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## **SPECIFICITY OF TRANSACTION COSTS AT BIOENERGY PRODUCERS – A CASE STUDY**

Key words: transaction costs, new institutional economics, biomass combined heat and power plant, bioenergy, bioeconomy

**ABSTRACT.** One of the nexus in the modern energy sector are bioenergy companies. To generate green electricity, economic operators trade in the market, incurring transaction costs. The main objective of the paper is to identify and describe the transaction costs using a case study of biomass combined heat and power plant (CHP). The company used for the case study was Polmos Żyrardów. A diagnostic survey with a questionnaire was carried out. It was found that information procurement and negotiation costs are the most significant in the transaction cost structure of a biomass CHP plant. The importance of access to information about biomass suppliers in the region and the company's closest surroundings was highlighted the most. This factor significantly increases the time-consuming activities that make up the process of acquiring information about a potential business partner. The aspect of the formalisation of the contract and the building of mutual trust between the participants in the transaction were emphasised as elements to minimise the uncertainty and opportunism of the partners. It is argued that the level of transaction costs influences decision-making within the organisation, also translating into the efficiency of the entire biomass CHP area. Conscious management of energy resources and care for the environment has made Polmos Żyrardów self-sufficient in energy. In light of the challenges of the energy transition, bioenergy installations make an important contribution to reducing greenhouse gas emissions and building circular bioeconomy.

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## INTRODUCTION

One of the most important concepts of contemporary economic thought, relevant from a theoretical and application point of view, is the institutional approach presented by New Institutional Economics (NIE). NIE builds on the foundations of Institutional Economics established at the dawn of the 20th century. Unlike the prototype, NIE proposes its research agenda as well as potential research methods and takes a constructive approach compared to classical and neoclassical economic theories [Kowalska 2005]. The main distinguishing feature of this heterodox theory is that NIE uses the perspective of institutions to explain phenomena occurring in the economic environment. Institutions, on the other hand, are defined as rules of human behaviour, which are assumed to reduce uncertainty and improve the degree of coordination of actions taken and economic relations established [Owczaruk 2013].

Transaction costs are relevant to each sphere of the economy and the behaviour of economic actors, with the institutions shaping sectoral determinants having varying degrees of impact on the amount of transaction costs. The energy sector is one of the cornerstones of the modern economy, which currently relies heavily on conventional energy resources. The use of fossil fuels, particularly coal, for energy production translates into greenhouse gas emissions, including carbon dioxide (CO<sub>2</sub>). According to the 2021 National Inventory Report [KOBiZE 2021], CO<sub>2</sub> emissions in Poland accounted for 81.8% of total greenhouse gas emissions in 2019. As the authors of the study point out, the subcategory of fuel combustion was responsible for 92.1% of total CO<sub>2</sub> emissions in 2019. To other European Union countries, Poland is a country with one of the highest levels of greenhouse gas emissions [Mierzwiński et al. 2021]. To counteract the effects of climate change, which pose a serious threat to the environment and modern economies, the European Commission's European Green Deal initiative was established. As a result of the implementation of the European Green Deal, the economies of the member states are to be transformed into modern, competitive, and resource-efficient economic systems.

The challenges posed by the reduction of greenhouse gases in the European Green Deal require building the nexus in approach to how electricity is produced. One possible solution is the production of electricity from renewable energy sources, where energy from wind power plants, hydroelectric power plants, biomass and biogas installations, and photovoltaic installations. Changes in the way electricity are produced concern not only the sources of energy generation but also the decentralisation of the energy production system. The emergence of the prosumer, who is both a consumer and producer of electricity, results in tangible economic and environmental benefits. As Robert Mangoyana and Timothy Smith [2011] point out, decentralised energy production systems can promote local development and create local jobs. Ştefan Dragoş Cîrstea et al. [2019] highlight that

bioenergy production has the potential to contribute to climate change mitigation, as well as provide diversification of energy generation in the long term.

Bioenergy companies play a key role in achieving strategic objectives. At the same time, the aspect of transaction costs affects those using biomass and biogas for electricity generation by affecting to them.

