sustainability

Article

New Business Models in the Energy Sector in the Context of Revolutionary Transformations

Lazar Gitelman and Mikhail Kozhevnikov *

Department of Energy and Industrial Management System, Ural Federal University, 620002 Ekaterinburg, Russia
* Correspondence: m.v.kozhevnikov@urfu.ru

Abstract: The relevance of the problem of improving business models in the energy industry has become especially acute in recent years due to the energy transition, the emergence of new energy production and consumption technologies, and the increase in environmental requirements for energy companies' performance. The purpose of the study is to form recommendations for creating business models in energy companies that meet modern realities and ensure the sustainable development of the energy business in an environment that is characterized by increased uncertainty and aggressive competition. Based on the analysis of scientific publications and the systematization of industry cases, it is proved that business models in the energy sector are likely to transform in the following three aspects: implementation of green technologies as a response to the public demand for clean energy; spatial organization of production based on platforms and digital tools; and active implementation of customized knowledge-intensive services. This article discusses the development of the social investment concept, the key factors affecting its implementation in the energy sector and related industries, and its risks and limitations in the times of energy crises. It is justified that new business models require changes in energy market infrastructure and strategic management principles. In this regard, the authors developed recommendations for the adaptation of the wholesale and retail electricity and power market to the structural, technological, and economic transformations in the energy production and consumption areas. The main advantages, barriers, and ideas for the effective implementation of innovative business models in energy companies are verified through an expert survey.

Keywords: business model; energy transition; diversification; smart contract; platform; demand management; energy as a service; virtual power plants; knowledge-intensive service

check for updates

Citation: Gitelman, L.; Kozhevnikov, M. New Business Models in the Energy Sector in the Context of Revolutionary Transformations. *Sustainability* **2023**, *15*, 3604. https://doi.org/10.3390/su15043604

Academic Editor: Paolo Rosa

Received: 15 December 2022
Revised: 26 January 2023
Accepted: 12 February 2023
Published: 15 February 2023

1. Introduction

1.1. Genesis of the Business Model Concept

A business model is a client-centered concept: it is generally used to describe a company's prompt and precise response to any change in customers' needs; companies' efforts to foster enduring relationships with their customers, not only in the process of product design and manufacturing but also by providing after-sales services, e.g., support at the later stages of the product's (or project's) lifecycle. In fact, a business model is one of the key competencies which helps a company distinguish itself from the rivalling firms, create innovations, and quickly bring them to markets, as well as determine the strategic priorities and relationships between business processes.

In economics, the concept of a business model came to the fore in the 1980s and 1990s [1–4]. Initially, business models were mostly used in such spheres as the services sector, IT industry, media business, automotive industry, and electronics, that is, the spheres with a large number of products with various modifications intended for the mass market [3]. At this time, the most fundamental studies in the field of business models were published. Among them are the publications of D.F. Abell [5,6], P. Vervest [7,8], G. Hamel [9], H. Chesbrough [10,11], A. Osterwalder and Y. Pigneur [12–14], A. Slywotzky [15], and C.

Zott and R. Amit [1,16]. In the classical interpretation of these authors, the business model, as a rule, was considered as the process of creating and delivering values to the client with effective costs, that is, essentially answering the question of how the company earns money. Thus, the financial, economic, and marketing components were the basis of the business model concept.

Among recent studies, the most prominent works include the monographs by T. Clark and B. Hazen [17], C. Linz, G. Müller-Stewens, and A. Zimmermann [18]. The typology proposed by the latest authors integrates both traditional and advanced ideas about the concept (for example, platform or project business models) and includes four types, which can be used by companies when developing the customized products and services (Figure 1).

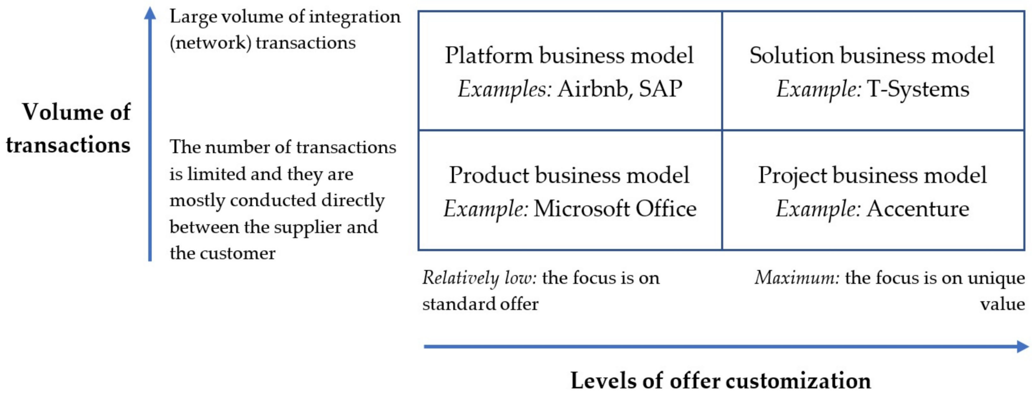

Figure 1. Modern typology of business models (based on [18]).

Platform business models today are of increased interest, which is due to the spread of platform markets (mainly in the high-tech segment of the tertiary sector of the economy) [19,20]. It is noted that the main advantage of such a business model is to reduce the role of the institution of traditional mediation and, accordingly, transactional, operating rooms, temporary, and other costs for all subjects of economic interaction—the manufacturer of the service, its consumers, and the owner of the platform [21,22]. In addition, the "everything-as-a-service" approach and convenient forms of payment (pay-as-you-go) used as part of platform business models contribute to the expansion of the assortment and the quality of the products and services provided to consumers [23,24].

In modern notations, the business model is also considered as an integral component of technological entrepreneurship [25], strategic (proactive) management [26], and crisis management [27]. Specialized areas of business modeling are developing, for example, business continuity management (BCM)—a systematic intelligent process of identifying potential threats, analyzing their impact on business, and developing proactive solutions to effectively respond to crisis situations in order to protect the interests of stakeholders, reputation, and the most significant business areas of the company [28–30]. Therefore, it can be stated that the boundaries of the business model concept are becoming wider, and today, the business model is perceived not only as a marketing tool that increases the competitiveness of the company but also as an integral element of the strategy, based on the use of advanced IT-tools and scientific and technical achievements.

1.2. Factors Determining the Spread of Business Models in the Electric Power Industry

In the electric power industry, which is one of the most complex infrastructural sectors and which is the object of the current study, the topic of business models has started to gain ground only comparatively recently [31]. The liberalization of energy markets and intensifying competition between energy companies, renewable energy development, and cascading innovation in the energy sector have been conducive to the transition from the single-product model (supply of electricity and/or heat) to the model based on a diversified portfolio of various energy services [32,33]. The latter, in turn, requires an adjustment of business modeling tools to the to the unique technological specifics of the industry, as well as its social function—ensuring reliable and sufficient energy production for all economic entities. However, in the opinion of a number of experts [31,34], the problems of business modeling in such a complex industry as the electric power industry have not yet found proper lighting in the literature. There is a serious deficiency of both theoretical and practical knowledge in this field. For example, it is critical to include technological features of energy production to the business model structure and to analyze their impact on the financial results of energy companies. These issues are often ignored by researchers, and therefore it is an important motive for writing and the subject of theoretical discourse of this article.

An Important role in the transformation of business models is played by the unfolding energy crisis, which makes the energy transition more complicated (in this article, the energy transition is understood as a set of profound technical and economic transformations in energy production, supply, and consumption aimed at minimizing the environmental impact of the energy industry [35–38]).

The transformations in the business models of energy companies are determined by the general logic of the energy transition and, in particular, by the number of factors. These factors include far-reaching revisions of the eco- and energy efficiency requirements for manufacturing processes; the development of 'green' energy technologies—the main goal of the energy transition [36,37]; advancements in smart energy infrastructure through the extensive use of smart grids, small-scale renewable energy systems, microgrids, cutting-edge diagnostics, and repair tools for energy equipment [39–41]; a new stage in electrification, encompassing smart cities, homes, industrial production, transport, and commercial and utilities sectors [42,43]; and the transition from the product-based business logic (energy is sold as a product) to the service-based logic, which means that energy companies not only supply electricity and heat but also offer a whole range of services for energy efficiency/energy consumption management [44–46]. The latter to a certain extent leads to the emergence of active energy consumers or prosumers, who become rightful participants in the bilateral relationships on the energy market [47,48].

One more factor that should be added to this list is the integral feature of energy supply—its stability, which is gaining a particular social significance in the period of the global energy crisis. This characteristic corresponds to the demand for energy and capacity in terms of their amount, parameters, time, and place; continuity of energy supply; affordable prices for all consumers, i.e., prices reflect the actual costs of services; and environmental friendliness and safety in all elements of the energy supply process.

As a result of the above-described changes, the line between energy producers and consumers is getting increasingly blurred. Energy services are now becoming more personalized, corresponding to individual consumption models. Energy users are now offered more and more new services provided by companies from different spheres—information and telecommunications (Google and Apple), automotive industry (General Motors, Tesla, and Volkswagen), software and digital solutions (SAP and Siemens), electronics (Samsung and Philips), and e-commerce platforms (Amazon) (Table 1).

As these companies are competing successfully with traditional participants in the energy market, the latter are forced to innovate to stay afloat. Thus, the nature of market relations in such a very conservative industry as electric power is fundamentally changing. Some energy companies have begun to use the elements of multiservice and platform business models, however, these attempts naturally face barriers caused by the unwillingness of energy market infrastructure, individual consumers, and utilities' management. The identification of the necessary conditions and restrictions arising from the introduction of such business models in energy enterprises is another important subject for theoretical analysis.

