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The Opportunities and Threats to a Community-Based Decentralized Energy System: Biomass Briquette Production in Bag, Hungary

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ABSTRACT OF THESIS submitted by: Richard Robert RACZ for the degree of Master of Science and entitled: "The Opportunities and Threats to a Community-Based Decentralized Energy System: Biomass Briquette Production in Bag, Hungary"

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Decentralized energy system are a way of ensuring access to modern and efficient energy sources in such areas of the developing countries, where modern energy services does not available. Contrary to the developing world, in the developed countries there are widely accessible energy services; however households with low income level are increasingly facing with challenges to afford their basic energy needs. Roma are highly represented among these household, who are not just facing with energy poverty but with environmental injustices as well. In Hungary a relevant share of the Roma are living in segregated areas many times without running water, adequate sewerage and heating and enough space required for healthy living, in addition to that they are facing with high level of poverty. Therefore for these segregated settlements an applicable solution can be the decentralized community based bioenergy models, which provide cost effective, environmental friendly local solution managed by the local community. In the Roma community of Bag a community based biomass briquette production successfully work as new heating strategy and by this to contribute to the decrease the illegal logging and burning of harmful materials, which many times appear as alternative heating strategy in poor and Roma communities.

Keywords: decentralized energy systems, energy poverty, environmental injustice, Roma community, biomass briquette.

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BESOM	Brookhaven Energy System Optimization Model
BB	Biomass briquette
CEE	Central and Eastern Europe
DES	Decentralized energy system
EBRD	European Bank for Reconstruction and Development
EPEE	European Partnership for Energy and the Environment
EU-SILC	European Statistics on Income and Living Conditions
GHG	Greenhouse gases
HUF	Hungarian Forint
IEA	International Energy Agency
MARKAL	Market Allocation Model
MCA	Multi-criteria Analysis
NEMS	National Energy Modelling System
NGO	Non-governmental Organization
OECD	Organization for Economic Cooperation and Development
REM	Renewable Energy Management
SCP	Sustainable Consumption and Production
TESOM	Time-stepped Energy System Optimization Model
UNDP	United Nations Development Programme
US	United States of America
UK	United Kingdom

1. Introduction

The current and future status of energy, energy systems and related services are widely discussed topics at both national and international levels. The two main forces that drive energy and energy related issues are climate change mitigation and the ambition to provide universal access to modern and affordable energy, which is determined as a key tool to alleviate poverty and a cornerstone of sustainable development. While in developed countries energy systems are generally well developed, developing countries are especially challenged to meet people's energy needs due to lack of infrastructure. According to recent studies globally 1.4 billion people live without access to electricity and 2.7 billion people rely on traditional biomass for cooking and heating and use candles, kerosene or diesel lanterns to get lighting (OECD/IEA 2010). However the cost of the extension of existing central energy system or the cost of constructing a new infrastructure would be extremely high. The economic status of developing countries does not allow such a large scale investment, therefore another approach, the decentralized energy systems (DES) is an alternative strategy to offer modern and affordable energy (Schäfer et al. 2011).

The implementation of the decentralized energy system on one hand positively contributes to the climate change mitigation efforts as it produces energy more efficiently, uses locally available renewable energy resources and local workforce in all levels of the energy production chain. On the other hand the energy production, contrary to the central energy systems, is situated near to the people, therefore decentralized energy systems are able to take into consideration the particular energy needs and economic status of the users. Additionally the size of these systems are mostly small or medium, therefore it can respond easier to any changes and occurring barriers in the energy production chain and requires less financial

investment (Herran and Nakata 2011; Mangoyana and Smith 2010; Kaundinya et al. 2009; Hiremath et al. 2005).

Contrary to the developing world, in the developed countries there are widely accessible energy services; however households with low income level are increasingly facing with challenges to afford their basic energy needs. Low income level is one of the key parameters, which determines the ability to afford basic energy needs for cooking, heating and lighting. However other factors such as the conditions of the houses (insulation; poor doors, windows, walls and roof; efficiency of heating equipment; behavior and needs related to energy, etc.), the price of the energy and lack of favorable energy policies are also determining (Energy Club 2010). Arduousness related to energy affects more and more households in the developed countries as well; therefore a new approach is needed which is able to provide cheap and sustainable energy for the poor households. Simple and cheap decentralized energy systems tested in developing countries can offer an optional local solution for the poorest segments of the developed countries.

The concept of energy poverty aims to formulate the inability of poor households to afford and access modern energies. Consequently the socio-economic status of the people can significantly limit or open the opportunities related to access to modern energy. The concept of environmental justice, which refers to the equal access to the environmental benefits and services, is an appropriate term to express the burdens of poor households, ethnic minorities, communities that cannot benefit from the modern energy services due to their low income level, discrimination and segregation (Steger et al. 2007).

The biggest and most disadvantaged minority in the European Union is the Roma. Most of the Roma families live in poverty with poor environmental conditions and it is mostly visible in the housing and living conditions. Over the past twenty years, many governmental programs

and non-governmental organizations tried to improve living conditions for the Roma population in Europe; however, majority of the Roma settlements are still inadequate for living. Many of these segregated settlements do not have running water, adequate sewerage and heating and enough space required for healthy living. These conditions are highly affecting the quality of life and closely linked to the health conditions of Roma. One of the main problems is the access to affordable and cleans heating sources and electricity. Poor energy access seriously intensifies in winter, when households in rural areas are left without traditional forms of heating and in this critical situation people mainly find harmful methods of alleviating this crisis, that is, they burn plastic, rubber and old clothes. Furthermore they are also forced to cut trees illegally, and logging sometimes is so extended that it results in local deforestation.

Most of the Roma settlements located in rural areas, which can have access to modern energy sources, but the households are not able to afford it due to their low social status, housing segregation linked to environmental inequalities and high prices of energy. Therefore for these segregated settlements an applicable solution can be the decentralized community based bioenergy models, which provide cost effective, environmental friendly local solution managed by the local community.

This thesis is going to analyze one community based bioenergy project, which introduces the production of biomass briquette to reduce the heating vulnerability of the local Roma community in Bag. The development of the used technology is aimed to ensure solution for the poorest in developing countries, which lack energy to cover their basic needs such as the cooking. In the Hungarian context the biomass briquette applied to meet mostly the heating needs of Roma communities during the cold season.

1.1 Research questions

A. What are the main factors of energy poverty in case of the Roma focusing on the Roma community of Bag?

B. What are the opportunities and threats of the implementation of the biomass briquette project in Roma settlement?

1.2 Definitions

Decentralized energy system: There is widely available literature related to the utilization of renewable energies in different context. Consequently many terms appeared in the literature such as decentralized energy system, bioenergy system, renewable energy system etc. However these terms can be differentiated based on their context; this thesis does not make differences in their interpretation, rather uses and focuses on the common aspects of them, namely the advantages which they indicate: the modern and affordable energies. So in thesis these terms appear as synonyms.

Environmental injustice/racism/discrimination: The term of environmental injustices is explained in the literature review. In this part I refer to the environmental racism and discrimination as part of US interpretation, which explains the terms as racial and ethnic inequalities related to environmental risks and benefits. During the thesis I use these terms as synonyms.

Energy poverty/fuel poverty: The terms are explained in the related chapter and are used as synonyms in the text.

Roma settlement/ Roma colony: It is a physically segregated area, which is populated mainly by Roma. In the Hungarian context these are usually part of the administration of the municipality and located at the edge of the locality.

2. Literature review and theoretical framework

This chapter of the thesis is going to analyze the theoretical framework regarding to the meaning of environmental injustice and energy poverty as the main definitions in context to the energy situation of Roma. In addition to that it will specifically evaluate and identify the main factors of energy poverty and injustice in the Hungarian context. This part is also going to introduce the advantages of small scale decentralized energy systems.

2.1 Development of Environmental justice

The definition of environmental justice and injustice can be defined based on the following dimensions: "*A condition of environmental justice exists when environmental risks, hazards, investments and benefits are equally distributed without direct or indirect discrimination at all jurisdictional levels and when access to environmental investments, benefits, and natural resources are equally distributed; and when access to information, participation in decision making, and access to justice in environmental-related matters are enjoyed by all*" (Steger 2007 et al. p. 10). While the definition of environmental justice: *"An environmental injustice exists when members of disadvantaged, ethnic, minority or other groups suffer disproportionately at local, regional (sub-national), or national levels from environmental risks or hazards, and/or suffer disproportionately from violations of fundamental human rights as a result of environmental factors, and/or denied access to information; and/or participation in decision-making; and/or access to justice in environment- related matters"*(Steger et al. 2007 p. 10).

The root of the environmental justice movements is originated from the United States in 1980s. There were two main cases which famed and determined the environmental justice movement. One of the cases was in Warren County in North Carolina where African

Americans protested to build a toxic landfill near their homes and the other case was in Love Canal, in New York, where the working class community reached their objective, namely the area where they lived to be declared as a disaster area due to contaminated soils from earlier industrial activities and people to be evacuated (Steger et al. 2007).

Inequalities in environment protection named some times as environmental racisms. This definitions aims to reflect on the racial and ethnic inequalities related to environmental risks and exclusion from implementation of environmental policies. In US the most affected groups were the African Americans, Hispanics and Native Americans (Laurent 2011).

The roots, opportunities and objective differ how to combat environmental injustice across regions. While in the US it appears as a civil right movement led by ordinary people without specific background focusing on the risk of inappropriate management of toxics, in the UK well prepared environmental organizations and non-governmental organizations emphasize the unequal distribution of the environmental benefits and harms (Harper et al. 2009).

In the European context the Scottish government defined the definition of environmental justice based on the principle of fair distribution and decision making: *"the 'distributive justice' concern that no social group, especially if already deprived in other socio-economic respects, should suffer a disproportionate burden of negative environmental impacts; the 'procedural justice' concern that all communities should have access to the information and mechanism to allow them to participate fully in decisions affecting their environment"*(Laurent 2011 p. 1848). The UK Environmental Agency argues that environmental injustice highly affects the quality of life of those communities who are discriminated. It also introduces a third principle into the Scottish definition which is the policy justice, which *"concerned with the principles and outcomes of environmental policy decisions and how these affect different social groups"* (Laurent 2011 p. 1848).