## MATERIAL AND METHODS

The main objective of the article is to identify and describe the specifics of transaction costs in a sample biomass combined heat and power plant. The case study company selected for research was Polmos Żyrardów, located in Żyrardów. The company was chosen due to the fact that in 2021 fully implemented an innovative biomass energy production system. To collect primary data, an in-depth interviews were conducted between April and June 2022 using a structured questionnaire. The information was gathered from different representatives of the company top management, traders, legal officers, administration, energy production unit workers, as well as representatives of cooperating companies. In total 7 persons were interviewed in person. The questionnaire consisted of sections that covered the different categories of transaction costs. The survey asked company representative about:

- previous experience in obtaining information on business partners,
- previous legal services for contracts, including the organisation's methods of securing contracts and legal proceedings,
- the processes of negotiating with suppliers, including the intensity and time-consuming nature of efforts to formulate a contract and reach an agreement,
- adherence by contract partners to agreed delivery times, volumes and payment methods,
- factors that may affect the transaction costs incurred,
- background information on the company and the respondent.

## RESULTS

### TRANSACTION COSTS AND THEIR DIVERSITY

NIE's covers a range of issues related to economic life including the theory of the firm, agency theory, or transaction cost theory. The founder of transaction cost theory, Ronald Harry Coase, defined transaction costs as the costs of using the price mechanism and market costs [Coase 1937]. Oliver Williamson, described transaction costs as the comparative costs of planning, adapting, and supervising the fulfilment of tasks in different

management structures [Williamson 1998]. Since Ronald Harry Coase, transaction costs have received many definitions, although there is still no single widely accepted one in the research community. Marian Gorynia and Katarzyna Mroczek [2013] pointed out that the differences in approaches to defining transaction costs are due to the diversity of sectors in the economy and the contracts occurring within them.

An enterprise, having an organisational structure and also functioning within a given sector of the economy, incurs certain transaction costs. In the banking sector, transaction costs are related to the provision of services and the handling of market transactions [Pielichaty 2018]. For example, the transaction costs associated with agri-environmental programs in agriculture are different from those occurring in the automotive industry, due to the nature of the contract between the farmer and the public represented by the government [Rørstad et al. 2007]. At the same time, as Laura McCann et al. [2005] pointed out, the amount of transaction costs in a particular company makes it possible to understand the decisions made within it. Ebel Berghuis and Frank den Butter [2017] argue that lower levels of transaction costs allow more value to be created for an organisation. Ekaterina Nikolaeva and Dmitri Pletnev [2016] emphasise the importance of transaction costs in the enterprise, signaling that those businesses that are unable to reduce their cost levels risk becoming unprofitable. Zhonghua Qu together with Michael Brocklehurst [2003], argues that transaction costs play almost as important a role as production costs in an offshore company. It is worth pointing out, following Dominika Milczarek-Andrzejewska [2012], that the size of transaction costs influences the bargaining power of a company within a given area of the economy. Katarzyna Bentkowska [2020], on the other hand, emphasises that the optimisation of transaction costs within a given company may increase its competitiveness.

One of the basic criteria for the division of transaction costs is the stage of the contracting process. Tomasz Gruszecki [2002] distinguishes in this case:

- pre-transaction costs – *ex-ante*, which relate to activities leading up to the transaction, including, inter alia, the costs of prospecting potential counterparties or preparing a contract proposal,
- post-transaction costs – *ex-post*, which occur during the performance of the terms of the contract, including costs related, inter alia, to the resolution of disputes that arise between the partners to a given transaction.

Ex-ante and ex-post transaction costs are interrelated and constitute an optimisation problem [Kállay et al. 2020]. Hence, as Małgorzata Roszkowska [2019] pointed out, they should always be considered simultaneously. The literature also highlights other possibilities for categorising transaction costs. Determining the place where transaction costs originated, following Olena Kyzenko and Dmytro Kyzenko [2016], the following types are distinguished:

- market transaction costs,
- managerial transaction costs,
- public transaction costs.

Market transaction costs consist of costs arising during the search for and collection of information about a potential business partner, the conduct of negotiations including decisions involving the conclusion of a contract, costs arising during the monitoring of the concluded contract, and costs arising from the enforcement of the rights of one of the contracting parties [Chotkowski 2010]. Managerial transaction costs arise within an entity and its organisational structure, covering both decision-making and implementation processes. In contrast, public transaction costs cover the maintenance of a given political, social, and economic system.

Alcido Elenor Wander [2014], on the other hand, proposes to divide transaction costs into:

- information costs including activities to obtain information on potential transaction partners,
- the costs of negotiation, focusing on the intensity and time-consuming aspect of the negotiation process, including the formulation of the contract and the reaching of an agreement by the contracting parties,
- control and monitor costs relating to the business partners' compliance with the details agreed in the contract, e.g. deadlines, quantities, price, etc.
- compliance costs associated with enforcing changes to the contract during the contract period.

