Tarım Makinaları Bilimi Dergisi (Journal of Agricultural Machinery Science)
2008, 4 (3), 227 - 230

Biomass Potential and Availability for Energetic Use - Barriers and Drivers

Márta SZABÓ, István BARÓTFI
Szent István University, Institute of Environmental Systems, Páter K. u. 1. ,H-2100 Gödöllő
szabo.marta@gek.szie.hu

Abstract: Biomass availability and potential has a lot of aspect including technical (i.e. land management, energy and moisture content of the biomass, grid connection, logistic issues…), environmental (i.e. erosion, soil compaction, nutrient input, pesticide, water abstraction, fire risk, biodiversity…) and economic (i.e. cost-supply, competition, prices, support schemes…) considerations. There are a lot of research about the suitable biomass crop mixes and their assesssment, development and sustainability and a lot of existing models try to predict the future compatible biomass potential. Our research focuses on the collection of the national, regional cases and also on a comparative analysis of the main forms of biomass. As a result a priorization of bioenergy crops and the main barriers and drivers in different regions for the sustainable bioenergy will be summarized.
Key words: RES, biomass potential

INTRODUCTION

The potential and availability has a lot of aspect including energetic, technical, environmental, economic and policy considerations. The EU directive for RES gives an indication for the use until 2020 however the commitments of each member state are facing with different difficulties, barriers, problems. The paper gives an overview over the main aspects of the present situation because of the complexity and on the research focused on the discussions, realities and targets of the national renewable energy policies regarding the biomass.

Biomass has the most significant role among renewable energy sources in Hungary. In order to increase the share of the Hungarian renewable energy use increasing the agricultural biomass and biofuel production is of key importance. It may be useful to consider the development of a biomass strategy for Hungary in inter-ministerial level, taking into account the availability, system limitations, environmental commitments.

In Hungary, the share of renewable energy sources in the total primary energy supply was 3,7 % (0,41 Mtoe) in 2000 and had an increase to almost 5 % (0,98 Mtoe) in 2004.

In 2004 in the total final consumption of energy the share of renewables was 3,7 %. In 2005 the share of renewable energy resources in Hungary accounted for 4.6% in total use, the majority of which originated from biomass. The largest part of it was firewood (25 PJ) and other solid wastes (22 PJ), while from biogas only 0.3 PJ energy was used. The use of other renewable energy types are also significant: from geothermic energy 3.6, from water energy 0.8 and from solar energy 0.1 PJ was used in 2005 (Table 1.). (AKI)

Table 1. Use of renewable energy resources in 2005 (PJ)

Type of energy	Total renewable
Electric energy of water power station	0,8
Electric energy of wind mills	0,0
Geothermic energy	3,6
Firewood	25,0
Other solid wastes	22,0
Solar energy (collector + photovoltaic)	0,1
Biogas	0,3
Total	51,8
Domestic energy use	1130
Share of renewable in total energy use	4,6%

Source: MVM (AKI)

In Hungary, renewable energy sources are used in heat production and electricity generation and today already also for producing biofuel for transport. The major utilisation of RES is in heat production with a share of 72 % (2004).

The gross electricity consumption in Hungary – total electricity fed to the grid – reached 41,1 TWh in 2007. The recent assessments show that ca 1,67 TWh came from power plants powered by RES. It can be seen, that this 4,1 % is higher already that our undertaking by 2010. It has to be noted that this percentage already has been reached in 2005 than in 2006 it dropped temporary to 3,4 %.

In the energy balance in 2007 the grid connected electricity from RES was

- from biomass combustion (mainly wood) in power plants 1194 GWh (2,91 %)
- water power plants 203 GWh (0,49 %)
- waste combustion 140 GWh (0,34 %)
- wind power plant 108 GWh (0,26 %)
- biogas 26 GWh (0,06 %)

Power plants fed by RES 1671 GWh (4,06 %)

It is visible that the main amount was covered by dendromass (wood and arboreal biomass) combustion (in 5 big power plant together with the combustion of other fuels – mainly coal – and three other small power plant fuelled mainly by wood). Relevant plus can not be expected here.

Utilisation of biogas in power plants is not relevant for the time being but it is in developing phase (i.e. gases from wastewater treatment used in gas engines).

Biomass

Biomass has the major share among the renewable energy sources in Hungary. Biomass is used for heat and electricity production as well for producing biofuel. Hungary's potential is significant also with compared with the EU average (Table 2.) having 5 Mio hectares of farmland and 3 Mio hectares of forest land. In Hungary yearly 942 PJ energy can be produced potentially from biomass.

Table 2. Comparison of biomass production potential between EU average and Hungary

	EU (15)	HU
Population	100 %	2,8 %
Area	100 %	2,9 %
Area pro person	0,9 ha/person	0,9 ha/person
Agricultural land use	0,4 ha/person	0,6 ha/person
Arable land	53 %	77 %
Forest land	35 %	19 %

The most used form of biomass is fuel wood. The solid biomass in the form of fuel wood is used for heating in the rural areas with the supply quantity of 2 million cubic meters yearly, its energy value is ~21,6 PJ. The theoretical energy value of the approximately 1 million m3 wood waste available is 14.4 PJ/year. Unused wood waste of approximately 0.7 PJ per year can be taken into account as energy resource.

