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Prospects for Wood Pellet Production in Kazakhstan: A Case Study on Business Model Adjustment

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Abstract: Biomass and renewable resources are becoming substitutes for fossil-based resources, providing opportunities for more sustainable environmental management and reductions in environmental damage. This paper studies the prospects for wood pellet production in Kazakhstan through the lens of business model adjustment in a microenterprise in Kazakhstan. This study focuses on answering the following questions: (1) How do microenterprises propose, create, deliver and capture value through business models in the wood industry? (2) What are the opportunities and challenges relating to these business models in the context of wood pellet production in Kazakhstan? Kazakhstan has a high potential for biomass production, providing a particularly interesting case for analysing how microenterprises can tap into this potential to create value. This paper combines an analysis of bioenergy and forestry trends with a qualitative case study. The analysis of the business model is based on Osterwalder's business model canvas. The value proposition of the enterprise studied herein is to provide a local biomass-based alternative to fossil fuels. The overall growth of wood-based industries in Kazakhstan and the national movement towards renewable energy create favourable prospects for microenterprises engaged in the production of wood pellets; however, these industries are also characterised by high institutional and regulatory dependencies.

Keywords: biomass; biomass production; business models; wood pellets

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1. Introduction

Nowadays, the search for energy sources that can be used as alternatives to fossil fuels is an acute global problem.

Bio-based fuels offer superior sustainability compared to petroleum-based fuels due to their carbon-neutral nature and renewability, which stem from the use of biomass as the source material [1]. Traditional fossil fuels and energy sources have been shown to be energy-consuming and extremely harmful to the environment. Thus, many countries are shifting to alternative energy sources to reduce environmental damage and emissions. Woody biomass is one such alternative source of bioenergy. In the pursuit of reducing the consumption of fossil fuels, forest-based biomass emerges as a compelling and promising energy source [2]. The energy derived from this source could significantly reduce the emission of harmful substances into the environment, reduce dependency on foreign energy producers, create new business opportunities for local micro-, small- and medium-sized enterprises (MSMEs) and provide a reliable source of energy for the local population. Wood, grass and other lignocellulosic biomass resources from forestry and agricultural waste are globally abundant resources, thus sparking interest in new methods of utilising them that would facilitate a reduction in carbon emissions [3,4] and provide opportunities for the development of high-value-added products [5]. However, the development of technology itself is not enough to achieve this goal, as the diffusion of technology depends on various economic and social factors. The transition towards a bioeconomy requires new business models (BMs) that translate emerging technologies into value propositions and product–market applications [6].

A BM can be defined as a simplified representation of how an enterprise operates [7]. BMs designed to improve the use of alternative energy sources can range from very simple and transferable to very complicated and hard to replicate. A company can use the development of its BM to enhance its performance and determine its niche in the relevant market. The design and reconfiguration of a BM determines how well the enterprise adjusts to changing market and technological conditions [8]. The last decade has seen growth in research on BMs, including research on the interrelated topics of sustainable BMs [9,10], bioeconomy BMs [6] and circular bioeconomy BMs [11–13]. However, the research is fragmented [11], and the literature on BMs in a bioeconomy is still limited. More research on the particularities of bioeconomies and how they relate to BMs is warranted [6]. The research on BMs in the forestry and wood industry in particular has been scarce [12]. The need for research on BMs and BM innovation has been well acknowledged in the sector, which is undergoing major changes and must innovate to survive the transition to a bioeconomy [14].

Kazakhstan is a significant producer of fossil fuels [15], but it has established a strategy for transitioning to a low-carbon economy that aims to increase the utilisation of renewable energy sources [16]. While Kazakhstan is one of the major suppliers of fossil fuels in the global market and has strongly developed heavy industries, it is also very rich in natural resources. Thus, it has strong potential for engaging in the production of bioenergy, particularly wind and solar energy. However, at present, a variety of challenges hinder the diffusion of bioenergy [17].

