ASSESSMENT OF TRANSPORT SUBSTRATES FOR SELECTED AGRICULTURAL BIOGAS PLANT

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Abstract
The paper presents transportation problem the biomass to biogas plants. An assessment real data from the area of the selected agricultural biogas plant. We analyzed the number of shipments executed by the transport units and established a theoretical transport set capacity of 17300 kg. For such a set of defined theoretical number of shipments and the theoretical amount of kilometers.

Key words: calorific biomass, transport, biogas plant.

INTRODUCTION

The use of fossil fuels is the biggest source of pollution and greenhouse gases' emission. Last years the European Union countries' leaders have accepted a comprehensive package of activities aiming at prevention of climate changes and providing Europe with reliable and sufficient energy supplies. The package constituting the widest so far ranging reform of the European energy policy aims at assuring the Union the world leader's position in the field of renewable energy and low-emission technologies. The result of these arrangements there is to be limitation of greenhouse gases' emission by 20% by the year 2020, as compared to 1990. The European Union is planning to obtain the above goal most of all limiting of energy's consumption and increasing of the use of energy originating from renewable sources. Such a state of affairs drove to the increase of use of energy production's technologies based on renewable sources, including among the others to the dynamic increase of biomass use for energy purposes, in particular as the raw material for bio-fuels production.

The energy use of biomass as a raw material for bio-fuels production is justified when it makes it possible to obtain a positive ecological effect (reduction of greenhouse gases), with a desire to reach the highest production and economical efficiency as compared to the use of conventional fuels. In many literature sources, as the sources influencing the bio-fuels' production, there are mentioned appropriate location of biofuels' production, considering among the others the areas richness in biomass as well as efficient production's organization with reference to the raw material's transport and storage (MAJ ET AL., 2014; DUDA-KĘKUŚ, 2011). From the point of an appropriate location of bio-fuels' production, important is correct identification of raw material resources as well as the trends of their use, pursuant to the balanced development rules. At present, more and more often techniques based on spatial information GIS (PANICHELLI, GNANSOUNOU, 2008; JANOWICZ, KUNIKOWSKI 2008) systems are used while looking for favorable location.

Acceptance of an appropriate logistic strategy of raw-material's supplies – biomass, is a very important aspect while planning bio-fuels' production. Logistics means planning of demand, efficiency in time and space as well as controlling and use of the planned stream, mass and energy having regard to the cost optimum. In case of already existing biomass processing installations, the logistic activities change most often as regards planning of raw materials' sourcing. There are attempts aiming at reduction of their sourcing's costs by sourcing of the cheapest raw materials The cost of raw materials transport most often incurred by a customer is the second important factor.

With the growing use of biomass for purposes connected with energy's generation, optimization of supplies logistics requires correct planning, organization and management of raw materials' base and means of transport (ROGULSKA ET AL., 2011).

The use of biomass for energy purposes is connected with the following production processes: biomass production, biofuels production from biomass and energy generation from biomass or biofuels. There should be stressed the fact, that these processes are usually performed by separate economic entities. Production of biofuels seems to be particularly advantageous locally, for the purposes of local communities.

Such a manner of biomass' use has many advantages, among the others it decreases the costs connected with transport of raw materials and distribution of biofuels and bioenergy, may contribute to create new places of work, makes it possible to manage wastes and raw material surpluses from agrarian production, wood and food industry, and also increases the local energy safety (ŻARSKI 2012).

Energy intensity of its generation and processing (ZASTEMPOWSKI 2014) is one of the main aspects of biomass production for energy purposes. However, transport of the harvested material to the place of destination is the element which may be controlled in a deliberate manner. It is caused by low density of energy included in biomass. Application of optimum solutions in this field may generate sizeable benefits.

Raw material's availability is one of the more important information which should be taken into consideration while designing installation for biomass processing. Prior to the investment's commencement, the analysis of the processing plant's functioning area with biomass abundance should be conducted.

