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# Green-strategic analysis of the use of pellets from selected wood and waste materials for heating purposes

## *Ekologiczno-strategiczna analiza wykorzystania pelletów z wybranych materiałów drzewnych i odpadowych na cele grzewcze*

*Abstract*

The paper presents the possibilities of using wood, waste and energy plant biomass as a material for the production of fuels in the form of pellets. Pine sawdust, energy willow chips, sunflower husk and corn straw were analysed. The materials were pelletized. Selected physicochemical properties and elemental composition were determined. It has been shown that the best alternative to replace wood pellets can be pellets made from both energy willow and sunflower husks. Sunflower husk pellets were selected as the most promising fuel and subjected to a strategic analysis using the SWOT/TOWS method. Based on the analyses, it was shown that sunflower husk pellets, due to their competitive price, appropriate physicochemical parameters and wide availability, can be successfully used as a fuel in boilers adapted to burn wood pellets and more.

*Keywords:*
biomass pellets, waste, alternative fuels, energy plants, SWOT/TOWS analysis

*Streszczenie*

W pracy przedstawiono możliwości wykorzystania biomasy drzewnej, odpadowej i pochodzącej z upraw energetycznych jako materiału do produkcji paliw w formie pelletów. Analizie poddano trociny sosnowe, zrębki wierzby energetycznej, łuskę słonecznika i słomę kukurydzianą. Materiały poddano procesowi pelletyzacji. Określono ich wybrane właściwości fizykochemiczne i skład elementarny. Wykazano, że najlepszą alternatywą dla pelletu z drewna mogą być pellety zarówno wytworzone z wierzby energetycznej, jak i łuski słonecznika. Jako najlepiej rokujące paliwo wytypowano pellet z łuski słonecznika i poddano go analizie strategicznej z wykorzystaniem metody SWOT/TOWS. Wykazano, że pellet z łuski słonecznika ze względu na konkurencyjną cenę, odpowiednie parametry fizykochemiczne i szeroką dostępność może być z powodzeniem stosowany jako paliwo w kotłach przystosowanych do spalania pelletów drzewnych i nie tylko.

*Słowa kluczowe:*
pellety z biomasy, odpady, paliwo odnawialne, analiza SWOT/TOWS

JEL: Q16, Q44, Q55

## Introduction

Thermal energy is obtained from fossil fuels in most countries of the European Union. The combustion of fuels such as coal, oil and natural gas causes significant emissions, including $CO_2$, which requires constant restrictions due to increasingly higher environmental standards (IPCC, 2018; Mateus et al., 2023; Sulaiman et al., 2020; M. Wang et al., 2015). According to the European Commission's Energy Strategy for 2020–2030, the priority is to reduce greenhouse gas emissions by 40%, increase the share of renewable energy sources to at least 27%, continuously increase energy efficiency and ensure competitive, affordable and secure energy. The use of biomass is one of the key solutions proposed by the European Commission in order to reduce dependence on imported oil and petroleum products and, thus, improve security of energy supply in the long term (European Biofuels Technology Platform, 2008).