Table 1. Examples of tech companies entering the energy sector (developed by the authors on the basis of systematization of the data given in [49–52]).

Sector of Economy	Main Strategic Focus	Examples of Integrated Solutions	Examples of Companies
Original equipment manufacturers	All the services where devices play the key role	• Smart home • Energy supply management systems based on preinstalled software • Closed protocol systems	Schneider Electric, Google, Siemens, Semtech, and General Electric
Information and communication technologies	Comprehensive solutions of data collection and processing	• Maintenance of energy generating assets and optimization of energy consumption with the help of software • Event data management and data accumulation • Consumer data, personalization, and analytics	Oracle, Accenture, IBM, and Cisco
Car industry	Rebuilding operating models and entering new markets	• Industrial solar panels • Wind generators and solar cells for EV charging • Use their own RES plants to reduce CO_2 emissions	Seat, Honda, Volkswagen, and General Motors

1.3. The Purpose and the Scope of the Study

In light of the identified trends and modern challenges facing the energy industry, the purpose of this study is to form recommendations for creating business models in energy companies that meet new realities and ensure the sustainable development of the energy business in an environment that is characterized by increased uncertainty and aggressive competition.

It is important to emphasize that the authors do not set the goal of creating a template of a business model that is universal for any energy company. The main idea of the article is to demonstrate how unique technological features of the electric power industry and changes in market relations that occur under the influence of numerous factors listed above should be taken into account when creating new business models, which barriers can occur during their implementation, and what practical decisions should be made in order to soften potential risks. This is the main increase in theoretical knowledge in the field of the problem of business modeling, which generally corresponds to ideas about the role of theory in science, including economics and management [53,54].

To achieve the purpose, the following tasks are set: identifying key features of business models in the energy sector; systematizing the directions of their transformation and determining their most promising configurations in the context of new realities, including crisis phenomena in the economy and energy transition; identification of the necessary transformations in energy market infrastructure; and determining the conditions, barriers, and decisions for the practical implementation of business models in electric power utilities.

The author's position regarding the definition of a business model is expressed in the fact that this concept characterizes organizational forms of attracting investments to update production at the most modern scientific and technical level and promoting products (services) in the market that ensure steady growth in financial results. In this regard, the article attempted to justify that the radical changes taking place in the industry against the background of energy transition and structural shifts in the economy open up new opportunities for the energy business, allowing it to create diversified portfolios of services with increased value for consumers.

Our analysis revealed that energy business models are increasingly using platform elements while expanding the range of products offered by the utilities, primarily due to the service component, which emphasizes customization and environmental performance (to confirm this thesis, the authors separately studied the penetration of the 'environmental–social–governance' (ESG) concept into the industry). Thus, despite the unique technical and economic features of the energy sector, which leave a peculiar imprint on the functioning of energy companies, it can be argued that the principles of forming business models in the energy and other industries are converging. We believe that the implementation of the proposed recommendations in practice will contribute to the sustainable development of the electric power industry in the interests of various actors—energy companies and consumers, as well as regulatory authorities that form the "rules of the game" in specific energy markets.

2. Data and Method

Methodologically, the study relies on the methods of systems analysis, logical structure analysis, content analysis, conceptual design methods, visualization methods, and interview methods. To identify the priority areas in business development, we surveyed 74 experts—top and line managers from the energy industry, energy services sphere, and IT and telecommunications companies (see Table 2). The main criteria for the selection of experts were their interest in the issue (willingness to take part in achieving the objectives set), their competence (length of working experience, position, experience in participating in innovative projects, and level of education), their general scope of knowledge, views, and creative abilities. The survey focused on identifying the attitude of the companies' leaders to business modeling as a tool for ensuring the strategic sustainability of the modern energy business, as well as the main advantages and barriers that arise when implementing business models in energy companies.

Table 2. Sample breakup by sector.

Sector	Business Sphere	Number of Experts
Electric power industry	Energy generation	8
	Energy transmission and distribution	12
	Power supply and trading	9
Energy services	Energy efficiency services	8
	Engineering	7
	Maintenance and repair	8
	Installation and commissioning services	6
IT	Software solutions	6
Telecommunications	Telecom operator	10
	Total	74

The study relies on the data from academic publications; expert analytical reports of the International Energy Agency, UN Energy Commission for Europe, International Renewable Energy Agency (IRENA), and the consulting companies PwC, Accenture, and Deloitte (more than 15 reports issued in the 2017–2022 period in total); statistical data provided by online databases Lazard and Enerdata; an the official websites of energy companies. About 80 scientific publications were analyzed, including classic studies that laid the foundations of business modeling [1,5–16], as well as industry-specific studies that consider the business model through the prism of the technical and economic features of the energy industry. The search for publications was mainly carried out in the ScienceDirect, SCOPUS, and MDPI databases.

3. Results

3.1. Vectors of Transformation of Energy Companies' Business Models

The analysis of scientific publications and practical industrial cases allows to identify three main areas in which the business models of energy companies are developing.

3.1.1. Transition from 'Linear' to 'Spatial' Models of Production Organization through Platform- and Network-Based Solutions and Digital Tools

According to the traditional idea of business models in the energy sector, an energy company performs all types of activity within the sectoral value chain in three dimensions (Figure 2). Electricity (the main product) is transmitted only in one direction: from the source to 'passive' consumers, who pay for it according to the tariffs. In the classical model, energy companies' margin growth can be achieved only by cutting the costs of energy production or through economies of scale. The latter, in turn, can be achieved through vertical and/or horizontal integration.

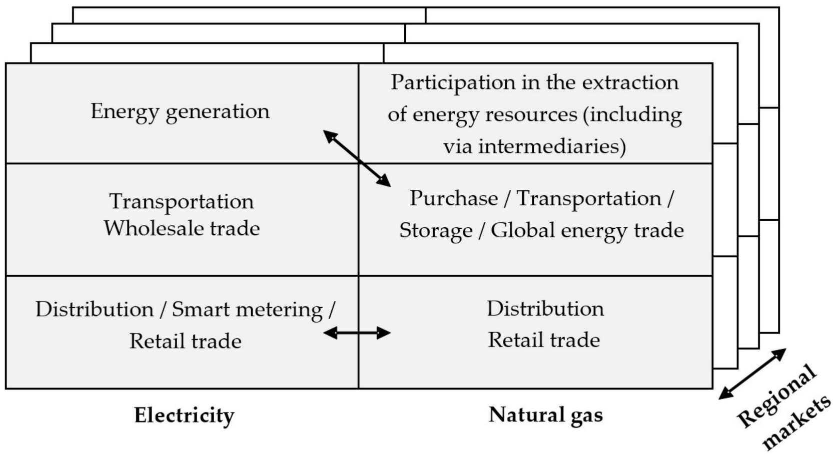

Figure 2. Classical business model of a large energy company.

For a long time, energy companies have used the vertical integration of operations in the sphere of energy generation, natural gas production, energy transportation and wholesale trading, and the supply of energy and services to end users in order to optimize their businesses and manage their risks. The horizontal integration of production processes in the energy sector and in the gas industry creates synergy and increases growth potential through the convergence of the two sectors, especially the growing importance of natural gas in energy generation and further development of dual-fuel products for end users. The business model shown in Figure 2 is underpinned by the classical concept of the linear value chain: generation–transmission–distribution–trading–consumption. This concept, however, had grown obsolete by the early 2010s.

A good example of a company that was able to proactively meet these challenges is the German-based company E.ON. In 2014, E.ON split into two companies, one of which focused on energy business centered around renewables, intelligent systems, and the Internet of Energy (IoE), while the other, called Uniper, concentrated on conventional energy [55,56].

In today's world, energy companies seek to make their business models more network-based. An illustrative example is the business model of the Switzerland-based energy company EGL, which has three major areas of activity: energy trading, management of its own asset base, and gas supply (Figure 3). EGL uses its own productive capacities to supply fuel for high-efficiency electric power generation, which, through the system of asset management, is closely tied to trading operations. Along with supplying gas to its own power stations, EGL also supplies gas to other consumers via long- and short-term contracts. Moreover, this energy company is a European center of competencies in the sphere of market analysis.

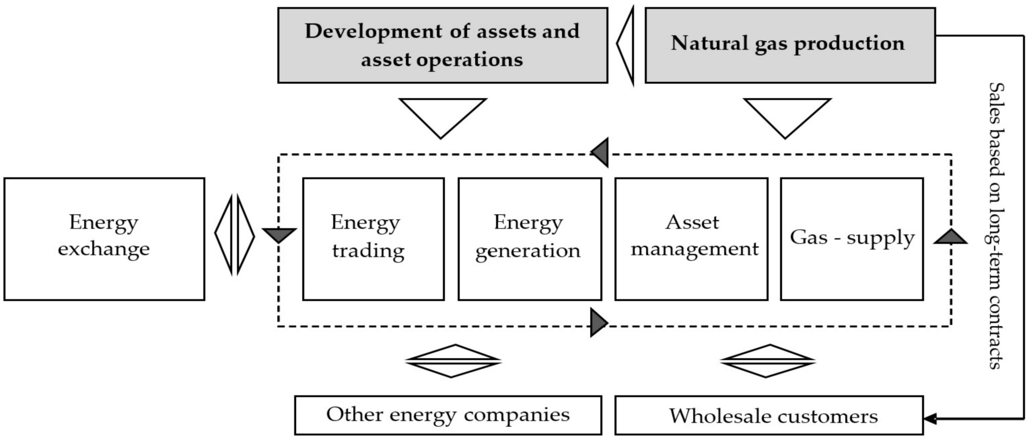

Figure 3. EGL business model.

