

Article

Identifying Resilience Factors of Power Company Business Models

Joanna Staszewska ¹ and Lilla Knop ^{2,*}¹ Tauron Polska Energia S.A., 40-114 Katowice, Poland; joanna.staszewska@tauron.pl² Faculty of Organization and Management, Silesian University of Technology, 44-100 Gliwice, Poland

* Correspondence: lilla.knop@polsl.pl

Abstract: The paper focuses on the issue of the resilience of energy company business models under energy transition conditions. The main aim of this paper is to identify the key factors responsible for the resilience of an energy company's business model. This paper presents an excerpt from research on the resilience of energy company business models and the development of a system for assessing the resilience of the energy company business model. The research used a systems approach and a multi-criteria method of hierarchical analysis of decision-making problems, the so-called AHP (Analytic Hierarchy Process). Its selected elements were adapted to solve the scientific problem presented in this paper. Additionally, an approach to building resilient business model strategies was used in the research process. The research instrument adopted for the analyses was a model using the concept of the so-called New Era of Innovation. It was supplemented with the elements of the Canvas model. The results of the research in the form of identified key resilience factors of the energy company's business model are presented in this article. Of the 79 resilience factors analyzed, 28 were identified as being key to the resilience of the business model. These findings formed the basis for the development of a business model resilience assessment system. The research indicates that learning about the key factors responsible for the resilience of an energy company's business model is an important and necessary part of the tool for assessing resilience.

Keywords: business model; resilience; business model resilience; energy company; energy transition; climate neutrality; power sector



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1. Introduction

The future of modern energy is shaped by the common policy initiatives of European Union countries, particularly those contained in the European Green Deal [1]. The European Green Deal and measures to stimulate economic recovery set long-term goals and establish financial instruments for the European Union and European countries to meet the challenges of a climate-neutral world [2]. The pursuit of climate neutrality characterizes the contemporary circumstances of the power sector and the challenges faced by companies in the sector.

Energy transformation means building a new energy sector by replacing coal and gas-fired generation sources with renewable energy sources (RES) [3] and making large-scale use of digital technologies in the information and communication technology (ICT) industry [4]. A permanent change in the structure of electricity production, a reduction in the share of coal, and an increase in the share of RES in the energy mix result in a radical change in the current operating model of the energy sector. This also applies to companies

in this sector. This article focuses on energy companies involved in the production of electricity. The structure of electricity generation in Poland and the European Union is still, depending on the country, characterized by a significant share of electricity generation from fossil fuels. Therefore, companies generating electricity from coal and renewable energy sources were included in this study. The energy transformation of these enterprises is aimed at eliminating coal-based energy production. Indeed, the transformation is forcing a change in the business models of energy companies to the extent that they can actively participate in the transformation and, at the same time, achieve their long-term strategic goals. A key challenge for today's enterprises is the changes determined by the energy transition to enable them to maintain the core business model concept of delivering and capturing value for customers, owners, and other stakeholders. The current operating environment for energy companies in the energy market is further determined by the geopolitical situation related to the Russian Federation's invasion of Ukraine [5], the economic and social challenges still being felt, and social challenges related to the effects of the COVID-19 pandemic [6]. These amplify the risks of increases and fluctuations in the prices of raw materials and energy, as well as the energy security of countries in Europe. Therefore, in light of the above considerations, the resilience of the business models of energy companies under the described conditions of transition remains an important scientific problem that requires further investigation. However, assessing resilience and taking appropriate action to build and maintain it in the long term requires an understanding of the key factors responsible for the resilience of the business model.

This paper focuses on the issue of the resilience of energy company business models during the energy transition. The aim of this paper is to identify the key factors responsible for the resilience of an energy company's business model. These factors are discussed in the context of their importance and role in the business model resilience assessment system. This paper presents a piece of research dedicated to the resilience of energy company business models and the development of a system for assessing the resilience of an energy company business model. Due to the complexity and multidimensional nature of the resilience of an energy company's business model, solutions for assessing the resilience of the business model should include a multivariate analysis of the factors shaping the current and future structure of energy production and the implementation of the strategy and business model of transformation and development directions responding to current and future challenges of the environment. This inspired an in-depth study to identify resilience factors to build knowledge and implement actions to assess and define actions to increase the resilience of the business model.

A review of the literature and business practices has shown that a systematic approach to examining the resilience of an energy company's business model is not in place in energy companies. A functioning comprehensive system for assessing business model resilience, including the principles and process for conducting business model resilience assessments and defining conclusions and recommendations for the company in this regard, was not identified in the groups surveyed. Based on the above considerations, the following research gaps relating to the resilience of the energy company business model and its assessment were identified:

- Lack of an approach adequate to the current situation of Polish energy companies to study the effects of the energy transition on energy companies.
- The dimensions and factors of business model resilience have been insufficiently investigated in relation to energy companies in the literature.
- However, an adequate methodological framework for identifying the elements of the energy company business model vulnerable to change and a methodolog-

ical framework for measuring and assessing the resilience of the model has not been developed.

- A comprehensive system for assessing the resilience of an energy company's business model, including the principles and processes for conducting business model resilience assessments and defining conclusions and recommendations for the company, has not yet been developed.

Given the high levels of uncertainty and ongoing transformations in the energy sector, the discussion surrounding the role of resilience in the business models of these companies is increasingly relevant. To guide our investigation, we pose the following research questions:

RQ1: *How is the academic discourse evolving regarding business model resilience within the energy sector?*

RQ2: *What factors and areas influence the resilience of energy companies' business models?*

RQ3: *What are the key factors that contribute to the resilience of the business models of energy companies?*

The research used a systems approach and a multi-criteria method of hierarchical analysis of decision-making problems, the so-called Analytic Hierarchy Process (AHP) [7]. Selected elements of this analysis were adapted to solve the scientific problem of this paper. This enabled the analysis and identification of key factors for the resilience of the business models of energy companies. In addition, this research used the approach to building resilient business model strategies proposed by Taeuscher and Abdelkafi [8]. This was used to identify the determinants of the resilience of business model elements. The research instrument used in this paper to configure these elements was a model using the concept of the so-called New Era of Innovation [9]. This was supplemented with the elements of the Canvas model [10]. The research indicates that learning about the key factors responsible for the resilience of an energy company's business model is crucial for assessing this resilience.

The identification of factors for the resilience of the energy company's business model enabled the next stage of the research, which was the development of a comprehensive system for assessing the resilience of the energy company's business model. This is because the implementation of the challenges arising from the energy transformation of energy enterprises requires the functioning of tools supporting management processes aimed at ensuring the ability of this enterprise to adapt to changes in operating conditions and, at the same time, to shape these processes.

The remainder of this article is organized as follows: Section 2 reviews the existing literature on business models and resilience in the energy sector. In Section 3, we outline our research process and detail the steps involved in applying the Analytic Hierarchy Process (AHP) method. Sections 4 and 5 present and discuss the research findings. Finally, Section 6 summarizes the results and highlights potential avenues for future research on business model resilience in the energy sector.

2. Literature Review

2.1. The Business Model and Its Resilience

The business model, through the unique concept of resources and competencies used by the enterprise in the value chain, allows the delivery of values that constitute the competitive advantage of the enterprise in the market. This instrument has been an important research issue and area of interest among management theorists and practitioners for several years. Many diverse approaches have been developed, reflected in the defini-

tions of the business model itself and the concepts proposed for the configuration of its components [11].

The definitions of the business model by authors Zoott and Amit [12–14] and Teece [15] emphasize value as a key element of a business. In Zoott and Amit's definition of a business model, the instrument is an abstract rational describing how a corporation creates, delivers, and obtains value and the core competitive advantage of the business from a value creation perspective [14]. Teece calls the business model the design or architecture of the value creation, delivery, and capture mechanisms it employs. He treats the enterprise in this concept as a set (system) of logically interconnected elements that allow the enterprise to create value and enable it to profit from this created value [15]. In addition to the above-mentioned authors, studies on business models by the authors are known in the literature: Chesbrough, Rosenbloom [16], Seddon, Lewis [17], Magretta [18], Afuah, Tucci [19], Afuah [20], Shafer, Smith, Linder [21], Osterwalder, Pigneur [10], as well as Johnson et al. [22] and Sliwotzky et al. [23]. The description of a business idea that ensures its competitiveness by creating and delivering customer value is the common ground of the approaches presented by these authors. In this article, we define a business model as the foundational framework that outlines how a company operates to create value for its customers and other stakeholders while effectively capturing and retaining that value. Research on business model decomposition is also of great interest in the literature. The value offered to customers is a key element of the proposed approach. An interesting business model configuration was proposed by Afuah and Tucci [19]. The structure of the business model in this concept includes the value offered to customers by the market participant, the market segment, the pricing policy, the sources of revenue, the necessary activities related to making the value offered available, the organizational capabilities that underpin the business, the skills and ventures that are important for sustaining key aspects of competitive advantage, and the activities that enable competitive advantage to be sustained. The New Era of Innovation presents the concept of a business model at three basic levels. The first two are social architecture and technical architecture, which describe resources and competencies. The last one is formed by business processes [9]. On the other hand, on the application side in business practice, the concept of Osterwalder and Pigneur is very popular (model CANVAS) [10]. The nine elements in the four business areas (customers, offer, infrastructure, and relevant financial position) are customers, value proposition, channels, customer relationships, revenue streams, key resources, key activities, key partners, and cost structure. The inclusion of value and, in addition to key resources, processes (value chain), the scope of the offer to the customer, and competitive advantages is a common feature of the described configurations of the business model components [24].

Adapting to a changing environment and reorienting corporate objectives toward energy transformation while increasing value requires the resilience of business models. The issue of resilience is considered at the level of the economy, communities, corporate governance, organizations, and business models. The concept is used in many scientific fields, including psychology, sociology, ecology, materials engineering, biology and medicine, organization theory, economics, public administration, and political science. Many definitions of resilience have also been developed, referring to various levels of analysis (individual, group, community, organization, and business models). Palzkill-Vorbeck has proposed an interesting definition of organizational resilience [25,26]. It is the ability of a company to adapt its business model in the face of external pressures (e.g., market pressures) without losing its identity and value proposition based on the core business model. In their research on organizational resilience, Ince et al. [27] focused on the dimensions of resilience, the actions and responses of organizations to disruptions or crises that affect performance

and business continuity, and the characteristics and capabilities that distinguish resilient organizations from other organizational management concepts such as strategic planning, knowledge management, and innovation.

Summarizing the research on resilience, including the business model, it is necessary to mention the works of the authors presented in Table 1.

Table 1. Summarizing the research on resilience.

Item	Researchers	The Approaches Presented
1.	Berkes, Ross [28]	Presenting an integrated approach to community resilience research.
2.	Francis, Beker [29]	Discussing the resilience assessment framework in five elements: identification system, vulnerability analysis, setting resilience goals, stakeholder engagement; the most important element of the assessment—continuous questioning of the organization’s risk model and recognition that failures may be inevitable.
3.	Tobin [30]	Pointing to a framework for analyzing sustainability and resilience based on based on three theoretical models: the mitigation model, the recovery model and the structural—cognitive model.
4.	Cutter, et al. [31]	Discussing a set of community resilience indicators that include ecological, social and economic, institutional, infrastructural and community competence dimensions.
5.	Norris, et al. [32]	Describing a resilience model that links a network of adaptive capacities (resources with dynamic attributes) to adaptation after disruption or adversity, resilience results from four basic sets of adaptive capacities: economic development, social capital, information and communication, and community competence.
6.	Mallak [33]	Presenting six factors influencing the resilience of an organization or individual: solution-focused goal orientation, avoidance, critical understanding, role dependence, source dependence, and resource availability.
7.	Bruneau et al. [34]	Describing the dimensions of resilience, both physical and social systems: robustness, redundancy, resourcefulness, speed—four dimensions of resilience: technical, organizational, social and economic.
8.	Walker et al. [35]	Presenting an assessment of resilience along four dimensions: latitude (the spectrum of attraction and diversity of system options), resistance (the system’s capacity for change and thus the system’s ability to talk and learn), uncertainty (distances to critical points and the probability of exceeding them) and panarchy (the system’s dependencies on other systems and interactions).
9.	Longstaff et al. [36]	Pointing out critical elements for assessing resilience; five subsystems in terms of efficiency, diversity and redundancy and its adaptability in terms of institutional memory, capacity for innovation and internal and external bonding; proposing questions to assess the resilience of the community subsystem.

Table 1. *Cont.*

Item	Researchers	The Approaches Presented
10.	Ince et al. [27]	Discussing research on organizational resilience, focusing on the dimensions, actions and responses of organizations to disruptions or crises that affect performance and business continuity, as well as the characteristics of and capabilities that distinguish resilient organizations from other organizational management concepts: strategic planning, knowledge management and innovation.
11.	McManus [37]	Describing a method of multiple case studies and a five-step process for assessing resilience, interviews and observation; 15 indicators of resilience.
12.	Stephenson et al. [38]	Representing a modification in S. McManus' model for measuring organizational resilience with an additional dimension—the resilience ethos; an additional six indicators.
13.	Otola et al. [39,40]	combine theoretical and empirical perspectives on the two issues of trust and organizational resilience in an environment that is difficult to predict.
14.	Taeuscher and Abdelkafi [41,42]	find that the reliability of a business model decreases if the structure is intolerant of the uncertain dynamics associated with its components. The robustness of a business model increases with decreasing uncertainty about its components and increasing tolerance to unpredictable component dynamics. The level of uncertainty of key components, tolerance to volatility and unpredictable component dynamics, feedback on the effectiveness of the business model, and adaptability of the business model structure constitute the four groups of business model resilience analysis criteria proposed by the authors.

