Perception of Farm-Fed Anaerobic Digestion Plants

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Anaerobic digestion (AD) plants undoubtedly represent an integral and irreplaceable element in rural energy transition and sustainable waste management.

Keywords: anaerobic digestion plants ; biogas

1. Introduction

Anaerobic digestion plants (AD plants) producing biogas energy, heat, and secondary energy play a decisive role in the greening and diversifying of the energy sector in Europe [1][2][3]. Development of the renewable energy sector in post-socialist Central and Eastern European (CEE) countries is especially important due to incredibly high carbon emissions per capita in

part of Europe. (The Czech Republic is fourth, Poland seventh and Slovakia sixteenth among the EU-27.) Although the possibilities for the utilization of renewable energy sources such as hydropower, wind, or solar energy are relatively abundant, under prevailing societal perceptions their use has been rather limited so far [4]. On the other hand, AD plants—with widely available food- and farm-waste as their feedstock—have been recognized as being among the most promising renewable energy sources [5][6] for their great contribution to progress towards the sustainability of national energy systems.

It is well known that an unprecedented inflow of European incentives after the EU accession of CEE countries in 2004 induced rapid growth in biogas energy and the spread of AD plants in all these countries [6][7]. Currently, more than 550 AD plants with an installed electrical capacity of 367 MWe can be found in the Czech Republic, 129 AD plants in Poland (127 MWe), and 113 (115 MWe) in Slovakia. The potential of biogas energy for sustainable and more resilient rural development is often emphasized, especially for peripheral rural areas [8]. It has also been shown in many studies that energy generation from farm-fed AD plants also suitably contributes to the advancement of multifunctional approaches and sustainability principles in agriculture, as well as a more diversified offer of rural jobs [9][10][11]. AD plants and their products also have a clear potential for social advancement in rural peripheries.

Generous support from the EU has greatly assisted Poland, Slovakia, and the Czech Republic in meeting their obligations to the European Union and have contributed to their energy transition, but they have also led to many unintended environmental and social consequences [12]. It has been shown in many studies that the operation of farm-fed AD plants might involve many environmental, social, and economic benefits for the host community, but the real or even perceived negative impacts also need to be seriously taken into account at the same time [13][14][15]. Farm-fed AD plants in the CEE countries are primarily fed by purpose-grown maize and utilize only a limited amount of agricultural waste [16]. The limited amount of biowaste from farms processed for energy certainly makes these AD plants less beneficial for the environment [17][18]. Even the planning and construction phases of individual AD plant projects frequently lead to severe local tensions and controversies in their host communities [14][19], which generally reinforce the negative perceptions associated with biogas generation [20]. It has also already been revealed in previous studies that this phenomenon is highly affected by individual personal experiences with the operation of AD plants, [14] which frequently are not in line with the expectations of the host community [6][8][21].

2. Special Features of Anaerobic Digestion Plants in Post-Socialist Eastern Europe

The emergence of AD plants in CEE countries dates back to just after their accession to the European Union in 2004 [22]. For instance, in Poland the first AD plant appeared in 2005, and since then the development of farm-fed AD plants has proceeded in waves according to changes in Polish renewable energy policy [8]. The first AD plant in Slovakia began

operation also in 2005, but considerable development of farm-fed biogas energy did not begin until the end of the decade. The decisive drivers were the approval of the Act on the Promotion of Renewable Energy Sources (Act No. 309/2009 Coll.) and the National Action Plan for RES (National Action Plan for RES, 2010). Both policy documents provided generous support for feed-in tariffs, which stimulated the rapid development of the biogas sector in Slovakia. The slower development of the biogas sector in Poland is due to business uncertainty caused by the constantly changing feed-in tariff policies [8]. On the other hand, institutional support for AD plants in the Czech Republic is somewhat older, as it commenced already in 2002 with the introduction of a feed-in tariffs policy; moreover, the country's first experimental AD plant was built already in the mid-1970s. It can be concluded that that in the Czech Republic, as in Poland and Slovakia, the establishment and development of the biogas sector is strongly dependent on national-level support for both the construction and operation of AD plants. Additionally, the decision was made by these national governments that that the buyout prices for biogas energy would be legally guaranteed to support the stability of the emerging renewable energy sector [5][7].

