

# Pro-environmental and Pro-Social Activities of a Functional Energy Company on the Polish Energy Market

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*Abstract:* - Protecting the environment and improving the quality of life of societies has become an important goal for modern manufacturing companies and societies. Companies in the energy sector, whose business activities have a negative impact on the state of the environment and society, also contribute to achieving this goal. This article presents the activities of a Polish energy company aimed at reducing or completely eliminating its negative impact on the environment and local society. The results of the own research present the opinions of the local community on the ways in which the company communicates, the actions taken to reduce the negative activities of the company. The aim of the study is to determine the level of development of sustainable pro-environmental management in a Polish energy production enterprise. An indicator for the development of sustainable pro-environmental management for the energy company was also calculated. The survey was conducted on a random sample of 300 people. The response rate was 31%. Respondents were residents of the province in which the energy company is located

*Key-Words:* natural environment, society, energy company, sustainable environmental management, sustainable development

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## 1 Introduction

Economic development caused by technical and technological progress, mass production and increased consumption as well as the growth of the world's population contribute to the negative impact of enterprises on the Earth's ecosystem [1-2]. The progressive degradation of the natural environment and increasing social problems are the result of human activity. Industrial organisations use the Earth's natural resources to produce all kinds of goods to meet the needs of consumers. Excessive exploitation of natural resources, increased consumption of water, energy and fuels, and the emission of harmful gases and substances to the atmosphere accompanying production processes is a common activity of many production companies, including entities involved in energy production in Poland [3-4]. Much of the environmental pollution is related to the activities of companies involved in the extraction of crude oil, coal, natural gas, oil refining and energy production [5-7].

The demand for electricity results not only from the economic development of Poland, but also from the progressive consumerism of Polish society. In order to meet the demand for energy, energy

companies make efforts to meet market expectations. In order to meet the existing environmental and social problems, more attention should be paid to sustainable pro-environmental management in enterprises involved in the production and distribution of electricity [8]. The dominant objects in the structure of electricity generation in Poland are power plants and combined heat and power plants that use hard coal and lignite to produce energy. However, due to the need for Poland to meet the objectives of the EU climate policy, the segment of producers of electricity and heat from renewable energy sources (RES) has developed dynamically in recent years. Their use significantly minimizes the negative impact of conventional energy on the natural environment, mainly by reducing the emission of carbon dioxide, dust and sulphur and nitrogen compounds [9].

## 2 The Concept of Sustainable Environmental Management

An important factor influencing the sustainable economic activity of heavy industry enterprises, including power plants in Poland, is the attitude of

managers responsible for the functioning of the organisation. The middle and high-level employees create organisational conduct of the company focused on environmental protection, and therefore their attitude determines the implementation of economic activity based on the principles of sustainable development. Environmentally safe and pro-social activity of an energy company is the basic idea on which a group of highly qualified employees who understand and apply the principles of sustainable development bases its operations. It is the company's staff who create practices aimed at improving the environmental performance of the organisation. The pro-environmental activity of the company based on sustainable practices is possible only if the employees of higher and lower level have knowledge and skills in the implementation of the concept of sustainable development. For this reason, the third management function, i.e. motivating and managing personnel, is increasingly seen as a driving force for the sustainable development of modern organisations [10-15].

Sustainable production management includes ecological activities aimed at minimising the negative impact of the organisation on the environment [16]. The area of sustainable management also includes the issue of improving the quality of life of societies. Sustainable management of production activities requires reorientation of the current management method, including planning, organising, directing and motivating staff as well as controlling production activities in the enterprise. Therefore, responsible pro-environmental management forces the adjustment of the indicated executive functions to the principles of sustainable development, which in turn will contribute to the transformation of an energy company into a sustainable economic organisation [17]. Conducting enterprises in accordance with the principles of sustainable development aims to provide development opportunities for future generations, and even increase these opportunities for development [18]. Management of environmental innovations is based on the innovation business strategy that must respect the business strategy, meaning the company's long-term missions, visions and targets [19].