The prospects for biomass-based energy production and related challenges at the MSME level have so far received relatively limited attention in Kazakhstan. In the last decade, the interest of practitioners and academics towards BMs and the environmental and social sustainability context has increased rapidly [18]. However, knowledge gaps exist, particularly with respect to opportunities, values and the social dimension [19]. On the global level, analyses of bioenergy-related BMs have been fragmented, and most of the research has been performed on advanced economies, while developing and emerging economies, such as the economy in Kazakhstan, have received less attention [20]. Thus, the focus of the present paper is to create a better understanding of the BMs in the small-scale production of bioenergy in Kazakhstan and how they relate to the prospects for biomass-based production in the Kazakhstani context.

The research questions of this study are as follows: (1) How do microenterprises propose, create, deliver and capture value through BMs in the wood industry? (2) What are the opportunities and challenges relating to these BMs in the context of wood pellet production in Kazakhstan? These research questions were adapted from a previous research study by D'Amato et al. [12] on Finnish forest-based enterprises.

The novelty of this research stems from its focus on wood pellet production, its examination of a microenterprise case study and its emphasis on research on the adjustment of a BM for the adoption of sustainable energy in Kazakhstan, which provides a unique context. The analysis of the case study combines a BM analysis and a review of the development trajectory of the enterprise and its environmental context to provide insights into the prospects and challenges relating to BM changes in a distinct, real-life environment.

This paper is structured as follows. The second section following the introduction provides an overview of the definition of BMs and explains global trends in biomass and wood pellet production and the development of the wood industry in Kazakhstan. The third section explains the methodology, while the fourth section provides the results from the case study and the BM analysed. The fifth and sixth sections present the discussion and conclusions.

2. Conceptual Background

2.1. Business Models

In the last three decades, the concept of BMs has become an increasingly popular topic in management theory and practice [21–23]. Although a significant number of publications have explained the assumption of a BM, no generally accepted definition has been developed yet [22–24]. Providing an explanation of the concept can also prove challenging for professionals [25]. A BM is an abstract representation of business logic [26]. It can be generally defined as a description of a planned or existing venture and its specific characteristics with respect to the creation of value and market orientation [22,27,28]. The BM concept combines elements of a company's resource-based and market-based views and thus adopts a comprehensive perspective [27,29].

A BM comprises a series of interconnected parts that address an enterprise's consumers, value proposition, organizational design and economics [30], thus serving as a reference framework for practitioners to use while thinking, creating and conveying business concepts [31–33]. A BM is a particularly useful tool in the context of rapidly developing markets, which are characterised by uncertainty, an increasing degree of complexity and the appearance of a wide range of BMs and new stakeholders in the global business landscape [34].

Most researchers agree that the definition of a BM is the way in which a business creates value [35–37], i.e., how the venture turns resources into products and services for its customers. Value creation is focused on the following question: how can a specific customer value proposition be developed? [38]. Value proposition refers to a description of how the enterprise intends to provide value to its customers [39], i.e., the bundle of products and services that the enterprise provides to the customers to satisfy their needs [32]. Value capture refers to the process of retaining financial and non-financial returns from the value creation process [40]. Value delivery explains the methods and techniques for communication and the distribution of products and services [41].

The scholarly literature examines how enterprises create and innovate their BMs [36,42,43]. Business model innovation refers to changes in a BM that can range from minor adjustments of some elements to the complete reformulation of the value proposition and the redesign of the business logic [44]. A BM is also a useful structured management tool, particularly for practitioners [45]. A BM canvas refers to a template that visualises and summarises the main elements of a BM and their relationships [32].

In the present study, Osterwalder and Pigneur's [32] BM canvas is used (Figure 1).

<table>
<tr><td rowspan="2">Key partners</td><td>Key activities</td><td rowspan="2">Value proposition</td><td>Customer relationships</td><td rowspan="2">Customer segments</td></tr>
<tr><td>Key resources</td><td>Customer channels</td></tr>
<tr><td colspan="2">Cost structure</td><td colspan="3">Revenue streams</td></tr>
</table>

Figure 1. Osterwalder and Pigneur's business model canvas explanation [32].