In CEE countries the basic environmental and human right legislation and institutions has been introduced due to the accession process and membership of the European Union. Therefore EU provides a framework for promoting environmental protection, human rights in form of Charter of the Fundamental Rights of the European Union and European Union Sustainable Development Strategy (Harper et al. 2009). The environmental justice movement is relatively a new phenomenon in CEE, but can be understood and analyzed based on the UK and US developments. In CEE the environmental injustice ensures to bridge three policy areas for researches and activists: environmental protection, social cohesion and discrimination against Roma, who are the biggest minority of Europe and experience disproportional level of poverty. Roma are living in CEE for many centuries but mostly due to the transition to free market economy their traditional crafts became obsolete and in addition to that they are facing with discrimination in all sectors of the society (education, health care, employment, social care etc.) (Harper et al. 2009).

2.2 Definition of energy poverty/fuel poverty

One form of the environmental injustice is the energy poverty, which aims to reflect on the capability of families to access and afford energy, but there is still no common definition used by the countries. Furthermore there are even countries, despite the fact that the vulnerabilities related to access to modern and affordable energy seriously affect more and more people or households, which are not aware of the phenomenon of energy poverty (Herrero and Ürge-Vorsatz 2010). The two basic elements of the description of energy poverty, which are similar in all of the definitions, are the inability of the households to warm up the rooms to appropriate level and disproportionally high share spent from income on domestic energy (Energy Club 2012).

The other difficulty around the energy poverty is the appellation of the definition as the literature equally uses fuel poverty and energy poverty. While fuel poverty was used (in the beginning) to describe and emphasize the problem to get appropriate heating, energy poverty basically means the lack or difficulties to access to energy services and lack of the energy system infrastructure (Energy Club 2012). However by this time the literature mostly use the term of energy poverty and fuel poverty interchangeably.

The evolution of the definition can be well observed in the European Union and Hungary according to the Energy Club research (2012). The first definition belongs to P. Lewis who described the problem in 1982 as an inability to keep the homes warm. The following and most used definition on fuel poverty is belongs to Boardman (1991), she determined those households as energy poor households which spent more than 10 percent of their total income to keep the home warm. As there was not scientific backgrounds which demonstrate the 10 percent limit, this definition was widely criticized for instance by J.D. Healy (1999) who also missed the scientific evidence on the 10 percent limit. He defined energy poverty as someone's inability to warm up his or her home to appropriate level due to low income level and the bad energy efficiency of the houses. Professionals of the European Bank for Reconstruction and Development (EBRD), namely S. Fankhauser and S. Tepic concluded in their research in 2003 that the determination of the expenditures of the households on heating is impenetrable due the various heating modes and used energy resources. They determined that if the household spend more than 25 percent from the total annual income, it can be considered to energy poverty. The 25 percent is divided to three parts, such as electricity and heating which represent 10 – 10 percent, water and sewage which represent 5 percent from the expenditure. S. Buzar (2007) conducted research in East Europe and defined energy poverty as the inability to warm up home to such level which satisfies our basic social and material needs, he also agrees not to use any ratio number.

Basically the causes of the energy poverty can be determined by three factors, these are the low income, the households low energy performance and the high energy prices (Energy Club 2012; EPEE 2009). According to the interpretation of Energy Club (2012), energy poverty is based on poverty (social problem) and energy efficiency problem at the same time. It says that those households affected mostly by energy poverty which have inappropriate energy performance due to the low energy efficiency and face with high energy prices compared to the income level. These households cannot afford to improve the status of the house and consequently cannot come out of the energy poverty status.

Based on the European Fuel Poverty and Energy Efficiency (EPEE) project, which analyzed five European countries approximately 50-125 million people are affected by energy poverty, which is expected to increase due to disadvantaged economic situation. UK was among the first countries of the EU which adopted measures to handle the energy poverty. It adopted and developed the definition, drafted a comprehensive strategy and allocated relevant financial resources to improve the situation. In 2001 the government adopted The UK fuel Poverty Strategy and allocated 20 million Pound for this objective (Energy Club 2012).

2.3 Analyzing the main factors of energy poverty and environmental injustice in Hungary

2.3.1 Energy poverty in the Hungarian context

According to the UK definition of energy poverty, 10 percent of income spent on energy, approximately 80 percent of the Hungarian families would be classified to be energy poor, which do not reflect the reality because the median spending of an average Hungarian family is 17 percent of their income. Therefore the Hungarian Energy Club tried to adopt the definition to the Hungarian context and it determines three criteria which have to meet

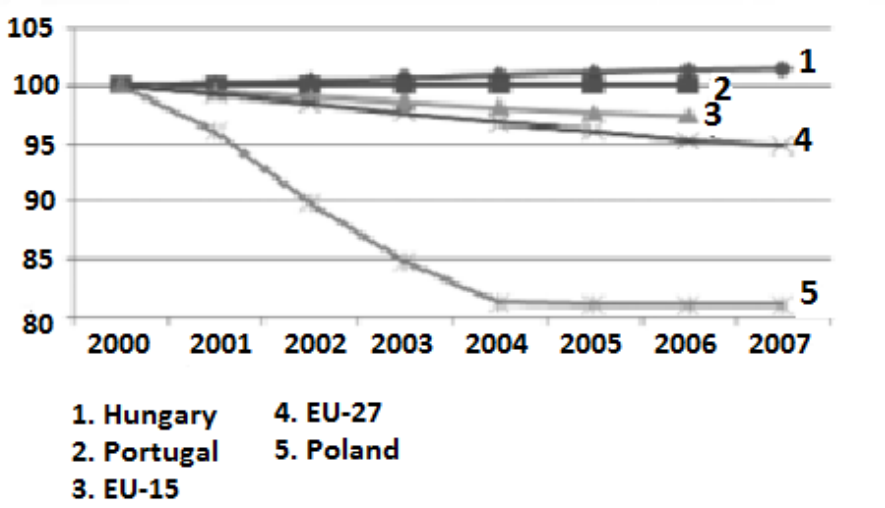
simultaneously. First, "*the annual income of the household is below 60% of the median Hungarian household income"*. Second, ''*the ratio of the theoretical annual energy cost of heating the house to 20°C and providing hot water and the household's total income is more than double the median rate based on the total number of households' actual, declared data, namely 34%''*. Third, ''*the building has an energy performance certificate rating below F''* (Energy Club 2012 p. 2). Based this definition 8-10 percent of the Hungarian households are energy poor meaning approximately 300-380 thousands households.

In Hungary the access to energy is not causing significant problem to the population, rather the increases in the energy prices, the inappropriate energy performance of the houses and the low income level which much lower than the average in EU (Ürge-Vorsatz and Herrero 2010). In 2000 – 2007 Hungary was among the first three countries of the EU where the price of gas and electricity increased significantly. The salaries and retired pay were also increasing by higher ratio, but the increase was stopped in 2006 when the price of the gas and district heating doubled (Ürge-Vorsatz and Herrero 2010). Based on the report of the Energy Club due to the increased prices the poorest people spent 35-40 percent of their income on energy (Energy Club 2010).

According to the analysis of EU-SILC 14.4 percent of the Hungarian population could not afford their basic heating needs, 16.6 percent had debt due to the high energy bills, and 26.3 percent of the Hungarian population had poor housing conditions (missing or inappropriate insulation, humid walls, old doors and windows in bad conditions, etc.) between 2005 and 2007 (Energy Club 2010). Despite the fact that relevant ratio of the Hungarian population suffers from debts related to energy consumption, Hungary was among the top ten countries in the EU where the average energy consumption per 1 m^2 of household was the highest (Energy Club 2010). So the Hungarian households consume lot of energy which raises the question of effective energy use which is linked to the energy performance and conditions of

the houses. According to the ODEX energy efficiency index (Figure 1.), Hungary is the only country where this index showed increased energy inefficiency of civil sector during 2000-2007 (Ürge-Vorsatz and Herrero 2010).

Figure 1. The ODEX energy efficiency index change related to the households. Hungary vs. EU and other countries (2000-2007) (2000=100).



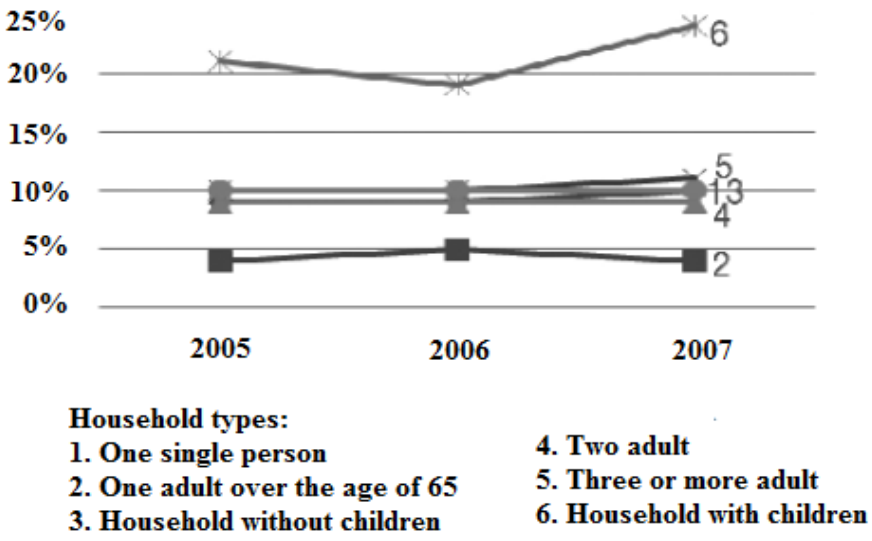
Source: Ürge-Vorsatz and Herrero 2010 p. 9. (ODYSEE database)

The main factors which correlates with energy poverty in Hungary are the following: (1) size of the house (45 percent of energy poor families are living in more than 100 m2 house); (2) geographical position of the household (29 percent of energy poor families are living in rural areas, in villages); (3) if there is retired family member in the household (45% of energy poor household has retired member); (4) if there is unemployed family member (27 percent of the energy poor household has unemployed member) (Energy Club 2012).

