10 %	≤ 15 %	≤ 10 %	≤ 10 %
Ash content	≤ 0,5 % *)	≤ 6,0%*)	≤ 0,7 %	≤ 1,5 %	>1,5 %	< 1,5 %			≤ 0,7 %	≤ 0,7 %	≤ 1,5 %	to be stated	< 1 %, < 3 % or 6	< 1 %, < 3 % or 6
Calorific value	≥ 18,0 MJ/kg*)	≥ 18,0 MJ/kg*)	≥ 16,9MJ/kg ≥ 4,7 kWh/kg	≥ 16,9MJ/kg 4,7 kWh/kg	≥ 16,9MJ/kg 4,7 kWh/kg	17,5 - 19,5 MJ/kg ***)			≥ 16,9MJ/kg	≥ 16,9MJ/kg	≥ 16,2MJ/kg	to be stated	>4,7 kWh/kg	>4,2 kWh/kg
Sulphur	≤ 0,04 %*)	≤ 0,08 %*)	≤ 0,08 %	≤ 0,08 %	anges	< 0,08			≤ 0,05 %	≤ 0,05 %	≤ 0,05 %	to be stated	< 300 ppm	< 300 ppm
Nitrogen	≤ 0,3 %*)	≤ 0,6%*)				< 0,3			≤ 0,3 %	≤ 0,3 %	≤ 0,3 %	to be stated		
Chlorine	≤ 0,02%*)	≤ 0,04%*)	≤ 0,03%	≤ 0,03%	anges	< 0,03			≤ 0,03%	≤ 0,03%	to be stated	to be stated	< 800 ppm	< 800 ppm
Arsenic						<0,8 mg/kg								
Cadmium						<0,5 mg/kg								
Chromium						<8 mg/kg								
Copper						<5 mg/kg								
Mercury						<0,05 mg/kg								
Lead						<10 mg/kg								
Zinc						<100 mg/kg								
EOX, extractabl.org. halogens						<3 mg/kg			≤ 1.0 %	≤ 1.0 %	≤ 1.0 %	to be stated		
Fines. bevor delivery to costumer	max. 1 %					max. 1 %								
Additives	max.2 % only natural		to be stated						none	to be stated	to be stated	to be stated		
Ash melting point			temperatur to be stated											
Durability									≥ 97.7 %	≥ 97.7 %	≥ 95.0 %	≥ 90.0 %		

*) of dry basis **) at factory ***) witout ash and water

Annex 5: Preliminary simulation: Consumption of Fuel by Brick Stove without fire grate (rate 35%)

Heating Solution:	Fuel used:	U.M.	Surface of house (m2)			
			40	75	90	110
Homemade brick stove without fire grate	Wood	t	7,8	14,75	17,70	21,63
	Coal	t	3,2	6,02	7,22	8,83
	Coal & Wood mix	t				
	Wood chips	t	7,7	14,4	17,36	21,22
	Wheat Straw (loose biomass)	t	5,3	10,03	12,04	14,71
	Sunflower (straw)	t	5,3	10,10	12,12	14,81
	Sunflower (husk)	t	3,9	7,34	8,81	10,76

Annex 6: Methodology of heating calculations

In order to present the feasibility of biomass heating solutions they should be compared with other already installed heating systems, then different combinations of fuels used should be included in calculations. As a result of calculations, the following financial indicators and instruments will be presented:

1. "Cash flow of future economy" will be elaborated to show the period of investment repayment
2. Net present value (NPV) of the project
3. Comparing Diagram of Price for one MJ (in calorific and fuel type value)
4. Amount of money necessary for the heating season

Following household profiles and variables were taken into consideration:

Household Area: (Based on survey)

- 40m^2
- 75m^2
- 90m^2
- 110m^2
- 150m^2

Household height *– 268cm (average height of a household under survey)*

Hot water: *Not available / Available*

Members of the household: 4.1 *– (average number of family members in rural areas according to the National Bureau of Statistics of the RM)*

Average amount of hot water per family member in 24h. *– 85l*

Hot water temperature: *50°C*

Initial water temperature: *5°C*

Average duration of heating season: *166 days*

Average temperature of air during heating season: *0.6°C*

Target temperature of air inside the house: *18°C*

Average temperature of the rural household during heating season: *14°C*

Temperature of outside air for the coldest period:*-15°C*

Fuel and heating solution used:

For biomass- based solutions efficiency rates have been applied in accordance with the information provided by official distributors in the RM. The main criterion for choosing heating solutions was the ability to cover peck load (Power of heating solutions), after which the most affordable heating solution was taken.

Pellet Boiler / Stove		***Rate depends on scenario***
Straw pellets-	*15 MJ/kg*	*Price: 1800 MDL/t.*
Briquette Boiler / Stove		Rate depends on scenario
Straw briquettes-	*15 MJ/kg*	*Price: 1800 MDL/t.*
Low Rate Brick Stove (LRBS)	Rate= 35%	
Coal-	*25MJ/kg*	Price: 3000 MDL/t.
Wood (log wood) -	*12 MJ/kg*	Price: 940 MDL/t.
Wood chips -	*10.2MJ/kg*	Price: 940 MDL/t.
Wheat (straw) -	*15.9MJ/kg*	
Sunflower (straw) -	*14.9MJ/kg*	
Sunflower (husk) -	*20.5MJ/kg*	
Combination:		
Wood (80%)	*12 MJ/kg*	
Coal (20%)	*25MJ/kg*	
High Rate Brick Stove (HRBS)	Rate= 75% for coal (70% other fuels)	
Coal-	*25MJ/kg*	Price: 3000 MDL/t.

Wood (log wood) - *12 MJ/kg* Price: 940 MDL/t.