The evaluation of abundance is performed on the basis of the method of biomass' energy potential assessment, otherwise referred to as "cascade method." (IEO, 2007). It consists in determination of energy's volume possible to be generated from biomass, taking into account different criteria limiting the opportunities of its use. We can distinguish the following levels of energy potential (JASIULEWICZ 2010):

- Theoretical potential – volume of energy possible to be used from biomass on condition of having appropriate installations efficient in 100% (process defects are not taken into consideration), and also assuming that the complete available potential is used for energy purposes only.
- Technical potential – it is that part of theoretical potential, which may be used, decreased due to technical restrictions, (efficiency of machines now available on the market , sometimes the process's own needs, geographical location, energy storage). Usually determined on the basis of detailed technical analyses.
- Economical potential – determined as a part of the technical potential defined above which may be used with consideration of economic criteria.

MATERIALS AND METHODS

The agrarian biogas producer has been buying raw material from farmers from the area around Rypin on the contracting rules. The biogas plant purchases sowable material and guarantees transport of substrate to the biogas plant. Slurry is collected from pigs producers, management of which is difficult due to arduous smell and problems with excessive, harmful fields' manuring. Farmers delivering products for biogas generation may in exchange receive post-fermentation substance free from harmful substances which can also be used for fields' fertilizations. Corn for biogas generation, is harvested from about 500 hectares. On average, from 1ha of corn cultivation about 50 tons of green fodder may be harvested what gives the total sum of about 25000 tons. The raw material is stored at the turn of September and October. Then, ensilage is prepared at the territory of the plant. Corn ensilage is prepared by green fodder's shredding and pressing. The process of ensilage's forming lasts for about 6 weeks, when by appropriate coverage and cutting off air, earlier prepared corn undergoes the process of ensilaging. Each day about 56 tons of corn ensilage is used in the process of biogas generation. The annual demand amounts to approx. 20000 tons of corn ensilage. Moreover, about 20% of raw-material reserve that a plant should have, has to be taken into consideration. Slurry delivered by farmers specializing in pigs' breeding is the second raw material in the process of biogas generation. Slurry in whole is delivered by the local farmers. The daily demand for slurry in the plant amounts to approx. 24 tons. The results of the energy potential's assessment on the economic level for green fodder from corn show, that in the commune it shall be possible to acquire raw material for that purpose from the area amounting to approx. 500 ha. For the Rypin poviat, that area is estimated to be about 1500 ha.

The study analyzed data on transport costs of biomass in 2013. The aim of analysis was to determine the cost-transport due to its transport sets.

As a basis for research was adopted the actual shipments of biomass. Determined the average weight of the transported material for individual transport sets. The vehicle with the largest capacity has been recognized as a model. The vehicle model was used to determine the theoretical amount of travel and the theoretical amount of kilometers. The results obtained are presented in the form of graphs.

RESULTS AND DISCUSSION

For the analysis the field of which was collected biomass was divided because of the distance from the biogas plant. Determined ranges about the size of 5 km. The amount of the collected biomass and percentage of the total weight is shown in Fig. 1.

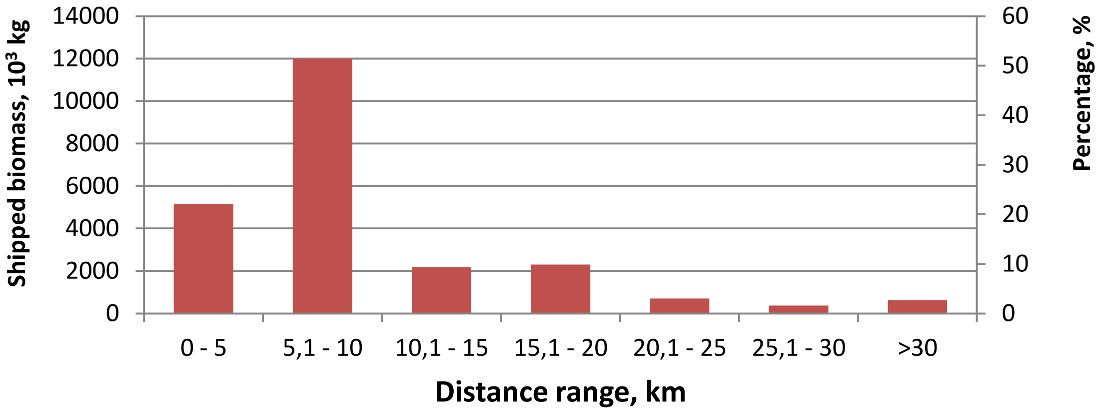

Fig. 1. – The amount of the collected biomass and percentage of the total weight

As can be seen from Figure the largest biomass was collected in the range 5.1 – 10 km. Whereas the last two ranges are not of interest to the Management Board of the biogas plant and the decision to use them was a result of considerations beyond the economic. As a model set of a transport was adopted farm tractor with a trailer of medium capacity of 17300 kg (item 13 on the Fig. 2).