Barbara Zbroińska [2013], on the other hand, distinguished more specific types of transaction costs, pointing to such costs as costs of searching for alternatives, costs of implementing settlements, costs of measuring, costs of contracting, costs of required procedures, costs of specification and protection of property rights, costs of opportunistic behaviour.

The literature on the subject distinguishes several possible breakdowns of transaction costs. Due to the separate nature of individual sectors of the economy, as well as the nature of transactions concluded between entities on the market and transactions taking place within an organisation, it should be indicated that the above approaches to the division of transaction costs may be mutually complementary. It should also be stressed that, depending on the issue undertaken by the researcher, including, among other things, the characteristics of the industry in which the analysed enterprise operates, a given division of transaction costs may be more adequate and expose the nature of the costs arising within the framework of transactions.

Discussing the theoretical approaches to transaction costs, it is important to point out that transactions have their specific characteristics. Oliver Williamson [1998] distinguished the following characteristics of transactions that affect the emergence of costs:

- asset specificity: understood as resources involved that are unique to the transaction in question;
- opportunism: which is the tendency of participants in a transaction to put their objectives before those of the transaction;
- uncertainty: transaction participants can minimise this aspect by building mutual trust;
- frequency of transactions.

It should be emphasised that it is the contracts that play a very important role in the case of transaction costs. It is through the conclusion of agreements – contracts by individual market participants that certain transaction costs are created. A contract is a structured transaction in which its participants take on certain obligations [Kowalska 2005]. Within the contract, specific assets are involved and participants in the transaction may be characterised by both a high degree of uncertainty and opportunism. As highlighted by Robert Dahlstrom and Arne Nygaard [1999], opportunistic behaviour implies an increase in transaction costs, and the way to counteract this is to increase the degree of formalisation of a given transaction. Marek Zygan [2014] points out that the aspect of trust is very important within the internal relations within an organisation, as well as the company's relations with external stakeholders, which counteracts uncertainty.

Bearing in mind that transaction costs are inextricably linked to the transactions that take place and their structured forms – contracts – it is important to point out that these aspects are influenced by institutions, which, as Douglass Cecil North [1990] emphasised, constitute the basic structure of exchange between actors, influencing the dynamics of organisational activities. Ewa Gruszewska [2017] pointed out that the set of institutions existing in a given society forms a systematised set of laws, rules, and norms. At the same time, each sector of the economy has a slightly different system of institutions, influencing the nature of the contracts concluded, and which affect the level of transaction costs in a given economic entity. Ivan Kotliarov [2017] emphasised that the profile of a company's activity also determines the amount of transaction costs incurred. Thus, the characteristics of transactions distinguished by Oliver Williamson that interact with the emergence of transaction costs should be related to the specific characteristics of a given sector of the economy and the system of institutions that shape it, as well as the form, scope, and organisational structure of a given enterprise.

## TRANSACTION COSTS IN THE CASE STUDY COMPANY

Polmos Żyrardów operates as a limited liability company that employs a total of 160 people. Since 2005, the company has been part of the international LVMH consortium, which is one of the world's largest manufacturers of luxury goods. Polmos Żyrardów is a producer of super premium vodkas – Belvedere. The production process is based on the rectification of agricultural spirit supplied by distilleries. The rectification process itself is closely linked to the plant's need for electricity and heat. Therefore, there is a biomass combined heat and power plant (CHP) on the site providing a key energy resource. The energy production unit has been built for three years and was put into use in 2021, since Belvedere was the first distillery to receive a grant from the National Center for Research and Development for research and development in the field of energy. The plant uses biomass in the form of woodchips from local suppliers and biomass – a by-product of agro-food production from the closest surroundings of Żyrardów and business partners. The company utilises by-products from the raw spirit and finished product production for energy purposes. In total 90% are waste wood chips purchased from external companies, and 10% is liquid biomass – stillage coming from our own plant as waste from the production of raw spirit. The resulting steam is used to generate electricity on a small scale – 200 kW – and also powers the spirit distillation process. The entire system, combined with the installation of heat recovery from the rectification process and the boiler house, creates an efficient cogeneration system.

The company cooperates with 17 companies in the supply of the biomass required for electricity generation. It enters into long-term contracts with suppliers lasting more than six months. Biomass, being a strategic fuel, forces the company's managers to constantly seek new suppliers close to the company's headquarters to ensure continuity of production. At the same time, Polmos Żyrardów cooperates with other companies to further develop the technology used, develop energy awareness, and support its business partners in their quest for energy self-sufficiency.

