Agricultural University of Tirana

Project co-financed by the European Regional Development Fund

WP3: Testing, Activity 3.19
Fostering RES awareness through School Programmes

Deliverable 3.19.1: Planning for RES Future

July 2018

European Union
European Regional Development Fund

WP3 (TESTING) LEADER
Technical University of Crete, School of Environmental Engineering, Renewable and Sustainable Energy Systems Lab (TUC ReSEL)

RESPONSIBLE PARTNER: Agricultural University of Tirana (AUT)

DELIVERABLE 3.19.1 PLANNING FOR RES FUTURE
July 2018

AUTHORS: Ing. Valter Begaj, Fatbardh Sallaku, Seit Shallari (AUT)

1 Introduction

Bioenergy could supply a significant part of the heat energy in many communities and industries in Albania. Biomass is not very widely used in municipal or industrial energy production, but it is a quite common energy source for households. All in all, activities in the Albanian bioenergy sector have increased in the last years and are expected to increase substantially in the near future. At present, biomass is used to a lesser degree, even though the biomass resources in Albania are vast.

The consumption of biomass is very low in Albania. From the total energy consumption, the share of biomass is only about 1-2 % of the total primary energy consumption. The main users of biomass are the forest industry companies using bark and sawdust for their own energy production. The forestry companies are also working together with the municipal sector and supply wood fuel for the municipal power plants.

Kamza Municipality is situated 11 km away from the center of the capital at its northwestern part. To the north Kamza it is confined to the rural area of Fush Kruja, to the south with the commune of Paskuqan, to the east with Zall Herr commune and to the west with Berxull commune. The terrain is mostly flat, with a slight splay toward the north-western part. The area is situated in a quota which varies from 80-90 m above the sea level in the southern part, going down to 45m above the sea level in the northern part, close to Rinas Airport. The area of this administrative unit is ,2364 Ha. The national road that connects the capital with northern part of the country goes through Kamza.

The aim of the study

The aim of this study is to analyze the feasibility of the biomass uses in Albanian and especially in public buildings in Kamza Municipality. The study covers *the assessment of energy wood resource potential, the study of harvesting technology of wood fuel for the plant and biomass plant assessment. Also the report aim to* analyze the fuelwood supply chain, processing and combustion to identify opportunities to increase the efficiency of firewood use and to estimate the overall balance between the sustainable supply and current demand. *In the assessment of wood energy resource potential,* the objective is to estimate the forest chip potential. The forest chip potential calculation follows the normal procedure used in Albania and in some other countries in EU. The availability of energy wood is based on the felling data from the area (stand size, tree species, volume of harvested timber, road network, topography and geographical information on the location of cutting areas and etc.). For the calculation of the suitability of the logging stands for logging residue harvesting, the recovery rate for logging residues from the logging stands and the crown mass factors have also to be known.

The aim of biomass plant assessment is to evaluate the feasibility of the selected boiler plant investments. The boiler plants can be based on co-firing, or on heat and/or power production. The production costs of heat and/or electricity will be calculated in the assessments.

Typology

The major traded forms of fuelwood are firewood (logs, bolts, slabs, blocks etc.), chips, pellets and briquettes. The particular form used depends upon factors such as source, quantity, quality and application.

Firewood (logs, bolts, slabs, blocks etc.) is the most easily available form of fuel, requiring little tools in the case of picking up, although specialized tools, such as skidders and hydraulic wood splitters, have evolved to mechanize production. Harvesting for firewood is normally carried out by hand with chainsaws. Thus, longer pieces, requiring less manual labour and less chainsaw fuel, are less expensive. It usually has a uniform length, typically in the range of 200 mm to 1000 mm. The energy content of wood varies from 5 kWh/kg (superior content, 10% MC) to 1 kWh/kg (inferior content, 70% MC). Firewood is not suitable for powerful boilers because of disability of boiler's wood feeding mechanization, also for high ash's quantity to be removed.

Wood chips are small wood pieces derived from wood's cutting by chippers. Those give solution of huge space, transport and boiler's feeding mechanization issues, of forest exploitation or logs sawing residues. Their production for energetic intentions includes wood material's cutting and chips storage. Material may be chipped on site to reduce volume for removal in general purpose chippers. Wood chips should be stored under cover to prevent wetting, however good airflow is necessary to disperse water vapour and minimize the chance of composting and mould formation. Wet chips production is less expensive, but their use is limited in boilers capable to burn wet material for public heating or electricity production. The bulk energy density of wood chips is about 50% of that of the solid wood. With a large surface area to volume ratio they can also be burned very efficiently.