Source: own work based on the literature review.

The literature review allows us to formulate the following conclusions relating to the current state of knowledge in the field of research on resilience, including the business model presented in scientific publications.

- There is considerable interest in research on the meaning and measurement of resilience from various research perspectives (mainly foreign publications).
- A significant number of studies deal with the identification of dimensions and indicators for measuring resilience to natural disasters and climate change as one of the important challenges facing economies, communities, and at the local or societal level—inspiring research on the resilience of organizations and business models.
- Business model resilience is introduced as a conceptual framework to better understand the systemic dimensions of businesses affected by sustainability transformations and how they are shaped.
- The close relationship between systems, organization and business model resilience, and sustainability is identified; additionally, the need for a holistic, integrated approach to measurement and assessment is highlighted. Building and measuring resilience are considered a process in relation to the dimensions, characteristics, and factors of resilience, as well as the relationship between them in various cross-sections.

2.2. Resilience Under an Energy Transition Conditions

Energy transition means a change in the entire socio-economic and political system and political system involving a shift from a traditional energy supply path to a system

based on zero and low-carbon sources [43,44]. It brings with it the need for energy market players to adapt their business models to regulatory, market, technological, and social changes, with a particular focus on changes and customer needs [45].

In addition, it is worth mentioning the research of Giehl et al., who identified 638 business models in the field of energy [46]. Brzóška and Krannich conducted research on the concept of business models in the context of technological and organizational transformations based on a wide range of implemented innovations [47]. The analysis of business models in the context of distributed energy resources, photovoltaic applications, and energy storage using an empirical approach was dealt with by Burger et al. [48]. Strupeit et al. [49] are using the business model concept as an analytical tool; their comparative study has investigated organizational configurations related to the deployment of customer-sited photovoltaic (PV) systems in Germany, Japan and the United States. Similarly, Brzóška et al. [50] identified the antecedence of business models for the renewable energy sector, characterized their concepts and structure, and assessed the importance of innovation in the creation of value for the customer and for the business in the examined business models. Complementing these results, Hamwi's [51] business model classification framework for start-ups in the energy sector provides a conceptual tool for business model management in research and development.

Until 2020, the ETS (Emissions Trading System) was modified several times to meet changing and more ambitious climate targets included in further packages: the "Paris Agreement" [52])—2015, the "Winter Package" [53]—2016, the "European Green Deal" [1]—2019 and its development—the "Fit for 55 Package" 2020 and 2021 [54]. In 2022, the REPowerEU Plan was prepared [53,54]. The European Union's regulatory framework for the transition is defined by the 'Fit for 55' legislative package, which aims to update and adjust existing regulations to a greenhouse gas emissions reduction target of at least 55% by 2030. It also includes an increase in the emission reduction target for the sectors covered by the scheme (up to 61% by 2030, compared to 2005), an increase in the target for the share of energy from RES in the final energy consumption (to 40% in 2030), and an increase in the annual target for RES consumption in the district heating and cooling sector. In addition, it calls for an improvement in energy efficiency to 36% by 2030 and introduces a borderline carbon 'tax' for energy-intensive sectors: steel and iron, aluminum, cement, fertilizers, and electricity. The national implementation of the EU regulations is contained in the 'Energy Policy of Poland until 2040' [55], which presents a vision for the reconstruction and transformation of the Polish energy sector and a path toward climate neutrality.

The REPowerEU Plan [53] was a response to the energy and fuel market situation caused by the conflict in Ukraine. Its aim was to accelerate the transition to green energy and make Europe independent of Russian fossil fuels well before 2030 by, among other things, reducing dependence on Russian gas and accelerating the transition to sustainable energy. The REPowerEU Plan sets out to reduce fossil fuel consumption by expanding renewables, energy efficiency, electrification, and gas alternatives. It also set out to increase the EU's renewable energy target to reach 45% of energy consumption by 2030 [54] and to help achieve the medium-term goal of at least 55% greenhouse gas emissions reduction (compared to 1990) and CO₂ neutrality by 2050 [56].

A prerequisite for the successful implementation of energy companies' development strategies and for meeting the challenges of energy transition is ensuring the resilience of their business models. This means that the business models of today's energy companies must be adaptive to change in the form of the ability to survive disruptions and make changes that guarantee the continuity of their operations. Indeed, because of the changes taking place, the traditional value chain is being and will continue to be transformed. The energy market, because of new technologies, social changes, microgrids, and the rapidly

growing scale of distributed generation based on RES micro-sources [57], is taking on the character of a heterogeneous structure, becoming an alternative to the traditional energy market [58,59]. It results in a new structure of energy market actors and the emergence of new market players. New players are entering the market with new business models in terms of how they create, deliver, and capture value. They represent an alternative and threat to traditional energy companies. There are studies available in the literature relating to the typology of new business models in the energy industry. One should mention here the research of Bryant et al. [60], who proposed five types of business models of energy companies and the research of Frantzis et al. [61], who distinguished a general division of these concepts into so-called client-side and utility-side models and mixed models (prosumer/customer business models, large-scale producer business models, service business models—most often as: product as a service). Matusiak [62] proposed five business models for a new energy market built on smart and efficient energy management. Giehl et al. identified 638 business models into 69 prototypes and 17 classes of business models according to the dimensions of 'customer proximity' and 'proximity to the classic energy value chain'. They created a Business Model for Energy Transformation (BMFE) framework [46]. The results of this work are relevant in the context of business model typologies in the energy transition; however, they do not directly address the issue of identifying key business model elements sensitive to change. In the studies carried out on the impact of transformation on business models, different business model logics and their application to accelerate the energy transition are highlighted. New business models in energy are based on value creation under sustainable conditions, combining environmental and community aspects, using renewable energy sources, and disruptive innovation. In conclusion, it should be noted that the concept of resilience, as a new paradigm in management, including climate change adaptation, hazard mitigation, and sustainability, is embedded in the operation of energy companies. It is gaining importance in the face of challenges associated with energy transitions. Decarbonization, decentralization, and digitalization, as well as pressure to increase energy efficiency, are shaping the transformation processes of today's energy industry. The decarbonization of energy production and the shift in energy production toward renewable, CO₂-neutral energy sources are promoting the decentralization of the sector. The traditional centralized and monopolistic structure of the energy sector is being transformed into a market of decentralized and distributed renewable energy systems. They are developing entirely new types of business models with new value chains in the energy market, taking advantage of virtualization effects, and creating new areas for the development of innovative technologies, including information technology. This has resulted in the search by traditional energy companies for new, effective methods of competition and changes in their business models. A prerequisite for the successful transformation of energy companies is the resilience of business models to changes in environmental conditions and the ability to respond to emerging threats and opportunities in a manner that enables business continuity and value maximization. Resilience is fundamentally necessary for energy companies to adapt to changing market needs and conditions, technology developments, investment directions, and other unpredictable factors, including new business models. The complexity of these changes emphasizes the role of the resilience of the business model of energy companies and the search for solutions and strategies to support building and maintaining this resilience [63].

Previous research on business model resilience and its assessment, as well as the practice of energy companies, has not addressed this issue. In light of the above research conclusions, the evaluation calls for more attention to the issues of business models' vulnerability to changes in the environment, resilience building, and its assessment—especially with regard to energy companies. According to the doctoral student, the issue of resilience

requires in-depth further research due to its complexity and multidimensionality. The issue of resilience of the business model of an energy company requires a conceptualization of the defining dimensions of the model and identification of risk factors, both threats and opportunities, in order to build knowledge and implement measures to increase the resilience of the model in these dimensions.

A review of the literature and research relating to the practice of energy companies, in particular the impact of the environment and the experienced energy transition on the resilience of the business model of energy companies and the assessment of resilience, confirmed that the knowledge of the environmental factors determining the resilience of the business model and the identification, measurement, and assessment of the interrelationship between them is an important subject area of theoretical and practical research. Available research provides original approaches to identifying attributes that measure and assess resilience, which can inspire and contribute to future research. However, despite many works, the issue of resilience requires further in-depth research due to its complexity and multidimensional nature. This is due to the fact that the research conducted to date on the resilience of business models does not exhaust the issue. While there have been studies related to the resilience of the business model and corporate strategy in a crisis, more attention is still needed on issues related to the vulnerability of business models to changes in the environment and the building of resilience and its assessment.

3. Methodology

The inspiration for the adopted methodology and research process dedicated to the key factors responsible for the resilience of an energy company's business model was the approach to building resilient business model strategies proposed by Tauscher and Abdelkafi [8]. The research process was designed to identify the key factors influencing the resilience of an energy company's business model, considering the climate-environmental, regulatory, market, technological, and social conditions of the electricity sector and the resulting challenges for the energy company [64]. The research process is presented in Figure 1.

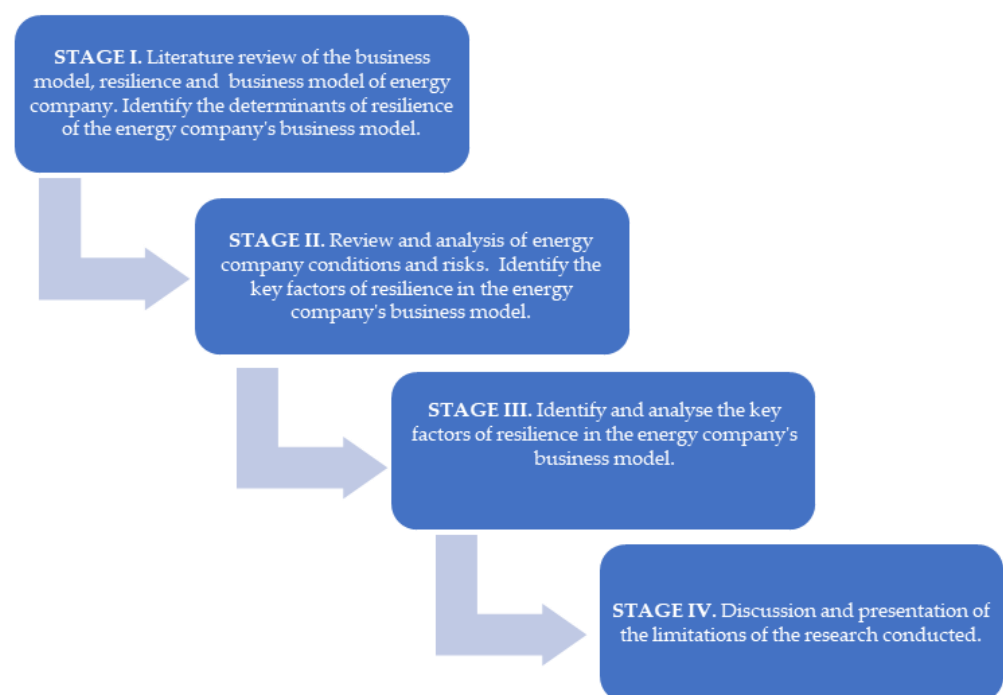


Figure 1. The research process. Source: own work.

Stage I involved a literature review of the business model, resilience, and resilience of the business model, as well as approaches to measuring resilience, including business model resilience. The determinants of business model resilience relating to the general characteristics of the energy company's business model are as follows [65,66]:

- (1) Determinants related to the role of the business model:
 - the dynamics and alignment of the various components of the model with the implementation of the strategy and its change,
 - tolerance of the model to volatility to accommodate strategy implementation,
 - feedback systems on model effectiveness/fit with strategy/strategy conditions.
- (2) Determinants of the dominant types/types of models:
 - relationship between customer value creation and company profitability,
 - the impact of business architecture and its changes on value creation,
 - the role of innovation in value creation,
 - dependence of the business model on components outside the company's control,
 - the ability of the business model to balance potentials,
 - the relationship between balancing potentials and building long-term value,
 - the impact of social responsibility on building long-term value.
- (3) Determinants related to the main activities of the business model:
 - the interrelationship between the elements of the chain,
 - the level of risk and uncertainty of the entire value chain and its individual links,
 - tolerance/ability to absorb changes in individual links and the whole chain,
 - systems for securing/maintaining business continuity and risk prevention,
 - communication and feedback systems between links in the chain,
 - adaptability of chain links to change—adapting and driving change in an efficient and cost-effective way without compromising quality.
- (4) Determinants related to the main products:
 - the impact of individual product changes on the value offered to the customer,
 - the level of risk and uncertainty of individual products on the value offered to the customer,
 - feedback on how products match the value expected by customers,
 - ability to adapt the value offered to changes in the environment—responding quickly and flexibly to customer needs,
 - systems to protect innovative product solutions from imitation and copying,
 - product innovation.
- (5) Determinants relating to ownership structure:
 - adaptability to stakeholder/owner expectations,
 - risks and uncertainty of the effects of ownership decisions on the business.