In addition to that it is important to evaluate profile of those families who has accumulated debts due to unemployed energy bills, which can be considered as the most disadvantaged among the energy poor households. According to the EUROSTAT data (Figures 2.,3.,4.), the most affected families in terms of accumulated debts are families with more children and

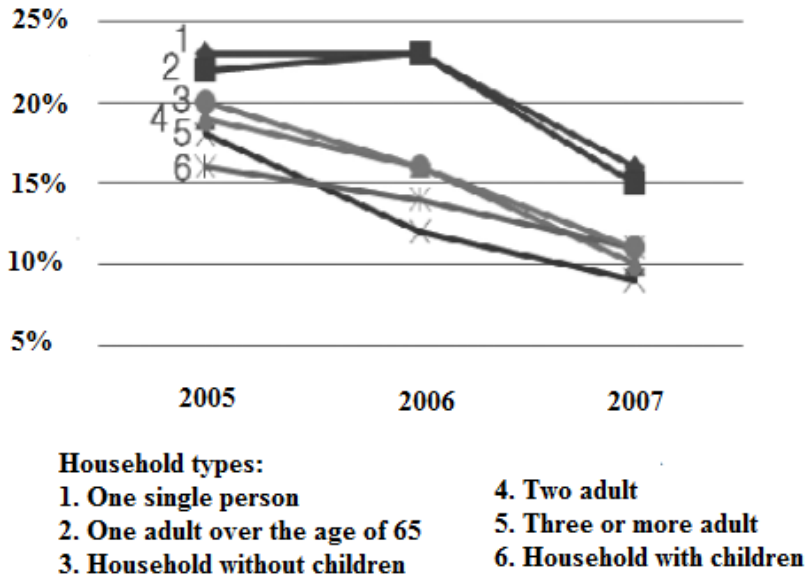
whose income is under 60 percent of the median Hungarian income level; and the other most effected groups are adults older than 65 years old (Ürge-Vorsatz and Herrero 2010). These households use short term solution to be able to catch up with their expenditures such as delayed paying of bills and/or switching off the heating. Families from rural arear are mostly using fuelwood for heating, but they also suffering from inability to warm up their houses, because the price of the fuelwood increased by 122 percent in 2000 – 2008. Therefore the poorest households in rural areas forced to use illegal channels to meet their heating needs such as illegal logging (Ürge-Vorsatz and Herrero 2010).

Figure 2. The ratio of people with utility depts. Hungary (Household types).



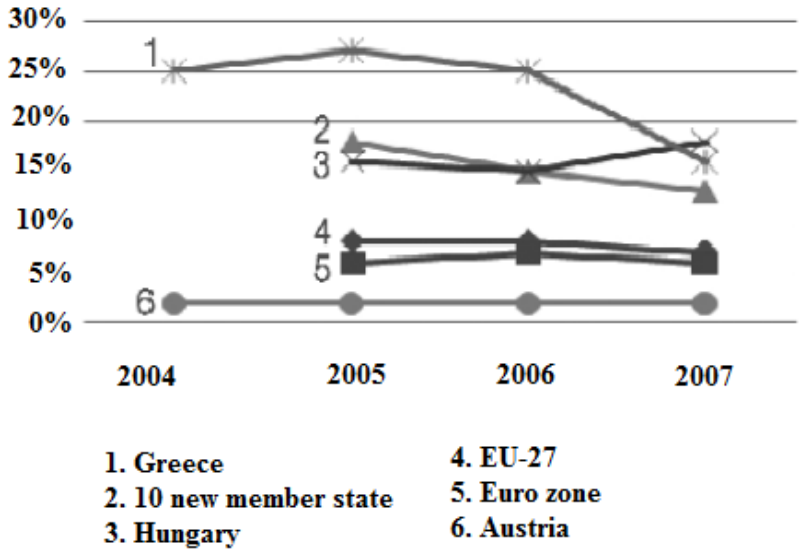
Source: Ürge-Vorsatz and Herrero 2010. P. 12. (EUROSTAT, EU-SILC)

Figure 3. The ratio of households with inability to warm up their homes to appropriate level. Hungary (household types).



Source: Ürge-Vorsatz and Herrero 2010. p. 12. (EUROSTAT, EU-SILC)

Figure 4. The ratio of people with utility depts. Hungary vs. EU-27.



Source: Ürge-Vorsatz and Herrero 2010. p. 12. (EUROSTAT, EU-SILC)

Energy poverty has also impact on the health status of the most affected groups (elderly people, children and poor), because during the winter time the insufficient warm level of the

houses and unhealthy housing conditions linked to poverty (humid and mold walls, doors in bad conditions) cause higher winter mortality ratio. Naturally, not all of the winter mortality caused by energy poverty, but the humid, mold walls and cold rooms definitely contribute to increased ratio. Based on rough estimate annually 1400-2400 people die due to bad housing and living conditions related to energy poverty. In 1995-2007 the risk of winter mortality in case of 60 years old or older people was ten times higher compared to 40-59 years old (Ürge-Vorsatz and Herrero 2010).

We can conclude that the energy poverty in Hungary mostly affects families in rural areas who have low income and there are children and retired or unemployed persons in the family. The poorest communities in Hungary are the Roma minority, which disproportionally hit by environmental inequalities as well. Therefore energy poverty in Hungary also combines the social problems and environmental racism. The next chapter is going to analyze deeper this question.

2.3.2 Environmental injustice and energy poverty in case of Roma in Hungary

Researchers estimate that 650-750 000 Roma are in living in Hungary, which means 6-7 percent of the total population. Majority of Roma are living in rural areas and concentrated on the most deprived parts of Hungary (North East part of Hungary). According to the National Inclusion Strategy of the Hungarian government there are about 500-1660 colonies with 280 000 – 315 000 people, which involves 3 percent of the total Hungarian population. These colonies are located on the edge of the locality or on outskirts (National Inclusion Strategy 2011).

The housing of socially excluded groups is more likely to be in flood areas, lack access to water and sanitation. These families are not able to improve their housing condition and afford modern energy sources due to their social status. According to the UNDP survey (2012) 30 percent of the Roma households in Hungary are without improved water sources, 30 percent without sanitation and 5 percent without electricity (Peric 2012). 54.9 percent of Roma households in Hungary do not have access to hot running water, 34.7 percent do not have access to cold running water, 66.6 percent do not have adequate sewerage, 49.8 percent do not have bathrooms or showers in their homes, 50.1 percent do not have indoor toilets and 13.2 percent have one or more member sleeping on earthen floors in their homes based on the World Bank report from 2003 (World Bank 2003).

According to research from 2004, in large number of cases where sewerage and gas mains exists in the town, but not in the Roma settlements. The National Public Health and Medical Officers' Service reported 15 percent of 767 Romani colonies are within 1000m of illegal waste deposits and 11percent within 1000m of animal carcass disposal sites (Steger et al. 2007).

These inadequate, unhealthy housing conditions are combined with high poverty among Roma. According to Ladányi (2007) one fourth of those suffering from extreme poverty belong to the Roma community. He finds that among the Roma, families with children are the most severely affected, whereas extreme poverty is more prevalent among the elderly and the childless in the rest of the society (Ladanyi 2007). Officially poor household means, when the monthly income for one capital is less than 28 500 HUF (92 Euro)[1] (Bass 2011). The two main costs of the households are the energy bills and the food, if they do not have credit. In

[1] 310 HUF=1 Euro in 2014

2010 a poor family at least 30% of their income spends on energy and approximately 40% on food (Bass 2011).

Many Roma families are not connected to gas network, 81 percent of the asked households of UNDP survey, are using wood for heating. However as it was mentioned in the previous chapter, the price of wood was also increased in the last years, so to cover the heating energy sources is getting challenging for the families. It is also important to note that 35 percent of the Roma population is living in ruined houses, slums which correlate with the lack of energy efficiency of these houses[2] (Peric 2012).

The housing conditions of poor and marginalized ethnic minorities are particularly reflecting the most important cases of environmental injustices and energy poverty. Roma are the most vulnerable group of Hungary and suffering environmental racism and also energy poverty which correlates with their low income level and high energy prices. In spite of the fact that majority of the Roma settlement can have access to modern energy, because the network exists, they cannot benefit but disadvantage them because they cannot afford the prices of the energy. So, in contrary to the rural areas of the developing countries, majority of the Hungarian Roma communities might live in a modernized environment, but due to their low social status and environmental injustice they are excluded. However energy problems of the Roma settlements are not unified, therefore small scale decentralized energy systems can serve as an alternative solution for individual cases.

2.4 Advantages of the small scale decentralized energy systems

Although centralized energy production systems represent a high percentage in energy production worldwide, decentralized energy systems (DES) have an increasing role in energy

[2] According the UNDP survey (2012) houses need to ensure physical safety and provide shelter from high, low temperature, dampness, heat, rain and other treats. This is how the 35 percent can be understood.

production. The main negative features of large scale centralized energy systems which are highly criticized are the hidden environmental and social costs. Large scale bioenergy productions are also resulting negative effect on the environment namely monocultures due to continuous and loads of feedstock demand (Mangoyana and Smith 2010). There seems to have a great deal of evidences which suggest that decentralized energy units will be viable solutions to a more sustainable future. DES widely used with different scale both in developed and developing countries to ensure local development, employment and energy services. (Mangoyana and Smith 2010; Buchholz and Volk 2008). Bioenergy in developing countries is possible source for income generation through new job opportunities and basic energy services, while in developed countries it serves as a key tool in environmental protection and energy security (Domac et al. 2005).

Approximately 83 percent of rural population of the developing world is using traditional biomass for cooking and it is estimated by International Energy Agency that this rate will increase by 2020 from 2.5 billion people to 2.7 billion people. As the households are regularly using traditional biomass to have energy for cooking they are exposed to the risk to have serious health problem such as respiratory and lung diseases. Additionally they have to spend hours every day to collect and carry home the fuel, therefore the time for other activities such as income generation or school are reduced. The consequence of indoor smoke is 1.6 million untimely deaths every year from which half is affecting the children under five year. (Kaygusuz 2010; Domac et al. 2005; Schafer et al. 2011).

Decentralized energy or distributed energy systems are small or relatively small energy production units which using locally available renewable energy sources (e.g. biomass, wind, solar, biogas, geothermal or ocean-based energy) in the energy production processes (European Parliament 2010). There are many advantages and benefits of these systems both in the production process and users' sides as well (SCP Taskforce 2008):

- "*increased conversion efficiency (capture and use of heat generated, reduced transmission losses);*
- *increased use of renewable, carbon-neutral and low-carbon sources of fuel;*
- *more flexibility for generation to match local demand patterns for electricity and heat;*
- *greater energy security for businesses that control their own generation;*
- *greater awareness of energy issues through community-based energy systems, driving a change in social attitudes and more efficient use of our energy resources*" (SCP Taskforce 2008 p. 4).