Effective management of a sustainable enterprise, including staff at all levels of employment, requires the implementation of the above-mentioned management functions and their appropriate adaptation to individual needs and conditions of a given enterprise [20]. An important resource deciding on responsible pro-ecological management is equipping the company with

sustainable industrial technologies that allow to reduce the emissions of gases, dust, harmful gases, industrial wastewater and production waste that are destructive to the natural environment [21-22]. In addition, the company must be equipped with machines and devices with which specific goods will be produced [23]. However, taking into account the scale of enterprises, it should be indicated that activities focused on sustainable management are characteristic of large enterprises rather than those of the SME group [24-25].

The managers responsible for activities leading to the achievement of the company's financial goals face a difficult task. The difficulty lies in the balancing between the economic goals of the enterprise and social and environmental goals. The triad of goals presented in the literature as a triple bottom line [26-27] is not a commonly dominant business model in manufacturing companies due to the need to maintain a balance between the three indicated areas [28-29].

High-level employees making strategic decisions in the enterprise should be aware of the importance of adjusting the management of the enterprise to the requirements of sustainable development [30-32]. The method and degree of implementation of sustainable management of production activities will have a significant impact on the functioning and success of the company on the market in the changing economic environment of the organisation [33-35].

### 3 Materials and Methods

The research presented in this publication is based on a company operating in the energy sector. The company is part of Polish Energy Group (PEG) and generates over 20% of electricity in Poland. The power plant is also the largest lignite-fired power plant in Europe, which plays a very important, stabilising role in the Polish power system.

The aim of the study was to determine the level of development of sustainable pro-environmental management implemented in the examined energy company. In addition to the research goal contained and outlining the ways to achieve it by collecting secondary and primary data, the research the research hypotheses was also included:

*H1: Energy company is taking steps to implement sustainable management of environmental activities.*

*H2: Sustainable management undertakings for environmental activities are not fully implemented and need to be improved.*

The following research problems were identified in the course of the analyse:

- *what is the level of implementation of environmentally friendly practices in the enterprise?*
- *how effective is the policy of public communication of pro-environmental actions implemented in the enterprise?*

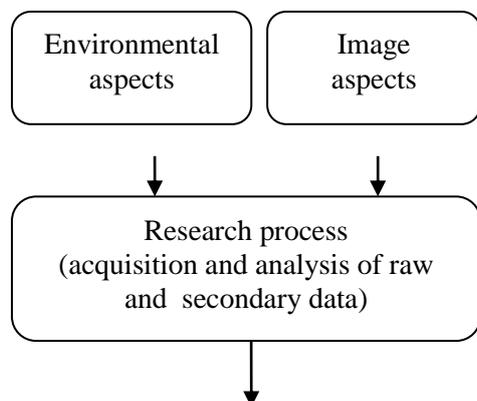
The research problems defined in this way indicate a two-stage course of research. The first stage concerned the environmental area. An attempt was made to assess the degree of implementation of practices aimed at environmental protection. This section focuses on the following:

- the impact of the power plant's operations on the natural environment,
- activity of the power plant in the field of environmental protection,
- perception of the power plant as an innovative enterprise whose economic activity includes environmental protection.

The second stage of the research concerned the policy of effective communication of the company's activity in the field of environmental protection to the social environment. The second stage of the research covered issues related to:

- respondents' knowledge about the activities undertaken by the power plant in the field of environmental protection,
- evaluation of the effectiveness of informing the public about pro-environmental activities undertaken by the enterprise,
- assessment of the power plant's image-building policy among the respondents.

Taking into account the assumptions made regarding the two-stage research course, Figure 1 presents a conceptual research scheme.



**Sustainable pro-environmental management**

Fig.

Source: Own study

CAWI (Computer Assisted Web Interview) method was used in the conducted research. The respondent was asked to fill in a research questionnaire in an electronic form included in a web application. The presented method has many advantages. The use of the CAWI method makes it possible to carry out research on very large, targeted samples in a short time and at relatively low costs. In addition, the advantage of this method is the anonymity of the respondent, and thus the freedom to answer, for example, questions about the amount of earnings. The overall goal of the method used was to get to know the facts and capture as many details as possible in relation to the questions posed.

A questionnaire containing an ordered list of questions was the tool applied to conduct the research. It included questions about environmental issues implemented in the surveyed company from the energy sector. During constructing the research tool, the determination of the measurement scale was of substantial importance.

The group of samples used in the study was random and included 300 people, which means that each person had the same chance to be chosen. 94 respondents from the voivodeship where the energy company is located took part in the study. The research was conducted from January to March 2021.