Thus, the EGL business model is based on close ties between the system of gas supply, power generation (gas-based cogeneration plants), transport infrastructure, energy trading platforms (energy exchanges), and additional financial tools. The key competence distinguishing EGL from its competitors is the network form of organization. Through its expertise in trading, presence in all European countries, and marketing know-how, EGL has managed to significantly broaden its product portfolio and expand into a variety of markets.

The business models of E.ON and EGL can be classified as gentailer models ('gentailer' is a term coined by combining the words generation and retailer). Gentailer companies are involved both in power generation and retail, in other words, they own both ends of the supply chain. A gentailer company usually pays network tariffs to the operators but also buys and sells energy on the spot market to bridge the gap between supply and demand at a certain moment of time [49,57]. This term became popular in the 2010s in the practice of American and Australian energy companies, subsequently spreading to other countries with developed liberalized energy markets [49,58,59].

E.ON and EGL are justifiably considered the world's innovation leaders in the energy industry. Their service portfolio, however, is typical of vertically integrated energy companies, while their forms of interaction with clients are not very diverse. The energy transition, together with the ongoing digitalization and energy decentralization, as well as changes in the economic relationships between energy producers and consumers, result in the emergence of completely new business models with a focus on environmental sustainability, personified approach, and flexibility [31,49,60–62]. These, for example, include the Grid Developer model—a company that buys, develops, builds, owns, and serves power transmission lines connecting decentralized generators with the operators of local distribution systems. Another model is called Network Manager—an operator of energy distribution devices that provides access to its networks to industrial enterprises and telecommunications companies. The testing of these business models is still fragmented and occurs mainly in regions with a high concentration of distributed generation plants.

Another striking example is the conceptual business model of a virtual power plant (VPP) operator (Figure 4). Particularly noteworthy about this model is the dramatic increase in reciprocally directed flows of energy transactions, data, and tangible products (primarily equipment) between the VPP and multiple participants of energy supply, including those that are not directly connected to the energy industry.

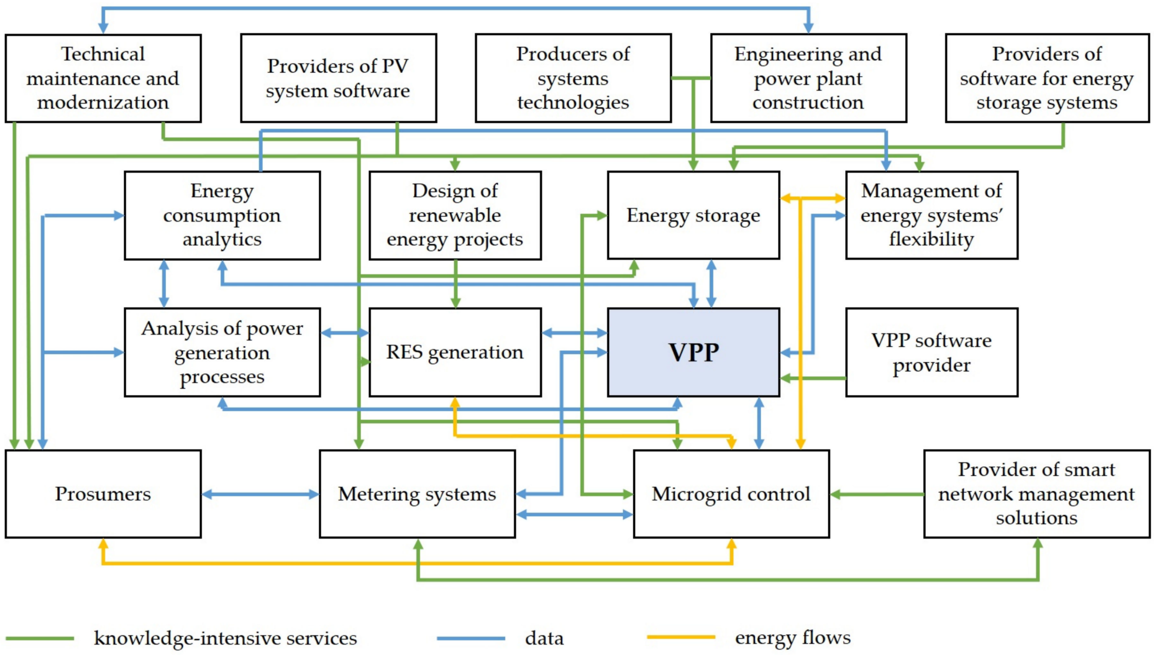

Figure 4. Business model of a VPP operator (developed by the authors on the basis of [34,63–65]).

Companies with business models of this kind make a special focus on the optimization of the sources of energy in terms of their cost, reliability of supply, and appeal to customers [34,63]. A VPP operator can also perform the functions of demand management and control various power receivers of commercial consumers and households to eliminate imbalances within the system. This can be done via a wholesale market or through direct agreements with owners/operators of power grids.

Let us consider, for example, the case of the British company LimeJump [66], which has entered the UK grid balancing market via its VPP (the purpose of the balancing market is to balance electricity supply and demand in real time). LimeJump is an energy tech platform, acting as an aggregator of renewable generators, energy storage units, and demand management resources connected via software involving big data analytics and machine learning technologies. For this company to operate, a complex set of legal foundations and mechanisms is needed so that units of different types and sizes can work together as one large power station.

Another example is the project realized by the American company New Brunswick Power [67], involving 1400 households and 30 companies. To balance the load on the wind farm, the energy company installed a control system that detects and uses large amounts of flexible loads of consumers (by regulating the air temperature, capacity of hot water boilers, and other equipment that can store energy and is suitable for interval operation). According to New Brunswick Power, a VPP can provide an extra regulatory resource of 17 MW and thus help mitigate the daily grid load during morning peak periods.

Based on formal criteria, the following VPP-related models can be identified. First, this is the traditional model/model of a power supply company: a company operating on the energy market creates a network that controls various distributed generation units and flexible capacity units of its consumers. The second model is client-oriented: consumers install a VPP to meet their energy needs. In this case a VPP is used to manage the consumers' own energy consumption, for example, large supermarkets such as the American chain Wal-Mart use VPPs to control and regulate energy consumption by different objects in their stores nationwide: refrigeration systems, air conditioners, lighting, and systems of ventilation and heating. Finally, there is the aggregator model, when an independent organization (aggregator) is established on the market to serve as a VPP operator. An aggregator connects consumers to its VPP and pays the participants for taking part in the so-called energy demand management programs. The amount of payments de-pends on the conditions in a particular market. Thus, a VPP can be used for commercial (wholesale of energy) or technical purposes (system services—load frequency control and power quality maintenance) or combine these two functions.

The most attractive for VPP operators are the markets with a wide network of distributed generation sources and where consumers have a legal right to choose their energy suppliers, as well as insular energy systems and remote (isolated) energy systems.

In the business model shown in Figure 4, an important role is played by knowledge-intensive services based on metering, financial accounting, and information security [46]. For instance, energy companies may use customer analytics tools to tailor their marketing offers (e.g., new solutions in the sphere of energy efficiency) and newsletters (changes in the legislation and tariffs) for particular segments and groups. The collected data can also be analyzed and decoded for plan-fact analysis of services by categories, for benchmarking of the portfolio of performance contracts, and for expenditure forecasting. Moreover, energy companies may use blockchain technologies for concluding smart contracts. This way, they can significantly reduce their administration and cybersecurity transaction costs [68,69].

Blockchain and smart contracts underlie the model of peer-to-peer (P2P) trading, which emerged as a result of the fast development of the sharing economy. For the energy industry, P2P trading holds a lot of practical value because it enables companies to integrate intermittent small-scale generation into a system while keeping the intermediate costs low. In the energy sector, P2P trading refers to the buying and selling of energy between two or more parties connected to the network via a secure digital platform. The first recorded peer-to-peer energy trade occurred in New York in 2016, when a resident with solar panels sold a few kilowatt hours to his neighbor via the Ethereum blockchain.

Experts believe [70,71] that P2P is an effective option for businesses because, in this business model, it is possible to use different profiles of generation and demand from different clients. The drawbacks of this business model are mostly connected to the normative and administrative difficulties impeding the mass spreading of P2P technologies.

3.1.2. The Rise of the Corporate Green Agenda as a Reaction to Public Demand

This trend in the development of business models seems natural in light of the ongoing energy transition, but what is interesting is the details of how this model is implemented by the companies engaging in the risk-fraught renewables business and how they make this business profitable and scalable. The theoretical aspects of creating such business models are considered in sufficient detail, for example, in [72–74]. In this article, we decided to focus on a number of specific industrial examples in order to make appropriate practical generalizations.

NextEra Energy (Juno Beach, FI, USA) is the world's largest generator of wind and solar energy [75]. It is an electric utility holding company, the owner of two subsidiaries—Florida Power & Light (FPL) and Gulf Power—and a number of startups investing in renewable energy assets. Moreover, NextEra is the world's leader in the field of battery storage energy. In 2019, NextEra owned a 15.1-gigawatt wind farm and a 2.5-gigawatt solar farm and also launched new RES projects with a combined capacity of 11 GW. The company's business model is based on selling electricity to end users as part of a long-term fixed-price Power Purchase Agreement (PPA). Fixed-price PPAs ensure a stable cash flow, providing funds that can be reinvested into R&D for further growth.

A similar business model is implemented by Brookfield Renewable Partners (Toronto, ON, Canada), a company which owns a variety of hydropower, wind, solar, and storage facilities [76]. Fixed-price contracts help to dampen the risks of uncertainty associated with the energy tariffs in the regions of the company's presence (especially in the countries with unstable geopolitical situation such as Colombia and Brazil).