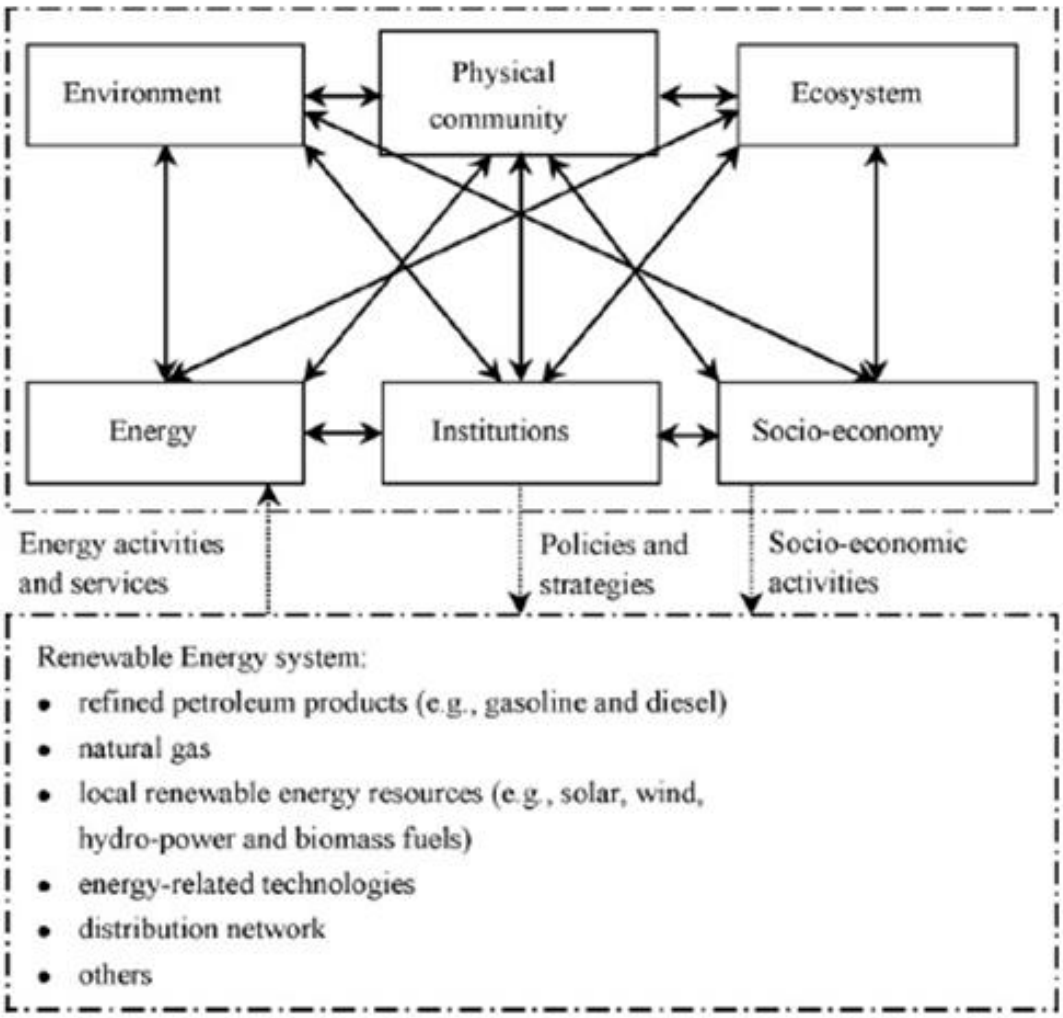
There are different types of production models used in a small scale decentralized energy systems. These can be community based, private based, public based and combination of private and public based models. In community based models the presence and assistance of the local people significantly contribute to the bioenergy production. They take part in all level of the bioenergy production chain such as feedstock production, the converting process, marketing and distribution of the produced energy. This model provides benefit to the community members through the new products which resulting economic gain for them, because it is focusing for local use and the produced goods are distributed among the participated members. The general forms of this model are the community cooperative, partnerships and family businesses and typically used and popular in agricultural communities (Mangoyana and Smith 2010). There are examples for these models both in developed and developing countries.

Mangoyana and Smith (2010) highlight and conclude from their case studies analysis that the success of different scale bioenergy projects both in developed and developing countries is depending on different factors. These factors are the available feedstock, capital, technical skills, technologies and support from different sides such as policies, institutions and the community. Furthermore the potential synergies among these factors are also key elements.

Renewable energy management (REM) system is one of the appropriate tool for decision makers to plan community-scale energy system, because they have to understand complex processes (energy production, conversion processes, etc.) and system parameters (availability of resources, production efficiency and capacity, etc.) to determine optimal mix of energy resources, technologies and investment at the lowest cost. Additionally there are many uncertainties related to the environmental and economic performance of these energy systems. Therefore different type of models (e.g. software packages such TESOM, BESOM, MARKAL, NEMS etc.) and methods have been developed to help to understand and analyses the connections among systems (socio-economic and environmental subsystems), economic feasibility of the projects, the potential GHG emissions reduction, technologies and other components of the energy systems (Cai et al. 2008). Others suggest the usage of multi-criteria analysis (MCA) which also emphasizes the collective interpretation of economic, social and ecological consequences of energy projects to help decide *"when, where and how bioenergy systems can contribute to development"* (Buchholz et al. 2007 p. 6092).

Communities have multiple connections with different subsystem trough which interact, influence each other (Figure 5.). Therefore REM takes into consideration these connections, interactions and limitations (e.g. available renewable energy source and financial resources, policies, strategies, institutions, etc.) to optimize the socio-economic and environmental output of the energy systems.

Figure 5. Interactive relationships among different system components within a community



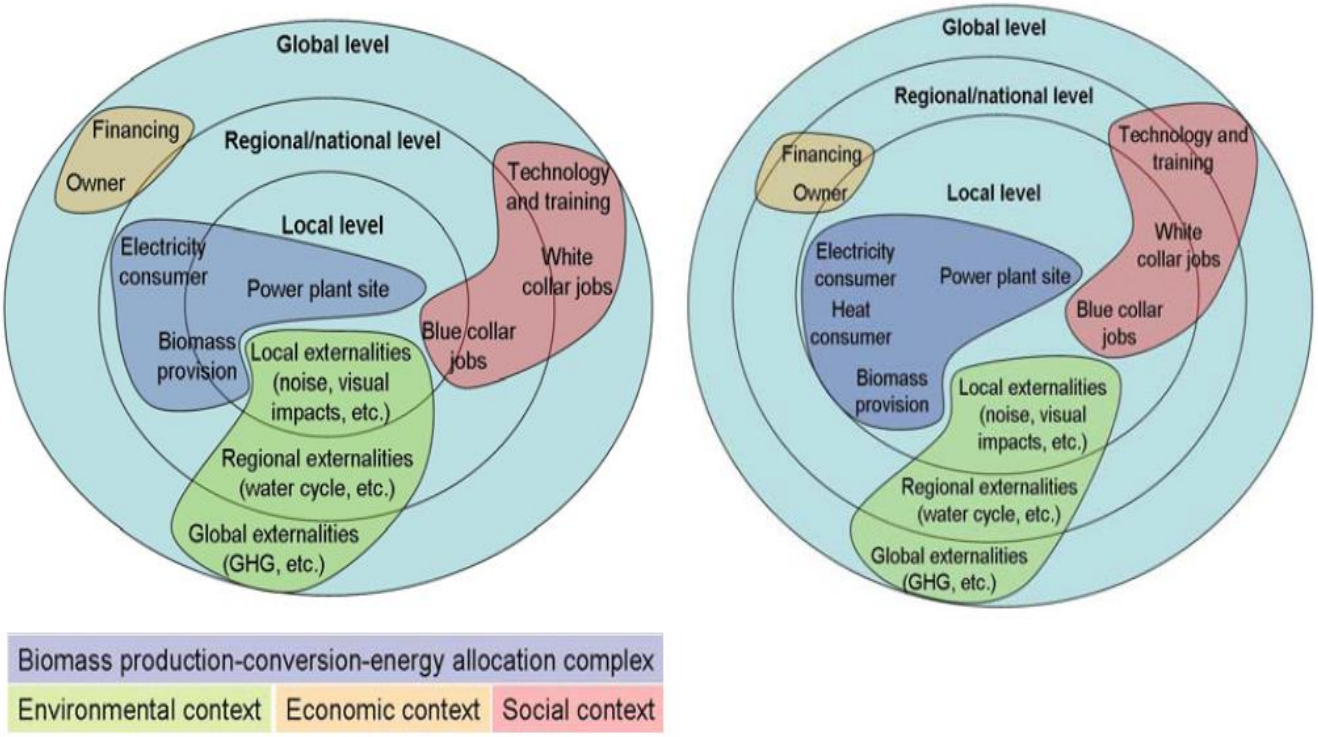
Source: Cai et al. 2009 p. 723.

To sufficiently and reliably satisfy the energy need of the communities multiple sources of renewable energies and technologies needed because of the spatial and temporal fluctuations of the renewable energies (e.g. wind and solar energy) (Cai et al. 2009).

Buchholz and Volk (2008) are highlights that the despite small-scale energy projects could provide more benefits and advantages related to ecological and local social fields, large scale energy projects most like to be implement as there is a stronger background behind them such as international financial sources which goes with wider information sources and

technological choices. Additionally the leadership of large scale projects has to meet different regulations; therefore management and control are easier over the system. Furthermore other favorable conditions are also available to larger scale energy systems such as tax concessions, carbon market, and media reputation. However with the increasing scale of energy projects the complexity of the systems is also increasing which requires more actors to be involved into the financial and investment fields with high chance from global level, and also to the decision making and management parts. However the participation of the local stakeholders is corner point of the sustainability, the local participation ratio is reduced in all level of the system in the larger-scale energy projects (Figure 6.). Therefore the larger-scale bioenergy projects rather seem to be as a centralized energy systems.

Figure 6. Socio-ecological levels affected by larger (50 MW) and smaller (200 kW) energy systems.



Source: Buchholz and Volk 2008 p. 4.

Additionally as the large-scale energy systems require more feedstock for the energy production, consequently the negative impacts on the ecosystem is much higher. Furthermore the produced energy, contrast to the small-scale energy system, is not only serve to the local people energy needs, however the feedstock is from local sources, but also provide energy for people living farther from the production place (Buchholz and Volk 2008).

However bioenergy projects provide wide range of advantages and benefits (Table1.) both at global and national levels (e.g. GHG reduction, less harmful impacts on the ecosystems, energy security, etc.), the most important increment for the local community are the new job opportunities. However the rate of the possible job opportunities which can be available for the local community largely depending on the type of the energy system (used technologies and feedstock, the need for skilled and unskilled labor, etc.) and the local economic and social conditions. Bioenergy projects generate both direct and indirect employment. While direct employment contains those work phases which belong to the feedstock production and transportation, and also to construction of the plant and energy production. Indirect employment or secondary jobs appear out of the bioenergy production chain and relates to those new jobs which indicated by the activity of the bioenergy project such (Domac et al. 2005).

