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IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOALS AT A MANUFACTURING ENTERPRISE THROUGH RES[1] ENERGY OPTIMISATION. CASE STUDY OF NORTHWOOD COMPANY

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Purpose: The objective of the paper is to present and evaluate the realization of Agenda 2030 as well as the implementation of the EU goals concerning sustainable development through energy optimisation at Northwood manufacturing enterprise.
Design/methodology/approach: For the purpose of accomplishing the assumed goal first of all selected aspects of the literature of the subject on sustainable development issues, energy optimisation and enterprise competitiveness were presented. The next step entailed a case study analysis of Northwood company operations. In the presented case study energy optimisation activities were demonstrated.
Findings: Implementation of RES energy optimisation at Northwood company has significantly affected the company's development, increasing the quality and number of fulfilled orders at substantially reduced costs of electrical energy. The incorporation of sustainable development goals in the company's process also indicates positive results.
Practical implications: The results of the analysis are a signal to all institutions and individuals, including managers, people managing production companies, that for the purpose of a company's development it is worth using modern tools and implementing sustainable development goals, which include, inter alia, energy optimisation through the employment of a company's own photovoltaic plant.
Originality/value: The article can be an example and inspiration for similar enterprises.
Keywords: sustainable development, energy optimisation, sustainable production, corporate social responsibility.
Category of the paper: case study.

[1] RES – Renewable Energy Sources.

1. Introduction

An increase in the demand for products of socially responsible companies caused by growing social awareness and responsibility results in a change of conditions in which such enterprises operate. "Green development" of the economy involving effective implementation of sustainable development goals becomes a new path of development. Sustainable development is a socio-economic growth of contemporary society involving the fulfilment of its needs in such a way that does not diminish the possibility of satisfying the needs of future generations. Accomplishing the idea of a sustainable development requires: global conservation of the natural environment, solidarity in relations between various countries, especially rich and poor ones, as well as solidarity with future generations and treating the planes of economic, political, social and ecological activities as being interdependent. The concept of sustainable development is understood as a process within the scope of which it becomes possible to achieve high quality of life in the long term while simultaneously respecting natural and environmental resources and at the same time accounting for growth in the social, economic and spatial spheres.

One of the areas of the economy in which the impact of sustainable development can be noticed is manufacturing of wooden packaging, which plays a crucial role in the contemporary trade and logistics, ensuring the protection and transportation of various products all over the world (Fechner, 2016). An issue gaining importance in the reorganization of production achieved, inter alia, through optimisation of processes, including energy optimization (Europe, 2020). For the purpose of this paper the operations of Northwood company were described, a company operating in a sector manufacturing wooden packaging. A great inspiration to implement changes in Northwood towards sustainable energy and production was the long-term cooperation with the Danish company Provipal Aps Mikkel Jorgensen. The EU climate and energy goals implemented in the presented production company translate not only into changes in the operation of a single enterprise, but they also demonstrate the need for undertaking such actions in the entire industrial sector that is the driving force of the economy.

2. Methods

The objective of the paper is to present and evaluate the realization of Agenda 2030 as well as the implementation of the EU sustainable development goals through energy optimisation in Northwood production enterprise.

For the purpose of accomplishing the assumed goal first of all selected aspects of the literature of the subject on sustainable development issues, energy optimisation and enterprise competitiveness were presented. The next step entailed a case study analysis of Northwood company operations. In the presented case study energy optimisation activities were demonstrated. In that part of the paper the materials provided by Northwood were used and they included the company's internal materials, sales reports and costs reports for the period from 2017 to 2022.

3. Sustainable development, energy optimisation and organisation competitiveness – theoretical aspects

In Gro Harlem Brundtland Report of 1987 of the World Commission on Environment and Development titled "Our Common Future" sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Thereby making economic development with simultaneous environmental and socio-cultural balance a priority goal (Rogall, 2010).

