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Review

Business Models on the Energy Market in the Era of a Low-Emission Economy

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Abstract: In the energy market, we observe a dynamic development of innovative business models that take into account various aspects related to the direction of zero-emission economic growth. Companies are intensifying their efforts in utilizing renewable energy sources, implementing significant photovoltaic projects, and advancing technologies related to wind and hydrodynamic energy. Within this trend, microgrids become a crucial element, enabling efficient management of local energy sources. Contemporary energy companies also focus on innovative digital technologies, harnessing the potential of the Internet of Things (IoT) and artificial intelligence (AI). These tools allow for precise monitoring and optimization of energy consumption, resulting in increased operational efficiency. The expansion of subscription-based energy services encompasses not only traditional energy deliveries but also new aspects, such as intelligent management of home energy installations or the provision of advisory services on energy conservation. This approach emphasizes the customer as a partner in sustainable energy usage. Hybrid energy models, integrating diverse energy sources, constitute a key element in the transformation of the sector. The combination of photovoltaic, wind, and traditional power plants allows for flexible adaptation to changing conditions and maintains stability in the energy supply. In the face of a changing energy landscape, companies consistently strive for sustainable practices, implementing strategies that not only reduce their carbon footprint but also contribute to improving efficiency, ecology, and the decentralization of the energy system. Adapting to these dynamic changes becomes not only a challenge but also an opportunity to create a more sustainable energy future. The objective of this research is to analyze key business models in the energy market and identify their impact on operational efficiency and market competitiveness. The main results indicate significant improvements in energy management and sustainability through the adoption of these models.

Keywords: business model; energy transition; energy market; ESCO; EaaS; business model classification

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1. Introduction

In the face of the growing challenge of climate change and the need to reduce greenhouse gas emissions, the energy sector is undergoing fundamental transformations. The leading idea is the transition towards a zero-emission economy, resulting in a revolution in business models in the energy market. The shift to renewable energy sources (RES) and modern technologies poses challenges for businesses but, at the same time, opens up broad perspectives for innovative approaches to energy generation, distribution, and consumption.

The research problem is the issue of building and implementing business models that will enable effective management of enterprises in the energy sector and will allow for flexible energy management through energy storage, intelligent consumption control, and integration with modern technologies. The main question that the researchers faced was what business models should be introduced in connection with the development of new technologies to effectively manage the energy sector.

One of the key business models gaining significance in the era of zero emissions is the model of distributed energy. Instead of relying on central energy sources, companies increasingly invest in distributed generation systems, such as micro photovoltaic installations or microwind turbines. This not only allows for emission reduction but also creates local power sources, increasing the energy independence of communities.

An innovative approach is also the Energy-as-a-Service (EaaS) model [1]. Instead of the traditional model of charging for the amount of energy consumed, companies offer customers comprehensive energy services, including efficient consumption management, RES, and even energy storage. This approach promotes energy efficiency and encourages more sustainable practices.

The energy platform model is also gaining importance. Creating digital platforms that integrate producers, distributors, and consumers enables more flexible and efficient energy exchange. Blockchain, the Internet of Things (IoT), and artificial intelligence play a crucial role in this revolution, providing transparency, security, and process automation [2].

However, on the path to a zero-emission economy, changes in financing models are also essential. The "pay-as-you-save" model, paying for energy savings, is gaining popularity. Investments in energy efficiency or RES installations are funded from the savings they generate, eliminating traditional financial barriers.

It is worth emphasizing that companies in the energy market, to operate effectively in the era of a zero-emission economy, must consider not only economic aspects but also social and ecological factors.

Previous research has shown that new skills will be needed if new business models need to be implemented. New business models will require people to have sales and marketing skills and employ knowledgeable workers [3,4]. The literature has also highlighted the need to implement models that have great potential to support energy flexibility in a cost-effective and sustainable way [5].

Recent studies by Richter [6] and Wainstein and Bumpus [7] have extensively examined the role of business models in the energy sector's transition towards sustainability. Richter [6] discusses the impact of distributed generation and the shift from traditional utilities to prosumer-oriented models. Wainstein and Bumpus [7] analyze the potential of innovative business models like EaaS in enhancing energy efficiency and customer engagement.

Other significant contributions include the work of Boamah [8], who highlights the integration of digital technologies in business models for the energy market, and Lüdeke-Freund et al. [9], who provide a comprehensive framework for sustainable business models in the energy sector.

The business model should be integrated with the principles of sustainable development, simultaneously ensuring active engagement with local communities and support for pro-environment initiatives. The novelty and added value to the existing knowledge lie in a detailed analysis of two business models and indicating the possibility of utilizing additional models that will enable the management of the energy sector in an innovative, efficient manner, allowing for the achievement of a zero-emission economy.

In the face of climate change, business models in the energy market must evolve towards a zero-emission future. Distributed energy, energy as a service, energy platforms, and innovative financing models are key elements of this revolution. Companies that take on these challenges and invest in sustainable practices will not only survive but also succeed in a dynamic and sustainable energy sector.

2. Materials and Methods

Scientific research forms the cornerstone of knowledge development and understanding the world around us. When analyzing business models in the energy sector, it is valuable to scrutinize existing and already published sources. One of the crucial stages of this process is the selection of appropriate research methods. One such method gaining increasing popularity is known as desk research, involving archival research also referred to as secondary research, or the use of existing sources of information. Many researchers use this method [10,11], and it is widely used in social sciences, economic sciences, and technical sciences [12,13], which confirms the validity of using this method in the research conducted.