With regard to information procurement costs, in the company, the processes related to obtaining information on potential new business partners are handled by 2 people. On average, it takes employees up to 5 hours to find information about possible business partners, which includes activities related to the first contact and arranging a meeting. It takes between 5 and 10 hours for employees to familiarise themselves with a potential one supplier's offer, including agreeing on initial terms of cooperation. Polmos Żyrardów did not send employees on business trips related to thematic fairs or conferences to obtain information about offers from other companies that could supply biomass to the company's CHP plant. Therefore, the organisation did not incur costs in this aspect.

Taking into account the legal service costs Polmos Żyrardów has legal services for contracts entered into within the organisation. It has been indicated that it is not always necessary to use legal assistance when agreeing on transaction terms. In contracts with business partners, contractual penalties are always applied, amounting to a few percent of the contract value per day, depending on the agreed details with the respective supplier. At the same time, it was pointed out that, in the practice to date, contractual penalties have not been applied and any disputes or problems that arose between the contracting parties were resolved on an ongoing basis.

Having in mind the negotiation costs, for the negotiation processes, it was indicated that between 3 and 6 meetings are needed, both online and at the premises of one of the contracting parties, to establish satisfactory contract provisions for both parties. It was highlighted that meetings take place both at the premises of one of the contracting parties and online. In the case of a negotiation meeting held at the biomass supplier's premises, according to the respondent, between PLN 300 and PLN 600 is spent at a time. To analyse the provisions of the contract, an average of 5 to 10 hours are spent by a Polmos Żyrardów employee. As far as the difficulties during negotiations are concerned, it was pointed out that the provisions concerning contractual penalties used in the organisation, delivery dates, as well as guarantees, and corporate provisions used may be incomprehensible for some partners. At the same time, it was emphasised that it is rather difficult to predict the behaviour of counterparties during negotiations, and also rather difficult to predict them during the contract. At the same time, business partners are unlikely to try to exploit imperfections in concluded agreements. If additional negotiations are necessary to amend the agreed contractual terms, it was pointed out that the discussions take place at the offices of Polmos Żyrardów. It was emphasised that when contract provisions are changed, an average of 1 to 5 hours are needed to analyse them. It was stated that as a result of the negotiations it is rather often possible to reach an agreement to amend the terms of the contract. The changes made most often include delivery dates, as well as the applicable prices in a given contract. It was indicated that a designated staff member spends between 5 and 10 hours per week in ongoing communication with the business partner concerned to coordinate the contract.

With regard to the control and monitoring costs suppliers of biomass to the Polmos Żyrardów CHP plant are located within a radius of 4 to 50 kilometers. It was pointed out that during the contract period there are often problems with the timeliness of deliveries from business partners. It was pointed out that business partners cooperating with the organisation complete missing deliveries within 1 to 3 days. It was indicated that problems with the volume of deliveries were rather rare during the contract period. When shortages were identified, the company waited between 1 and 3 days to make up for the shortfall in supply. Polmos Żyrardów makes payments once a week for deliveries



Table 1. Assessment of the importance of transaction costs in biomass bioenergy production at Polmos Żyrardow

Type of cost	Specificity in the company	Importance*
Information procurement costs	Access to information about biomass suppliers in the region and the company's closest surroundings, as well as transaction conditions, can sometimes be difficult. This increases the time-consuming nature of the activities involved in acquiring information about a potential business partner.	+++
Legal service costs	The biomass CHP plant, being part of a larger company, has a structured way of entering into and analysing contracts. Due to the correct relationship with existing partners, the company did not incur additional costs.	+
Negotiation costs	Negotiation costs are an important element of the total transaction costs of a biomass CHP plant. Formalisation of the contract, as well as building mutual trust between Polmos Żyrardów representatives and suppliers minimise the negative features associated with opportunism and uncertainty.	+++
Control and monitoring costs	Suppliers do not always fully fulfill their contracts. At the same time, any inconvenience caused to the biomass CHP plant is remedied.	++

\* Less +, ++, +++ very

Source: own elaboration

made during the week by the business partner. It was emphasised that during the period of the contracts, differences in price between those agreed in the contract and the invoice prices were rather rare.

Within the factors influencing transaction costs, the respondent indicated that, in his opinion, it takes more than 3 months to train a new employee in the area of biomass CHP plant operation, so that has a similar level of knowledge and skills as the employees already employed. At the same time, the need for additional training for employees in specific technical knowledge was highlighted. The respondent indicated that so far the cooperation between Polmos Żyrardów and its current business partners has been satisfactory.

