Resources, Conservation and Recycling 104 (2015) 152–161

Contents lists available at ScienceDirect

Resources, Conservation and Recycling

journal homepage: www.elsevier.com/locate/resconrec

Biogas digestate marketing: Qualitative insights into the supply side

Johannes Dahlin[a,b,*], Carsten Herbes[b], Michael Nelles[a,c]

[a] Faculty of Agricultural and Environmental Sciences, Chair of Waste Management, University of Rostock, Justus-von-Liebig-Weg 6, 18059 Rostock, Germany
[b] Faculty of Business Administration, Nuertingen-Geislingen University, Neckarsteige 6-10, 72622 Nuertingen, Germany
[c] DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH, Torgauer Str. 116, 04347 Leipzig, Germany

ARTICLE INFO

Article history:
Received 24 April 2015
Received in revised form 26 August 2015
Accepted 26 August 2015
Available online 1 October 2015

Keywords:
Marketing
Biogas digestate
Organic fertilizer
Compost

ABSTRACT

Managing digestate output and developing a market for the product is a serious challenge for the biogas industry. Without effective strategies for sustainable management, the large volume of digestate produced by biogas plants may cripple the industry and its potential. Through interviews with diverse biogas stakeholders, we examine current approaches to digestate marketing to identify factors that support and those that inhibit its success. We find that marketing to regions with a nutrient demand or into the non-agricultural sector holds promise. Upgraded digestate products offer increased marketability due to their higher nutrient content and lower water content. Fertilizer and soil manufacturers, farmers, horticulturists and private customers all represent markets for digestate. Current disposal prices range from negative to strongly positive, depending on the regional nutrient availability, agricultural structure, season, feedstock and degree of upgrading. Marketers agree that concealing the biogas origin of digestate products is still necessary to avoid negative perceptions by customers. One implication of this is the need for better understanding by marketers of consumer concerns and preferences, and for better education of consumers regarding the safety and benefits of digestate. Overall, we find that opportunities for digestate marketing remain largely unexploited and marketing strategies remain immature. Our findings should prove helpful to current and future digestate marketers.

1. Introduction

Over the last decade, economic incentives, including feed-in tariffs, have led to a steady increase in the use of biogas technology. In 2013, more than 14,500 biogas plants were operating in Europe, including 9,035 plants in Germany (EBA, 2014). Produced through anaerobic digestion of organic feedstock and consisting mainly of methane and CO_2, biogas is used in Combined Heat and Power units (CHP) to generate electricity and heat. It can also be upgraded to biomethane and used as fuel for vehicles or heating. Biogas also offers more flexibility than other forms of renewable energy, as it can be stored for use at times of peak demand (Hahn et al., 2014).

Although biogas is a promising renewable energy alternative, its sustainable production also depends on the ability of plant operators to manage the digestate remaining after the anaerobic digestion of biodegradable feedstock. To date, 95% of the digestate produced in Europe is used as an organic fertilizer for field crops on agricultural land (Saveyn and Eder, 2014), where it substitutes for chemical fertilizers (Vaneeckhaute et al., 2013). Direct application on the plant operator's own land is usually the best option (Fuchs and Drosg, 2013), yielding the economic benefit of savings on nutrient purchases (Jones and Salter, 2013).

Other options for reusing the available nutrients include the marketing of digestate to third parties in the agricultural and non-agricultural sectors (e.g. private gardeners). Biogas plant operators may have to consider these alternatives if they have insufficient land of their own, or if there is a nutrient surplus in the region.

In Germany, the low public acceptance of biogas technology has been noted (Herbes et al., 2014), and the absence of broad public acceptance for bioenergy encumbers successful digestate marketing. Still, many questions remain worthy of research, from the effectiveness of different marketing approaches to the perceptions of different customer groups to even seemingly straightforward questions of digestate-related product requirements. Customer perceptions of different digestate feedstocks, of product forms and of the origin of biogas remain open issues. Since the digestate market is just developing, strategies for marketing have not yet been outlined. However, if the biogas industry is to mature into a sustainable energy production system, establishing marketing strategies for digestates and developing the digestate market will

* Corresponding author at: Faculty of Business Administration, Nuertingen-Geislingen University, Neckarsteige 6-10, 72622 Nuertingen, Germany.
E-mail addresses: Johannes.Dahlin@hfwu.de (J. Dahlin), Carsten.Herbes@hfwu.de (C. Herbes), Michael.Nelles@uni-rostock.de (M. Nelles).

http://dx.doi.org/10.1016/j.resconrec.2015.08.013
0921-3449/

prove critical challenges, especially with the use of digestate in the agricultural sector facing imminent legislative restrictions.

Nutrient variability, pressure on available land (Huttunen et al., 2014; Riding et al., 2015), and insufficient knowledge of the use and fertilizing value of digestate among farmers are additional barriers for successful marketing (Schüsseler, 2009; Golkowska et al., 2014). These factors are discussed below.

1.1. Legal constraints

The use of digestate in the agricultural sector is strictly regulated (Huttunen et al., 2014). At the EU level the Nitrate Directive (91/676/EEC) provides the regulatory framework for protecting ground and surface water from nitrate pollution. It has to be implemented within the national law of all EU members. In Germany, this directive is implemented through a fertilizer ordinance that restricts the use of digestate as an alternative for chemical fertilizers (Düngeverordnung – DüV 10.01.2006). Upcoming changes in the fertilizer ordinance will pose further restrictions on using digestates in the agricultural sector. For example, the timeframe for digestate application after harvest will be further restricted (BMEL, 2014).