The main advantage of biomass is its production in the process of photosynthesis, in which carbohydrates necessary for growth are obtained from $CO_2$ and $H_2O$. In this way, the $CO_2$ obtained during combustion is equivalent to the amount necessary to produce biomass, resulting in net zero $CO_2$ emissions (Cherubini et al., 2011; Possell et al., 2005). Replacing fossil fuels with biomass is therefore one of the best solutions to reduce greenhouse gas emissions, as well as $SO_2$ and $NO_x$ (Obaidullah et al., 2012; Ozgen et al., 2021; L. Wang et al., 2012). Compared to fossil fuels, biomass is widely available, cheap and easier to prepare for direct use as a fuel (Bala-Litwiniak, 2020; Sulaiman et al., 2020; Variny et al., 2021). Biomass becomes biofuel as a result of mechanical, thermal or chemical processing. The properties of biomass are variable and have a significant impact on the biofuels produced from it. Therefore, the physicochemical properties of biofuels depend to a large extent on the chemical composition of biomass, i.e. both the content of combustible and mineral parts, as well as the content of volatile matter and ash and its composition. The origin of biomass is very diverse, ranging from field crop production, through biomass of animal origin, to that of municipal origin. Biomass can also come from wood waste in forestry, wood and pulp and paper industries (Amjith & Bavanish, 2022; Bilgili et al., 2017). Industries such as food and agriculture can also generate large amounts of waste which, if properly prepared, could be used for heating purposes (Bala-Litwiniak & Musiał, 2022; Kougioumtzis et al., 2021; Theerarattananoon et al., 2011). We also should not forget about plants grown typically for energy purposes. Such plants are characterized by high calorific value, high dry matter gain during the growing season and, at the same time, low soil and climatic requirements. Intensive research has been carried out on the selection of this type of plants for many years (Baker et al., 2022; Mckendry, 2002; Von Cossel et al., 2022). The group of energy crops suitable for the production of heat energy by combustion includes, among others, flagelliform willow, Pennsylvania mallow, Chinese grass, tuberous sunflower and common reed (Borkowska & Molas, 2012; Bridgeman et al., 2008; Long et al., 2016; Stolarski et al., 2019).

Therefore, biomass can be divided into three groups by origin: wood biomass, waste biomass and biomass from energy crops. The VAT rate in Poland is 23% for wood fuels, 8% for non-wood pellets and 7% for pellets from energy crops. Therefore, the production of pellets from raw materials other than wood seems to be the best economical solution. A reasonable solution may be to produce pellets from agricultural waste, however, the chemical composition and physicochemical properties of this type of waste may have an adverse effect on the composition of flue gases, as well as on the operation and maintenance of the boiler (Bala-Litwiniak & Zajemska, 2020; Hardy et al., 2012; Pawlak-Kruczek et al., 2020).

The aim of the study was to analyse the suitability of selected wood and waste raw materials for the production of pellets for heating purposes as an alternative to fossil fuels. Therefore, an green-strategic analysis was carried out for pellets produced from wood, waste and energy biomass. One type of wood biomass material (pine) and energy crop material (energy willow) as well as two materials from waste biomass (corn straw, sunflower husk) were selected as materials representative for each group. Pellets were produced from the studied raw materials. Their selected physicochemical properties were determined in terms of their usefulness as a fuel, and an analysis of the composition of flue gases was carried out. Based on the results of this research, a strategic analysis was carried out for the most promising fuel, using the SWOT/TOWS method.