In turn, a new vision of sustainable development outlined in Agenda 2030 focuses on five areas defined as 5P: People, Planet, Prosperity, Peace, Partnership. Within the scope of individual areas, the following action rules were developed (Agenda 2030):

- people – activities aiming at reaching out to excluded groups, creating conditions and opportunities for the use of universal human rights and economic advancements by all people, guaranteeing equal access to economic resources, basic services, land, natural resources, technologies and funds to everyone;
- planet – activities integrating social, economic and environmental aspects of development for the purpose of economic growth, social inclusion, rational use of natural environment resources, achieving better quality of life and solving the problem of poverty;
- prosperity – changes in economies intended to create new jobs, development of sustainable consumption and production, the use of new technologies and business potential, ensuring access to good education, health care, clean water, electricity, transport, telecommunication, facilitating starting up a business, investing, trade exchange and intensive sustainable urban development;
- peace – activities aimed at building peace, efficient, fair and responsible institutions, strengthening the rule of law, social inclusion and co-deciding by relevant institutions supporting government, property rights, freedom of speech and the media, political freedom, access to justice and lack of discrimination;

- partnership – actions for partnership based on solidarity, cooperation, responsibility and transparency between governments, local, regional administration, scientific communities, business and all stakeholders.

Contemporary organisations operating in a turbulent and increasingly more demanding environment are forced to undertake various actions in order for them to achieve a competitive advantage. At the age of sustainable development, which in itself creates certain demands towards an organisation, an organisation's competitive advantage is frequently the result of undertaking multi-dimensional activities. When realizing the activities in the areas of sustainable development in their day-to-day operations, modern organisations try to offer products and services, better than competitive ones, but at the same time suited to the expectations of value-conscious consumers. Competitiveness may reflect not only the way in which a company operates on the market, or its ability to survive on the market, but also its ability to adapt to market demands and effective development in specific circumstances, while simultaneously obtaining profits, benefits and building a market position (Kraszewska, Pujer, 2017; Klima, 2017, 2018).

One of the aspects of a modern company operations entails energy. Contemporary development and economic growth stimulate demand for energy, which is its driving force. Energy also constitutes a basic human need, significantly affecting human well-being. Both the production and the use of energy are inextricably linked to the environment. The most realistic way of reducing CO2 emissions entails a sustainable energy efficiency strategy in combination with renewable energy sources (Pinault, 2021). The purpose of achieving a balance between the environment protection, social development and economic growth, i.e. the pillars of sustainable development, is the use of renewable energy sources and reducing CO2 emissions (Regulation of the European Parliament…, 2022), improvement of air quality and limiting the extraction of natural resources (Bansard, Schröder, 2021). Investing into renewable energy sources improves the competitiveness of regions in the international arena, increasing their innovativeness and income, thereby leading to industry development 4.0 (Bianchini et al., 2019).

4. Energy optimisation in terms of organisation independence and good-will improvement - discussion

The assumptions of the green economy, constituting the basis for the concept of sustainable development, include investments and development carried out in a way that limits greenhouse gas emissions[2] and increases energy efficiency, while simultaneously preventing loss of

[2] Greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

biodiversity (Greenfield, Weston, 2021). Leaving resources in the natural environment to future generations lies at the basis of the definition of sustainable development, that is why energy optimisation with the use of renewable energy sources is an environmental compromise. The foundation of a model sustainable development entails the development of renewable energy sources and economic growth without damaging the environment, which traditionally goes together with economic growth[3] (The 17 goals. Sustainable Development Goals).

Closed circle economy constitutes a significant element, which in practice means protection of the environment, health and economic growth by limiting the use and waste of resources and businesses operating in a closed circle (Kara et al., 2022). Circular economy is a fundamental element of the green economy in the energy sector (Muñoz et al., 2021). A source of energy that carries no risk of depletion constitutes sustainable energy, which provides an answer to humanity's energy needs (Bhowmik, Bhowmik, 2020). Examples of sustainable energy sources include wind, water and the sun, which the society considers to be inexhaustible and available to everyone, despite the fact that the methods of such energy generation are capital intensive (Glorieux, 2022).