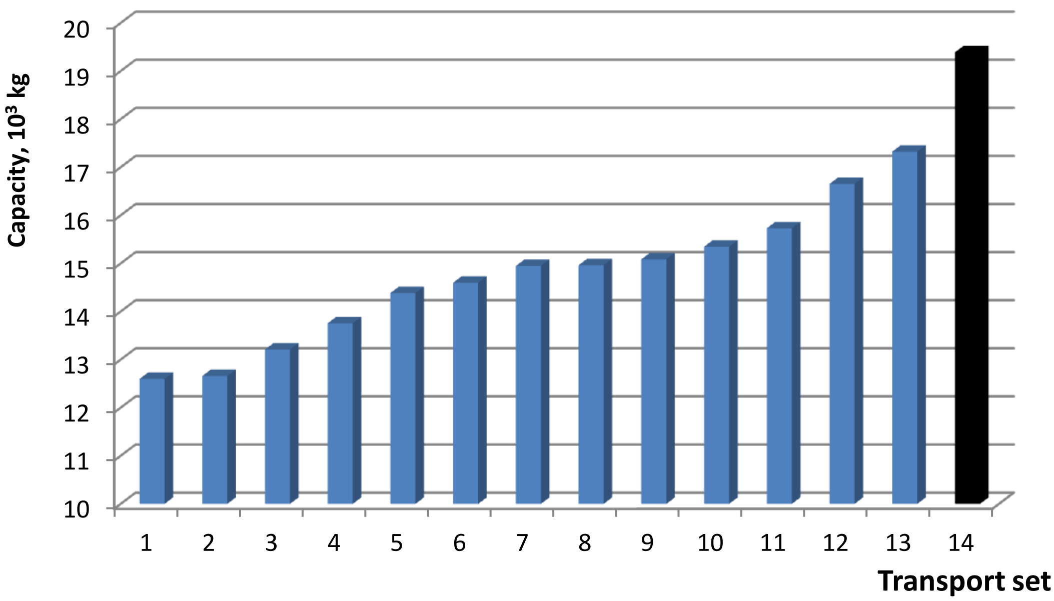

Fig. 2. – Comparison of the capacity of transport sets

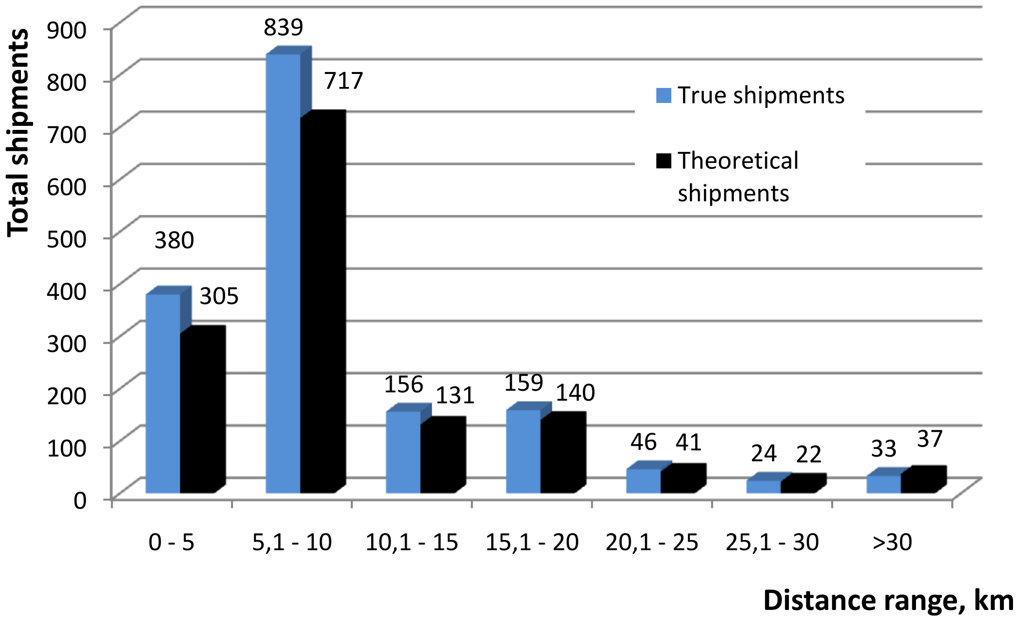

Fig. 3. – Comparison of the number true and theoretical shipments

For a set of model calculated the theoretical number of shipments for the real yield obtained from the data fields. Fig. 3 presents a summary of real and theoretical shipments.

As can be seen from the graph the theoretical amount of shipments sniffed from 80% (0 – 5 km) to 90% (25 – 30 km). This is caused by a better selection of transport sets and more care during loading of biomass for transport sets. For the range of > 30 km obtained more theoretical shipments (item 14 on the the Fig. 1). However, this is caused by using a set of enhanced capacity. The set consisted of a tractor and two trailers. It was designed for long-distance transport.

Similar summary was prepared for the distance which was realized transport. However, this statement also included only road transport set with a cargo of biomass. Summary of results is shown in Fig. 4.

