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Business Models in Terms of the Strategy for Sustainable Management in Economic Entities Taking into Account Energy Transformation

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Abstract: The article presents the results of research on the importance of managing the energy transition in various economic sectors. The barriers and benefits of implementing a knowledge management and environmental management system in enterprises were considered. These factors are necessary for the effective planning and proper functioning of enterprises. Knowledge becomes the main and most dynamic factor responsible for the development of a given company, while environmental management ensures it achieves high economic efficiency of production and environmental rules and regulations. The article presents the results of the functioning of knowledge-based enterprises in contemporary conditions characterized by constant changes in the environment in terms of energy transformation. As part of my research, an algorithm was built based on which essential elements of the Polish energy policy strategy were defined enterprises in various sectors of the economy. In the holistic approach, a model of the functioning of knowledge-based enterprises was built and tested. On its basis, a prosumer/customer business model was proposed on the example of a photovoltaic installation. The study was conducted using the methods of economic measurement models. These methods allowed us to calculate the market value of the investment with the assumed boundary criteria and to determine its effectiveness. The research was carried out in 2020–2022 on the example of a real photovoltaic installation. The use of a photovoltaic installation in a company based on a business model is justified in practice and allows the company to reduce the electricity costs incurred, in this case by about 60%. Taking into account the result for the calculated payback period of 3 years, this proves that such an investment is very profitable for the company. The developed business model showed that the project of its implementation is fully economically justified and will allow investors to create various economic areas as part of the ongoing energy transformation.

Keywords: management strategy; energy transformation; photovoltaic installation; ecology

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1. Introduction

Changes occurring in the environment of enterprises in various sectors of the economy in the era of energy transformation significantly affect their functioning. These changes result from many phenomena inherent in the macro- and microenvironment [1–3]. Through the relationships between the company and the environment, changes mentally determine the directions and scope of the company's activities, which in turn translates into its competitive position and market value [4–6]. The ability to quickly adapt to changes can therefore be treated as a key factor in the development of modern enterprises. In today's world, the market success of an enterprise depends to an increasing extent on effective knowledge and environment management [7–10]. Knowledge is currently perceived as a resource of strategic importance for the company; therefore, it should be subject to constant identification and assessment, and thus continuous development to use it effectively and protect it. For decisions, the importance of knowledge for enterprise management is influenced by the following: the rapidly growing amount of knowledge; radical changes in technological

progress; and constant changes in the political, economic, and social environment, among others [11–13]. The consequence of the above changes is the transformation of traditional enterprises (based on production or service tasks) into knowledge-based organizations that use their resources to increase their competitiveness in the market, i.e., adopt innovative pro-ecological solutions [14–17]. On the other hand, environmental management is perceived as a strategic resource based on the use of knowledge, skills, and techniques of enterprise management, which ensures high economic efficiency of production and services and minimal burden on the natural environment.

The ongoing green transformation forces enterprises in various sectors of the economy, i.e., transport, construction, agriculture, energy, and industry, to adapt their operations to the fundamentally changed environmental conditions. These sectors of the economy have a significant and real impact on the ongoing energy transformation in Poland, aimed at meeting the emission obligations of the European Union (EU) and giving a positive impulse to the national economy, ensuring its energy security. Currently, Poland can observe a transition from an economic system based mainly on fossil fuels to a system based on renewable and low-emission energy sources and, ultimately, emission-free production methods. This mechanism of activity should be described as the green industrial revolution [18–20]. Hence, changes in the strategy of enterprises are required, which will prepare them for the development of the green economy, increased expectations of societies in terms of reducing the carbon footprint, and changes in financial markets. As a result, companies need to reorient their strategies in such a way as to ensure profitable operations in a fundamentally changed business environment and secure economic performance against rapidly increasing climate risk and the need to meet climate goals. This means a combination of increasingly energy-saving solutions in construction, transport, agriculture, energy, and industry, which will lead to increased energy efficiency and will reduce the risk of the unsustainable energy balance of the state and the low energy efficiency of enterprises [21–24]. Bearing in mind the EU climate and energy regulations imposed on the Polish energy sector, including enterprises that are an integral part in the face of climate protection, it should be stated that lower consumption of fossil fuels in Poland will allow for more intensive development of the energy sector obtained from renewable energy sources, and this should make this part of the energy sector particularly prospective and attractive for all enterprises in various branches of the economy.

Bearing in mind the importance of implementing sustainable development, one should not forget about the essence of the enterprise, which must first achieve economic goals related to maximizing profit. This study is an attempt at a synthetic presentation of the essence of enterprise management in the conditions of energy transformation focused on environmental protection and the implementation of social interests. The work aims to develop business models in terms of sustainable management strategies in business entities, taking into account energy transformation. Due to the need to adapt the transformations to environmental management conditions, necessary research was undertaken to supplement theoretical and applied knowledge.

The novelty of the article is the development of an integrated business model for a prosumer on the example of a photovoltaic installation based on knowledge management. The model indicates the bottlenecks of the analyzed investment processes and indicates the key needs to apply new trends and innovations. There are no studies in the literature on a comprehensive individual approach to the assessment of sustainable energy management, taking into account environmental and technological conditions, including the determination of the nature and intensity of the relationships between the factors examined. Therefore, this article fills the research gap and provides the necessary information on how to perceive knowledge management in investment processes and how to adapt to changes in the external environment on its basis.

The further material is divided into several parts. Section 2 presents the essence, main assumptions, barriers, and scope of the research problem. Section 3 contains the research methodology used to analyze the company's sustainable management strategy. Section 4

describes the results and interprets them. Section 5 presents the conclusions from the research and the prospects for their further development.

2. Current State of the Research Problem

2.1. Review of the Literature

Research on business models has resulted in many definitions and concepts. In terms of the research issues of the article, those that concern the creation of value and the role of innovation are important. A business model can be understood as a set of activities, methods of their organization, and strategic resources necessary for the individual to pursue their interests and motivations and to create and capture value in this process [25]. The importance of creating value through business models is also indicated in the works of S.M. Shafer, H.J. Smith, J.C. Linder [26], B. Demil, and X. Lecocq [27], as well as M. Johnson, C. Christensen, and H. Kagermann [28]. In research on business models in the Polish economy, the phenomenon is characterized by T. Gołębiowski, T.M. Dudzik, M. Lewandowska, and M. Witek-Hejduk [29]. The value proposition for the customer is a central part of the business model concept presented by A. Osterwalder and Y. Pigneur [30]. Creating unique value and competitive advantage is related to innovations driven by the business model—this is reflected in the works of J. Brzóska [31], G. Hammel [32]., C.K. Prahalad and M.S. Krishnan [33], and K. Obłoj [34]. Research on new concepts appropriate for the liberalizing energy market as well as concepts of functioning of innovative energy companies was undertaken by B. Matusiak [35]. An interesting approach, enabling the analysis and creation of business models of innovative enterprises, is the concept of the so-called New Era of Innovation, founded by C.K. Prahalad and M.S. Krishnan [33]. On the other hand, knowledge management is a fundamental change in the way a company is managed, and knowledge is ordering chaos.

When developing business models of enterprises, it is important to take into account the principles and methods of knowledge management. Knowledge management is a fundamental change in the way a company is managed, and knowledge is ordering chaos. Alvin Toffler [36] stated that the value of successful companies is related to their strategic ability to acquire, create, distribute, and apply knowledge. Uszula Kwast and Urszula Herman [37] indicate four types of knowledge from the point of view of an enterprise: customer knowledge, market knowledge, product knowledge, and service and environmental knowledge. Knowledge management consists of the skillful use of intellectual capital and obtaining a synergistic effect, i.e., obtaining better results than would result from the direct use of individual elements of resources at the organization's disposal [38]. Knowledge management consists in creating a project for its use, and the goals of this project include building a corporate knowledge base, increasing access to knowledge, and introducing a culture of knowledge [39]. This process concerns the generation of knowledge, its identification, and creating conditions in which it can freely develop and spread; it is also a process that enables the storage of knowledge and its implementation. Trajer, J., Paszek, A., and Iwanand, S. [40] believe that knowledge management means acquiring knowledge that allows for achieving certain business goals. Knowledge management includes methods, instruments, and tools that in a holistic approach contribute to the course of the main processes involving knowledge and the distribution of knowledge (with the support of the definition of knowledge goals and its identification) in all areas and levels of the organization [41]. Many authors conducted their research with an understanding of knowledge management and the concept of knowledge management.

