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ADVANTAGES OF BIOGAS POWER PLANTS IN ENERGY TRANSITION OF PANNONIAN COUNTRIES – BENEFITS FOR THE LOCAL COMMUNITY

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Abstract: This paper points out the benefits for the local community from the construction of biogas power plants (BgP) – which are no from using other renewable energy sources. Benefits from BgP for local community are: additional income to local farmers, higher level of agro technologies in the village, strengthening social cohesion, ecological disposal of rural waste, electricity and heat production, organic fertilizer, hiring local labor and better quality of life for all inhabitants. In paper presented and important elements for planning the construction of biogas power plants.

Keywords: Biogas power plants, Energy transition, Local community, Renewable energy sources, Smart village

INTRODUCTORY NOTE

The energy transition is a pathway toward transformation of the global energy sector from fossil–based to zero–carbon by the second half of this century. At its heart is the need to reduce energy–related CO_2 emissions to limit climate change. Renewable energy and energy efficiency measures can potentially achieve 90% of the required carbon reductions. [1]

Biogas plants are not adequately represented in the energy transition plans of the new EU members, nor in the EU candidate countries. Stakeholders for wind and solar power plants strongly influence decision makers in the investment policy in the energy sector through (in) transparent processes. Intensified construction of wind farms and large solar systems in the Pannonian countries is essentially detrimental to many local communities and the national economy and energy transition of these countries – because national credit lines, RES funds and preferential tariffs are used; all of which minimizes investment in other renewable energy.

On the other hand, biogas plants (BgP) – which do not have structured interest groups (because there are not so many opportunities to earn without work in this sector) are unfairly neglected – are put in the background. This paper therefore points to the advantages of biogas power plants – particularly important for villages in Pannonia – a natural area for biogas power plants in rural areas. In addition, the Pannonia areas have problems with: unfavorable demographic trends, insufficient economic development based on agriculture, and an unfavorable situation with local waste management.

Research data, as well as the work of members of Panon think tank Osijek show that biogas plants have the most favorable effects on the development of rural local communities and the GDP of the national economy – through investment, intermediate consumption and employment of domestic labor and putting into service national resources. This will be illustrated by the example of the Republic of Croatia. [2–6]

The benefits of biogas power plants are multiple for both the local community and the national economy. From this title, this analysis is conducted on two levels: local and national.

BENEFITS OF BIOGAS POWER PLANTS FOR THE LOCAL COMMUNITY

The construction of biogas power plants contributes to a number of local development goals; raising the standard of living and quality of life in villages, raising the organizational and technological level of life and business in villages, employment of young people and other benefits – as shown in Figure 1.

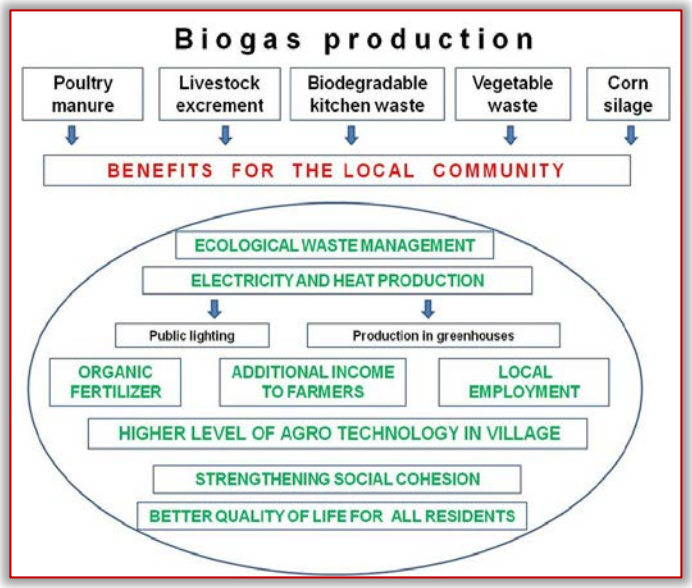

Figure 1. Benefits to the local community from the construction of biogas power plants

Biogas is produced in rural areas from poultry manure and livestock excrement, biodegradable kitchen waste and green biomass (vegetable waste and silage). In urban areas, it is also produced from sewage sludge and biodegradable municipal waste.

