Agricultural biogas plant
(Warmia and Mazury, Poland)

The concept:

Biogas production is an environmentally friendly solution in the field of waste management, including residues from agricultural production, which contributes to reducing greenhouse gas emissions and minimizes the negative impact of waste on the environment. There are three levels of agricultural residues for usage in biogas plant – primary residues as the product of photosynthesis (e.g. straw, vegetable food waste), the secondary residues as the product of livestock production (e.g. manure) and tertiary residues from agricultural processing (e.g. potato peels, slaughterhouse waste, food waste). In general, all residues with a high amount of sugars and oils compose valuable substrate for biogas plant. In Poland there are 150 agricultural biogas plants with total power 145 MW, and among them especially the smaller ones (<200 kW) use manure as the only or main substrate, but in the many other cases corn silage still compose the important input. It is worth noticing that most of biogas plants use a mix of substrates including a great share of agricultural residues.

Biogas production, including agricultural activities may be carried out for the farm's own needs, but also for the purpose of sale. Then it can be an additional source of income for a farm. Therefore, considering the profitability of biogas plant, the Polish biogas plants can be divided into three types of biogas-plant-based businesses depending on the installed power of biogas plant. Name them as follows:
(i) <200 kW, **energy prosumer**, i.e. all energy produced is consumed at the farm (energy prosumer) and all digestate is used for fertilization of own fields (industry prosumer) and profit from biogas plant is in lower amount on invoices for electricity and production means;
(ii) 200-500 kW, **energy prosumer surplus**, i.e. generating a profit added to normal agricultural production of the farm; such scale of biogas production combines the benefits of prosumerism with the sale of surplus electricity produced;
(iii) >500 kW, **energy producer**, i.e. it is a strict commercial approach with all activities orientated on maximisation of profit; biogas plant is usually located in big farms (>1000 ha) or constructed by investors not associated with agricultural production,

Feasibility:

Success in agricultural biogas production can be achieved by building a strong and durable supply chain, well-developed technology tailored to specific needs and competent laboratories. In Poland all biogas plant activity depends on national electric energy companies through a bilateral agreement related to buying electricity from biogas plant by energy company and selling energy to the owner of biogas plant. Even if the biogas plant technologies are mature now there is and will be a great demand for a specialised data from laboratories such as those related to the composition of feedstock to estimate stability of the process of methanisation as well as environmental and socio-economic analysis that are important at the stage of the decision on investment or during biogas plant operation.
It is also important that clients/partners involved in cooperation are aware of the need for sustainable development and responsibility for the environment.

Viability:

The revenues of an agricultural biogas plant depend on many factors. The first factor is the size of the agricultural biogas plant, because it affects the amount of electricity/heat energy it produces. Another important factor is the price of electricity/heat. It directly affects the profitability of the agricultural biogas plant. When calculating the profitability of an agricultural biogas plant, the costs of its start-up and operation should also be considered.
For a given farm the biogas plant should be dimensioned in terms of the potential of available substrate and energy demands. Therefore, in Polish reality, where the size of an average farm is under 20 ha, there is a great prospect for development of microbiogas plants (in Polish regulations <50 kW) or small or medium ones (100-250 kW). For bigger ones there can be more considerations related to the purchase of substrate and proximity to farms or to agri-food processing plants that can provide substrate, utilisation of a huge amount of heat energy and digestate (limitation of application of nitrogen with natural fertilizers to 170 kg N per ha and per year). In Polish reality, microbiogas plant (50 kW), small biogas plant (100 kW) or medium biogas plant (200 kW) should be considered in the case of the farm with plant production in between 50-1000 ha (corn as the main substrate) or livestock production 40-800 LSU (manure as the only or main substrate).

The cost of biogas plant, return on investment, and final revenues are closely related with its size. The large biogas plants over 1MW bring relatively higher revenues and allow for higher rates of return of employed capital. In Poland there are single biogas plants with the installed power over 1 MW. Such installation has more opportunities for diversification of its products (electricity, heat, fuel, network gas, marketable fertilizers, etc.). However, the market potential for such installations in Poland is strongly limited due to numerous constraints, including mostly the social ones. Therefore, the option for prosumer approach with micro- small- and medium biogas plants seems to create the main future businesses related to biogas plants in Poland.