Desk research relies on the analysis of available data, documents, reports, publications, or other existing sources before commencing the study. In the context of hypothetical-deductive research, this method proves highly effective in seeking answers to posed questions.

The primary strength of the desk research method is its accessibility. Researchers leverage pre-existing information, saving time and resources, particularly in the initial stages of the research process. This is particularly significant in the context of hypothetical-deductive research, where there is a need to gather the appropriate theoretical context on which subsequent stages of the study will be based.

Another aspect worth emphasizing is the extensive availability of diverse sources of information, such as Internet resources, databases, scientific articles, and institution reports—these are just a fraction of the sources that can be utilized in desk research. The wealth of available data allows for a holistic perspective on the research topic, which can be crucial in developing a specific research question.

It is also worth noting that the desk research method facilitates the analysis of historical data, which can be essential in studying the evolution of phenomena, trends, or processes. This enables researchers to direct their research questions toward understanding changes over time, providing invaluable contributions in the context of hypothetical-deductive research, where the aim is to deduce general regularities.

The utilization of the desk research method provides a comprehensive framework for the in-depth analysis of various issues directly associated with the research question, particularly focusing on the exploration and development of a business model. This model is envisaged (assumed) to play a pivotal role in not only fostering but also facilitating innovation and efficiency within the operational dynamics of the energy market.

Desk research studies constitute an extremely important element of the research process, and their application has allowed for a deepening of knowledge in the field of business models. Through the review and analysis of previously published research in this area, it was possible to gather significant knowledge about various approaches and strategies employed by companies in the creation, development, and adaptation of business models. Thanks to desk research studies, trends, patterns, and proven practices in this area were identified, enabling an understanding of which strategies are most effective in different business contexts. Additionally, the research facilitated an analysis of factors influencing the effectiveness and durability of implemented models (including the prosumer model, ESCO model, network operator model, and virtual power plant model).

As a result, desk research studies not only allowed for a thorough understanding of existing business models but also contributed to proposing new and innovative solutions in the energy sector (such as virtual power plants and value-added activators). They enable better utilization of available knowledge and more effective adjustment of business strategies to changing market conditions and customer needs.

The main elements of desk research are listed below:

Defining research objectives—Determining the specific objectives and scope of the study to determine what information and data are needed. In the case of this scientific research, the main goal is to analyze and indicate the possibility of creating innovative market models among energy companies to achieve low emissions.

Setting search criteria—Selecting appropriate search criteria such as keywords, thematic categories, or specific sources of information related to business models, zero-emission or low-emission.

Data mining—Browsing available sources of information, such as databases, research articles, industry reports, or books, to gather relevant data and materials.

Selection and evaluation of materials—Analysis of the collected materials in terms of their usefulness, credibility, and connection with the research topic and their substantive value.

Data analysis and interpretation—Processing collected data to draw conclusions and identify trends, patterns, or relevant information.

Presentation of results—Preparation of a scientific article transparently presenting research results and documenting the sources and methods used.

Quality control—Checking the accuracy, completeness, and reliability of collected data and materials.

However, it is essential to remember that the desk research method has its limitations. Depending on the research topic, there is a risk that some information may not be available or may be incomplete. Furthermore, there is a risk of subjectivity, especially if the sources of information are not adequately verified.

The applied desk research method is a valuable tool in the analysis of hypothetical-deductive research. Its accessibility, wealth of sources, and ability to analyze historical data make it a technique that effectively supports the process of generating and testing scientific hypotheses. Of course, the application of this method requires a judicious selection of sources, critical analysis of information, and a focus on precisely defined research questions.

3. Results and Discussion

Energy companies aiming to function effectively in contemporary conditions, especially within the framework of the so-called energy transformation, must abandon the belief in their permanence and excellence and acquire the ability to adapt to market requirements. Due to the continuous and abrupt variability of conditions, they must create new characteristics, behaviors, and attitudes that will constitute an adequate response to the globally transforming reality. In this regard, the issue of business models and their utilization may become a priority for scientific exploration in the near future within the realm of management science for contemporary enterprises. Theoretical and empirical research on the business model in the energy industry is gaining importance. In the context of the energy market, the business model becomes a crucial tool describing how a company creates value, delivers products or services to customers, and generates revenues to sustain its operations. In this sector, the business model encompasses complex issues related to energy production, transmission, distribution, and sales.

The revenue structure in the energy business model may rely on various sources such as energy sales, distribution services, contracts for renewable energy sources, or innovative fee models like subscriptions for energy services. Cost sources encompass all expenses related to energy production, infrastructure maintenance, fuel purchases, or technologies. Contemporary business models in the energy market increasingly incorporate investments in renewable technologies and digital solutions, significantly influencing cost structures.

The value creation proposition in the energy business model may involve not only providing energy but also addressing issues related to sustainable development, energy efficiency technologies, or loyalty programs for customers.

The business model in the energy market must account for the unique challenges and opportunities of this sector, and its effectiveness depends on flexibility and the ability to adapt to the changing energy landscape and customer expectations.