In Hungary in the last year there was a big effort in introducing biofuel for transport focusing on bioethanol from cereals. It is reflecting the present situation of the agriculture. Hungary has a surplus production from cereals with yearly quantity of 2,8-3 Mio tonnes which can not be exported according to the WTO restrictions. This amount will increase according the expectation to 4 Mio tonnes till 2013. According to the Ministry of Agriculture the estimated amount of cereals for producing bioethanol is between 0,63 and 1,5 Mio tonnes and 110000 to 220000 tonnes of sunflower and rapeseed is expected for biodiesel production. (OECD/IEA)

According to to several reports only very few type of biomass for energetic use has regular market and this is unstable and not organized enough.

Biomass for heating and electricity

In Hungary at present for biomass combustion the small scale domestic appliances are dominating especially in local level. The firewood requirement of the population is 2.7-2.9 million m3 (1.8 million tonnes) annually, representing 20-22 PJ heating value annually.

The industrial heating stations are based on the use of the waste generated during their main activity based on forestry raw material

The main biomass plants in Hungary are in Kazincbarcika with 30 MW, Ajka 20 MW, Pécs 49 MW, mixed fuel plants are in Tiszapalkonya and Mátra. Biomass had a rapid grow also in electricity production in the last five years, in 2003 in the total electricity generation the share of solid biomass was 3,5 %. It is mostly used in co-fired in reconstructed/adapted old coal fired power stations.

Biofuel for transport

Bioethanol and biodiesel production started to develop in 2006. At present this segment of biomass use requires the largest amount of subsidies both for investments and for profiable operation.

In Hungary there are at present two bioethanol plants in operation with a total capacity of 83 thousand tonnes (Table 4), and other construction of additional 20 bioethanol plants are in process (these belong to four large investor groups (SEKAB, United BioFuels Holding, CSLM Holding, Mabio Zrt.)) and 40 smaller plant are planned to be supported in the period of 2007-2008 from the budget of rural development with 15 thousand tonnes capacity. As a result of the developments in 4-5 years the already existing two plants will be able to meet the domestic demand for bioethanol, if all the planned plants start to operate, the volume of bioethanol will exceed the domestic demands.

Hungary has biodiesel plants in operation with an annual total capacity of 10 thousand tonne of biodiesel. In autumn 2006 another 14 plants have been started to be planned or implemented with a total capacity of approx. 40 thousand tonnes, for which 1.3 million tonnes oil seed are required. These capacities largely exceed the domestic demand of biodiesel, but if all these plants are completed the available domestic raw material will not be sufficient for them. (AKI)

In order to reach by 2010 the 5.75% bioethanol mixing rate about 144 thousand tonnes of bioethanol has to be available. In the case of biodiesel 4.4% volume percentage mixing rate means the use of 118 thousand tonnes of biodiesel as biofules; in order to reach the indicative goal by 2010 the mixing of 183 thousand tonnes biodiesel would be required.

Biogas

The only plant using agricultural raw material uses liquid manure of dairy farms and the waste generated by poultry processing plants in the neighbourhood and has of 1.6 MW electric energy capacities produced 7 GWh electric energy in 2003. The biogas produced covers the energy requirement of the poultry processing plant and produces electric energy.

Biomass resources

In Hungary the majority of used energy resources is firewood (2 million m3) and in addition significant amount of waste wood and wood processing waste are also produced but a significant amount of this volume is not used for energy production. Because of the fully utilization of the fuel wood the prices increased strongly, which occurred a problem in the competitive use market. Other aimpact was the growing of the natural gas price for residents in the last time which occurred a new demand for fire wood.The suggested solutions are increase the reforestation or introduce/increase the production of dedicated energy crops and short rotation biomass.

The encouragement of the production of combustible raw material and their use in energy plants might decrease the use of fossil energy resource and the energy firewood. Energy grass could be used for the production of heat and electricity with the lowest cost of unit of energy. SRF is also can be taken into account in Hungary, significant area of Hungary is suitable for the plantation of acacia, used as firewood. Poplar clones has a yield in experimental field 13-35t/ha/year (130-350 GJ/ha/year) although the plantation of poplar is limited due to its high water requirements. In the experiments with energy plants in willow plantation the yields attained were 35t/ha/year (350 GJ/ha/year). The areas which are regularly inundated by water (flood areas, areas with internal water, areas endangered by floods) seemed to be the most suitable for plantations. The area of energy plantations was few hundred hectares in 2006, the 2015 goal is 100000 hectares, with than 50% state and EU support for low quality agricultural lands for transition.

The use of by products of crop production can be taken also into account.

The stalk of maize is available in enormous volumes as raw material for renewable energy for combustion and gasification technologies. The silo maize stalks provide an appropriate raw material for the biogas plants.

