

RENEWABLE ENERGY SOURCES FOR SUSTAINABLE RURAL DEVELOPMENT IN HUNGARY

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ABSTRACT

The given article has the aim to analyse the key aspects of renewable energy source usage in rural areas of Hungary and their impact on sustainable rural development including the agricultural sector. The shares of renewable energy in gross final energy consumption, transport, electricity, heating and cooling were considered. Besides this, the promotions of the national policy with regard to renewable energy sources and their impact on the agricultural sector were investigated. Biomass was potentially recognised, as a primary source for energy purposes in rural areas. The article concludes with the overview of the relevant policy implications and consideration of the topic's case studies in Hungary.

Keywords: renewable energy sources, sustainable rural development, agriculture, biomass

INTRODUCTION

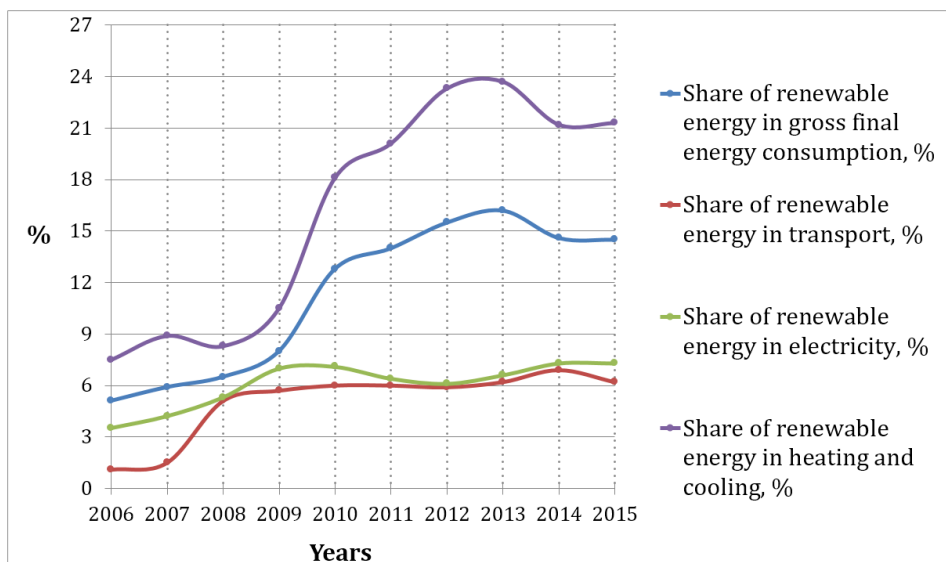
It is reasonable to start the consideration of the topic with the analysis of the basic renewable energy indicators in Hungary and their change during the period of the analysis. The particular time period of the consideration is from 2006 to 2015, it consists of 10 full years. It is sufficient time to draw certain conclusions about the main trends of the relatively recent past, to trace the development of the indicators and to investigate the current situation in the renewable energy sector of the country. The set of the basic indicators includes the following: the shares of renewable energy in gross final energy consumption, transport, electricity, heating and cooling represented in %. According to the data provided by Eurostat, the biggest growth from 2006 to 2015 was demonstrated by the share of renewable energy in heating and cooling - 13.8%, the second indicator is the share of renewable energy in gross final consumption- 9.4%. It is worth noting that the other indicators showed an increase as well: the share of renewable energy in transport was raised from 1.1% in 2006 up to 6.2% in 2015 and the share of renewable energy in electricity from 3.5% in 2006 up to 7.3% in 2015. *Figure 1* represents the graphical reflection of the data.

According to *Figure 1*, there is a rapid growth of the share of renewable energy in heating and cooling and the share of renewable energy in gross final energy consumption from 2006 till 2013 with a following little decline until 2015. The similar shapes have trend lines representing transport and electricity indicators: there is a short period of the growth at the beginning of the time considered, then

the curves are moving while preserving almost parallel directions. In general, a positive dynamics was investigated.

