THE IMPACT OF THE UTILIZATION OF RENEWABLE ENERGY SOURCES ON RURAL DEVELOPMENT

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Abstract: *Rising energy prices, geopolitics and concerns over the impact of greenhouse gas emissions on climate change are increasing the demand for the utilization of renewable energy sources. Meeting energy needs is always a current issue in Central Europe Countries, irrespective of climate change because of the high dependency of the countries on oil and gas imports, limited opportunities to replace them with domestic production, and the pollution associated with using fossil energy sources. As a primary sector activity, agriculture is strongly linked to natural resources. Examining the use of renewable energy sources requires a proper understanding of definitions for sustainable development and multifunctional agriculture. Even when explicit markets for environmental quality are lacking, implicit linkages between agricultural productivity and environmental quality may give farmers incentives to provide some environmental protection. It is important to identify the best guideline for interconnecting regional, rural and agricultural development, especially with respect to protecting the environment.*

Keywords: *renewable energy sources, biogas production, sustainable development, rural development*

INTRODUCTION

Energy prices are high in the Central European Countries compared to other parts of Europe. Primary energy is mainly imported, its transport is relatively costly, the markets are fragmented and energy infrastructures are not well interconnected. In addition, the Danube Region is specifically vulnerable regarding security of supply, as it was demonstrated in January 2009 when gas supplies were cut. Energy production and consumption are also significant sources of pollution.

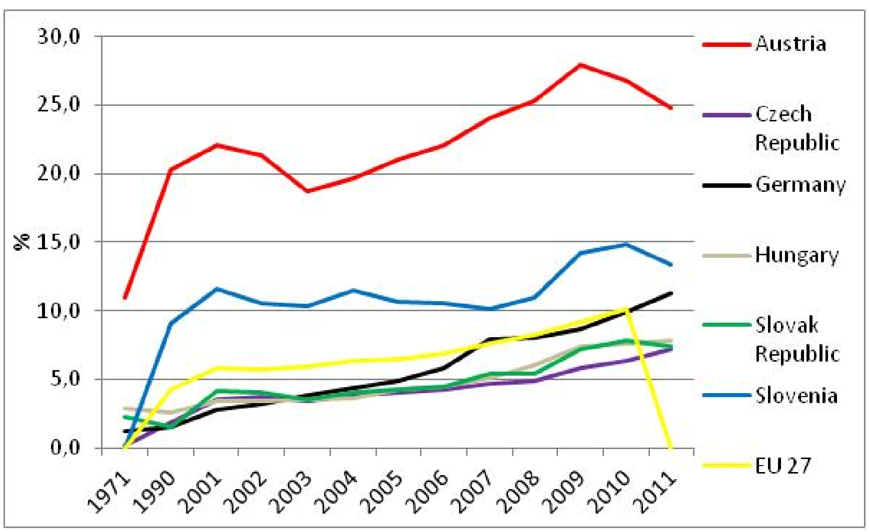

Figure 1 Contributions of renewable to energy supply in some countries in the Danube Region

As Figure 1 shows the percentage of renewable energy from total primary energy supply is quite low and it has been relatively slowly increasing in most of the concerned countries. A greater diversity of supply at national level through interconnections and the establishment of a genuine regional market will inevitably increase energy security. Reducing energy needs and increasing the share of energy produced at local level (including small scale energy production) would be beneficial for all consumers in the region.

MATERIALS AND METHODS

The main objective of present study is to review some aspects of the usage of renewable energy sources especially focusing on the utilization of wastes coming from agri-food sector. Beside some general considerations a newly established biogas plant is also demonstrated. This study also tries to analyse some legal and economic circumstances of bio-energy production. Some literature sources and statistical data as well as own calculations and recommendations are applied.

RESULTS AND DISCUSSION

Energy from solid and gaseous biomass has great importance in most of the countries having significant potential to increase production from renewable energy sources. Furthermore the use of biomass helps addressing climate change, improves security of supply by reducing the amount of imported energy and contributes to economic growth and job creation, particularly in rural areas. According to Kis and Bodnár (2004) rural development is a conscious activity coming from the outside of the system (local communities, micro-regions etc.) with the purpose to improve the life conditions and the role of the rural areas in society and in spatial structure.