1.2. Pressure on available farmland

Several regions in Europe with intensive livestock farming suffer from excessive concentrations of nutrients in the land, which must be controlled to limit eutrophication of water bodies. As a result, only limited amounts of unprocessed digestate can be returned to agricultural land in such regions (Vaneeckhaute et al., 2013), leading to higher competition for available farmland and higher land rent prices in the affected areas (Emmann et al., 2011). Finding sufficient arable land for permissible digestate application is especially difficult for larger biogas plants (Döhler and Wulf, 2009) whose plant operators must often pay high prices for digestate transport over long distances to areas of application in need of nutrients. Resulting transportation costs reduce the overall profitability and hence economic viability of a biogas plant (Delzeit and Kellner, 2013).

1.3. Nutrient variability and properties

Complicating the marketing of digestate is the fact that digestate characteristics depend on the properties of the input biomass (Huttunen et al., 2014) and so are highly nonuniform. Nutrient contents of Nitrogen, Phosphorous and Potassium (NPK) varies widely (Nkoa, 2014), making the economic value of digestate as a substitute fertilizer highly variable. Similarly, dry matter content varies widely, with values around 7% being typical (FNR, 2010). The correspondingly high volume of liquid digestate impacts the economics of digestate marketing, as prohibitive transportation costs often preclude distribution over long distances (Huttunen et al., 2014). These and other factors make the optimal use of digestate as an alternative fertilizer for the agricultural and non-agricultural sector sometimes difficult to realize.

1.4. Approaches to facilitate digestate marketing

Treatment options that reduce the volume and therefore increase the fertilizing value of digestate can facilitate its export to areas where nutrient demand is high (Holm-Nielsen et al., 2009; Rehl and Müller, 2011; Delzeit and Kellner, 2013; Golkowska et al., 2014).

There are several treatment alternatives for digestate that produce different products with distinct physical characteristics and fertilizer values (Golkowska et al., 2014). Depending on the complexity of the technology used, these treatment options range from partial to complete upgrading (Fuchs and Drosg, 2013). Different upgrading technologies result in different nutrient contents in the products. When using a screw press for example, most of the nitrogen and potassium are extruded along with the liquid phase of the untreated product, while phosphorous is predominantly retained in the dry matter. Other upgrading technologies, such as evaporation and membrane processes, account for upgrading costs of up to 10 € per cubic meter and more. These costs for the treatment of digestate have to be counted against the estimated disposal costs (Fuchs and Drosg, 2010). In a Life Cycle Assessment of seven different treatment options, Rehl and Müller (2011) investigated the environmental performance of each but observed that profitability is a plant operator's primary criterion in selecting one over another. Indeed, less than 3% of the digestate in the European Union is currently being upgraded to products that could be more widely marketed. These products are, for instance, constituents for growing media and manufactured soils or pellets (Saveyn and Eder, 2014) suitable for the use in the non-agricultural sector.

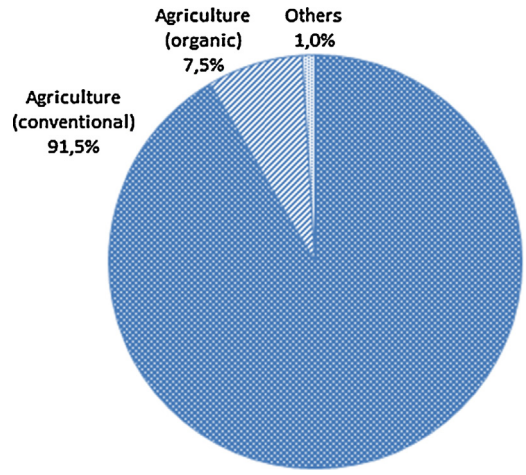

Fig. 1. Distribution channels for liquid digestate.
Source: Based on BGK (2015).

While such treatments can increase the market value of digestate, the price premia obtainable in existing, especially agricultural, markets may be insufficient to justify the investment in treatment technologies. There is therefore pressure to develop alternative markets outside of the agricultural sector where greater price premia might be obtainable. The horticultural and private gardening markets both have intriguing potential for further development (Döhler and Wulf, 2009; King et al., 2013). For example, from an agronomic point of view, digestate-based products such as potting media provide an acceptable alternative to peat-based products (Vaughn et al., 2014). Even the use of digestate pellets as a solid fuel has been explored technically and is already being practiced (Kratzeisen et al., 2010; García-Maroto et al., 2014). The possibility of expanding the market for liquid digestate products to domestic gardening applications as well as attempts to use digestate as a construction material are also being explored (Rigby and Smith, 2011).

Recent data from Germany shows, that liquid digestate is almost exclusively being used in the agricultural sector as Fig. 1 illustrates (BGK, 2015).

Solid digestate (e.g. pellets and compost) has more penetration of the non-agricultural sector, in contrast to liquid digestate. Fig. 2 illustrates that 17% of the solid digestate is marketed to private gardeners, soil manufacturers and others (BGK, 2015).