Each business model defines the essence of a company's functioning, and in cases where it is not specified by intentional actions of the company's management, it can still be assumed that the company operates under a certain structure of mechanisms, a configuration of dependencies that determine a certain style of functioning. In the first and second decades of the 21st century, energy groups underwent consolidation and developed their business models. This is reflected in regulating internal and external relations, ways of organizing internal social relations, decision-making, planning actions, assuming risks, and approaches to fulfilling tasks and obligations towards the environment.

The process of energy transformation requires consistent implementation of energy efficiency and a fundamental shift in the source of energy supply towards renewable, CO_2-emission-neutral sources [14]. The decarbonization process of energy production favors the trend towards distributed production structures [15]. Furthermore, the digitization of processes and industries has an increasing impact on the energy sector and new players entering energy markets [16]. Traditional energy structures, which emerged after the liberalization of electricity and gas markets in Europe, including entrenched business models, are undergoing significant changes [17].

Strategic management in energy companies requires the selection of a business model that leverages the resources and competitive advantages available in the organization. A commercial approach to the market and the selection of a model that serves as a mechanism linking strategy to its economic outcomes are necessary. Business models are an art form because there is no true plan for their design, construction, or execution. Available business modeling tools facilitate this process. However, there is a research gap in the literature regarding tools for creating and describing business models in the energy industry. The business model determines and establishes the basis for how an entity will compete once it has defined the rules of the market game—where it will choose to participate and take its place in the game, the way the game is played, and the way to win.

There is a limited number of articles and studies in the scientific literature describing current or future business models related to the energy sector.

A critical review of existing literature on the subject allows for the identification of emerging trends. Firstly, paradoxically, research on business models often fails to define either the business model of energy companies or business models in a broader sense, as noted by J. Newcomb [18] and R. Lehr [19], among others. Secondly, many studies define and analyze individual business models or a small set of business models associated with a single technology without examining how these models may be competitive compared to others, for example, M. Bell, J. Creyts, V. Lacy, J. Sherwood [20], J. Vasconcelos, S. Ruester, He X., Chong E., Glachant [21], and Behrangrad [22].

Energy sector companies have little experience with non-traditional business models and often employ simple models, such as integrated and regulated or separate and unregulated, depending on the value chain segment. Until the end of the first decade of the 21st century, there was no need to refine these models to accommodate non-uniform markets or role separation. However, with energy becoming a commodity traded on the stock market, there arose the necessity to change the paradigm regarding energy supply. While energy companies are to ensure the country's energy security, this is to be achieved under market conditions.

In the second decade of the 21st century, energy companies developed and adopted various business models to stimulate value chain integration and integration within separate segments, such as energy trading, distribution, and generation. However, these business models, usually traditional in nature, were based on roles, such as asset owners—power plants, or broadly defined, such as distribution companies. The redesign of the business model accelerates with the increasing pace of technological development and the emergence of efficient startups in the sector. The scope of potential business models offers a broader picture of the nature of future roles of energy companies and questions conventional norms regarding their place in the value chain.

In such a delineated reality, management sciences, through their methodological potential, must identify, diagnose, and project emerging business models. The increased interest in the issue of business models in energy is associated with the following six elements [23]:

- Applicability of the business model as a transparent and understandable concept of creating value for customers and shareholders of energy companies at every stage of the value chain, i.e., extraction, generation, trading, and distribution;
- The potential use of the business model as a carrier of innovation in the areas of processes, products, marketing activities, and CSR. In the energy sector undergoing transformation, the use of business models in innovative initiatives will become an area of particular interest for company managers (emergence of new technologies, electromobility, relationships with customers—prosumers);
- Seeking methods to achieve competitive advantages. Business models focused on achieving competitive advantages in terms of process and cost optimization will be

replaced by business models focused on delivering value to customers and achieving greater profitability in operational activities through new revenue streams;
- Strategic management through the identification and application of the business model as a business activity architecture aimed at delivering lasting value to shareholders by generating income and transforming business activities into profitable areas while maintaining energy security in the face of increasing climate policy requirements;
- Application of the business model to build the company's development strategy. The possibility of examining the impact of the business model on the way of development, both internal and external, through mergers, acquisitions, and business partnerships;
- Benchmarking of the business models used in Poland to those used in Europe. Considering the Energy Union and policies related to the harmonization and liberalization of energy markets, business models in Poland must follow more developed foreign markets.

As a result of the review of research and analysis concerning energy, five main trends shaping business conduct and creating value for customers and shareholders can be presented [24,25] as follows:

- Trend 1—Introduction of a two-way market—capacity market, EU decarbonization policy, and subsequent regulations aimed at reducing emissions, the introduction of the qualitative regulation model in distribution, changes in the support system for RES installations, and EU actions towards a common electricity market;
- Trend 2—Changing forecasts for electricity prices, oversupply and coal prices, electricity demand, power demand, increasing competition in the retail market, increasing level of RES generation with simultaneous withdrawal of European players, and limited funding for conventional energy;
- Trend 3—Increasing customer awareness and demands in terms of meeting needs and the complexity of offerings, increasing expectations regarding quality and availability of customer service;
- Trend 4—Falling prices of renewable and distributed technologies, increasing competitiveness of these sources compared to conventional sources, changing role of distribution in relation to the development of distributed energy, development of smart technologies, microgeneration, and energy storage;
- Trend 5—Electromobility.

Trends 1 and 2 signify the introduction of a two-way market and a change in the generation structure, resulting in an increased share of renewable energy sources and the gradual phasing out (by 2040) of decommissioned coal power plants. This trend, visible to a much lesser extent in the Polish market, will require players in the generation market to adjust their strategies. To create investment incentives in the generation sector, a capacity market was introduced, allowing for new investments.

