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Innovative Agricultural Biogas Plant utilizing a revolutionary "biotechnological accelerator"

# SECURING TOMORROW'S ENERGY WITH BIOGAS

**A**ssociate Professor Paweł Kowalczyk of the PAS Institute of Animal Physiology and Nutrition explains how research on animal feed can – perhaps surprisingly – improve our health and help bolster Poland's energy security.

**You conduct research at the intersection of food safety and energy security – two areas that are not immediately perceived as interconnected in any way.**

PAWEŁ KOWALCZYK: Our Institute's core research is related to veterinary medicine and agriculture. In medicine, we analyze tissues of farm animals and implement the findings of this research in the context of various systems in the human body. Research on the circulatory system and organs of the pig, including the

heart, provide an excellent model for studies of ischemic events in humans. With this goal in mind, we organize workshops addressed to medical and veterinary students. We want future doctors to work on animal heart tissue, for example in cardiology and veterinary medicine, and to learn the anatomy of heart valves.

In addition, we conduct research related to agriculture, more specifically the analysis of nutrients in the diet of animals that receive animal feed. We check which ingredients can cause inflammation in



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the tissues of the digestive tract in animals. Ingredients used in the food consumed by pigs and present in their feces may have a considerable impact on energy security.

### In what way?

Pig farming results in the production of a large amount of manure and slurry, and their piles can be seen lying on fields. It is a huge waste not to put this organic material to use. Moreover, manure slurry – which a liquid, fermented mixture of livestock feces and water (from washing stands and watering animals) – easily soaks into the ground, and if it is handled incorrectly it can pose a threat to the environment.

We should bear in mind that the European Union must reduce the emissions of greenhouse gases, such as methane and nitrous oxide, by a net 55% by 2030 because the border tax on CO<sub>2</sub> emissions will come into effect in the following years. To avoid this tax, we should look for alternative energy sources. At our Institute, we are therefore developing and optimizing research work related to animal nutrition.

The large surpluses of manure and slurry generated from pig farming could be a valuable source of potentially useful biomethane. Biogas plants with a capacity of 0.5–1.5 MW could be built alongside agricultural facilities. State-owned companies are interested in building such facilities because they could use such substrates in biogas plants.

To produce manure and slurry more efficiently, livestock animals must be fed efficiently, or with feed high in protein and macro- and micronutrients. Our role as scientists is to study, optimize, and select feed and nutrients that can fully meet the needs of animals, while simultaneously allowing them to produce manure efficiently with no detriment to their health. The best feed mixtures are based chiefly on high-protein plants from the legume family, such as the medick, the soybean, the broad bean, and the horse bean.

### Do these mixtures also affect the quality of the meats produced from these animals?

Yes. By using food mixtures rich in micro- and macronutrients, we want to produce beef or pork with special, health-promoting properties. We hope that by producing such meat we can contribute to reducing the incidence of modern lifestyle diseases, such as atherosclerosis and heart disease, and such neurodegenerative disorders as Parkinson's disease and Alzheimer's disease. Unfortunately, typical Polish cold cuts and sausages do not yet have such properties. Of course, some small factories produce high-quality cold meats and cheeses using home methods. Such products contain much smaller amounts of harmful fats. We also want people to eat healthier meat and sausages and thus take better care of their health. We

are collaborating with many scientific and medical centers in Poland in this field, as a result of which complementary and interrelated systems of health and food safety and energy security can be created.

### Are the climate costs of animal husbandry offset by the production of biomethane from animal feces?

Animals are natural incubators of biomethane, which is released into the atmosphere on a daily basis. Chemically, biomethane and methane are the same substance. The only difference lies in their origin and in the level of greenhouse gas emissions associated with their combustion. Unlike methane, which is the main component of extracted natural gas, biomethane is formed through the fermentation of biological waste (feces, wastewater, distillery waste, and waste from fruit and vegetable production). Burning biomethane, either pure or contained in biogas, is likewise linked to the emission of carbon dioxide, but this is carbon dioxide that has been drawn out of the atmosphere

By producing good-quality meat, we can contribute to reducing the incidence of diseases such as atherosclerosis, heart disease, Parkinson's, and Alzheimer's.

relatively recently by crops. In simple terms, burning biomethane results in net-zero emissions of CO<sub>2</sub>. In other words, we release into the atmosphere what was extracted from it, so the overall level of greenhouse gases in the atmosphere does not grow.