Regarding the direct use – that is, combustion - of agricultural by-products, the most significant biomass energy resource is the cereal straw. Under normal conditions 4,5-7.5 million tonnes of cereal straw are produced annually, from which the animal breeding and industry uses 1.5-5.5 million tonnes. On the basis of statistical data less than 60% of cereal straw was harvested in the last years and the rest, more than 40% was ploughed, or was burn of the stubble. At present straw is not used in fact for energy production due to the lack of combustion equipments in Hungary but a 50 MW 250 thousand tonnes capacity power plant is planned to build in Hungary.

In sunflower production the volume of residues or by-products is also significant and also relevant volume of vine-branches is about 800 thousand tonnes per year is produced. The total volume of vine-branches can be used as renewable energy raw material, first of all for gasification and for combustion.

In crop production annually about 17-23 million tonnes by-products are generated, in which 14-18 million tonnes can be used for energy production (Table 6.). This volume would be sufficient for the production of 187-242 PJ/year and this could cover 17-22% of the energy requirement of Hungary.

The biofuel production provides an alternative primarily for using the surplus of grain, which has a difficulty with the high transportation costs and also with the limited transportation capacities.

The planned bioethanol capacities are declared to be established for meeting the export demand of biofuel, and will make the processing of 3-4 million tonnes of maize annually as well as the processing of 0.8-1.2 million tonnes of wheat possible.

The total capacity of the known planned biodiesel capacities is little more than 400 thousand tonnes,

which would make the processing of 1.3 million tonnes of oily seed necessary. The planned capacities exceed by 120% the biodiesel requirement to be expected in 2010.

For biogas production as a consequence of the decreasing livestock numbers the volume of manure decreased too. Annually 360 thousand tonnes of animal carcass, slaughterhouse waste is generated and 3.5 million m3 liquid manure is produced, the total volume of which can be used as biogas raw material.

The energy use of grain is also advantageous because it makes the financing of intervention and storage subsidies, the sale of intervention volumes and the payment of export subsidies all superfluous.

Presumably, during the next years the volume of fermentable waste will not change significantly, however, their energy use will rapidly grow.

The future of RES in Hungary

The gross electricity consumption by 2020 can reach 53 TWh with the yearly satisfactory average 2 % increase. Even with this amount Hungary will belong to countries in the EU which are behind the average, and only several of the EU 27 countries will be behind us with the electricity use per inhabitant. This growth rate according to the last data can be real. The planned 13,2 % proportion of RES means 7 TWh electricity. The main question is how this 4 times more increase can be realised? According to the main renewable energy sources it means like the following calculations:

Biogen fuels

Combustion of biomass (wood) in power plants

1200 GWh

Combustion of agricultural residues

1800 GWh

Utilisation of biogas

300 GWh

Total with biogen fuels

3300 GWh (6,2 %)

The realities

The utilisation of the biomass is the main relevant possibility in Hungary. Our givens are mainly perceptible with the comparison of the geographical characteristics of Hungary and the EU.

The foreseen increase can be realised only with the combustion of the agricultural residues. It is now not known what will be the first experiences of the first power plant fuelled by straw which will be put in operation in 2010. If it reach the favourable 300 GWh/a electricity output at least five power plant with the same size will be needed. That's why it is very important to have the first experiences from the Szerencs power plant. It is a big question that the 26,5 HUF/kWh (1 EUR ~ 250 HUF) price today how can cover the expected costs. In Austria wood combustion is subsidised with 32-35 HUF/kWh, and this is more cheap and favourable than straw combustion.

CONCLUSION

It can be concluded that in Hungary theoretically the 7 TWh/a (4,2 times more than in the last year) net electricity production can be covered with Renewable energy sources, but only with much intensive incentives, with more public, industrial and other consumer based charges. These decisions need political determinations, which can not be foreseen in the new member states of the EU.

Concerning the direction of raw material production of the agricultural energy programme the priorities are: energy plantations of ligneous plants (willow, poplar, acacia), energy plantations of herbaceous plants (energy grass, straw, cereals), biofuels (biodiesel, bioethanol) production, biogas production (from liquid manure and silo maize).

REFERENCES

1. M. SZABÓ: The role of renewable energy in Hungary. In Proceedings of the Conference "The role of renewable energy in Central and Eastern European Countries", Gallbrunn 22-24 April 2007.
2. Energy policies of IEA countries: Hungary. 2006 Review. International Energy Agency
3. Megujulo energiaforrasaink megitelese: lehetosegek es kovetelmenyek. Energiapolitikai fuzetek IX. Szam. GKI Energiakutato es Tanacsado Kft. Budapest, 2007 januar
4. BODO, P.: Latest developments on RES policy, implementation and Planning in Hungary. In Proceedings Workshop Data Gathering on Renewable Energies for New Member States and Candidate Countries Cavtat-Dubrovnik, Croatia, 15-16 November 2006. EC DG JRC, Institute for Environment and Sustainability.
5. Bioenergy: Methodological improvement of statistical data collection regarding biomass availability and use in EU new Member States. Agricultural Economics Research Institute, Hungary