An analysis of a BM focuses on the enterprise (micro) level, but based on the patterns of prevalent BMs, the extant literature provides various typologies for categorising BMs. Bröring and Vanacker [6] suggest three main generic types of BMs that are specific to the bioeconomy. BMs building on the substitution of fossil-based products with bio-based products focus their value offers on offering environmentally friendly alternatives to customers and usually depend on the availability of large quantities of biomass, sales in bulk and pressure for low prices. BMs relating to new bio-based products entail the development of novel products with new functionalities and often require new production processes, new knowledge and value chains. BMs that integrate bio-based services include BMs that are based on the provision of additional services or those that offer their customers the use of products without ownership [6]. Sustainable BMs are BMs that are not only concentrated on economic value but that also create significant social and environmental benefits to different stakeholders through their value creation, delivery and capture [18]. Sustainable BMs can be viewed as a subcategory of bioeconomy BMs as they overlap, but not all bioeconomy BMs are sustainable [6]. Bocken et al. [9] reviewed the most common sustainable BMs in the literature and in practice and categorised them on the basis of the type of innovation (technological, economic and social) into eight archetypes of sustainable BMs. Three archetypes of BMs based on technological innovations were the maximization of material and energy efficiency; the creation of value from waste; and substitution with renewables and natural processes. Social innovation-based archetypes are related to the delivery of functionality, the adoption of a stewardship role and the encouragement of sufficiency, while organizational innovation archetypes are re-purposing the business for society/the environment and the development of scale-up solutions [9]. Lüdeke-Freund et al. [10] developed a more detailed taxonomy based on sustainable BM patterns. These patterns were divided into 11 pattern groups that were, in turn, related to specific types of value creation, such as economic, social, ecological and integrative value creation. BMs focusing on the maximization of material productivity and energy efficiency, product design, substitution with renewables and natural processes were grouped under eco-design patterns, for which the key activities and value propositions of the BMs mainly contribute ecological value but also economic value to a certain extent.

The forestry sector is usually characterised as a traditional and mature industry focused on a high volume of productivity, low costs and process-based innovation [14]. Previous research on forest industry-based BMs has demonstrated that sustainability-oriented bio-based BMs tend to be dominated by traditional practices such as the maximization of energy and material efficiency and the use of forestry-based renewable resources, with less focus on social or organizational innovation in BMs [12].

2.2. Global Biomass and Bioenergy Trends

Biomass is widely considered to be the renewable energy source with highest potential for the future [46–48]. The potential benefits of the substitution of coal-based composite fuel—lowering greenhouse gas emissions—are crucial [49]. Brack [50] notes that many countries classify biomass as a renewable energy source in their national policies, and it therefore receives financial and regulatory support as a carbon-neutral energy source. Nevertheless, if biomass is burnt in the presence of oxygen, it is not carbon-neutral at the point of combustion as carbon dioxide is produced [50]. The carbon-neutral classification is based on one or both of two assumptions. First, biomass emission levels are part of a natural cycle in which the carbon emitted by burning wood for energy is absorbed by forest growth. Second, under international greenhouse gas emission rules, biomass emissions are classified as belonging to the land-use sector, not the energy sector [50]. Woody biomass is only renewable if it is produced in a sustainable manner. The incremental growth rate at harvest, which equals the average overall growth rate, is shown to be the best and most sustainable production rate of standing biomass [51].

The share of biomass energy is expected to continue to increase as countries all over the world continue to develop support policies for the use of biomass in response to concerns about climate and energy security [50]. In 2020, the share of bioenergy was 12.3% of total global energy consumption [50]. The traditional use of biomass refers to burning biomass such as wood, charcoal, dung and agricultural residues in simple and inefficient fires and stoves for cooking and heating in developing and emerging economies. The traditional use of biomass has decreased globally, and in 2020, it accounted for more than half of the use of biomass. Modern bioenergy (biofuels, biogas and wood pellet-based efficient systems for heat and electricity) comprised 5.6% of the total final energy consumption in 2020 [52].

Driven by its policy targets, the European Union (EU) has been the world's largest consumer of modern biomass energy [50]. Within the framework of the EU's long-term strategy, the primary objective is to attain climate neutrality by the year 2050, aligning with the objectives set forth in the Paris Agreement while recognising the imperative of intensifying global climate action [53]. In 2009, the Renewable Energy Directive target for 2020 was to derive 20% of the EU's energy from renewable energy sources [54]. This was achieved, and the new, revised policy target is to generate 32% of the EU's energy from renewable energy sources by 2030 [55].