Due to the lack of collective, original, and current research, especially on how to perceive knowledge management in investment processes as part of the energy transformation of various economic entities, the presented considerations are the first, according to authors' knowledge, which provides the necessary theoretical and application knowledge regarding the analyzed issue.

2.2. Key Elements of the Energy Policy Strategy of Polish Enterprises

Knowledge management and environmental management are the ability to properly manage the company's resources while using the innovations available on the market as effectively as possible. Following the solutions of F.E. Kasta and J.E. Rosenzweig, management is a process of coordinating collective efforts to achieve organizational goals by people, using technology in organized structures, based on assigned tasks. It can therefore be said that management understood in this way consists of the conscious and rational shaping of interdependencies between the separated elements of the organizational system [42,43]. Therefore, skillful management should include mutually complementary processes of creating and disseminating knowledge consisting primarily in creating an organizational culture conducive to learning, implementing new technologies, improving existing processes, and treating human resources as the most important resource of the company concerning the environment [44]. It should be emphasized that the concept of knowledge management is based on several initiatives related to quality management and a systemic approach to the knowledge management process, which begins with establishing the company's strategy, identifying problems and needs of the organization, and ends with controlling the results obtained. Almost 75% of global greenhouse gas emissions are related to businesses and their production and processing of energy. Achieving the state of climate neutrality, which is pursued by global climate agreements or the European Green Deal, depends on the effective use of energy and the transition to renewable energy sources (RES). The energy transformation consists in moving from obtaining energy from high-emission fossil fuels towards more environmentally friendly technologies [45–47]. In its well-thought-out implementation, it helps to develop an adequate knowledge-based energy strategy, including the energy efficiency of enterprises and RES, while respecting the natural environment. The knowledge-based energy strategy is a set of actions aimed at optimizing the costs of obtaining energy by the company and adapting its operations to current trends in the field of sustainable development. The changes in the energy market observed in recent years force companies to change their energy strategies. Electricity is a significant cost of the company's operation, affecting, among others, competitiveness in its industry on the domestic and international markets. The latter is related to the growing regulatory requirements at the junction of energy and climate policy, as well as the expectations of market players and consumers. Based on knowledge and effective environmental management, the European Commission's vision outlines the following seven key strategic elements for enterprises in various sectors of the economy of the Member States [48,49]:

- Maximizing energy efficiency, including zero-emission buildings;
- Maximizing the use of renewable energy sources (RES) and electricity for the full decarbonization of energy supply in Europe;
- Adopting the principles of clean, safe, and connected mobility;
- Competitive EU industry and circular economy as key factors in reducing greenhouse gas emissions;
- Development of appropriate smart grid infrastructure and interconnections;
- Full use of the advantages of the economy and the creation of the necessary carbon sinks;
- Tackling the remaining CO_2 emissions with carbon capture and storage (CO_2 Capture and Storage, CCS).

In key sectors of the economy, Poland has been obliged by 2050 to [50]:

- Reduce greenhouse gas emissions by up to 55%;
- Increase the share of RES in final energy consumption to 32%;
- Improve energy efficiency by up to 32.5%.

The most important commitments of Poland until 2050 in key sectors of the economy are presented in Table 1.

Table 1. Poland's commitment to key sectors of the economy as part of the energy transformation.

Energy Sector	Construction Sector	Agricultural Sector	Industry Sector	Transport Sector
- Increase the share of solar and wind energy in the total energy mix. - Increase investment in new infrastructure. - Introduce nuclear energy in place of coal. - Modernize units in coal-fired power plants; - Use biomass in the district heating network.	- Thermal modernization of buildings. - Replace high-emission energy sources with devices powered by energy from low-emission alternative sources. - Introduce energy-saving and passive construction.	- Popularize low-emission fuels in agricultural machines. - Introduce low-emission land management, e.g., by using ecological fertilizers. - Promote the development of biogas plants. - Prevent the destruction of forest areas and protect their emission-reducing functions.	- Electrify the heat generation process. - Use carbon capture, use, and storage technologies. - Apply a circular economy. - Use biomass to replace fossil fuels and raw materials.	- Use biomass to replace fossil fuels and raw materials. - Replace internal combustion engines with electric vehicles. - Build a charging station infrastructure.

Source: own study.

The implementation of the energy transformation of Polish enterprises must be based on three main pillars: a just transition, a zero-emission energy system, and good air quality. The main tool to achieve climate neutrality by 2050 is the energy transformation based primarily on the decarbonization of the energy sector, as well as its decentralization and digitization [51–53]. It can be achieved if all sectors of the regional economy contribute to the adoption of flagship projects and set specific targets to reduce greenhouse gas emissions. These goals should be reflected in the national strategy of energy policy, and above all in the energy sector and climate plan to which Poland has committed to the EU. The main objective of the strategy can be achieved through the implementation of operational objectives concerning: the improvement of air quality, high energy efficiency, and development of renewable sources of energy and energy storage technologies. As part of the energy transformation, Polish enterprises, according to the author, should aim at:

- Moving away from the use of fossil fuels in the production of electricity and the generation of heat and cold;
- Reduction of CO_2 emissions to the level of 80–95% compared to the emissions in the 1990s;
- Achieving the share of RES at the level of 70% in total energy production and 97% in electricity production;
- Continuous improvement of energy efficiency in construction, transport, agriculture and the energy sector;
- Promoting electroprosumerism;
- Full electromobility of transport;
- Use of electricity from RES in all areas of economic activity and life of residents;
- Obtaining security of energy supply based on industrial storage technologies;
- The use of innovative technologies, including the share of "green" hydrogen at the level of 13–14%, by the EU hydrogen strategy.

These assumptions meet the urgent need to determine the direction of support for the energy sector.

To achieve a higher level of sustainability, it is necessary not only to improve design strategies and have more determined and educated project team members and decision makers to make pro-ecological decisions, but also to have sustainable standards, new visions, and inspirations, which, on the one hand, should be based on experience and have a source in the history of cultural heritage, and, on the other hand, should use knowledge and innovative solutions, taking into account respect for the environment. Currently, knowledge management and environmental management have become the dominant elements of the resources of any enterprise. Knowledge management is a concept that currently has a large impact on the development of enterprises and determines its further functioning in the future. Knowledge management opens prospects for building a competitive advantage based on the effective use of knowledge and intellectual capital. Effective knowledge management, understood here as all activities aimed at identifying, preserving, disseminating, and using the explicit and tacit knowledge of the company's personnel to increase the efficiency and effectiveness of employees' activities [54,55], should bring many positives for the company, such as maintaining the current market position or its further

development, the progressiveness of results, increasing competitiveness, discovering the knowledge possessed in the organization and enabling access to its resources, stimulating innovative activities, generating innovative ideas, making full use of the possessed intellectual potential, and constantly gaining knowledge and experience.

3. Materials and Methods

Globalization, technological changes, and the flow of information have contributed to the emergence of a knowledge-based economy, as well as enterprises operating in its conditions. New conditions dictated, among others, by emerging market changes, new competitors, new products, and new technologies require modern enterprises to take new actions and transform into a new type of organization. Knowledge-based organizations, because this is whatentities that are successful in the modern economic reality should be called, constantly maintain their innovativeness at a high level. The success of these entities lies in the unique way of acquiring, processing, and creating, knowledge [56]. In conditions of permanent uncertainty, only knowledge can be a source of competitive advantage for a company that is able than the requirements of the environment, e.g., environmental law. This stage of research is aimed at presenting the characteristics of contemporary socio-economic reality, the so-called knowledge-based economy, as well as enterprises operating in its conditions [57]. Concepts, characteristics, and principles of operation of a new knowledge-based enterprises will be presented. Attention will also be paid to the most important resource of modern organizations: technological innovations in response to the energy transformation.