In addition to the primary research carried out using the CAWI method, the study also used secondary data obtained from the resources of an energy company

**4 Research Results**

The analysed energy company undertakes activities in the field of environmental protection. The obtained secondary data [36], shows that the company limits, among others, the emission of dust, sulphur dioxide, carbon dioxide and nitrogen oxides.

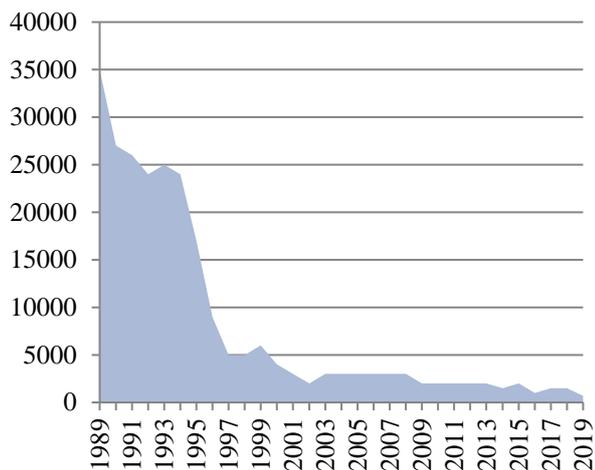


Fig. 2: Reduction of dust emissions in the period 1989-2019[Mg]

Source: Company's internal materials

Dust emission was reduced by 98% during the entire activity period from 35,000 tons of dust in 1989 to the level of 700 tons in 2019.

The power plant is also taking steps to reduce sulphur dioxide emissions. For this purpose, the company applied an innovative method of lime-gypsum flue gas desulphurization, which is 95% effective. In order to increase the efficiency of the flue gas desulphurization process, more FGD installations are currently modernized to achieve SO<sub>2</sub> emissions below 130 mg/Nm<sup>3</sup>. Figure 3 shows the level of SO<sub>2</sub> emission reduction in 1989-2019.

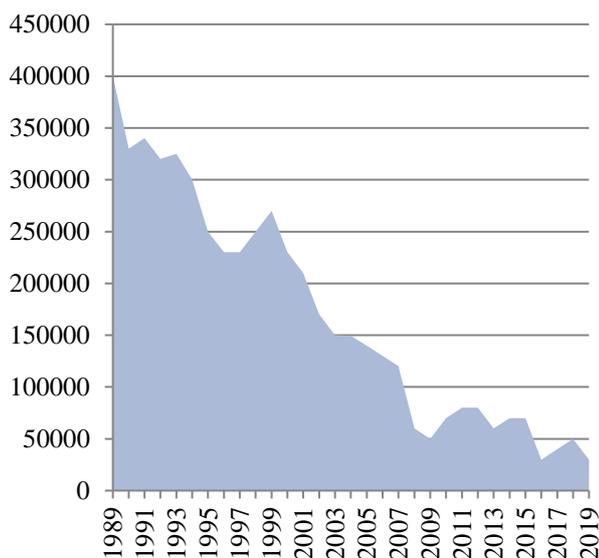


Fig. 3: Reduction of SO<sub>2</sub> emissions in 1989 - 2019 [Mg]

Source: Company's internal materials

Thanks to the pro-ecological awareness and determination of the company's managers, the power plant reduced SO<sub>2</sub> emissions by 93% from the level of 400,000 tons in 1989 to the level of 30,000 tons in 2019.

The analysed energy company is a significant point emitter of CO<sub>2</sub> greenhouse gases. This is due to the fact that it is the largest organisation in Poland and one of the largest in the world that produces electricity based on lignite. As a result, the emission cumulated in one place reaches significant absolute values. Despite the impact on the natural environment, the power plant carries out a number of modernization and investment activities aimed at improving the efficiency of production and reducing the energy consumption of production processes and own needs, thus reducing CO<sub>2</sub> emissions.