In Stage II, based on the New Age of Innovation [9] and CANVAS [10] models, the following components of an energy company's business model were adopted for further research: customer value, resources and competencies, value chain, capture, and profitability. To identify resilience factors, the risks of energy companies' operations were reviewed and analyzed by risk category, that is, commercial, financial, and credit risks; environmental risks; technology, infrastructure, and security risks; employee and organizational culture risks; compliance risks; customer and counterparty risks; and regulatory risks [67–70]. The analysis of the main determinant areas and business risk factors revealed the resilience elements of an energy company's business model. These factors were subsequently aligned with the core components of the model: the customer value proposition, resources and capabilities, value chain, and profitability. Considering the unique characteristics of the

energy company and its commitment to sustainability in its pursuit of climate neutrality, along with the importance of the business model as a mechanism for executing strategy [71], we propose two additional areas for exploration: sustainability practices and the alignment of the business model with the overarching strategic objectives. Based on the specific determinants of resilience and risks of the energy company, a wide list of business model resilience factors was prepared.

Stage III involved identifying the key resilience factors highlighted in the components of the energy company's business model. To identify the key factors responsible for the resilience of the energy company's business model, selected elements of the AHP hierarchical decision problem analysis were used, centered around the main objective of the AHP method, which is to find a ranking of options, ranked according to their suitability from the point of view of various criteria [7,72–74]. The method was appropriately adapted to meet the needs and objectives of this study. The main feature of the AHP method is the ability to measure uncountable factors. To measure uncountable criteria and objectives, the opinions expressed in verbal form must be presented in numerical form. In the first phase, a hierarchical structure of the problem is prepared, which, regarding the issue under study, can be referred to as the formulation of the purpose of the study, the definition of criteria, and the evaluation sub-criteria. The hierarchical structure of the main problem (goal): key factors of resilience in the business models of energy companies were developed, and then the evaluations within that structure were generated (Figure 2). The key factors were assessed according to the main criteria.

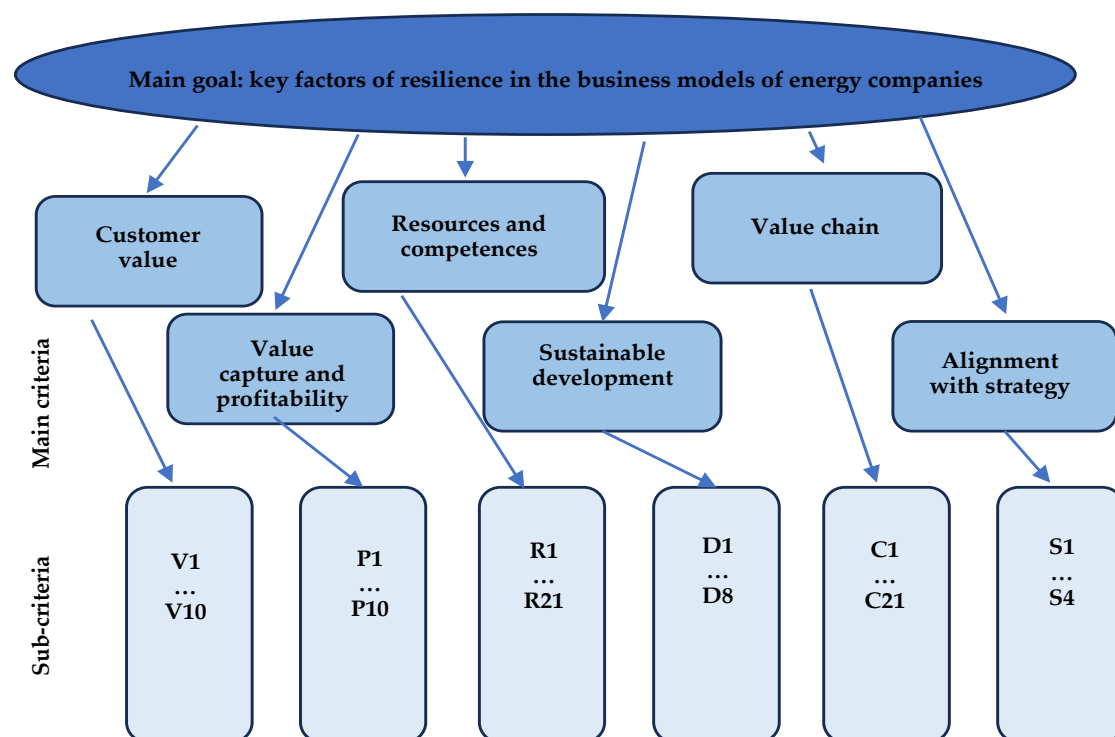


Figure 2. Hierarchical structure of the problem. Source: own work based on [72,74].

In the second phase, the evaluation of the elements of the system is conducted using pairwise comparisons, and the consistency of the evaluations is verified. The subject of evaluation is the relative importance of the elements at a given level of the system from the point of view of the elements that are located immediately above the hierarchical structure. The elements of each level are evaluated by the method of pairwise comparisons, i.e., each with each. A rating scale from 1 to 9 points (natural numbers) is used. In phase two,

analytical sheets were prepared, and a series of pairwise comparisons were made of all the resilience factors identified for the factor area. Ratings were formulated according to an eight-point scale developed from Saaty's ten-point scale [7], in which verbal judgments correspond to numerical values:

- comparable importance: 1,
- moderate prevalence: 3,
- strong advantage: 5,
- very strong advantage: 7,
- extreme advantage: 9,
- intermediate values between those described above: 2, 4, 6, 8.

The assessment of the two elements boils down to a statement of three situations:

- (a) the first and second elements are equally important (rating: 1),
- (b) the first element is more important than the second (rating: 2, 3, 4, 5, 6, 7, 8, 9),
- (c) the second element is more important than the first (rating: 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9).

In the described stage of the study, verbal opinions were assigned numbers from the adopted scale. The assessment was performed in a focus group with experts; that is, the assessment was mutually agreed upon by the experts. The results obtained were synthesized by selecting the best option (with the highest priority magnitude) and the subsequent ones (with priorities in the next order) that contribute most to the adopted analysis objective. The ratings are stored in a square matrix, $A = [a_{ij}]$. Based on the assessment of pairwise comparisons, matrix A was prepared— A is a so-called proportional matrix, the properties of which are useful in determining relative importance (weights). The pairwise comparison matrix A is transformed (normalized) into matrix $B = [b_{ij}]$, the elements of which are equal [72]:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad (1)$$

where n is the number of pairwise comparisons of the elements. The weights (w_i)—priorities of the evaluated elements are finally determined as the arithmetic averages of the rows of the normalized B [72]:

$$w_i = \frac{1}{n} \sum_{j=1}^n b_{ij} \quad (2)$$

The focus meetings with selected experts were used to identify a list of resilience factors (Step 2) and identify key ones (Step 3). The selection process for the expert sample was carefully designed to ensure a comprehensive understanding of the resilience factors influencing the business model of the power company. Given the complexity of the electric power sector, it is imperative to include individuals with diverse expertise and experience. The key criteria for selecting experts included the following:

- Competence and Knowledge: Experts were chosen based on their deep understanding of the electric power industry, ensuring that they possessed relevant technical and operational knowledge.
- Experience: A focus on practical experience in operational and strategic management is crucial. This allows for insights that are grounded in real-world applications and challenges.
- Diversity of Perspectives: To capture a wide range of insights, experts were selected from various areas of the company's operations. This diversity helps in understanding the multifaceted nature of resilience within the business model.

- Independence: Ensuring that the selected experts are independent and not biased by internal company politics or specific agendas was essential for obtaining objective viewpoints.

In the case of pairwise comparisons based on subjective expert evaluations, two measures are used to assess consistency, i.e., consistency index (CI) and consistency ratio (CR). The consistency index (CI) increases as the inconsistency of the estimates increases and is calculated using the following formula [72]:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

where λ_{max} is the quotient of the product of matrices A and w_i (Aw_i) and w_i . The consistency ratio (CR) is calculated based on the following formula [72]:

$$CR = \frac{CI}{r} \quad (4)$$

where r (random inconsistency index) is based on a computer simulation of its value [7].

The fourth stage includes a discussion and presentation of the limitations of the research conducted.

4. Results

Data

To effectively identify the key resilience factors of an energy company's business model, we considered several general determinants (Stage 1, Table 1) that influence business model resilience, particularly in the context of the energy sector's unique challenges. Based on these determinants and the risk analysis of energy companies, a list of resilience factors of the energy company's business model was identified. Therefore, specific supporting questions were proposed for each business model component. These questions are presented in Table 2.

Table 2. Components and supporting questions for analyzing key factors in the resilience of an energy company's business model.

Item	Component	Supporting Questions
I	Customer value	What are the key factors responsible for the resilience of the value offered to customers in the business model? (Is the model aligned with customer/segment requirements and market environment? Is it consistent with external expectations?)
II	Resources and competences	What are the key factors responsible for the resilience of resources and competencies in the business model? (Are the resources required by the business model for its implementation secured in the company's existing capabilities now and in the future?)
III	Value chain	What are the key factors responsible for value chain resilience in the business model? (Do the designed value chain and processes allow for effective exploitation and renewal of resources and skills?)

Table 2. *Cont.*

Item	Component	Supporting Questions
IV	Value capture and profitability	What are the key factors responsible for the resilience of value capture and profitability in the business model? (Does the designed architecture of the value creation mechanisms enable value delivery? Is the designed architecture of the value capture mechanisms effective?)
V	Sustainable development	What are the key sustainability drivers influencing the resilience of the business model? (Do the mechanisms of the business model enable sustainability?)
VI	Alignment with strategy	What are the key factors responsible for aligning the business model with the company's strategy? (Do the mechanisms of the model enable strategy implementation?)

Source: own work.

The research was conducted through focus group interviews with experts. The expert group consisted of a total of six practitioners, with two representatives from Polish companies and four from international firms. With few variations, many authors [75,76] suggest that the size of the focus group should range from six (6) to twelve (12) participants. This mix aimed to balance local insights with global perspectives and enrich the research outcomes. Through these meetings, the research sought to gather nuanced perspectives that could lead to actionable conclusions regarding the resilience of the power company's business models. By leveraging the collective wisdom of these experts, this study aimed to identify key resilience factors that can drive sustainability and adaptability in the ever-evolving energy landscape. Based on literature research, risk analysis, and focus group interviews with experts, a broad list of resilience factors for the energy company's business model was presented—see Table 3.

This list of factors became the basis for identifying the key factors. The AHP method was used for this purpose. In the first phase, the hierarchical structure of the problem was developed (Figure 2), and then two matrices, A and B, were developed for each component: customer value proposition, resources and capabilities, value chain, profitability, sustainable development, and alignment with the strategy.

The worksheets for the analysis, A matrix—proportional matrix, B matrix—transformed matrix of the business model resilience factors are shown in Appendix A. Based on matrices A and B, the key resilience factors of the energy company's business model were identified. The values of the weights (priorities)— w_i are presented in Appendix B.

Based on the results of the scales, the priority-key factors and resilience of the energy company's business model are presented in Figure 3a–f.

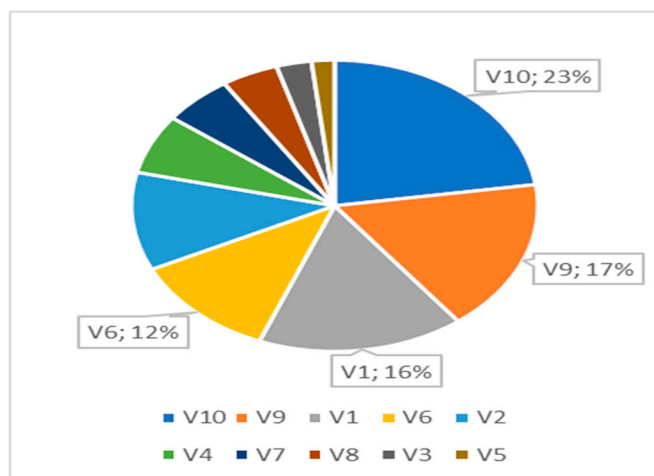
Table 3. List of business model resilience factors.