The situation in the energy market and climate policy leads to reduced profitability of electricity production in conventional sources and even significant financial losses. Consequently, energy producers in such sources are forced to take action to restore profitability in the medium and long term. Besides the capacity market, which stimulates investments in generation, companies are conducting development activities aimed at optimizing and reducing the level of fixed and variable production costs and effectively managing capital expenditures (e.g., for new investments, modernization, and repairs).

Trend 3 signifies the development of product offerings in the electricity sales market, which has ceased to be treated by end customers and energy companies as a public good and has become a market product. To compete in the market, sellers must build an enticing value proposition for diverse customer groups.

In the sales segment, changing customer behavior and intensifying competitive struggles indicate three main challenges for electricity sellers: loss of customer base, margin erosion, and acquiring new customers. A changing customer base and deteriorating profitability require companies to develop tools and take action to secure their current position on one hand and capitalize on emerging market opportunities on the other. Three strategies to win in the market are as follows:

- Understanding and managing the customer base;
- Intelligent partnership;
- Building an "energy" value proposition.

Trend 4 signifies assigning new roles to distribution system operators (DSOs)—the development of renewable energy sources (RES) and new obligations for DSOs necessitate significant investments in the distribution network and the creation of a platform for collaboration and information exchange with consumers. Due to the natural monopoly in the electricity distribution area, DSOs do not have as tangible a dimension as in competitive areas of the energy market. This allows for the identification of three groups of business actions/strategies that distinguish efficient and modern DSOs from distributors solely relying on their historical position. With the introduction of elements compensating for the effects of actions into the tariff system by the Energy Regulatory Office, higher efficiency should also lead to better results in the medium term. The three identified strategies are as follows:

- Smart DSOs;
- Efficient DSOs;
- DSOs as distributors of information, not just energy.

Trend 5 denotes the development of business around charging infrastructure, which can, in turn, contribute to the achievement of various strategic goals. Some companies may opt for limited involvement, including only single chargers or company cars. These actions aim to improve their image and support company promotion. More complex strategies may involve using funds from investments in this area to strengthen and modernize the power grid. This business can also improve customer retention by creating appropriate products. It can also strengthen defense against competition, which will have an attractive e-mobility offer combined with basic energy products, which in turn may increase customer churn rate. A well-crafted strategy can thus lead to an increase in company value through increased revenue and margin mass from product and service sales.

Creating value for customers, one of the key elements that must be taken into account when defining a business model, involves considering trends in customer behavior. Based on PwC's analysis of consumer trends shaping the service market, those implying the type of business of energy companies in the energy trading area have been identified [26] as follows:

- Digitization of life;
- Seeking convenience;
- Value for money;
- Supporting ecology;
- Increasing transparency.

From the perspective of the market situation in Poland, three of them have been prioritized as the most relevant as follows:

- Digitization of life—the growing penetration of the Internet translates into the development of e-commerce and other alternative channels and models of service and sales (so-called multichannel);
- Seeking "convenience"—for customers, this element becomes an increasingly important purchasing criterion, which affects the development of convenient products and sales channels;
- "Value for money"—an increasing number of customers prefer good quality at a reasonable (not the lowest) price—a visible trend in the development of retail networks and private labels.

The analysis of energy companies in foreign markets indicates that these trends are taken into account when constructing business models and product offerings. One example could be the widespread introduction of simple and inexpensive products for customers seeking "value for money"; the section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Business Model in the Energy Sector

"It would be foolish to ignore the potential for significant changes in the business models of energy companies."—Theodore Craver Jr., CEO of Edison International [27]. Craver, working for one of the largest energy companies in the USA and serving as the president of the Edison Electric Institute, an industry organization representing American energy companies, is not alone in his belief that the business model of energy companies is on the verge of radical changes. A study conducted in 2013 showed that 94% of senior energy executives surveyed predict "a complete transformation or significant changes in the business model of energy companies" by 2030 [28].

These changes are primarily driven by the influx of distributed energy resources, including photovoltaics and other distributed generation, thermal and electrical energy storage, as well as more flexible and price-responsive demand-side management of electricity. Many predict that the changes brought about by distributed generation assets will be highly disruptive to the electric power sector and that without adaptation, traditional energy companies may fall into a "death spiral," threatening their financial profitability [29].

In a series of studies on business models in the energy sector, analyses of specific technologies are conducted without examining the full range of services that this technology provides or could provide (e.g., Huijben [30] or Weiller [31]). Only a small fraction of business model researchers have analyzed the business models of energy companies using an ontological approach. Some of these studies focus on subsets of business models that utilize specific technology (e.g., Schoettl and Lehmann-Ortega [32] or Okkonen and Suhonen [33]). Richter [34], in his research, utilizes case studies and surveys combined with an ontological approach to understand the business models of energy companies that utilize various renewable energy technologies.