The Europe 2020 Strategy targeted to save 20% (368 Mtoe) of the primary energy consumption of the European Union by 2020 compared to the projections made about such consumption back in 2007. However, the continent is not on track to reach this energy efficiency goal set for 2020. A consultation paper of the European Commission dated February 2012 has listed some well-known obstacles to investments in energy efficiency projects in the European Union in general. The main barriers to initiating such projects are of market, financial and/or regulatory in nature.

In a model laying down the foundations of a sustainable future, energy saving and energy efficiency, an increased use of renewable energy sources, and the priority of own resources will be of key importance. These logically consequent steps can, if integrated into a coherent economic model, provide adequate answers to such questions as how will we deal with the effects of global climate change on economic and social development, with non-sustainable growth, with the worldwide tendency of increasing energy demands or the unpredictable changes in the prices of fossil fuels? These changes urge the world as well as the EU Member States to take action (NAP 2010).

"Greening the economy", "green growth" of gross domestic product, and new welfare indicators that measure the state of societies extensively and not just its economic performance, are common phrases in different statements and documents. "Sustainability", meaning to ensure an environmentally-friendly, economically sound, and socially responsible approach to all activities in all dimensions of society, is a common motto in theoretical and practical political guidance papers (EPRC 2011).

In the long run, research on technologies of refining the organic raw materials for energy production is a critical need, because the high cost of these processes inhibits the growth of the bio-based economy. Research could improve national security and the trade balance by reducing dependence of the given country on imported petroleum. It enables the transition of the country to renewable sources of energy and bio-based products. Research also enables significant new, environmentally, economically, and socially sustainable economic opportunities for rural areas. Research facilitates farmers to maximize their economic returns from the renewable energy and bio-based products use of the nation. Last but not at least research allows rural areas to become more self-sufficient in energy, thereby minimizing energy cost volatility (and maximizing local control over energy costs) in rural communities.

USDA (2008) says that research to maximize sustainable production of bio-energy feedstock is a critical need worldwide because more than half of the total production cost for bio-energy is tied up in the cost of feedstock. Further, crop residues such as corn stover and cereal straws hold much promise as large-scale bio-refinery feedstock, but understanding of the long-term impact of residue removal on soil productivity is imperfect. However, limits must be placed on the amount of crop residue removed for bio-energy production to protect lands from erosion and to sustain soil organic carbon. Soil erosion removes topsoil, which is rich in nutrients (e.g. carbon, nitrogen, phosphorus), thus further reducing the quality of soil in the field. The displacement of soil from the field into waterways increases turbidity and accelerates eutrophication, thereby degrading water quality. A sustainable bio-fuel and bio-product industry must be based on management practices that maintain soil cover, reduce the risk of erosion and that maintain soil organic matter; thereby sustaining soil productivity.

Not all potential biofuel crops can tolerate the same growing conditions. Concerning the raw material, one of the most important tendencies is to use principally those wastes and by-products for energy production which cannot be used for other purposes. Vegetable oils have been recognized as a particularly good source of material that can be burned. Brassica seed provides oils that are used to cook foods, and they can be used to fuel the cooking of food. Sweet corn, not so much for the ear, but the biomass can likely be planted several times in a season to obtain the carbohydrates that can be burned (Russo, 2008). At the same time ethanol production means also a strategy for reducing dependence on imported energy and release of greenhouse gases from use of fossil-energy-derived motor vehicle fuel.

Table 1

The main parameters of a new biogas plant in Hungary

Feedstock of current use	Slaughterhouse waste, turkey and cow manure, liquid pig manure, whey and process sludge, sweet sorghum
Biomass consumption	Approximately 135,000 tons/year
Source	Surrounding animal breeding and food-processing facilities (max. 70 km), crop residues
Water consumption	10,000 m^3/year
Waste production	Digestate (biogas residue) is categorized as waste: 116,000 tons/year Used engine oil cca. 1.5 tons/year
Waste recycling	Digestate is 100% recycled Engine oil is recycled by subcontractor
Waste utilisation	Digestate is used as fertilizer
Waste disposal	Minimal communal waste
Savings of CO_2	17,500 tons CO_2 e/year as electricity offset, plus cca. 15,000 tons CO_2 e/year from fertilizer offset

One of the most obvious ways of utilization the wastes originating from the agri-food sector is biogas production. The largest and most modern biogas plant in Hungary with 4,17 MW of electrical power generation capacity has been put into operation in Szarvas. The high density of animal breeding enterprises as well as food-processing facilities in the surroundings of the plant provides high amounts of organic manure and wastes to be converted into energy by anaerobic digestion. Moreover, the region offers proper conditions for the cultivation of renewable raw materials such as sweet sorghum as an additional energy source.