Table 1. Benefits associated with local bioenergy production.

"Dimension	***Benefit***

Social aspects	• *Increased standard of living*
	  ○ *Environment*
	  ○ *Health*
	  ○ *Education*
	• *Social cohesion and stability*
	  ○ *Migration effects (mitigating rural depopulation)*
	  ○ *Regional development*
	  ○ *Rural diversification*

Macro level	• *Security of supply/risk diversification* • *Regional growth* • *Reduced regional trade balance* • *Export potential*
Supply side	• *Increased productivity* • *Enhanced competitiveness* • *Labour and population mobility (induced effects)* • *Improved infrastructure*
Demand side	• *Employment* • *Income and wealth creation* • *Induced investment* • *Support of related industries"*

Source: Domac et al. 2005 p. 98.

Despite the fact that decentralized energy systems widely spread and technologies behind them well developed during the last three decades, there are many examples for failures due to the inappropriate knowledge transfer to the user or the ignored local conditions such as local specific extreme weather or pest animals which can make damage in the infrastructure. Furthermore as the poorest households cannot afford such investment due the limited household budget, the microfinancing models, microcredits are the only one source for them. However without long term planning and fair solutions (the lifetime of the applicants is shorter than the payback period) the households can easily find themselves in serious trouble (Schafer 2011).

The next chapter is going to analyze the main opportunities and threats of a concrete decentralized energy project, the biomass briquette production, introduced in Hungarian Roma settlement. Due to the features of the project implementation, the case study will specifically analyze the planning phase as a mentioned critical phase of adapting project models.

3. Materials and methods

To understand better the opportunities and threats of the community scale biomass briquette project, which was implemented in the Roma settlement in Bag by the BAGázs Association in 2013, field research had been conducted which involved interviews and observations. The association does not have any documentation about the project planning, implementation and evaluation phases; therefore the analysis is based on data collection through the personal depth interviews and desk-based research. During the field research 2 project leaders, professional expert and 14 local people who involved in the project had been interviewed.

The conversations with the project leaders were focused on their professional background, on the work of the BAGázs Association, the living conditions of the local Roma people and finally on the experiences related to the biomass briquette project planning and implementation. The purpose of the interview with the professional expert was to know the technical aspect and project methodology of the biomass briquette production. The conversations with the local people are focused on three main areas such as their living conditions (income sources, main expenditures, housing, and access to energy services), strategies related to winter heating and the experience of the production and usage of the biomass briquettes.

The main limitations of the project evaluation are the lack of project documentation and lack of detailed survey of the Roma households related to their energy vulnerabilities. Furthermore the project was tested for a short period in last year (1 month) and just started again in 2014 summer. Therefore it does not have long term experience and production results to be evaluated, however the planning and implementation phases were well observed.

4. Biomass briquette as an alternative heating sources in the Roma settlement of Bag

In this chapter of the thesis I am going to evaluate a small scale biomass briquette project as example of decentralized energy system. The project aims to offer heating solution for the local Roma community which is facing with high level energy poverty. This part will deeply analyze the level of energy poverty of the Roma community and their main heating strategies during the winter time. In addition to that it will briefly introduce the general aspect of the biomass briquette production and in more details will analyze the concrete biomass briquette project through the SWOT analysis.

4.1 Description of Bag and local Roma community

The village of Bag is located in the Aszód micro region, 39 km far from Budapest and 13 km from Gödöllő, which is the closest town to the village. Bag has 3900 inhabitants of which approximately 700 belonging to the Roma ethnic minority based on the local estimations (Local Educational Equal Opportunity Analysis 2007). Originally Bag was an agricultural village, but after the economic transition the inhabitants started to work mostly in the industrial sector. Currently the working opportunities in the locality are limited; therefore mainly 70% of the inhabitants commute to the neighboring towns (Budapest, Vác, and Gödöllő) for employment. This ration even higher comparing to the average of the Aszód micro region, which is 65.4 percent (Labat and Molnar 2009).

The village located on the developed part of Hungary, according to Beluszky P. and Sikos T.T. classification, Bag is village with good labor market opportunities, stable population and with high ration of out-commuters (Beluszky and Sikos 2007 cited in Labat-Molnar 2009).

According to the local estimations out of the 700 Roma 500-600 people living in the isolated, so called Roma colony. Roma are living in Bag since the beginning of 20th century who were originally living in the center of village and was producing bricks. In 1959-60, the Community Council "forced" them to move to new plots provided at the edge of the village, where they started to build houses. During these years more and more Roam families moved in this part of the village, so the area populated by Roma expanded. During the communist period the Roma community was involved into industrial work (Gödöllői Gépgyár, Ganz Áramerőmű Gyár) or was living from season works. After the economic change majority of unskilled, unqualified people lost their job, among them the majority of Roma as well. The smooth closure of factories resulted into long term employment of the Roma community (Morvay 2009).

Majority of Roma at the settlement did finished only primary education or less, so the labor market options are very limited for them. Their primary livelihood relies on social benefits and/ or season works in the agriculture, which mostly accessible during the summer time. According to estimation one family with three children can access 79 500 HUF from the child benefits and 22 500 HUF as social benefit. Therefore the monthly regular income of an average family with three children is about 102 269 HUF, which approximately 66 Euro per capital[3] (Bass 2011).

Child benefits: 17 000 HUF/child

Maternity allowance: 28 500 HUF
(if there is child under 3 years)

Social benefit: 22 769 HUF[4]
(Only one family member can access):

102 269 HUF/month

[3] 310 HUF= 1 Euro (2014)
[4] http://kezenfogva.hu/Adatbazis/ellatasok/23.html

In addition to that if there is public work at the locality, adults can be employed for 3-4 months (only one member per family can be employed in the same time). Minimum salary of the public work is net 50 632 HUF in 8 house employment, but usually the municipalities prefer part time employment (4-6 hours per day), which proportionally decrease this monthly salary, in order to involve more people into the public work[5].

Based on the local Public Educational Equal Opportunity Analysis from 2007 the number of children who get regular child protection benefit is 313[6], it can roughly indicate the number of children who are living in poverty. According to the Equal Opportunity Plan from 2007 there is/was problem with the regular attendance of preschool age children, who are living at the Roma settlement. In addition to that the Plan also assume that that children with special need are segregated at primary level and in kindergarten as well, where there is a group for 6-7 years old children coming from disadvantaged families (Local Educational Equal Opportunity Analysis 2007).

However the settlement is not just physically/socially isolated as well as 'mentally', meaning that interactions between Roma and non Roma mainly happen due to official responsibilities (teacher, mayor, doctor) or as part of the everyday life during shopping. Real personal relationship between Roma and non Roma are rare or not long lasting. According to the Molnar's "mental map" the most unlike part of Bag is the Roma settlement which is based on the survey among Roma and non Roma. The result of this map can demonstrate the social, mental gap between the community of the Roma settlement and who are living out of the settlement (Molnar 2009). Those Roma families who can afford are moving from the Roma

[5] http://officina.hu/gazdasag/58-koezmunkas-minimalber-oesszege-2014-emelkedik-a-koezfoglalkoztatasi-minimalber-2014-tol

[6] The regular child protection benefit is linked to monthly amount per family member calculated based on the monthly income of the family. So it can well indicate the poverty level of the families.

settlement to another locality or to the center of Bag. At the moment there are few tens of Roma families who are living outside of Roma settlement.

Energy injustice and energy poverty of the local Roma: The Roma settlement consists of 5-6 streets with around 60 houses. There is asphalt road only on a small part of the colony; therefore during the autumn and spring the settlement is in mud. The houses are in bad condition, some of them has garden, and some does not have only a small yard. We can differentiate two types of houses, one of them made of loam, these are quite old houses, and the other type is made of bricks financed by the state supported social program, so called 'szocpol'. Mainly the poorer families are living in the old, loam made of houses (Morvay 2009). The energy efficiency of the houses is weak due to old doors, windows or due to half-finished work. There is electricity, gas, water and sanitation network at the Roma settlement, but just some of the houses are connected to these networks. Even though there is opportunity for gas connection, only 1 family linked to it, so the primary energy source remained to be wood and electricity for the households. According to the local Roma coordinator of the BAGázs Association, approximately 30 families has water and sanitation in their houses, and about 20 families does not have. The last group is using the public drinking fountain of which there are three at the settlement for cooking, cleaning, washing. He also mentioned that many of these families got financial penalty because they do not have sanitation and they contaminate the soil by the wastewater. This is the so called soil load fee[7], which was calculated retroactively for the families. This issue again cause serious burden for the families, because they cannot afford to connect to the water and sewerage network, however they are fined if they do not do so.

[7] In 2011 the municipality increase the unit cost by ten times, which is now 1200 HUF/m^3

The condition of the houses in the Roma settlement in Bag.

In terms of the ***energy poverty*** of the local Roma community, majority of the Roma does not have long term employment; they are mainly living from season works and from social benefits. The above mentioned example, about the average income of a family with three children (regular income 69 Euro/capital/month), can well demonstrate the limitations of the families to cover their energy needs. Approximately 50% or more of their income would be spent on energy related bills according to the interviewed persons. As an illustration an average household spent 25 % of the income on energy related bills in 2010, this ratio is 30% in case of poor families, which was close to 50 000 HUF (161, 2 Euro) according to the Sociopoly study (Bass 2011).

The income of the Roma families is not enough to cover all needs of the household (meal, schooling, clothing, energy), therefore most of them accumulated debts which lead to the disconnection of the electricity. In case if they want to be connected again to the network they have to pay fee, which is again a relevant amount for the families. On the other hand they cannot live without electricity, therefore majority of these families access the electricity illegally which can cause serious penalty or even physical danger. According to a member of the Roma community: "There *are only few households on the settlement which are paying regularly the electricity bills, the rest of the families access it illegally*. *This problem is very heavy for the families, nobody likes to steal, but for many of these families even the daily meal cause real trouble"*.

Many families has already high amount of fine due to illegal connection to the electricity network and due to inability to connect to sewage network, in spite of the fact the both the municipality and electricity providing company know that they will not abele pay the fines. In fact this system penalties the poverty of this people and by this making their situation even harder, but not provides any long term solution for the households.

Heating strategies during the cold season: Based on the 17 interviews we can conclude that the primary heating source for the households is the fuelwood. In addition to that some of them use the electricity as well.

The average conditions of the stoves in the Roma settlement in Bag.