Wood chips - *10.4MJ/kg* Price: 940 MDL/t.

Wheat (straw) - *15MJ/kg* Price: 940 MDL/t.

Sunflower (straw) - *14.9MJ/kg*

Sunflower (husk) - *20.5MJ/kg*

Combination:

Wood (80%) *12 MJ/kg*

Coal (20%) *25MJ/kg*

Natural gas Boiler Rate=90%

Natural Gas - *48Mj/m³* *Price:6.6 MDL/m³*

An additional adjustment will be taken into consideration if people use their own biomass as a fuel. The adjustment will take into consideration an average amount of biomass available in the household and it will be assumed that a household owner will use pelletizing services.

Description of methodology:

Calculations for heat load:

$$Q_c = aq_vV(t_i - t_e)$$

Where:

Q_c – Heat load for heating of air

a – Empirical coeficient that adjusts heat loss per 1 m^3 for the RM

q_v – Therm load reported to the area of a building $\left(\frac{W}{m^3 K}\right)$

V – Volume of a building (m3)

t_i – Temperature of air inside a house (target temperature)

t_e – Average temperature outside a house in the coldest 5 days of a year

Calculations of boiler heat load for hot water:

$$Q_{ac} = m_{ac}C_p(t_{ac}-t_{ar})$$

Where:

Q_{ac} – Mean heattransfer rate

m_{ac} – Mean fluid flowrate $\left(\frac{l}{h}\right)$

C_p – specific heat capacity for secondary fluid

$\left(\frac{J}{kg}K\right)$ For water Cp = 4190 $\left(\frac{J}{kg}K\right)$

t_{ac} – Initial temperature of cold water

t_{ar} – Target temperature of cold water

Energy consumption during heating season:

$$\left(\frac{Q_c(t_i-t_{im})}{t_i - t_e}T_{sez}\right)$$

Where:

Q_{sez} – Energy consumption for heating season (J)

t_i – Temperature of air inside the house (target temperature)

t_{em} – Average temperature of outside air during heating season

t_e – Average temperature of air outside outside the house in the coldest 5 fays of a year

T_{sez} – Duration of the heating seazon

Energy consumption for heating water during entire year:

$$Q_{an} = 365m_dn(t_{ac} - t_{ar})C_p$$

Where:

Q_{an} – Anual energy consumption for water heating (J)

m_d – Average daily water consumption per person (l.)

n – Number of hot water users

t_{ac} – Initial temperature of cold water

t_{ar} – Target temperature of hot water

C_p – Specific heat capacity for secondary fluid

$\left(\frac{J}{kg}K\right)$ For water Cp = 4190 $\left(\frac{J}{kg}K\right)$

Quantity of fuel needed for heating:

$$B = \frac{Q}{Q_{ic}\,\eta_c}$$

Where:

B – Quantity of fuel required

Q – Target energy amount (J)

Q_{ic} – Heat value of a fuel $\left(\frac{J}{kg}\right)$

η_c – Heating solution rate (%)

Cross-checking the calculation model calculations:

For stated above calculations a spreadsheet document was elaborated and is considered to be a part of current report.

For cross-checking calculations with the current reality the following steps were taken:

From a statistical database the multi-criteria analysis was generated depending on the household area and the amount of money spent for heating during the heating season. Table 26

Table 25: **Multi-criteria analysis household heating expenses and house surface**

Money spent on heating during season	Household surface m2			
	<40	41-75	76-110	>110
Less than 3000 lei	38%	28%	24%	20%
3001-6000 lei	48%	54%	57%	51%
6001-12000 lei	5%	13%	13%	22%
12001-18000 lei	1%	1%	1%	2%
more than 18000 lei	0%	0%	0%	1%
NS/NR	8%	4%	5%	5%
N:	157	399	529	199

It can be seen that there is a correlation between the area of a house and expenses for heating.

For further verification two scenarios were taken for the household areas of 30m^2 and 120m^2; no hot water; Fuel Used: Wood 80% Coal 20%; heating solution: HRBS (Rate 75% for Coal; 70% other fuels).

Results:

For the area of 30m^2, per household costs for the heating seasons are equal to 2.8 K MDL, this amount enters into Upper left cell (38%) of Table X.

For the area of 120m^2 , per household costs for the heating season are equal to 10.6 K MDL, this amount enters into cell on the intersection of 6001-12000 MDL and >110 (left corner of Table X).

Assumptions:

