Manure processing and biogas production in Hungary

Hungary's total biomass resource is estimated to be 350 - 360 million tonnes. From this amount 105-110 million tonnes is primary biomass (deriving from vegetation) which is annually regenerated. In the present only 3% of this is utilised by the energy sector. The renewable energy sources represent 4.9% (54.8 PJ) of Hungary's primary energy consumption. It is estimated that 65% of the renewable energy sources is used for heat generation, 33% for electric power production and the rest for the production for biofuels.

Biogas production

The political target in the Renewable Energy Action Plan (REAP) by 2020 is to increase the energy production from renewable resources to 13%. According to the Renewable Energy Strategy (RES) to obtain this level it is expected an increase from 55 PJ in 2006 to 186,4 PJ by 2020. It is expected that by 2020 the potential biogas production to reach 34MW, which will be equal to 5% of the total renewable energy sources in the country. Hungary has very good natural conditions to reach the mentioned targets, the country has the potential to generate almost 9 billion m3 biogas from agricultural resources, animal by-products, sewage sludge and municipal organic waste.

The average biomass resources for biogas

Biomass resource	Energy value
Plant cropping by products	131.3 PJ
Forestry by products	39,22 PJ
Animal by products	3,72 PJ
Sewage sludge	5,91 PJ
Industrial waste	0,42 PJ
Solid communal waste	42,25 PJ
Total	222,84 PJ

Source: Szunyogi I., (2008)

The policy is planning to develop a Biogas Action Plan. The 222,84 PJ amount expressed in raw biogas having the upper heating value of 25MJ/m3 is 8,914 million m3 or expressed in methane gas with the upper heating value of 39 MJ/m3 is equivalent with 5,714 million m3. It should be outlined that the yearly 222,84 PJ average biogas potential is a theoretical value. The values can be real if all available technologies are working with a maximum efficiency. If the technologies are working with a minimum efficiency the value should be 74,7 PJ, which is equivalent with 1,9 million m3 of methane gas. Comparing the Hungarian biogas potential to other CE countries can be mentioned that Hungary's potential is above the medium level:

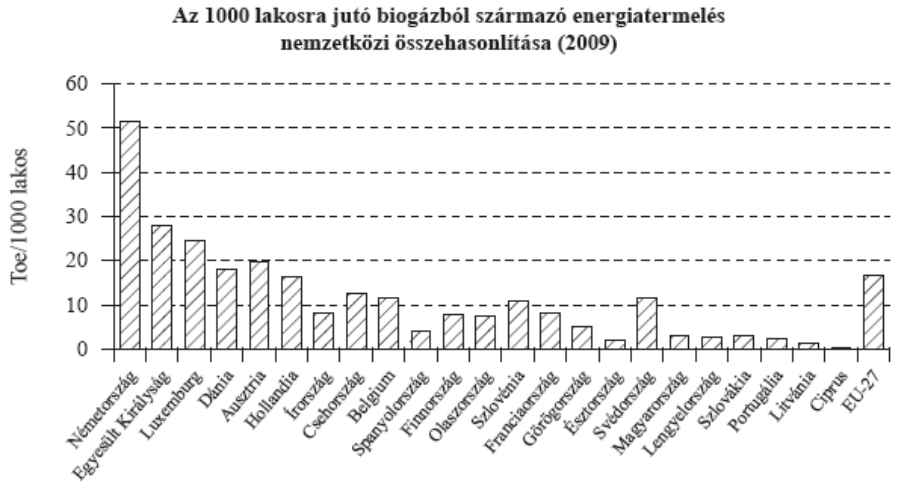
The biomass and biogas potential of different countries

Country	Average biomass potential		Average biogas potential	
	PJ	%	PJ	%
Germany	1390	10	1390	42
Poland	483	12	483	93
Hungary	222	21	222	47
Czech Republic	171	9	171	53
Greece	120	8	120	99

Source: Szunyogi I., (2008)

Comparing the primary energy balance with other CE countries Hungary is situated above the medium level. On the other hand it is clear that at the moment the biogas utilisation is lagging behind the other countries potential and to the EU average. The energy produced from biogas resources in different EU countries is presented in the figure below:

The produced energy from biogas /1000 inhabitants (2009)



Forrás: EurObserver [2010b]

The figures show that the utilisation of the Hungarian biomass potential has sufficient reserves for the future developments. According to the Eurobarometer survey (2011) the primary biogas energy output for Hungary from different resources in 2008 and 2009 are as follows:

Hungary primary biogas energy output amounts (ktoe)

Year	Landfill gas	Sewage	Other, biogas	Total
2008	2,1	8,0	11,7	21,8
2009	2,8	10,3	17,5	30,7

Source: Szunyogi I., (2008)

Primary biogas energy production/inhabitant is Hungary in 3,1 toe/1000 habitant, the EU level is 16,7 toe.