Customer Value	Resources and Competences	Value Chain
(V1) A diversified, flexible offer tailored to the needs of products and services and meeting the needs of customers. (V2) The speed of introducing changes to the offer, allowing you to stay ahead of the competition. (V3) Media monitoring, building contacts and relations with the media. (V4) Communication and customer relations. (V5) Continuous improvement of customer service standards. (V6) Communication processes with the external and internal environment. (V7) Standards and procedures for testing the quality of products/services and customer service. (V8) Monitoring the effectiveness of marketing activities, including acquiring new and losing customers. (V9) Procedures and tools to support the maintenance of existing and recovery of lost customers. (V10) Standards to protect the value offered to the customer and the competitive advantages achieved.	(R1) Production assets adapted to the consequences of extreme weather events and weather variability in Business Areas sensitive to these factors. (R2) Production and network assets adapted to the generation of renewable energy and zero and low-emission technologies for the generation of electricity and heat. (R3) Availability of environmental resources. (R4) Meeting the requirements of the licensed activity. (R5) Procedures for maintaining the required level of performance of pollution abatement devices. (R6) Constant supervision over compliance with the conditions of environmental decisions. (R7) Constant technical supervision of production assets, particularly those exposed to weather anomalies. (R8) Procedures for monitoring the condition of machinery, equipment and installations and for responding to emergencies. (R9) Asset insurance against random events (excluding assets underground). (R10) Procedures for monitoring the availability of generating units and demand reduction and transferring capacity obligations requiring reservation to dedicated intra-group reserve units or external entities. (R11) Developed and maintained business continuity plans. (R12) IT solutions with technical parameters, ensuring an acceptable level of reliability and efficiency of operation. (R13) Plans for the protection of facilities subject to mandatory protection. (R14) Procedures for complying with applicable information protection rules. (R15) Procedures and mechanisms to reduce the risk to resources in the event of emergency events. (R16) Ability to meet obligations on an ongoing basis. (R17) Ability to obtain and handle financing. (R18) Conducting a policy of dialogue with the Social Party and active internal communication in employee matters. (R19) Adoption and implementation of the Recruitment, Selection and Adaptation Policy of Company Employees and the Policy of compliance with the Ethics Rules and counteracting Mobbing and Discrimination. Diversity Policy and Human Rights Respect Policy. (R20) Development of staff competences, enhancing professional skills and the work culture of employees in line with strategic objectives. (R21) Raising the level of employee awareness in the field of security and data protection.	(C1) Risk level of the entire value chain and its individual links. (C2) Compliance of the processes with the applicable regulations. (C3) Monitoring and analysis of new technological solutions limiting the impact of adverse weather conditions on the volume of electricity produced. (C4) Implemented Internal Control System and control mechanisms for conducted processes. (C5) Implemented business continuity plan. (C6) Implemented mechanisms and tools for collecting information on threats and identifying potential security threats. (C7) Implemented Code of Conduct for Contractors. (C8) Standardization of the rules of conducting proceedings in the purchasing process and its transparency. (C9) Durability of relations with contractors/suppliers. (C10) Diversification of contractors and suppliers, eliminating business continuity threats. (C11) Process maturity and flexibility of process management. (C12) Implemented procedures for reporting external fraud. (C13) Constant monitoring of the legal environment and changes in legal regulations related to information security or compliance. (C14) Monitoring the process of implementing changes to internal regulations required by law. (C15) Procedures and standards for monitoring working conditions and the correctness of its organization. (C16) Use and development of external and internal communication tools. (C17) Monitoring of situations and events that may cause social anxiety. (C18) Constant monitoring of external and internal threats. (C19) Planning and conducting training in the field of continuity of operation and security of manufacturing infrastructure, IT and OT. (C20) Planning and conducting training for employees in the field of applicable safety procedures. (C21) Debt management

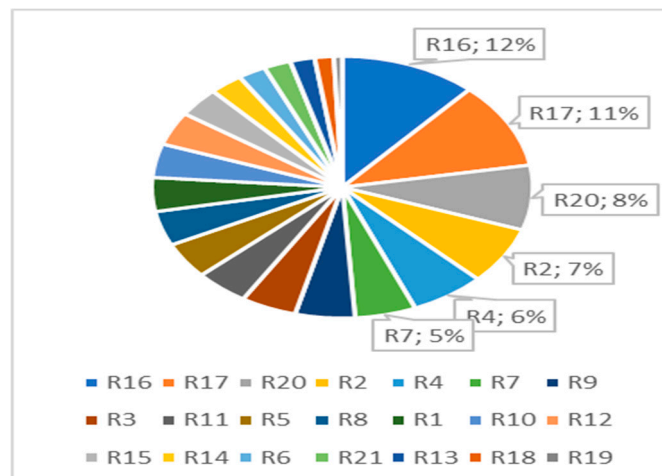
Table 3. Cont.

Value capture and profitability	Sustainable development	Alignment with strategy
(P1) Diversified revenue streams (P2) Stability of revenue streams (P3) Planning, monitoring and control of financial parameters (revenue, costs, results) and the impact of changes on the covenant. (P4) EBITDA generated within the business model. (P5) Mechanisms to eliminate the adverse impact of changes in exchange rates on earnings and the size of exposure to minimize the negative effects of changes in interest rates. (P6) Mechanisms to eliminate adverse price movements in the wholesale electricity market and related product markets, including the price of CO₂ emission allowances, resulting in a negative impact on the financial result. (P7) Procedures to monitor changes in weather conditions to take action to mitigate the effects of falling energy and heat sales volumes, falling production volumes, deteriorating quality indicators and regulated revenue. (P8) Transfer of interest rate risk using derivatives. (P9) Procedures and standards for assessing the financial health and reliability of suppliers, contractors and subcontractors. (P10) An organizational culture focused on building value.	(D1) Defined strategy of sustainable development. (D2) Mechanisms and tools of corporate social responsibility aimed at building long-term value. (D3) The degree of impact of business activities on the environment and the use of its resources. (D4) Implemented Climate policy. (D5) Implemented Environmental policy. (D6) Mechanisms to prevent above-normal pollution, damage, disturbance or failure of installations or equipment resulting in a negative impact on the environment. (D7) Implementation of investments from the sphere of environmental protection to minimize the effects of the adverse impact of mining and processing activities on the environment and climate. (D8) Technical and organizational solutions to minimize the impact of activities on climate change	(S1) Defined strategy with strategic options considering changes in the conditions of the environment. (S2) Matching individual components of the model to the strategy. (S3) Include EU climate policy objectives in the strategy. (S4) Strategy review and update mechanisms

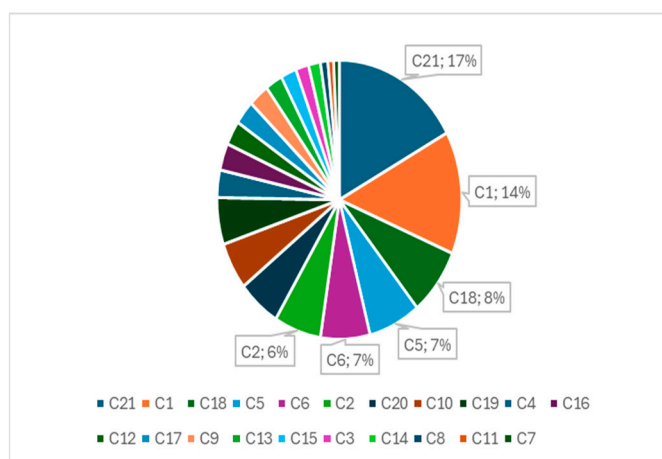
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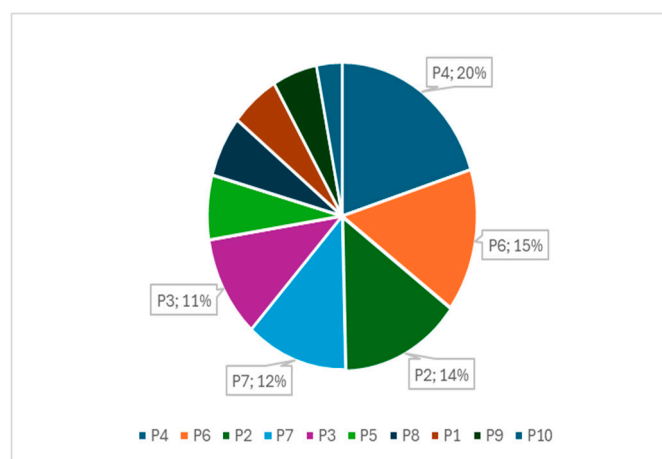
(a)



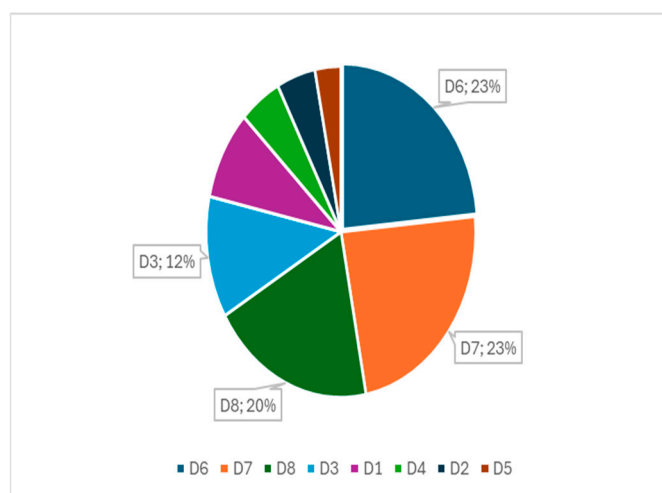
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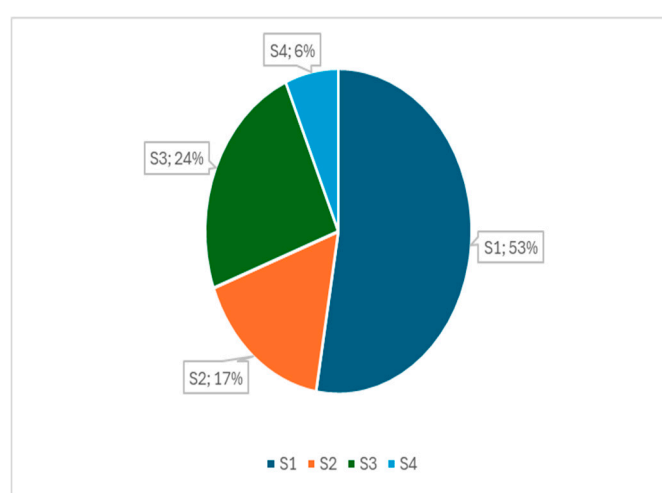
(c)



(d)



(e)



(f)

Figure 3. Priorities—key factors of resilience in the business models of energy companies in the area of (a) customer value, (b) resources and competences, (c) value chain, (d) value capture and profitability, (e) sustainable development, and (f) alignment with strategy.

The consistency index (CI) was used to assess the consistency of each pairwise comparison (Table 4).

Table 4. The consistency index indicator for evaluations carried out.

Customer Value	Resources and Competences	Value Chain	Value Capture and Profitability	Sustainable Development	Alignment with Strategy
0.1754	0.4148	0.2751	0.5029	0.1862	0.1440

The consistency index indicator (CR) in all cases was above 0.1, which means that the evaluation results was not consistent. This means that it was necessary to review and rethink the assessments made using additional data or information to justify the assessments or allow additional discussions within the team to better understand the differences in the assessments.

Another meeting was held with experts, during which they were presented with all the results and inconsistency indicators. During the discussion, the experts agreed that the key factors contributing to the resilience of the energy company's business model, as identified based on the findings, corresponded to the reality. Ultimately, they identified the factors that they believe are key to the resilience of an energy company's business model (see Table 5). According to the experts, the inconsistencies observed could be attributed to a number of factors, which are explained in the discussion section.

Table 5. Key factors of resilience in an energy company's business model.

Item	Model Element Business	Key Resilience Factors Identified Through Relevance Analysis
1.	Customer value	(V10) Standards to protect the value offered to the customer and the competitive advantages achieved. (V9) Procedures and tools to support the retention of existing and recovery of lost customers. (V1) A diversified, flexible offer tailored to the demand for products and services and in line with customer needs. (V6) Communication and customer relations.
2.	Resources and competences	(R16) Ability to meet obligations on an ongoing basis. (R17) Ability to obtain and handle funding. (R20) Development of staff competences, enhancing professional skills and the work culture of employees in line with strategic objectives. (R2) Production and network assets adapted to the generation of renewable energy and zero and low-emission technologies for the generation of electricity and heat. (R4) Meeting the requirements of the licensed activity. (R7) Constant technical supervision of production assets, particularly those exposed to weather anomalies.
3.	Value chain	(C21) Receivables management. (C1) Risk level of the entire value chain and its individual links. (C18) Constant monitoring of external and internal threats. (C5) Implemented business continuity plan. (C6) Implemented mechanisms and tools to collect threat information and identify potential security risks. (C2) Compliance of the processes with the applicable regulations (C20) Planning and conducting training for employees on applicable safety procedures. (C10) Diversification of contractors and suppliers, eliminating threats to business continuity.

Table 5. Cont.

Item	Model Element Business	Key Resilience Factors Identified Through Relevance Analysis
4.	Value capture and profitability	(P4) EBITDA generated within the business model. (P6) Mechanisms to eliminate adverse price movements in the wholesale electricity market and related product markets, including the price of CO ₂ emission allowances resulting in a negative impact on the financial result. (P2) Stability of revenue streams. (P7) Procedures to monitor changes in weather conditions to take action to mitigate the effects of falling energy and heat sales volumes, falling production volumes, deteriorating quality indicators and regulated revenue. (P3) Planning, monitoring, and control of financial parameters (revenue, costs, results) and the impact of changes on the covenant.
5.	Sustainable development	(D6) Mechanisms to prevent above-normal pollution, damage, disturbance or failure of installations or equipment resulting in a negative impact on the environment. (D7) Implementation of investments from the sphere of environmental protection to minimize the effects of the adverse impact of mining and processing activities on the environment and climate. (D8) Technical and organizational solutions to minimize the impact of activities on climate change.
6.	Alignment with strategy	(S1) Defined strategy with strategic options considering changes in the environmental conditions. (S2) Matching the individual components of the model to the strategy. (S3) Include EU climate policy objectives in the strategy.