The energy industry is an important sector of the economy that is decisive for the social, economic, and civilizational development of each country. Its strong impact on the environment and climate change means that the energy sector belongs to the field of the global economy where major technological and organizational transformations are taken on a wide range of implemented innovations. They influence not only changes in the business models of operating energy companies, but also generate new models in which innovations play a dominant role. The strategic model of the company is a combination of the concept of competitive advantage with a set of activities and resources necessary for its implementation, enabling the company to achieve the intended goals, especially profitability, and contributing to ensuring energy security [58]. In the competitive race, the so-called companies are leading the way in intelligence, as they are capable of innovative and quick adaptations.

The research problem focused on the socio-management and economic aspects related to the creation of enterprises in various sectors of the economy—agriculture, construction, industry, energy, and transport of harmful emissions of dust and gases—as well as the possibility of undergoing energy transformation, taking into account the knowledge possessed by building business models. Figure 1 shows the decision-making model developed by (Niekurzak M.) for managing the energy transformation of enterprises based on knowledge and environmental management.

The presented model presents a group of logically related mental and computational operations to select the best solution. Operations can be based on decision criteria based on the knowledge of data, e.g., from surveys, Central Statistical Office data, or from a database of measurements. These data can be expressed by functional dependencies, and the criteria values can be compared with thresholds or decision sticks. Decision characteristics should be based on computational methods based on artificial neural networks, fuzzy sets, fuzzy neural networks, expert methods, etc. Thanks to the knowledge of these data, a representative sample for training and testing can be selected and, on this basis, various structures of forecasting models can be tested to select the most advantageous variant. These data will allow you to build effective business models.

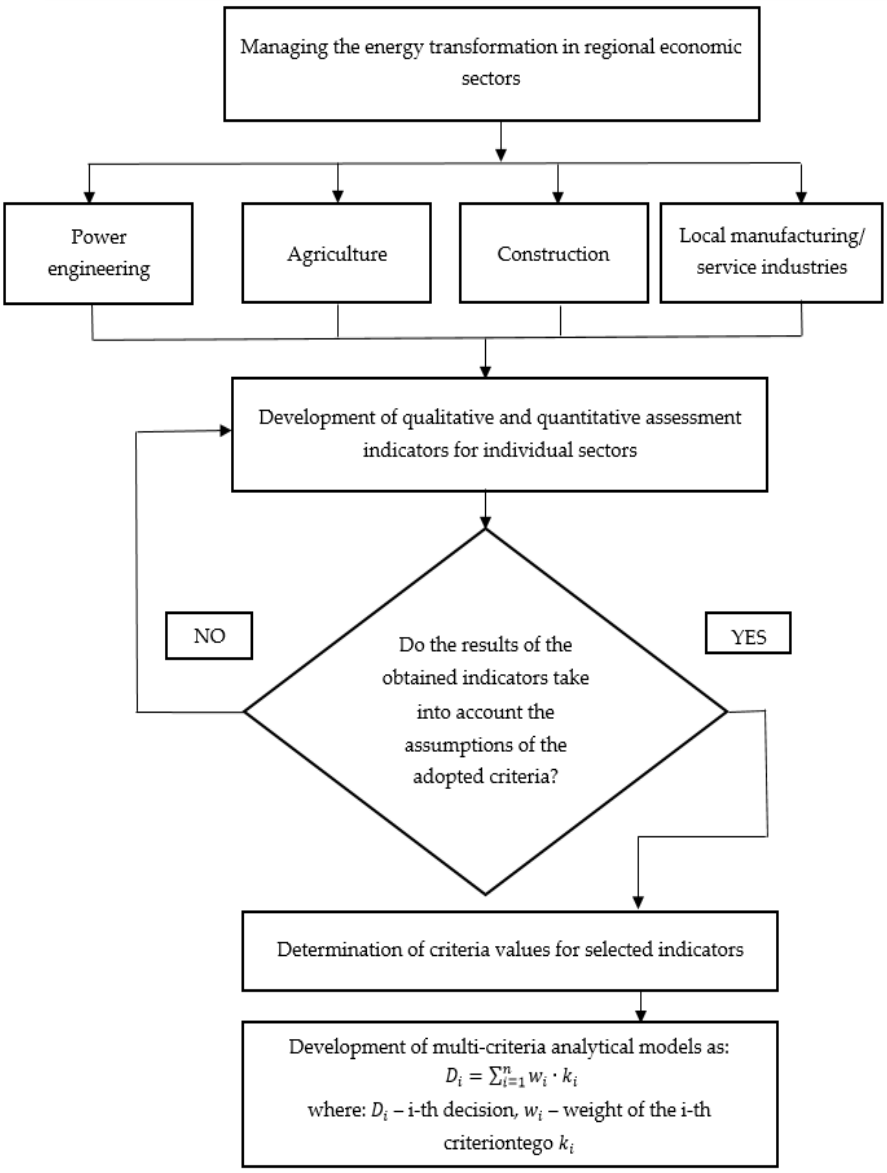

Figure 1. A decision model for energy transformation management. Source: own study (Niekurzak M.)

Due to the extensive range of topics and business models, energy companies were, for example, presented as companies from which models can be built for a local biogas plant, construction, transport, and industry, taking into account legal, environmental, social, technical, and economic conditions.

Two types of information sources were used in the research on building the rules for the functioning of a knowledge-based company and business models: sources of primary information, which came from production and service plants, and sources of secondary information, which consisted of the following: bibliographic items, including domestic and foreign literature on the subject and including particular documents of a legislative nature; acts of Polish and EU law; and statistical materials, industrial research, industry reports and studies, surveys, and numerous Internet sources, among others. The following methods were used in the individual stages of the research:

- Collecting data from primary sources as part of inspection visits to various production and service enterprises and secondary ones;
- Analysis of statistical data from primary sources (derived from collected empirical data) and secondary sources;

- Logical analysis when creating models and analysis of the results obtained during the research;
- Synthesis enabling the combination of components separated by analysis;
- Mathematical and statistical analysis, enabling qualitative and quantitative presentation of the results of primary and secondary research;
- Inductive and deductive reasoning, used in the interpretation and synthesis of research results and the creation of a model.

The research methodology developed business models for a photovoltaic farm in terms of value creation consisting of three stages. The first stage consists of analytical and study works devoted to the theory of business models, analysis of external factors (en gy policy, legal and regulatory conditions, energy markets, macroeconomic situation, research, and development), and analysis of internal factors (sector situation, ownership structure, electricity generation structure, rules for connecting distributed energy sources). The second stage of research is devoted to the structure and features of business models. The following elements were considered significant: elements of social architecture, i.e., human capital (including prosumers), strategic competencies and skills, and knowledge resources; and elements of technical architecture, including own material resources, sources of supply, etc. In the third stage, the value created by the business model is assessed in terms of its sources and measurable effects. In the case of innovative energy projects, the social aspect of value creation is important. The developed models take into account the current state of the energy law according to the RES Act [59].

In business models developed for new technologies—currently, it is not so much the technology itself that is problematic, because the cost of its purchase and technological risk can be estimated and known—the method of its specific application in a given case remains unknown. The technology for the production of solar cell panels is already quite well-known, and its continuous improvement and development make it more effective, more efficient, cheaper, and more accessible than before with each year. Although the costs of technology cannot be omitted—e.g., the cost of producing a solar panel—the method of technological production and obtaining knowledge about the technology is not considered in this paper. It is not the production and delivery of technology, but the method of its use and reliable installation, as well as knowledge about the possibilities of optimal configuration of supporting devices, and the business logic of the management system, etc., that determines the scale of financial and implementation difficulties in building models business for the prosumer.