Wood pellets are mostly manufactured from waste products from sawmills and other wood processing industries. They are extremely dense (density excess 1,4 ton/m^3) and can be produced with a low humidity content (below 10%) that allows them to be burned with very high combustion efficiency. No chemical additives are needed, the natural lignin of the wood itself serving as a binder, although sometimes small quantities of maize starch are added as well. Pellets cannot contain any wood based panel, recycled wood or outside contaminants. Their diameter is normally 6 mm, sometimes 8 mm or larger. Pellets have low dust and ash content. Their regular geometry and small size allow automatic feeding to a burner. Their high density also permits compact storage and rational transport over long distance. Wood pellets are one of the more efficient and practical ways to use forest biomass as a source of energy. Their energy content is approximately 4.8–5 kWh/kg. High-efficiency automatic wood pellet stoves and boilers have been developed in recent years, offering combustion efficiencies of over 90%.

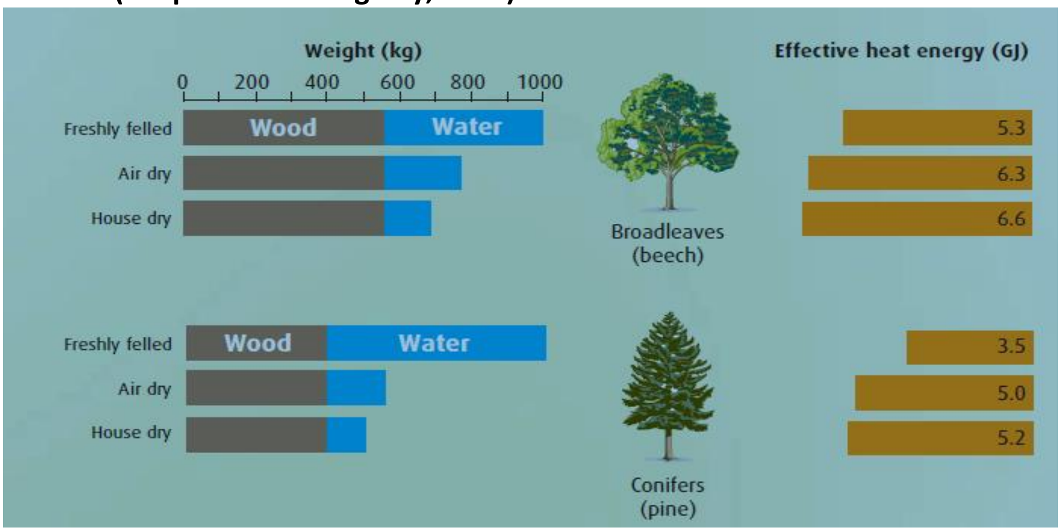
Briquettes are similar to wood pellets, but physically larger. They are made of dry, untreated wood chips (wood shavings) and pressed with high pressure without any binder. If the moisture content of wood wastes is higher than 17% (wet basis), and if it doesn't pass through a screen of maximum 10 mm, it can't be briquetted without any prior preparation (grinding and/or drying). Briquettes can vary in diameter from around 50 mm to 100 mm and are usually between 60 mm and 150 mm in length. They can resemble fire logs in appearance and function, though with improved storage, handling and combustion properties. The combination of low moisture content (8-10%) with a compressed, dense briquette (approximately 1-1.4 ton/m^3) and the ability to flow and pack closely, gives a fuel with a high bulk energy density. This then requires less storage space than lower density fuels such as firewood and wood chips. The high calorific value of briquettes (around 4-5 kWh/kg) and their low ash content (lower than 1%), are reducing the energy and maintenance costs considerably. Briquettes can be used for familiar or public heating. Public heating boilers may be equipped even with mechanized feeding systems.

THE EFFICIENCY OF FUELWOOD ENERGY

Moisture matters

When wood is burned, it should be used as efficiently as possible. The efficiency of the combustion process is heavily influenced by moisture content. Therefore, it is best to reduce moisture content before the wood is burnt so that a greater proportion of the energy from burning the wood goes into useful heat rather than converting moisture in the wood to steam.

Figure 1 Moisture content of 1m3 of wood and resulting impact on effective heat energy when burned (adapted from Keighley, 1996).



The diagram above shows how moisture content changes during drying for 1 m^3 of freshly felled timber and gives the corresponding effective heat energy over a range of moisture contents, from freshly felled to air dry to house dry. The fuel specification varies with the boiler or burner; some units can use wood with a greater moisture content than others, and this should be taken into account when specifying fuel from a supplier.