The use of wood in the production of electricity and heat has been increasing as it is seen as a relatively cheap and flexible means of producing renewable energy with benefits to the global climate and forestry sector [50]. The main concerns are related to its greenhouse gas emissions, forest conservation and the impact of biodiversity [50]. Wood has been preferred over a wide range of biomass sources for the generation of biomass-based energy and heat [56,57]. The alternatives, such as organic waste, agricultural residues and energy crops, tend to be less energy-intensive, more costly and harder to collect and transport [50]. Thus, wood, mainly wood pellets, is currently the dominant solid biomass feedstock on the global markets and is likely to remain the preferred biomass-based fuel for some time [50].

Wood pellets are a renewable energy source generated from different wood waste products [56]. Wood pellets are manufactured by compressing and extruding the wood material into cylinders (which are usually 6–12 mm in diameter and 10–30 mm long) [50]. The production process requires energy in combination with the necessity of drying the wood. Wood pellets are manufactured without adding glue, so no additives are required in the modern process; rather, the natural glues present in wood are used to bind the pellets together [58]. The pellets are denser and have a lower moisture content than wood chips and are thus better suited for transport and storage [50]. Wood pellets can be categorised as high-quality pellets (white pellets produced in bulk or in bags) designed for the residential heating market or industrial-grade pellets (brown pellets supplied in bulk), which are manufactured for centralised systems from low-cost raw materials [59,60]. Wood pellets are mostly used in domestic heating furnaces, but they have many additional uses, such as in the large-scale generation of electricity [58].

Wood pellets are an essential and well-accepted fuel, and their market is expected to grow further in the future [61]. The production of wood pellets experienced a revival in the 1990s and has experienced continued steady growth since then [62]. In 2010, the global production of pellets was 14.3 million tons, while the consumption of pellets reached 13.5 million tons. This shows that the global production of wood pellets has increased by 110% in comparison with the production in 2006 (~6–7 million tons) [59]. This rapid growth has continued in recent years. The global production growth from 27 million tonnes in 2015 to 41 million tonnes in 2020, with the EU being the largest producer [50,52], suggests that wood is likely to remain the overwhelmingly preferred biomass fuel for the production of electricity and heat, at least in the short- to mid-term, as it is now in North America, Europe and Japan.

With the rapid growth of wood pellet production in the last decade and the favourable market outlook, wood pellets and their supply chains in particular have become dynamic areas of research [63]. Logistics and transportation costs are the fundamental concerns for the production of biomass for biofuel [64–66]. The production of wood pellets is characterised by challenges such as the geographical dispersion of biomass, raw material availability, the seasonality of production, production and storage constraints, the low energy density, price pressure from other energy sources that require the optimization of material flows along the supply chain [63] and production processes [62]. The sustainability of the BMs of the enterprises operating in this sector require the capability to address these specific production pressures by effectively cooperating with a wide range of supply chain stakeholders in a rapidly changing economic and political environment.

2.3. Forestry and Wood Industry in Kazakhstan

The Republic of Kazakhstan is located in the middle of the Eurasian continent in Central Asia. The country spans 1600 km from north to south and 3000 km from west to east. The country is the ninth largest in the world, with an area of 272,490,000 ha. Most of the country's territory is desert (44%), semi-desert (14%) and steppes (26%) [67]. The territory is vast and the population size is relatively small, resulting in a low population density of 6.2 persons per square kilometre [67].

Kazakhstan's government released the National Green 2050 Economy Concept in 2013 (directive no. 577 of 30 May 2013), the Law on Green Economy in 2016 (directive no. 506-V of 28 April 2016) and the Renewable Energy Action Plan for 2012–2030 to support the growth of renewable energy in Kazakhstan (Directive no. 068 of 24 February 2017) [68]. Kazakhstan has set a goal of increasing the percentage of renewable resources used to produce power from 3% in 2020 to 50% by 2050 [17]. These objectives and government policies support the adoption and commercialization of the biogas industry, liquid fuels derived from biomass and biomass-based electricity industries [69]. In the latest report prepared by British Petroleum (BP), the total bioenergy share of energy in Kazakhstan was 3.9%. The following Figure 2 presents the share of primary energy derived from low-carbon sources until 2022 [70].