The subject of the research was a photovoltaic installation installed on the roof slopes of the production company. To see the benefits of a photovoltaic installation, the author analyzed the energy consumption of individual manufacturing processes in the company. The research carried out in the company consisted in collecting the results during the implementation of manufacturing processes, subjecting them to processing, and analyzing in order to provide recommendations on the efficiency of the operation of a given installation. In total, 1747 photovoltaic installation panels were installed, which were integrated and connected so that all the energy from all the generators goes to production, and their total power is 653.89 kWp. With the current self-consumption of the company, i.e., the consumption of energy produced by modules directly by working machines, the generated power covers 70% of the demand.

4. Results and Discussion

4.1. The Way a Knowledge-Based Enterprise Functions

Intangible assets and their growing share in the income structure of a global enterprise change the internal conditions of its operation and require the creation and implementation of knowledge management mechanisms. Data and information are categories of knowledge and its components and are often dispersed. Knowledge, on the other hand, is most often characterized by order. Skillful transfer of knowledge can lacerate the adaptation of the implementation of new solutions related to the energy transformation of enterprises in

various sectors of the national economy. The differences in an organization operating in a knowledge-based economy are presented in Table 2.

Table 2. A traditional enterprise and a knowledge-based enterprise, taking into account the aspects of environmental management in the era of energy transformation.

Itemization	A Traditional Enterprise	Knowledge-Based Enterprise
Objective	making a profit	creating global value through the highest quality standards
Focus attention	on the mass production of material goods	on the design and application of modern technology based on the highest environmental standards
Strategy	passive or reactive, i.e., the organization does not react to changes in the environment or reacts with delay	proactive, i.e., anticipating changes in the environment and preparing the organization and mechanisms of action for them in advance, to use them as an opportunity in the era of energy transformation
Dominant resource	tangible and financial capital	knowledge supported by global solutions and standards, intellectual capital
Market value	determined mainly by possessed material resources	determined mainly by intangible resources and environmental certificates
The dominant direction of investment	investing in material resources	investing in the development of new RES technologies and the use of knowledge and intellectual capital
An approach to uncertainty	treating unusual events as threats	treating unusual, innovative events as a source of inspiration and opportunities
Ways of operation	structured and stable, adhering to stereotypes, and rejecting contradictory information	each time adapted to the situation, e.g., legal requirements, certification, etc., rejection of stereotypes
Basic knowledge	highly specialized	interdisciplinary
Approach to change	emphasizing the stabilizing role of the organization, treating changes as a threat, forced changes are introduced periodically at a specific pace and in an easy-to-assimilate way	change orientation: sudden, fast, and often radical changes; the continuous improvement process
Organizational structure	traditional, focused on the functions of the enterprise with the dominance of hierarchical dependencies, strong emphasis on control	network of cooperative units that are self-managed and focused on processes and informal mechanisms of exerting pressure (communication, participation, culture)
Cooperation with suppliers, cooperators, and clients	lack of close cooperative ties, price competition between suppliers and cooperators, limited contacts with the customer, and frequent lack of response to customer preferences	close partnership based on trust and quality traceability throughout the supply chain, e.g., energy transmission
Marketing	focus on transactions—the principles of mass marketing prevail, e.g., focus on product prices, selling one product to many customers	focus on relationships—relationship management rules prevail, e.g., regarding energy and fuel prices
Production	based on economies of scale, long production lines, infrequent production shifts, narrow production range, and use of specialized machines	based on scope economy, short production lines, frequent product and production improvements, wide range, flexible machines with easy assembly, and low cost

Source: own study.

In the competitive environment, those companies that pay attention to the ability to adapt to the environment, as well as the ability to manage in all conditions in the era of energy transformation, come to the forefront. Knowledge management brings measurable benefits to both the company and its employees. That is why it is a popular concept that prepares companies for all the challenges of a changing environment. Knowledge-based enterprises, by accumulating and creating knowledge, are subject to changes in the following areas [60]:

- Increasing innovation in relations with the environment and the efficiency of implementing new solutions;
- Increasing the role of factors facilitating the creation and transfer of knowledge and information in the enterprise;
- Wider use of information technologies supporting the activity of the organization;

- Increasing environmental awareness is understood as the state of knowledge, views, and ideas about the role of the environment in the organization's activities and about the impact of the organization on the environment.

Summing up the quoted features of the new type of enterprise, it should be noted that its success depends on the introduction of many adjustment measures to the new socio-economic conditions. The new socio-economic reality forces the transformation of traditional organizations into so-called knowledge-based organizations. It is knowledge, specific skills, and competencies that make it possible for an organization to function effectively in modern economic conditions.

4.2. The Business Model of Energy Companies

Defining the business model of vertically integrated energy companies in the knowledge-based economy will result, inter alia, from the scope of tasks and the knowledge needed for their implementation. Therefore, such a list is presented in Table 3, covering tasks in individual business areas, together with an example of the scope of necessary knowledge.

Table 3. List of tasks and the scope of knowledge needed for their implementation in the current business areas of energy companies.

Scope of Performed Tasks	The Scope of Knowledge Needed
In the area of the distribution system operator	
- Traffic management; - Measurement operator; - Exploitation; - Technical balancing; - Development planning; - Investments and tenders; - Sale of distribution services.	- Artificial intelligence and innovative models of the national power system used in traffic management; - Innovative system balancing mechanisms, prices in various market segments, and measurements of energy production and consumption and pollution; - Non-outage techniques for operating power distribution equipment; - Robotics and automation in innovative traffic management and operation of energy distribution devices; - Effective conduct and management of investment projects; - Effective sale of distribution services and purchase of system services; - Research and development of energy distribution technologies.
In the area of electricity generation	
- Electricity generation; - Operation of generating equipment.	- Innovative technologies for generating electric energy; - Innovative environmental protection technologies; - Robotics and automation in the innovative operation of energy generation equipment; - Non-outage techniques for operating generation equipment; - Research and development of energy generation technologies.
In the area of electricity trading	
- Wholesale trade; - Retail turnover; - Ex officio salesman.	- Development of energy prices in various market segments in the European Union, - Innovative techniques and ways of selling energy, - Expectations of various customer groups and their segmentation in terms of energy sales.
In the area of customer service	
- Customer service for the distribution system operator; - Customer service for the needs of an electricity trading company.	- Innovative customer service technologies; - Modern customer marketing research; - Modern ways of creating brands and products.

Source: own study.

The presented models of innovative energy represent only a part of many solutions in the area of RES. Similar models can be built for various sectors of the economy, taking into account the essential elements of the energy policy strategy. In Figure 2, the author proposes a strategy for the energy transformation of various economic entities to achieve the climate neutrality desired by the EU.