Burning natural gas, on the other hand, involves reintroducing CO<sub>2</sub> that has been trapped underground for millions of years. More greenhouse gases in the atmosphere lead to higher mean temperatures and climate change. As scientists, we want to bind this methane and put it to good use. Biogas extracted in this way can be stored in special tanks and sold on exchanges for heat and energy production. Traditional agricultural biogas plants produce biogas with methane content at the level of around 55%. After purification in special modules, it is used to produce biomethane with methane content of about 98%, which is around the level found in natural gas. Poland's biomethane production capacity is estimated at up to 8 billion cubic meters, but practitioners believe that this figure will be up to 4 billion cubic meters, taking into account the limitations related to the availability of substrates and to the gas network. Biogas plants truly are the



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future for our country. According to estimates by leading state-owned companies, to produce 2 billion cubic meters in Poland, which is how much is needed to create the most optimal energy mix, we would need around 10,000 biogas plants of about 0.5 MW. This solution will work best for smaller cities of up to several thousand inhabitants. The future belongs to modern energy sources, and biomethane plants are among the stable and environmentally friendly ones.

#### What does this look like in practice?

If farmers want to have biogas plans, local-government leaders can notify the National Support Center for Agriculture (KOWR), for example, and fill in applications for financial support under the program “Energy for Rural Areas.” Poland has nearly 150 small biogas plants with a capacity of 0.125 MW. They are used to power houses or barns. Building a small biogas plant costs about 250,000 zlotys, and the net cost of a large plant, or one with a capacity of 0.5 to 1.5–2 MW, is around 16 million zlotys. If you want to invest in a larger plant, you can build a suitable installation and connect it to the existing power or gas installation. The best locations are areas of former State Agricultural Farms, small housing estates, nurseries, preschools, and small towns. In the future, biogas installations may be built in larger cities too.

In Germany, there are now already 9,500 biogas plants. In Poland, we’re still grappling with certain psychological barriers. For example, people think that biogas plants emit unpleasant smells. But this is not actually true. Besides, anyone who sets up a biogas plant and compares their energy bills before and after will realize that we really should take advantage of this innovation. The establishment of new plants may soon be accelerated by the Biogas Plant Act. This bill stipulates that biogas plant projects can be initiated, for example, by natural and legal persons that run agricultural farms, wine producers, and ener-

gy cooperatives. Biogas plants will have to use the substrate generated on such farms. This holds great potential – we already produce more than 1 million cubic meters of manure slurry per day, which could be used for this purpose.

#### What could be the share of biogas in Poland’s energy mix?

It is estimated that this share could reach 45% by 2030, even more in the following years. It’s worth mentioning that one biogas plant generates about 3 million zlotys in profit every year. Initially, you have to invest more capital, more specifically around 16 million zlotys, but you can apply for targeted research grants or subsidies from government agencies. Biological and other organic waste can also be used in biogas plants, but we should remember about the need for methane bacteria. Moreover, biogas plants can also be used for cooling. In other words, we can use them to keep warm in the winter and keep cool in the summer.

#### Have such solutions been used worldwide?

Yes, but they lost impetus after the initial phase. Those were mostly small projects. A biogas plant produces fuel in a steady and predictable manner, thus powering gas-fired cogeneration plants. By using innovative technologies, companies could gain energy security and independence and simultaneously reduce their net greenhouse gas emissions. In Germany, the first biomethane plants were established in 2006. By May 2021, it had already 232 such plants. Other countries that support biomethane production include Denmark, where the authorities expect it to meet 75% of the country’s gas demand as early as 2030 and 100% in 2034. These examples demonstrate a very promising outlook for the development of biogas plants in Poland.

INTERVIEW BY JUSTYNA ORŁOWSKA, PHD