As is apparent from Fig. 4, a similar relationship was obtained in an amount of real of kilometers as compared to theoretical as in Fig. 3.

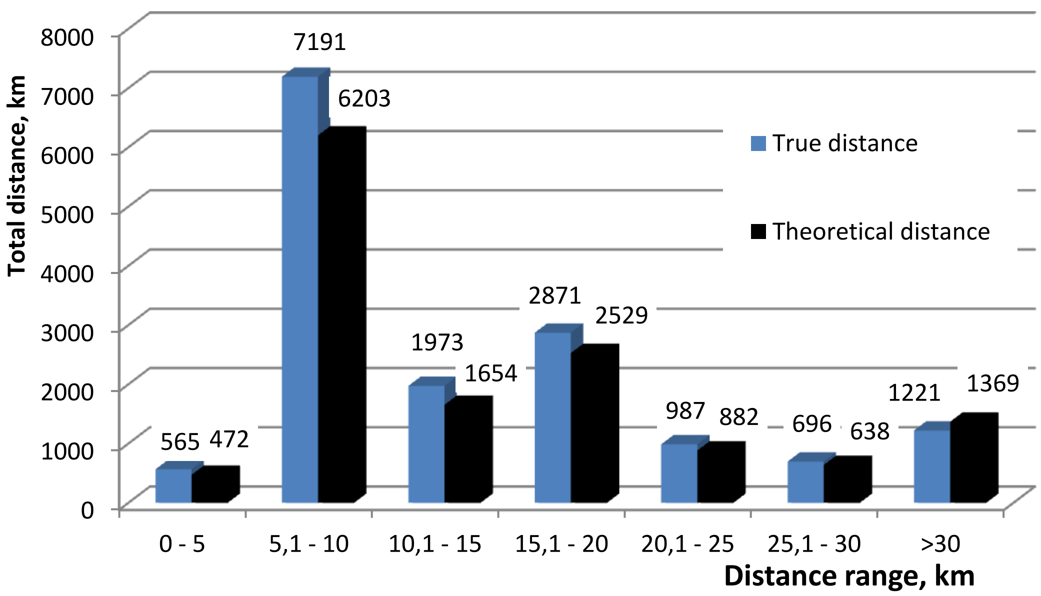

Fig. 4. – Comparison of the true and theoretical distance

CONCLUSIONS

As shown in the research transport of biomass to biogas plants in 2013 was carried out incorrectly. It should determine the economically justified the maximum distance at that can be transport the biomass.

The use of transport sets with a high capacity can reduce 10% to 20% of the number of passes. This value a direct impact on number of people employed in the transport and reducing transport sets.

In the same way to reduce the number of of kilometers. Unfortunately, no data are available on fuel consumption during transportation. They are not possible to estimate the fuel savings. It should in the coming yearcarry out necessary research to estimate the size.

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