Energy companies are undergoing a cultural shift towards a data-driven digital economy where core processes are digitized, and market flexibility is achieved through technical optimization [35]. Overall, researchers focusing on energy have primarily concentrated on technological aspects because the energy trading system and energy as a commodity are still in the early stages from a business perspective [36]. Alvaro-Hermana et al. [37] proposed a new business model for energy trading between two sets of electric vehicles. Inam et al. [38] discussed the microgrid structure in a distributed energy system with the division of electrical energy. Much theoretical work has been performed on blockchain technology, which can be used in a wide range of applications, including using electric vehicles in grid services to assist with congestion management, recording energy consumption data, billing, changing suppliers, exchanging production capacity, and so on [39]. Burger and Weinmann studied the development of blockchain technology and its potential in the energy sector [40]. Kim et al. [41] presented a scheme of peer-to-peer (P2P) energy loans using a blockchain-based P2P energy loan procedure. Recently, more attention has been given to the social and economic consequences of electricity trading. Giotitsas et al. [42] reviewed the evolution procedure of energy trading technology and examined its potential impact on the global socio-economic structure. Roy et al. [43], on the other hand, discussed the benefits and feasibility of peer-to-peer electricity trading on the Australian domestic electricity market, analyzing its social, economic, and technical aspects.

Existing energy trading systems are generally based on traditional energy contracts, which are settled centrally, and transactions must be made with the help of network companies. Bilateral agreements [44], hourly (or daily, so-called day-ahead) markets, ancillary service markets, and capacity markets are commonly used forms of the traditional business model in the energy sector [45]. On the other hand, the advancing digitization in energy provides opportunities for decentralization and deepening of these markets through the creation of new business models. Digitization in energy provides corporations, entrepreneurs, and startups with new opportunities to provide solutions and create new businesses in this sector. At this point, new business models are emerging that will capture a share of this total amount of existing energy expenditure. According to Cuofano, "(. . .) business modeling is about finding a systematic way to unlock long-term value for an organization while delivering valuable products and services simultaneously" [46].

In Poland, research on new concepts of the functioning of innovative energy companies suitable for the liberalizing energy market has been undertaken by B. Matusiak. The author believes that such a model should include the following information [47]:

- What is the specific value proposition for the participants of the model?
- What customer relationship model has been applied?
- What is the model for returning value from the invested capital?
- What is the configuration of all material and immaterial values involved in obtaining this value?

B. Matusiak characterizes the following five business models suitable for the integrated energy market [48]:

- The prosumer business model (exchange of value between customer and supplier);
- The ESCO (Energy Saving Company) model, which provides comprehensive energy management services;
- The market aggregator business model (a company operating between distributed energy producers and consumers);
- The business model of electric vehicle users in the energy market;
- The producer business model (application of large-scale ecological, often renewable energy sources).

The authors of this research have detailed the first two business models, the prosumer business model and ESCO, which are currently very popular and used in Poland and many other countries. The case of Poland serves as a valuable example for other countries due to its significant reliance on coal and the resulting urgent need for energy transformation. Transitioning to renewable energy sources is not only crucial for achieving climate goals but also for reducing emissions and mitigating environmental impact. Poland's proactive approach to investing in renewable energy showcases a feasible path towards achieving sustainable development and resilience in the energy sector. Additionally, the emergence of innovative business models in response to this transformation underscores the flexibility and potential scalability of these solutions to fit various contexts worldwide. The case of the applied business models in Poland and the country's situation allows for the extrapolation of these experiences to other countries. By observing and learning from Poland's experiences, other countries can gain valuable insights and strategies for effectively and efficiently conducting their own energy transformations.

The term "prosumer" is a portmanteau of "producer" and "consumer", representing a paradigm shift in the energy market. In the prosument model, individuals or entities are both producers and consumers of energy, actively participating in the generation and consumption of electricity. This concept challenges the traditional one-way flow of energy from centralized power plants to end-users, promoting a more decentralized and participatory approach [49]. For instance, countries like Poland, which is renowned for its progressive energy policies, and companies such as Columbus Energy S.A., with their innovative approach to integrating prosumer technologies, have led the way in transforming the energy landscape [50].

The prosument model encourages the decentralization of energy production. Rather than relying solely on large, centralized power plants, individuals, businesses, and communities can generate their own energy through renewable sources like solar panels, wind turbines, or other distributed energy systems.

Prosument models often emphasize the integration of renewable energy sources. Prosumers commonly invest in technologies that harness sustainable energy, reducing reliance on fossil fuels and contributing to environmental sustainability.

By becoming both producers and consumers, prosumers aim to achieve a degree of energy independence. They can generate their own power, store excess energy, and potentially even sell surplus energy back to the grid, contributing to a more resilient and self-sufficient energy ecosystem.

Prosument models leverage smart technologies and automation to optimize energy consumption. Smart meters, home energy management systems, and other IoT devices enable prosumers to monitor, control, and optimize their energy usage in real time, enhancing efficiency.

The prosument model challenges the traditional power grid by enabling two-way communication. Prosumers can feed excess energy into the grid during periods of surplus and draw power when their own production is insufficient, fostering a more dynamic and responsive energy infrastructure.

Prosument models often lead to the formation of community energy initiatives. Communities may collaborate to install shared renewable energy systems, creating local energy resilience and fostering a sense of collective responsibility for sustainability.

Prosumers can enjoy economic benefits through the prosument model. They may receive financial incentives for generating excess energy, selling it back to the grid, or participating in demand response programs. Additionally, prosumers can potentially reduce their energy bills through increased efficiency and on-site generation.

The prosument model poses regulatory challenges related to grid management, pricing structures, and energy market dynamics. Policymakers need to adapt regulations to accommodate the evolving role of prosumers, providing fair compensation for the energy they contribute to the grid.