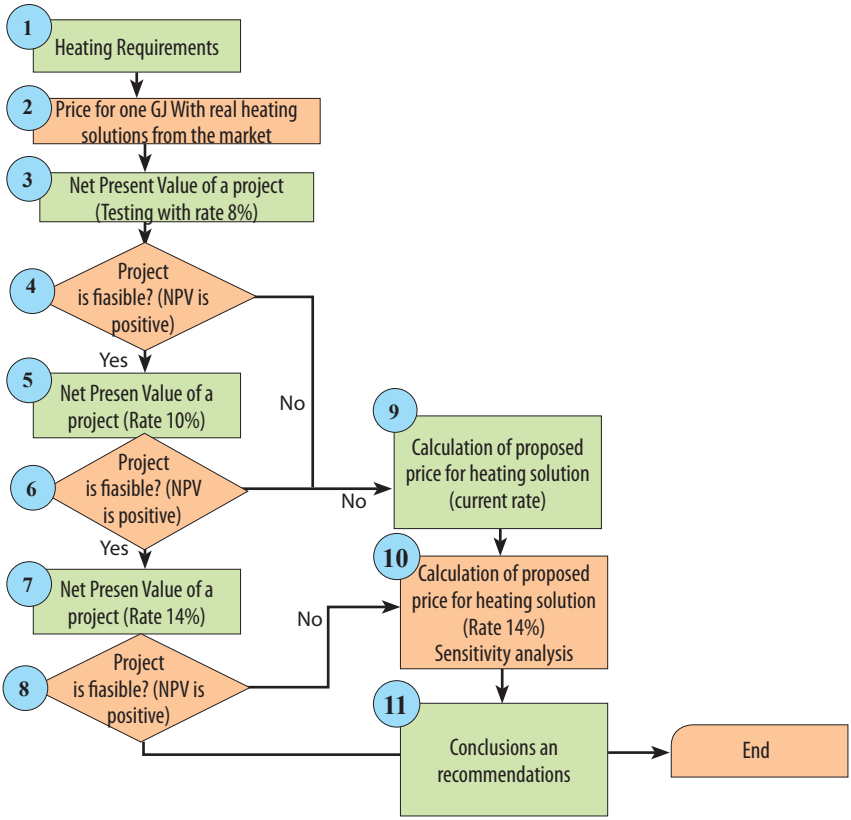
It is worth mentioning here that calculations are based on keeping the temperature in a household constant during the entire heating season, however, this regime is not often respected by rural households, where a house is being heated only when its landlord or other members of the family are at home. Thus the amount of the fuel used can be lower hence expenses on heating will be also lower.

Another assumption is that a homemade brick-stove with a fire grate is of a certain construction and with it rates are as stated in reference books and not lower. (This assumption will provide more difficult criteria for selecting proper heating solution. If the current rate is lower, then a possibility of investment repayment will be more real)

Annex 7: Methodology of Investment calculations

A particularly important point in the present study is economic feasibility of heating solutions. In order to understand the facilities for switching from the current heating solutions to that based on biomass, investment costs related to acquisition and installation of biomass-based heating solutions along with costs related to dismantling of old heating systems were evaluated. One of the future benefits of utilization of the biomass-based heating solution is savings on fuel (heating costs with old system – heating costs with biomass based heating), this economy will be considered as future cash flows.

Figure 34: **Logic of Investment calculations**



All calculations related to economic feasibility of heating solutions were made in MDL but prices for some heating solutions were given in EURO by the distributor. An exchange rate was taken for the period of 1 year from the date of beginning the calculation stage (31.10.2011): Euro: MDL - 1:16.4001

To understand the cash flow of future benefits related to usage of biomass-based heating solutions. Several scenarios of Net Present Value (NPV) of a project related to switching from the current heating solution to the biomass-based one were calculated. To this end, several discount rates were applied to the scenarios stated above. They are:

8% - discount rate taken lower than inflation rate in the RM for first 10 months of year 2011 (inflation rate 8.8%[25]) (optimistic scenario).

10% - actual discount rate published by the National Bank of the RM at the time the present study was conducted.

14% - discount rate taken in order to understand behavior of the project in case of significant inflation rate (pessimistic scenario).

For understanding the current situation of the biomass based heating solution market of the RM, in the economic model of real heating solutions provided by the local importers and distributors, the three main criteria - heating rate, power and price were used in the calculation model.

Calculations related to investment effectiveness of heating solution were made using the following logic:

1. After elaboration of the technical and economic model on the PC, the physical characteristics of a heating solution for every household area and the modes of heating (water and/or air heating) were obtained. According to these characteristics, real biomass-based heating solutions on/for the RM market were introduced into the model.
2. From this data primary indicators were obtained related to the price of one GJ of heat, for every heating solution included in a scenario and for every type of fuel used, both for air and water heating and air heating group of scenarios.

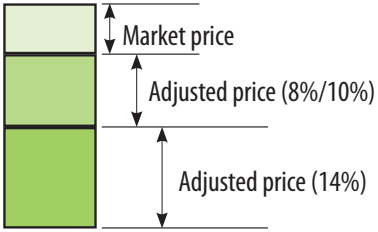
[25] - National Bank of Moldova "Report Concerning Inflation Nr.4" 4th of November 2011

3. As in the majority of cases biomass-based heating solution will ideally replace the current heating solution used by a household, the analysis of future benefits of "Heating Solution Change" investment project was made. Each household owner having a certain type of heating system and using a certain type of fuel or combination of fuel must make a decision to switch or not to switch to biomass-based heating solution. With this in mind, savings of money due to smaller amounts of fuel consumption will be considered as a cash inflow. At the beginning of the present study the most optimistic scenario was selected with the discount rate of 8%. This kind of approach will provide a necessary filtering of scenarios that are not feasible (Net Present Value is negative) even with the lowest rate.
4. After obtaining the results of the scenarios, a decision for the calculation of scenarios with higher discount rate (10%) will be taken and calculations will be made of proposed prices for heating solutions.
5. Calculation of investment project feasibility with 10% discount rate. Practically at this stage the same logic is being followed as in Step 3.
6. Decision related to feasibility of changing heating solution.
7. Calculations of NPV of a project with most difficult scenario (discount rate 14%)
8. If the project proves to be feasible even under the most difficult conditions, then a decision related to the elaboration of recommendations will be taken.
9. If the investment project demonstrates negative NPV in most scenarios, then calculations related to an affordable price are to be made. At this step, the economic model is aimed at modification of the price of a heating solution in the way that NPV of a project is at least equal to zero (discount rate 8% or 10% depending on the decision step). Here it should be mentioned that for this calculation the biomass-based heating system was compared with High Rate Brick Stove (rate 70%) and fuel mix of wood 80% and coal 20%. This kind of combination was used because: it provides reasonably difficult conditions from the heat rate point of view, and also the combination of fuel mixing is very common among households. With this in view, if the

combination stated above shows 0 NPV, then other less efficient heating systems (with rate less than 70%) will show positive NPV.