The results of the analysis and an assessment of the importance of transaction costs in the production of bioenergy from biomass at Polmos Żyrardów are shown in Table 1.

## CONCLUSIONS

In light of the challenges of the energy transition, bioenergy installations make an important contribution to reducing greenhouse gas emissions. In the case of the company surveyed – Polmos Żyrardów, the biomass CHP plant generates electricity, heat, and process steam necessary for production processes. The company can feed surplus electricity into the grid. The company's long-term energy policy, conscious management of energy resources, and care for the environment have made Polmos Żyrardów self-sufficient in terms of energy. The company generates green electricity and heat for its own needs with the possibility of transferring its surplus to external networks. At the same time, the biomass CHP plant incurs certain transaction costs. Information procurement and negotiation costs have the most important role in the transaction cost structure of the Polmos Żyrardów biomass CHP plant. Difficult access to information about biomass suppliers in the region and the company's closest vicinity significantly increases the time-consuming activities involved in acquiring information about a potential business partner. The formalisation of the contract and the building of mutual trust between the participants in the transaction are very important factors in reducing the uncertainty and opportunism of the partners. It was found that the level of transaction costs influences decision-making within the organisation, also translating into the efficiency of operation of the entire biomass CHP plant area.

The current geopolitical situation, the vision of energy poverty, and galloping fuel prices make it necessary to save and consciously manage energy resources. Many companies have surplus heat production that they are unable to manage (or are not aware of) not only for their use but also for the local energy industry. Implementing an Open Energy – District Heating System (locally) into which everyone can feed their surplus energy, especially from heat recovery and waste heat, would probably prove very beneficial for many businesses. Polmos Żyrardów reaches for its waste heat and wants to transform it into a different type of energy or with higher potential and feed it into the local grid. The prerequisite for both parties to benefit from such an action, however, is cooperation. The basic limitation of the presented research is its contributing nature due to the selection of only one research object and the short period of analysis. Nonetheless, the topic of bioenergy enterprises is still poorly recognised in empirical research and literature. Hence, it requires further exploration, particularly about their scope, scale, and level.

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## SPECYFIKA KOSZTÓW TRANSAKCYJNYCH W PRZEDSIĘBIORSTWACH WYTWARZAJĄCYCH BIOENERGIĘ – STUDIUM PRZYPADKU

Słowa kluczowe: koszty transakcyjne, nowa ekonomia instytucjonalna, elektrociepłownia biomasowa, bioenergia, biogospodarka

### ABSTRAKT

Jednym z ogniw współczesnego sektora energetycznego są przedsiębiorstwa wytwarzające bioenergię. W celu wytworzenia zielonej energii elektrycznej podmioty gospodarcze prowadzą wymianę rynkową, ponosząc koszty transakcyjne. Głównym celem artykułu jest identyfikacja i opisanie specyfiki kosztów transakcyjnych w przykładowej elektrociepłowni biomasowej. Firmą, która posłużyła do opracowania studium przypadku była spółka Polmos Żyrardów. W celu zebrania danych pierwotnych wykonano sondaż diagnostyczny z wykorzystaniem kwestionariusza ankiety. Stwierdzono, że w strukturze kosztów transakcyjnych elektrociepłowni na biomasę największe znaczenie mają koszty pozyskania informacji i koszty negocjacji. Podkreślono istotność dostępu do informacji o dostawcach biomasy w regionie i najbliższym otoczeniu firmy. Czynnikiem ten znacząco zwiększa czasochłonność czynności składających się na zdobycie informacji o potencjalnym partnerze biznesowym. Zaakcentowany został aspekt formalizacji kontraktu oraz budowania wzajemnego zaufania pomiędzy uczestnikami transakcji, jako elementów minimalizujących niepewność i oportunizm stron. Stwierdzono, że poziom kosztów transakcyjnych wpływa na podejmowane decyzje w obrębie organizacji, przekładając się również na efektywność funkcjonowania całego obszaru elektrociepłowni biomasowej. Świadome gospodarowanie zasobami energetycznymi oraz dbałość o środowisko naturalne sprawiło, że firma Polmos Żyrardów stała się samowystarczalna energetycznie. W obliczu wyzwań transformacji energetycznej instalacje wytwarzające bioenergię, stanowią istotny wkład w ograniczanie emisji gazów cieplarnianych i budowę biogospodarki cyrkularnej.

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