The shift towards the prosument model aligns with broader environmental and social goals. Increased use of renewable energy and community-driven initiatives contribute to mitigating climate change, reducing dependence on non-renewable resources, and fostering a sense of shared responsibility for environmental stewardship.

The prosument model reflects a transformative approach to the energy market, emphasizing sustainability, community engagement, and technological innovation. As it continues to evolve, the prosument model has the potential to reshape the energy landscape, making it more resilient, inclusive, and environmentally friendly.

Solar photovoltaic installations installed and used by consumers are currently one of the most rapidly developing markets according to the prosumer model in the energy sector worldwide. In Table 1 below, the characteristic features of such a business model are presented.

Another business model worth exploring and analyzing due to its market potential is the ESCO (Energy Service Company), business model. The energy transformation and the aim to reduce CO_2 emissions and energy consumption require companies to increase energy efficiency.

ESCO, which stands for Energy Service Company or Energy Saving Company, is a business model that operates in the energy market with a focus on providing energy efficiency and sustainable energy solutions. ESCOs play a crucial role in helping clients, often commercial and industrial entities, improve energy performance, reduce energy consumption, and lower overall operational costs [51].

ESCOs typically offer a range of energy efficiency services, including energy audits, retrofitting, and the implementation of energy-efficient technologies. They identify areas where energy consumption can be optimized and propose solutions to enhance efficiency.

One distinctive feature of the ESCO model is performance contracting. In this arrangement, the ESCO guarantees a certain level of energy savings for its clients. The payment for ESCO services is often linked to the actual energy savings achieved, creating an incentive for the ESCO to deliver tangible results.

ESCOs may provide upfront funding for energy efficiency projects. Instead of clients bearing the entire financial burden of upgrades and improvements, ESCOs invest in the necessary technologies and services. The costs are then recovered over time through the achieved energy savings.

ESCOs are typically equipped with technical expertise in energy systems, renewable energy, and energy-efficient technologies. They leverage this knowledge to recommend and implement solutions that align with their clients' sustainability goals.

In addition to energy efficiency measures, many ESCOs are increasingly involved in the integration of renewable energy sources. This includes the installation of solar panels, wind turbines, or other sustainable energy solutions to further reduce reliance on conventional energy sources.

ESCOs often provide ongoing monitoring and maintenance services to ensure that the implemented energy efficiency measures continue to deliver the expected results. Regular assessments help identify opportunities for further optimization.

ESCOs are familiar with energy regulations and incentives, helping clients navigate compliance requirements and take advantage of available financial incentives for energy-efficient projects.

ESCOs tailor their services to meet the specific needs and requirements of each client. This customization ensures that energy efficiency solutions align with the operational context and goals of the businesses they serve.

The ESCO model contributes to the broader goal of creating a more sustainable and energy-efficient future by addressing energy challenges in a holistic manner. It aligns economic interests with environmental responsibility, making it an attractive option for organizations seeking to improve their energy performance [52].

ESCO services are used for energy management (services related to reducing consumption and demand for energy for their clients). The characteristics of the ESCO business model are presented in Table 2.

An interesting approach enabling the analysis and creation of business models for innovative companies in the energy sector is the concept of the so-called New Era of Innovation, created by C.K. Prahalad and M.S. Krishnan [53]. The business model consists of three basic components. The first two are social architecture and technical architecture, representing specific resources. The third component consists of business processes. Based on conducted studies of business modeling theory and our own research, the business model of prosumer energy was defined as a configuration of business processes combining and developing resources, shaped in the form of social and technical architecture, creating value based on renewable energy sources.

Table 1. Characteristics of the prosumer business model parameters for investments in photovoltaic sources [54].

Business Model Elements	Market Participants	Brief Description
Basic Financing	NFOŚiGW (National Fund for Environmental Protection and Water Management)	Grants and incentives for solar investments. Non-repayable amounts reduce the value of construction credit—if PV investments are made.
Supporting Financing	BOŚ (Bank of Environmental Protection) and other banking institutions, as well as private funds	Preferential loans and support in various forms: municipal bonds, debt buyback, bank guarantees.
Advanced Financing (for the construction of source diversification and microgrids)	Private funds, venture capital, purpose-built foundations, special-purpose companies	Financing requires a long-term, stable state tax policy for the application of exemptions and supportive incentives. For example, this applies to issues such as wholesale gas prices freed for negotiation or freed prices for retail customers.
Consumer Leasing Lessors	Consumer leasing companies	Current market interest rates, averaging around 4.12%.
Technological Partner	Companies supplying panels and installations with assembly and service, additional necessary equipment, and on-site installation	The market offer is very wide and diverse in terms of price; the choice of panel technology is crucial for its efficiency and acquisition costs.

Table 1. *Cont.*

Business Model Elements	Market Participants	Brief Description
Technological Partner	OSD (Distribution System Operator)	Connection agreement and connection capacity, no connection fee, installation of meters and metering, for which OSD is responsible.
Purchase of Energy from the Grid (Energy Trading)	Selected electricity supplier under the TPA principle (or aggregator—assuming settlement services)	Prosumer settlement and balancing—on average, in the G11 tariff (tariff for individuals), the price of 1 kWh gross (including transmission fee and excise duty) is approximately 0.5 to 0.6 PLN (0.12 to 0.15 USD); there is also a need to free prices for users from the G tariff.
Selling Energy to the Grid—Support: Feed-in Tariff (FIT) Support System	State regulations. Implemented by the designated electricity supplier	Regulation resulting from the RES Act: installation with a total electrical power of up to 3 kW—the rate is 0.75 PLN for 1 kWh for 15 years, up to 10 kW is 0.65 PLN for 1 kWh, >10 kW is 0.16 PLN for 1 kWh.