One more company using fixed-price contracts is *Ormat Technologies* (Reno, NV, USA). The company [77] manages the portfolio of geothermal power plants in the USA, Central America, Asia, and Africa. It also designs, manufactures, and sells power equipment and other products to third-party geothermal operators. What distinguishes Ormat Technologies' business model is the concentration of competencies in a quite peculiar niche—geothermal energy. It took the company only several decades to become a global leader in this segment of RES and, by using its subsidiaries, organize the production of unique power equipment. The annual revenue of Ormat Technologies is now USD 700 million, 60% of which come from electricity sales and 40%, from sales of equipment and related services.

First Solar (Tempe, AZ, USA) specializes in manufacturing thin-filmed solar panels based on cadmium telluride (CdTe) in a semiconductor layer, instead of crystalline cadmium as in most other panels [78]. First Solar panels have a larger size and are more expensive, but due to their higher efficiency, the productions costs of 1 kilowatt-hour are lower in comparison with rivalling products. The key factor behind First Solar's success in the field of solar generation is that it is has managed to achieve the best financial balance in the sector: at the end of 2019, the company's net cash on the balance sheet was USD 2.1 billion against the liabilities of USD 600 million, which gives First Solar enough resources to continue investing in R&D and testing various technical and structural solutions.

SolarEdge Technologies (Herzliya, Israel) specializes in unique technologies for the optimization of renewable energy consumption. This company [79] has developed smart inverter solutions to improve the process of conversion of DC power from solar panels to AC power used by the power grid. This solution enables solar cells to maximize their electricity output while simultaneously cutting the costs of electricity production. SolarEdge Technologies also invests in such segments as battery storage systems and electric vehicle charging, which in the future will maximize its opportunities for cross-selling parts to adjacent markets. The company is planning to make its business model more balanced and diversified and expand beyond the niche (selling unique solutions in a local market segment) to address more of its customers' needs in various markets.

These examples show that companies operating in the sphere of green energy technologies rely primarily on the following three components in their business models. The first component is the technical know-how, which, on the one hand, gives the company a competitive advantage over its competitors and, on the other hand, increases its value in the eyes of customers by improving the sustainability and efficiency of energy consumption. The second component is the company's efforts to maintain steady growth by improving customer outreach and expanding into related markets and sectors [72]. Additionally, last but not least, continuous investment in the development of the company's own competencies makes it more competitive in the energy market.

3.1.3. Servitization: Companies Increase Their Revenue and Profits Not by Selling the Main Product—Electricity and Heat—But by Improving Their Sales of Services

An example of an energy company placing a bet on services is the Austrian enterprise EVN AG, which divided its business model into two key segments—energy business and environmental services based on the use of green tech solutions (Figure 5). For an energy company such as EVN AG, the development of ancillary services not only helps expand its offering but also shows that it is keeping up with the modern agenda and embracing ESG, thus making it more attractive to investors. EVN AG has managed to boost its competitive edge by offering its clients comprehensive solutions in the sphere of water supply and disposal, as well as waste utilization.

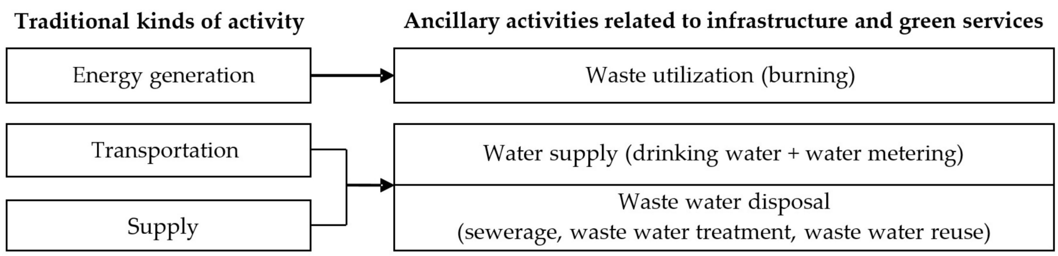

Figure 5. Service-oriented ESG business model.

A separate actively developing segment of service business models is Energy-as-a-Service, or EaaS. It means that a company sells a package of services that are really important to consumers and uses energy carriers only as a material foundation for these services (microenvironment control, system of integrated control over the household utilities infrastructure, and energy storage control) [80,81]. EaaS contracts are now becoming more and more popular: by 2026, the EaaS market size is expected to reach USD 220 billion [60].

The EaaS business model fits into the 'partner of partners' category [82,83], meaning that the company on a compulsory basis offers consumers ancillary services, increasing consumers' 'energy' comfort (e.g., change in batteries in energy storage systems at the end of their useful life, automation and programming of household appliances, control over the return of excess energy to the grid, etc.). Such services may be provided by the company itself or by its partners—other suppliers of goods and services with a good reputation in the market, for example, ABB, Siemens, GE, Tesla, and Solar City. Therefore, the success of this business model largely depends on investment in data analytics, which is necessary to estimate demand elasticity and identify partners with the most suitable complementary technologies, products, and services, thus increasing the value of a hybrid offer.

Not surprisingly, the EaaS business model is now used not only by energy companies but also by manufacturers of energy equipment and parts. Recently, Schneider Electric shifted its focus to smart power supply systems based on integrated solutions, including smart connected devices, edge control, applications, analytics, and services. In the early 2010s, the company started testing IoT technologies and developed a first-generation IoT-enabled platform, EcoStruxure, designed to digitalize and simplify electrical distribution and power management. The results of the transformation were impressive: in 2016, the company's revenue was EUR 24.7 billion, out of which 44% came from IoT solutions alone [84].

In general, it can be stated that the service business model that integrates platform tools and the latest information and communication technologies is considered by energy companies in the context of the ongoing technological transformations and the energy transition as the most promising. It allows for a reversal in the logic of doing business: to move from the 'single-product' model, which involves maximizing sales of the main goods (electricity and heat), to the implementation of packages of knowledge-intensive services aimed at optimizing energy consumption processes and growth of the consumers' energy comfort.

3.2. ESG as a New Framework for Energy Business Development

One of the rapidly developing trends in the energy industry is the growing importance of ESG compliance for energy companies. Its three pillars include environmental responsibility (waste and pollution control, waste management, and carbon footprint reduction), social responsibility (good working conditions and equal job opportunities, as well as ethical responsibility towards personnel, suppliers, clients, partners, and consumers), and governance (the high quality of corporate management, transparency, fair pay, responsibility towards stakeholders, and compliance of the management standards with modern social values) [85–87].

Energy companies are among the world's leaders in ESG compliance. On the one hand, this can be explained by purely economic factors (more efficient resource use improves companies' financial performance); on the other hand, compliance with ESG principles is important for investors: almost 100% of strategic investors are monitoring ESG-rankings of companies. In 2021, Schneider Electric (France, Rueil-Malmaison), which has the largest energy division, transnational company Ørsted A/S (Denmark, Fredericia), and oil company Neste Oyj (Finland, Espoo) were in the top five of the ESG corporations, according to Corporate Knights [88].

It should be noted that ESG rankings are justly criticized for evaluating not the actual performance of the companies in the sphere of social responsibility, environmental protection, corporate management, etc., but the documents describing these initiatives—

strategies, reports, declarations of intent, regulations, roadmaps, KPIs, and so on. In other words, in practice, it is quite difficult to verify whether corporate investment will really be directed to projects with high eco-economic efficiency. As a result, ESG may turn into a window-dressing gesture meant for investors rather than something meaningful and effective.

The direct impact of energy companies' sustainable development programs on their attractiveness for investors is reflected in green bond issuance. Russian banks have recently begun to issue ESG-linked loans, which is also a positive sign. Companies that commit to the ESG agenda may enjoy easier access to finance and global value chains, which is particularly important in the sanctions period. There has been a shift in the paradigm of behavior, demonstrated by young investors and executives in the energy sector: in addition to financial indicators, many of them have started paying attention to the 'green' aspects in companies' performance. At this point, however, it is crystal clear that, in addition to being more expensive than traditional energy sources, RES cannot fully meet our energy needs.

Digitalization is one of the factors contributing to the achievement of ESG goals in the energy sector. There is research evidence [87,89,90] that most of the digital solutions implemented by energy companies are intended to optimize consumption, to balance the load peaks, and to conserve energy, which helps save natural resources and reduce GHG emissions (see Table 3). Other solutions are aimed at ensuring workplace safety in power plants and promoting distance learning systems and virtual/augmented reality systems for personnel training, which has a positive impact on corporate social responsibility and the quality of corporate governance. There is a separate group of factors related to digitalization: for example, remote monitoring systems installed at energy facilities contribute to the development of 'manless' technologies, which improve workplace safety and allow companies to move to condition-based maintenance, thus promoting resource-conserving consumption [91,92].

Table 3. Examples of ESG factors and the corresponding digital solutions.

ESG Factor	Digital Solutions	Outcomes
Technology	Smart EV charging infrastructure Creation of EV charging infrastructure for private and public transport, implementation of platform solutions for EV charging infrastructure control, and testing of new technologies (e.g., smart charging, V2G, energy storage systems, and integration in smart grids).	Cutting CO_2 emissions by stimulating the development of electric transport, including public transport. Optimization of resource use with the help of V2G technology.
	Demand response management Creation of mechanisms for adjusting energy consumption in relation to the normal load profile through prices or incentive payments.	CO_2 emissions reduction and resource conservation. Demand response systems to reduce consumption in peak times, thus cutting CO_2 emissions.
	Digital technologies for remote load control and for remote control of power plants' equipment Creation of a technology to regulate the energy system's operation through automatic remote load control from the System Operator's dispatch centers.	Optimization of consumption and resource conservation. Solving the problem of intermittency in renewable energy with the help of balancing mechanisms.
Economy and management	Systems of predictive analytics for improved repair and maintenance planning Automated data system to control technical maintenance and repair, and modernization and revamping of equipment; integration with related business processes.	Optimization of equipment cost management. Building end-to-end processes of maintenance, repair, and modernization. Business process standardization. Enhanced quality of planning. Resource conservation. Accident risk reduction.
	Common Information Model (CIM) Creation of a unified digital model of the country's (or region's) energy system by logically connecting the data models of dispatch centers and power facilities.	Higher data quality, reduction in data heterogeneity and asynchronicity of data updates. Shorter commissioning time. Improvement of data accessibility.
	Implementation of intelligent systems for power equipment monitoring. Platform for automated control (monitoring) of high-voltage equipment in substations.	Transition to condition-based maintenance—savings in maintenance costs. Improvement of data accessibility. Accident risk reduction.