Raw biogas produced in an overall fermenter capacity of 20.000 m³ passes through the gas treatment facilities, where it is dried, compressed and desulphurised in a three-stage process. A large part of the biogas is transported via a 4.2 kilometres long gas pipe to a poultry processing factory and the three combined heat and power stations (CHPs) supplied by GE Jenbacher and converted into electricity. The electric output of each generator comes to 1,190 kW. The electricity produced is fed into the E.ON grid from the biogas plant as well as the poultry processing site. Thermal energy generated by CHPs is extracted to meet own heating demand of the biogas plant on the one hand as well as for producing hot water, steam and cooling energy to industrial customers (such as the poultry processor) on the other.

The selected technology enables the plant to optimize the production of electricity during peak load times by following the course of the time-variable Hungarian feed-in tariffs. Along with feeding electricity into the grid, the plant generates additional revenue through a unique heat recovery system. Thermal energy produced is sold as steam, hot water and cooling to industrial customers throughout the year. High-quality fertilizer as end product of the biological process is used for agriculture enabling the substitution and replacement of chemical fertilizer on an area of more than 5,000 ha.

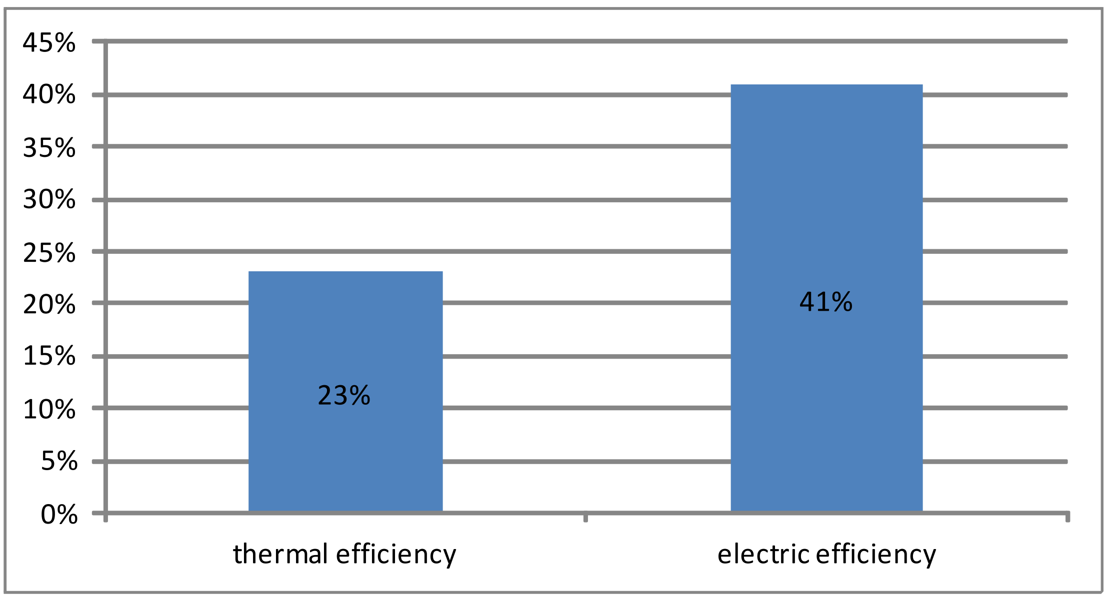

Figure 1 The technological efficiency of the biogas plant

Electricity produced is feed into the grid. Heat energy is used both for own demand and for producing steam, hot water, and cooling energy to industry. The plant is running altogether 8300 hours per year producing approximately 25 million kWh power (feed-in capacity). The electric efficiency is almost double than the thermal one but still not remarkably high.

Table 2

Economic data of the new biogas plant

Total budget	cca. 20 Million EUR
Public support	A non-reimbursable support
Investors	BayWa AG, Munich, Germany
Incentive type	Feed-in tariff
Support policy framework	Hungarian Operative Program for Economical Development Government directive no. 389/2007 regulates

In the feed-in tariff system, eligible electricity producers get pre-defined feed-in tariffs by law for the generated electricity sold in the feed-in tariff system. These tariffs are higher than the electricity market price (except for large hydro power installations above 5 MW installed capacity). On the other hand the responsible party for the so called KÁT (Compulsory Uptake System) balance group has to buy this electricity at the pre-defined feed-in tariffs. This subsidy form means that the supported producers are segregated and protected from the free electricity market. Eligible producers do not have to compete neither within the KÁT balance group nor with the other market players from outside the group.