An improvement in the efficiency of obtaining energy sources, the use of alternative energy sources, reducing emissivity and the use of new technologies represent the goals of Sustainable Energy Development – the SED. It is an area that concentrates on creating and promoting sustainable energy sources and technologies that minimise the impact on the natural environmental. The purpose of the SED is meeting present energy needs, while at the same time minimising greenhouse gases emissions and any other negative impact on the planet. Examples of sustainable energy sources include solar, wind, hydro and geothermal energy (Rosen, 2021). Long-term energy stability as well as energy balance and independence is provided by flexible investment approach and a revision of goals, planning processes and implementation of sustainable energy management. Additionally, one needs to remember, from the point of view of an enterprise, about a flexible investment approach to the realization of intended sustainable development goals (Dyukova et al., 2022). Therefore, it seems that the most profitable and the most constructive manner of meeting the challenges related to high energy prices, energy independence and energy security is introducing eco-power engineering into the concept of sustainable development (Baleta et al., 2019). Striving towards energy independence through the reduction of consumption, diversification of suppliers and obtaining energy from renewable energy sources as well as the concept of sustainable energy security plays an increasingly greater role. The European Commission specifies that by 2030 40% of the energy generated in the European Union countries must originate from renewable energy sources (Adamkiewicz,

[3] In September 2015 at a summit in New York, leaders of the UN member states signed a document entitled document "Transformation of our world: Agenda for Sustainable Development – 2030" containing 17 Sustainable Development Goals and 169 actions related thereto, which are to be achieved by all parties – ate governments, international organisations, non-governmental organisations, science and business sectors as well as citizens. They focus on 5 areas: 5xP: people, planet, prosperity, peace, partnership. (The 17 goals, Sustainable Development Goals).

2017), while global energy policy of states such as China, Indies and African countries will play a decisive role in that regard (Borchielini, Minuto, 2020). In highly developed countries the development of renewable energy sources (RES) is the dominant trend. Investments into RES are energy-friendly, they significantly limit the use of natural energy resources, i.e., oil, coal or gas. The UN Agenda report - Renewable Energy Policy Networt for the 21st country (REN 21) demonstrates that 27.7% of globally installed power comes from RES. That share corresponds to 22.8% of global demand for energy. Norway is the country with the highest share of RES in the final gross energy with its 65.5% share of renewable energy in its national energy production (Sowa, 2018).

5. Northwood wooden packaging producer – case study[4] - results

For the purpose of this paper, in order to demonstrate the effectiveness of the implementation of sustainable development goals through energy optimisation in order to increase organisation's competitiveness, an analysis of Northwood company operations was presented. Northwood is a company based in Strzykocin in the West Pomeranian Province.

Northwood has been linked to the lumber industry from the beginning of its existence, i.e., since 2008. The company has got a modern machinery dedicated to lumber processing and it has got innovative processes of gas driers, enabling the production and sale on the international market of certified pallets bearing an IPPC PL 32 436 mark. Northwood is a manufacturer of wooden pallets for distribution of products of high consumption industry, chiefly: food, chemical, metal industries. Production at the company is carried out in a sustainable fashion from direct preparation of the basic pallet components from certified timber (FSC), i.e., planks, struts from roundwood for their assembly, thermal processing and warehousing. Finished products are stored in a finished products warehouse, where they await collection by clients for no longer than three days. Production is planned in such a way so that finished components are collected by their recipient nearly immediately after their completion and so that they should be delivered to a suitable logistical centre in Germany, Denmark, Norway and Sweden. Thermal processing of wooden pallets plays a significant role, since 95% of orders concerns dried pallets with IPPC certificate. The company manufactures various pallet types differing in their specification, depending on the needs and their load carrying capacity. Specification of a pallet, i.e. its components parts such as upper planks, struts, lower planks, depends on the intended purpose of a given wooden pallet. Production of pallets and their components is typically linked with high demand for energy, which affects the costs of production and which has an ecological impact, particularly if such energy comes from non-

[4] Prepared on the basis of the data provided by Northwood.

renewable sources. That is why the producer strives to achieve processes optimisation in order to reduce energy consumption and to introduce more sustainable production practices.