Contribution to regional bioeconomy:

The Warmia and Mazury region buys electricity from outside, paying the highest rates in Poland. This is because there are no coal-fired power plants in operation in the region, so the price of energy increases because transmission fees are added. On the other side it is positive because the region is one of the environmentally cleanest in Poland. This is the reason that energy transformation and climate change are one of the factors shaping the development of the Warmia and Mazury region. This transformation will manifest itself in a different share of the use of renewable energy sources.

The development of the agricultural biogas sector in the Warmia and Mazury region, the increase in the number of biogas plants and the increasing amount of electricity and heat produced by these installations directly affect the increase in the share of renewable energy sources in the region's energy balance. Currently in the region there are 17 biogas plants, including 12 micro-installations. Today, their contribution to the total energy supply in the region is marginal. But in the future, if a biogas plant boom in the region as well as in Poland actually takes place, this support will be rather considered in terms of prosumerism by limiting the use of energy from the grid and decreasing farmers payment for electricity. Probably, the spectrum of use of biogas can be very wide - from the utilization for energy purposes - electrical and thermal energy, methane concentration and inject methane into network or into bottle, as well as it can be used as a means of transport as direct fuel or in fuel cells.

It should be underlined that agricultural biogas plants are characterized by high ecological value because, firstly, they enable the utilization of organic waste from agriculture and agricultural processing, and secondly, they reduce the consumption of natural and mineral fertilizers in favor of digestate. This is especially important in regions with valuable natural values, such as the Warmia and Mazury region. Therefore, **any investment in biogas plant is profitable in terms of environmental, social and economic terms.**

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ABOUT BRANCHES

BRANCHES is a H2020 "Coordinaton Support Action" project, that brings together 12 partners from 5 different countries. The overall objectiveof BRANCHES is to foster knowledge transfer and innovation in rural areas (agricolture and forestry), enhancing the viability and competitiveness of biomass supply chains and promoting innovative technologies, rural bioeconomy solutions and sustainable agricultural and forest management.

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THE PARTNERSHIP

BUSINESS CASE - POLAND

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Key Partnerships

- Partnerships with regional/government agencies
- In the case of large biogas plants, cooperation with nearby farms or agri-food processing plants that can supply substrate should be considered. If a biogas plant produces significant surpluses of electricity energy/heating, these entities may be its recipients.
- Farms interested in purchasing digestate

Key Activities

- Collection of waste/residues from agricultural production
- Disposal of waste/residues from agricultural production
- Biogas use/sale
- Marketing activities

Key Resources

- Access to agricultural waste/residues
- Financial resources for the investment in the construction of fermenters
- Human resources (employees) with relevant knowledge/experience
- Marketing resources

Value Propositions

- Collaborating with farmers operating in the region
- Revenues from biogas sales
- Revenues from the sale of digestate
- Potential for public incentives for biogas production
- Potential for environmental impact and sustainable waste management
- Reducing electricity consumption/heating costs
- Energy self-sufficiency

Customer Relationships

- Establishing cooperation through long-term contracts for the supply of waste/residues from farms
- Concluding long-term contracts with biogas recipients to ensure a constant source of income

Channels

- Direct sales to public utility entities supplying heat to residents of rural areas
- Direct sale of digestate to other farms
- Direct sales to agri-food processing plants electricity energy/heating

Customer Segments

- Farms in the region interested in purchasing digestate
- Local public utilities that need a stable supply of biogas to generate heat to power households in rural areas

Cost Structure

- Investments in fermentation chambers and anaerobic fermentation devices - the production of agricultural biogas requires high financial outlays related to the implementation of the project. These costs may vary depending on the size of the production plant.
- Costs of collection and transport of bio-waste - these costs depend on the distance of waste/residues suppliers from the production plant
- Costs of ongoing maintenance and repairs of biogas production installations to avoid serious failures
- Marketing and sales costs related to servicing contracts concluded with biogas recipients to provide stable income from biogas production. It is necessary to train marketing and sales staff to effectively reach buyers

Revenue Streams

- Revenues from the sale of biogas to a local public utility entity
- Revenues from the sale of digestate
- National subsidies co-financing the construction of agricultural biogas plants under the "Energy for Rural" program