The Act LXXXVI. 2007 on Electricity (hereafter Electricity Act) contains the framework conditions of the KÁT system, while more detailed rules of operation can be found in Government Decree No 389/2007 (XII. 23.) (hereafter KÁT Decree), and the Decree of the Minister for Economy and Transport No 109/2007 (XII. 23.) (hereafter Distribution Decree). Based on the Electricity Act, the Hungarian Energy and Public Utility Regulatory Authority (hereafter Authority) determines in its decision the feed-in quantity and feed-in period for each eligible electricity producer.

Table 3

Time zones on workdays for the determination of feed-in tariffs

Time zone	Winter time	Summer time
Peak	06:00 – 22:00	07:00 – 23:00
Valley	22:00 – 01:30 and 05:00 – 06:00	23:00 – 02:30 and 06:00 – 07:00
Deep valley	01:30 – 05:00	02:30 – 06:00

The producers can sell in the KÁT system until the feed-in period expires or until the feed-in quantity is used up. The determination of the KÁT period and quantity is to ensure that the producer only gets support until his investment is returned. In the case of biomass and biogas plants the benchmark feed-in period is 15 year. If there is any other kind of support than these periods are shortened proportionally.

Table 4

Time zones on non-working days for the determination of feed-in tariffs

Time zone	Winter time	Summer time
Valley	06:00 – 01:30	07:00 – 02:30
Deep valley	01:30 – 06:00	02:30 – 07:00

Tariffs are differentiated by time zones (peak, valley and deep-valley period). For waste-to-energy producers and those renewable producers who were commissioned after the 1st of January 2008, the price contains also an efficiency factor, so the adjustment factor is equal to the value of the consumer price index of the previous year reduced with one percentage point.

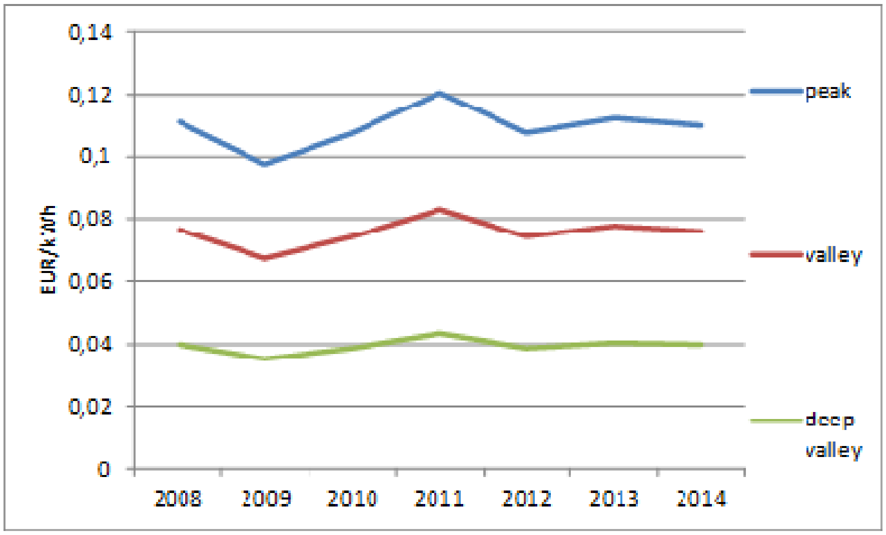

Figure 2 The changing of the feed-in tariffs between 2008 and 2014 in Hungary

CONCLUSIONS

The heavy use of fossil-based fuels and fertilizers in the food system lies at the heart of many of our environmental, health, and national security problems. Sustainable agriculture and sustainable energy are really two sides of the same coin. Present study tried to summarize some significant points and tendencies as well as presented an example on how local agri-food wastes can be utilized for energy production. Several other bio-energy production technologies can be found but there is not any generally applicable unique solution. Since the investment cost is significant the economic efficiency fundamentally depends on the cost of the feedstock and the technological efficacy of the energy generator. Therefore, improvement of technology systems as well as the freely available bio-wastes and by-products should be the key of further development.

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