In all likelihood, despite the ongoing economic and energy crisis, ESG principles will be playing an increasingly important role in the development of the energy business. This means that more and more energy companies and actors in related markets will be re-orienting their business models towards the green agenda, creating new eco- and energy-efficient services for end users and implementing low-carbon technologies for energy generation. Companies with high ESG ratings can also count on extra financial and regulatory support from national governments: such plans have already been announced by the American and British governments [93,94].

3.3. Adaptation of the Energy and Capacity Markets

The energy revolution alters not only the way energy companies organize their business but also the behavior of players in related spheres seeking to expand their offerings for end users through the application of innovative solutions. All of the above naturally entails transformations in the energy markets' architecture. As our analysis shows, this aspect still remains largely underexplored, both in the research literature and in practice. It is, therefore, important to place a special focus on several aspects of the model of the wholesale market of energy and capacity shared by different countries.

Wholesale energy spot market. The structural and technological transformations inherent in the energy transition will make the wholesale spot market obsolete for a number of reasons:

1. As products are becoming more technologically diversified, power facilities are acquiring a range of new functions: environmental, technical, and economic, which makes them noninterchangeable and incomparable in a wide range of parameters. Thus, they can no longer be considered as rivals (including the level of their variable costs). The actual competition between generating facilities is possible only for power plants using identical kinds of fuel of identical types and sizes. The technological progress increasingly narrows the range of generating facilities, and competition moves from the sphere of power generation to the sphere of investment and engineering;
2. Given the large discrepancies in fuel prices (natural gas–low-grade coal) and the energy efficiency of power plants, the method of marginal-cost pricing is becoming ineffective because, in this case, the closing price of electricity (its fuel component) will go far beyond the average value. In the case of radical structural shifts, this will trigger extra growth in the production costs in the energy systems, including both variable and fixed expenses;
3. The equilibrium (marginal) price of the spot market covers only the variable costs of manufacturers. Recovery of the fixed costs of equipment maintenance is becoming more complicated and requires manufacturing companies either to obtain an additional margin on the spot market or to participate in competitive capacity trading on a specialized market. The problem of covering the capacity-related expenses is made more serious by the implementation of new capital-intensive technologies.

All of the above points to the key role played by free bilateral contracts on the wholesale market of energy and capacity signed in different time periods and using different implementation mechanisms. Regulated tariffs determine the upper limits of negotiated prices.

Wholesale capacity market. Long-term regulation of the capacity market may be used to ensure that generating companies will participate in state investment programs, as they will be obligated to conclude capacity delivery contracts with the national government of the given country. Such contracts include the mechanism of guaranteed investment based on the price of a capacity unit set by the regulator. This price is calculated by using a certain payback period, the recovery period of capital expenditure, and the economically justified return on investment.

Retail markets of energy and capacity. A retail energy market functions within the limits of regional power supply systems. The market's transport infrastructure consists of power distribution networks. In retail markets, independent energy producers (owners of small-scale generators) sell energy and capacity through contracts to individual users and to local utilities companies (guaranteed supplier) at regulated tariffs. The mechanism of competition in such a market is activated when the potential amount of total energy generated by independent energy producers exceeds the total energy demand covered by small-scale (distributed) generation. In this case, independent producers can sell energy to the guaranteed supplier at the competitive prices that they set for the market operator. The latter distributes the load among the generators by applying the least-cost criterion (the fuel component of costs). The quoted price should not exceed the rate of the regulated tariff (in the part of the tariff related to electricity charges) set for a specific producer.

Through load distribution in the planned dispatch schedule, a unified weighted-average market price is set. This price is more favorable for consumers in comparison with the marginal price used in the wholesale spot market.

4. Discussion

The concept of a business model, which initially evolved in highly competitive markets and segments, is now gaining popularity in the energy industry. This trend is supported by empirical evidence and is reflected in the growing body of research on this topic. The survey we conducted as part of this study also confirms this conclusion. Over 60% of our respondents said that their companies are actively developing their own business models to become more competitive (Figure 6).

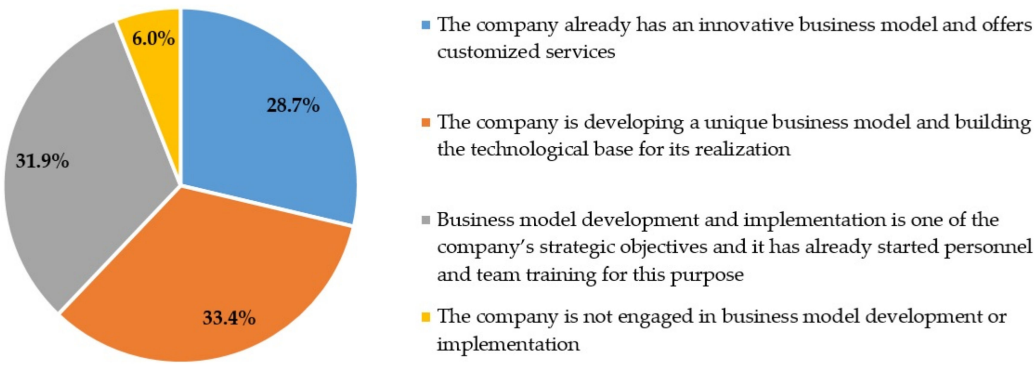

Figure 6. Implementation of business models in Russian energy companies (experts survey results).

On the one hand, experts note very typical advantages that appear in energy companies through the use of modern business models: for example, an integrated approach to customer service, as well as personalization of services ('smart home', individual tariffs for electricity and heat tariffs, and energy consumption forecasting). However, some other areas that are unique to the electric power industry are much more important in their opinion. In the field of asset life cycle management, advanced technological solutions help establish the optimal levels of remote control and preventative maintenance, thus extending the useful life of assets and the overall efficiency of the energy infrastructure and optimizing power grids' operation through real-time load balancing and IoE technologies.

Such innovative elements of business models contribute to reducing operating costs of energy companies and increasing the reliability of energy supply. Thus, taking into account the technological specificity of a particular industry in the design of business models is a significant factor; moreover, as approved in [1,95], it is the technological component that ultimately determines the viability of the business model. In this regard, it is difficult to agree with the authors stating that the content of the business model is universal for any market activity [96,97].

Changes in the technological architecture and the emergence of new market players, increasing the intensity of competition, lead to the fact that business models are implemented not only in energy companies operating in a market paradigm (power generation, retail, and service companies) but also in utilities, which are often natural monopolies and are, therefore, subject to rigid control from the regulator. For example, the large Russian regional electric grid company Bashkirenergo is now building a more diversified business model and transitioning to a partner-led model of customer service, involving a guaranteed supplier—a regional energy supply company. This model involves sharing the task of installing energy meters in homes: communal and individual metering devices are installed by the grid company, while the guaranteed supplier uses meter readings to track electricity consumption. It also implies sharing the task of meter data collection: the guaranteed supplier organizes metering data collection from households, for example, via email or text messages, and then sends the data to the grid company. The grid company, in turn, also collects the metering data in its offices and passes this information to the guaranteed supplier. The grid company is responsible for taking control readings, and it provides access to these data to the guaranteed supplier. Thus, the synchronization of documentation forms and computational models starts: for more convenient data import/export to/from data management systems, the guaranteed supplier and grid company adopt unified forms of aggregated data reporting and formulae for calculating the volume of energy services for the cases not regulated by the law.

In general, the development of the business models of energy companies, according to a number of experts [49,60], occurs as a response to radical changes in the chain of creating energy value. The authors tend to agree with this position. However, it should be noted that in this regard it would be more accurate to describe value chains as 'networks' rather than 'chains', since today's energy companies, consumers, and suppliers of equipment, service solutions, and software are embedded into a hyperconnected ecosystem (Figure 7). All of these actors will have to overcome the habit of considering each element of the value network in isolation and instead adopt a more comprehensive vision of the new power systems and their elements.