10. The next step in calculation will provide necessary sensitivity information for the project using a discount rate of 14% and a calculation of prices for a heating solution (same methodology as in Step 9). Comparing real market price of a heating solution with adjusted prices will provide necessary understanding of the attractiveness of a heating solution from the considerations of affordability.

Figure 35: **Sensitivity analysis of investment project**



11. Description of heating solutions which are affordable and feasible. Both aspects of heating solution are described with price related information and characteristics related to rate, power, autonomy. All those features will be selected in order to provide a competitive advantage to existing heating systems.

Calculation of cost for one GJ

According to the national catalogue of Fixed assets, stoves and boilers have the period of useful life equal to 8 years (position 8403)[26]. Thus 8 years were taken as a basis for calculation of depreciation and price for one GJ of heat generated by the boiler.

Since homemade brick stoves are the most popular heating solution in rural areas and most of the houses are older than 10 years (Figure 11), the depreciation of currently used heating solutions was not taken into consideration because their investment costs were fully depreciated in the first 8 years, assuming a homemade brick stove is considered as part of the construction of the house. Due to differences in constructions of houses and lack of proper information concerning construction costs it will be very difficult to estimate the remaining (un-depreciated) value of the stove considered as a part of the house.

[26] - Catalogue of Fixed assets and intangible assets. Government Decision nr.338 as at 21.03.2003

Annex 8: Importers of Biomass Based heating solutions in the Republic of Moldova

No	Importer	Website	Producer	Country of provenience	Website of producers
1	S.N.A."Systemebasa" s.r.l.		TermoFarc	Romania	http://www.termofarc.ro/
	Tel.830 361	www.sistembasa@mail.md			
2	Bioterm	http://www.bioterm.md	Atmos	Czech R	http://atmos.eu/romania/
	Tel. 294 366	manager@bioterm	EdilKamin	Italy	http://www.edilkamin.com/
			Koteko	Ukrain	http://www.koteko.com.ua/
3	Politermo grup	http://www.politermogroup@yahoo.com	Moderator	Latvia	http://www.moderator.lv
	Tel. 207 169				
4	Solaraterm	http://www.solaraterm.com/	Drew Met	Poland	http://www.kotlydrewmet.pl/en
	Tel. 512 379		Thermostahl PL|GR	Greece	http://www.thermostahl.gr/
5	Casa - Teh	http://www.utilaj.info/	Rojek Cz	Czech R	http://www.rojek.cz
	Tel. 320 676				
6	Termostal	http://www.termostal.md	Ferroli	Italy	http://www.feroli.it
	Tel. 744 934				
7	TermoComfort	http://www.termoconfort.md	Vailant	Germany	http://www.vaillant.com/
	Tel. 921 000				
8	EuroTerm	http://www.euroterm.md	Vailant	Germany	http://www.vaillant.com/
	Tel. 401 301				

Annex 9: List on heating solutions present on Moldovan market able to heat proposed household surfaces

	Producer / Importer	Name	Model	Thermal Power (kW)	Rate (%)	Heating Surface m^3/m^2	Fuel	Fuel consumption kg/h	Typical services	Post warranty services	Price (Euro)	Ref NR.
1	2	3	4	5	6	7	8	9	10	11	12	13
									Warranty	(euro/year)		
1	TermoFarc	Boiler	F1-15NSP	15,4/14	87	160 m2	Brique./Pellets	3,5/2,59	24 months	25-40	3,400	1
2	c/t "Systembasa"srl	Boiler	F1-22NSP	21,6/20,6	87	220 m2	Brique./Pellets	5,06/3,8	24 months	"	3,800	2
3	"	Boiler	F1-18GS	18	87 - 89	180 m2	Briqueeti	3.98	24 months	"	1,775	3
4	"	Boiler	F1-25GS	25.6	87 - 89	260 m2	Briquette	5.96	24 months	"	1,930	4
5	Atmos Chehia	Boiler	D15P	4,5 - 15	90 - 93	150 m2	Pellets|Brique.		24 months	30 - 40	4,170	5
6	Bioterm	Boiler	D20P	6,5 - 22	90 - 93	220 m2	Pellets|Brique.		24 months	"	4,470	6
7		Gasification Boiler	DC18S	14-20/6 -20	84 - 91	200 m2	Brique./Pellets		24 months	"	4,220	7
8	"	"	DC25S	17-25/7-24	84 - 91	240 m2	Brique./Pellets		24 months	"	3,820	8
9			DC15SP(L)	12-15/4,0-13	92.3	150 m2	Brique./Pellets		24 months		4,720	9
10	"	"	DC18SP(L)	14-20|4,5-15	92.3	200 m2	Brique./Pellets		24 months	"	5,020	10
11	"	"	DC25SP(L)	17-25/6 -20	92.3	250 m2	Brique./Pellets		24 months	"	5,320	11