5. Discussion

The resilience of power companies is increasingly crucial in the context of climate change, economic volatility and technological advancement. Based on the analysis of resilience determinants and business risks, 79 resilience factors of the energy company's business model were identified. Because of relevance analysis using the multi-criteria method of hierarchical analysis of decision-making problems, the so-called Analytic Hierarchy Process (AHP), the key factors responsible for the resilience of the energy company's business model were determined. Of the 79 resilience factors analyzed, 28 were determined to be key to the resilience of the energy company's business model. These are the factors responsible for resilience in relation to the customer value proposition, resources and competencies, value chain, value capture and profitability, sustainability, and business model-strategy alignment. The results of this research allow us to summarize the key findings as follows:

1. The proposed framework of resilience business model, grounded in the CANVAS framework and aligned with the principles of the New Era of Innovation, contributes to the ongoing discourse. It will be evaluated alongside alternative solutions, including the approach proposed by Radic et al. [77]. By validating findings from a systematic literature research in an empirical survey among managers and decision makers from SMEs in Saxony, they identified 11 factors that are constitutive of business model resilience.
2. The energy transition requires significant changes to the business models of energy companies, in particular, the reconfiguration of the chain and resources [78,79] toward the construction of low- and zero-carbon energy sources [43,54] necessary to achieve

climate neutrality [80–82], which, for business continuity and energy security, requires resilient business models.

3. Critical to the assessment of business model resilience is the identification of the key factors responsible for the resilience of an energy company's business model. Despite extensive research in the area of resilience, a cohesive framework for business model resilience that demonstrates practical applicability remains elusive. We believe that our investigation partially fills this gap and will significantly contribute to the broader discourse on identifying and understanding the resilience factors of business models in large corporations.
4. The use of the research process proposed in this paper allows for the identification of key factors responsible for the resilience of an energy company's business model. The AHP model used in this study is a structured tool that helps individuals and groups prioritize and select alternatives based on multiple criteria. While it is widely used due to its systematic approach, it does have several limitations:
 - Subjectivity: AHP relies heavily on the judgment of experts to assign weights and rates to criteria and alternatives. This subjectivity led to some inconsistencies in the results.
 - Complexity of large problems: As the number of criteria and alternatives increases, the pairwise comparison process becomes more complex and time-consuming. This led to cognitive overload for experts and may have resulted in less reliable judgments.
 - Inconsistency in judgments: Pairwise comparisons can lead to inconsistencies, especially when there are many comparisons. The consistency ratio (CR) is often used to measure this; however, achieving a high level of consistency in practice has proven difficult.
 - Sensitivity to input changes: Small changes in the input judgments can lead to significant changes in the final rankings, making the process sensitive to initial estimates and potentially leading to different decisions based on minor adjustments.
 - Difficulty in Measuring Intangible Criteria: AHP may struggle with criteria that are difficult to quantify, such as communication and customer relations or climate policy, making it challenging to assign accurate weights.
 - Dependence on a clear hierarchy: AHP assumes that criteria can be organized hierarchically, which may not always be the case in complex scenarios in which criteria are interrelated.

Building on the Analytic Hierarchy Process (AHP) methodology, future research could be enhanced by incorporating the Fuzzy Analytic Hierarchy Process (FAHP) [83]. This approach addresses the challenge of feature weighting by utilizing fuzzy expert opinions, often referred to as "soft opinions," which provide a more nuanced and realistic perspective compared to traditional precise assessments, known as "hard opinions".

5. Despite these limitations, the AHP remains a valuable tool for decision-making when used thoughtfully and in conjunction with other methods and considerations. Understanding the key factors responsible for the resilience of an energy company's business model is key to building a tool for assessing the resilience of the business model, allowing for the measurement of resilience in key areas of the company in this context, in particular the selection of appropriate metrics for assessing resilience and their definition.

It is important to acknowledge that the implementation of this study faced several challenges. A significant issue was the limited access to current data from power companies, which hindered our analyses. Additionally, rapidly evolving regulatory and market

conditions within the electricity sector pose further constraints [83–86]. Moreover, the availability of experts was restricted due to time constraints, which ultimately prolonged the process of gathering all necessary insights and evaluations.

By synthesizing the determinants of resilience with risk analysis, an energy company can develop a comprehensive framework of resilience factors that not only enhance its business model but also ensure its sustainability and competitiveness in a rapidly changing energy landscape. This structured approach can guide strategic planning and decision-making within the organization. Currently, work is underway to develop and verify a system for assessing the resilience of a business model using a tool in the form of a balanced scorecard. This will allow us to measure the resilience of the business model of the energy company.

6. Conclusions

The research conducted confirms that the resilience of energy companies' business models is complex and multidimensional in nature. Resilience is intended to ensure that the company can absorb disruptions during change so that it continues to retain essentially the same function, structure, identity, and feedback loops. Monitoring the resilience of an energy company's business model is key to maintaining the continuity of operations with growth in captured value and profitability. It is reasonable to develop solutions to assess the resilience of a business model as a basis for identifying and taking action to support building and maintaining this resilience. To develop these solutions, the results of this research can be used to address a multivariate analysis of the factors responsible for the resilience of an energy company's business model. Parameterizing these factors and building a comprehensive system for assessing the resilience of the business model may be an interesting area for continued research on the resilience of the business models of energy companies. Three research questions were answered in the research findings presented. The evolution of the academic discourse on business model resilience in the energy sector is summarized. The factors and areas influencing the resilience of business models of energy companies are described. Key factors that contribute to the resilience of business models in energy companies are identified.

This research has further defined the parameters and criteria for assessing the resilience factors of an energy company's business model as part of the development of business model resilience assessment systems. A balanced scorecard was used to build a system for assessing the resilience of an energy company's business model. Considering the specifics of the energy company, the construction of the strategic scorecard template within the framework of building a business model resilience assessment system began by defining the scorecard perspectives. Four perspectives of the BSC were proposed: the financial perspective, the customer perspective, the internal process perspective and the development and security perspective. It was assumed that the metrics in each perspective should provide a full and complete measurement of the key resilience factors while, at the same time, the objectives derived from the strategy fit into each perspective. A key resilience factor was assigned to each of the strategic scorecard perspective. Within each of the four perspectives, specific objectives have been identified for each resilience factor, for which measures of their achievement have been defined, as well as the source for obtaining data from the organization to measure them. In addition to outcome measures, the scorecard also used anticipatory (predictive) measures. For the resilience factors identified in each scorecard perspective, targets, measures, and their definitions were defined, as well as the source of data to perform the measurement. The method adopted to analyze the indicators proposed for assessing the resilience factors of the business model allows for the following:

- assessment of the achieved level of indicators in the different periods of analysis,

- assessment of changes and trends in the development of indicators over time in correlation with events that caused specific significant changes and the impact of changes on resilience,
- comparison of the results with benchmarks or accepted standards,
- interrelationships and relationships between resilience factors,

On this basis, conclusions are drawn from this assessment.

The results of this research make an important contribution to the science of factors influencing the resilience of an energy company's business model. Indeed, a prerequisite for the success of the energy transition is the resilience of energy companies' business models to changes in environmental conditions. This resilience is essential for energy companies to adapt to changing regulatory and climate-environmental energy market needs and challenges, technological and social conditions, and other unpredictable factors, including emerging new business models. At the same time, resilience should ensure that energy companies are able to respond to emerging opportunities and threats while maintaining business continuity and maximizing the value delivered by the business model. The development of a system to examine the impact of environmental change on business model resilience directly addresses the needs and challenges of energy companies and the sector. Consideration of the factors responsible for resilience in relation to the different elements of the business model is crucial in the assessment process.

In view of these challenges, the resilience of energy companies' business models and the identification of resilience factors are important and timely research topics that require further investigation.

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Conflicts of Interest: Author Joanna Staszewska was employed by the Tauron Polska Energia S.A. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix A

Appendix A.1

Analysis of the importance of resilience factors—Customer value area (A matrix)										
Factors	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
V1	1	1	7	7	7	3	3	3	1	1/3
V2	1	1	7	3	5	1	1	3	1	1/6
V3	1/7	1/7	1	1/6	2	1	1/3	1/4	1/7	1/9
V4	1/7	1/3	6	1	4	1	1	3	1/4	1/5
V5	1/7	1/5	1/2	1/4	1	1/6	1/6	1/4	1/5	1/6
V6	1/3	1	1	1	6	1	4	5	1	1
V7	1/3	1	3	1	6	1/4	1	1	1/4	1/6

Analysis of the importance of resilience factors—Customer value area (B matrix)

Appendix A.2

Analysis of the importance of resilience factors—Resources and competences area (A matrix)																					
Factors	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R1	1	1/4	5	2	1/5	8	1/5	1/4	1	1	1	1	3	3	1	1/5	1/7	3	5	2	2
R2	4	1	1	5	4	7	3	2	1	1	3	1	6	7	2	1/5	1/5	6	9	1	1
R3	1/5	1	1	1/5	1	1	1	1	1	6	1/4	5	4	1/4	1/3	1/2	1/3	5	9	1/4	5
R4	1/2	1/5	5	1	4	8	1	1/3	1	3	3	4	1	1	1/4	1/4	1/4	4	8	6	3
R5	5	1/4	1	1/4	1	1	1/3	1/4	5	1/3	1/4	1	4	4	1	1/4	1/3	4	3	1/3	9
R6	1/8	1/7	1	1/8	1	1	1/7	1/4	1/3	1/5	1/5	1	1/3	1/3	1	1/5	1/5	4	3	3	2
R7	5	1/3	1	1	3	7	1	1	1/3	3	1	1	4	2	1	1/3	1/3	5	6	1	5
R8	4	1/2	1	3	4	4	1	1	1/5	1	1	1	4	2	1	1/3	1/3	1	3	1/3	2
R9	1	1	1	1	1/5	3	3	5	1	1	4	3	1/4	3	2	1/5	1/3	3	4	1/5	2
R10	1	1	1/6	1/3	3	5	1/3	1	1	1	1/5	1/3	4	6	1	1/4	1/3	4	5	2	2
R11	1	1/3	4	1/3	4	5	1	1	1/4	5	1	1/5	4	3	1	1/4	1/4	5	7	1/6	1/3
R12	1	1	1/5	1/4	1	1	1	1	1/3	3	5	1	3	4	4	1/5	1/3	1	4	1/6	2
R13	1/3	1/6	1/4	1	1/4	3	1/4	1/4	4	1/4	1/4	1/3	1	1/3	1	1/7	1/5	2	2	1/4	1/3
R14	1/3	1/7	4	1	1/4	3	1/2	1/2	1/3	1/6	1/3	1/4	3	1	4	1/5	1/5	1	5	1/4	1/3
R15	1	1/2	3	4	1	1	1	1	1/2	1	1	1/4	1	1/4	1	1/4	1/5	5	6	1	1
R16	5	5	2	4	4	5	3	3	5	4	4	5	7	5	4	1	1	7	9	1	7
R17	7	5	3	4	3	5	3	3	3	3	4	3	5	5	5	1	1	5	7	1	4
R18	1/3	1/6	1/5	1/4	1/4	1/4	1/5	1	1/3	1/4	1/5	1	1/2	1	1/5	1/7	1/5	1	6	1/7	3
R19	1/5	1/9	1/9	1/8	1/3	1/3	1/6	1/3	1/4	1/5	1/7	1/4	1/2	1/5	1/6	1/9	1/7	1/6	1	1/9	1/3
R20	1/2	1	4	1/6	3	1/3	1	3	5	1/2	6	6	4	4	1	1	1	7	9	1	7
R21	1/2	1	1/5	1/3	1/9	1/2	1/5	1/2	1/2	1/2	3	1/2	3	3	1	1/7	1/4	1/3	3	1/7	1
Σ	39.03	20.10	38.13	29.37	38.59	69.42	22.33	26.67	31.37	35.40	38.83	36.12	62.58	55.37	32.95	7.16	7.57	73.50	114.00	21.35	59.33