Several factors can influence the biogas production efficiency as:

- optimisation the logistics: when implementing a biogas plant utilising agricultural

resources one of the key aspects is the optimisation of the logistics background in terms of provision the raw material (supply, storage) as input sources and the storage and distribution of the fermented digestate as output sources. It can be mentioned that the biogas generation based exclusively on liquid manure is not typical in Hungary.

- profitability: from biological aspects, the C/N ratio required for efficient fermentation

and biogas production can only be achieved by using a mixture of different plant and animal resources. From the economic point of view, if the farm uses more its own organic resources (e.g. by-products, wastes) which are permanently available in sufficient quantities, the better will be the profit. In many cases the storage and distribution of the fermented bio fertilizes is not taken seriously in consideration. The biogas plant profitability depends as well from the digestate logistics. Transportation is a major cost factor. The geographical location of the land accommodating for digestate and of those providing the raw materials has an impact on the financial results. It is

evaluated that neither the provision of the raw material, neither the distribution of the digestate to be on a distance more than 5-7 km.

- other factors: quantity and quality of the input sources, closeness to the input sources,

utilisation and the distribution of biogas, available capital for the investment, investment returns indicators etc.). Biogas generation based exclusively on liquid manure or solid manure is not typical. Instead biogas plants which work with three or four kinds of raw materials is more frequent as this units have lower production costs. The reason is that from biological aspects, the C/N ratio required for efficient fermentation and biogas production can only be achieved by using a mixture of several vegetable and animal materials. The main material inputs are presented below:

The yearly main material input resources for a conventional biogas plant

Input material	Volume (tonnes/year)	Dry matter (%)	Organic dry matter (%)	Organic dry matter (tonnes/year)
Maize silage	22750	33	95	7132
Animal/slaughterhouse by products	8750	20	80	1400
Pig manure	8750	6	85	446

Source: MIH Pilon (2011)

There is a requirement that the biogas plants to be established at min. 300-500 m distance from residential location, which influence the economic value of the biogas heat. From the investors it is expected that the investment return to be realised in 5-7 years. Depending on the input sources and the bio fertilizer utilisation possibilities in average the biogas plant cost can be 1,1–1,2 billion Ft/MW.

The agricultural biogas plants are in general placed close to the animal production farms (mainly pig and dairy farms) as Abonyi Mezőgazdasági Zrt, Biharnagybajomi Dózsa Agrár Zrt., Körös- Maros Biofarm Kft. or horticultural farms as Pilze-Nagy Kft. Others are linked with the food/animal processing units as Agrana—Kaposvári Cukorgyár, Gallicoop Zrt., Agrospeciál Kft. The biogas production capacity of these plants differs according to the input sources, and the size of the plants. The average capacity of the smaller sized biogas plants is about 500kW. It is projected that by 2020 the biogas generation capacity to be raised from 14 MW to 100 MW. The energetic efficiency of the biogas technology used for electricity production (36%) is close to the power plants using biomass (20 - 30%).