	Producer / Importer	Name	Model	Thermal Power (kW)	Rate (%)	Heating Surface m^3/m^2	Fuel	Fuel con-sumption kg/h	Typical services	Post warranty services	Price (Euro)	Ref NR.
12												
13	EdilKamin It	Pellet Burner	Babor	3,0 - 8	90.1	210/80	Pellets	0,6 - 2,7	24 months	30 - 40	2,600	12
14	Bioterm	Stove	Marini	3,0 - 8	90.1	210/80	Pellets	0,6 - 2,7	24 months	"	2,200	13
15	"	"	Marea	3,5 - 10	90.1	270/100	Pellets	0,7 -2,8	24 months	"	2,600	14
16	"	"	Serena	4,0 - 12	90.1	300/115	Pellets	0,7 - 2,9	24 months	"	3,300	15
17	"	Stove Termo Central	Klima CS	5,0 - 16	81.6	365/140	Briquette	1,7 -5,3	24 months	"	3200*	16
18	"	"	Thermofire	5,0 - 16	85.2	380/150	Briquette	1,7 -5,3	24 months	"	3450*	17
	Producer / Importer	Name	Model	Thermal Power (kW)	Rate (%)	Heating Surface m3/m2	Fuel	Fuel consumption kg/h	Typical services	Post warranty services	Price (Euro)	Ref NR.
19	"	Stove Termo Central	Stand.Line	3 -11 ,3	90.1	300/125	Pellets	0,7 - 2,5	24 months	"	2700*	18
20	"	"	Melodi Line	4,5 - 14	90.4	400/150	Pellets	1,0 -3,0	24 months	"	3480*	19
21	"	"	Top Line	5,6 - 18	91.4	470/175	Pellets	1,2 - 4,0	24 months	"	3860*	20
22	"	Boiler	Ek 17	5,0 - 17	92	420/160	Pellets	1,3 - 4,0	24 months	"	3,300	21
23	"	Boiler	Bazic	6,1- 18	92.7	470/175	Pellets	1,0 - 4,0	24 months	"	3,600	22
24												
25	Koteko UA	Boiler	Kotec 12	12.5	85 - 88	120 m2	Brique./Pellets		24 months	15 - 20	1,200	23
26	Bioterm	"	Kotec 20	20	85 - 88	200 m2	Brique./Pellets		24 months	"	1,560	24
27	Moderator PL	Universal Boiler	Unica Sensor	15	81	120 m2	universal		36 months	30 - 40	3 450*	25
28	Baxi	"	Bio.	20	81	200 m2	universal		36 months	"	3 680*	26

	Producer / Importer	Name	Model	Thermal Power (kW)	Rate (%)	Heating Surface m^3/m^2	Fuel	Fuel con-sumption kg/h	Typical services	Post warranty services	Price (Euro)	Ref NR.
29			Unica	15	84.6	120 m2	universal		36 months	"	2880*	27
30			Vento Eko	20	84.6	200 m2	universal		36 months	"	3060*	28
31	Thermostahl Pl.	Boiler	MCLBio	21	89	120m2	Pellets/bio mix	3,0 - 5,0 ?	24 months		3,030	29
32	"	"	MCLBioMIX	21	89	120m2	Pellets/bio mix	3,0 - 5,0	24 months		3,740	30
33	Drew Met	Boiler	MJ-Eko-Prim	17-24	87	150/200	Pellets/Coal				3,340	31
34	Solaraterm	"										
35												
36	Rojek Cz	Boiler	Rojec A 15	3,0 - 14	86	150m2	Brique./Pellets		36 months	30 - 40	4,250	32
37	Casa-the	"	Rojec TKA 20	8,0 -20	91	200 m2	Brique./Pellets	2,1 - 4,1	36 months	"	4,450	33
	Ferroli It.	Boiler	FSB 14	12,0 - 15	65 - 71	80 m2	Brique./Pellets	5.5	24 months	"	3,400	34
38	Termostal	"	FSB 17	16 - 18	66 - 72	80 -100 m2	Brique./Pellets	9.5	24 months	"	3,800	35
39			Benekov D25	min 17	85		Briquettes				1740	36
40			Benekov C25 P	min 17	85		Briquettes/ Pellets				2,772	37
41			Drew-Met MJ Ekonomik	min 17	85		Pellets				2479	38

Annex 10: List of companies capable of producing heating solutions in the Republic of Moldova

Name of the company:	Address:	Telephone:	Fax:	E-mail:	Web page:
Agrobloc SRL	Mun. Bălți, bd. Victoriei, 51 a	(231) 31–435, 32–433	(231) 32–433		
Drobmetal SRL	Mun. Bălți, str. Ștefan cel Mare, 137	(231) 21–128			
Moldagrotehnica SA	Mun. Bălți, str. Industrială, 4	(231) 88-711, 88-702, 88-703, 88-700	(231) 88-705,	agroteh@moldagrotenica.md	Http: www.moldagrotehnica.md
Nord-Instal SRL	Mun. Bălți, str. Pușkin, 74	(231) 24–054, 21–277		fedotkin@list.ru	
Zarafa SRL	Mun. Bălți, str. Tudor Vladimirescu, 40/5	(231) 30–099, 39–197		zarafa@nordnet.md	
Ancoraj Sistem SRL	MD-2023, Mun. Chișinău, str. Uzinelor, 2	(22) 40-77-80, 41-09-11	(22) 41-09-11	ancorajsistem@yahoo.com, mail@ancorajsistem.com	Http: www.ancorajsistem.com
Oiltech SRL	Mun. Chișinău, str. Calea Basarabiei, 5	(22) 57-16-13, 67-16-14	(22) 55-43-26	oiltech@mdl.net	Http: www.universaltubi.com
Smiit Company SRL	MD-2020, com. Stăuceni, str. Chișinău, 3/A	(22) 45-03-10, 45-03-12, 24-04-22	(22) 45-03-13	smiit@smiit.md, irina@smiit.md	Http: www.smiit.md
Dafsan SRL	MD-2068, mun. Chișinău, str. Decebal, 16	(22) 43-85-48, 44-99-19	(22) 43-85-48	(22) 43-85-48	Http: www.dafsan.ru
Dotarcom SA	MD-2004, mun. Chișinău, str. Columna, 170	(22) 75-18-97	(22) 75-18-97		