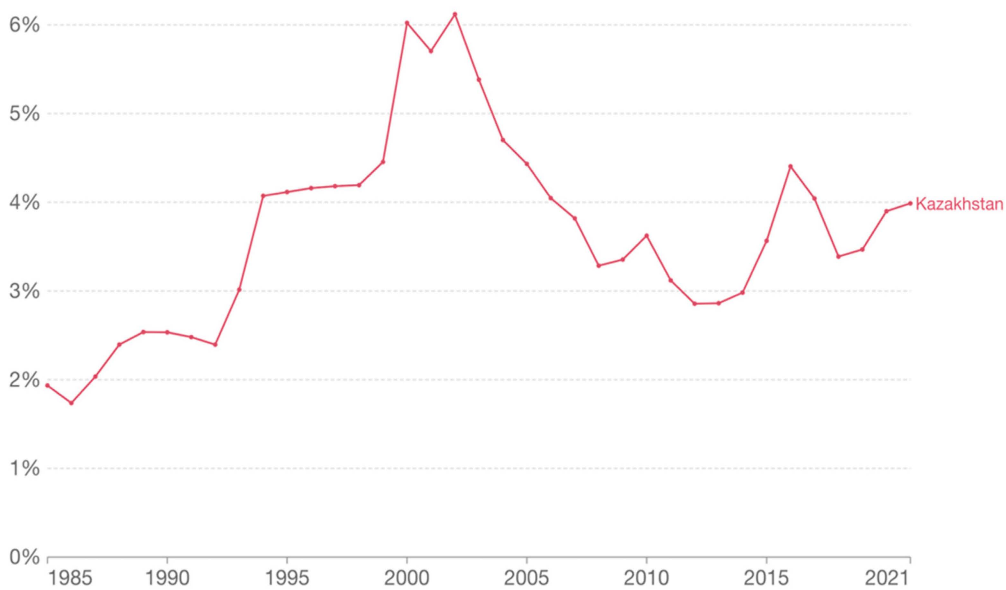

Figure 2. Share of primary energy derived from low-carbon sources, 2022 [70].

Kazakhstan possesses substantial forest resources [67]. The forests cover 12.4 million hectares of land. The country has the third-largest forested area in the regions of Eastern Europe and Central Asia [71]. However, the forests are distributed very unevenly across the country: the total forest cover is 4.57 percent, and the forest cover varies by individual administrative region from 0.1 percent to 16 percent [67]. In Kazakhstan, all forests are protective forests that carry out the important functions of water protection, field and soil protection, sanitation, health improvement and other useful functions [67]. The forests are divided into birch forests in the northern regions, island forests in the northwest, the pine forests of the Kazakh Melkosopochnik, the ribbon forests of the right bank of the Irtysh River, the mountain forests of the Kazakh parts of the Altai and Saura, Jungar (Zhetysu) Alatau and Northern and Western Tien Shan, desert saxaul forests in the southern part and riparian and floodplain intrazonal forests [67]. Saxauls dominate in the compositions of the forests (49.8% of the area), followed by shrub plantations (24.1%), which are located mainly in the desert and steppe zones [67].

In 2013, the forest area was approximately 12.4 mil ha [71], a slight increase from 2000 [71]. In 2022, the forest area in Kazakhstan was approximately 13.6 mil hectares or 5% of the territory [72]. Forest resources are distributed unevenly over Kazakhstan (Figure 3).

