Mladen ILIĆ*, Simeon OKA**

THE POSSIBILITY AND PROBLEMS OF USING BIOMASS FOR ENERGY PRODUCTION

Abstract: Biomass energy potential has a significant share in total energy potential of renewable energy sources in Serbia. The total estimated value of annual biomass energy potential is 2.7 million tons of equivalent oil (toe). Of that value about 1.7 million toe belongs to biomass residues in agriculture and about 1 million toe of biomass from forestry, including different biomass residues and fuel wood. The total annual biomass energy potential represents about 40% of the total coal energy production in Serbia. In 2009 the Government of the Republic of Serbia adopted a decree on feed-in tariffs stimulating investments in electricity generation from renewable energy sources. In spite of the significant energy potential of biomass and the stimulating prices the interest of investors is still lacking. It is obvious that investors encounter additional barriers which can be of several kinds: technological, logistic, regulatory and public acceptance.

Key words: *biomass energy, potential, barriers*

Sažetak: Energetski potencijal biomase ima značajan udeo u ukupnom energetskom potencijalu obnovljivih izvora energije. Ukupan procenjeni godišnji energetski potencijal biomase iznosi 2,7 miliona tona ekvivalentne nafte (toe), a od toga oko 1,7 miliona toe se odnosi na ostatke biomase u poljoprivredi, a oko 1 milion toe na šumsku biomasu, uključujući različite ostatke drvne biomase i ogrevno drvo. Ukupni godišnji energetski potencijal biomase predstvaljaoko 40% energije ukupno utrošenog uglja u Srbiji. U 2009. godini je Vlada Republike Srbije usvojila uredbu kojom su određene podsticajne mere za investitore u proizvodnju električne energije iz obnovljivih izvora energije. Uprkos značajnom energetskom potencijalu i usvojenim stimulativnim cenama nema zainteresovanih investitora. Jasno je da se investitori suočavaju sa dodatnim sa preprekama kojemogu biti različitih vrsta: tehnološke, logističke, regulatorne i opšte neprihvaćanje korišćenja biomase kao savrmene tehnologije.

* Dr Mladen Ilić, Energy Saving Group, Belgrade, Serbia

** Prof. dr Simeon Oka, Institute Vinča, Laboratory for thermal engineering and energy, Belgrade, Serbia

ENERGY POTENTIAL OF BIOMASS IN SERBIA

A great part of Serbian economy is based on agricultural production and agricultural relating industry. The north part of Serbia, the province Vojvodina together with territories along river Sava and Danube are crop farming regions with domination of wheat and corn. The agricultural biomass wastes are coming from cereals, mostly wheat, barley and corn, and from industrial crops mostly sunflower, soya and rape seed. In addition, these are regions with many farms of livestock breeding, where liquid manure is considered biomass waste. Fruit growing is present in this agricultural area as well, but main area of fruit growing is hilly region on the south.

In addition, Serbia belongs to countries relatively rich in forests. About 30% of the territory of Serbia is covered with forests, while about 55% of the territory is arable land. The forest area is further on the south of Serbia, but also on the east and west of the central part of Serbia. In 14 of 145 municipalities forests cover more than 45% of the appropriate territory of the municipality [1]. In next nine municipalities forests cover 40–45% of the territories. About 50% of forests are property of the state and managed by the Public company Srbijasume, while other half of forests are in private ownership. Dominant species in Serbian forests are deciduous trees.

The estimated value of annual biomass energy potential in Serbia is 2.7 millions *toe* (tons of oil equivalent). Of that value, 1.7 millions *toe* are coming from agricultural residues while 1 million *toe* is coming from forestry. The estimated value of residues from agriculture is obtained on the account of assumption that only 1/3 of the total volume of agricultural residues from crop farming will be available for energy, while other 2/3 of residues will be used for another purposes or will be left or burnt on land. The energy potential from forestry comprises fuel wood, residues in wood processing industry and residues in forest usually left after tree cutting. The importance of biomass energy potential can be expressed by comparing with the total annual energy consumption in Serbia of 15,6 millions *toe* and with the total coal consumption in Serbia without power industry of 1,5 million *toe*.

Ones of typical opportunities for implementation biomass projects are centralized heating systems on fossil fuels in municipalities rich in biomass residues. In three selected municipalities in agricultural area centralized heating systems use 8 830 tons of liquid fuel oil. The equivalent energy value has residues of crop farming (straw) from only 5% of the land used for crop farming in these municipalities. For another two municipalities in forest regions about 10% of the registered wood felling in forests at the territory of these municipalities would be enough for replacement fuel oil in their centralized heating systems [2].

REGULATION SUPPORTING RES

In 2009 the Government of the Republic of Serbia adopted two decrees for stimulation electricity generation from renewable energy sources. The first decree is on privileged power producers and it defines conditions for getting status of privileged

power producer and rights and obligations producers and entities that play role in transferring of electricity to consumers. Privileged power producers are those who use renewable energy or combined heat and power plants for electricity generation. Biomass, biogas and hydro power plants only with the capacities not over 10 MW can get the status of privileged power producers. While the total capacity of all wind and solar power plants that can get the status of privileged power producers are limited to the values of 450 and 5 MW respectively. The status of privileged power producers lasts maximum twelve years [3].

It can be seen (Table 1) that incentive electricity prices applied in Serbia are very similar to those in other European countries. They are little higher than in Germany and Spain, with the exception for solar and geothermal. While the prices in Czech Republic and Croatia are approximately in same range as it is in Serbia but with little higher maximum values than maximum values in Serbia.

After a year of implementation of feed-in tariffs in Serbia in spite of the fact that electricity prices for electricity generated in biomass plants seems very attractive there is neither energy permits nor construction permits issued. It is a sign that prospective investors encounter some other barriers and difficulties. The incentive price for electricity from biomass is necessary but not enough to attract investors.