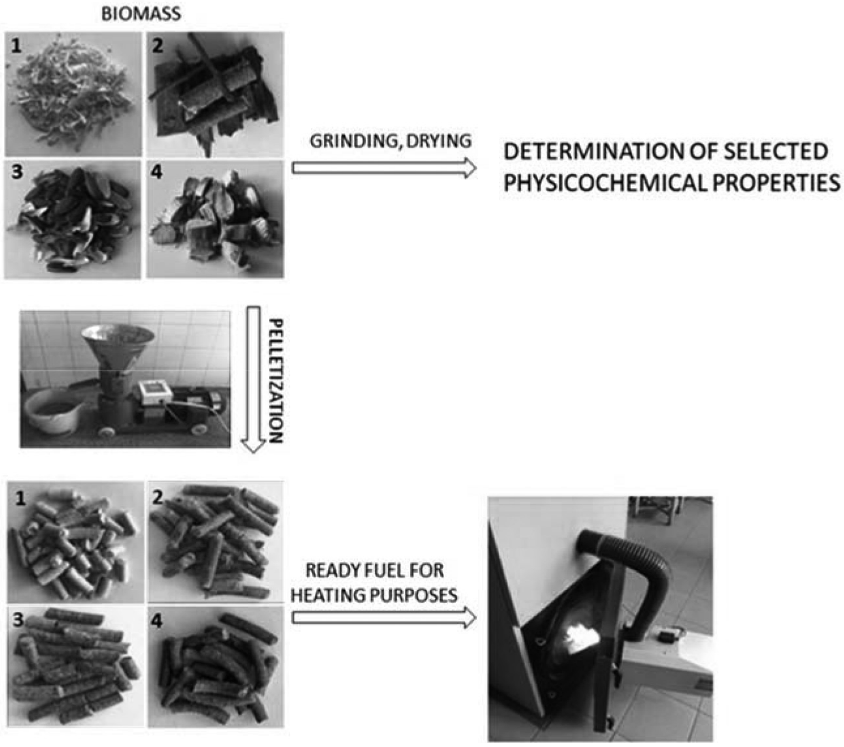
## Materials and methods

Four types of biomass were tested: pine sawdust, energy willow chips, sunflower husk and corn straw. Pre-dried, cleaned and shredded materials were pelletized. The method of management of the analysed types of biomass is shown in Figure 1.

Pellets were produced using a KL.ZLSP pellet mill with a power of 7.5 kW, production efficiency of 140–300 kg/h and die rotation speed of 200–300 rpm. In order to determine the selected physicochemical properties (moisture content, ash content, calorific value, CHN), the pellets were crushed in a blade mill using a sieve matrix with mesh size of up to 1 mm.

The moisture content was determined based on the loss in mass of 1.00 g of the sample after drying at 105 ± 5°C to a constant weight in accordance with EN ISO 18134–3:2015. The ash contents were determined by burning 1 g of each tested biomass fuel in a muffle furnace at 250 ± 10°C for 50 minutes, and then at 550 ± 10°C for 4 hours, in accordance with EN ISO 18122:2015. The calorific value of the tested pellets was determined using the KL-12Mn

Figure 1
Diagram of the processing of selected types of biomass into heating fuel in the form of pellets, where: 1 – pine, 2 – energy willow, 3 – sunflower husk, 4 – corn straw




Source: own elaboration.

calorimeter (PRECISION-BIT, Poland) in accordance with EN 14918:2009.

The content of C, H, N for all the four types of pellets was determined using an elemental analyser (Truspec CHN628 LECO, USA).

## SWOT analysis

The SWOT analysis is defined as a comprehensive method used to study the organization's environment and analyse its interior. The name SWOT comes from the first letters of the words: strengths, weaknesses, opportunities and threats. The concept of force field analysis, developed by Lewin in the 1950s was the scientific and methodological inspiration for the development of the assumptions of the SWOT analysis (Almutairi et al., 2021). Today, it can undoubtedly be considered one of the best-known and most frequently used strategic planning tools (Helms & Nixon, 2010). Some authors, however, refuse to allow the SWOT analysis the status of the method, treating it as a kind of analytical procedure combining various ways of collecting research material, which organizes their application and enables transparent presentation of their results. A characteristic feature of this procedure is heterogeneity expressed in the existence of many mutations existing in theory and practice. They differ in the operationalization approach, but in all cases the idea has been unchanged for years. The SWOT procedure consists in a detailed identification and, then, classification of all phenomena and states of economic categories affecting the development of a given organization. Two criteria apply. The first is the type of actual effect or potential impact of a given factor on the organization, while the second is the broadly understood location of the factor in relation to the organization (Namugenyi et al., 2019). The use of these two criteria allows to distinguish four groups of factors: strengths, weaknesses, opportunities and threats. It is assumed that the identification of strengths and weaknesses concerns the situation within the organization. On the other hand, the search for opportunities and threats is an analysis of external factors. The results of research based on this method are most often summarized in a table in which the first row contains strengths and weaknesses, and in the second – opportunities and threats (Yamagishi et al., 2021).

## Results

Selected physicochemical properties and elemental composition of the tested pellets are presented in Table 1.

