POLJOPRIVREDNA TEHNIKA
✧
Godina XXXV
Broj 4, decembar 2010.
Strane: 27 - 33

Poljoprivredni fakultet
Institut za poljoprivrednu tehniku

UDK: 631.621

SURVEY OF SOLID BIOMASS POTENTIALS OF HUNGARIAN AGRICULTURE

László Magó

Hungarian Institute of Agricultural Engineering, Gödöllő, Hungary

Summary: The survey focuses on the biomass potential from the agriculture, the possibilities of the energetic use of the biomass, biogas, biodiesel and the bioethanol, in Hungary.

The biggest biomass producer in Hungary is the agriculture producing 58 million tons of organic material annually in which primary product is 53 % (30.5 million tons) and by-products 47 % (27,5 mill t). The biomass utilized for energetic purposes is barely 1.8 million tons, a merely 0.3 % of the total quantity.

The proportion of the renewable energies gained from the biomass hardly exceeds 1 % in the energy consumption of the agriculture.

The renewable energies gained from part of the biomass produced by the agriculture could cover 10 % of the national energy demand on the short term.

Key words**:** *solid biomass, biomass potential, renewable energy*

1. INTRODUCTION

According to surveys there is a significant biomass potential in Hungary. The total bulk of biomass in the country is up to 350-360 million tons out of which 105-110 million tons (about 30 %) reproduce themselves annually. The energy content of the biomass developing annually is up to 1185 PJ which is 5 % more than the total annual energy consumption of the country (1120 PJ). The fact that quantity of coal generated annually by plants is four times as much as the quantity of fossil coal exploited for energetic purposes in a year – as much as 30.4 million tons.

Tab 1. Potential and utilization possibilities of energetic biomass from the agriculture

No.	Biomass	Quantity 1000 t/year		Energy content PJ/year	
		Min.	Max.	Min.	Max.
I. Biomass for combustion					
1.	Straw	1.000	1.200	11,7	14,0
2.	Stalk	2.000	2.500	24,0	30,0
3.	Energy grass	500	600	6,0	7,0
4.	Vine- and orchard shoot	300	350	4,3	5,0
5.	Energy plants on arable land	1.800	2.500	27,3	38,0
II. Production of biofuels					
1.	Corn maize	1.200	2.000	14,4	24,0
2.	Wheat/rye	600	1.800	7,2	21,6
3.	Rape	220	460	3,3	7,0
4.	Sunflower	50	200	0,8	3,2
III. Biogas production					
1.	Liquid manure, organic waste	6.000	10.000	5,4	9,0
2.	Silomaize, sorghum	1.600	3.200	5,4	10,8
Total:				109,8	169,6
In % of the total Hungarian energy consumption of 1120 PJ				9,7 %	15,0 %

2. RESULTS OF THE SURVEY

Biomass for energy

In the primary biomass produced by the agriculture first of all the by-products arising in better amount can be reckoned with for energetic purposes. Under common or regular conditions 2,6-2,9 million tons of **cereal straw** is processed annually of which 1,6-1,7 million tons are utilized for animal breeding and for industrial purposes. The major part of the remaining 1,0-1,2 million tons of cereal straw could be used for energy production and annually 11,7-14 PJ energy could be produced of it. At present straw is practically not utilized for energetic purposes in Hungary due to the lack of appropriate stokes.

Maize stalk production in Hungary is 8-10 million tons of which 2-2,5 million tons could be utilized for energetic purposes which could yield 20-24 PJ energy p.a. Among the by-products of crop growing sunflower stalk and rape straw also arise in big quantities which could be utilized for burning and could supply 5-6 PJ thermal energy annually should the appropriate technologies for harvesting and burning be available.

The quantity of **vineyard and orchard pruning residues** (branch tendrils and fruit tree loppings) arising annually is 300-350 thousand tons which could supply 4,3-5 PJ energy. There have only been attempts for their burning till now. The harvesting in bales and burning in small stokes of branch tendrils is a viable solution on the vine growing farms. For the chopping, collecting and burning of pruning residues no technology has been developed so far.

Among the plants which can be produced on big areas for energetic purposes first of all the “Szarvasi energiafű” and the energetic tree plantations can come into consideration in Hungary.