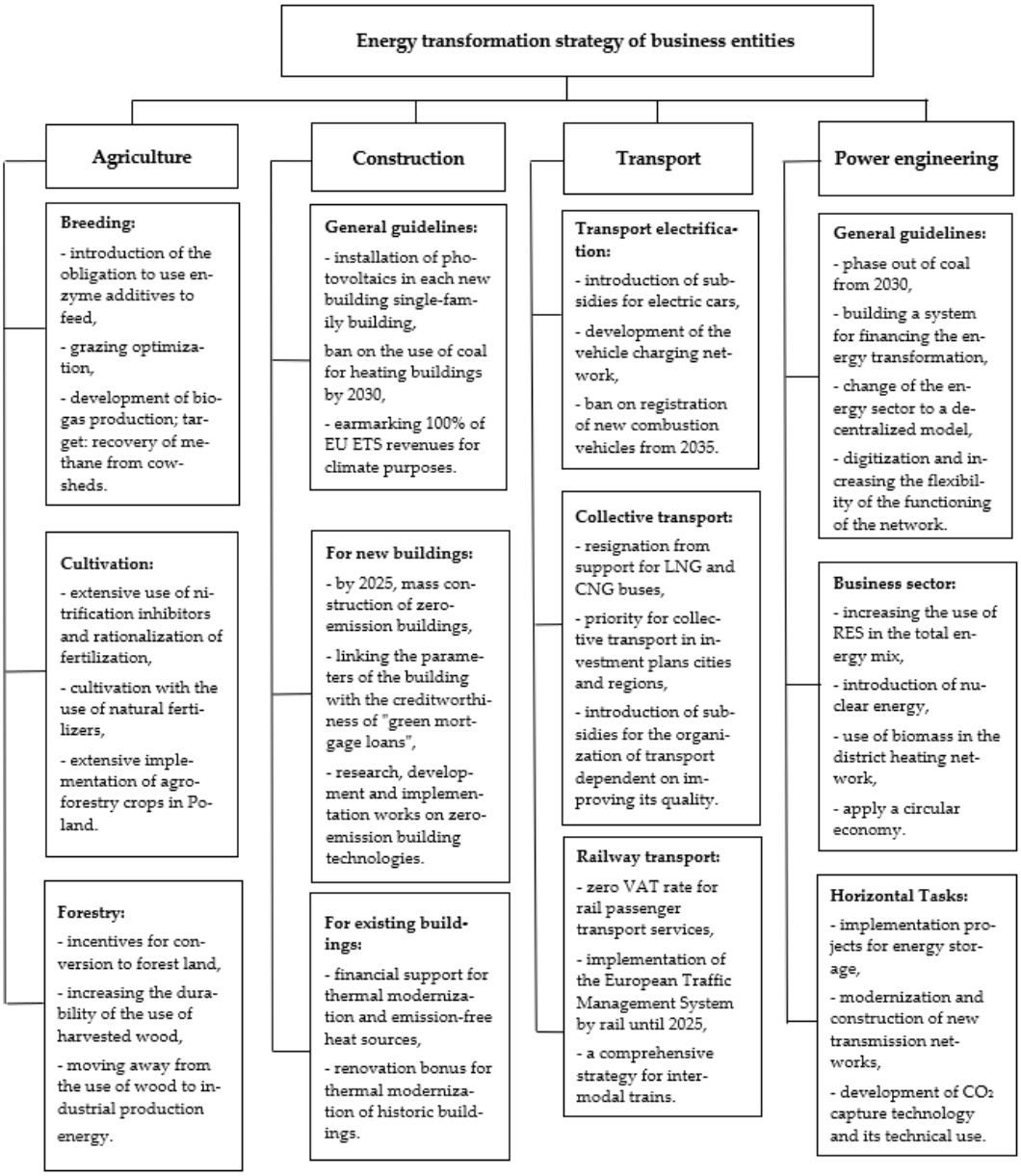

Figure 2. Key elements of the energy transformation strategy of Polish business entities. Source: own study (Niekurzak M.).

They differ in the concepts of social and technical architecture and business processes, they create different values, and they achieve different results. What they have in common is the use of different types of innovations to create value; hence, they can be included in the models of innovative business concepts, in which innovations are used to create new value for the customer (prosumer). In the case of a biogas plant, an important advantage of the business model may be the creation of high social value. The investment enables the development of local green resources and waste. The obtained electricity and heat can be used, for example, for social utility facilities. A passive building means high energy savings and comfortable conditions for its users. The prosumer photovoltaic farm still brings small benefits to its investors. Given the problems of the need to increase the security energy sector, this form of innovative business requires the use of effective support instruments, encouraging citizens to invest in "domestic" RES [61]. It should be added that in the current economic reality, the application of innovative energy models requires the co-financing of such projects from aid funds.

The proposed business model in the knowledge-based economy makes it possible to respond to flexible adaptation to frequent changes in the energy market and to the changing needs of customers [62]. This will happen especially when the energy market in Poland and the European Union is completely freed up, because then the price of energy will be set on the market and companies will start to compete with each other with the availability of production technologies, production capabilities and, above all, the quality of customer service and value-added services offered to them. In addition, this model fully corresponds to the pillars of the knowledge-based economy, creating innovative solutions, and educational systems at the organizational and local level and by creating regional innovative systems based on renewable energy and innovative energy agriculture, giving opportunities for the development of knowledge, technology, and entrepreneurship at the regional level in Poland. Thanks to this, this model becomes an innovative business model that may be subject to constant changes.

4.3. An Example of a Prosumer Business

In the described company, the method of settling the energy generated by the photovoltaic installation consists of the sale of surplus electricity to the distributor with whom the company has a contract, at a fixed price (at the moment it is EUR 79/MW) and the purchase of energy when it is needed, also at a fixed price (currently EUR 213/MW including the transmission fee). Payments are made both ways after each billing period (both for energy sold and purchased by the company). From the company's point of view, the profitability of owning a photovoltaic installation is justified only in the case of high self-consumption or in the case of having an energy storage facility. In the analyzed company, even though the degree of self-consumption is very high, there are times when surplus energy is sold, mainly on days off. The research was conducted in the period from May 2020 to July 2022. The data collected over this period made it possible to reflect on the functioning and impact of the photovoltaic installation on the consumption of electricity taken from the grid. Figure 3 shows exemplary data obtained from the daily production of the analyzed installations for the period 5–26 September 2022.

The analysis of Figure 3 shows a downward trend in the energy produced by the photovoltaic installation. This decline is not sudden, but there are smaller and smaller peaks for individual days, and there are also days when the production is significantly higher, but these are increasingly rare cases. The reason for this situation is the month in which the survey was conducted and the degree of insolation during this period. The sum of all results for individual years of operation of the entire photovoltaic system is shown in Figure 4.

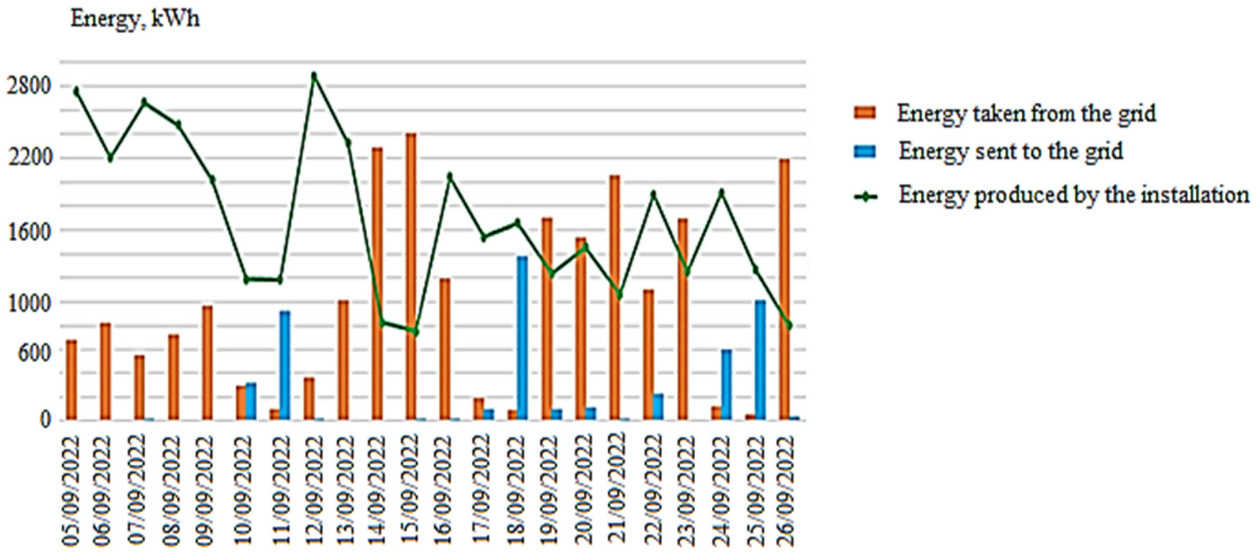

Figure 3. Distribution of energy consumption in the enterprise. Source: own study.