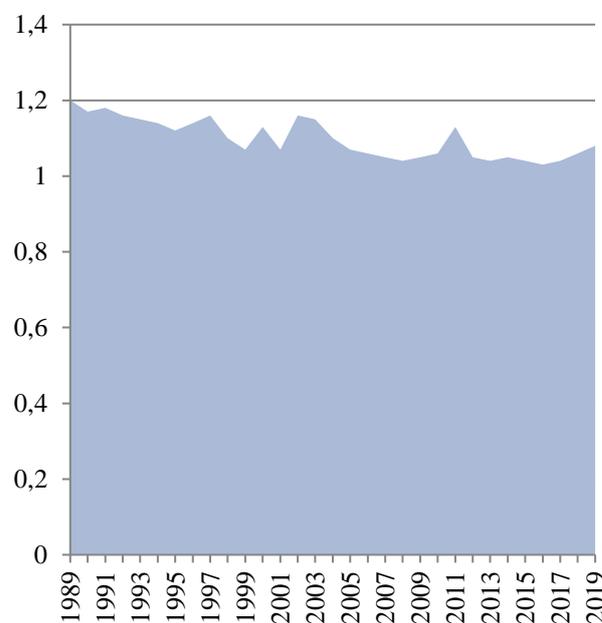


Fig. 4 Reduction of CO<sub>2</sub>emissions in 1989 - 2019 [Mg CO<sub>2</sub> / MWh]

Source: Company's internal materials

In the period from 1989 to 2019, the energy company significantly reduced the level of CO<sub>2</sub> emissions per unit of energy produced - from the level of approximately 1.20 t CO<sub>2</sub>/MWh to the level of approximately 1.08 t CO<sub>2</sub>/MWh. Thus, in the period 1989-2019, it was possible to reduce the unit CO<sub>2</sub>/MWh emission by as much as 10%. The scale of emissions per unit of energy produced in the enterprise is not at all higher, but comparable or even better, compared to European lignite-fired power plants.

Equally important as reducing sulphur dioxide emissions is reducing the emission of nitrogen

oxides (NOx). It is a group of compounds that are a product of combustion that is extremely difficult to eliminate from the exhaust gas. In 1992, in order to reduce the emission of nitrogen compounds, the primary methods of reducing NOx emissions were introduced in the power plant, consisting in the optimization of the combustion process. Automatic control systems and elements of technological lines responsible for the implementation of optimized boiler operating parameters were also modernized. As a result of these activities, NOx was reduced by approx. 40% compared to 1992.

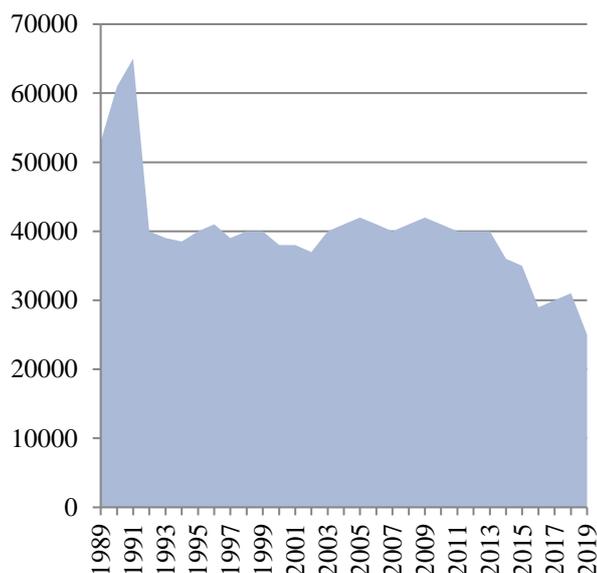


Fig. 5: NOx emission reduction in 1989-2019 [Mg]  
 Source: Company's internal materials

As a result of the carried-out pro-environmental measures, the emission of nitrogen compounds in the power plant was reduced from 65,000 tons of nitrogen compounds in 1991 to 25,000 tons in 2019. Currently, in order to increase the reduction of NOx emissions (to a level below 175 mg/ Nm<sup>3</sup>), boilers are successively equipped with highly efficient denitrification installations using the SNCR method reducing emissions thanks to urea dosing.

The research conducted among the inhabitants of the voivodeship where the energy company is located provided empirical data enabling the determination of the degree of sustainable pro-environmental management. Figure 6 presents the results of the research in relation to the issue of activities focused on environmental protection.