Pellets made from all the four raw materials meet the EN-ISO-17225-2:2014 standard in terms of bulk dimensions and moisture content. When it comes to pellets made from waste biomass, too high ash content and low bulk density and calorific value for pellets made from corn straw can be observed. Pellets made from sunflower husk have much better parameters and, together with energy willow pellets, meet the standard for each of the analysed parameters. Although pine pellets have the highest calorific value (17.55 MJ/kg), they contain the most nitrogen compared to all the four types of biofuels, so it does not meet the standard. Sunflower husk pellets have a slightly lower calorific value (17.35 MJ/kg). Based on the literature (Demirbas, 2004; Vassilev et al., 2010), it was observed that the sulphur content in all the four types of biomass does not exceed 0.1%. The same applies to the chlorine content: up to 0.03% in willow and pine and up to 0.1% for sunflower husk. Corn straw has the highest chlorine content (0.64%). In addition, in earlier articles, attempts were made to burn the analysed pellets in a boiler adapted to biomass combustion (Bala-Litwiniak & Musiał, 2022; Bala-Litwiniak & Zajemska, 2020). The research carried out in these articles shows that, due to the too low calorific value of corn straw pellets, it is not possible to burn them directly in this type of boilers. Burning sunflower husk pellets is no different from burning pine pellets and even contributes to lower $NO_X$ emissions.

In view of the above, it can therefore be concluded that pellets made from sunflower husk can be a cheap alternative to commonly used wood fuels, while meeting the EN ISO-17225-2:2014 standard and emitting less $NO_X$ during combustion. In the further part of the article, a SWOT/TOWS analysis was carried out for sunflower husk pellets.

In order to carry out the SWOT/TOWS analysis for sunflower husk pellets, the most important features of strategic importance were selected. Key areas were identified and adapted to external factors (opportunities, threats) and internal factors (strengths and weaknesses). Each of these four characteristics was given a weight according to which the assessment was made. The sum of the weights within each category must be equal to 1.0 (Table 2).

The next stage of the SWOT/TOWS analysis was the formulation of the key questions:

1) Will the strengths allow to take advantage of the opportunities?
2) Will the strengths overcome the threats?
3) Will the weaknesses not allow the opportunity to be seized?
4) Will the weaknesses strengthen the impact of the threats?
5) Will the opportunities increase the strengths?
6) Will threats weaken the strengths?
7) Will the opportunities overcome the weaknesses?
8) Will the threats exacerbate the weaknesses?

In order to answer the above questions, eight cross-tables were drawn up, containing specific features, their weights, the number of interactions and the Product of W&I. If there is

Table 1

Comparison of the selected physicochemical properties and the elemental composition for pellets made of pine, willow, sunflower husk and corn straw

| Parameter | Pine | Energy willow | Sunflower husk | Corn straw | EN ISO-17225-2:2014 |
|---|---|---|---|---|---|
| Moisture [%] | 4.65 | 5.35 | 5.42 | 5.45 | ≤10 |
| Ash [%] | 0.56 | 1.25 | 2.45 | 6.93 | ≤3 |
| Calorific val. [MJ/kg] | 17.55 | 16.85 | 17.35 | 15.38 | ≥16.5 |
| Bulk density [kg/m$^3$] | 640 | 620 | 635 | 525 | ≥600 |
| Length [mm] | 5–20 | 5–20 | 5–20 | 5–20 | 3.15–40.00 |
| Diameter [mm] | 6 | 6 | 6 | 6 | 6 |
| C [%] | 46.2 | 48.3 | 48.1 | 46.3 | – |
| H [%] | 6.3 | 6.0 | 6.5 | 6.2 | – |
| N [%] | 3.5 | 0.8 | 0.7 | 0.9 | ≤1 |
| O (bal.) [%] | 38.79 | 38.3 | 36,83 | 34.22 | – |

Source: own elaboration.

a dependency, the value is "1", if not – "0". The number of interactions means the sum of the instances of dependencies, while the Product of W&I means multiplying these variables and entering the result in the appropriate place in the table (Tables 3–10).