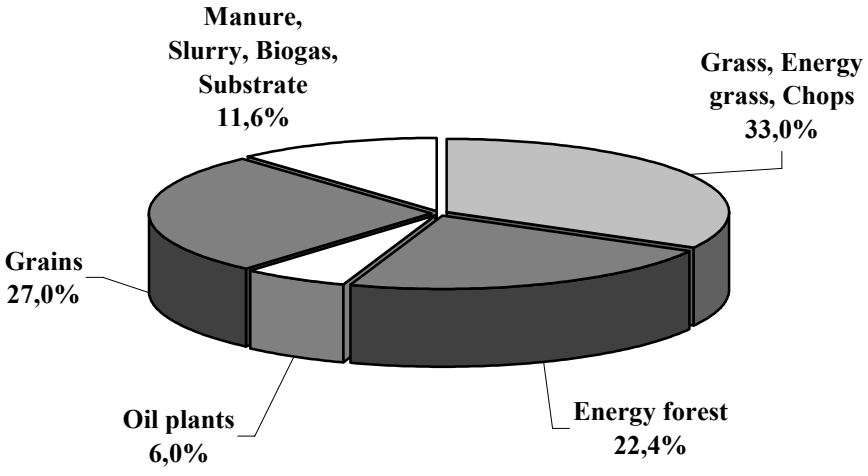

Fig. 1. Possibilities of agricultural energetic biomass potential and utilization in Hungary

The Szarvas **energy-grass** as a short rotation herbaceous grasses is able to provide a dry bulk of 10t/ha which can be baled for several years the energy content of which is 110-120 GJ/ha. The energy-grass can easily be pelletized. 6-7 tons of pellets can be produced of the grass yield of one hectare the burning features of which are more auspicious in lower capacity stokes than that of the chopped material in thermal power stations.

Should the final form of firing technology of energy-grass be developed cropping could be started in a short time maybe on 50-60 thousand hectares which would supply a 500-600 thousand ton bulk of biomass annually, of which 6-7 PJ energy can be produced.

Tab. 2. The real and feasible capacity for energetic utilization of solid biomass in Hungary

Biomass	Utilization	Actual capacity			Expected growth till 2020		
		Unit (pieces)	Capacity (MW)	Biomass demand (2000 t)	Unit (pieces)	Capacity (MW)	Biomass demand (1000 t)
1. Wood chips (forest or planted wood)	Electricity	5	140	1000	8	420	2800
	Central heating	5	24	25	25	120	150
	Central heating + electric energy production	2	12	32	20	120	180
2. Straw, Energy grass	Straw power plant, electric energy production and heat utilization	-	-	-	2-3	40-60	450
Sum total		12	176	1057	55-56	700-720	~ 3600

Another prospective source of bio-energy is the energetic tree plantation classified in the agricultural plantation management cultivation sector by which dendromass can be produced relatively fast and in big quantity for energetic purposes.

According to experiences hitherto it is expedient to plant the **short rotation wooden crops** varieties (poplar, willow) with a number of plants 12000-15000/ha which will be ready for felling in 3-5 years. The re-shooting tree stock can be harvested in another 3-5 years by felling totally 5-7 times assuming a plantation lifespan of 15-25 years. On the basis of long term-experiments made with different tree varieties yields of 11-20 t/ha/year can be achieved, of which 185-330 GJ/ha energy can be produced.

A rapid territorial expansion of the energetic plantations is expected in the near future which can achieve, or even exceed 100 thousand hectares of which 25-30 PJ energy can be gained.

For energy production under arable land conditions *triticale in the form of whole plant* cut into windrow and baled can also be taken into account the yield of which may reach 8-10 t/ha with 40 % grain bulk in it. Its energy content is 15-16 GJ/t so 120-160 GJ/ha energy can be produced. It has a favourable feature from the point of view of firing technology, that in baled form it burns more slowly and with a more even heat regress than wheat straw.

These biomasses originating from plants which can be produced on the field and utilized by direct burning are gaining a growing emphasis in our national energy policy in the coming years.