So, one of the factors which influence to efficiency of fuelwood energy is related with moisture percentage of the fuelwood used by large users. We have to stress out that in our country, mainly the fuelwood used for energy is not enough dried. The fuelwood used in schools and kindergartens is used with high percentage of moisture. This is related with the fact that the schools and kindergartens were provided with fuelwood harvested last 2 or 3 months. In such conditions, a part of energy is lost as result of high percentage of moisture. There is a big change related to this issue with the private subjects, which they use mainly dried fuelwood. Most of them they buy dried wood and store them for more than 6 months. We think that this issue should be addressed, in way to change the attitude/ behaviour of fuelwood users related to drying of fuelwood. As it is mentioned, fuelwood is an essential energy resource in Albania.

One of the way to reduce the demand in fuelwood is to improve the effectiveness in using the fuelwood. There are different alternatives to improve the effectiveness:

Drying of fuelwood: In Albania, it is very common to use fresh or nearly fresh fuelwood. The simplest and most effective method to reduce fuelwood demand is to dry it during the summer season, and to store it in the wet season on a dry place. Fresh fuelwood contains about 50% water. Burning those fuelwoods means to waste energy. The energy which remains for heating is reduced by 50%. Improved isolation/insulation of buildings: Isolation of the roofs and walls can notably reduce the demand in fuelwood energy. That means for buildings situated in the high mountains, isolation of walls, roofs, floors and especially of windows and doors is much more important to save energy and to reduce the demand for fuelwood.

Improved effectiveness of stoves: Most stoves used in schools and kindergartens are working in a very simple way, not taking care about efficiency. Modern stoves do have different systems of heat storage, warming of incoming and cooling of the hot waste air - such saving energy, saving fuelwood, saving forests.

Table 1 Heating value of fire wood – wet and dry (beech)

Water content in %	**5**	**15**	**20**	**30**	**50 (fresh)**
Heating value in kWh/kg	**5.00**	**4.15**	**3.86**	**3.30**	**2.16**

Table 2 Efficiency of fire places

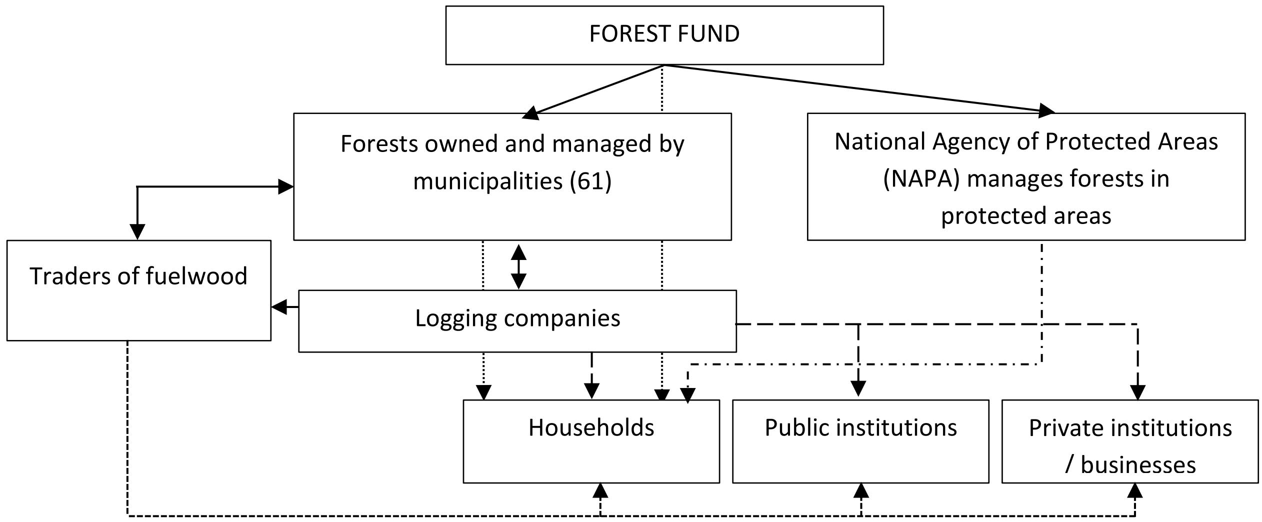
Type of stove	**Efficiency (%)**	**Total (m³)**	**Converted for energy (m³)**	**Wasted (m³)**
Open	**15 – 20**	**10**	**1.5 – 2.0**	**8.0 – 8.5**
Normal	**40**	**10**	**4.0**	**6.0**
Economic	**85**	**10**	**8.5**	**1.5**

Low energy efficiency of thermal generators increases the firewood consumption. According to the Census 2011, fireplace and stoves are the main thermal generators used by schools, hotels, and other units. Fireplaces have a low energy efficiency because only 15-20% of the energy produced by the fir trees is used for heating, while have an energy efficiency range from 40-65% (Toromani, 2009).