Table 2
List of weights for the opportunities, threats, strengths and weaknesses

| External factors | | | Internal factors | | |
|---|---|---|---|---|---|
| | **Sum of weights: 1.0** | **Opportunities** | | **Sum of weights: 1.0** | **Strengths** |
| O1 | 0.2 | Possibility of selling pellets for Polish energy producers | S1 | 0.1 | Natural, clean, green fuel from biomass |
| O2 | 0.3 | Subsidizing electricity produced from renewable sources | S2 | 0.3 | Freely available raw material |
| O3 | 0.2 | Constantly growing pellet market in Europe | S3 | 0.2 | Constantly growing demand for green fuels in industry and individual customers |
| O4 | 0.3 | Growing market for pellet-fired boilers | S4 | 0.4 | Low price of raw material |
| | **Sum of weights: 1.0** | **Threats** | | **Sum of weights: 1.0** | **Weaknesses** |
| T1 | 0.3 | Insufficient amount of raw material | W1 | 0.2 | Poor knowledge of the product |
| T2 | 0.2 | Possibility of increasing competition | W2 | 0.4 | Poor public awareness of the benefits of using biomass |
| T3 | 0.2 | Development of research on the possibilities of using other types of waste | W3 | 0.3 | Production line building costs |
| T4 | 0.3 | Rapidly growing market for renewable energy sources | W4 | 0.1 | Acquisition of qualified staff |

Source: own elaboration.

Table 3
Cross table: Will the strengths allow to take advantage of the opportunities?

| Strengths/opportunities | O1 | O2 | O3 | O4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| S1 | 1 | 0 | 1 | 1 | 0.1 | 3 | 0.3 |
| S2 | 1 | 0 | 1 | 0 | 0.3 | 2 | 0.6 |
| S3 | 1 | 1 | 1 | 1 | 0.2 | 4 | 0.8 |
| S4 | 1 | 0 | 1 | 1 | 0.4 | 3 | 1.2 |
| Weight | 0.2 | 0.3 | 0.2 | 0.3 | | | |
| # of interactions | 4 | 1 | 4 | 3 | | x | |
| Product of W&I | 0.8 | 0.3 | 0.8 | 0.9 | | | |
| Sum of interactions | 24/2 | | | | | | |
| Sum of products | 5.7 | | | | | | |

Source: own elaboration.

Table 4
Cross table: Will the strengths overcome the threats?

| Strengths/threats | T1 | T2 | T3 | T4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| S1 | 0 | 0 | 1 | 1 | 0.1 | 2 | 0.2 |
| S2 | 1 | 1 | 1 | 1 | 0.3 | 4 | 1.2 |
| S3 | 1 | 1 | 1 | 1 | 0.2 | 4 | 0.8 |
| S4 | 0 | 1 | 0 | 1 | 0.4 | 2 | 0.8 |
| Weight | 0.3 | 0.2 | 0.2 | 0.3 | | | |
| # of interactions | 2 | 3 | 3 | 4 | | x | |
| Product of W&I | 0.6 | 0.6 | 0.6 | 1.2 | | | |
| Sum of interactions | 24/2 | | | | | | |
| Sum of products | 4.0 | | | | | | |

Source: own elaboration.

Table 5
Cross table: Will the weaknesses not allow the opportunity to be seized?

| Strengths/opportunities | O1 | O2 | O3 | O4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| W1 | 1 | 1 | 0 | 1 | 0.2 | 3 | 0.6 |
| W2 | 0 | 0 | 0 | 0 | 0.4 | 0 | 0.0 |
| W3 | 0 | 1 | 0 | 0 | 0.3 | 1 | 0.3 |
| W4 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0.0 |
| Weight | 0.2 | 0.3 | 0.2 | 0.3 | | | |
| # of interactions | 1 | 2 | 0 | 1 | | x | |
| Product of W&I | 0.2 | 0.6 | 0.0 | 0.3 | | | |
| Sum of interactions | 8/2 | | | | | | |
| Sum of products | 2.0 | | | | | | |

Source: own elaboration.

Table 6
Cross table: Will the weaknesses strengthen the impact of the threats?

| Weaknesses/threats | T1 | T2 | T3 | T4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| W1 | 1 | 0 | 1 | 0 | 0.2 | 2 | 0.4 |
| W2 | 1 | 0 | 0 | 0 | 0.4 | 1 | 0.4 |
| W3 | 1 | 1 | 0 | 0 | 0.3 | 2 | 0.6 |
| W4 | 0 | 0 | 1 | 1 | 0.1 | 2 | 0.2 |
| WWeight | 0.3 | 0.2 | 0.2 | 0.3 | | | |
| # of interactions | 3 | 1 | 2 | 1 | | x | |
| Product of W & I | 0.9 | 0.2 | 0.4 | 0.3 | | | |
| Sum of interactions | 14/2 | | | | | | |
| Sum of products | 3.4 | | | | | | |

Source: own elaboration.