Moldovahidromaș SA	MD-2023, mun. Chișinău, str. Meșterul Manole, 7	(22) 47-40-90, 47-40-41	(22) 47-40-69	mold@hidromas.md; hidromas@hidromas.md	Http: www.hidromas.md
Stift SA	MD-2001, mun. Chișinău, str. București, 23 et.1	(22) 22-66-61, 21-21-18, 47-63-96	(22) 22-66-61	stifttmg@yahoo.com	Http: www.stift.ro
Forja Com SA	MD – 2004, mun. Chișinău, str. Columna, 170	75-25-97	75-27-24	forjacom@moldova.cc	
Sănăndtăz SRL	MD-4601, or. Edineț, str. Anton Cehov, 4	(0246)2-44-16	(0246)2-8612		
East European Hinghes SRL	Or. Orhei, str. V. Lupu, 59/6	(235) 9-31-99	(235) 9-31-99	victor579@mail.ru	
Duncan Service	MD-5501, or. Rîbnița, str. Iu. Gagarin, 2	2-37-14, 2-09-12	3-35-52	apnasos@idknet.com	
Uzina Metalurgică Moldoveniască SA IM	Mun.Tiraspol,or.Rîbnița ,str.Industriala 1.	3-08-38,3-13-07	40-0-18	ss@a ommz.com	
Răut SA	Mun. Bălți str. Decebal, 13	(231) 23–090, 29–269, 20–459	(231) 27–130, 21–300	raut99@mdl.net , reut@ beltsy.md	Http: www.beltsy.md/reut
TERMOPRIM S.R.L.	MD-2005, Chisinau. str. Feredeului 12	272-552	272-081		
UMECOOP	MD-2023 Str. Otovasca 15a	373 - 22 - 47-73-89	373 - 22 - 47-60-52	uumecoop@yahoo.com	
ICS "Industrial Manufacturing Group" SRL	MD-6801 or. Ialoveni, str. G. Vieru 28/1, Moldova	+373-26-827521	+373 268 26 609	info@img.md	
ACM-MUNCEȘTI S.R.L.	mun. Chișinău, șos. Muncești, 145/1	+373-22-384578	+373-22-384313		www.akmetal.md

Annex 11: List of briquettes and pellets producers in Moldova[27]

		Company name	Location	Contact person	Mob number	Type of produced fuel		Raw material used	Equipment country of origin	Average fuel prices, MDL/tone
						Briquettes, t/year	Pellets, t/year			
North		S.C.„PANTEHNO-NORD"	Singereii Noi, Singerei	Vadim Panciuc	68600621	2000	n/a	Straw	CIS	1200
		"Ecoverde" SRL	Rautel, Falesti	Iurie Rosca	60443524	4500	n/a	Straw, sunflower husk	Poland	1200
		"Beta Service" SRL	Otaci	Alexandru Bumacov	67269245	n/a	2000	Filed and energy crops	CIS	2500
		"Brilan Prim" SRL	Glodeni	Ruslan Chiriac	060522365 024922677	2000	n/a	Straw	CIS	Not known yet
		"Solutii IT" SRL	Girbova, Drochia	Vasile Pinzaru	68655200	2000	n/a	Straw	CIS	1600
		Individual person	Corjeuti	David Groza	69280926	2000	n/a	Wood waste	CIS	Not known yet
		S.R.L.„ECO-FOC"	Singerei	Andrei Cosovan	79354383	2000	n/a	Straw	CIS	1300
		Pohoarna Agro SRL	Pohoarna, Soldanesti	Alexandru Ciudin	69649599	1500	3000	Wood waste, straw	Ukraine, Italy	1500/2500
		Melentagro SRL	Floresti	TBC	TBC	4500	n/a	straw	CIS	TBD
		Argon Sigma	Riscani	Diaconu Alexei	069157274	Yes	n/a	straw	TBD	TBD
		ARGON-SIGMA SRL	Riscani		256 24 009	TBD	TBD	TBD	TBD	TBD
		Flaorea Soarelui S.A.	Balti	Mkt Dpt.	231-52644 / 52852			Sun flower husk	TBD	TBD
		Trefogroup SRL	s. Pirjota, Riscani	Victor Dalta	68624399 / 69434948	n/a	TBD	TBD	TBD	TBD
		BioTermEnerg SRL	Glodeni	Stircu Anatolii	069379332	TBD	TBD	TBD	TBD	TBD
		SRL Mercurii - Prim - Impex	Floresti	Iurii Tanasov	69143403	Yes	n/a	straw	Poland (Asket)	TBD

[27] The list contains only active production sites. Based on the number of equipment sets bought and the intentions of the entrepreneurs, the total number of productions sites in the next year may double as there is a waiting list for equipment import.