ROLE OF MUNICIPALITIES

Through the Decision of the Minister Council (Nr. 433, dated on 8.6.2016) "For transferring of public forests and pastures in ownership of municipalities)", the government delegated the management of forests to the 61 municipalities. Following the decision, the national government only retains the right to deal only with management of Nature Protected Areas.

Figure 2 Fuelwood supply chain



Under the new framework, municipalities are responsible for meeting all the needs for fuelwood of schools, kindergartens and municipality premises. Based on the total needs of institutions for fuelwood, municipalities are charged with determining forest parcels to be used for producing of fuelwood. The forest parcels where fuelwood will be collected should be approved in advance by the Ministry of Environment.

Municipalities typically determine the demand for fuelwood by conducting needs assessments in villages. In each village, the head of village prepares a list of households along with the amount of fuelwood requested per household. The lists of household demand are confirmed and signed by the Administrator of Administrative Unit and should be sent to the municipality. Based on the lists provided by villages, the municipality determines the total demand and approves the amount of fuelwood to be provided for households. Households pay the fee and the forestry staff at the municipality determine which forest parcels should be used for fuelwood. The forest parcels should be approved in advance by the Ministry of Environment.

Providing fuelwood to institutions

Municipalities have the responsibility to provide fuelwood not only to households but also to institutions or public entities (like schools, kindergartens, municipality premises etc). Based on the current legal framework, providing of fuel wood to institutions can be done through two options:

1. Set up their own structure (forestry team owned by the municipality) and implement all activities from fuelwood collection to marketing
2. Contract (using a tender process) a forestry company to do thinning operations. The contracted forest companies must leave the extracted fuel wood at the road side. Municipalities are responsible for transport and marketing this fuelwood.

The municipality collects information on the needs for fuelwood for schools, kindergartens and municipality premises. Based on the total needs of institutions for fuelwood, the municipality determines the forest parcels to be used for producing of fuelwood.

At present, municipalities face challenges to fulfilling the new mandate of supplying fuelwood from forest cleaning operations to citizens and institutions within their area. Municipalities often lack the capacities and funds to set up functional forest management structures with qualified staff, infrastructure and required equipment and give low priority to forestry activities. Furthermore, most municipalities face a much higher demand for fuelwood than can be supplied through forest cleaning operations. Therefore, municipalities can't meet the demand.

In order to smooth the big deficit between fuelwood supply and demands, another solution would be usage of other types of energy like sun and wind energy, natural gas etc. as well as improving thermal insulation of buildings and using more efficient heating equipment. In this framework can be mentioned the Decision No 14, February 20, 2017 of Tirana Municipality regarding to creation of Communities Fund. This decision foresees funding by the Municipality up to 50% of community initiatives to improve the infrastructure of residential blocks. One of the main activities listed into the Decision is that of thermo-insulation of buildings.

ALTERNATIVE AND RENEWABLE ENERGY POLICIES

At present, approximately 35% of Albania's energy is renewable. The country has set a target of 38% of energy coming from renewable sorces by 2020. This is far above the EU's Renewable Energy Directive binding target of 20% of the final energy consumption from renewable sources by 2020. Wood biomass as a source of renewable energy is mentioned in Albania's National Action Plan for Renewable Energy Resources (2015-2020). This plan foresees the following sources of renewable energy for reaching the set target of 38% by 2020:

- Hydropower, wind energy, solar energy (combined): 25%
- Biomass: 10%
- Biofuels: 3%

The Action Plan specifies that solid biomass will be applied for heating. Practically, solid biomass means fuelwood, because there is no any government plan to develop energy from agricultural cultures. Referring to the period 2010 – 2020 the role of biomass (fuelwood) in Albania will increase in absolute terms (see table below).

Table 3 Gross final energy consumption targets, Ministry of Energy and Industry (2017)

Year	2010	2015	2020
GFEC	2,105 ktoe	2,047 ktoe	2,678 ktoe
Fuelwood	247 ktoe (11.7%)	212 ktoe (5.4%)	267.9 ktoe (10%)

Household fuelwood demand and supply

Woody biomass, for the most part fuel-wood, has always been an important energy resource in rural areas. However, this has led to episodes of deforestation and forest degradation in Albania. The district heating systems in some of the main cities of Albania were abandoned in the early 1990s due to the lack of maintenance and high. The valuation of the potential capacity of fuelwood production operational costs. Approximately 96% of the residential building stock is privately owned. Households use to use very low efficient equipment in fuelwood combustion. Based on the National Energy Efficiency Action Plan (2010-2018) Energy Saving Target by Residential Sector is 22%.