Table 7
Cross table: Will the opportunities increase the strengths?

| Opportunities/strengths | S1 | S2 | S3 | S4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| O1 | 1 | 1 | 1 | 1 | 0.2 | 4 | 0.8 |
| O2 | 1 | 0 | 1 | 0 | 0.3 | 2 | 0.6 |
| O3 | 1 | 1 | 1 | 1 | 0.2 | 4 | 0.8 |
| O4 | 1 | 1 | 0 | 1 | 0.3 | 3 | 0.9 |
| Weight | 0.1 | 0.3 | 0.2 | 0.4 | | x | |
| # of interactions | 4 | 3 | 3 | 3 | | | |
| Product of W&I | 0.4 | 0.9 | 0.6 | 1.2 | | | |
| Sum of interactions | 26/2 | | | | | | |
| Sum of products | 6.2 | | | | | | |

Source: own elaboration.

Table 8
Cross table: Will threats weaken the strengths?

| Opportunities/strengths | S1 | S2 | S3 | S4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| T1 | 1 | 1 | 1 | 0 | 0.3 | 3 | 0.9 |
| T 2 | 0 | 0 | 1 | 0 | 0.2 | 1 | 0.2 |
| T 3 | 1 | 1 | 1 | 0 | 0.2 | 3 | 0.6 |
| T 4 | 1 | 0 | 1 | 1 | 0.3 | 3 | 0.9 |
| Weight | 0.1 | 0.3 | 0.2 | 0.4 | | x | |
| # of interactions | 3 | 2 | 4 | 1 | | | |
| Product of W&I | 0.3 | 0.6 | 0.8 | 0.4 | | | |
| Sum of interactions | 20/2 | | | | | | |
| Sum of products | 4.7 | | | | | | |

Source: own elaboration.

Table 9
Cross table: Will the opportunities overcome the weaknesses?

| Opportunities/weaknesses | W1 | W2 | W3 | W4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| O1 | 1 | 0 | 0 | 0 | 0.2 | 1 | 0.2 |
| O2 | 1 | 1 | 1 | 1 | 0.3 | 4 | 1.2 |
| O3 | 1 | 1 | 0 | 0 | 0.2 | 2 | 0.4 |
| O4 | 1 | 0 | 0 | 0 | 0.3 | 1 | 0.3 |
| Weight | 0.2 | 0.4 | 0.3 | 0.1 | | x | |
| # of interactions | 4 | 2 | 1 | 1 | | | |
| Product of W&I | 0.8 | 0.8 | 0.3 | 0.1 | | | |
| Sum of interactions | 16/2 | | | | | | |
| Sum of products | 4.1 | | | | | | |

Source: own elaboration.

Table 10
Cross table: Will the threats exacerbate the weaknesses?

| Opportunities/weaknesses | W1 | W2 | W3 | W4 | Weight | # of interactions | Product of W&I |
|---|---|---|---|---|---|---|---|
| T1 | 1 | 1 | 0 | 1 | 0.3 | 3 | 0.9 |
| T2 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0.0 |
| T3 | 0 | 0 | 0 | 1 | 0.2 | 1 | 0.2 |
| T4 | 1 | 1 | 0 | 1 | 0.3 | 3 | 0.9 |
| Weight | 0.2 | 0.4 | 0.3 | 0.1 | | | |
| # of interactions | 2 | 2 | 0 | 3 | | x | |
| Product of W&I | 0.4 | 0.8 | 0.0 | 0.3 | | | |
| Sum of interactions | 14/2 | | | | | | |
| Sum of products | 3.5 | | | | | | |