So the benefits to the local community are:

— Ecological disposal of rural waste

In most rural areas, the ecological disposal of waste from rural production (poultry manure and livestock excrement) and bio–degradable kitchen waste has not been effectively addressed. Rural households solve this traditionally – by disposing of their property. A small number of rural households, which own a larger number of livestock, dispose of livestock manure in their backyards – in their private compost bins and, later, use this organic fertilizer on their arable land. However, such a traditional method is not sanitary (stench, rats, insects, pigs, poultry, etc.) and endangers the quality of life of owners and neighbors and emits greenhouse gases (methane, etc.). In contrast, transporting such waste to a local biogas plant is a much more efficient way of disposing of rural waste.

— Electricity and heat production

Biogas power plants produce electricity that can be: (a) delivered to the national electricity system – for a fee (if there is a contract and the BgP is connected to the electricity grid) or (b) used locally – for public lighting, local water supply, for communal, social or educational facilities. E.g. many rural municipalities in the area of Slavonia and Baranja have problems with the financing of public lighting, and in many villages of these municipalities the public lighting is turned off after midnight. Therefore, with the construction of BgP, it is possible to solve the local electricity supply of communal facilities.

In the process of electricity production in BgP, waste heat is generated which can be used for heating business and social spaces, for drying agricultural products or for heating greenhouses and hothouses. E.g. in the area of Slavonia and Baranja, several biogas power plants supply heat for the hydroponic production of tomatoes in greenhouses (on 4 ha in Kneževi Vinogradi) or for the production of vegetables and flowers in greenhouses (in village Ivankovo and Tomašanci). [3]

— Additional income to local farmers

For the operation of BgP in the fermenter – in addition to livestock manure and organic kitchen waste – green biomass (vegetable waste and corn silage) is used in the amount of 40 to 60 percent in each cycle of BgP – which lasts about 29 days. This means that it is necessary to deliver tens of tons of silage for each cycle of BgP operation – depending on the installed BgP capacity and the model of structuring the input raw materials. In this way, local farmers earn additional income, because – silage is the calculated input cost in the production of BgP.

— Organic fertilizer

At the end of each BgP cycle (depending on the installed capacity), tens of tons of digestate remain – a high–quality organic fertilizer – which is used to fertilize agricultural land or is commercially packaged and sold in retail chains. It should be noted that according to the quantities of waste delivered (after the completion of the cycle in BgP) each local supplier of livestock manure receives the appropriate amount of digestate for use on their agricultural land; e.g. as it is applied in the municipal BgP (power 2 MW) in Dunaujvaros, Hungary.

— Hiring local labor

Given the significant share of construction work in the construction of BgP – there is a high probability that for several dozen local construction workers there will be work from one to two years – depending on the installed capacity of BgP.

When the BgP construction is completed, the BgP crew is hired – which is not numerous – from 3 to 5 employees with secondary technical education and one engineer? The importance of employing local technical staff should be pointed out here – which at the same time contributes to a higher level of technical competence of the local community.

— Higher level of agro technologies in the village

The existence (business) of BgP in each rural community contributes to increasing the level of application of modern agro technologies in the village – as opposed to traditional habits and customs. In this way – a regular rhythm of business is introduced in the village, a certain organization of business and social and business relations is introduced – in the wake of the concept of a smart village.

— Strengthening social cohesion

Planning and organization of the implementation of the BgP project and its construction, as well as the functioning of the plant itself, requires the agreement and cooperation of all local private, business and social entities and local self–government bodies. These are often significant challenges in practice, but basically – these processes contribute to strengthening social cohesion in the community; mutual trust of residents, their trust in local authorities and local organization and work on a joint project are strengthened.

— Better quality of life

Realization and operation of BgP – ultimately brings a better quality of life for all residents in the village; there are fewer unpleasant odors and stench in the settlement, there is more order and more organized business life, local farmers have additional earnings, part of the local workforce is employed and a higher level of technical and agro culture is achieved in the community.

PLANNING THE CONSTRUCTION OF BIOGAS POWER PLANTS

Planning the construction of a biogas power plant (location and capacity) starts from local potentials; important are – number of households, number of poultry, number of small livestock (sheep, goats), number of pigs and number of cattle – according to the model shown in Figure 2; i.e. a larger number of inhabitants and livestock allows the construction of higher–capacity BgP. The most common built capacities of biogas power plants in developed EU countries are 1 and 2 MW per locations where there is a large livestock production and a larger number of inhabitants, and power plants of lower power (300 to 500 kW) are built–in smaller villages.