		Company name	Location	Contact person	Mob number	Type of produced fuel		Raw material used	Equipment country of origin	Average fuel prices, MDL/tone
						Briquettes, t/year	Pellets, t/year			
Center		"Eurobricon" SRL	Chisinau	Tatiana S.	69778544	5000	n/a	Wood waste		2200
		"Eurolemn" SRL	Chisinau		69116116	4500	n/a	Walnuts shells	CIS	6000
		"Avantaj AV" SRL	Chisinau	Serghei	69744700	~ 1000	n/a	TBD	TBD	Internal use
		"BIOS-GRM" SRL	Criuleni, Baltata	Ochisor Nicolae	060260460	n/a	4500	Wood waste, Sunflower husk, straw	TBD	1800
		"BioInovative" SRL	Horasti, Ialoveni	Alexei Gheorghe	69649599	n/a	1000	Wood waste	CIS	TBD
		BioTop	Chisinau	Alexei	069109695	1000	n/a	Wood waste, straw	Moldova	1600
		Bucovat	Bucovat, Straseni	Vitalie Panaguta	069987700 069138340	n/a	1250	Sunflower husk, straw	CSI	Internal use
		"Arin Alb" SRL	Sociteni, Ialoveni	Rodica Eugeniu Scurtu,	069412608; 069457098	n/a	1000-2000	Wood waste	Czech Rep.	TBD
		„Biovista" SRL	Orhei, Soldanesti	Ochinca Sergiu	69980777	4000	n/a	Filed crops, wood waste	TBD	1500
		SRL "DIVEXIM-GRUP"	Chisinau	Vulpe Dumitru	79112781	n/a	1000	Sunflower husk	CIS	Not known yet
		"SC VladlemnCom" SRL	s. Lozova, Strășeni	Dosca Vladislav	79406228	1200	n/a	wooden waste	Poland	1600
		SRL Baltmorepellets	Chisinau	Edvinas Bautrenas	69455497	TBD	n/a	TBD	TBD	TBD
		SRL PROBAVARIA	Chisinau	Victor Bacaliuc	693 88332	TBD	n/a	TBD	TBD	TBD
		Luxiton SRL	Chisinau	Sergiu Lazarancu	22 29 65 91	TBD	n/a	TBD	TBD	TBD
		DIMITEH SRL	Chisinau	TBD	373 22 59 24	TBD	n/a	TBD	TBD	TBD
		SRL Ratzon Construction	Chisinau	Alexandru	68903551	TBD	n/a	TBD	TBD	TBD
		SRL Bioinovative	Chisinau	Plesca Alexei	78884888	TBD	n/a	TBD	TBD	TBD
		SRL Balimels	Bulboaca, r-n Anenii Noi	TBD	TBD	TBD	n/a	TBD	TBD	TBD
		"Bioresurse" SRL	Ciniseuti, Soldanesti	Victor Dolghii	69185555	600	1200	Wood waste, straw	Italy, Ukraine	1800/2500

		Company name	Location	Contact person	Mob number	Type of produced fuel		Raw material used	Equipment country of origin	Average fuel prices, MDL/tone
						Briquettes, t/year	Pellets, t/year			
South		"AgroBioBrichet" SRL	Festelita, Stefan Voda	Oleg Donoaga	79714848	4500	n/a	Straw	CIS	1200
		„Promo Concept" S.R.L	Antonești, Stefan Voda	Daguța Daniel	79584444	4500	n/a	Field crops	CIS	1200
		Agrosud-service SRL	s. Bucuria, Cahul	Chirilenco Igor	069160906	5000	n/a	sreaw	Czech Rep.	TBD
		AgroAndor SRL	Cimislia	Andrei Salaru	79154027	1000	1000	Straw crops	Poland	1200/1500
		TransOil Refinery	Ciadir Lunga	Mihail Caraseni	069102107	TBD	TBD	Sunflower husk	TBD	TBD
		Grupo Boieru	Burlaceni, Cahul	Boieru Maria	29354363	1000	1000	Straw, wood		
		Egrejius	Leova	Grosu Petru Alex	68444797	TBD	TBD	TBD	TBD	TBD

Annex 12: List of Fire-Prevention Society Branches

ASOCIAȚIA OBȘTEASCĂ
SOCIETATEA ANTIINCENDIARĂ
din REPUBLICA MOLDOVA
MD 2069 mun. Chișinău, str.Drumul Crucii nr.10
tel/fax. +(37322) 74-98-03; tel. +(37322) 74-56-03
BC "Mobiasbancă" S.A. fil. nr. 9 MOBBMD22749
c/d 225170049810440, c/f 237688, TVA 0500614

ОБЩЕСТВЕННАЯ АССОЦИАЦИЯ
ПРОТИВОПОЖАРНОЕ ОБЩЕСТВО
РЕСПУБЛИКИ МОЛДОВА
MD 2069 мун. Кишинэу, ул. Друмул Кручий, 10
тел/факс. +(37322) 74-98-03; тел. +(37322)74-56-03
BC "Mobiasbancă" S.A. fil. nr. 9 MOBBMD22749
р/с 225170049810440, ф/к 237688, НДС 0500614

_____nr._____

La nr._____din_____

Lista filialelor Asociației Obștești „Societatea Antiincendiară din Republica Moldova" cu prestarea serviciilor de hornărit,

verificare și curățire, reparația coșurilor de fum și canalelor de ventilare

Nr. d/o	Organizațiile teritoriale filiale ale A.O. SARM	Reprezentanță	Adresa	telefoane de contact	Președinte
1	Societatea Antiincendiară r-l Nisporeni		or. Nisporeni, str. Ștefan cel Mare nr.1, MD-6401	026426988/067328567	Tatarov Eduard
2	Societatea Antiincendiară r-l Ștefan-Vodă		or. Ștefan-Vodă, str.31 August 9/1-47, MD-4201	024223492/069490662	Dediu Igor
3	Societatea Antiincendiară r-l Cimișlia		or. Cimișlia, str.Ștefan cel Mare 81, MD-4101	024124506/079523579	Cicatii Dumitru
4	Societatea Antiincendiară r-l Rezina		or. Rezina, str.M.Eminescu 10/8 , MD-5400	067256064/025423774	Golban Nicolai
5	Societatea Antiincendiară r-l Briceni		or. Lipcani, str.Miciurina1,MD-4701	024761364/068224450	GorodițchiiVitalii
6	Societatea Antiincendiară r-l Călărași		or. Călărași, str. Alexandru cel Bun 148, MD-4404	024420479/079980223	Rața Vasile