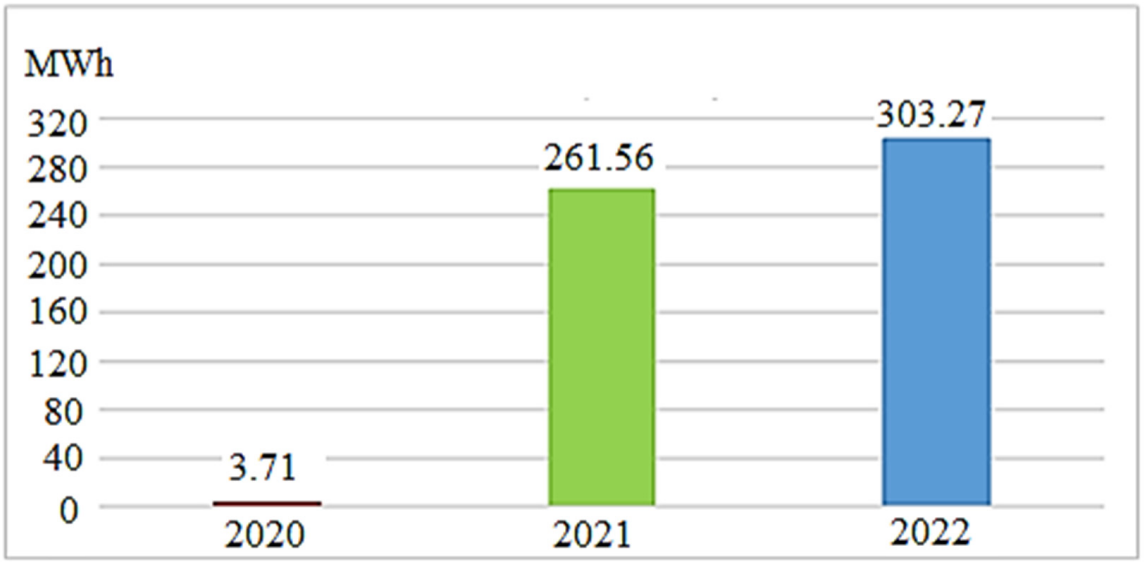

Figure 4. Total production in 2020–2022, photovoltaic installation 653.89 kWp. Source: own study.

Thanks to the use of the potential for photovoltaics in the company and the construction of new installations, the capacity of the photovoltaic installations increased, which made the production higher every year. After summing up the results for individual years, over the entire period of operation, the photovoltaic installation with a capacity of 653.89 kWp produced 1065.624 MWh of electricity for the company, which was mostly used for the needs of the company's production. Figure 5 presents the results of energy consumption from the grid and energy sent to the grid in the period from October 2021.

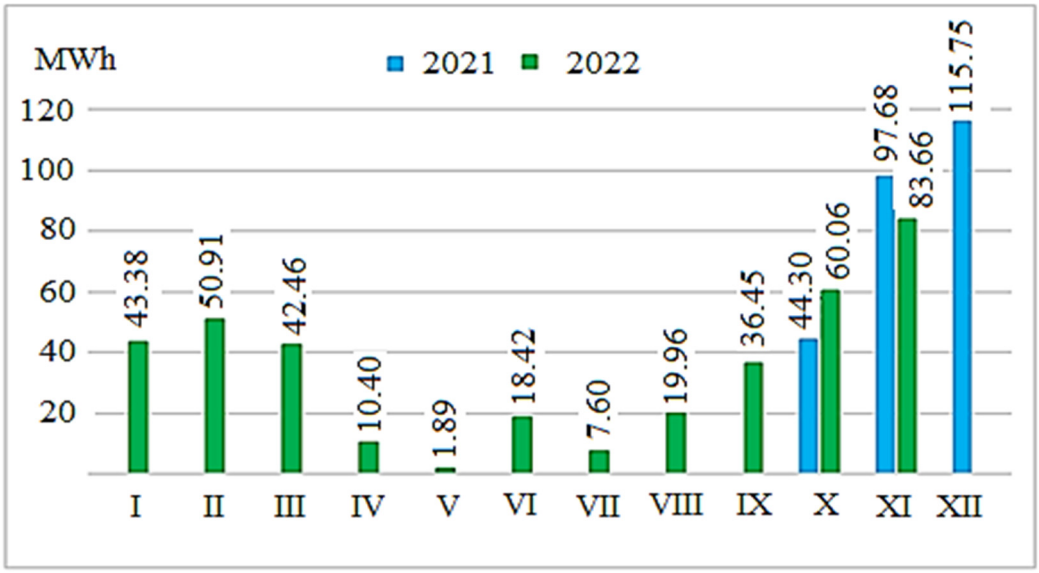

Figure 5. Electricity is taken from the distribution network by the company in 2021–2022, with photovoltaic installation 632.91 kWp. Source: own study.

In 2022, the amount of energy taken from the grid for production purposes was over 375 MWh, which, with the production by photovoltaic installations for this year in the amount of over 612 MWh, means that the annual energy consumption in the company oscillates around 850 MWh, and the energy produced by the system photovoltaic covers more than 60% of the total consumption. Figure 6 presents the results of energy consumption from the grid and energy sent to the grid in the period from October 2021.

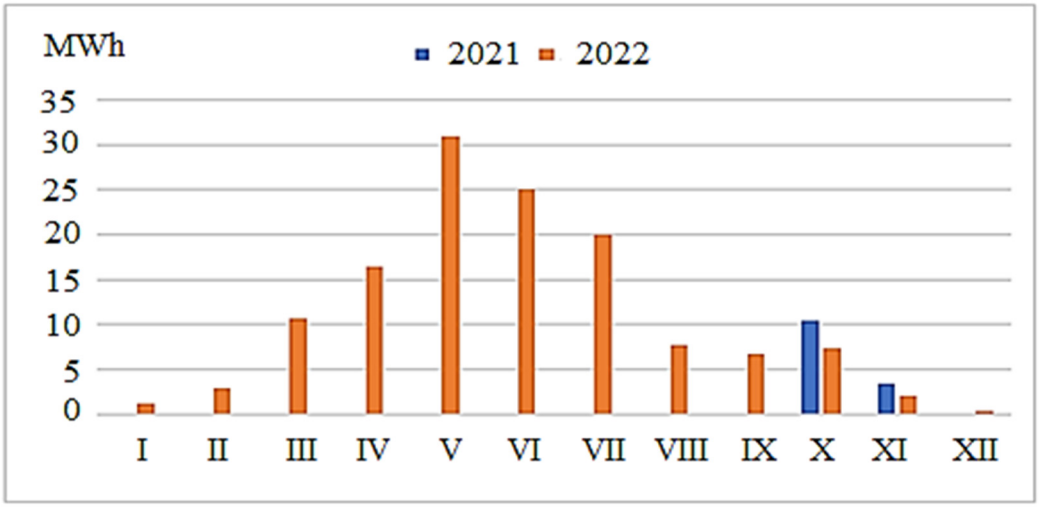

Figure 6. Energy sent to the distribution network by the company in 2021–2022, photovoltaic installation 632.91 kWp. Source: own study.

The obtained results provided comprehensive data on the functioning of the photovoltaic installation in the analyzed company and allowed us to determine the proportions in which energy is consumed in the company. Using the data from the entire study, the payback period and savings for the company for the energy generated by the installations over the entire period of its operation were calculated.

✓ Savings generated by the entire 653.89 kWp photovoltaic installation:

- Period of operation from 2020 to 2022;
- Energy produced during operation: 1065.624 MWh;
- Rate for energy from the network: EUR 213/MWh;
- Company savings thanks to the energy produced in this period: EUR 226,622.87.

✓ Rate of return on investment [63]:

$$\frac{\text{photovoltaic installation costs}}{\text{annual costs without PV installation} - \text{annual costs with PV installation}} = \frac{1,536,200}{834,331 - 318,208} = \frac{1,536,200}{516123} = 2.98 \approx 3 \text{ years}$$

The payback period of the installation, assuming the results and data for 2022 are 3 years. Thanks to these calculations, only a simplified calculation is presented, which does not take into account possible financing costs, operating costs, or financial ratios such as inflation or change in the value of money over time. The calculations do not take into account the operation time of individual installations, but the starting point is the first full period of operation of the entire installation. This does not change the fact that in the case of high self-consumption, which is the case in the described company, so these results give an optimistic view of the photovoltaics in the company, even if the calculated payback period, as a result of the above dependencies, was extended by half.

Summing up, the conclusions resulting from all the studies allow us to conclude that the use of a photovoltaic installation in an enterprise has its practical justification. Taking into account both the efficiency of work and the economic background, it can be stated that there is a high incidence of energy yields, and as a consequence, significant reductions in the costs incurred by the company for electricity consumption.