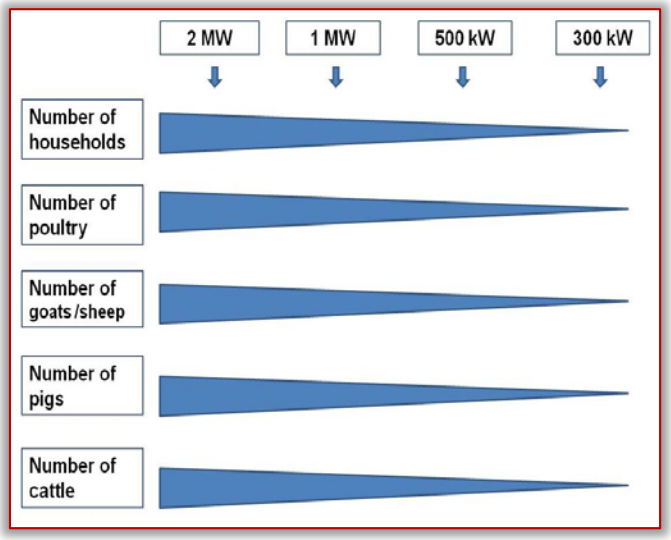

Figure 2. Elements for planning the construction of biogas power plants

We also graphically presented the model of financing the construction of BgP (Figure 3). Large business systems of agricultural production (LBS), national energy efficiency fund (NEEF), national energy market operator (NEMO), large private agricultural producers (LPAP) will participate in financing and crediting the construction of large BgP (1 MW of power and more). In construction of small capacity BgP in addition to the above entities (with a smaller share) will also finance: joint small agricultural producers (JSAP), local government (municipality), individual households in the local community (household) and regional government (county);

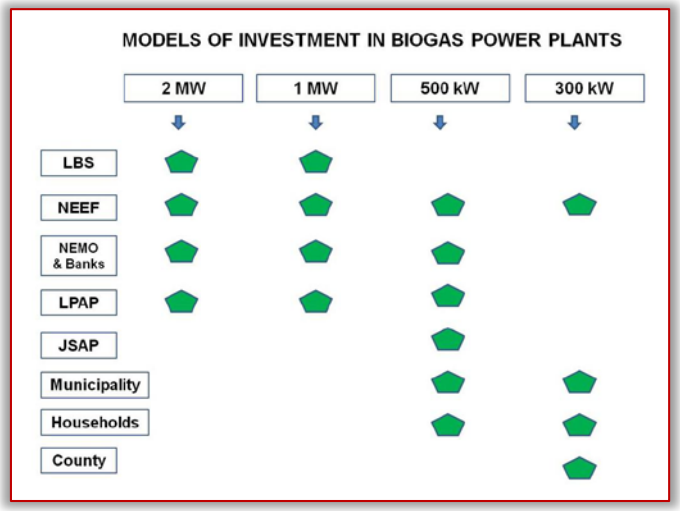

Figure 3. Investment models in biogas power plants

It should be noted here that the first biogas power plant in Croatia was built in 2009 in the agricultural cooperative Osatina near the village of Ivankovo (not far from Vinkovci), and in the following years another 38 biogas plants with a total capacity of 41.7 MWel were built and put into operation; of that number, 24 power plants (installed capacity 29,986 MWel and 30,292 QMW) were built in the Slavonia region (from these 15 BgP was built in the Osijek–Baranja County). It is significant that a large number of these plants in the region were designed, built and put into operation (connection to the power system) by Slavonian experts from Belišće, Osijek, Slatina, Sl. Brod, Vinkovci and Vukovar [4]. Figure 4 shows the newly built BgP (300 kW) in Hrastin village (about 20 km from Osijek) and Figure 5 shows the locations of the built BgP in the region of Slavonia until the end 2019.

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Figure 4. Biogas power plant (300 kW) in the Hrastin village

Figure 5. Locations of biogas power plants in the area of Slavonia and Baranja region (as of 2019)

CONCLUSION

The construction of biogas power plants in rural areas of the Pannonian countries contributes to a number of local development goals;

- Raising the standard of living and quality of life in the village,
- Possibility of additional earnings for local farmers,
- Ecological disposal of livestock and rural waste,
- Raising the organizational and technological level of business in the village,
- Youth employment and
- Raising social cohesion in the village.

In this paper, models for decision–making and construction of BgP are also proposed.

Examples from rural areas of Austria, Croatia and Hungary prove the importance and benefits of building biogas plants.

Note: This paper was presented at IIZS 2021 – The XI International Conference on Industrial Engineering and Environmental Protection, organized by Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad, in Zrenjanin, SERBIA, in 07–08 October, 2021.

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