The objective of the survey was to generate data that will serve as inputs for an analysis of the demand and supply for fuelwood in Albania. It is also aimed to:

- Provide analysis for the efficiency of the technologies used for fuelwood energy by the households.
- To outline the current level of the demand for fuelwood and to make projections.
- To enhance the understanding of the level of technology used and the level of efficiency of the usage of this fuel in the Albanian households.

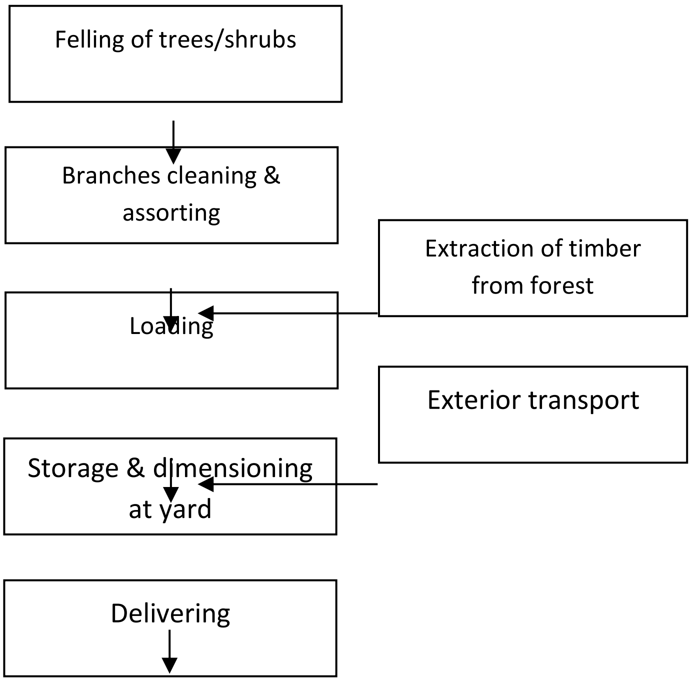
Analyzing of Wood Energy Balance

This analysis of the wood energy balance focuses on two directions:

1. Reducing the amount of forest (biomass) residues as well as MC of fuelwood,
2. Improving the efficiency of stoves/boilers and building insulation.

Forest residues and fuelwood MC

Figure 3 Chain of fuelwood production from forest in Albania



If the amount of forest residues during harvesting was reduced from 25% to 12%, the amount of fuelwood harvested in the forest to meet the current demand could be reduced from 2.99 million m^3 to 2.51 million m^3 producing a profit of 480,000 m^3 or 58 Ktoe. If the MC of 2.24 million m^3 fuelwood could be reduced from 55% to 30%, the respective energy capacity will be increased from 331 Ktoe to 389 Ktoe. Combining both options, the total fuelwood harvested in the forest would be reduced from 2.99 million to 2.25 million m^3.

Supply and delivery of a heating system with pellet boilers at Kamza e Re Kindergarten, Kamza Municipality

General Information

The Kindergarten in Kamza e Re village is an education center that provides service for more than 200 children for the whole community member of this village. Started as a project focused on promoting environmental health, installing the wood pellet boiler has generated substantial fuel-cost savings. The facility is an excellent example of how a business approach to sustainability can also make good financial sense.

The implementation of this pilot project undoubtedly has contributed to the increased interest in using biomass, building a multitude of installations using this renewable energy source, and thus to improve air quality in the region by a high degree of reduction of CO_2. This pilot project has contributed to the modernization and updated teaching program for the schools to a modern eco and safe biomass installations. Such activities will be disseminated in other neighbouring regions because they don't require expensive infrastructure and they focus on capacity building. The key innovation element is the increased capacity at all levels in order to consider energy test as key prerequisite for development planning, which this pilot action will demonstrate