Nr. d/o	Organizațiile teritoriale filiale ale A.O. SARM	Reprezentanță	Adresa	telefoane de contact	Președinte
7	Societatea Antiincendiară r-l Bălți		mun. Bălți, str.Păcii 28, MD-3101	023123101/069317672	Ostaf Mihail
		Societatea Antiincendiară r-l Glodeni	or. Glodeni, str.300ani Glodeni 100, MD-4900	024923302 069561941	Reprezentant Bucatca Boris
		Societatea Antiincendiară r-l Fălești	or. Fălești, str.Moldovei 43, MD-5902	025900148 069368039	Reprezentant Borovic Leonora
		Societatea Antiincendiară r-l Sîngerei	or. Sîngerei, str.Victoriei 4, MD-6201	026224561 068847732	Reprezentant Onceanu Sergiu
8	Societatea Antiincendiară r-l Orhei		or. Orhei, str.M.Sadoveanu 28-2, MD-3504	069227071	Morozan Nicolae
9	Societatea Antiincendiară r-l Rîșcani		or. Rîșcani, str.M.Kogălniceanu 105, MD-5601	025622286/079715699	Gurău Nicolai
10	Societatea Antiincendiară r-l Telenești		or. Telenești,str.B. Glavan 35, MD-5800	025824550/069012048	Poperecinîi Alexandru
11	Societatea Antiincendiară r-l Drochia		or. Drochia,str.A.Mateevici 31, MD-5202	025221233/0692190956	Broslavschi Ion
12	Societatea Antiincendiară r-l Cantemir		or. Cantemir,str.B.Glavan1,MD-7301	027323264/079212068	Profir Gavril
		Societatea Antiincendiară r-l Leova	or. Leova, str.Eminescu 15	027323264/079212068	Profir Gavril
		Societatea Antiincendiară r-l Cahul	or. Cahul, str.Doinelor 54, MD-3909	029942515 079385849	Reprezentant Galirov Ion
13	Societatea Antiincendiară r-l Ungheni		or. Ungheni, str.Decebal 29, MD-3603	023625573/069393269	Buruiană Victor
14	Societatea Antiincendiară r-l Anenii-Noi		or. Anenii-Noi, str. Concilierii Naționale 24, MD-6501	026522564/069204643	Timoșenco Victor

Nr. d/o	Organizațiile teritoriale filiale ale A.O. SARM	Reprezentanță	Adresa	telefoane de contact	Președinte
15	Societatea Antiincendiară r-l Comrat		mun. Comrat, str.Comsomoliscaia 17, MD-3805	029822601/079901402	Cînalî Piotr
		Societatea Antiincendiară r-l Ceadîr-Lunga	or. Ceadîr-Lunga,str.Kutuzov 2-1, MD-6104	029126727 067376727	Reprezentant Manaf Demian
		Societatea Antiincendiară r-l Taraclia	or. Taraclia,str.1 mai 73, MD-7401	029493385 029434188	Reprezentant Cahșci Ivan
16	Societatea Antiincendiară r-l Strășeni		or. Strășeni, str.S.Lazo 2, MD-3701	023723282/079906323	Vidrașcu Leonid
17	Societatea Antiincendiară r-l Florești		or. Florești, str.Florilor 40/2, MD-5001	025020442/069320672	Armaș Iacob
18	Societatea Antiincendiară r-l Hîncești		or. Hîncești, str.M.Hincu 163, MD-3401	026923791/079611452	Tiron Anatolie
19	Societatea Antiincendiară r-l Rîșcani		or. Rîșcani, str.M.Kogălniceanu 105, MD-5601	025622286/079715699	Gurău Nicolai
20	Societatea Antiincendiară r-l Soroca		or. Soroca,str.Nedovschi 73, MD-5800	023033071/069087527	Pînzaru Vasilii
21	Societatea Antiincendiară r-l Dondușeni		or. Dondușeni, str.31 August 2-41, MD-5101	067185888/060221026	Martîniuc Andrei
22	Societatea Antiincendiară r-l Căușeni		or. Căușeni, str.M.Costin 35, MD-4300	-	Fatculin Viorel
23	Societatea Antiincendiară r-l Vulcănești		or. Vulcănești, str.Cosmonavtov 8/4	-	-

Annex 13: Example of a Framework for an informational booklet

House
90 m^2

	Home Made Brick Stove	Biomass Based Heating System	
Efficiency:	50-70%	88-93%	Fuel is burning efficiently, Heat is not going up the chimney
Consumption of fuel In season:	**Expenses:**		
Wood: 12 t.	11 000 Mdl	Straw briquettes / pellets: 5t. **Expenses:** 8 000 Mdl	**Economy 3 000 – 5 000 Mdl** per heating season **Investment recuperation in X years**
Coal: 7 t.	13 000 Mdl		
Natural Gas: 2 000 m^3	13 000 Mdl		
Mix: Wood (80%): 9 t. Coal (20%): 1.5 t.	12 000 Mdl		
Hot Water:	⛔	✓	
Regulating temperature:	⛔	✓	
Environmentally Neutral:	⛔	✓	

Address: **Examples of biomass based heating systems in your village**	**Useful contacts:**
	Fuel suppliers:
Information about fuel	Pelleting / Briquetting services:
Caloric value: **Market price:**	
Wood	
Coal	
Natural Gas	Producers of heating solutions:
Straw briquettes	
Straw pellets	Private owners of heating systems on biomass:

(Footnotes)

1 Natural Resources Canada, RETScreen Clean Energy Project Analysis Software

2 Current heat load of rural household was calculated on the basis quantity of fuel consumed by average household described in Table 9.

3 Optimal heat load was calculated in accordance with norms of living described in Decision #191 of Government of the RM as 19.02.2002, this document stipulates minimal comfortable conditions of in-house temperature during heating season.