Forest cleaning: There is opportunity at the municipality to get parts of the surrounding forests for cleaning. Sometimes 20-25 families can be involved during the autumn season into forest cleaning, from which they can cover their wood needs for the whole winter period. "*It is great opportunity for the families, however it is responsibility and hard physical work as well, because they must to clean the forest part given by the municipality*" noted by one of the interviewed person. In addition it has some financial consequences, because they need to cover the transportation cost of the collected wood. In fact this is option is the primary wood purchasing source for the local households.

Buying of wood: During the last 4-5 years the price of the wood increased significantly. None of the local families buy wood, because it would cost too much for them. Based on the estimations of the interviewed persons the average cost of wood for the winter period would be 200 000 HUF.

Social wood: Every municipality can provide social wood if they are able. Bag also provides social wood to the poorest one, but in fact "*it is so small amount that it is enough only for 2-3 days*" mentioned by the local people

Illegal logging: 4-5 years ago Roma families were collecting the needed wooden fuel from the neighboring forest; it did not cause any trouble, according to the interviewed people. Later on the price of the wood increased and the presence of police became usual at the settlement. Families who have wood illegally from the forest can get serious financial penalties and have to take part in the legal procedure. Based on the estimations at least 15 families has been involved in legal procedure due to illegal logging, which usually end up with financial penalty and suspended sentence. Since the situation of these families has been not solved by the penalties, they are forced to go back illegally into the forest. Based on the interviews currently women are going to collect the wood, because men are afraid due to the suspended sentence what they got.

Harmful methods (burning of clothes, shoes, plastic): Some of the interviewed families said that when they do not have fuelwood they burn different materials collected from the trash, unused clothes, and shoes in order to warm up the room. One woman mentioned that when she has no wood she is going to her yard or road to collect enough material to be able to cook the meal. On other women said the she is buying the second hand clothes for heating because it is still cheaper than wood. These methods are very harmful for the health of the people as well as for environment and in long run can cause serious health diseases.

We can summarize that Roma in Bag are highly isolated from the non Roma community and facing with employment, educational and housing problem as well. The working opportunities are very limited for them, which explain that they cannot improve their living conditions without external help. The energy poverty is also high at the Roma settlement, majority of the families has been disconnected from the electricity network. The primary energy source is the fuelwood; however none of the families afford to buy it legally. Part of the families are able to match their heating needs due to the forest cleaning opportunities, while other part of the families are using other methods such as the illegal logging, using of electricity or burning of harmful materials. Their situation is even further complicated by the poverty related penalties got due to illegal access of electricity, illegal logging or non-payment of soil load fee. In addition to that as in the developing countries women are highly involved/responsible for the heating and solving the cooking, 99% of the interviewed person was female.

4.2 BAGázs Public Benefit Association

BAGázs Public Benefit Association (BAGázs) was started by 13 volunteers in 2010. They defined to use the methods of non-formal education and volunteerism to enable the youth of Bag to work towards their self-defined goals and to enhance their freedom to choose their own path in life, in order to break out from the poverty trap that defines their current lives. The work of the organization is linked to Roma settlement of Bag. It is working together with 30 volunteers from Budapest and 10 locals.

The primary goal of the BAGázs is to help those living the in the Roma settlement of Bag: „*to articulate goals for themselves and take steps towards achieving them; to obtain tools and knowledge that broaden their possibilities of choice and that help them to break away from the limited life paths currently available to them; to find new occupations and activities, as alternatives to involvement with drugs, thus freeing themselves from the trap of addiction; to*

be more aware of health and environmental issues; to develop more successful methods of conflict resolution, based on dialogue" (official webpage of the association)[8].

The working attitude of the organization emphasizes the involvement and mobilizations of the community, which can be later on represent their own interest and implement their ideas. Two project examples of the organization can well demonstrate this approach. One of them is the mentoring program, which has been started in 2011. The association trained local youth and college students to become mentors, in order to enable them to support crime involved youths. As a result of the project 29 mentors of 15 are local Roma mentors and 14 mentors are from Budapest, in addition app. 20 mentees are participating in the individual mentoring.

Other important project which also helped to build the Roma community is the house renovation project. The BAGázs Association in partnership with other three civil organization (Habitat for Humanity, Reflect Stúdió, Szociális Építőtábor) and Perzi.com company implemented a house renovation program in 2013. The project built on the financial support of the Prezi.com and on the involvement of volunteers coming from the involved organizations (140 people) and local Roma (120 people). The project activities relied on the ideas and needs of the local Roma community, who were actively involved in the planning and renovation process as well. As an out of the project the team renovated 54 houses in addition to that they purchased a community container too, where the Association can organize different activities.

The outcomes and development of this project are very relevant antecedent of the biomass briquette. Both projects highly contributed to the mobilization and strengthening of the local

[8] www.bagazs.org (accessed on 19th of August)

Roma community, which in fact enable the introduction of the community based bioenergy project.

4.3 What is biomass briquette and how it is produced

In rural households of the developing countries, the energy need mainly relate to cooking while in the poorest households of developed countries the heating energy is the most demanding. One alternative solution can be the biomass briquette which can be produced both in large industrial scales with high efficiency machines and also in small scales with simply and low efficiency machines which operating with manual work.

"Biomass briquetting is the densification of loose biomass material to produce compact solid composites of different sizes with the application of pressure" (Bikash et al. 2013 p. 1707). We can differentiate three types of densification technologies which are currently introduced. These technologies are the pyrolizing technology, direct extrusion technology and the last called wet briquetting (Bikash et al 2013). The development of the wet briquetting process is connected to Dr. Benjamin Bryant in the middle of 1980. The technology had been further developed and put in the field by Legacy foundation[9] (US) which widely used in the developing countries nowadays (Stanley 2003). The wet process is the most applicable for the small, excluded communities because the production process is managed and located within the community; it does require low investment, solid technical background and manual work (Stanley 2003).

Process: Biomass briquette production process is based on the following main steps

- *"Selection of suitable biomass*
- *Decompose biomass*

[9] http://www.legacyfound.org/

- *Pressurization to form wet briquettes*
- *Sun dry wet briquettes: the moisture of the briquettes usually is 15 percent* (Bikash et al. 2013 p. 1708).*"*
-

Resources: The basic feedstock of the biomass is the agricultural by-products which include rice husks, bagasse, sawdust, choir, and cardboard, in addition to fallen, browned, nutrient-leached leaves, grasses, stems roots stalks, nuisance aquatic plants such as water hyacinth. The commercial processing residues such as rice husks, peanut shells, maize-milling residues, sawdust, coir dust or waste papers are recommended because these do not require chopping, pounding or decomposition (Stanley 2003). In many countries waste paper is the other main in credits beside the agricultural byproduct and water.

There are many advantages of the wet biomass briquette production as per below (Bikash et al. 2013).

- *"This is one of the alternative methods to save the consumption and dependency on fuel wood.*
- *Densities fuels are easy to handle, transport and store.*
- *They are uniform in size and quality.*
- *The process helps to solve the residual disposal problem.*
- *The process assists the reduction of fuel wood and deforestation.*
- *Indoor air pollution is minimized.*
- *Briquettes are cheaper than COAL, OIL or LIGNITE*
- *There is no sulfur in briquettes.*
- *There is no fly ash when burning briquettes.*
- *Briquettes have a consistent quality, have high burning efficiency, and are ideally sized for complete combustion.*
- *Combustion is more uniform compared to coal.*
- *Unlike coal, lignite or oil, briquettes are produced from renewable source of energy, biomass.*

- *Loading/unloading and transportation costs are much less and storage requirement is drastically reduced.*
- *Briquettes are clean to handle & can be packed in bags for ease of handling & storage.*
- *Briquettes are usually produced near the consumption centers and supplies do not depend on erratic transport from long distances.*
- *The technology is pollution free and Eco-friendly.*
- *The briquette is easy to ignite.*
- *Continuous burning and long burning duration"* (Bikash et al. 2013 p. 1707-1708).

4.4 Implementation of the biomass briquette project

The first time when the BAGázs Association heard about the community scale biomass briquette (BB) was in the Forum on Hungarian Anti-Poverty Network of Northern Hungary[10] event in Budapest in 2012. The forum was organized by the occasion of the World Day to Combat Poverty, where non-governmental organizations, individuals and social workers, who work against poverty, had opportunity to share their experiences. One of the presenters was the Real Pearl Foundation[11] which successfully implemented a BB project in Told village in 2011. The professional leader of the project introduced the project methodology and local results.

The BAGázs Association was represented on the event by the leader of the NGO and two other employees from the Roma settlement of Bag. One of them was the local Roma coordinator, who remembered very well for the presentations: *"It immediately glints in my head that we have to try it in our Roma Settlement" It is very simple, it is only agricultural by product, paper, and water, press machine what can be order or constructed on site, which is not so expensive".* They considered that the project can be applied to the Bag, since they have

[10] http://mszeh.hu/
[11] http://igazgyongy-alapitvany.hu/en/?s=briquette&submit=Search

a well-established Roma community and good relationship with the people. The introduction of BB project can lean on their previous works (mentor program, brigade), which has already formed an active community.

The project planning phase: After that event, at the beginning of 2013, two members of the NGO started to brain storm about the opportunities of the BB in the Roma settlement in Bag. They also invited for this meeting the professional leader of the BB project in Told. According to the local Roma project leader: "*That time was winter, and the families did not have not fuelwood at the Roma settlement. We felt that we had to do something".*

The professional leader of the Real Pearl Association shared with them the basic elements of the project and also provided guidelines; documentations about the community scale BB production and soon more local people, who worked in previous projects, had been involved in the project planning phase. They had a few further discussions until they got to understand all aspects of the BB project. Part of the Roma community agreed to pilot the project in their settlement, so they started to work with seven families to implement the BB project from 100 000 HUF donated by the BAGázs Association.

The first most important step was the finding of the agricultural byproduct, which is the basis of the biomass briquette project. According to the local Roma project coordinator: "*we phoned the local and lots of close co-operatives, we went out to the agricultural lands, we mapped the area. It was very difficult task, because we started the search after the harvest period when all co-operatives had already decided how to use the byproducts. We spent the all summer to find something…"* Finally a co-operative from Kartal (little village 10 km from Bag) provided one ton mix of chaff and mustard-seed for free. According to the local Roma project coordinator: *"Although we only spoke by phone and did not meet personally, when I*

described the reason why we need for his help, He simply said, no problem, came and take it, it is not a quantity to me".

Other important ingredient of the biomass briquette is the paper. The collection was firstly organized in the Roma settlement and also in center of the village. The team contacted the post office, lottery and soma shops, but they did not get help. Later on this task has been taken over by the BAGázs Association, which used its existing relationships and collected the paper in their Budapest office.