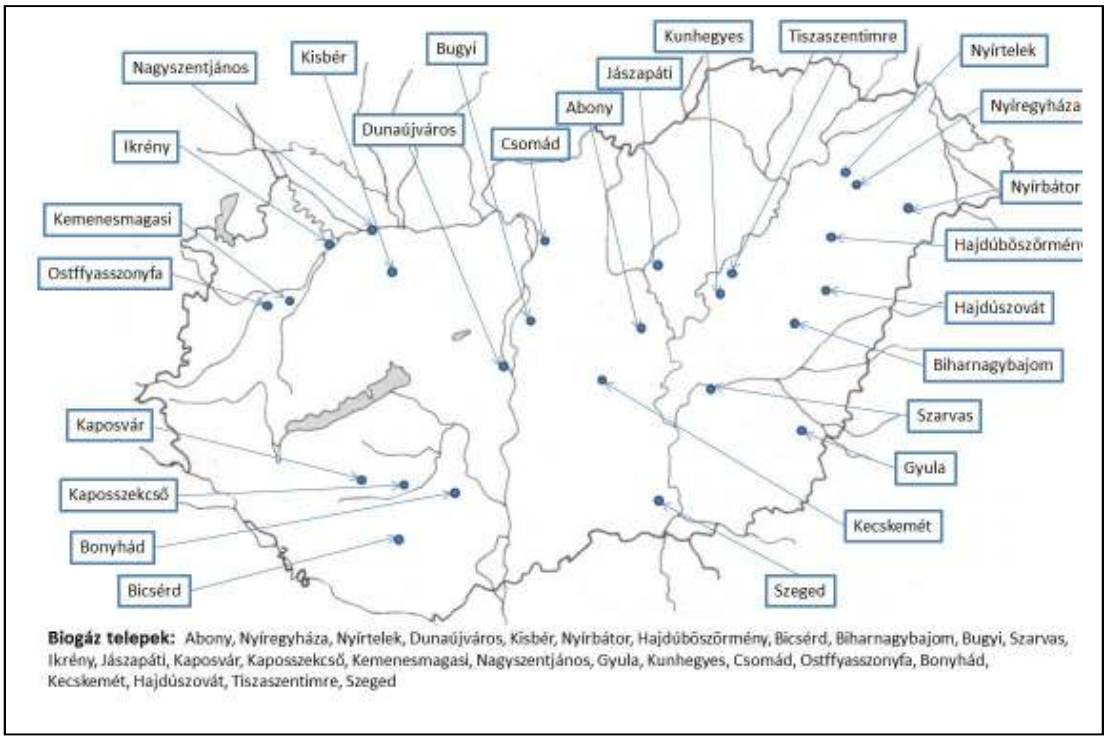
For constructing and licensing the biogas plants there are no standard procedure. Obtaining the licence is complicated and the period required to plan and licence a biogas plant is much longer than to build it. It is estimated that the average investment costs for a biogas plant per 1kW may be from 1.2- 1.3 million HUF. The project costs may be even higher if the biogas power plant has also to perform special functions such as waste management. As a general rule, the specific costs are slightly decreasing with the capacity increase. In general the average electricity cost is 26 Ft/kWh, which is taken in the grid at a price of 30 Ft/kWh in the frame of the Mandatory Take-off Scheme (kötelező átvételi tarifa rendszer, KÁT). In general the plants are using their heating and electricity output resources for in-house use as heating the fermenting units and using in the animal farms e.g. nurseries. As the raw biogas require further cleaning and dewatering at the moment the biogas is not supplemented in the national gas grid.

From 2012 it is expected that the KAT to be changed. The warranted take off price probably will remain the basis for the new system, but the take-off quantity could be limited under a quota system. The novelty aspect is that smaller power plants may join the system, but they shall operate at a higher efficiency level than in the KÁT system. The Ministry of National Development would like

to extend the scope of the new system to include the heat gained from renewable energy sources, and to stop supporting the co-generated electricity from natural gas resources. The Action Plan approved in December 2010 envisages a 14.6% share of the renewable energy sources in the gross final energy consumption. For the time being, Hungary has been utilising hardly 25% of its biomass potential suitable for energy production.

In Hungary – at the actual cost/return ratio and due to the KÁT – smaller biogas plants (< 500kW) can operate economically only in exceptional cases, while the implementation of such plants may be still justified, principally for the sake of waste management. Few biogas plants are based on waste processing e.g. Gallicoop Zrt. The utilisation of waste products, mainly of animal origin for biogas production is from categories 2 and 3. The biggest animal waste provider company ATEV Zrt. has 5 functioning and 3 non-functioning processing units. The total collected animal waste in 2008 was cca.190.000 tonne, out of from 11 % from the 1st group, 24% from 2nd and 65% from 3rd group. The national animal waste storage capacity is 7400 m3 (5900 tonne). The utilisation of animal waste and by products in biogas plants is regulated by the 1774/2002/EC Regulation (modified by 1069/2009 EC) adopted by the 71/2003. (VI. 27.) FVM Order.

Identified biogas farms for the INEMAD project



Biogáz telepek: Abony, Nyíregyháza, Nyírtelek, Dunaújváros, Kisbér, Nyírbátor, Hajdúböszörmény, Bicsérd, Biharnagybajom, Bugyi, Szarvas, Ikrény, Jászapáti, Kaposvár, Kaposszekcső, Kemenesmagasi, Nagyszentjános, Gyula, Kunhegyes, Csomád, Ostffyasszonyfa, Bonyhád, Kecskemét, Hajdúszovát, Tiszaszentimre, Szeged