Table 1. Feed-in tariffs in Serbia and some European countries [3]

Price (c€/kWh)	Serbia	Germany	Spain	Czech (Croatia)
Hydro	7.8–9.7	6.6–9.6	7.8	6.6–9.9
Biomass	11.4–13.6	8.4–11.5	12.5	9–15 (16,7)
Biogas	12–16	13–15.5	13.1	9–15 (16.7)
Wind	9,5	8.7	8	9–12,5
Solar	23	45–57	23–40	25–50
Geothermal	7.5	7–15	9	17

BARRIERS AND DIFFICULTIES FOR EXTENSIVE USE OF BIOMASS FOR ENERGY PRODUCTION

Barriers and difficulties for biomass use for energy production mainly relates to the following aspects: biomass fuel characteristics, logistics of biomass fuel, technologies of conversion and preparation and regulation.

Biomass fuel characteristics

Under wood biomass fuel we understand: forest residues, tiny branches, sawdust, bark and other residues of tree cutting and primary processing of wood. While under agricultural residues we mainly understand straw, corn residues and cobs. Except the residues in wood and food processing firms, potential biomass fuels are dispersed over agricultural land and in forests. Therefore it is necessary to spent considerable quantity of energy for collecting those biomass residues. Collecting by machines or manually over large area contribute to biomass fuel cost in-

creasing. After biomass fuel is collected it is necessary to transport it to a storage area. Since the collection is carried out over large area, and since the bulk density of residues like straw and tiny branches is relatively small, transport costs can not be neglected. Some assessment says that maximum distance for biomass transportation is about 50 km. But, for every heating or power plant a separate feasibility study including economic viability should give the answer on maximum transportation distance. The low bulk density of biomass fuel has effects not only on transport cost but on storage volume and storage costs as well. In spite of a very low initial price of biomass (agricultural and forest) before collecting the final price of biomass fuel is not negligible.

Wood and food processing firms have significant advantage against other prospective users of biomass for energy production, because they have available relatively large volume of biomass residues without needs to collect and transport them. Based on continuous production of biomass residues they do not need to have big storage capacities. Because of the very low cost of biomass fuel, the wood and food processing firms are the best locations for energy production from biomass.

Technologies for biomass conversion

As an oldest technology for biomass energy conversion the combustion process is still the most applied technology. Combustion of biomass is usually is used mostly for heat production only, but more and more there are plants where the heat produced from biomass is used for electricity generation in so called combined heat and power plants. Typical values of biomass as fuel are as follows [4]:

Moisture content	Lower heat value	Bulk density
10–50%	7,9–16,6 MJ/kg	120–600 kg/m^3

One of typical drawback of biomass fuel is low melting temperature of ash. Especially agricultural biomass is well known for that characteristic, and for avoiding blockage in combustors and heat exchangers it is necessary very often to maintain combustion temperature below 800°C [4].

Biomass fuels are of different sizes and shapes (straw, bark, sawdust, corn cobs) and with different combustion characteristics (moisture content, heating value) and therefore it was necessary to develop different types of combustors and auxiliary equipment for internal transportation and feeding of biomass fuel. Different technologies are developed, proven in practice and reached fully commercial stage of the development. But for successful use of biomass it is necessary to install appropriate equipment designed for that kind of biomass which would be used in the given plant.

Regulation and policy

The greatest part of trees felled in forests is used as fuel wood. But remarkable part of wood is used for production of different wood products, for example for

production of different kind of boards, furniture, doors, paper and viscous production.

In the last decade wood pellets has become very interesting fuel for many consumers in Western Europe. Following the increasing interest of customers the price of wood pellets has been increasing as well. Almost total present production of wood pellets in Serbia is being sold in Western Europe. Hence the price of wood pellets for customers in Serbia is practically formed on the account of the demand in other developed European countries.

Public company Srbijasume managing the state owned forests in Serbia define the price list for all categories of wood assortment from their forests, including forest residues and fuel wood of different wood species. Other private owners of forests define independently prices of their wood, but in some extent in correlation with the price list of Srbijasume. In every case, domestic entities define the prices of all wood resources in Serbia.

Taking into account relatively low prices of different wood assortments and even fuel wood, with in the same time high price of wood pellets, many potential investors have expressed great interest for starting production of wood pellets. Their assessment is that production of wood pellets is a very profitable business under these circumstances.

In addition, there are other firms in Serbia dealing with wood and wood residues, like producers of different kind of boards, furniture and paper. Especially production of boards is in the competition for resources with wood pellets production. The both production are mainly based on milled wood and can use wood residues like sawdust. But generally there is a competition between users of wood and wood residues for energy and fuel production on one side and users of wood for other purposes on another side.

The boards produced in domestic firms mainly supply domestic market while the wood pellets dominantly are for international market. Taking into consideration the social conditions of customers at these two markets it can be concluded that under these circumstances, with a rapid expansion of wood pellet producers, the competition between producers of these two different industrial activities could lead to endangering one side, the side oriented to more poor domestic market.

CONCLUSIONS

Biomass is a hard fuel in comparison especially with liquid and gaseous fossil fuels. It needs more energy for transportation and preparation and more organizational skills. The great demand for wood pellets in many Western European countries turned the interest of prospective investors in biomass to production of wood pellets. But regarding environmental protection, the more appropriate way for using biomass energy is to use it with as less as possible energy consumed for biomass preparation, namely direct use of different kind of biomass residues and wood chips, but not wood pellets. It is necessary to promote and support direct utilization of biomass. For successful implementation of biomass energy projects it is not

enough to have financial incentives, but it is necessary to have solved or at least mitigated the majority of the potential barriers related to technology, logistics and regulation as well.

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