Important economic information

The economy of Kamza is characterized by a high level of informality and by the predominance of small scale and family businesses. There is a prevalence of businesses in trade and services. Small business dominates the economic structure of the Municipality of Kamza. The services sector is the most developed; it accounts for about 48% of the employment rate. Next to the service sector, there exist a number of small-scale activities on construction, light industry and food processing. The Municipality of
Kamza has benefited from the influx of the inhabitants whose aim is to settle in the direct vicinity of the capital, by offering an increased level of services. The area is characterized by an intensive urban development and by the fast and unplanned transformation of land. The inhabitants tend to invest heavily in housing, which is mainly financed by the transformation and sale of former agricultural land. A decrease of interest towards developing traditional activities of agriculture and livestock production is quite visible. On the other hand, existing agricultural activities are targeted at fulfilling only family needs, and are limited to the utilization of plots not bigger than 1-3 ha for this purpose. With regard to farming and agricultural production, the most active production cathegories relate to 1) orchard plants (4 ha), 2) swine-breeding centers, 3) poultry breeding and 4) green-houses.
Since 1991, the population of the Greater Tirana Region (which includes Tirana and Kamza) has increased on an average rate of 7% per year (2% natural growth and 5% migration growth). The annual growth of the population in the Municipality of Kamza during the last years is 66%. Its annual growth is expected to be at about 9%. Under these circumstances, the urban development is expected to be more concentrated from the spatial point of view. This situation urgently calls for a more effective planning, management and service provision. There are at least 200 ha of new buildings which are built without having the respective building permit every year. This is the most typical example of an irregular urbanization process, which affects the entire country since the early 90's.
The population of Kamza has experienced a dramatic demographic boom in the beginning of '90s. In the early nineties it was marked by an increase from 6,000 to 60,000 inhabitants. In a time when urbanization and population influx is a permanent and daily process, the Municipality of Kamza does not have yet an exact figure of its current population. At present, 85,000 inhabitants are registered in the civil registry office. The average age of the population is 27 years, more than one third is under the age of 15 years and about 62% of the population belongs to the age group of 14-60 years. In 1990, Kamza had 6,000 inhabitants and in 2015 the population reached 74,000. Better employment opportunities, relatively cheap housing and the availability of unused land were the main driving factors behind the influx of new population towards Kamza.

Municipal Services

In Kamza, there are 7 kindergartens hosting 1647 children. There are 8 colleges hosting 10,491 pupils, 2 high schools hosting 2,469 pupils, and 1 vocational high school (covering the areas of auto-mechanic, agricultural, agrobusiness, hotels tourism) hosting 687 pupils and 800 students following the university studies).
Municipality has already started to provide land for building 8 new schools. The Municipality provides social aid for 1,233 families, due to their disability, health status, age, etc. The contribution for the social aid for during 2008 increased 2.4 times. The daily center for the old people has been established. Non Profit Societies such as; The Albanian Red Cross, Global Care, AIBI, etc have provided assistance to families in need, orphans.

Environment

Information on its general situation, problems and trends

Due to the rapid population growth that reflects in the construction boom, and in the growth of the private trade sector, Kamza is facing serious environmental problems related to solid waste management, recycling, rehabilitation of green areas etc. The service for the green areas in Kamza is currently provided by the Cleaning/Greeness Enterprise operating in the Municipality. There is a trend to outsource this service to private enterprises. The Municipality has applied as a partner organisation for a regional project of solid waste management in the framework of the EU programme for the South-Eastern Europe.

Implementation of a heating system with pellet boilers in a Kindergarten in Kamza Municipality

Wood pellets are a manufactured biomass fuel. They are made from wood waste materials that are condensed into pellets under heat and pressure. Natural plant lignin holds the pellets together without glues or additives. Wood pellets are of uniform size and shape (between 1-1½ inches by approximately 1/4-5/16 inches in diameter), making them as easy to store and use as traditional fossil heating fuels. Wood pellets also take up much less space in storage than other biomass fuels because they have a higher energy content by weight (roughly 7,750 Btu per pound at six percent moisture content) due to their densified nature and low-moisture content (typically between 4-6 percent moisture by weight).

Components of a Wood Pellet Heating System

The Technology

Wood pellet boilers are relatively simple systems that are easily installed and operated. The wood pellets are typically stored in a standard outdoor silo. Pellets are delivered in trucks similar to those that deliver grain. Wood pellet fuel is automatically fed to the boiler via auger systems similar to those used for conveying feed and grain on farms. The pellets are discharged from the silo and conveyed to the boiler using automatically controlled augers set to provide the right amount of fuel based on the building's demand for heat.

Figure 4. View of the Kindergarten where the system is installed

Figure 5: Process of system installation in Kindergarten

Operation & Maintenance

Requirements
Wood pellet boilers are relatively simple biomass heating systems. Because wood pellets are generally uniform in size, shape, moisture and energy content, fuel handling is very straightforward. Nevertheless, there are some ongoing maintenance requirements for these systems. A wood pellet boiler will take more time to maintain and operate than a traditional gas, oil, or electric heating system. At the institutional or commercial scale, however, many of the maintenance activities can be cost-effectively automated by installing off-the-shelf

equipment such as soot blowers or automatic ash removal systems. Some of the typical maintenance activities required for wood pellet systems are:

How are wood pellets made?
Wood pellets are made from densified wood waste material, typically from logging, sawmill, or packaging residues. Wet sawdust is pressed into pellets under high heat and pressure. There are no additives in wood pellets, therefore they burn cleanly.

How are wood pellets delivered?
Bulk wood pellets are brought to the site in a truck that delivers directly into the storage silo using either
compressed air or a pneumatic conveyance system.