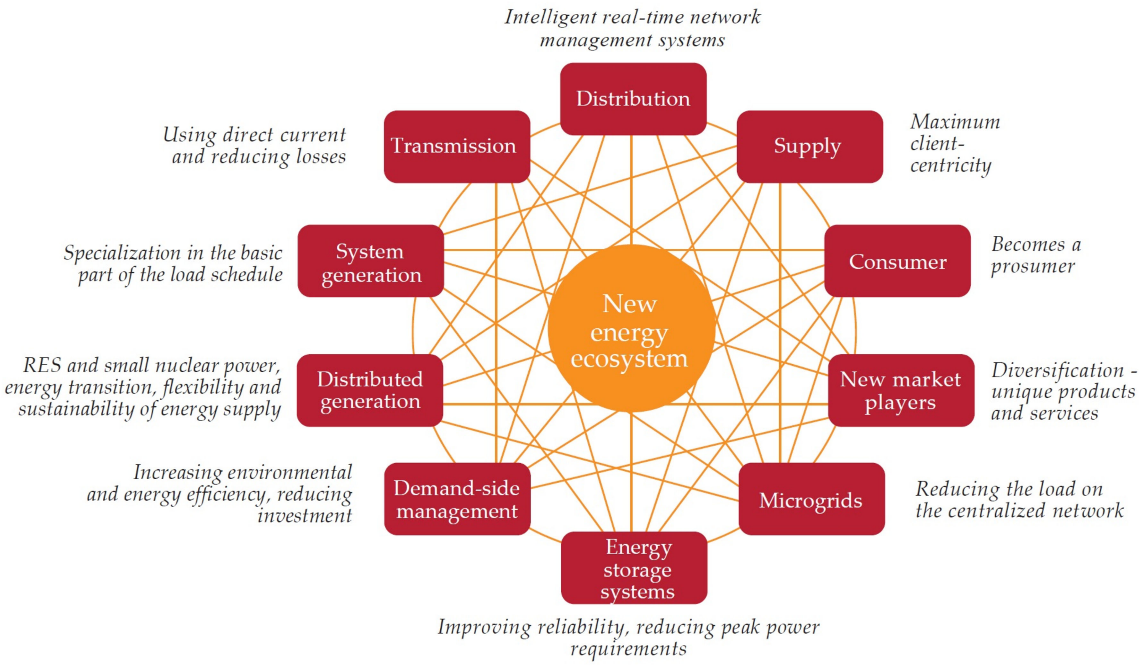

Figure 7. Hyperconnected architecture of the future energy industry (developed by the authors on the basis of the data given in [49]).

The key problems of implementing business models in the energy sector are as follows:

- State regulators and energy infrastructure companies tend to see increased competition in the energy sector as undesirable. The sector in general is 'over-regulated', which impedes business diversification (implementation of an innovative business model inevitably leads to diversification) [72].
- Regional power systems are technically not ready for a massive increase in the number of active users connected to the grid. Other problems include the spreading of bidirec-

tional and multidirectional energy flows and capacity flows and challenges associated with the certification of new technologies [31].
- Some energy market players, primarily large private and state-owned companies, lack economic motivation to improve their performance by offering new services. Instead, they prefer to increase generation of electricity and heat, their main product. Moreover, their management may lack awareness of the benefits of green energy and ESG [98].
- Obsolete technologies and systems of corporate governance block the process of innovation in companies; there is a shortage of qualified specialists capable of generating new ideas and putting them into practice [99].
- Cybersecurity and data protection are considered a priority in the transition to digitalization of operations, business processes, and communication with clients [100].

Therefore, the following practical guidelines can be recommended for those energy businesses that are standing at the beginning of this road. These principles have been successfully tested by energy companies from different parts of the energy sector (generation, transmission, and supply). First, it is necessary to evaluate the readiness of the market (consumers and regulator), its pricing mechanisms, and the availability of the technological infrastructure for new energy services. Second, since innovation lies at the heart of any business model, corporate managers have to evaluate the amount of available intellectual, technological, organizational, and investment resources. This also makes the question of building 'smart partnerships' with universities and suppliers of knowledge-intensive solutions more relevant for the business. Such issues are discussed in detail in other studies of the authors of this article [101,102]. Third, it is recommended to create an integral automated management system connecting all the business processes and elements of the value chain (resource planning, document flow, utility connection, budgeting and finance, investment program, tariff calculation, and environmental and cyber security) into a single cycle. It should be noted that these management systems not only can improve the company's performance but also make the business more flexible and responsive to change, which is an essential task in times of crisis and uncertainty.

5. Conclusions

The energy sector is on the threshold of one of the most significant technological transformations. In the future, energy companies' business models will be focused on innovation, especially in the sphere of decentralized energy generation (provided that its costs will continue to decline—a trend that is particularly relevant in crisis periods). Widescale automation and advanced analytics will provide a new foundation for value chain management. Thus, energy enterprises will be able to benefit from the optimization of corporate governance processes, cost cutting, increased transaction security, and innovation in end user services.

This study demonstrates the main vectors for the development of business models in the electric power industry—a complex and conservative sector which has been for a long time oriented towards the maximization of profit by selling a single product: electricity and heat. The innovation cascade brings a major change to consumers' attitudes to energy as a service with unique characteristics. Similarly, business models are also undergoing radical transformations. The three most popular types of business models include the following: 'spatial' models of production organization based on platform network and digital tools; introducing eco-friendly products to stimulate sustainable consumption; and offering services to ensure 'energy comfort' and manageability of the energy supply process. Identification of the characteristics of these types of business models and determination of the basic conditions for their implementation in energy companies can be considered as a theoretical result of the current study.

ESG provides a new conceptual framework for energy companies, resulting in new business operations requirements and parameters of services. The use of ESG principles in the energy business in conjunction with digital solutions has significant social implications: this not only leads to the deep customization of services for consumers and an increase in the environmental efficiency of energy production but also generally contributes to the formation of an energy culture of consumers, as well as awareness of the value of energy as a key resource for the economy, which in turn lays the foundation for the sustainable development of regions in the long-term perspective.

Our analysis of research literature and expert survey results show that the key factor in the development of new business models should become the changes in the architecture of the energy market's retail sector, deregulation of the economic relationships between the actors in the market, and the creation of simplified interfaces for easier technological and information exchange between distributed energy systems and the country's (or region's) energy system. All of the above should lead to the appearance of a new class of market actors—active consumers and prosumers, operators of microenergy systems, and aggregators of distributed energy resources, creating the demand for high-tech equipment and services. In this regard, we have given recommendations for adapting the configuration and rules of the wholesale and retail energy and capacity markets, which is an important practical result of the article.

The variety of business model templates presented in the scientific literature and practical cases does not allow to analyze the possibilities of their use in the energy sector within the framework of just one article. Nevertheless, we tried to highlight the most relevant types of business models for the modern electric power industry, demonstrate their possible configurations, and justify the conditions for their successful implementation in specific companies.

Another limitation could be found in the engagement of mainly Russian experts in the surveys. However, it should be noted that the respondents' professional and academic background, their experience of participation in energy innovation projects, and a broad scope of general knowledge were the key selection criteria employed by the authors. This is why the majority of the surveyed experts are top managers of large companies. In order to increase the reliability of the conclusions, a large number of practical cases and many authoritative opinions of specialists from different countries were analyzed within the framework of the study.

The issue of business modeling remains very promising for further investigations by the authors. A broad horizon opens up as part of the study of the concepts of BCM, proactive management, and strategic intelligence of the organization in relation to the unique specifics of the electric power industry and energy markets. A special series of research can be devoted to the use of platform business models and the analysis of the transactional effects in energy companies of various sectors (generation, electric distribution complex, energy supply, and energy trading). This also opens avenues for research on the scenarios of business models' transformation amid the increasing energy and economic crisis, disrupted logistics chains, and investment shortages. The latter factors may change the course of the energy transition, leading companies to choose familiar tools and solutions over more progressive and intelligent ones.

Author Contributions: All authors contributed equally to the present work. Conceptualization, L.G. and M.K.; methodology, L.G.; investigation, L.G. and M.K.; writing—original draft preparation, L.G. and M.K.; writing—review and editing, M.K.; visualization, M.K.; supervision, L.G. All authors have read and agreed to the published version of the manuscript.