Table 2. Characteristics of the ESCO Business Model Parameters [54].

Business Model Elements	Market Participants	Brief Description
Basic Financing	Third parties—all institutions financing investments in RES and internal infrastructure modernization	Banking products, leasing, credits. Grants and incentives for PV investments.
Supporting Financing	White certificates	Trading white certificates.
Advanced Financing (in the case of diversification of sources and microgrid construction)	Private funds, venture capital, target foundations, special-purpose companies	Financing requires a long-term, stable state tax policy, for applying exemptions and supporting incentives. For example, it concerns issues such as negotiated wholesale gas prices or released prices for retail customers.
Technological Partner	ESCO, and through it, companies providing panels and installations with assembly and service, additional necessary equipment, and on-site installations	The market offer is very wide and diverse in terms of price; the choice of panel technology itself is crucial for its efficiency and acquisition costs.
Technological Partner	OSD and/or market aggregator	Connection and connection power agreement, no connection fee, installation of meters and metering, for which OSD is responsible. Alternatively, cooperation with a market aggregator for balancing ESCO clients.
Purchase of Energy from the Grid for Own Needs	Selected electricity supplier according to the TPA principle (or aggregator—taking over settlement services)	Settlement and balancing according to agreements for a large business customer (ESCO), according to free-market prices. In special cases, selling energy to the grid if provided for in the contract, e.g., leasing the customer's roof—for energy production for the grid (producer model)

B. Nogalski conducted research on business models in energy companies [55]. The study characterized the elements and features of the business model in the following areas:

- General Characteristics of the Business Model, including:

  Dominant types of models
  Way of creation and legal forms
  Basic areas of activity
  Main products
  Ownership structure

- Competitive Advantage, covering:

  Values offered to customers
  Market segments served

Types of competitive advantage
Sources and methods of profit generation related to value capture

- Resources and their Utilization, addressing:

  Material resources
  Intangible resources
  Strategic competencies

- Scope of Operations, analyzing:

  Character of basic activities
  Type of value chain enabling the identification of sources of value creation
  Value chain structure indicating cost determinants and differentiation

From the conducted review of research on business models in energy companies, it emerges that researchers have identified at least eight business models that will be implemented in energy companies in the future. Apart from the current traditional business model based on energy generation in conventional power plants, sales, and distribution of energy, new business models will appear, complementing the offerings of so-called incumbents, i.e., traditional energy sector companies. Figure 1 presents a comparison of business models that can be applied in the energy industry.

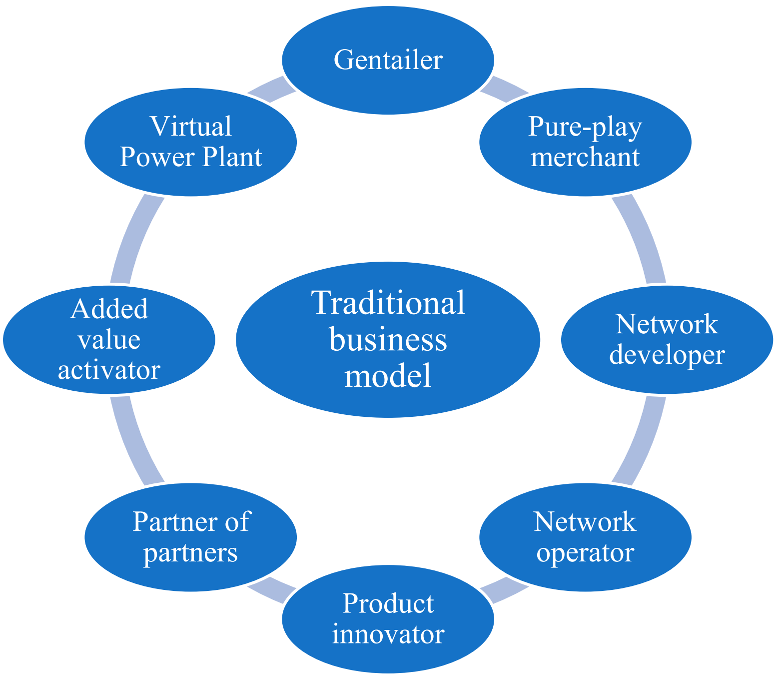

Figure 1. Business Models in the Energy Sector.

The results of the literature review in this area have identified the following business models in the energy sector that could be implemented in Polish energy companies in various areas of activity (generation, distribution, trading), as presented in Table 3.

In summarizing the table of business models in the energy sector, it is evident that a diversity of models is implemented by energy companies. The emergence of new actors, such as network operators and virtual power plants, who utilize technologies and platforms for integrating distributed energy resources, is also significant. This indicates that the future of the energy industry will be based on various business models that must be flexible and ready to adapt to the changing market and technological innovations with the aim of achieving sustainability for the economy and society [56]. Diversification and flexibility in approaching business models can enable energy companies to maintain competitiveness and effectively adapt to dynamically changing market conditions.