On the grounds of the premises presented in the theoretical part, the following goals for analysing Northwood operations have been set:

1. assessment of Northwood's energy resources prior to the introduction of RES photovoltaic power plant;
2. assessment of Northwood's energy resources after the introduction of RES photovoltaic power plant;
3. evaluation of advantages and disadvantages of the implementation of sustainable development goals through energy optimisation and the use of RES photovoltaic power plant.

The analysis was conducted with regard to the period from 2017 to 2022. The study took into account the data concerning: production volume, sales volume of finished products, energy demands and production costs related to energy. The data was compared for two periods:

1. the first one, comprising the years of 2017-2019, prior to the use of energy optimisation in the form of photovoltaic plant, and
2. the second one, comprising the years of 2020-2022, following energy optimisation and the incorporation of a photovoltaic plant into the production process.

As previously mentioned, Northwood company has been operating since 2008. In line with Agenda 2030, Northwood has been realizing the sustainable development goals already since 2016 by:

- organising sustainable transport,
- organising sustainable production,
- organising processing including heat recovery,
- exchanging machinery,
- implementing innovations concerning product certification,
- implementing the 3R principle (reduce, reuse, recycle).

In pursuance of goal No. 12 of Agenda 2030 concerning responsible consumption and production, since 2016 Northwood company has been striving to produce more while using less resources and reducing the scale of degradation and pollution, and simultaneously improving their products quality. Sustainable production is additionally linked with promoting effective use of energy. The year 2019 was a breakthrough moment in Northwood in that regard, when it was decided that a new tool in the accomplishment of sustainable development goals will involve the implementation of energy optimisation by building and installing a photovoltaic plant (RES) for the needs of own production. To that end, an analysis was carried out in order to choose the best suited installation for production needs. The choice of the installation was made by specialised companies on the grounds of an analysis of energy consumption data from previous years (the analysis encompassed the years of 2009-2018).

It was determined that the production volume not only kept growing, but it was further predicted that such a trend would likely continue. When building the photovoltaic plant, photovoltaic cells converting solar energy into electricity were used. Photovoltaic panels used comprised:

- photovoltaic cells made of silica, which are responsible for the conversion of solar energy,
- anti-reflex layer applied to the panels surface, which enables increasing the effectiveness of solar light absorption,
- a housing and a frame, protecting the panels from unfavourable atmospheric conditions,
- cables and connections – the panels are fitted with integrated cables and connections, which enable connecting them to the company's electric power system.

Photovoltaic panels collecting solar energy were mounted on the ground. The energy collected is converted into alternating current with the use of an inverter and it directly powers electrical devices and production. The development of sustainable energy at production companies is possible thanks to advancing technologies. When building the photovoltaic plant, microfibers were use apart from the panels, which increase the efficiency of panels. Microfibers are thin layers of materials of very mall fibre diameter, smaller than 1 micrometre (1/1000 mm). Fibres are made of silica and polymers Thanks to the use of microfibers in the panels a higher efficiency was achieved, since microfibers placed on the ground with the use of solar energy reflection result in energy recovery from the bottom layer of photovoltaic panels.

After the introduction of the new energy solution in the form of the photovoltaic plant, Northwood company continued to carry out production consistent with the profile adopted at the beginning of its existence. Details of Northwood's production volumes in the years 2017-2022 were presented in Table 1.

Table 1.
Northwood's production volumes of finished products in 2017-2022 (production expressed in m^3)

Year	2017	2018	2019	2020	2021	2022
Production volumes in m^3	2.500	3.000	3.500	4.000	4.500	5.000

Source: own compilations on the basis of the data provided by Northwood.

According to the analyses conducted by external companies, prior to the implementation of energy optimisation production volume was on the rise from 2017 to 2022, despite numerous market difficulties in the analysed period (inter alia, COVID-19 pandemic, hostilities in Ukraine). The growing production was further accompanied by increasing sales value of products offered by Northwood (Table 2).