Figure 1

Dynamics of basic renewable energy indicators in Hungary



Source: Based on Eurostat energy statistics,
<https://ec.europa.eu/eurostat/web/energy/data/shares>

The position of renewable energy in the structure of gross final energy consumption in Hungary became stronger. The usage of renewable energy especially expands to the sector of heating and cooling. For transport and electricity the rates of growth are relatively low. The national target of energy from renewable energy sources in gross final consumption of energy in 2020 - 14.65% is practically reached in 2015 and equals to 14.5%. But, for instance, in comparison with the targets of the neighboring EU countries (Austria - 34%, Slovakia - 14%, Romania - 24%, Croatia - 20%, Slovenia - 25%), Hungary is still lagging behind.

MATERIAL AND METHODS

This article is based on the overview of relevant information and data on renewable energy sources provided by Eurostat energy statistics, the frameworks of Hungarian national development programs: National Renewable Energy Action plan 2010-2020 (*Ministry of National Development, Hungary, 2011*), National Energy Strategy 2030 (*Ministry of National Development, Hungary, 2012*): and National Rural Development Strategy 2020 (*Ministry of Rural Development, Hungary, 2012a*), Hungarian scientific publications in the field of renewable energy, rural development and agriculture. Only descriptive statistics were used in the analysis and time series were illustrated.

RESULTS AND DISCUSSION

Overview of renewable energy production by type in Hungary

After the analysis of basic renewable energy indicators in Hungary, the composition of primary production of renewable energy by type is following (Table 1). This structure consists of the given sources: solid biofuels (excluding charcoal), biogasoline, biodiesel, biogas, municipal waste (renewable), geothermal energy, hydro power, solar thermal, solar photovoltaic, wind power. Table 1 makes us understand the distribution of the shares of each type of renewable energy in the total structure of the renewable energy supply of the country.

Table 1

Primary production of renewable energy by type in Hungary

Primary production of renewable energy by type, Hungary (1 000 tonnes of oil equivalent)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Renewable energy, in total	1242,1	1336,6	1609,7	1850,9	1921,9	1857,9	1965,3	2052,0	2018,6	2217,9
Solid biofuels (excluding charcoal)	1064,7	1146,1	1244,2	1471,3	1524,2	1429,4	1384,9	1423,6	1404,3	1489,0
Biogasoline	10,7	9,1	39,5	41,4	15,4	15,1	152,7	180,0	187,1	246,0
Biodiesel	0,0	8,2	122,7	112,3	126,6	127,0	128,9	125,4	119,2	131,2
Biogas	12,2	16,7	21,8	30,9	36,2	60,7	52,8	76,8	75,9	79,7
Municipal waste (renewable)	46,8	40,5	46,1	46,1	53,2	41,6	45,0	42,5	44,1	65,8
Geothermal Energy	86,0	86,0	95,5	96,3	98,6	104,4	107,2	112,7	91,1	105,3
Hydro power	16,0	18,1	18,3	19,6	16,2	19,1	18,3	18,3	25,9	20,1
Solar thermal	2,0	2,5	3,8	4,5	5,4	6,6	8,5	8,8	9,7	10,7
Solar photovoltaic	0,0	0,0	0,0	0,1	0,1	0,1	0,7	2,1	4,8	10,5
Wind power	3,7	9,5	17,6	28,5	45,9	53,8	66,2	61,7	56,5	59,6

Source: Based on Eurostat energy statistics

<https://ec.europa.eu/eurostat/web/energy/data/main-tables>

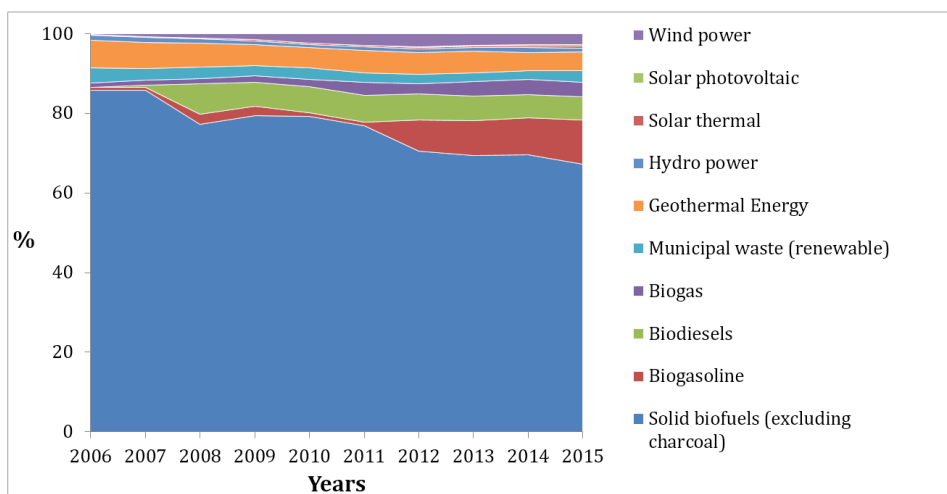
Figure 2 represents the composition of the primary production of renewable energy by type in Hungary graphically.