Briquette press machine, other tools and production site: The following step was to find appropriate location for the production in the settlement. According to the local Roma project coordinator: *"our criteria were that to find a place which can be used for free and it has enough space for the machines, for the storage of feedstock and the produced briquettes. Furthermore the production requires large amount of water, so we needed a space where we can use the water for free.* They got a house with large yard which was near to the public drinking fountain. The only criterion of the owner was who let them to use the space for free, to keep clean the yard. The hose-pipe and the cask were donated by a local Roma person, while the tub was rented from the village. The construction of the dryer, which is usually the most costly part of the BB production, was financed by the Habitat for Humanity Foundation, but the construction was done by the project team.

The professional leader of the BB project from Told suggested two types of press machine for production. One of them is made of wood which is widely used in the developing countries; the other type is made of metal which enable to produce more briquettes by one press. Finally they ordered the metal press machine on the internet which was constructed in Budapest by a private person. The price of the machine was gross 45 000 HUF.

The local community was involved and helped the project planning with their own network, ideas and tools. According to the project leaders: *"They did not only wait that we will manage everything alone, it was a really community action! The biggest help from them was that they came to the meeting. We did not want to impose anything on people".*

Community building and testing the production: The local coordinators visited the households one by one to introduce the BB project, and they offered them the chance to be involved into the production. Although they explained the advantages of the project and successful results from Told, the motivation of the families was challenging. According to the project leaders: "*To motivate people is not easy task, because we spoke about such things what they could not see. We visited and spoke with the families more times".* Finally 25 households were involved into the project. The professional leader of the Told project presented the BB production process and explained the working method for the families. The people realized that it is working very easily, they said *"It is working easily and fast and not requiring hard physical work"*. The people were involved equally in the discussion to decide and determine the rules and steps related to the production such as:

- how many people need for one brigade;
- how they formulate brigades;
- all brigades have to choose a leader;
- how many hour can be spent on BB production per day/week;
- how they share the briquettes with each other.

The minimum number of the group is five: two or three woman tear the paper, one or two man mix and deliver the feedstock and the finished briquettes, and one handle the press machine. On the last meeting they formed 4 brigades with 22 people, they also choose brigade leaders who are managing the production and responsible for the documentation (how many

briquetted had been done and who and how many time spent on production) and also inform the people when they can go to do briquettes.

Briquette production: According to the projects coordinator: "*The first time when the first brigade started the work the production was slowly as everybody has to find their own role in the production, but the second brigade* had better start *because the first brigade told their experience… and so on, the brigades change each other every two hours".*

Feedstock and production process of the biomass briquette.

Paper tearing and mixing of agricultural residue with paper and water.

Biomass briquette production.

Drying briquettes.

The briquette drying system and the new press machine.

During the first weeks 1-2 families tested the briquettes at home how it works in the stoves. They were very satisfied with the results. According to one member of the family: *"They burnet very well, lasted long time and warm up the room well".* Some teams managed to produce 220 pieces during two hours, which meant that one member could take home 40-50 briquettes after drying. However the people could work only 1 month due to the wet weather. During this time period the team produced 1600 briquettes, which were shared among 15 families, because some of the families donated their share to the poorest ones. The local coordinators identified two closely linked weaknesses of the production; one is that they have started the production in autumn, so there was not enough sun for the briquettes to dry. In addition to that the agricultural byproduct used contained mustard-seed, and since the weather was wet, the briquettes were germinating. This was the heavy turning point in the project, when most of the people lost their motivation, because they could not use the produced briquettes.

One household needs approximately 1000-1200 briquettes to meet the heating needs for one month according to the professional leader of the Told project: *"However this number is an average and depends on different factors such as: how many stoves used; the condition and efficiency of the stoves; the conditions of the house (doors, windows, walls, roof, etc.); only briquettes used or mixed with wood. As a comparison around 900 -1000 pieces can be produced during 5 hours with a good press machine and good team work"*.

In 2014 the same number of people started again the bio briquettes production. They got 3 tons of feedstock from the same cooperative and they got one additional press machine and paper tearing machine, donated by external organizations. They managed to start the production at the end of June now with two press machines and with a paper tearing machine, which significantly shortened the production process. However they have to stop the work due technical problem with the machines. Additional burden that the project implementers can expect some financial costs in the future because the cooperative and the owner of the house, where the work is going on, have already indicated that they would expect them to pay for part of feedstock and for space. The project cost in total 100 000 HUF which was spend on the first metal press machine, travel and transportation of the feedstock. The total amount will be further increased by the expected cost of house rental and feedstock.

4.5 Opportunities and threats of the biomass briquette production in the Roma settlement in Bag

To identify and understand better the opportunities and threats of the biomass briquette project in the Roma settlement of Bag, I used the SWOT analysis method. It ensures to involve external, contextual and internal, community related factors. However it is important to mention that I cannot analyze longer term production because during the first phase it was

only one month and the second phase is still ongoing. Table 2. contains only the main points of the analysis.

Table 2. SWOT analysis of the biomass project in the settlement in Bag.

Strengths	**Weaknesses**
• Experience in community action/work • Experience in manual labor work • Free working force • It does not require hard physical work • The production does not time consuming • Decrees illegal logging and tension between Roma and non Roma • Reduce the burning of harmful materials • It provides a special knowledge and value for the community • Two press machine and paper mashing machine	• new costs (feedstock, rental) • Residue is not the best feedstock • People lost their motivation • There is no official partnership with the co-operative • Technical difficulties with the machines
Opportunities	**Threats**
• Supportive EU and national program, strategies • It can attract other bioenergy related projects (biogas, solar energy) • It can serve as a good practice for other settlement	• The NGO leave the settlement or stop working • The cooperative stops providing the feedstock • Appearance of new cheap energy source

• Raise public awareness through media • Raise the attention of municipality	

Strengths: There are more internal strengths for what the biomass briquette project can be built. One of the main strengths of the project is the strong Roma community. The Bagázs NGO has been working and implemented different type of project since 2011 in the Roma settlement with the involvement of the local community. The people learnt to work together and to help each other. They became an active community, which is able to improve the production and its efficiency with their ideas and experiences. These people has experience in manual work, therefore the biomass briquette production is not causing difficulties.

The BB is attractive for the community, mainly for women, because the production is not requiring hard physical work and not time consuming as for instance the forest cleaning. The women and bigger children and can have more time for other activities (relaxing, cooking, community life, education). In case of appropriate project planning, the people can produce their own briquettes during the summer, therefore the families can prepare in time for the winter period, which contributes to their security and comfort. It can serve as an alternative heating source, so the heating related stress is also less in the family. In addition to that introduces the usage of BB they do not need to invest financially, because they can use their already existing stove. Moreover the production process is very simple; it does not require any special education, so anybody after a few training can be familiar with the method. The family members can form their own brigade and produce together their needed heating source for winter. These advantages of the BB made very attractive for the families.

BB production can have effect on the heating strategies of the families too. As we have learned for the interviews many families are involved in illegal logging or burring harmful materials. The BB can provide a new heating strategy for the families and to decrease penalties, police procedures associated with illegal logging, in addition decrease health care and environmental harms caused by the burning of harmful materials, cloths, plastics. It can also contribute to the social cohesion of Rom and non Roma, because Roma will not rely on illegal energy sources, but they produce their own heating sources.

Further strengths of the project that production did not required real financial investment. Cost related to transportation of the feedstock was also cheap, because the cooperative is only 10 km far from the settlement, in addition to that the water is coming from the public drinking fountain and other tools were donated by the local communities. In fact the only real cost of the project was the press machine. In the second phase, in 2014, they got one additional press machine and paper masticating machine, which can speed up the production process.

Weaknesses: One of the main weakness of the project is the during the first phase implementation the production started in autumn when the produced briquettes did not have enough sun shine to dry. Moreover one of the ingredients of the feedstock is mustard seed, which started to germinate due to the wet environment. In fact these weaknesses made impossible to use part of the produced briquettes and contributed to the de-motivation of the people according to the local coordinator. However in the next year the team started the production earlier and approximately the same number of people get involved, which can indicate that the community did not lost its interest.

In 2014 the project team should count with increased financial costs, because both the cooperative and house owner, who provides the space for the production, have already noticed that they would like to get paid. Until today none of them requested the fee, but in

long term the project team has to budget the related costs. In addition to that the project team has to ensure the sustainability as well and establish legal partnership with the cooperative, and the production of BB might be terminated if the cooperative decide to sell its feedstock to someone else. However, currently one of the main problems of the project is that the press machine went wrong and people had to stop the production. This is serious issue, because the community cannot fix it without external help as well as it is costly.

Opportunities: The mentioned weakness related to the agricultural feedstock can be compensated if the project manages to get involved the municipality into partnership. The municipality of Bag owns the agricultural lands around the village and around the Roma settlements, which are rent by agricultural companies and private persons. These companies grow corn, wheat and rape, of which residue can serve as good feedstock for BB. In case of official agreement with municipality or with the producers the Roma community can access new sources for the BB production.

In addition that the project can provide an alternative heating strategy for the families and by this reduce the illegal logging which is due to the fuel poverty of the households. By decreasing illegal logging it can reduce the associated legal actions, prosecution and penalties as well.

Furthermore the project can attract new supporters due to the favorable EU and national governmental strategies, CSR activities of companies which would enable them to improve the machines and purchase more. These activities can raise the awareness of the public and of the local municipality for the situation of Roma living in segregated settlements and present cheap and simple solutions to reduce their heating needs of the poorest. Additional opportunity of the project is to attract new energy poverty related ideas such as solar energy or biogas, which can help them to solve electricity problem.

Threats: The work of BAGázs Association is very visible in the development of the local Roma community. One of the main treats can be if the association cannot continue their work in the settlement due to financial problems or other reasons. Additional risk can be for the BB production if a new, cheap alternative energy source would appear. However it can be positive for the community itself, because it would mean new heating option for them.

5. Summary of findings

A. What are the main factors of energy poverty in case of Roma focusing on Roma community of Bag?

The Roma ethnic minority is one of the most vulnerable groups of Hungary, majority of them are living in segregated areas and having poor housing conditions, which highly correlate with the weak energy performance of houses (old doors, windows, weak insulation). In addition to that they are facing with high poverty level due to long term unemployment and low educational level. Majority of Roma households in Bag depend on social benefits, seasonal work and public work offered by the municipality, but their regular and stabile income remain to be the social benefits. Based on the estimations the regular income per capital is approximately 66 Euro/months in a family with three children. In case of irregular seasonal work or public work this amount might increase, but still they will not be able to cover all the family and household related costs such as meal, education, clothing, heating.

