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The general feasibility of industrial woody bioenergy investments in Kosovo

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ABSTRACT *Developing renewable energy sources provides benefits in terms of reducing import dependence whilst also facilitating the achievement of environmental objectives. However, current utilization of renewable energy resources for electricity generation is almost not existent in Kosovo. The majority of existing biomass consumption is in the form of firewood and wood waste used as a heating source.*

Wood is the most traditional form of bioenergy and most of the current wood boilers are small household burners. The direct combustion of firewood is very common, which is highly ineffective because in most cases it is carried out in facilities with low efficiency (<50%). Many households still use electricity for heating as well, and it would be very economical to substitute with biomass.

The following paper will help to relevant stakeholders in Kosovo to assess the general feasibility of industrial wood biomass investments, particularly investments in the region in Kosovo heat. This paper covers aspects relating to the supply of raw materials, techniques, economic and environmental criteria related to energy production, infrastructure and organizational aspects.

INTRODUCTION

Using woody biomass in a more efficient way could be secured by installing new decentralized district heating plants.

The selection of the heating plant capacity depends first of the available heat load and secondly the full cost calculation including raw material prices. The specific investment cost reduces when plant size increases, since the main equipment can be scaled up greatly

The utilization of the biomass potential in the country depends on the presence of the following key factors:

- Availability of feedstock
- Access to grid
- Financial support for small-scale facilities
- Sufficient infrastructure allowing the use of different types of woody biomass

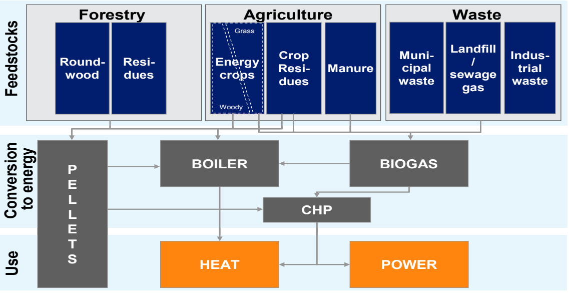
Currently, biomass energy generation has almost no commercial application. Economic constraints in forest-related biomass are related mainly to the investment costs and the cost of raw material at the energy plant (MED, 2010).

The following study should help relevant actors in Kosovo to assess the general feasibility of industrial wood bioenergy investments, especially focused on district heating investments in Kosovo. This study paper covers aspects concerning the raw material supply, technical, economic and environmental criteria concerning the energy production.

RAW MATERIAL SUPPLY

One of the major challenges for the growing bioenergy economy is the reliable and efficient supply of sustainable woody biomass feedstock. The following figure describes some of the co-dependencies between the different feedstock supply chains, its conversion into energy and the different end uses (Pira, et al., 2011).

Figure 1.
Biomass feedstock's and their conversion to energy use



Sufficient, continuous raw material supply is crucial to operate a biomass plant.

Availability and quality of the raw material

- Is there a reliable source of raw material? Does a resource assessment exist? Are there e.g. long-term contracts with the supplier?
- Does the quality of the raw material keep the correct standard?

The reliability of the raw material is a critical factor in the success of a plant. A reliable source must be secured and secondary sources identified in case of problems with the primary source.

Potential volumes of biomass feedstocks required to produce bio-energy are closely linked to the land resources. Kosovo's total area comprises diverse landscapes ranging from the high mountains to flat terrain where agriculture is dominating, (Sahiti, 2012), (FAO, 2003).

Feedstocks from the forestry sector include roundwood, firewood, harvest residues as well as residues/by-products from the forest industry. Harvest residues comprise branches and lopping's which are chipped either at the forest site or at the plant, and then are dried to reduce the moisture content.

Fast-growing species are currently not existent but could be used as raw material for heating plants. Several hundred hectares of poplar and willow stands could be created alongside rivers. In addition to the production of wood material, this practice could have the objective of contributing to strengthening the river banks. In optimal conditions (the so-called "typical poplar stand"), the wood growth could be as high as 930 m3sub/ha during a period of 20 years. This corresponds to an average annual yield of more than 17 tonnes of dry matter per hectare per year. It should be noted that there is a difference between fast-growing tree stands and short rotation coppice (SRC). Usually fast growing trees are left to grow during a period of at least 20 years. Short rotation coppice stands are harvested every 3–4 years (when the willow shoots are approximately 6 meters high) and their cultivation is more like an agricultural activity (with irrigation, fertilizers, herbicides, weeding, etc.).

A resource assessment carried out e.g. by a forestry management consultant may help to guarantee the availability of the raw material required over the short, medium and long term.

If a local resource, such a saw mill, is available, it would be prudent to explore the possibility of setting up a long term contract which guarantees cost and raw material quality. One way of ensuring the quality of the fuel supplied is to base payments to the supplier on the amount of energy produced by the raw material (by monitoring the heat output using a heat meter) rather than paying for the fuel by weight or volume. It has to be stated that sawmills and wood processing companies are very small scale in Kosovo. From residue potential point of view this means that the transportation distances will be long and yields per factory low (AgriPolicy, 2009).

Sustainability of the raw material

- Are the sustainable forest management regulations fulfilled?
- Which sustainability standards and certification systems are used?

A big share of forest residues is currently used and just small amounts are left on the site as nutrition for the field. Collection of harvest residues is generally done manually.