How much wood pellets will I need and where will I store them?
The amount of wood pellets required—measured in tons—can be estimated based on the amount of fuel currently being used to heat your building. Commercial wood pellet suppliers and other experts can assist with these calculations. The amount of storage space required will be dependent on the amount of wood pellets needed. Typically, wood pellets are stored in a silo (similar to those housing grain) or other type of bin. The storage tank must provide good access for the fuel delivery truck. Wood pellets can be conveniently stored for up to one year.

Economic Analysis of Wood

A primary advantage to using wood pellets for space heating is the savings in heating costs that are generated by replacing expensive fossil fuels with less expensive wood pellets. These savings can be calculated on a first-year basis, or the savings can be projected into the future over the expected life of the wood pellet boiler. An important question for potential owners of wood pellet boilers is the extent to which the fuel cost savings justify the cost of the project.

When are Pellet Boiler Systems Cost Effective?

Life cycle cost (LCC) analysis can be used to inform a building owner's decision to convert to wood pellet heating. In calculating potential fuel cost savings, the LCC analysis considers several economic variables, such as estimates of fuel price and average inflation rates. The LCC analysis compares the projected costs of an existing fossil fuel boiler system to the projected costs of a new wood pellet boiler system, and shows the net present value (NPV) of savings over the life of the system.
Spreadsheet-based LCC analysis tools are available from:

- Biomass Energy Resource Center
- Natural Resources Canada (RETScreen)
- Universities of Wisconsin and Alaska
- Select architects or engineer

General Indicators of Cost Effectiveness

The best candidates for heating with wood pellets are buildings between 10,000 and 50,000 square feet (SF) that use heating oil, propane, or electricity for space heat and/or for serving large domestic hot water loads. Electric heat is the most expensive, therefore fuel cost savings generated by switching from electric heating to wood pellets could potentially be substantial, although the costs of converting the electric heaters to hot water heat distribution must be part of the analysis. Propane is typically the next most expensive heating fuel, followed by heating oil. LCC analysis assumes conservative inflation rates for fossil fuels as well as the general inflation rate, and does not take into consideration any additional financial incentives for wood energy, such as possible future taxes on carbon emissions.

The graphs on the following page show the potential for wood pellets to be a cost-effective alternative heating fuel when compared to oil, propane, natural gas, and electric heat. The LCC of a wood pellet heating system was compared to that of each of the fossil fuel heating systems across a range of heat load sizes and fuel prices. On each graph there is a line that represents the “break-even” point, at which the wood pellet system costs just as much as it saves over the life of the system (30 years). At conventional energy prices and consumption rates above the break even line, wood pellets would be a cost-effective alternative heating fuel. At the prices and consumption rates below the break even line, wood pellets are not likely to be cost effective. The farther above or below the break-even line, the clearer the message of the graph. While these graphs give a general idea of cost effectiveness for a range of situations, a site-specific LCC analysis will give more definitive answers.

The energy content of wood pellets is approximately 4.7 – 5.2 MWh/tonne (~7450 BTU/lb). High-efficiency wood pellet stoves and boilers have been developed in recent years, typically offering combustion efficiencies of over 85%.The newest generation of wood pellet boilers can work in condensing mode and therefore achieve 12% higher efficiency values. Wood pellet boilers have limited control over the rate and presence of combustion compared to liquid or gaseous-fired systems; however, for this reason they are better suited for hydronic heating systems due to the hydronic system's greater ability to store heat. Pellet burners capable of being retrofitted to oil-burning boilers are also available.

Table Nr 3: The calorific value and cost for several fuels (according to the local price)

Nr	Model	Consumption	Cost
1	Gas	8600 kcal/m3	1.1 Euro/m3
2	Automotive diesel fuel	12000 kcal/kg	1.4 Euro/kg
3	Wood Pellets	4300 kcal/kg	0.3Euro/kg
4	Resistance Heating	859.8 kcal/h	0.41Euro/kW

Many building owners use fossil heating fuels, such as oil or propane, for space heating. These fuels are often expensive and unstable in pricing and are threatening the global climate and sustainability of communities. Biomass fuels are a local, renewable resource for providing reliable heat. Wood pellets are a common type of biomass. Biomass is any biological material that can be used as fuel—including grass, corn, wood, and biogas as well as other forestry and agricultural residues.