Funding: The research funding from the Ministry of Science and Higher Education of the Russian Federation (Ural Federal University Program of Development as part of Priority-2030 Program) is gratefully acknowledged.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Zott, C.; Amit, R.; Massa, L. The business model: Theoretical roots, recent developments and future research. *J. Manag.* **2011**, *37*, 1019–1042.
2. Nielsen, C.; Lund, M. (Eds.) *A Brief History of the Business Model Concept*; The Basics of Business Models; Ventus: Copenhagen, Denmark, 2014; pp. 21–27.
3. Rodet-Kroichvili, N.; Cabaret, K.; Picard, F. New Insights into Innovation: The Business Model Approach and Chesbrough's Seminal Contribution to Open Innovation. *J. Innov. Econ. Manag.* **2014**, *15*, 79–99. [CrossRef]
4. Lindgren, P.; Rasmussen, O.H. The Business Model Cube. *J. Multi Bus. Model Innov. Technol.* **2013**, *1*, 135–180.
5. Abell, D.F. *Defining the Business: The Starting Point of Strategic Planning*; Prentice-Hall, Inc.: Upper Saddle River, NJ, USA, 1980.
6. Abell, D. *Managing with Dual Strategies*; Free Press: New York, NY, USA, 1993; p. 292.
7. Vervest, P.; Heck, E.; Pau, L.-F. *Smart Business Networks*; Springer: Berlin/Heidelberg, Germany, 2005; p. 442.
8. Vervest, P.; van Heck, E.; Preiss, K.; Pau, L. Introduction to Smart Business Networks. *J. Inf. Technol.* **2004**, *19*, 225–227. [CrossRef]
9. Hamel, G. *Leading the Revolution: How to Thrive in Turbulent Times by Making Innovation a Way of Life*; Harvard Business School Press: Boston, MA, USA, 2000.
10. Chesbrough, H. Business Model Innovation: Opportunities and Barriers. *Long Range Plan.* **2010**, *43*, 354–363. [CrossRef]
11. Chesbrough, H.; Rosenbloom, R.S. The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spin-off Companies. *Ind. Corp. Chang.* **2002**, *11*, 529–555. [CrossRef]
12. Osterwalder, A.; Pigneur, Y.; Clark, T. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*; Wiley: Hoboken, NJ, USA, 2010; 288p.
13. Osterwalder, A.; Pigneur, Y.; Bernarda, G.; Smith, A.; Papadakos, T. *Value Proposition Design: How to Create Products and Services Customers Want*; John Wiley & Sons: Hoboken, NJ, USA, 2014; 320p.
14. Osterwalder, A.; Pigneur, Y.; Smith, A. *The Invincible Company: How to Constantly Reinvent Your Organization with Inspiration from the World's Best Business Models*; John Wiley & Sons Inc.: Hoboken, NJ, USA, 2020; 400p.
15. Slywotzky, A.J. *Value Migration: How to Think Several Moves Ahead of the Competition*; Harvard Business School Press: Boston, MA, USA, 1996; 240p.
16. Zott, C.; Amit, R. Exploring the fit between business strategy and business model: Implications for firm performance. *Strateg. Manag. J.* **2008**, *29*, 1–26. [CrossRef]
17. Clark, T.; Hazen, B. *Business Models for Teams: See How Your Organization Really Works and How Each Person Fits*; Portfolio: New York, NY, USA, 2017; 272p.
18. Linz, C.; Müller-Stewens, G.; Zimmermann, A. *Radical Business Model Transformation: How Leading Organizations Have Successfully Adapted to Disruption*; Kogan-Page: London, UK, 2020; 368p.
19. Parker, G.; Van Alstyne, M. Innovation, Openness, and Platform Control. *Manag. Sci.* **2018**, *64*, 3015–3032. [CrossRef]
20. Periyasami, S.; Periyasamy, A.P. Metaverse as Future Promising Platform Business Model: Case Study on Fashion Value Chain. *Businesses* **2022**, *2*, 527–545. [CrossRef]
21. The Sharing Economy. 2015. Available online: https://www.pwc.com/us/en/industry/entertainment-media/publications/consumer-intelligence-series/assets/pwc-cis-sharing-economy.pdf (accessed on 23 January 2023).
22. Romero, M.C.; Lara, P.; Villalobos, J. Evolution of the Business Model: Arriving at Open Business Model Dynamics. *J. Open Innov. Technol. Mark. Complex.* **2021**, *7*, 86. [CrossRef]
23. Kim, J.; Min, J. Supplier, Tailor, and Facilitator: Typology of Platform Business Models. *J. Open Innov. Technol. Mark. Complex.* **2019**, *5*, 57. [CrossRef]
24. McCabe, M.J.; Snyder, C.M.; Fagin, A. Open Access versus Traditional Journal Pricing: Using a Simple "Platform Market" Model to Understand Which Will Win (and Which Should). *J. Acad. Librariansh.* **2013**, *39*, 11–19. [CrossRef]
25. Wang, R.; Chebo, A.K. The Dynamics of Business Model Innovation for Technology Entrepreneurship: A Systematic Review and Future Avenue. *SAGE Open* **2021**, *11*, 21582440211029917. [CrossRef]
26. Brege, H.; Kindström, D. Exploring proactive market strategies. *Ind. Mark. Manag.* **2020**, *84*, 75–88. [CrossRef]
27. Beqiri, G. Innovative Business Models and Crisis Management. *Procedia Econ. Financ.* **2014**, *9*, 361–368. [CrossRef]
28. Sawalha, I.H. Views on business continuity and disaster recovery. *Int. J. Emerg. Serv.* **2021**, *10*, 351–365. [CrossRef]
29. Niemimaa, M.; Järveläinen, J.; Heikkilä, M.; Heikkilä, J. Business continuity of business models: Evaluating the resilience of business models for contingencies. *Int. J. Inf. Manag.* **2019**, *49*, 208–216. [CrossRef]
30. Gitelman, L.D.; Kozhevnikov, M.V.; Chebotareva, G.S. Strategic Intelligence of an Organization Amid Uncertainty. *Int. J. Energy Prod. Manag.* **2021**, *6*, 294–305. [CrossRef]
31. Brzóska, J.; Knop, L.; Odlanicka-Poczobutt, M.; Zuzek, D.K. Antecedents of Creating Business Models in the Field of Renewable Energy Based on the Concept of the New Age of Innovation. *Energies* **2022**, *15*, 5511. [CrossRef]
32. Kallio, L.; Heiskanen, E.; Apajalahti, E.-L.; Matschoss, K. Farm power: How a new business model impacts the energy transition in Finland. *Energy Res. Soc. Sci.* **2020**, *65*, 101484. [CrossRef]
33. Hamwi, M.; Lizarralde, I. Energy Entrepreneurship Business Models Innovation: Insights from European Emerging Firms. Available online: https://hal.archives-ouvertes.fr/hal-01961930/document (accessed on 5 January 2023).
34. Giehl, J.; Göcke, H.; Grosse, B.; Kochems, J.; Müller-Kirchenbauer, J. Survey and Classification of Business Models for the Energy Transformation. *Energies* **2020**, *13*, 2981. [CrossRef]

35. Theme Report on Energy Transition—Towards the Achievement of SDG 7 and Net-Zero Emissions. 2021. Available online: https://www.un.org/sites/un2.un.org/files/2021-twg_2-062321.pdf (accessed on 13 December 2022).
36. Perspectives for the Energy Transition—Investment Needs for a Low-Carbon Energy System. 2017. Available online: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Mar/Perspectives_for_the_Energy_Transition_2017.pdf (accessed on 13 December 2022).
37. Global Energy Transformation—A Roadmap to 2050. 2017. Available online: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_Report_GET_2018.pdf (accessed on 13 December 2022).
38. Henderson, J.; Sen, A. The Energy Transition: Key Challenges for Incumbent and New Players in the Global Energy System. 2021. Available online: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2021/09/Energy-Transition-Key-challenges-for-incumbent-players-in-the-global-energy-system-ET01.pdf (accessed on 13 December 2022).
39. Gitelman, L.D.; Kozhevnikov, M.V.; Adam, L.A. Sustainable energy for smart city. *Int. J. Energy Prod. Manag.* **2019**, *4*, 273–286. [CrossRef]
40. Gitelman, L.D.; Kozhevnikov, M.V. Adoption of technology platforms in the electric power industry: New opportunities. *WIT Trans. Ecol. Environ.* **2022**, *255*, 23–34. [CrossRef]
41. Gitelman, L.D.; Kozhevnikov, M.V.; Kaplin, D.D. Asset management in grid companies using integrated diagnostic devices. *Int. J. Energy Prod. Manag.* **2019**, *3*, 230–243. [CrossRef]
42. Gitelman, L.D.; Kozhevnikov, M.V. Electrification in Industrial Revolution 4.0. *Int. J. Energy Prod. Manag.* **2020**, *5*, 367–379. [CrossRef]
43. Martins, F.; Moura, P.; de Almeida, A.T. The Role of Electrification in the Decarbonization of the Energy Sector in Portugal. *Energies* **2022**, *15*, 1759. [CrossRef]
44. Singh, M.; Jiao, J.; Klobasa, M.; Frietsch, R. Servitization of Energy Sector: Emerging Service Business Models and Startup's Participation. *Energies* **2022**, *15*, 2705. [CrossRef]
45. Mourik, R.; Bouwknegt, R. Energy Service Business Models and Entrepreneurial Skills: Identifying Models and Patterns. *Proceedings* **2020**, *65*, 26. [CrossRef]
46. Kozhevnikov, M.V. A transition to knowledge-intensive service activities in power industry: A theoretical framework. *WIT Trans. Ecol. Environ.* **2019**, *222*, 13–25. [CrossRef]
47. Xia-Bauer, C.; Vondung, F.; Thomas, S.; Moser, R. Business Model Innovations for Renewable Energy Prosumer Development in Germany. *Sustainability* **2022**, *14*, 7545. [CrossRef]
48. Santa, A.-M.I. Prosumers—A New Mindset for Citizens in Smart Cities. *Smart Cities* **2022**, *5*, 1409–1420. [CrossRef]
49. The Road Ahead—Gaining Momentum from Energy Transformation. 2014. Available online: https://www.pwc.com/gx/en/utilities/publications/assets/pwc-the-road-ahead.pdf (accessed on 13 December 2022).
50. World Energy Investment 2021. 2021. Available online: https://iea.blob.core.windows.net/assets/5e6b3821-bb8f-4df4-a88b-e891cd8251e3/WorldEnergyInvestment2021.pdf (accessed on 13 December 2022).
51. Pakulska, T.; Poniatowska-Jaksch, M. Digitalization in the Renewable Energy Sector—New Market Players. *Energies* **2022**, *15*, 4714. [CrossRef]
52. Platform Economy: Technology-Driven Business Model Innovation from the Outside in. 2017. Available online: https://www.giz.de/expertise/downloads/Accenture_Platform-Economy-Technology-Vision-2016.pdf (accessed on 13 December 2022).
53. Whetten, D.A. What Constitutes a Theoretical Contribution? *Acad. Manag. Rev.* **1989**, *14*, 490–495. [CrossRef]
54. Suddaby, R. Editor's comments: Why theory? *Acad. Manag. Rev.* **2014**, *39*, 407–411. [CrossRef]
55. Asset-vs. Service-Based Business Models—Where Lies the Future for Utilities? Available online: https://www.enerquire.com/blog/the-future-business-model-of-utilities-like-eon-innogy-services-vs-assets (accessed on 13 December 2022).
56. New Corporate Strategy: E.ON to Focus on Renewables, Distribution Networks, and Customer Solutions and to Spin off the Majority of a New, Publicly Listed Company Specializing in Power Generation, Global Energy Trading, and Exploration and Production. Available online: https://www.eon.com/en/about-us/media/press-release/2014/new-corporate-strategy.html (accessed on 13 December 2022).
57. Electricity Network Transformation Roadmap—Insights from Global Jurisdictions, New Market Actors & Evolving Business Models. 2016. Available online: https://www.energynetworks.com.au/resources/reports/insights-from-global-jurisdictions-new-market-actors-evolving-business-models/ (accessed on 13 December 2022).
58. Three Possible Business Models for Distributed Storage. Available online: https://wattclarity.com.au/articles/2014/03/three-possible-business-models-for-distributed-storage/ (accessed on 5 January 2023).
59. Palmié, M.; Boehm, J.; Friedrich, J.; Parida, V.; Wincent, J.; Kahlert, J.; Gassmann, O.; Sjödin, D. Startups versus incumbents in 'green' industry transformations: A comparative study of business model archetypes in the electrical power sector. *Ind. Mark. Manag.* **2021**, *96*, 35–49. [CrossRef]
60. Energy-as-a-Service—The Lights Are on. Is Anyone Home? 2019. Available online: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/energy-resources/deloitte-uk-energy-as-a-service-report-2019.pdf (accessed on 13 December 2022).
61. The Potential of Digital Business Models in the New Energy Economy. 2022. Available online: https://www.iea.org/articles/the-potential-of-digital-business-models-in-the-new-energy-economy (accessed on 13 December 2022).
62. Cleary, K.; Palmer, K. Energy-as-a-Service: A Business Model for Expanding Deployment of Low-Carbon Technologies. Resources for the Future. 2019. Available online: https://media.rff.org/documents/IB_19-09_EaaS.pdf (accessed on 13 December 2022).