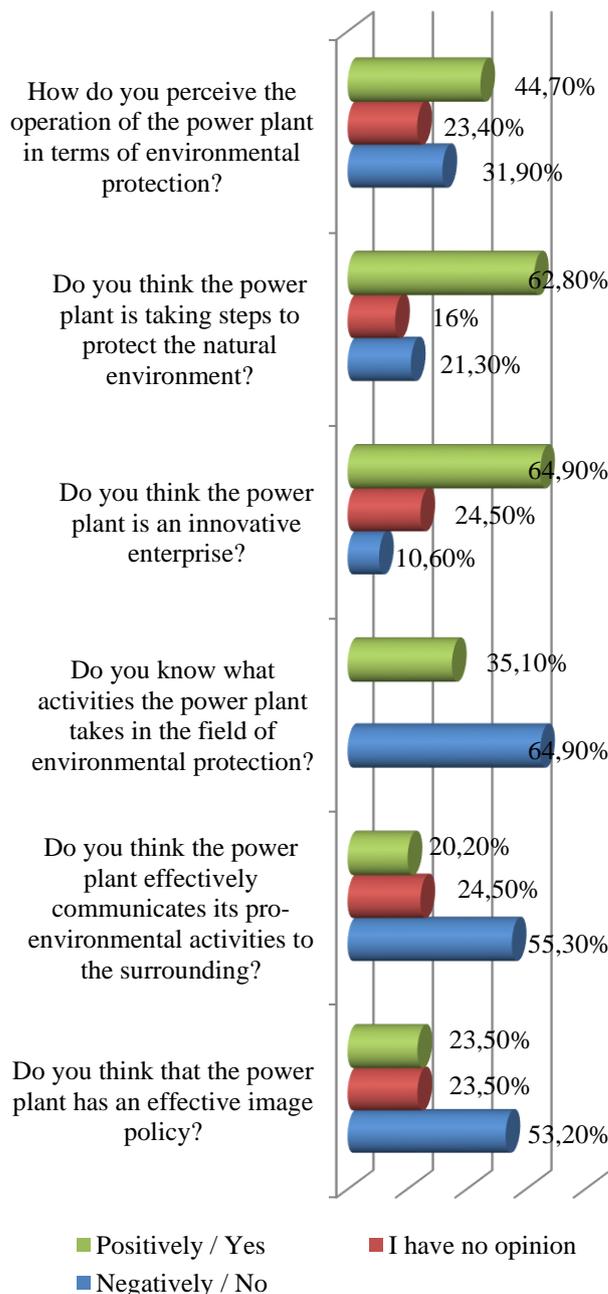


Fig. 6: Respondents' opinions on the company's environmental protection projects  
 Source: Own study

Referring to the data presented in the Figure 6, it can be indicated that the respondents perceive the activities of the power plant in a positive way in terms of environmental protection. 44.7% of the respondents expressed a positive opinion. 31.9% of the respondents expressed a negative opinion on this

subject. In turn, 23.4% did not take a clear position on this issue.

The research questionnaire also included a question about activities undertaken by the company to protect the natural environment. The responses obtained prove that the enterprise undertakes such activities - as indicated by 62.8% of the respondents. On the other hand, 21.3% of the respondents claim that the enterprise does not undertake such activities. The remaining respondents, i.e. 16%, do not have an opinion on this subject.

The question concerning the perception of an enterprise as an innovative organisation was of significant importance in the conducted research. An affirmative answer was indicated by 64.9% of the respondents. 10.6% of the respondents had the opposite opinion, while the remaining respondents 24.5% were unable to give an unambiguous answer. The part of research questionnaire devoted to the issue of the policy of effective communication of the company's activity in the field of environmental protection to the social environment includes a question about the respondents' knowledge about the activities undertaken by the company in the field of environmental protection. Only 35.1% of the respondents know what activities are undertaken by the organisation, while 64.9% of the respondents do not have such knowledge.

In terms of communication to the social environment of pro-environmental activities undertaken by the enterprise, the results of the research show that 55.3% of respondents expresses a negative opinion on the effectiveness of communicating such activities. 20.2% of the respondents have a different opinion. The remaining respondents - 24.5% did not have an opinion on this subject.

The image-related aspects of the company complemented the research. The obtained research results prove that only 23.5% positively assess the company's image policy. 53.2% of the respondents have a different opinion. The remaining respondents, constituting 23.5%, were not able to give a clear answer.