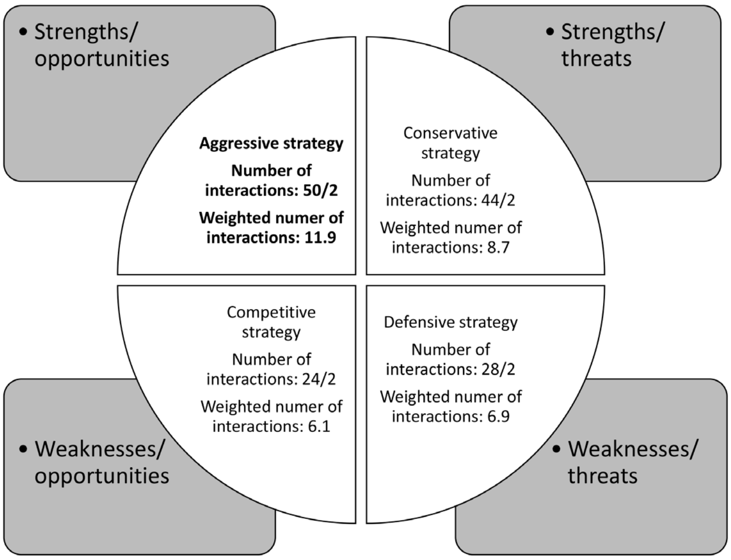
Source: own elaboration.

Table 11
Summary of the SWOT/TOWS analysis

| Combination | SWOT results | | TOWS results | | SWOT/TOWS results | |
|---|---|---|---|---|---|---|
| | Sum of interactions | Sum of products | Sum of interactions | Sum of products | Sum of interactions | Sum of products |
| Strengths/opportunities | 24/2 | 5.7 | 26/2 | 6.2 | 50/2 | 11.9 |
| Strengths/threats | 24/2 | 4.0 | 20/2 | 4.7 | 44/2 | 8.7 |
| Weaknesses/opportunities | 8/2 | 2.0 | 16/2 | 4.1 | 24/2 | 6.1 |
| Weaknesses/threats | 14/2 | 3.4 | 14/2 | 3.5 | 28/2 | 6.9 |

Source: own elaboration.

Figure 2
Strategy matrix for the sunflower pellet sector




Źródło: own elaboration based on: Redlich et al., 2019, s. 2.

Based on the data contained in Tables 2–10, a summary of the results obtained was made (Table 11), as well as a strategy matrix was created (Figure 2).

Analysing Table 3, it can be seen that among the opportunities and strengths for the use of sunflower husk pellets as fuel, there are such aspects as: low price, high demand, easy access and ecology. The weaknesses and threats, in turn, are insufficient knowledge of this type of product and the benefits of its use.

Based on the SWOT/TOWS analysis (Tables 3–11), it was noted that the highest number of interactions and the highest weighted number of interactions indicated the strategy that should be chosen for the promotion and dissemination of sunflower husk pellets. It can be concluded from the matrix of strategies that aggressive strategy will be the most beneficial: max-max (Figure 2). This strategy concerns a situation in which strengths and opportunities offered by the environment prevail, i.e. the possibility of using opportunities through strengths.

The strategic analysis carried out confirms the legitimacy of introducing this type of fuel to the energy market.

## Statements and conclusions

Pellets made of pine, energy willow, sunflower husks and corn straw comply with EN-ISO-17225-2:2014 in terms of bulk density, dimensions and moisture content. Straw pellets deviate from the norm in terms of calorific value and ash content. In turn, pellets obtained from sunflower husk and energy willow meet the standard in every respect. Due to the comparable calorific value and lower $NO_X$ emissions, compared to commonly used wood pellets, sunflower husk pellets were identified as the most promising alternative fuel.

This is also confirmed by the strategic analysis. The SWOT/TOWS analysis allows to conclude that the most beneficial for the further development of the analysed product will be the maxi-maxi aggressive strategy, in which the strengths and opportunities offered by the environment prevail. This strategy assumes a high demand for this type of products. Therefore, it should be expected that, in a short time, fuels made of biomass, especially waste, will become more beneficial not only in terms of lower emission of harmful compounds into the atmosphere, but will also be one of the competitively priced materials used to generate heat.

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