5. Conclusions

The energy industry is an important sector of the economy, decisive for the social, economic, and civilizational development of each country. Its strong impact on the environment and climate change means that the energy sector belongs to the field of the global economy where major technological and organizational transformations are taking place. They influence not only changes in the business models of operating energy companies, but

also generate new models in which knowledge management and environmental management play a dominant role. The article presents the concepts of business models in the field of innovative energy on the example of a prosumer/customer of a photovoltaic installation. The presented model represents only a part of many solutions in the area of RES. They differ in the concepts of social and technical architecture and business processes, they create different values, and they achieve different results depending on how knowledge is managed. What they have in common is the use of different types of innovation to create value; hence, they can be included in the models of an innovative business concept, in which knowledge and innovations are used to create new value for the prosumer. In the case of a photovoltaic installation, an important advantage of the presented business model is the creation of high social value and the possibility of obtaining effective environmental protection. Given the problems of the need to increase energy security, this form of innovative business requires the use of effective support instruments, encouraging citizens to invest in "home" RES. It should be added that in the current economic reality, the application of innovative energy models requires the co-financing of such projects from aid funds.

The conducted research on the use of the knowledge and environment management method in innovative processes, preceded by literature studies, allows for the following conclusions to be drawn:

- Increasingly, knowledge management is used by enterprises as an effective tool to change the way they operate and adapt to changes in the environment in the conditions of the ongoing energy transformation. This inexhaustible resource enables a quick and flexible response to the needs of the dynamically changing market and aids in making the right strategic decisions.
- The use of a photovoltaic installation in the company based on the business model is justified in practice and allows businesses to reduce the electricity costs incurred by the company, in this case by about 60%.
- Thanks to the knowledge management aspects, it is possible to analyze the distribution of energy, with a subdivision into energy consumed and sent to the grid, as well as taking into account the amount of energy produced by the photovoltaic installation, depending on weather conditions.
- Based on the analysis of the measurement results, the annual energy consumption oscillates around 850 MWh, and an installed photovoltaic installation covers over 60% of the total demand. These data give a positive assessment of the functioning of business models and their effective use for various investments in RES.
- The savings generated in a relatively short period from the analyzed prosumer/customer installation prove that this installation allows for significantly reduce electricity costs. Taking into account the result for the calculated payback period of 3 years, it proves that such an investment is very profitable for the company.

Summing up, the conclusions resulting from all the studies allow us to conclude that the use of a photovoltaic installation in an enterprise based on the business model of knowledge and environmental management has its practical justification. Taking into account both the work efficiency and the economic background, high energy yields can be seen, and as a consequence, a significant reduction in the costs incurred by the company for electricity consumption.

A certain limitation of the research was the use of a deterministic approach to take into account the profitability of a given investment. To develop more efficient models, a hybrid approach should be considered that combines machine learning and fuzzy logic techniques, taking into account all boundary conditions and determinants of the input data. Better forecasts obtained in this way will allow for the building of innovative business models based on knowledge management and will contribute to their more effective use in various sectors of the economy as well as the promotion of renewable energy sources. The future research agenda will be based on the use of these tools and more data based on measurements taken to build this type of innovative business model.

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References

1. Szymańska, W.K.; Walecka, A. *Wybrane Aspekty Zarządzania Nowoczesną Organizacją*; Polskie Towarzystwo Ekonomiczne Oddział w Łodzi: Łodź, Poland, 2012.
2. Al Shaar, E.M.; Khattab, S.A.; Alkaied, R.N.; Manna, A.Q. The Effect of Top Management Support on Innovation: The Mediating Role of Synergy Between Organizational Structure and Information Technology. *Int. Rev. Manag. Bus. Res.* **2015**, *4*, 499.
3. Griffin, R. *Podstawy Zarządzania Organizacjami*; PWN: Warszawa, Poland, 2017.
4. Klimczok, M.A.; Tomczyk, A. Zarządzanie wiedzą—Współczesna koncepcja zarządzania przedsiębiorstwem. *Zesz. Nauk. Wyższej Szkoły Humanit. Zarządzanie* **2012**, *2*, 165–174.
5. Bosma, N.; Wennekers, S.; Amoros, J.E. *Global Entrepreneurship Monitor 2011 Extended Report: Entrepreneurs and Entrepreneurial Employees Across the Globe*; Global Entrepreneurship Research Association: London, UK, 2012.
6. Gierszewska, G. *Zarządzanie Wiedzą W Przedsiębiorstwie*; Oficyna Wydawnicza Politechniki Warszawskiej: Warszawa, Poland, 2011.
7. Czarkowski, J.J. *E-learning Dla Dorosłych*; Diffin: Warszawa, Poland, 2012.
8. Dalkir, K.; Liebowitz, J. *Knowledge Management in Theory and Practice*; MIT Press: Cambridge, MA, USA, 2011.
9. Klimek, J. *Inteligentny Rozwój Firmy Rodzinnej a Współczesne Wartości*; Warszawa: Warszawa, Poland, 2019.
10. Kozioł, M. Wykorzystanie e-learningu w procesie szkolenia pracowników małych i średnich przedsiębiorstw. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej* **2013**, *22*, 45–57.
11. Miodek, P.; Speer, Ł. Inżynier globalny—Z perspektywy prawa i zarządzania. *Przedsiębiorstwo Przyszłości* **2014**, *1*, 50–51.
12. Tworek, K.; Walecka-Jankowska, K.; Martan, J. Structure reorganization due to IT information functions support for knowledge management. *China-USA Bus. Rev.* **2015**, *14*, 216–227.
13. Walczak, W. Zarządzanie wiedzą w przedsiębiorstwie. *Ekonomika i Organizacja Przedsiębiorstwa* **2009**, 1–10.
14. Juchniewicz, M.; Grzybowska, B. *Innowacyjność mikroprzedsiębiorstw w Polsce*; PARP: Warszawa, Poland, 2010.
15. Nieć, M. Sytuacja mikroprzedsiębiorstw w Polsce w latach 2011–2012. In *Raport o Stanie Sektora Małych i Średnich Przedsiębiorstw w Polsce w Latach 2011–2012*; Tarnawa, A., Zadura-Lichota, P., Eds.; PARP: Warszawa, Poland, 2013.
16. Sułkowski, Ł. *Metody Zarządzania Współczesnym Przedsiębiorstwem*; SAN: Łodź, Poland, 2015.
17. Drucker, P.F. *Myśli Przewodnie*; Wydawnictwo MT Biznes sp. z o.o.: Warszawa, Poland, 2008; ISBN 978-83-61040-37-8.
18. Wróblewska, V. Charakterystyka wpływu czynnika strategicznego na zarządzanie wiedzą. In *Przedsiębiorczość i Zarządzanie, XV(111)*; Gołębiowska, E., Ed.; Wydawnictwo SAN: Łodź, Poland, 2014.
19. Jaruzelski, B.; Dehoff, K. The global innovation 1000, Strategy and Business. *Tech Innov.* **2010**, *61*, 48.
20. Kowalczyk, A.; Nogalski, B. *Zarządzanie Wiedzą. Koncepcja i Narzędzia*; Difin: Warszawa, Poland, 2007.
21. Liao, C.; Chuang, S.H.; To, P.L. How knowledge management mediates the relationship between environment and organizational structure. *J. Bus. Res.* **2011**, *64*, 728–736. [CrossRef]
22. Dobni, C.B. The relationship between innovation orientation and competitive strategy. *Int. J. Innov. Manag.* **2010**, *14*, 331–357. [CrossRef]
23. Fidel, P.; Schlesinger, W.; Cervera, A. Collaborating to innovate: Effects on customer knowledge management and performance. *J. Bus. Res.* **2015**, *68*, 1426–1428. [CrossRef]
24. Janczewska, D. Logistyczno-marketingowe uwarunkowania transferu wiedzy w sektorze mikroprzedsiębiorstw. *Pr. Kom. Geogr. Przemysłu Pol. Tow. Geogr.* **2013**, *21*, 225–238. [CrossRef]
25. Svejenova, S.; Planellas, M.; Vives, L. An Individual Business Model in the Making: A Chef's Quest for Creative Freedom. *Long Range Plan.* **2010**, *43*, 408–430. [CrossRef]
26. Shafer, S.M.; Smith, H.J.; Linder, J.C. The Power of Business Models. *Indiana Univ. Bus. Horiz.* **2005**, *48*, 199–207. [CrossRef]
27. Demil, B.; Lecocq, X. Business Model Evolution: In Search of Dynamic Consistency. *Long Range Plan.* **2010**, *43*, 227–246. [CrossRef]
28. Johnson, M.W.; Christensen, C.M.; Kagermann, H. *Reinventing Your Business Model*; Harvard Business Review: Cambridge, MA, USA, 2008; Volume 86.
29. Gołębiowski, T.; Dudzik, T.M.; Lewandowska, M.; Witek-Hajduk, M. *Modele Biznesu Polskich Przedsiębiorstw*; Szkoła Główna Handlowa w Warszawie: Warszawa, Poland, 2008.
30. Osterwalder, A.; Pigneur, Y. *Business Model Generation: A Handbook of Visionaries, Game Changers, and Challengers*; Strategyzer Series; Wiley: Hoboken, NJ, USA, 2010.
31. Brzóska, J. *Innowacje Jako Czynnik Dynamizujący Modele Biznesowe*; Wydawnictwo Politechniki Śląskiej: Gliwice, Poland, 2014.