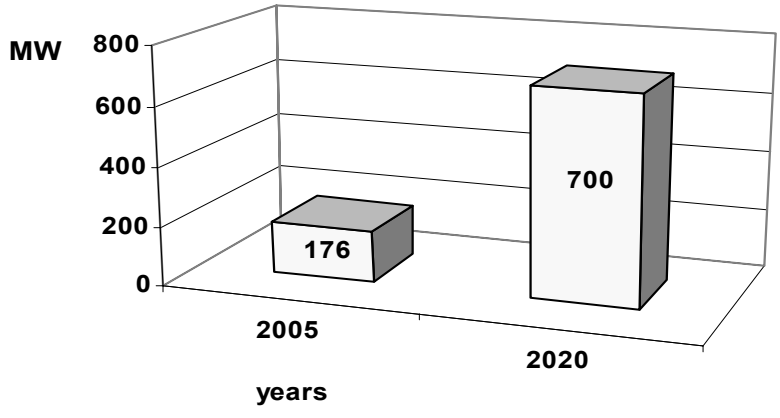

Fig. 2. Planned enlargement of energetic utilization of solid biomass

Economical background

Among the obstacles of the transformation into energy and the utilization of biomasses of agricultural origin the financing of investments, matters of thrift, matters of regulation and the lack of appropriate integrations and logistics are the most significant.

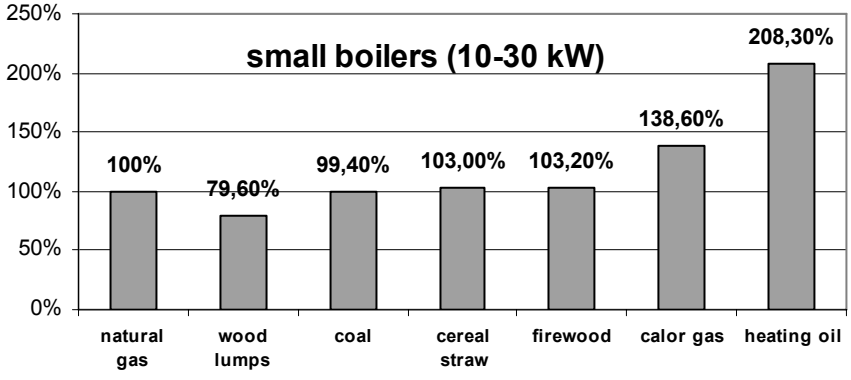

Fig. 3. The comparison of the expense of the heat production on natural gas base in case of different energy sources and 10-30 kW boilers

The costs of heat produced from the biomass are also highly dependent from the production costs of raw-materials, from the connected logistic costs, and from the construction and size of firing appliances, from the efficiency of firing and last but not least from the servicing and operational costs of the appliances.

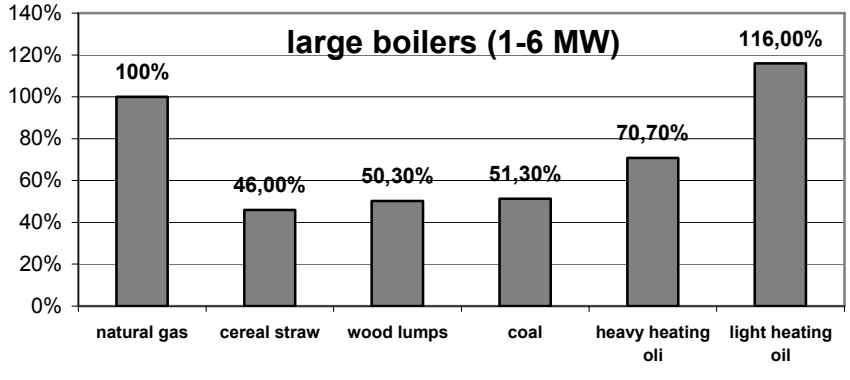

Fig. 4. The comparison of the expense of the heat production on natural gas base in case of different energy sources and 1-6 MW boilers

The production costs of heat produced of renewable fuels are inversely proportional with the size of firing appliances. Among the renewable energy sources *young trees* can be used for heat energy production at the lowest cost. The price of heat energy produced by young trees can even compete with natural gas. The heat energy produced by burning straw-bales is in case of big size boiler – with a performance of 1-6 MW - *more economical than natural gas*.

Examining the inner cost structure of heat production it can be stated that by renewable energy sources the operational and maintenance costs of the firing appliances

are far higher than those of firing appliances operating by traditional fuels. In the latter case the majority of the costs (85-95 %) arises from the price of fuels.