The prevailing position in the structure of renewable energy supply during the period analysed having renewable energy sources is based on solid biofuels. Despite the fact that the share of solid biofuels decreased from 85.7% in 2006 to 67.1% in 2015, it remained the biggest amount in comparison with other renewable energy sources. The second share belongs to biogasoline, which demonstrated rapid growth from 0.9% in 2006 to 11.1% in 2015. The next sources are biodiesel and geothermal energy - 5.9% and 4.7% in 2015 respectively. Biogas expanded to 3.6%, renewable municipal waste to 3%, wind power to 2.7% according to the data of 2015. The lowest shares contributed from hydro, solar thermal and solar photovoltaic energy - less than 1% for each source. Thereby, renewable energy sources based on biomass including solid biofuels, biogasoline, biodiesel and biogas

in total had a dominant share in the structure of renewable energy supply in Hungary - more than 90% in 2015.

Figure 2

Primary production of renewable energy by type in Hungary



Source: Based on Eurostat energy statistics,
<https://ec.europa.eu/eurostat/web/energy/data/main-tables>

Thus, biomass can be recognised as the main source for the renewable energy production in Hungary almost without any competition from another renewable energy sources. This situation demonstrates, on one hand the great potential of biomass products for energy purposes in Hungary (for instance, high improvement of biogasoline production), on the other hand insufficiency in the development of the other renewables (wind, hydro and solar powers). The next part of the article is intended to conduct a deeper analysis of the actual situation taking into account national statistics and strategic plans and their critical reflections based on literature and reality.

RES for sustainable rural development

National renewable energy policy

According to the National Renewable Energy Action plan 2010-2020 (*Ministry of National Development, Hungary, 2011*), one of the strategic goals for renewable energy policy in Hungary is recognised as “Agriculture and rural development”. First of all, it implies the use of biomass (as a predominant renewable source in Hungary) for energy purposes based on sustainability aspects including biodiversity and soil quality protection. The application of renewable technologies based on biomass in rural areas should contribute to the retention of working places in the agricultural sector and to facilitate promotions of new jobs. The use of organic matter from

livestock for biogas production can improve the efficiency of waste management and to increase the competitiveness of the sector. The use of sub-products, solid wastes from agriculture and forestry for local energy purposes and their transformation into the final products will provide an additional income for rural residents and reduce the need of fossil fuels in rural communities.

In the future, renewable energy sources of agricultural and forestry origin (primarily biomass) may play a major role in the complex regional development of rural areas, the utilization of land no longer used for food production, in addressing the environmental problems of rural settlements and increasing their population-retaining capacity - and in the creation of new jobs in rural areas (National Energy Strategy 2030 - *Ministry of National Development, Hungary, 2012*):).

National Rural Development Strategy 2020 (*Ministry of Rural Development, Hungary, 2012a*) also declares the main targets of the program, which can be reached by the use of renewable energy sources based on biomass:

- Preservation of working places and creation of new jobs in rural areas;
- Maintenance of rural population, demographic balance recovery;
- Energy and food security procurement;
- Competitiveness improvement in agriculture and food industry, restoration of the balance of animal and plant productions;
- Protection of biodiversity, soil, water and landscapes, environmental security improvement;
- Application of local resources and systems in energy production, increase of energy independence;
- Diversification of rural economy, increased quality of life;
- Establishment of close connections between urban and rural areas.