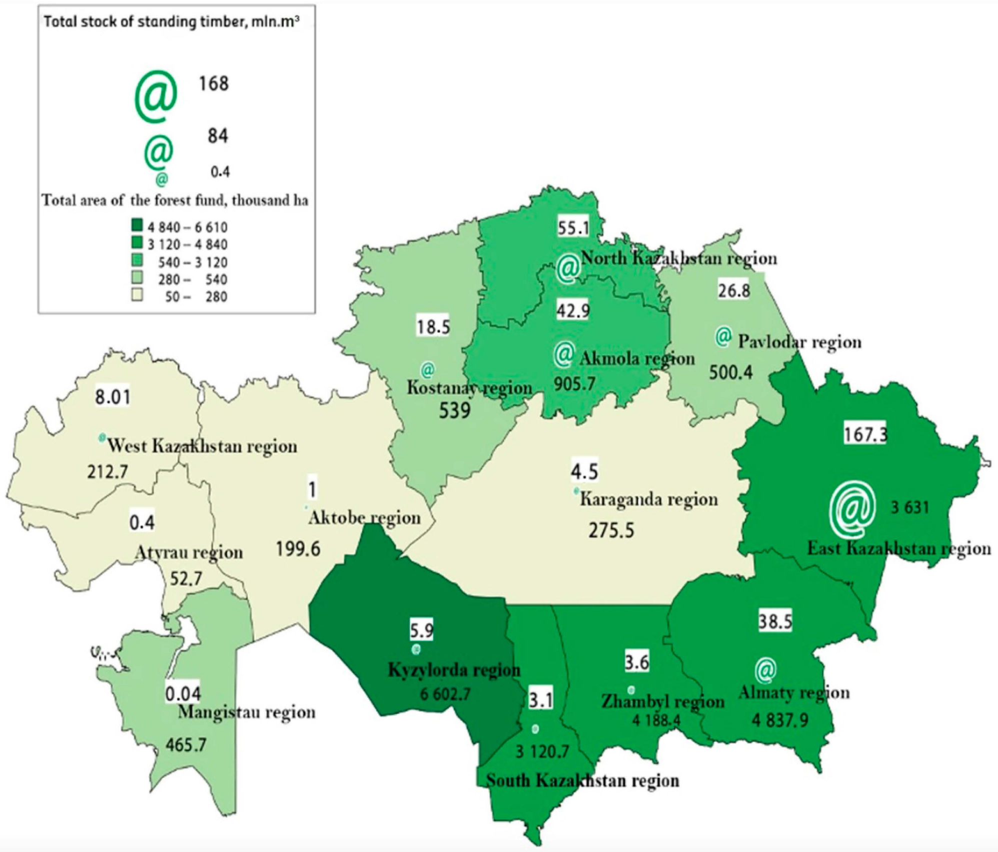

Figure 3. Forest fund and standing timber stock [67].

Key forestry indicators in the Republic of Kazakhstan are presented below (Table 1). In recent years, the overall economic output of the forestry sector and the logging volume have been increasing.

Table 1. Key forestry indicators in the Republic of Kazakhstan [67].

	2017	2018	2019	2020	2021
Volume of products (services) in forestry in current prices, thousand KZT	12,731,842	13,234,374	15,079,584	15,836,857	18,859,632
Index of the physical volume of forestry products (services), as a % of the previous year	132.1	102.2	98.9	104.3	118.1
The harvesting of untreated wood, dense m^3	320,804	366,849	422,681	496,306	493,242
The logging of softwood logs, m^3	37,826	56,713	52,088	48,833	39,208
The logging of hardwood logs, m^3	70,778	99,212	137,965	143,923	227,665
The harvesting of wood fuel, m^3	212,080	210,924	232,628	303,550	226,369
Harvested forest tree seeds, kg	141,974	118,443	129,170	182,880	278,299
Forest management, thousand hectares (ha)	4431	2199	2953	6405	2567

Source: The Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2022.

In 2020, Kazakhstan exported USD 8.83 M in wood products, making it the 120th largest exporter of wood products in the world. In the same year, wood products were the 18th most-exported product in Kazakhstan [68]. The main destinations of wood products exported from Kazakhstan are as follows:

- Uzbekistan (USD 3.63 M);
- Kyrgyzstan (USD 2.57 M);
- Tajikistan (USD 1.19 M);
- Russia (USD 896 k);
- China (USD 273 k).

The top three increasing export destinations for wood products from Kazakhstan between 2019 and 2020 were Iraq (USD 62.6 k), Mongolia (USD 42 k) and Belgium (USD 39.1 k).

Kazakhstan ranked as the world's 54th largest importer of wood products in 2020, with a total value of USD 363 M. Wood products ranked as Kazakhstan's 17th most-imported item that same year. For USD 293 M, USD 20.3 M, USD 12.6 M, USD 11.4 M and USD 4.7 M, respectively, Russia, Belarus, Turkey, China and Italy are the top five countries from which Kazakhstan purchases wood products. In the period from 2019 to 2020, the three countries that saw the greatest increases in imports of Kazakhstan's wood products were Turkey (USD 7.46 M), Italy (USD 2.22 M) and Norway (USD 951 k) [68]. In Kazakhstan, forestry is big business, with 189 registered companies and 47 companies actually operating at any given time. An overview of Kazakhstan's forestry sector reveals that there is a total of:

- Two large enterprises (with more than 250 employees);
- Five medium enterprises (employing from 101 to 250 workers);
- One hundred and eighty-two small enterprises (employing from five to 100 people).