In order to assess the degree of sustainable pro-environmental management, a development index based on the distance from the template was proposed. Let the object  $X_i$  described by the vector  $(x_{i1}, x_{i2}, x_{i3}, \dots, x_{in})$ , be evaluated, the pattern will be  $X^*_i(x^*_{i1}, x^*_{i2}, x^*_{i3}, \dots, x^*_{in})$ , and the anti-pattern  $X^-_i(x^-_{i1}, x^-_{i2}, x^-_{i3}, \dots, x^-_{in})$ . The development index of an object is determined from the formula:

$$m_i = 1 - d^*_i / d^-_i \tag{1}$$

where:

$d^*_i$  is the Euclidean distance of the examined object  $X_i$  from the pattern  $X^*_i$ ,

$d^-_i$  is the Euclidean distance of the pattern  $X^*_i$  from the anti-pattern  $X^-_i$ .

The development index (1) is in the range [0; 1] and the higher it is, the higher the degree of development of a given object.

Based on the conducted research, indicators for the development of sustainable pro-environmental management for an energy company were determined from the formula (1). The indicators are presented in Table 1.

Table 1. Indicators of the development of sustainable pro-environmental management for an energy company

<b>X1</b> The impact of the power plant's operations on the natural environment	0,44	<b>X2</b> Assessment of power plant activity in the field of environmental protection	0,62	<b>X3</b> Perception of the power plant as an innovative company focused on environmental protection	0,64	<b>X4</b> The respondents' knowledge about the activities undertaken by the power plant in the field of environmental protection	0,35	<b>X5</b> Assessment of the effectiveness of informing the public about activities related to environmental protection	0,20	<b>X6</b> Assessment of the image policy of the power plant	0,23
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Source: Own study

The table presents the determined values of the company's general assessment in terms of the use of sustainable pro-environmental management. For the examined enterprise, the indicators X1, X2, X3 representing the environmental area have an average value of 0.56. On the other hand, the indicators X4, X5, X6 relate to the policy of effective communication to the social environment of the company's activity in the field of environmental protection and assume an average value of 0.26. Additionally, the average value of Y was determined for the assessment of the examined enterprise.

Table 2. Average value of the Y indicator assessing the elements X1, X2,... X6 of sustainable pro-environmental management

Indicator	X1	X2	X3	X4	X5	X6	Y
Average value of indicator	0,44	0,62	0,64	0,35	0,20	0,23	<b>0,41</b>

Source: Own study

The presented values of the X1, X2, ... X6 indicators inform to what extent individual factors contribute to the implementation of sustainable pro-environmental management in an energy company. On the basis of the values of the X1, X2,... X6 indicators, the average value of the Y indicator was calculated, which is 0.41. This means that sustainable pro-environmental management in the examined enterprise is quite far from the ideal which amounts to 1.

## 5 Discussion

The article presents a case study of responsible environmental management on the example of a Polish company that produces electricity. The results of the research show that the company is making efforts to reduce the negative impact of its activities on the natural environment. The analysis of the collected materials proves that the company systematically reduces the emission of harmful substances into the atmosphere, thus achieving improved environmental indicators. From the beginning of the 1990s to 2019, the power plant reduced sulphur dioxide emissions by 93%, nitrogen oxides by 55% and dust emissions by 98%.

The results of the conducted research show that the organisation understands the need to implement the concept of sustainable environmental management in order to achieve environmental neutrality. The certificates held by the organisation, such as: ISO 9001: 2015, ISO 3834-2: 2007 or ISO / IEC 17025: 2005, indicate that the company is well prepared to conduct pro-environmental activities.

## 6 Conclusion

Sustainable environmental management development indicators were carried out for the purpose of assessing the functioning of this management method in an energy production company, which enabled the effective identification of areas requiring improvement and at the same time indicating positive trends requiring further implementation. Thanks to the conducted research,

it can be concluded that the research hypotheses was confirmed.

However, taking into account the image-related aspects of the company, it can be said that the company should reflect on this area of management. The results of the conducted research are not optimistic. The indicators concerning the company's communication policy with the social environment remain at a very low level. This area of image management requires significant improvement and refinement. Aspects such as increasing the trust of residents, building positive relations with the environment, or improving the image of the company in the awareness of the public are as important as pro-environmental activities.

The subject matter of the study undertaken does not fully exhaust the problem under discussion. For this reason, there is a need for further research in both theoretical and empirical aspects.

The article may be a support for other heavy industry enterprises wishing to implement the concept of sustainable environmental management.

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