According to Bass (2011) the poor households spend minimum 30 percent of their income on energy related expenditures; Roma in Bag reported more than 50 percent to be spent on these costs. The low income level of Roma and high prices of energy leads to accumulated debts and disconnection of energy network, since families with children will have other preferences then the energy. In case of Bag almost the all settlement is disconnected from the electricity network due to debts and the reconnection would mean extra fee for the households. This issue raised another dangerous problem at the settlement, because currently these households access illegally the electricity.

The primary heating source of the Roma is the fuelwood, however during 2000-2008 the price of wood increased by 122 % (Ürge-Vorsatz and Herrero 2010). In Bag only one family is connected to the gas network, the rest of households use wood for heating and cooking.

However none of the families afford to buy fuelwood, they rely on strategies such as forest cleaning offered by the municipality, illegal logging and burning of harmful materials.

Energy poverty in Hungary mostly effect families in rural areas in bigger than 100 m2 house, who has low income, and there are children, retired or unemployed person in the family based on the findings of the Energy Club (2012). Among the Roma, families with children are the most severely affected by poverty as such, whereas extreme poverty is more prevalent among the elderly and the childless in the rest of the society (Ladanyi 2007). It can mean that energy poverty in the general society mostly affect elder people, while in case of Roma community more children are affected.

B. What are the opportunities and threats of the implementation of the biomass briquette project in Roma settlement?

BB can serve as a small scale, community based decentralized energy solution for individual cases. The following opportunities can be listed in terms of introducing BB production in Roma settlements:

- The Roma settlements are located in rural areas where the agricultural activates are relevant, therefore there is available feedstock (agricultural by-products) for the BB production. However more structured programs, incentives should be offered for the municipalities, NGOs and cooperatives to implement such programs.
- It can be attractive option both for municipalities/NGOs and poor Roma communities, because the BB production based on cheap and simple technology, which can be easily adopted. In addition to that it does not require specific qualification; therefore communities with low education can easily acquire. Furthermore as the production is not requiring heavy physical work, women and bigger children can be involved in the work.

- The upfront cost of BB production is relatively low, so any municipality or NGO can pilot it without real financial risk.
- The technology of the small scale biomass briquette production is environmental friendly and relies only on manual workforce.
- The introduction of BB can serve as a new heating strategy for poor communities and by this to contribute to the decrease the illegal logging and burning of harmful materials, which many times appear as alternative heating solution in poor and Roma communities.
- It usage of BB able to decrease the heating vulnerability of Roma households, hence can contribute to the environmental equality and reduction of fuel poverty.

The following threat can be listed:

- Sustainable production requires long term cooperation and agreement with the main actors of the project such as local community, NGO, municipality, agricultural companies, industrial companies.
- Technically it should be adjusted to the needs of the community. Originally the small scale biomass briquette technology was developed to provide cheap and clean energy source for cooking in the developing countries. In case of Roma communities in Hungary the BB serves as an alternative heating source, which requires bigger amount of BB, by this technological development of the production process is needed to speed up the production.
- It can be a threat of the project if part of a community would be excluded from the BB production due the personal interests, while the other part, who is involved in the project, would start to trade with the BBs. In Hungary it has been introduced as a non-profit, community based production.

- Costs of the BB production can increase significantly if the needed large amount of water and feedstock is not provided for free.
- Lack of community cohesion can result in conflicts and in poor performance of the project. It is suggested to introduce a pre-phase when the community is developed for such level to be capable for the BB introduction.
- Inappropriate implementation sometimes can cause more harms than advantages. The project methodology should be always adjusted to the local needs, circumstances and opportunities.

6. Conclusion

Energy poverty among Roma communities appears exponentially due to their socio-economic status. Small scale decentralized energy project such as the BB can be a potential heating strategy for Roma communities in rural areas. In spite of the fact that the project has been just piloted in Bag, already many advantages and opportunities were listed as part of the SWOT analysis. However, the biomass briquette projects in Hungary were implemented mostly by NGOs. Knowledge of such programs and alternative solutions should be collected, evaluated and shared with the local leaders. However in order to ensure the long term suitability of this initiatives and dissemination the involvement of municipalities and government would be necessary. Minimal financial incentive should be ensured at central level and to be accessible in form of special call for the municipalities.

7. References

Bass, L. 2011. Játék és valóság. A magyarországi szegénység tényei. [Game and reality. The facts of the Hungarian poverty]. http://www.szociopoly.hu/szociopoly_kezikonyv.pdf.

Bikash, B., Bhowmik, R. and Saikia, M. 2013. Challenges of wet briquetting from locally available biomass. International Journal of Modern Engineering Research (IJMER) Vol.3, Issue.3, May-June, 2013 pp-1707-1711.

Buchholz, T. and Volk, T. 2008. Is project scale the key to sustainable modern bioenergy systems? 2008 Berlin Conference on the Human Dimensions of Global Environmental change.

Buchholz, T.S., Volk, T.A. and Luzadis, V.A. 2007. A participatory system to modeling social, economic, and ecological components of bioenergy. *Energy Policy 35* (2007) 6094.

Cai, Y.P., Huang, G.H., Yang, Z.F., Lin, Q.G., Tan, Q. 2009. Community-scale renewable energy systems planning under uncertainty – An interval chance-constrained programming approach. *Renewable and Sustainable Energy Reviews 13* (2009) 721-735.

Domac, J., Richards, K. and Risovic, S. 2005. Socio-economic drivers in implementing bioenergy projects. *Biomass and Bioenergy 28* (2005) 97-106.

Energy Club. Fellegi, D. January, 2010. Vizsgálat és javaslatok az energia szegénység és az energiaárak állami támogatásának kérdéskörében. [Assessment and recommendations in terms of energy poverty and state aid on energy prices].

Energy Club. Fellegi, D. and Fülöp, O. 2012. Szegénység vagy energiaszegénység? Az energia szegénység definiálása Európában és Magyarországon. [Poverty or energy poverty? Defining energy poverty in Europe and Hungary].

European Partnership for Energy and the Environment (EPEE). 2009. Tackling Fuel Poverty in Europe. Recommendations Guide for Policy Makers.

European Parliament. 2010. Decentralized Energy Systems. Directorate General for Internal Policies. Policy department A: Economic and Scientific Policy. Industry, Research and Energy.

Harper, K., Steger, T. and Filcák, R. 2009. Environmental Justice and Roma Communities in Central and Eastern Europe. *Environmental Policy and Goverance 19* 251-268 (2009).

Herrero, T.S. and Ürge-Vorsatz, D. 2010. Energiaszegénység Magyarországon. Első értékelés. [Fuel poverty in Hungary, the first evaluation]. Climate Change and Sustainable Energy Policy Centre, Budapest.

Herran, D.S. and Nakata, T. 2011. Design of decentralized energy systems for rural electrification in developing countries considering regional disparity. *Applied Energy 91* (2012) 130–145

Hiremath, R.B., Shikha, S., Ravindranath, N.H. 2005. Decentralized energy planning; modeling and application—a review. *Renewable and Sustainable Energy Reviews* 11 (2007) 729–752

Kaundinya, D.P., Balachandra, P., Ravindranath N.H. 2009. Grid-connected versus stand-alone energy systems for decentralized power—A review of literature. *Renewable and Sustainable Energy Reviews 13* (2009) 2041–2050.

Kaygusuz, K. 2010. Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews 15* (2011) 936–947.

Labat, A. and Molnar, M. 2009. *Bag, az ingázó falu*. [*Bag, the commuter village*]. *A Faluszeminárium.* [The *village seminar*], ed. Z. Deaky and M. Molnar, 23 – 33. Gödöllő: Szent István University.

Ladányi, J. 2007. Az antiszegregációs programok szükségességéről és lehetőségeiről. [On the necessity and prospects of antisegregation programs]. http://www.tankonyvtar.hu/hu/tartalom/tamop425/0010_2A_05_Ladanyi_Sandor_Tarsadalom_es_terszerkezeti_atalakulasok/ar20.html

Laurent, É. 2011. Issues in environmental justice within the European Union. *Ecological Economics 70* (2011) 1846-1853.

Mangoyana, R.B. and Smith, T.F. 2010. Decentralized bioenergy system: A review opportunities and threats. *Energy Policy 39* (2011) 1286–1295.

Morvay, J. 2009. *A látható és láthatatlan határok*. [*Visible and invisible borders*]. *A Faluszeminárium.* [The *village seminar*], ed. Z. Deaky and M. Molnar, 40 – 55. Gödöllő: Szent István University.

Molnar, M. 2009. *Népesedési és foglalkozásszerkezeti változások Bagon*. [*Population and occupational changes in Bag*]. *Bag mentális térképe.* [*Mental map of Bag*]. *A Faluszeminárium.* [The *village seminar*] ed. Z. Deaky and M. Molnar, 12 – 17, 33 - 35. Godollo: Szent Istvan University.

Municipality of Bag. 2007. *Közoktatási esélyegyenlőségi helyzetelemzés*. [*Local Educational Equal Opportunity Analysis*].

Organization for Economic Cooperation and Development (OECD) International Energy Agency (IEA). 2010. *Energy poverty. How to make modern energy access universal*?

Peric, T. 2012. *The Housing Situation of Roma Communities: Regional Roma Survey 2011*. Roma Inclusion Working Papers. Bratislava: United Nations Development Programme.

Schäfer, M., Kebir, N. and Neumann, K. 2011. Research needs for meeting the challenge of decentralized energy supply in developing countries. *Energy for Sustainable Development 15* (2011) 324-329.

Stanley, R. 2003. Fuelling development. *Boiling Point No 49.*

State Secretariat for Social Inclusion, Hungary. 2011. National Inclusion Strategy.

Steger, T., Antypas, A., Atkins, L., Borthwick, F., Chan, C., Filcak, R., Harper, K., Malbasic, I., Medarove, K. March, 2007. *Making the case for environmental justice in Central & Eastern Europe.* CEU Center for Environmental Policy and Law (CEPL). The Health and Environment Alliance (HEAL). The Coalition for Environmental Justice.

UK Government's Business Taskforce on Sustainable Consumption and Production (SCP). 2008. Decentralized Energy. Business opportunities in resource efficiency and carbon management.

World Bank. Ringold, D., Orenstein, M.A. and Wilkens, E. 2005. Roma in an Expanding Europe: Breaking the Poverty Cycle.

Personal interviews:

- Two project leaders of the biomass briquette project, BAGázs Association.
- The professional expert
- Local Roma Community