Analysis of the importance of resilience factors—Resources and competences area (B matrix)																						
Factors	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	Σ
R1	0.0256	0.0124	0.1311	0.0681	0.0052	0.1152	0.0090	0.0094	0.0319	0.0282	0.0258	0.0277	0.0479	0.0542	0.0303	0.0279	0.0189	0.0408	0.0439	0.0937	0.0337	0.88
R2	0.1025	0.0498	0.0262	0.1703	0.1036	0.1008	0.1344	0.0750	0.0319	0.0282	0.0773	0.0277	0.0959	0.1264	0.0607	0.0279	0.0264	0.0816	0.0789	0.0468	0.0169	1.49
R3	0.0051	0.0498	0.0262	0.0068	0.0259	0.0144	0.0448	0.0375	0.0319	0.1695	0.0064	0.1384	0.0639	0.0045	0.0101	0.0699	0.0440	0.0680	0.0789	0.0117	0.0843	0.99
R4	0.0128	0.0100	0.1311	0.0341	0.1036	0.1152	0.0448	0.0125	0.0319	0.0847	0.0773	0.1108	0.0160	0.0181	0.0076	0.0349	0.0330	0.0544	0.0702	0.2811	0.0506	1.33
R5	0.1281	0.0124	0.0262	0.0085	0.0259	0.0144	0.0149	0.0094	0.1594	0.0094	0.0064	0.0277	0.0639	0.0722	0.0303	0.0349	0.0440	0.0544	0.0263	0.0156	0.1517	0.94
R6	0.0032	0.0071	0.0262	0.0043	0.0259	0.0144	0.0064	0.0094	0.0106	0.0056	0.0052	0.0277	0.0053	0.0060	0.0303	0.0279	0.0264	0.0544	0.0263	0.1405	0.0337	0.50
R7	0.1281	0.0166	0.0262	0.0341	0.0777	0.1008	0.0448	0.0375	0.0106	0.0847	0.0258	0.0277	0.0639	0.0361	0.0303	0.0466	0.0440	0.0680	0.0526	0.0468	0.0843	1.09
R8	0.1025	0.0249	0.0262	0.1022	0.1036	0.0576	0.0448	0.0375	0.0064	0.0282	0.0258	0.0277	0.0639	0.0361	0.0303	0.0466	0.0440	0.0136	0.0263	0.0156	0.0337	0.90
R9	0.0256	0.0498	0.0262	0.0341	0.0052	0.0432	0.1344	0.1875	0.0319	0.0282	0.1030	0.0831	0.0040	0.0542	0.0607	0.0279	0.0440	0.0408	0.0351	0.0094	0.0337	1.06
R10	0.0256	0.0498	0.0044	0.0114	0.0777	0.0720	0.0149	0.0375	0.0319	0.0282	0.0052	0.0092	0.0639	0.1084	0.0303	0.0349	0.0440	0.0544	0.0439	0.0937	0.0337	0.88
R11	0.0256	0.0166	0.1049	0.0114	0.1036	0.0720	0.0448	0.0375	0.0080	0.1412	0.0258	0.0055	0.0639	0.0542	0.0303	0.0349	0.0330	0.0680	0.0614	0.0078	0.0056	0.96
R12	0.0256	0.0498	0.0052	0.0085	0.0259	0.0144	0.0448	0.0375	0.0106	0.0847	0.1288	0.0277	0.0479	0.0722	0.1214	0.0279	0.0440	0.0136	0.0351	0.0078	0.0337	0.87
R13	0.0085	0.0083	0.0066	0.0341	0.0065	0.0432	0.0112	0.0094	0.1275	0.0071	0.0064	0.0092	0.0160	0.0060	0.0303	0.0200	0.0264	0.0272	0.0175	0.0117	0.0056	0.44
R14	0.0085	0.0071	0.1049	0.0341	0.0065	0.0432	0.0224	0.0188	0.0106	0.0047	0.0086	0.0069	0.0479	0.0181	0.1214	0.0279	0.0264	0.0136	0.0439	0.0117	0.0056	0.59
R15	0.0256	0.0249	0.0787	0.1362	0.0259	0.0144	0.0448	0.0375	0.0159	0.0282	0.0258	0.0069	0.0160	0.0045	0.0303	0.0349	0.0264	0.0680	0.0526	0.0468	0.0169	0.76
R16	0.1281	0.2488	0.0525	0.1362	0.1036	0.0720	0.1344	0.1125	0.1594	0.1130	0.1030	0.1384	0.1119	0.0903	0.1214	0.1397	0.1321	0.0952	0.0789	0.0468	0.1180	2.44
R17	0.1794	0.2488	0.0787	0.1362	0.0777	0.0720	0.1344	0.1125	0.0956	0.0847	0.1030	0.0831	0.0799	0.0903	0.1517	0.1397	0.1321	0.0680	0.0614	0.0468	0.0674	2.24
R18	0.0085	0.0083	0.0052	0.0085	0.0065	0.0036	0.0090	0.0375	0.0106	0.0071	0.0052	0.0277	0.0080	0.0181	0.0061	0.0200	0.0264	0.0136	0.0526	0.0067	0.0506	0.34
R19	0.0051	0.0055	0.0029	0.0043	0.0086	0.0048	0.0075	0.0125	0.0080	0.0056	0.0037	0.0069	0.0080	0.0036	0.0051	0.0155	0.0189	0.0023	0.0088	0.0052	0.0056	0.15
R20	0.0128	0.0498	0.1049	0.0057	0.0777	0.0048	0.0448	0.1125	0.1594	0.0141	0.1545	0.1661	0.0639	0.0722	0.0303	0.1397	0.1321	0.0952	0.0789	0.0468	0.1180	1.68
R21	0.0128	0.0498	0.0052	0.0114	0.0029	0.0072	0.0090	0.0188	0.0159	0.0141	0.0773	0.0138	0.0479	0.0542	0.0303	0.0200	0.0330	0.0045	0.0263	0.0067	0.0169	0.48
Σ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Appendix A.3

Analysis of the importance of resilience factors—Value chain management area (A matrix)																					
Factors	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21
C1	1	7	7	5	5	1	8	8	4	3	9	7	7	8	8	8	8	6	4	4	1
C2	1/7	1	2	3	1	1	5	2	1	1/4	5	1	1	1	5	3	2	1	6	6	1
C3	1/7	1/2	1	1/3	1/4	1/6	1	4	1	1/6	1	1	1	5	1	1/5	1/3	1/8	1	1/4	1/9
C4	1/5	1/3	3	1	1	1/5	6	8	1	1	3	1	1	1	1	4	3	1/5	1/3	1/3	1/7
C5	1/5	1	4	1	1	1	9	9	5	3	9	4	4	9	3	6	3	3	1	1	1/4
C6	1	1	6	5	1	1	9	7	3	1	9	1	6	9	8	3	3	1/4	1/3	1/3	1/8
C7	1/8	1/5	1	1/6	1/9	1/9	1	1	1/8	1/9	1	1/9	1/8	1/3	1/4	1/5	1/4	1/9	1/5	1/5	1/8
C8	1/8	1/2	1/4	1/8	1/9	1/7	1	1	1/7	1/9	1	1/3	1	1/3	1	1/6	1/3	1/8	1/3	1/3	1/8
C9	1/4	1	1	1	1/5	1/3	8	7	1	1	8	1/6	1/3	1/3	2	1	1	1/5	1/3	1/3	1/7
C10	1/3	4	6	1	1/3	1	9	9	1	1	7	1	5	7	5	3	3	1/6	1/3	1/3	1/4
C11	1/9	1/5	1	1/3	1/9	1/9	1	1	1/8	1/7	1	1/4	1/3	1/3	1/5	1/7	1/5	1/5	1/6	1/6	1/9
C12	1/7	1	1	1	1/4	1	9	3	6	1	4	1	1/3	1	1/2	1	1/3	1/6	1/3	1/3	1/7
C13	1/7	1	1	1	1/4	1/6	8	1	3	1/5	3	3	1	3	1	1/4	1/4	1/6	1/6	1/6	1/9
C14	1/8	1	1/5	1	1/9	1/9	3	3	3	1/7	3	1	1/3	1	1/6	1/5	1/7	1/7	1/8	1/8	1/9
C15	1/8	1/5	1	1	1/3	1/8	4	1	1/2	1/5	5	2	1	6	1	1/3	1	1/5	1/2	1/2	1/9
C16	1/8	1/3	5	1/4	1/6	1/3	5	6	1	1/3	7	1	4	5	3	1	1	1	1/3	1/3	1/9
C17	1/8	1/2	3	1/3	1/3	1/3	4	3	1	1/3	5	3	4	7	1	1	1	1/4	1/3	1/3	1/9
C18	1/6	1	8	5	1/3	4	9	8	5	6	5	6	6	7	5	1	4	1	1	1	1/6
C19	1/4	1/6	1	3	1	3	5	3	3	3	6	3	6	8	2	3	3	1	1	1	1/9
C20	1/4	1/6	4	3	1	3	5	3	3	3	6	3	6	8	2	3	3	1	1	1	1/9
C21	1	1	9	7	4	8	8	8	7	4	9	7	9	9	9	9	9	6	9	9	1
Σ	6.0825	23.1000	65.4500	40.5417	17.8944	26.1345	118.0000	96.0000	49.8929	28.9913	107.0000	46.8611	64.4583	96.3333	59.1167	48.4929	46.8429	22.3040	27.8250	27.0750	5.4702

Analysis of the importance of resilience factors—Value chain management area (B matrix)																						
Factors	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	Σ
C1	0.1644	0.3030	0.1070	0.1233	0.2794	0.0383	0.0678	0.0833	0.0802	0.1035	0.0841	0.1494	0.1086	0.0830	0.1353	0.1650	0.1708	0.2690	0.1438	0.1477	0.1828	2.99
C2	0.0235	0.0433	0.0306	0.0740	0.0559	0.0383	0.0424	0.0208	0.0200	0.0086	0.0467	0.0213	0.0155	0.0104	0.0846	0.0619	0.0427	0.0448	0.2156	0.2216	0.1828	1.31
C3	0.0235	0.0216	0.0153	0.0082	0.0140	0.0064	0.0085	0.0417	0.0200	0.0057	0.0093	0.0213	0.0155	0.0519	0.0169	0.0041	0.0071	0.0056	0.0359	0.0092	0.0203	0.36
C4	0.0329	0.0144	0.0458	0.0247	0.0559	0.0077	0.0508	0.0833	0.0200	0.0345	0.0280	0.0213	0.0155	0.0104	0.0169	0.0825	0.0640	0.0090	0.0120	0.0123	0.0261	0.67
C5	0.0329	0.0433	0.0611	0.0247	0.0559	0.0383	0.0763	0.0938	0.1002	0.1035	0.0841	0.0854	0.0621	0.0934	0.0507	0.1237	0.0640	0.1345	0.0359	0.0369	0.0457	1.45
C6	0.1644	0.0433	0.0917	0.1233	0.0559	0.0383	0.0763	0.0729	0.0601	0.0345	0.0841	0.0213	0.0931	0.0934	0.1353	0.0619	0.0640	0.0112	0.0120	0.0123	0.0229	1.37
C7	0.0206	0.0087	0.0153	0.0041	0.0062	0.0043	0.0085	0.0104	0.0025	0.0038	0.0093	0.0024	0.0019	0.0035	0.0042	0.0041	0.0053	0.0050	0.0072	0.0074	0.0229	0.16
C8	0.0206	0.0216	0.0038	0.0031	0.0062	0.0055	0.0085	0.0104	0.0029	0.0038	0.0093	0.0071	0.0155	0.0035	0.0169	0.0034	0.0071	0.0056	0.0120	0.0123	0.0229	0.20
C9	0.0411	0.0433	0.0153	0.0247	0.0112	0.0128	0.0678	0.0729	0.0200	0.0345	0.0748	0.0036	0.0052	0.0035	0.0338	0.0206	0.0213	0.0090	0.0120	0.0123	0.0261	0.57
C10	0.0548	0.1732	0.0917	0.0247	0.0186	0.0383	0.0763	0.0938	0.0200	0.0345	0.0654	0.0213	0.0776	0.0727	0.0846	0.0619	0.0640	0.0075	0.0120	0.0123	0.0457	1.15
C11	0.0183	0.0087	0.0153	0.0082	0.0062	0.0043	0.0085	0.0104	0.0025	0.0049	0.0093	0.0053	0.0052	0.0035	0.0034	0.0029	0.0043	0.0090	0.0060	0.0062	0.0203	0.16
C12	0.0235	0.0433	0.0153	0.0247	0.0140	0.0383	0.0763	0.0313	0.1203	0.0345	0.0374	0.0213	0.0052	0.0104	0.0085	0.0206	0.0071	0.0075	0.0120	0.0123	0.0261	0.59
C13	0.0235	0.0433	0.0153	0.0247	0.0140	0.0064	0.0678	0.0104	0.0601	0.0069	0.0280	0.0640	0.0155	0.0311	0.0169	0.0052	0.0053	0.0075	0.0060	0.0062	0.0203	0.48
C14	0.0206	0.0433	0.0031	0.0247	0.0062	0.0043	0.0254	0.0313	0.0601	0.0049	0.0280	0.0213	0.0052	0.0104	0.0028	0.0041	0.0030	0.0064	0.0045	0.0046	0.0203	0.33
C15	0.0206	0.0087	0.0153	0.0247	0.0186	0.0048	0.0339	0.0104	0.0100	0.0069	0.0467	0.0427	0.0155	0.0623	0.0169	0.0069	0.0213	0.0090	0.0180	0.0185	0.0203	0.43
C16	0.0206	0.0144	0.0764	0.0062	0.0093	0.0128	0.0424	0.0625	0.0200	0.0115	0.0654	0.0213	0.0621	0.0519	0.0507	0.0206	0.0213	0.0448	0.0120	0.0123	0.0203	0.66
C17	0.0206	0.0216	0.0458	0.0082	0.0186	0.0128	0.0339	0.0313	0.0200	0.0115	0.0467	0.0640	0.0621	0.0727	0.0169	0.0206	0.0213	0.0112	0.0120	0.0123	0.0203	0.58
C18	0.0274	0.0433	0.1222	0.1233	0.0186	0.1531	0.0763	0.0833	0.1002	0.2070	0.0467	0.1280	0.0931	0.0727	0.0846	0.0206	0.0854	0.0448	0.0359	0.0369	0.0305	1.63
C19	0.0411	0.0072	0.0153	0.0740	0.0559	0.1148	0.0424	0.0313	0.0601	0.1035	0.0561	0.0640	0.0931	0.0830	0.0338	0.0619	0.0640	0.0448	0.0359	0.0369	0.0203	1.14
C20	0.0411	0.0072	0.0611	0.0740	0.0559	0.1148	0.0424	0.0313	0.0601	0.1035	0.0561	0.0640	0.0931	0.0830	0.0338	0.0619	0.0640	0.0448	0.0359	0.0369	0.0203	1.19
C21	0.1644	0.0433	0.1375	0.1727	0.2235	0.3061	0.0678	0.0833	0.1403	0.1380	0.0841	0.1494	0.1396	0.0934	0.1522	0.1856	0.1921	0.2690	0.3235	0.3324	0.1828	3.58
Σ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Appendix A.4