The East Kazakhstan area (50), Akmola region (22) and Almaty city (16) have the highest numbers of forest industry firms [73].

The Mangistau area (2), Kyzylorda region (3) and West Kazakhstan region (3) have the fewest firms engaged in logging and forestry. The companies engaged in forestry and logging in Kazakhstan are registered under the following general classifiers of types of economic activity codes (GCTEACs). The number of enterprises is provided in parentheses [44]:

- 02100—Forestry and other forestry activities (69);
- 02200—Logging (86);
- 02400—The provision of forestry (forestry and logging) services (24);
- 02300—The collection of non-wood forestry products (10).

2.4. SMEs in Kazakhstan

SMEs are essential for local economic development, contributing significantly to job creation, reducing poverty and supporting economic growth, but they face several financial challenges [74]. SMEs are an important source of economic growth [75]. Most economies throughout the world, especially those in underdeveloped and emerging countries, rely on them [76]. For example, SMEs represent around 99% of all business in the European Union (EU) and provide two-thirds of jobs [77].

Kazakhstan has a different classification for MSMEs on the basis of the number of employees. Microenterprises have up to 15 employees (in the EU, up to 9) and small enterprises have 16–100 employees (in the EU, 10–49) (Table 2). In Kazakhstan, SMEs accounted for 96.7% of all companies in 2018, employed 37.5% of the overall workforce and generated 28.9% of the country's gross domestic product (GDP) [78].

Table 2. Categorisation of firms in Kazakhstan as of 01.01.2019 [78].

Category	Annual Average Number of Employees	Average Annual Income (KZT)	Average Annual Income (EUR)	The Distribution of SMEs in Kazakhstan (in Numbers)
Microenterprise	0–15	KZT 72.1 million	145.7 thousand	1,188,629
Small enterprise	16–100	KZT 721.5 million	1.4 million	377,925
Medium enterprise	101–250	KZT 7 215.0 million	14 million	2787
Large enterprise	More than 250	KZT 7 215.0 million	>14.6 million	2410

Source: Financing SMEs and Entrepreneurs 2020: An OECD Scoreboard Kazakhstan.

In Kazakhstan, the government plays a significant role in sustaining SMEs' access to credit by placing funds in commercial banks to offer concessional lending to SMEs amid market liquidity constraints [78]. In 2018, the greatest allocation of public money for SME financing took place. In 2014–2016, the majority of loans were provided to support SMEs in the manufacturing industry at a rate of 6% per year, and these loans were issued on a revolving basis by banks [78]. The government provides additional funding on a yearly basis [78]. Under the Business Roadmap 2020 program, the government also waived interest rate expenses and has offered loan guarantees for SMEs through the Damu Entrepreneurship Development Fund since 2010 [78].

3. Data and Materials

The research process began with a review of the research on sustainable and bioeconomy BMs and bioeconomy trends in Kazakhstan. As the preliminary investigation showed that very little information is available on bioeconomy-related BMs in Kazakhstan, the authors decided to take a qualitative approach, using a single case study and utilising the BM canvas in the BM analysis, an approach that is common in this stream of literature [32]. Given the current state of the phenomena under investigation, data were gathered using a qualitative interview, which allowed for the capture of the relevant informants' knowledge and experience [79]. In the social sciences, qualitative, semi-structured interviews are some of the most common and frequently utilised data collection methods [80]. They provide researchers with opportunities to examine different perspectives and to compile detailed information about individuals' experiences [81].

The interview format allows the researcher to address a certain topic while enabling the respondent to reply in their own words and explore concerns and subjects that are important to them [82]. This was deemed a suitable approach for the present study as this study aimed to understand how the enterprise itself understood its value creation and capture and the implementation challenges faced by the enterprise in adopting a BM related to forest biomass resources.