Table 2.
Sales value of finished products in 2017-2022 in Northwood (in PLN)

Year	2017	2018	2019	2020	2021	2022
Sales value (PLN)	3 320.000,00	3 850.000,00	6 500.000,00	7 950.000,00	8 300.000,00	9 500.000,00

Source: own compilations on the basis of the data provided by Northwood.

An important aspect of the analysed period is the fact that the company was carrying out the same profile of operations both before the implementation of sustainable development goals as well as during and after the implementation of sustainable production, transport and energy optimisation. Simultaneously the service quality was maintained at high level, constantly perfecting the product (R&D since 2016). It is worth noting that in the examined period, along with the introduction of the restrictions related to COVID 19 pandemic (year 2020) and transferring many areas of operations into the virtual world, with energy optimisation in 2022 the company had a record number of orders with increasing energy costs (see Table 2). The sales volume in 2022 rose in relation to 2017 nearly threefold.

A significant indicator of the conducted analysis is energy demand, which along with an increase in production typically rises. In Table 3 changes in Northwood's energy demand were presented for the examined period.

Table 3.
Changes in Northwood's energy demand in 2017-2022

Year	2017	2018	2019	2020	2021	2022
Energy demand (KW)	100	105	110	120	130	140

Source: own compilations on the basis of the data provided by Northwood.

Along with growth and increased production thanks to the acquisition of new machinery the company's energy demand rose. Greater production and new machinery required increased amounts of energy to power the machinery and to illuminate production halls. Because of increasing industrial production energy demand grew as well, and in order to meet the demand for energy, more effective and sustainable energy sources were implemented, i.e. solar energy obtained from photovoltaic panels. As a supplementation to the above tables, additionally total production costs related to obtaining energy were presented in Table 4. It is worth pointing out and comparing those numbers in the first period (2017-2019) – before the application of the photovoltaic plant, when traditional methods of energy use were employed and in the second period (2022-2022) – after the photovoltaic plant was incorporated into production, when the optimisation solution began to be used.

Table 4
Costs of using energy for production in Northwood in 2017-2022 (PLN)

Year	2017	2018	2019	2020	2021	2022
Costs of using Energy for production PLN	173.400	183.200	192.100	179.800	169.200	159.200

Source: own compilations on the basis of the data provided by Northwood.

An analysis of the data in Tables 3 and 4 indicates that, on the one hand, a growing production is accompanied by an increase in demand for energy use, however, on the other hand, costs of using such energy since 2020 (i.e., since the implementation of the photovoltaic plant) have been diminishing. It means that the employed optimisation solution in the area of power engineering at Northwood brought about the desired effects. On the grounds of the information obtained from the company it can be concluded that along with the implementation of sustainable development goals and an exchange of machinery to achieve more sustainable production and the incorporation of energy optimisation, total demand for energy from outside has been decreasing with a simultaneous rise in the amount of electric current generated for the needs of production from the company's own power plant (figure 1).

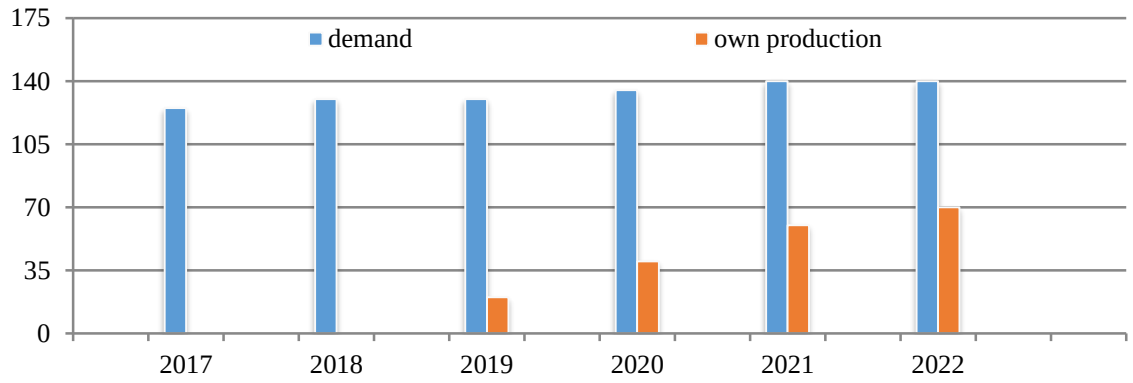

Figure 1. Energy demand at Northwood in 2017-2022, including energy production from its own power plant in 2020-2022.