Table Nr 4. The shortest PayBack for different heating systems (according to the local price)

Model	Gas	Automotive diesel fuel	Wood Pellets	Rezistance Heating
Consumption	30093kcal/h	30093kcal/h	30093kcal/h	30093kcal/h
Cost	3.85 Euro/h	3.5 Euro/h	2.1 Euro/h	3.4 Euro/h

From the above data, there is clear that the heating system using the wood pellet is more effective on the economical view. Based on our calculation, it is estimated that the quantity of wood pellet could be easly provided by the Municipality or from parents themselves. Using biomass fuels helps mitigate such environmental issues as acid rain and global climate change. Perhaps the greatest advantage of biomass fuels, however, is that they cost on average 25-50 percent less than fossil heating fuels and are more stable in pricing. It is unlikely that any future carbon or energy taxes will increase the cost of biomass fuels and are more likely to raise the cost of heating with fossil fuels. The technology is becoming well established in the North American market and the choice to heat with biomass fuels can be as simple as choosing a traditional fossil fuel heating system. Wood pellets are a condensed uniformly sized form of biomass energy, making them easier to store and use than many other biomass fuels. Pellet heating technology is also quite simple, minimizing operation and maintenance requirements. These heating systems can be easy to plan for and install and can save a building owner thousands of dollars in energy costs over time while providing significant local economic and environmental benefits.

Environmental consideration

Air pollution emissions

Emissions such as NO_x, SO_x and volatile organic compounds from pellet burning equipment are in general very low in comparison to other forms of combustion heating. A recognized problem is the emission of fine particulate matter to the air, especially in urban areas that have a high concentration of pellet heating systems or coal or oil heating systems in close proximity. This $PM_{2.5}$ emissions of older pellet stoves and boilers can be problematic in close quarters, especially in comparison to natural gas (or renewable biogas), though on large installations electrostatic precipitators, cyclonic separators, or baghouse particle filters can control particulates when properly maintained and operated.

Global warming

There is uncertainty to what degree making heat or electricity by burning wood pellets contributes to global climate change, as well as how the impact on climate compares to the impact of using competing sources of heat. Factors in the uncertainty include the wood source, carbon dioxide emissions from production and transport as well as from final combustion, and what time scale is appropriate for the consideration.

Air Emissions

There have not been any independent emissions tests performed in Albania on institutional- or commercial-scale wood pellet boilers, although efforts are underway. While the actual data is not available for wood pellet boiler technology, test results are available for other modern institutional-or commercial-scale wood-burning technologies, particularly school-sized woodchip boilers. It is well known that the emissions from wood-burning boilers are different than emissions from such traditional heating fuels as heating oil, propane, or natural gas. All heating fuels—including wood—produce particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NOx), and sulfur dioxide (SO2) in varying amounts. Burning wood in a modern and well maintained woodchip boiler, for example, produces more particulate matter than burning any of the fossil fuels, but less SO2 than oil or propane.

Advantages to Heating with Biomass

Using biomass fuels helps mitigate such environmental issues as acid rain and global climate change. Perhaps the greatest advantage of biomass fuels, however, is that they cost on average 25-50 percent less than fossil heating fuels and are more stable in pricing. It is unlikely that any future carbon or energy taxes will increase the cost of biomass fuels and are more likely to raise the cost of heating with fossil fuels. The technology is becoming well established in Albanian market and the choice to heat with biomass fuels can be as simple as choosing a traditional fossil fuel heating system.

In addition, wood pellets:

• are convenient and easy to use, and can be bulk stored in less space than other biomass fuels

• have a high energy content, and the technology is highly efficient compared to other biomass fuels

• are a clean-burning renewable fuel source

• are produced from such waste materials as forestry residues and sawdust

• are price stable compared to fossil fuels

Who Should Consider Wood Pellet Heating?

There are currently about 400-450 homes in the Kamza Municipality using wood pellet stoves or furnaces for heating, according to the survey accomplished. Wood pellets are manufactured in the local market or Italy, and are available for residential use in 30-40-kg bags from feed stores, nurseries, and other supply outlets.

Increasingly, heating with wood pellets is becoming common on larger scales—in municipal or national buildings, educational facilities, housing complexes, office buildings, and other businesses. While the majority of installations of this size are in the northern part of Albania, a growing number are in Central and South-East part of Albania, including Kamza zone. The greater heating requirements of these larger buildings differ from those of residential settings, thus requiring different technology (boilers rather than stoves) and fuel supply infrastructure (bulk wood pellet supply rather than bags).

Where can be used the Wood Pellet Heating

The best candidates for wood pellet boilers are buildings between 250 and 300 square meter (m^2) that use heating oil, propane, or electricity to produce space heat and/or hot water. Natural gas is generally a less expensive fossil fuel for space heat, and wood pellet prices are not always competitive. When natural gas prices are significantly higher than the national average price, wood pellets may be the better alternative. Wood pellet heating systems are also a viable option for new construction.

Other important site characteristics to consider include the layout of the building. It should have—or the owner should plan to convert to—a centralized hot water heat distribution system. There should be adequate space for the wood pellet boiler and storage silo as well as adequate access to the silo for fuel truck deliveries.