63. A Brief Review of Energy Storage Business Models. Available online: https://leylinecapital.com/news/a-brief-review-of-energy-storage-business-models (accessed on 13 December 2022).
64. Xia-Bauer, C.; Große-Kreul, F.; Thomas, S. Business Models of Virtual Power Plants (VPPs) in Germany. Available online: https://www.energypartnership.cn/fileadmin/user_upload/china/media_elements/publications/Business_Models_of_Virtual_Power_Plants__VPPs__in_Germany-EN.pdf (accessed on 5 January 2023).
65. Roozbehani, M.M.; Heydarian-Forushani, E.; Hasanzadeh, S.; Elghali, S.B. Virtual Power Plant Operational Strategies: Models, Markets, Optimization, Challenges, and Opportunities. *Sustainability* **2022**, *14*, 12486. [CrossRef]
66. LineJump Official Website. Available online: https://www.limejump.com (accessed on 13 December 2022).
67. New Brunswick Power Official Website. Available online: https://www.nbpower.com (accessed on 13 December 2022).
68. Khatoon, A.; Verma, P.; Southernwood, J.; Massey, B.; Corcoran, P. Blockchain in Energy Efficiency: Potential Applications and Benefits. *Energies* **2019**, *12*, 3317. [CrossRef]
69. Kirli, D.; Couraud, B.; Robu, V.; Salgado-Bravo, M.; Norbu, S.; Andoni, M.; Antonopoulos, I.; Negrete-Pincetic, M.; Flynn, D.; Kiprakis, A. Smart contracts in energy systems: A systematic review of fundamental approaches and implementations. *Renew. Sustain. Energy Rev.* **2022**, *158*, 112013. [CrossRef]
70. Junlakarn, S.; Kokchang, P.; Audomvongseree, K. Drivers and Challenges of Peer-to-Peer Energy Trading Development in Thailand. *Energies* **2022**, *15*, 1229. [CrossRef]
71. Soto, E.A.; Bosman, L.B.; Wollega, E.; Leon-Salas, W.D. Peer-to-peer energy trading: A review of the literature. *Appl. Energy* **2021**, *283*, 116268. [CrossRef]
72. Gabriel, C.-A.; Kirkwood, J. Business models for model businesses: Lessons from renewable energy entrepreneurs in developing countries. *Energy Policy* **2016**, *95*, 336–349. [CrossRef]
73. Kindström, D.; Ottosson, M. Local and regional energy companies offering energy services: Key activities and implications for the business model. *Appl. Energy* **2016**, *171*, 491–500. [CrossRef]
74. Trapp, C.T.C.; Kanbach, D.K. Green entrepreneurship and business models: Deriving green technology business model archetypes. *J. Clean. Prod.* **2021**, *297*, 126694. [CrossRef]
75. NextEra Energy Official Website. Available online: https://www.nexteraenergy.com (accessed on 13 December 2022).
76. Brookfield Renewable Partners Official Website. Available online: https://bep.brookfield.com (accessed on 13 December 2022).
77. Ormat Technologies Official Website. Available online: https://www.ormat.com/en/home/a/main/ (accessed on 13 December 2022).
78. First Solar Official Website. Available online: https://www.firstsolar.com (accessed on 13 December 2022).
79. SolarEdge Technologies Official Website. Available online: https://www.solaredge.com (accessed on 13 December 2022).
80. Wedekind, S. Energy as a Service: A Strategic Challenge and Key Opportunity for ESCOs. Available online: https://energycentral.com/o/Guidehouse/energy-service-strategic-challenge-and-key-opportunity-escos (accessed on 13 December 2022).
81. Wedekind, S. Energy Service Companies Face Increasing Pressure from Energy as a Service. Available online: https://guidehouseinsights.com/news-and-views/energy-service-companies-face-increasing-pressure-from-energy-as-a-service (accessed on 13 December 2022).
82. Järvi, K.; Sainio, L.-M.; Ritala, P.; Pellinen, A. Building a framework for a partnership business model. *Int. J. Manag. Concepts Philos.* **2010**, *4*, 100–117. [CrossRef]
83. Chaurey, A.; Krithika, P.R.; Palit, D.; Rakesh, D.; Sovacool, B.K. New partnerships and business models for facilitating energy access. *Energy Policy* **2012**, *47*, 48–55. [CrossRef]
84. Weill, P.; Woerner, S. *What's Your Digital Business Model? Six Questions to Help You Build the Next-Generation Enterprise*; Harvard Business Review Press: Boston, MA, USA, 2018; 256p.
85. The 17 Goals. Available online: https://sdgs.un.org/goals (accessed on 10 November 2022).
86. The Rising Need for ESG in The Energy Industry. Available online: https://ifsolutions.com/the-rising-need-for-esg-in-the-energy-industry/ (accessed on 13 December 2022).
87. Nitlarp, T.; Kiattisin, S. The Impact Factors of Industry 4.0 on ESG in the Energy Sector. *Sustainability* **2022**, *14*, 9198. [CrossRef]
88. 2021 Global 100 Ranking. Available online: https://www.corporateknights.com/rankings/global-100-rankings/2021-global-100-rankings/2021-global-100-ranking/ (accessed on 13 December 2022).
89. Assessing ESG Factors in the Energy Sector: A Handbook. Available online: https://www.dlapiper.com/en/us/insights/publications/2020/10/assessing-esg-factors-in-the-energy-sector/ (accessed on 13 December 2022).
90. Puttachai, W.; Phadkantha, R.; Yamaka, W. The threshold effects of ESG performance on the energy transitions: A country-level data. *Energy Rep.* **2022**, *8*, 234–241. [CrossRef]
91. Cozzi, L.; Goodson, T. Empowering Electricity Consumers to Lower Their Carbon Foot-Print; International Energy Agency. 2020. Available online: https://www.iea.org/commentaries/empowering-electricity-consumers-to-lower-their-carbon-footprint (accessed on 13 December 2022).
92. Smart Meter Benefits: Role of Smart Meters in Responding to Climate Change—Delta-EE Viewpoint. Available online: https://www.smartenergygb.org/media/i0pjpsqm/smart-meter-benefits-climate-change.pdf (accessed on 13 December 2022).
93. Reilly, T.; Mahween, S. ESG in the Energy Sector. Available online: https://www.insideenergyandenvironment.com/2021/04/esg-in-the-energy-sector/ (accessed on 13 December 2022).

94. ESG: Transforming Energy's Risk Landscape. Energy Market Review 2020. Willis Tow-Ers Watson Analytical Report. 2020. Available online: https://www.wtwco.com/assets/image/Energy-Market-Review-v10.pdf (accessed on 13 December 2022).
95. Grabowska, S.; Saniuk, S. Business Models in the Industry 4.0 Environment—Results of Web of Science Bibliometric Analysis. *J. Open Innov. Technol. Mark. Complex.* **2022**, *8*, 19. [CrossRef]
96. Jensen, A.B. Do we need one business model definition? *J. Bus. Model.* **2013**, *1*, 61–84.
97. Magretta, J. Why business models matter. *Harv. Bus. Rev.* **2002**, *80*, 86–92.
98. Bürer, M.J.; de Lapparent, M.; Capezzali, M.; Carpita, M. *Governance Drivers and Barriers for Business Model Transformation in the Energy Sector*; Hettich, P., Kachi, A., Eds.; Swiss Energy Governance; Springer: Cham, Switzerland, 2022; pp. 195–243. [CrossRef]
99. Gitelman, L.D.; Kozhevnikov, M.V. A Science and Education Platform for Intellectual Support of Breakthrough Teams in the Energy Sector. *Int. J. Energy Prod. Manag.* **2022**, *7*, 388–400. [CrossRef]
100. Troup, E.G. Growing Role of Platforms in Cybersecurity. *Cyber Def. Rev.* **2017**, *2*, 61–70.
101. Gitelman, L.; Kozhevnikov, M. New leaders for technological breakthroughs in the energy industry. *WIT Trans. Ecol. Environ.* **2017**, *224*, 499–511. [CrossRef]
102. Gitelman, L.; Kozhevnikov, M.; Ryzhuk, O. Advance Management Education for Power-Engineering and Industry of the Future. *Sustainability* **2019**, *11*, 5930. [CrossRef]