Analysis of the importance of resilience factors—Value capture and profitability area (A matrix)											
Factors	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	
P1	1	1/5	1	1/5	1/5	1/5	1/5	1	4	4	
P2	5	1	1	1/8	6	1	2	5	3	3	
P3	1	1	1	1/7	3	1	2	3	3	3	
P4	5	8	7	1	3	1/3	1/5	1/3	3	6	
P5	5	1/6	1/3	1/3	1	1/3	3	1	1/3	1	
P6	5	1	1	3	3	1	3	3	3	3	
P7	5	1/2	1/2	5	1/3	1/3	1	6	1	3	
P8	1	1/5	1/3	3	1	1/3	1/6	1	3	1	
P9	1/4	1/3	1/3	1/3	3	1/3	1	1/3	1	3	
P10	1/4	1/3	1/3	1/6	1	1/3	1/3	1	1/3	1	
Σ	28.50	12.73	12.83	13.30	21.53	5.20	12.90	21.67	21.67	28.00	
Analysis of the importance of resilience factors—Value capture and profitability area (B matrix)											
Factors	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Σ
P1	0.0351	0.0157	0.0779	0.0150	0.0093	0.0385	0.0155	0.0462	0.1846	0.1429	0.58
P2	0.1754	0.0785	0.0779	0.0094	0.2786	0.1923	0.1550	0.2308	0.1385	0.1071	1.44
P3	0.0351	0.0785	0.0779	0.0107	0.1393	0.1923	0.1550	0.1385	0.1385	0.1071	1.07
P4	0.1754	0.6283	0.5455	0.0752	0.1393	0.0641	0.0155	0.0154	0.1385	0.2143	2.01
P5	0.1754	0.0131	0.0260	0.0251	0.0464	0.0641	0.2326	0.0462	0.0154	0.0357	0.68
P6	0.1754	0.0785	0.0779	0.2255	0.1393	0.1923	0.2326	0.1385	0.1385	0.1071	1.51
P7	0.1754	0.0393	0.0390	0.3759	0.0155	0.0641	0.0775	0.2769	0.0462	0.1071	1.22
P8	0.0351	0.0157	0.0260	0.2255	0.0464	0.0641	0.0129	0.0462	0.1385	0.0357	0.65
P9	0.0088	0.0262	0.0260	0.0251	0.1393	0.0641	0.0775	0.0154	0.0462	0.1071	0.54
P10	0.0088	0.0262	0.0260	0.0125	0.0464	0.0641	0.0258	0.0462	0.0154	0.0357	0.31
Σ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Appendix A.5

Analysis of the importance of resilience factors—Sustainable development area (A matrix)								
Factors	D1	D2	D3	D4	D5	D6	D7	D8
D1	1	5	1/5	3	3	1/4	1/4	1/5
D2	1/5	1	1/4	1	1	1/3	1/3	1/4
D3	5	4	1	4	4	1/5	1/5	1/6
D4	1/3	1	1/4	1	3	1/4	1/4	1/4
D5	1/3	1	1/4	1/3	1	1/6	1/6	1/5
D6	4	3	5	4	6	1	1	2
D7	4	3	5	4	6	1	1	2
D8	5	4	6	4	5	1/2	1/2	1
Σ	19.8667	22.0000	17.9500	21.3333	29.0000	3.7000	3.7000	6.0667

Analysis of the importance of resilience factors—Sustainable development area (B matrix)									
Factors	D1	D2	D3	D4	D5	D6	D7	D8	Σ
D1	0.0503	0.2273	0.0111	0.1406	0.1034	0.0676	0.0676	0.0330	0.70
D2	0.0101	0.0455	0.0139	0.0469	0.0345	0.0901	0.0901	0.0412	0.37
D3	0.2517	0.1818	0.0557	0.1875	0.1379	0.0541	0.0541	0.0275	0.95
D4	0.0168	0.0455	0.0139	0.0469	0.1034	0.0676	0.0676	0.0412	0.40
D5	0.0168	0.0455	0.0139	0.0156	0.0345	0.0450	0.0450	0.0330	0.25
D6	0.2013	0.1364	0.2786	0.1875	0.2069	0.2703	0.2703	0.3297	1.88
D7	0.2013	0.1364	0.2786	0.1875	0.2069	0.2703	0.2703	0.3297	1.88
D8	0.2517	0.1818	0.3343	0.1875	0.1724	0.1351	0.1351	0.1648	1.56
Σ	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	

Appendix A.6

Analysis of the importance of resilience factors—Alignment with strategy area (A Matrix)					
	S1	S2	S3	S4	
S1	1	3	5	5	
S2	1/3	1	1/3	4	
S3	1/5	3	1	4	
S4	1/5	1/4	1/4	1	
Σ	1.7333	7.2500	6.5833	14.0000	
Analysis of the importance of resilience factors—Alignment with strategy area (B Matrix)					
	S1	S2	S3	S4	Σ
S1	0.5769	0.4138	0.7595	0.3571	2.11
S2	0.1923	0.1379	0.0506	0.2857	0.67
S3	0.1154	0.4138	0.1519	0.2857	0.97
S4	0.1154	0.0345	0.0380	0.0714	0.26
Σ	1.0000	1.0000	1.0000	1.0000	

References

- European Commission. Delivering the European Green Deal. COM/2019/640-2019; 2019. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#key-steps (accessed on 15 June 2024).
- Schleussner, C.-F.; Ganti, G.; Lejeune, Q.; Zhu, B.; Pfeleiderer, P.; Prütz, R.; Ciais, P.; Frölicher, T.L.; Fuss, S.; Gasser, T.; et al. Overconfidence in Climate Overshoot. *Nature* **2024**, *634*, 366–373. [\[CrossRef\]](#) [\[PubMed\]](#)
- Kaczmarek, J.; Kolegowiec, K.; Szymła, W. Restructuring of the Coal Mining Industry and the Challenges of Energy Transition in Poland (1990–2020). *Energies* **2022**, *15*, 3518. [\[CrossRef\]](#)
- Popczyk, J. Transformacja energetyki (za pomocą reformy ustrojowej rynku energii elektrycznej) do monizmu elektrycznego odnawialnych źródeł energii 2050—Raport. *Energetyka Społeczeństwo—Polityka* **2018**, *2*, 3–87. [\[CrossRef\]](#)
- Agarwal, R. Economic Analysis of Renewable Power-to-Gas in Norway. *Sustainability* **2022**, *14*, 16882. [\[CrossRef\]](#)
- Sołtysik, M.; Kozakiewicz, M.; Jasiński, J. Profitability of Prosumers According to Various Business Models—An Analysis in the Light of the COVID-19 Effect. *Energies* **2021**, *14*, 8488. [\[CrossRef\]](#)
- Saaty, T.L. How to make a decision: The analytic hierarchy process. *Eur. J. Oper. Res.* **1990**, *48*, 9–26. [\[CrossRef\]](#)
- Taeuscher, K.; Abdelkafi, N. Business Model Robustness: A System Dynamics Approach. In Proceedings of the Conference: European Academy of Management (EURAM), Warsaw, Poland, 13 January 2015.
- Prahalad, C.K.; Krishnan, M.S. *New Age of Innovation*; McGraw Hill: New York, NY, USA, 2008; pp. 15–29.
- Ostervalder, A.; Pigneur, Y. *Business Model Generation*; John Wiley & Sons: Hoboken, NJ, USA, 2010.
- Ibrahim, Y.; Aslan, S.; Maryam, M.B.Y.; Saleh, K.I.; Amina, U.S. Review of Literature on Business Models and Innovation. *J. Adv. Res. Dyn. Control Syst.* **2020**, *12*, 1470–1486. [\[CrossRef\]](#)
- Zott, C.; Amit, R. Business Model Design and the Performance of Entrepreneurial Firms. *Organ. Sci.* **2007**, *18*, 183. [\[CrossRef\]](#)
- Zott, C.; Amit, R. Business Model Design: An Activity System Perspective. *Long Range Plan.* **2010**, *43*, 216–226. [\[CrossRef\]](#)
- Amit, R.; Zott, C. *Business Model Innovation Strategy*; John Wiley & Sons Inc.: Hoboken, NJ, USA, 2020.
- Teece, D.J. Business Models, Business Strategy and Innovation. *Long Range Plan.* **2010**, *43*, 172–194. [\[CrossRef\]](#)
- Chesborough, H.; Rosenbloom, R. The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spinoff companies. *Ind. Corp. Change* **2002**, *11*, 533–534.
- Seddon, P.; Lewis, G. Strategy and Business Models: What's the Difference? In Proceedings of the PACIS 2003 Proceedings 17, Adelaide, Australia, 10–13 July 2003.
- Magretta, J. Why Business Models Matter. *Harv. Bus. Rev.* **2002**, *80*, 86–92. [\[PubMed\]](#)
- Afuah, A.; Tucci, C.L. *Internet Business Models and Strategies*; McGraw-Hill Higher Education: New York, NY, USA, 2003; Volume 5.
- Afuah, A. *Business Model Innovation. Concepts, Analysis, and Cases*; Taylor&Francis Ltd.: Oxfordshire, UK, 2014.
- Shafer, S.M.; Smith, H.J.; Linder, J.C. The Power of Business Models. *Bus. Horiz.* **2005**, *48*, 199–207. [\[CrossRef\]](#)
- Johnson, M.W.; Christensen, C.C.; Kagermann, H. Reinventing Your Business Model. *Harv. Bus. Rev.* **2008**, *87*.
- Sliwotzky, A.; Morrison, D.; Andelmann, B. *The Profit Zone: How Strategic Business Design Will Lead You to Tomorrow's Profits*; Crown: Savannah, GA, USA, 2002.
- Gassmann, O.; Frankenberger, K.; Csik, M. Revolutionizing the Business Model. In *Management of the Fuzzy Front End of Innovation*; Gassmann, O., Schweitzer, F., Eds.; Springer: New York, NY, USA, 2014; pp. 89–98. [\[CrossRef\]](#)
- Palzkill-Vorbeck, A. *Business Model Resilience in the Context of Corporate Sustainability Transformation*; Wuppertal Institute for Climate, Environment and Energy: Wuppertal, Germany, 2014.
- Palzkill, A.; Augenstein, K. Business model resilience—Understanding the role of companies in societal transformation processes. *UmweltWirtschaftsForum* **2017**, *25*, 61–70. [\[CrossRef\]](#)
- Berkes, F.; Ross, H. Community resilience: Toward an integrated approach. *Soc. Nat. Resour.* **2013**, *26*, 5–20. [\[CrossRef\]](#)
- Francis, R.; Beker, B. A metric and frameworks for resilience analysis of engineered and infrastructure systems. *Reliab. Eng. Syst. Saf.* **2014**, *121*, 90–103. [\[CrossRef\]](#)
- Tobin, G.A. Sustainability and community resilience: The holy grail of hazards planning? *Environ. Hazards* **1999**, *1*, 13–16.
- Cutter, S.L.; Barnes, L.; Berry, M.; Burton, C.; Evans, E.; Tate, E.; Webb, J. A place-based model for understanding community resilience to natural disasters. *Global Environ. Change* **2008**, *18*, 598–606. [\[CrossRef\]](#)
- Norris, F.H.; Stevens, S.; Pfefferbaum, B.; Pfefferbaum, R. Community Resilience as a Metaphor, Theory, Set of Capacities and Strategy for Disaster Readiness. *Am. J. Community Psychol* **2008**, *51*, 127–150. [\[CrossRef\]](#)
- Mallak, L. Measuring Resilience in Health care Provider Organizations. *Health Manpow. Manag.* **1998**, *24*, 148–152. [\[CrossRef\]](#) [\[PubMed\]](#)
- Bruneau, M.; Chang, S.E.; Eguchi, R.T.; Lee, G.C.; O'Rourke, T.D.; Reinhorn, A.M.; Shinozuka, M.; Tierney, K.; Wallace, W.A.; von Winterfeld, D. Framework to quantitatively assess and enhance the seismic resilience of communities. In Proceedings of the 13th World Conference on Earthquake Engineering, Vancouver, BC, Canada, 1–6 August 2004.