Table 3. Business Models in the Energy Sector.

Business Model in Energy	Description of Business Model
Gentailer	Gentailer operates at both ends of the value chain, owning generation assets and selling energy to end customers in the competitive market. The gentailer model provides a natural hedge for trading activities and can take either a long position (generates more energy than it sells) or a short position (sells more energy than it generates).
Pure-play merchant	The company owns and operates generation assets, selling energy on competitive wholesale markets at market prices or based on negotiated bilateral contracts. Companies generate Dark Spread or Clean Dark Spread margins (coal or gas-fired power plants). Generating energy from wind and solar power plants is becoming increasingly important.
Network developer	Companies in this model acquire, develop, build, own, and maintain transmission and distribution assets that connect decentralized generation units with local distribution system operators. Network developers continuously assess the system's capability to meet current and future needs and seek new assets and renewal opportunities.
Network operator	The network operator manages distribution assets and provides access to its networks for generators, connections, and retail service providers. A potential new role could be a platform optimizer providing data and services such as integrating distributed energy resources.
Product innovator	The product innovator offers electricity and gas, as well as over-the-counter products, expanding the role of the entrenched operator. Products beyond the meter could combine retail supply packages, such as green energy, with service and pricing packages for flexibility. This model may evolve towards smart devices, such as energy hubs.
Partner of partners	The partner program offers energy products and services, such as vehicle support throughout the life cycle of an electric vehicle and home comfort services. The energy company may be the exclusive provider of these services, but it is more likely that customers will take advantage of the offer when services are bundled with branded providers.
Value-added activator	A company positioning itself as a value-added provider uses its core capabilities, such as data collection and analysis, to enhance its role and value to the customer. The energy company becomes a value-added energy manager, considering its knowledge and the customer's lack of knowledge about basic energy management activities.
Virtual power plant	A virtual power plant aggregates generation from various distributed systems and acts as an intermediary in energy markets. The virtual power plant also serves as an integrator of non-traditional resources and services provided by third parties to customers, such as distributed energy resources beyond its traditional service territory.

4. Conclusions

This scientific paper provides a synthetic overview of definitions and concepts of business models, focusing on the diversity in methods of their construction and structure. Each case emphasizes that the primary goal of building a business model is to identify the value that the enterprise provides to both customers and stakeholders.

The article discusses the essence of selected business models, such as the prosumer model and the ESCO model, highlighting their roles as key elements in enterprise management. The prosumer model, where customers act as producers and consumers of energy, and the ESCO model, based on energy efficiency, exemplify significant approaches in contemporary enterprise strategies.

In the context of the energy industry, the paper underscores the challenge of introducing innovative business models that simultaneously deliver value to customers and ensure energy security. It concludes with an analysis of the essence and diversity of these models, stressing their crucial role in shaping enterprise development strategies, particularly within the dynamic energy landscape.

New business models in the energy sector are pivotal for future transformations in the field, facilitating the realization of goals related to a zero-emission economy. Through innovative management and technological solutions, these models enable flexible adaptation to evolving environmental requirements, addressing global challenges posed by climate change.

The article focuses on business models specific to the Polish energy sector, acknowledging their potential impact on global trends, albeit requiring further exploration of their transferability. Given the sector's continual evolution, ongoing scrutiny of these prototypes is necessary to accommodate new developments and empirical evidence.

The implementation of modern technologies, such as intelligent energy grids, energy storage, or distributed energy sources, allows for increasing energy efficiency and reducing losses in the energy supply system. New business models also focus on the integration of renewable energy sources, which promotes the sustainable development of the energy sector. The use of new technologies, such as artificial intelligence or data analysis, enables optimization of the management of energy networks, which leads to more efficient use of resources and minimization of negative impact on the environment.

In the long term, new business models will not only contribute to meeting zero emissions requirements but will also open the way to new growth opportunities for energy companies. Innovation in the area of management, technology, and operational strategy will become a key element of success in the energy industry while allowing for the harmonious integration of economic goals with the needs of sustainable development. Ultimately, new business models in the energy sector are a key step toward building a more sustainable, efficient, and eco-friendly energy infrastructure.

The current development of the energy sector, driven by innovative technologies and evolving market structures, poses numerous challenges to the industry while opening the field for the emergence of new, sustainable business models. Dynamic changes in the production and distribution of energy, the introduction of renewable sources, and the growing demand for effective management of energy resources encourage in-depth research on business strategies that will be adequate to contemporary challenges. Given the growing importance of renewable energy sources and the growing emphasis on reducing greenhouse gas emissions, there is a need to develop business models that favor ecology, energy efficiency, and sustainable development.

It is worth noting that changing market structures, including the growing role of energy microgrids and prosumer energy producers, require innovative approaches to energy management, distribution, and trading. This, in turn, generates the need to systematically conduct research on appropriate business models that will respond efficiently to these dynamic changes.

Looking ahead, these innovative business models not only aim to meet zero-emission goals but also create new growth opportunities for energy companies. Embracing innovation in management, technology, and operational strategies is pivotal for achieving a harmonious integration of economic objectives with sustainable development goals.

In conclusion, the ongoing evolution of the energy sector, driven by technological innovation and evolving market structures, presents challenges and opportunities for developing sustainable business models. Research into adaptive strategies is imperative to effectively respond to dynamic changes and contribute to a resilient, eco-friendly energy infrastructure.

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