From the point of view of sustainable forest management, it is important that some harvest residues and their content of plant nutrients remains in the forests. Majority of plant nutrients (e.g., nitrogen, phosphorus, potassium, etc.) are contained in the active parts of the tree and the needles and the bark make up only a small proportion of the biomass (Pira, et al., 2011).

Special attention should be paid to soil degradation and the role of biomass in limiting these. The economic activities in the forests that influence the degradation of lands are:

- Recovery and preservation of the landscape diversity in forestry through the application of sustainable practices
- Failure in execution of the measures planned in the forest development plan (e.g. wrong soil preparation procedures in forestry measures)
- Utilisation of unsuitable technologies for wood harvesting
- Unregulated pasturing of animals
- Wrong construction of forest roads

The production of biomass is characterised by a number of restrictions, such as lack of arable lands and freshwater, loss of biodiversity, competition with food production, deforestation, etc. This should be solved through careful land use planning, effective international cooperation and regulatory mechanisms that allow avoiding satisfying energy demand in order to growing food crops and manage water resources or prevent threats to biodiversity.

A good way to ensure sustainability of forestry and forest operations is certification according to third-party verified certification schemes. Up to now no Forest Certification Scheme such as Forestry Steward Council (FSC) or Programme for the Endorsement of Forest Certification Schemes (PEFC) has been implemented.

ENERGY PRODUCTION

Regarding the energy production the following technical, economic and environmental criteria should be considered when assessing the viability of a district heating system:

Technical criteria

Heat demand

- **Estimated amount of heat demand**

In order to accurately determine the size of boiler required to power the system and the size of the grid it is necessary to determine the space heating and hot water demand. Heat demand is based on the number, size and type of properties and will vary according to factors such as level of occupancy, age and energy efficiency (Sahiti, 2012).

The heat demand of each property can be calculated using a combination of assessment of available information including current fuel bills and modelling (Pira, et al., 2011). As much of the information as possible should be collected for each property to assist with this process:

- annual energy bills for the last two years
- building size, age, construction, services provision, current space and water heating
- current occupancy information – who uses the building and how often
- description of levels of comfort/inadequacies
- energy efficiency levels
- room dimensions

Boiler systems, boiler house and raw material (fuel) store

- boiler system data
- boiler house data
- fuel store data

Boiler

The most suitable system will be determined by the available space, level of automation required, cost and importantly, fuel type. Unless there is a high level of confidence in the security of fuel supply it is prudent to choose a boiler that can accept biomass of varying quality (and moisture content). Some wood chip boilers can accept pellets, but in general pellet boilers cannot accept wood chip.

The cost will obviously vary depending on the size, type, make and model of boiler. Biomass boilers are most efficient when operated relatively continuously and some can modulate to operate at between 30-100 % of their related output. The boiler can be sized to meet the sites entire heat demand (peak load) or the continuous heat load required all year round (base load) with another system installed to meet excess demand. Many schemes also have a fossil fuel boiler either to support the biomass boiler in times of peak demand (auxiliary boiler) and/or to provide security due to boiler or fuel supply failure (back-up boiler). The optimum choice will depend on the demand profile of the site.

Boiler House

Ideally the boiler house and store should be as close to the properties as possible to minimise the length of pipe required. However this is dependent on suitable land being available and potential planning issues. It may be possible to modify an existing building or a purpose built boiler house can be constructed.

Fuel Store

The size of the fuel store is dependent on the fuel type (wood chips require a greater storage volume than pellets for the

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same quantity of heat delivered). In general it will be more cost effective to have large deliveries; however this requires a larger storage area and access for heavy haulage vehicles. There are many storage options, including subsurface stores, hoppers etc. and the choice will depend on the fuel type, available space, vehicle access and method of transferring the fuel from the store to boiler. The time and labour requirements needed to make a delivery and potential disturbance through noise and disruptions need to be considered in the design.

ECONOMIC CRITERIA

- Investment costs?
- Operational and maintenance costs?
- Projected revenues?
- Financial possibilities?

With the data listed above the efficiency of a DH plant can be calculated. It is recommended to consider a number of different scenarios of future development (inflation, interest rate, energy price, shortage in supply).

There are different ways of calculating the profitability of the plant. One example e.g. is the present-value method.

When using the present-value method, future yearly expenses/costs and incomes/savings (actually payments in and out) are converted into their values as of today. The present value depends on the costs of capital, increase of energy prices and the period of calculation that have been chosen. The present value of future payments in and out, minus the original investment costs, is referred to as capital value. If the capital value is above zero the investment is profitable (Sentro, 2008)

It has to be considered that the initial investment costs per produced energy unit are relatively high in small district heating units.

ENVIRONMENTAL CRITERIA

Air quality

- **emission data**

The combustion of biomass (in common with other combustion systems) contributes to emissions of air pollutants such as nitrogen and sulphur oxides and particulate matter. A well maintained biomass boiler will generally produce more emissions than a gas boiler but less than coal or oil equivalents. The additional contribution of particulate matter in urban areas has the potential to lead to excedances in areas already clos to particulate matter target concentrations. The use of abatement technologies can reduce emissions and may help to ensure that there is no significant contribution to overall particulate matter concentrations.

CONCLUSIONS

We can say that using woody biomass in a more efficient way could be secured by installing new decentralized district heating plants.

The selection of the heating plant capacity depends first of the available heat load and secondly the full cost calculation including raw material prices. The specific investment cost reduces when plant size increases, since the main equipment can be scaled up greatly

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