34. Walker, B.; Holling, C.S.; Carpenter, S.R.; Kinzig, A. Resilience, Adaptability and Transformability in Social-ecological Systems. *Ecol. Soc.* **2004**, *9*, 5. [CrossRef]
35. Longstaff, P.H.; Armstrong, N.J.; Perrin, K.; Parker, W.M.; Hidek, M.A. Building Resilient Communities: A Preliminary Framework for Assessment. *Homel. Secur. Aff.* **2010**, *6*, 3–17.
36. McManus, S. *Organisational Resilience in New Zealand*; University of Canterbury: Christchurch, New Zealand, 2008; pp. 129–131.
37. Stephenson, A.; Vargo, J.; Sewilla, E. Measuring and comparing organisational resilience in Auckland. *Aust. J. Emerg. Manag.* **2010**, *25*, 27–32.
38. Otolá, I.; Knop, L. A bibliometric analysis of resilience and business model using VOSviewer. *Pol. J. Manag. Stud.* **2023**, *28*, 255–273. [CrossRef]
39. Otolá, I.; Grabowska, M.; Krupka, Z. *Trust and Organizational Resilience*; Routledge: New York, NY, USA, 2023. [CrossRef]
40. Taeuscher, K.; Abdelkafi, N. Scalability and robustness of business models for sustainability: A simulation experiment. *J. Clean. Prod.* **2018**, *170*, 654–664. [CrossRef]
41. Abdelkafi, N.; Taeuscher, K. Business Models for Sustainability From a System Dynamics Perspective. *Organ Environ.* **2016**, *29*, 74–96. [CrossRef]
42. Jorge-Vazquez, J.; Kaczmarek, J.; Knop, L.; Kolegowicz, K.; Nández Alonso, S.L.; Szymła, W. Energy transition in Poland and Spain against changes in the EU energy and climate policy. *J. Clean. Prod.* **2024**, *468*, 143018. [CrossRef]
43. Straková, J.; Kostiuk, Y. Importance of Business Process Quality for Creating Added Value and Raising Reputation of Companies in Low-Carbon Economy. *Energies* **2023**, *16*, 6388. [CrossRef]
44. Abdelkafi, N.; Makhotin, S.; Posselt, T. Business models innovations for electric mobility—What can be learned from existing business model patterns? *Int. J. Innov. Manag.* **2013**, *17*, 13400033. [CrossRef]
45. Giehl, J.; Göcke, H.; Grosse, B.; Kochems, J.; Müller, J. Survey and Classification of Business Models for the Energy Transformation. *Energies* **2020**, *13*, 2981. [CrossRef]
46. Brzóśka, J.; Krannich, M. Modele biznesu innowacyjnej energetyki (Business Model of Innovative Energy Sector). *Stud. Ekon. Zesz. Nauk. Uniw. Ekon. W Katowicach* **2016**, *280*, 7–20. Available online: <https://bazekon.uek.krakow.pl/rekord/171455163> (accessed on 15 June 2024).
47. Burger, S.P.; Luke, M. Business models for distributed energy resources: A review and empirical analysis. *Energy Policy* **2017**, *109*, 30–248. [CrossRef]
48. Strupeit, L.; Piał, A. Overcoming barriers to renewable energy discussion: Business models for customer sited solar photovoltaics in Japan, Germany and the United States. *J. Clean. Prod.* **2015**, *123*, 124–136. [CrossRef]
49. Brzóśka, 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]
50. Hamwi, M.; Understanding and Analysing Business Models in the Context of Energy Transition. Proposition of the DRBMC (Demand Response Business Model Canvas) to Design New Entrepreneur’s Business Model in “Demand Response” Markets. Automatic. Université de Bordeaux. 2019. Available online: <https://theses.hal.science/tel-02316384v2> (accessed on 15 June 2024).
51. European Commission. Fit for 55 Package. COM/2021/550-2020 and 2021. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0550> (accessed on 22 February 2023).
52. European Commission. REPowerEU: A Plan to Rapidly Reduce Dependence on Russian Fossil Fuels and Fast Forward the Green Transition. 2022. Available online: https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131 (accessed on 1 July 2022).
53. European Commission. Renewable Energy Targets. 2022. Available online: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en#:~:text=The%202030%20targets,-Building%20on%20the&text=The%20Commission%20presented%20Europe%E2%80%99s%20new,overall%20energy%20mix%20by%202030 (accessed on 31 July 2022).
54. PEP 2040, 2021. Polityka Energetyczna Polski do 2040r. (PEP 2040. Energy Policy of Poland Until 2040). Ministry of Climate and Environment: Poland. Available online: <https://www.gov.pl/web/klimat/polityka-energetyczna-polski-do-2040-r-przyjeta-przez-rade-ministrow> (accessed on 14 January 2024).
55. Jonek-Kowalska, I. Towards the reduction of CO₂ emissions. Paths of pro-ecological transformation of energy mixes in European countries with an above-average share of coal in energy consumption. *Resour. Policy* **2022**, *77*, 102701. [CrossRef]
56. Hargroves, K.; James, B.; Lane, J.; Newman, P. The Role of Distributed Energy Resources and Associated Business Models in the Decentralised Energy Transition: A Review. *Energies* **2023**, *16*, 4231. [CrossRef]
57. Sułek, A.; Borowski, P.F. Business Models on the Energy Market in the Era of a Low-Emission Economy. *Energies* **2024**, *17*, 3235. [CrossRef]
58. Atstaja, D.; Cudecka-Purina, N.; Koval, V.; Kuzmina, J.; Butkevics, J.; Hrinchenko, H. Waste-to-Energy in the Circular Economy Transition and Development of Resource-Efficient Business Models. *Energies* **2024**, *17*, 4188. [CrossRef]

59. Bryant, S.; Straker, K.; Wrigley, C. The typologies of power: Energy utility business models in an increasingly renewable sector. *J. Clean. Prod.* **2018**, *195*, 1032–1046. [CrossRef]
60. Frantzis, L.; Grahmann, S.; Katofskym, R.; Sawyerm, H. Photovoltaics Business Models. In *Subcontract Report of the National of the U.S. Department of Energy, Office of Energy Efficiency& Renewable Energy*; National Renewable Energy Laboratory: Golden, CO, USA, 2008.
61. Matusiak, B.E. *Modele Biznesowe na Nowym Zintegrowanym Rynku Energii*; Uniwersytet Łódzki: Łódź, Poland, 2013; Available online: <https://dspace.uni.lodz.pl:8443/xmlui/handle/11089/30259> (accessed on 14 January 2024).
62. Faridpak, B.; Musilek, P. Resilient Operation Strategies for Integrated Power-Gas Systems. *Energies* **2024**, *17*, 6270. [CrossRef]
63. Ford, R.; Hardym, J. Are we seeing clearly? The need for aligned vision and supporting strategies to deliver net-zero electricity systems. *Energy Policy* **2020**, *147*, 111902. [CrossRef] [PubMed]
64. Erdiwansyah; Gani, A.; Mamat, R.; Nizar, M.; Yana, S.; Rosdi, S.M.; Zaki, M.; Eko, S.R. The Business Model for Access to Affordable RE on Economic, Social, and Environmental Value: A Review. *Geomat. Environ. Eng.* **2023**, *17*, 5–43. [CrossRef]
65. Knop, L.; Staszewska, J. Odporność modeli biznesu przedsiębiorstwa energetycznego w kontekście neutralności klimatycznej. *Pr. Nauk. Uniw. Ekon. We Wrocławiu* **2024**, *68*, 64–78.
66. Staszewska, J. The impact of energy transition on the changes to the energy company's business model. *Sci. Pap. Silesian Univ. Technol.—Organ. Manag. Ser.* **2022**, *157*, 537–558. [CrossRef]
67. Gitelman, L.; Kozhevnikov, M. New Business Models in the Energy Sector in the Context of Revolutionary Transformations. *Sustainability* **2023**, *15*, 3604. [CrossRef]
68. Gorzeń-Mitka, I.; Wieczorek-Kosmala, M. Mapping the Energy Sector from a Risk Management Research Perspective: A Bibliometric and Scientific Approach. *Energies* **2023**, *16*, 2024. [CrossRef]
69. Tokarski, S.; Magdziarczyk, M.; Smoliński, A. An Analysis of Risks and Challenges to the Polish Power Industry in the Year 2024. *Energies* **2024**, *17*, 1044. [CrossRef]
70. Spada, M.; Paraschiv, F.; Burgherr, P. A comparison of risk measures for accidents in the energy sector and their implications on decision-making strategies. *Energy* **2018**, *154*, 277–288. [CrossRef]
71. Franc-Dąbrowska, J.; Madra-Sawicka, M.; Milewska, A. Energy Sector Risk and Cost of Capital Assessment—Companies and Investors Perspective. *Energies* **2021**, *14*, 1613. [CrossRef]
72. Cabała, P. Proces analitycznej hierarchizacji w ocenie wariantów rozwiązań projektowych (Analytical Hierarchy Process in the Assessment of Project Variants). *Przedsiębiorstwo We Współczesnej Gospod.—Teor. I Prakt. Res. Enterp. Mod. Econ.—Theory Pract.* **2018**, *1*, 23–33. [CrossRef]
73. Encyclopedia of Management, Analytic Hierarchy Process—Encyclopedia of Management. Available online: <https://www.mfiles.co.uk/> (accessed on 28 August 2021).
74. Adamus, W.; Gręda, A. Wspomaganie decyzji wielokryterialnych w rozwiązywaniu wybranych problemów organizacyjnych i menedżerskich (Multiple criteria decision support in organizational and management chosen problems solving. *Badania Oper. I Decyzyjne* **2005**, *2*, 5–36. Available online: <https://yadda.icm.edu.pl/baztech/element/bwmeta1.element/baztech-article-BUJ3-0004-0026> (accessed on 14 January 2024).
75. Casey, M.A.; Kueger, R.A. *Focus Groups: A Practical Guide for Applied Research*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2000.
76. Dilshad, R.M.; Latif, M.I. Focus Group Interview as a Tool for Qualitative Research: An Analysis. *Pak. J. Soc. Sci.* **2013**, *33*, 191–198. Available online: <https://pjss.bzu.edu.pk/index.php/pjss/article/view/189> (accessed on 14 January 2024).
77. Radic, M.; Herrmann, P.; Haberland, P.; Riese, C. Development of a Business Model Resilience Framework for Managers and Strategic Decision-makers. *Schmalenbach J. Bus. Res.* **2022**, *74*, 575–601. [CrossRef] [PubMed]
78. Kashav, S.; Centobelli, P.; Cerchione, R.; Ertz, M. Managing supply chain resilience to pursue business and environmental strategies. *Bus. Strat. Env.* **2019**, *29*, 1215–1246. [CrossRef]
79. Wieland, A.; Durach, C.F. Two perspectives on supply chain resilience. *J. Bus. Logist.* **2021**, *42*, 315–322. [CrossRef]
80. Kasperczyk, D.; Urbaniec, K.; Barbusiński, K.; Rene, E.R.; Colmenares-Quintero, R.F. Development and adaptation of the technology of air biotreatment in trickle-bed bioreactor to the automotive painting industry. *J. Clean. Prod.* **2021**, *309*, 127440. [CrossRef]
81. Capros, P.; Zazias, G.; Evangelopoulou, S.; Kannavou, M.; Fotiou, T.; Siskos, P.; de Vita, A.; Sakellaris, K. Energy-system modelling of the EU strategy towards climate-neutrality. *Energy Policy* **2019**, *134*, 110960. [CrossRef]
82. Wang, Y.M.; Luo, Y.; Hua, Z. On the extent analysis method for fuzzy AHP and its applications. *Eur. J. Oper. Res.* **2008**, *186*, 735–747. [CrossRef]
83. International Energy Agency. *Net Zero by 2050 A Roadmap for the Global Energy Sector*; International Energy Agency: Paris, France, 2021. Available online: www.iea.org (accessed on 6 February 2025).
84. European Environment Agency. *A Future Based on Renewable Energy*; European Environment Agency: Copenhagen, Denmark, 2022; p. 7. Available online: www.eea.europa.eu (accessed on 6 February 2025).

85. European Commission. *Open Access to the Power Grid Shapes a More Sustainable Energy Future*; European Commission: Luxembourg, Brussels, 2022. Available online: www.cordis.europa.eu (accessed on 6 February 2025).
86. International Energy Agency. *World Energy Employment*; International Energy Agency: Paris, France, 2023. Available online: www.iea.org (accessed on 6 February 2025).

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