3. CONCLUSIONS

It can be stated that bio-ethanol and bio-diesel as fuels for internal combustion engines can be produced in Hungary at a competitive price by the utilization of biomass of agricultural origin as well as chopped wood on energy plantations and baled wheat straw apt for burning for the production of heat energy. The Hungarian agriculture could provide for 10 % of the domestic energy demand to be covered by these renewable energy sources.

Acknowledgement

The authors would like to express theirs gratitude to the National Office for Research and Technology (NKTH) for the financial support.

NKTH
National Office for Research and Technology

Established by the support of the National Office for Research and Technology.

REFERENCES

[1] Dolenšek M., Oljača Snežana., Kovačević D., Oljača M. V.: (2008) Technics and Tehnologycal Solutions of Modern Usage of Biomass for Energy Production in Houses, Agricultural Engineering Scientific Journal, Beograd-Zemun Serbia. Vol XXXIII, No. 3. p. 99-107.

[2] Fenyvesi L.. Hajdú J.: (2005). Ökonomische Zusammenhänge der Nutzung von Biomasse, Biomasse – Energie aus der aus Landwirtschaft, Dreigrenze-Konferenz, Slowakei und Ungarn, Tagungsband, Nyitra, 3-4. May 2005, p.133-138.

[3] Fenyvesi L., Pecznik P.: (2004). Is Hungary the source of bioenergy for Europe?, Second World Biomass Conference, Proceedings of the World Conference held in Rome, Italy 10-14 May 2004. (1): 542-545.

[4] Hajdú J., Fenyvesi L., Pecznik P.: (2005). Impaction of EU Joining for Renewable Energy Utilisation in Hungary, The 4th Research and Development Conference of Central and Eastern European Institutes of Agricultural Engineering. Moscow, 12-13. May. 2005. 25-32.

[5] Hajdú J., Magó L.: (2006) The Possibilities of Use of the Biomass in Hungary, Proceedings of the 34th International Symposium "Actual Tasks on Agricultural Engineering", Opatija, Croatia, 21-24. February 2006. Proc. 111-120.

[6] Hajdú J., Magó L.: (2008) „Agricultural Biomass Potential in Hungary", Proceedings of 10th International Congress on Mechanization and Energy in Agriculture, Antalya, Turkey, 14-17 October 2008., p. 512-517.

[7] Magó L., Hajdú J., Fenyvesi L.: (2009) „Biomass Potential from Agriculture in Hungary", Journal of Scientific Society of Power Machines, Tractors and Maintenance "Tractors and Power Machines", Novi Sad, Serbia. Vol. 14. No. 1., p. 15-21.

[8] Oljača Snežana, Oljača M., Kovačević D., Glamočlija Đ.: (2007) Ekološke posledice upotrebe biljaka za dobijanje energije, Agricultural Engineering Scientific Journal, Beograd-Zemun Serbia. Vol XXXII, No. 4. p. 91-97.

PREGLED POTENCIJALA ČVRSTE BIOMASE U POLJOPRIVREDI MAĐARSKE

László Magó

Mađarski institut za poljoprivrednu tehniku,
Gödöllő, Mađarska

Sadržaj: Ovaj pregled se odnosi na potencijal biomase iz poljoprivrede, mogućnosti energetske primene biomase, biogas, biodizel i bioetanol, u Mađarskoj.

Najveći proizvođač biomase u Mađarskoj je poljoprivreda, sa 58 miliona tona organske materije godišnje, u čemu primarni proizvod čini 53 % (30.5 miliona tona) a sporedni proizvodi 47 % (27,5 mil. t). Biomasa namenjena za energetsku upotrebu čini oko 1.8 miliona tona, samo 0.3 % ukupne količine.

Učešće obnovljivih izvora energije dobijenih iz biomase retko prelazi 1 % ukupne potrošnje energije u poljoprivredi.

Obnovljiva energija dobijena iz dela biomase proizvedenog u poljoprivredi mogla bi, u kratkom roku, da pokrije preko 10 % nacionalnih potreba za energijom.

***Ključne reči*:** *čvrsta biomasa, potencijal biomase, obnovljiva energija*