Especially in Poland, AD plants are developed as stand-alone business projects separate from farms [15]. These off-farm AD plants therefore do not have one major feedstock provider, rather ensuring their feedstock supplies via short-term contracts with numerous individual farmers. On the other hand, due to the presence of traditionally large farms in Slovakia (around 100 hectares) and the Czech Republic (130 hectares), the AD plant installations in these countries tend to be rather large scale (around 1 MWe of installed electrical capacity). In all three studied countries, researchers were not able to find much experience with the operation of small-scale AD plant installations, because these were not eligible for subsidy programs [5]. There is no doubt that both the off-farm AD plant installations in Poland and the large-scale on-farm AD plants dependent on agricultural production in Slovakia and the Czech Republic have stimulated recent changes in agriculture.

3. Factors Affecting the Perception of Anaerobic Digestion Plants

In previous Eastern European biogas studies, increased attention was paid to the problem of the acceptance of biogas production, especially in rural areas [23], where the vast majority of farm-fed AD plants are located. Specifically, a number of studies indicate that the perception of AD plants is rather negative among rural populations [14]. Among other reasons given to justify the negative image of AD plants, the following factors were listed: a perceived reduction in the quality of the environment (including odor leakages) and a reduction in the attractiveness of the community for tourism [6]. The image of biogas production was further tarnished by the not especially environmentally friendly, ethically controversial processing of purpose-grown energy crops, grown on good-quality arable land, in AD plants [24]. The displacement of food production away from farm-fed AD plants and changes in regional farming systems in the CEE countries have become apparent. However, by far the greatest controversy surrounding AD plants is connected with their impact on host communities and their immediate vicinities [25]. Researchers know that the performance of biogas businesses can be substantially superimposed by how these are reflected in local public perception [14].

A general lack of awareness when planning AD projects regarding the pros and cons of biogas production and limited knowledge about the anticipated impacts of AD plants on the surrounding localities are often the cause of biogas controversies [26]. Companies operating AD plants carry out many informal educational activities and informational events to convince the public of the benefits of AD, while potential negative impacts are frequently suppressed or concealed. Moreover, the real impact of these events is usually lower than expected as their attendance is typically low, especially in the post-socialist space. More attractive ways of engaging the public who will be most impacted urgently need to be sought. There is no doubt that a lack of transparency and clarity in sharing information about a particular biogas project has the potential to lead to further controversies [14]. The most frequently organized events include joint public hearings with investors and visits to AD plants already in operation [8]. In other words, inadequate or even no involvement by the local community in the planning phase, failure to provide sufficient information, provision of misinformation, and concealment of key aspects of the project and its expected impacts on the community all have the clear potential to increase the level of opposition toward an AD project and to generate avoidable tensions within host communities [19][27].

Most social science studies that touch on the issue of AD plants and their location in communities examine the factors behind their acceptance and study the different methods of participation and involvement in the planning phase [14][24][28][29]. Considerably less attention has been paid to what happens in communities after a renewable energy project reaches its operational phase [20][30]. There is clear evidence that the social acceptance of renewable energy projects tends to increase once a facility is finally in the operational phase [25][31]. However, it has proved invaluable to consult and discuss an AD plant project with affected residents not only in the pre-investment stage but also, even more intensively, during AD plant operation [30]. Many studies have shown that the two-way flow of information between the public and the operators of AD plants leads to positive changes in the perception of biogas through personal real-world experiences [32][33]. In order

to successfully operate AD plants in host communities in the long-term without conflicts, there is an urgent need to mitigate changing preferences and attitudes towards biogas energy and to ease the transition from the planning phase to the operational phase. The key factors affecting the perception of AD plants are summarized in **Table 1**.

Table 1. Key factors affecting the perception of AD plants.

Data	
Rather negative general perception of AD plants among rural population.	[14]
Real or perceived reduction in the quality of the environment around AD plants (including odor leakages and increased traffic).	[6]
Reduction in the attractiveness of the community for tourism.	[6]
Ethically controversial processing of purpose-grown energy crops grown on good-quality arable land in AD plants.	[24]
Displacement of food production away from farm-fed AD plants.	[24]
Changes in regional farming systems due to AD plant operations.	[24]
Impact on host communities and immediate neighborhoods.	[25]
Lack of awareness and limited knowledge of the anticipated impacts of AD plants on surrounding neighborhoods.	[26]
Lack of transparency and clarity in sharing information about AD plant projects.	[14]
Lack of participation by the local population in the planning phase.	[14][24][28] [29]
Less attention to AD plants in the operational phase.	[20][30]

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