However, the real situation in Hungarian rural areas is not so positive. The typical socio-economic problems are: unemployment, low level of income, lack of capital, ageing of the population, migration of young and educated people to the big cities (*Gonda, 2011*). In such conditions further development is problematic. In this context, the share of biomass in the production of energy based on statistics, probably could be explained by traditional firewood usage for heating purposes of households in rural areas. The main reason for that is the poverty of the local population.

Biomass as a resource of energy in agriculture

Agriculture and farming remain the main role of labour engagement in rural areas, therefore the most potential of biomass energy applications comes from those sectors.

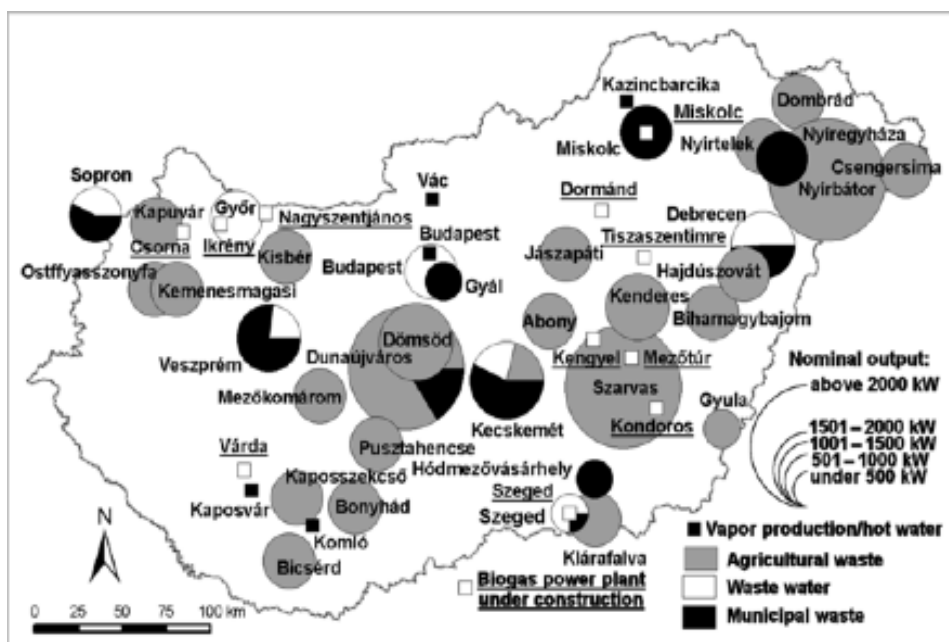
The areas of possible application of biomass for energy purposes in agriculture can be described as the following (*Szálavik and Csete, 2012*):

- Combustion, heat production, electricity production;
- Production and sale of bio-briquettes as fuel for gas generators;
- Producing bioethanol and biodiesel;
- Burning and pyrolysis of combustible gases;
- Biogas production.

Agricultural sources of biomass for energy purposes: cereal straw, maize stalk, sunflower stalk and rape straw. These sources should be appropriate if technologies for harvesting and burning are available. Vineyard and orchard pruning residues (branch tendrils and fruit tree loppings) can be also an appropriate solution. The harvesting in bales and burning in small stokes of branch tendrils is a viable solution on the vine growing farms (Magó *et al.*, 2009). According to the study of biogas utilization and its environmental benefits in Hungary (Fazekas *et al.*, 2013), the realization of the local biomass potential contributes to the financial savings of companies, it diversifies resources, has a positive impact on regional development and job creation. Besides that, it helps to protect the environment, to limit fossil fuel consumption and to fight against climate change. The majority of raw material used for bioenergy production in Hungary comes from agricultural waste (74% in 2012). There are several different types of such raw material applied in Hungary: cattle slurry, cattle manure, pig slurry, poultry-litter, silage maize, sweet sorghum, green waste in settlements, swill, butchery waste/meat pulp. The number of agricultural biogas power plants reached 34 by 2012 with the installed capacity more than 34.2 MW increasing rapidly over the time. *Figure 3* shows the geographical location of Hungarian biogas power plants. Most of the facilities are situated in rural areas, perhaps, due to easy access to required raw material.