32. Hamel, G. *Leading the Revolution*; Harvard Business School Press: Boston, MA, USA, 2002.
33. Prahalad, C.K.; Krishnan, M.S. *New Age of Innovation*; McGraw Hill: New York, NY, USA, 2008.
34. Obłój, K. *Tworzywo Skutecznych Startegii*; PWE: Warszawa, Poland, 2002.
35. Matusiak, B. *Modele biznesowe na nowym zintegrowanym rynku energii*; Uniwersytet Łódzki: Łódź, Poland, 2013.
36. Toffler, A. *Budowa Nowej Cywilizacji: Polityka Trzeciej Fali*; Wyd. Zysk I S-ka: Poznań, Poland, 1996; ISBN 83-7150-102-1.
37. Kwast, U.; Herman, U. Wiedza jako czynnik konkurencyjności polskich przedsiębiorstw. In *Zarządzanie wiedzą. Wybrane Problem*; Szuwarzyński, A., Ed.; Zakład Zarządzania Wiedzą i Informacją Naukowo-Techniczną: Gdańsk, Poland, 2004; ISBN 83-88617-02-8.
38. Kisielnicki, J. Kapitał intelektualny w procesie zarządzania wiedzą: Relacje i czynniki. *Probl. Zarządzania* **2007**, *4*, 26–42.
39. Skrzypek, E. *Jakość i Efektywność*; Wydawnictwo UMCS: Lublin, Poland, 2002; ISBN 83-227-1626-5.
40. Trajer, J.; Paszek, A.; Iwan, S. *Zarządzanie Wiedzą*; PWE: Warszawa, Poland, 2012; ISBN 978-83-208-2015-7.
41. Mikuła, B. Geneza, przesłanki i istota zarządzania wiedzą. In *Zarządzanie Wiedzą w Przedsiębiorstwie*; Perechuda, K., Ed.; Wydawnictwo Naukowe PWN: Warszawa, Poland, 2005; ISBN 83-01-14492-0.
42. Kaczmarek, B.; Sikorski, C. *Podstawy Zarządzania*; Wyd. Absolwent: Łódź, Poland, 1999.
43. Kulińska, E.; Kulińska, K. Development of ride-sourcing services and sustainable city logistics. *Transp. Res. Procedia* **2019**, *39*, 252–259. [CrossRef]
44. Wilmańska, A. (Ed.) *Raport o Stanie Małych i Średnich Przedsiębiorstw w Polsce w Latach 2008–2009*; PARP: Warszawa, Poland, 2010.
45. Gobble, A.M. Innovation and strategy. *Res.-Technol. Manag.* **2012**, *55*, 63–67. [CrossRef]
46. Eurostat Statistics Explained, Electricity Price Statistics. 2023. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics (accessed on 24 April 2023).
47. Solar Power Europe—Leading the Energy Transition. 2023. Available online: https://www.solarpowereurope.org/events2/solarpower-summit-2 (accessed on 24 April 2023).
48. IEO Instytut Energetyki Odnawialnej. Główny Raport Solar. Rynek Fotowoltaiki w Polsce. 2019. Available online: https://ieo.pl/pl/projekty/raport-rynek-fotowoltaiki-w-polsce-2019 (accessed on 24 April 2023).
49. IEA. *World Energy Outlook 2019—Analysis—IEA*; Part of World Energy Outlook IEA: Paris, France, 2019; ISBN 978-92-64-97300-8.
50. Bukowski, M.; Śniegocki, A. Forum Energii. Polska Energetyka 2050—4 Scenariusze. 2017. Available online: https://forum-energii.eu/pl/analizy/polska-energetyka-2050-4-scenariusze (accessed on 24 April 2023).
51. Green, M.A.; Dunlop, E.D.; Hohl-Ebinger, J.; Yoshita, M.; Kopidakis, N.; Hao, X. Solar Cell Efficiency Tables (Version 56). *Prog. Photovolt. Res. Appl.* **2020**, *28*, 629–638. [CrossRef]
52. Modanese, C.; Laine, H.; Pasanen, T.; Savin, H.; Pearce, J. Economic Advantages of Dry-Etched Black Silicon in Passivated Emitter Rear Cell (PERC) Photovoltaic Manufacturing. *Energies* **2018**, *11*, 2337. [CrossRef]
53. Lachiewicz, S.; Nogalski, B. *Osiągnięcia i Perspektywy Rozwoju Nauk o Zarządzaniu*; Wolters Kluwer Business: Warszawa, Poland, 2010.
54. Kulińska, E. Model of Axiological Dimension Risk Management. *Found. Manag.* **2016**, *8*, 211–226. [CrossRef]
55. Tworek, K. *Wpływ Technologii Informacyjnych na Struktury Organizacyjne Przedsiębiorstw*; Oficyna Wydawnicza Politechniki Wrocławskiej: Wroclaw, Poland, 2014.
56. Miroński, J. Wyzwania zarzadzania wiedzą w zespołach wirtualnych. *E-mentor* **2014**, *5*, 50–55. [CrossRef]
57. Pietrzyk, S. Innowacyjne podejście do zarządzania wiedzą na przykładzie szkolenia osób 50+. *Przedsiębiorczość i Zarządzanie* **2015**, *16*, 9–21.
58. Stefaniuk, T. *Komunikacja w Zespole Wirtualnym*; Diffin: Warszawa, Poland, 2014.
59. Kancelaria Sejmu, R.P. *Dz.U. 2022 poz. 2370 Ustawa z dnia 29 Września 2022 r. o Zmianie Ustawy—Prawo Energetyczne Oraz Ustawy o Odnawialnych Źródłach Energii*; Sejm RP: Warszawa, Poland, 2022.
60. Niekurzak, M. The Potential of Using Renewable Energy Sources in Poland Taking into Account the Economic and Ecological Conditions. *Energies* **2021**, *14*, 7525. [CrossRef]
61. Hayibo, K.S.; Pearce, J.M. A review of the value of solar methodology with a case study of the US VOS. *Renew. Sustain. Energy Rev.* **2021**, *137*, 110599. [CrossRef]
62. Stamatellos, G.; Zogou, O.; Stamatelos, A. Energy Performance Optimization of a House with Grid-Connected Rooftop PV Installation and Air Source Heat Pump. *Energies* **2021**, *14*, 740. [CrossRef]
63. Mikulik, J.; Niekurzak, M. Impact of a Photovoltaic Installation on Economic Efficiency on the Example of a Company with High Energy Consumption. *Zeszyty Naukowe Politechniki Śląskiej* **2023**, 521–540. [CrossRef]