Source: own compilations on the basis of the data provided by Northwood.

Thus, as is evident from the above data, the results of employing energy optimisation by constructing the company's own photovoltaic plant can be presented not only on the grounds of energy generation statement, but also on the basis of expenditure incurred on external energy. With expanded production of own energy for the purpose of production the transfer of external energy was decreasing, thereby charges for external energy and for energy transfer were falling as well. In 2018, before the incorporation of energy optimisation in the form of the photovoltaic plant, the presented company's average expense incurred on energy was fairly high - over 190 thousand zlotys per year. In 2020, when Northwood introduced energy optimisation and began to produce electricity itself for the purpose of its production, spending on external energy markedly decreased to 180 thousand zlotys per year, with a simultaneous increase in production. Furthermore, surplus of energy generated in the afternoons and at weekends in the summer period were transferred to the power grid and they constituted a passive income for the company, since they were resold. In 2021 and 2022, despite expanding production and sales, energy costs at Northwood were reduced. Energy spending was successively decreasing, moreover, an additional income emerged in the form of resold energy generated in the summer season and at weekends.

On the basis of the information featured in Tables 1-4 and in figure 1 it can be concluded that the implementation of energy optimisation involving the implementation of the company's own photovoltaic plant ought to be preceded by other measures related to the accomplishment of sustainable development goals, which in time will ensure the company's full optimisation and partial independence. The second major conclusion is the fact that the introduction of RES energy optimisation itself would not yield the desired results if it was not consistent with other operations conducted by the company thus far related to the accomplishment of sustainable development goals. Another issue that seems to be of significance in the case of implementation of RES energy optimisation is the consistency and repeatability of the activities in that regard.

A schedule of data for 2017-2022 for Northwood company demonstrated a successive development of the company and the growth of its competitiveness. Thereby the justifiability and at the same time the necessity for the employment of modern and innovative optimisation techniques have been proven with the aim of promoting the brand and improving its competitiveness. The data analysis allows for presenting weak and strong points of RES energy optimisation. The advantages include an increase in production with a reduced cost of energy in a short period of time with relatively low outlays. A disadvantage of the employment of photovoltaic plant, considering the experiences of Northwood company, chiefly involves technical problems related to the organisation and introduction of a new tool, and thereby the need to entrust such types of activities to a professional company having experience in similar operation on the market.

The use of RES energy optimisation by constructing one's own photovoltaic plant for the needs of own production and implementing sustainable development goals also constitute a modern tool of brand promotion. Implementation of sustainable development goals at the company had an impact on the improvement of the brand good-will and warming of its image from heavily industry-focused to a more environmentally-friendly one.

6. Summary

Implementation of RES energy optimisation at Northwood company has significantly affected the company's development, increasing the quality and number of fulfilled orders at substantially reduced costs of electrical energy. The results achieved by Northwood unequivocally demonstrate the positive effects of energy optimisation at a production company through the implementation of a photovoltaic plant for the needs of a company's own production. The incorporation of sustainable development goals in the company's process also indicates positive results. The great inspiration for Northwood Bronisław Misikonis was Provipal Aps Mikkel Jorgensen, which shared the solutions and implementations used. International cooperation between organizations influenced the changes introduced at

Northwood towards sustainable energy and production. The conducted analysis provides evidence to the fact that the fulfilment of sustainable development goals may constitute a promotion not only for the company itself, but it may also increase its competitiveness on the market. The results of the analysis are also a signal to all institutions and individuals, including managers, people managing production companies, that for the purpose of a company's development it is worth using modern tools and implementing sustainable development goals, which include, inter alia, energy optimisation through the employment of a company's own photovoltaic plant. Another important indicator is also the fact that organisations wishing to expand need to establish cooperation with external entities specialised in that area, taking advantage of their experience and granting them freedom to act.

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