Figure 3

Biogas power and heating plants in operation or under construction in Hungary in 2012



Source: *Fazekas and Buda*, 2013

The biomass potential in the micro-region of Eger including wine-branch, cuttings of fruit trees and field crops was determined as 250000 GJ. There are 2 power plants utilising biomass. One of them, Mátra power plant, has installed capacity of 836 MW. Biomass was found as the most suitable source for the local development and the settlements' value-added increase. It contributes to the local economy with the involvement of business activities: hardwood floor, wood-chips and wood-pellets production (Bujdosó *et. al.*, 2013). Other aspects of biomass utilization with regard to sustainability were also explored (Gálosi-Kovács and Rudlné Bank, 2012).

CONCLUSIONS

The analysis of basic renewable energy indicators in Hungary revealed that the biggest growth from 2006 to 2015 was demonstrated by the share of renewable energy in heating and cooling – 13.8%. The national target of energy from renewable energy sources in gross final consumption of energy in 2020 – 14.65% - was practically reached in 2015 and equaled to 14.5%. The prevailing position in the structure of renewable energy supply during the period analysed having renewable energy sources was based on solid biofuels. Thereby, renewable energy sources based on biomass including solid biofuels, biogasoline, biodiesel and biogas in total had a dominant share in the structure of renewable energy supply in Hungary - more than 90% in 2015. Thus, biomass can be recognised as the main source for the renewable energy production in Hungary almost without any competition from other renewable energy sources. The aspects of Hungarian national renewable energy policy and their contribution to sustainable rural development including agriculture were considered as well. The relevance of regional researches on RES is proved by a number of projects which investigated the use of RES in rural areas of Hungary as Interreg RuRES programme.

REFERENCES

- Bujdosó, Z., Patkós, Cs., Kovács, T., Radics, Zs. (2013): Theoretical approach of a possible value-added chain in the biomass industry in rural areas giving the example of a Hungarian microregion. In: *International Journal of Agricultural Management & Development*, 3. 1. 65-71. p.
- Fazekas, I., Buday, T. (2013): Biogas utilization and its environmental benefits in Hungary. In: *International Review of Applied Sciences and Engineering* 4. 2. 129–135 p.
- Gálosi-Kovács, B., Rudlné Bank, K. (2012): Characteristics of biomass utilization in Hungary; possibilities and restrictions regarding sustainability. In: *Journal of Environmental Research and Protection* 32. 5–12. p.
- Gonda, G. (2011): Utilization of renewable energies and changing energy structure at local government, as drivers of economic recovery: Hungarian case study. In: *International journal of social sciences and humanity studies*, 3. 2. 267–276 p.
- Magó, L., Hajdú, J., Fenyvesi L. (2009): Biomass potential from agriculture in Hungary. In: *Tractors and power machines* 14. 1. 15-21. p.

Ministry of National Development, Hungary (2011): REPUBLIC OF HUNGARY national Renewable Energy Action Plan/ 2010–2020 [online] <URL: [http://2010-2014.kormany.hu/download/6/b9/30000/RENEWABLE ENERGY_REPUBLIC OF HUNGARY NATIONAL RENEWABLE ENERGY ACTION PLAN 2010_2020.pdf](http://2010-2014.kormany.hu/download/6/b9/30000/RENEWABLE_ENERGY_REPUBLIC_OF_HUNGARY_NATIONAL_RENEWABLE_ENERGY_ACTION_PLAN_2010_2020.pdf)>

Ministry of National Development, Hungary (2012): National Energy Strategy 2030, [online] <URL: [http://2010-2014.kormany.hu/download/4/f8/70000/Nemzeti Energiastrategia 2030 teljes változat.pdf](http://2010-2014.kormany.hu/download/4/f8/70000/Nemzeti_Energiastrategia_2030_teljes_valtozat.pdf)>

Ministry of Rural Development, Hungary (2012b): National Rural Development Strategy 2012-2020, [online] <URL: [http://videkstrategia.kormany.hu/download/4/37/30000/Nemzeti Vidékstrategia.pdf](http://videkstrategia.kormany.hu/download/4/37/30000/Nemzeti_Videkstrategia.pdf)>

Szlávik, J., Csete, M. (2012): Climate and energy policy in Hungary. In: *Energies*, 5. 2. 494–517 p.

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