In the present paper, Kazakhstan was chosen as the country in which the empirical research was carried out. Based on the latest changes in rural development and innovation policies, the topic of biomass and related bioenergy has begun to receive more attention from the government. Considering the implementation challenges, businesses of all sizes and categories are driving significant development in sustainability-driven BMs [83].

The interviews were conducted with a key company executive. The company included in the case study was purposefully selected based on a report of innovation-driven companies that was published by the Kazakhstan Ministry of Agriculture. This purposeful selection ensured that the insights gained from this company's experiences would be highly relevant and informative for understanding the challenges and opportunities in adopting sustainable BMs in the context of forest biomass resources in Kazakhstan. The criterion for selection was that the targeted business should produce or provide services based on forest biomass resources.

The interview was conducted online, via a WhatsApp video call, in the Kazakh language. The design of the questionnaire was based on the conceptualization of a BM canvas by Osterwalder and Pigneur [32]. The company's value proposition, key partners, key resources, customer segments, channels, cost structure, revenue streams and customer relationships were studied. More specifically, the questions covered the company's background, strategy, business environment-oriented activities, key partners, value propositions, value creation, channels and delivery, business channels, BM description, revenue and cost analysis, future expectations, the limits of the market, the size of the market and insights from the company's manager.

The interview was recorded, reproduced and then translated from Kazakh into Russian and then English.

The questions were provided to the interviewee in advance, along with the study rationale. The interviewee and the firm they work for were assured anonymity. Data from the interviews were combined with information from other sources, such as the company's website. A thematic analysis was used for data analysis to identify the main themes in the case study data. The results of the analysis are presented in the form of a narrative.

4. Results

4.1. Company Background

The current form of the business was established in 2015. However, its roots and the owners' first working experience began in 1985. The company's first experience in wood production began during the period of the Soviet Union on a collective farm (kolkhoz) in a region in North Kazakhstan. The company was engaged in the production of wood products. There was a sawmill on the enterprise's territory which processed timber brought in from all over the region.

The collective farm existed until 1992. Then, due to privatisation, the kolkhoz was reorganised into another form of ownership. The current owners, who had worked in the kolkhoz, established a limited liability company (LLC) using the sawmill facilities. From 1992 to 1998, the enterprise existed as a private SME organization and started to produce firewood for the private household sector. The main activities were processing and treating wood and selling the firewood to the local market.

From 1998 to 2001, the company experienced difficulties amidst the global economic crisis and issues with financial resources (declining credits from the government, problems with leasing machinery and a high inflation ratio). Thus, the company ceased its activities temporarily in 2002. The facilities were sold to the municipality.

From 2002 to 2013, the original owners of the firm were working in a quasi-public sector or in the private sector. The business owners decided to re-establish the business in 2015, using the original facilities and their expertise. The business was created in the form of a new limited partnership with a new BM. The main factor in the re-establishment of the company was the broader push towards and debate surrounding the transitioning to more sustainable sources of energy, which are associated with a gradual withdrawal from conventional energy sources (oil, coal, fuel and lubricants). This was combined with the owners' previous experience, local support and the availability of facilities and financial support.

The enterprise purchased machinery and equipment with the aid of a governmental leasing program through the national holding company "KAZAGRO". "KAZAGRO" is a state company that helps farmers and rural enterprises with investments, subsidies, leasing, marketing and R&D. The owners also received training through "KAZAGRO" for SMEs, but they have since taken advanced training courses for mid-level managers on business in agriculture and innovative products based on alternative energy sources (biomass).

At present, the company employs seven people. The main activities are the production of wood pellets and wood chips as biomass for energy fuel. The company is exporting its products to the neighbouring regions and the Russian Federation. The innovative component of the firm is incremental. It has purchased foreign equipment for wood processing and a heating plant, which is connected to the central heating system for selling heat energy to private homes. The company purchased separate equipment with low levels of energy consumption and the ability to press wood into pellets and wood chips for sale.

This production is fully automated, and the operations are documented using software. While the company is a microenterprise, it can be viewed as one of the leading companies in its niche and local region.

The firm has two main regional competitors in the biomass-to-energy conversion and heat-transfer boiler sales market. One competitor sells wood pellets for household use and sawdust for heating livestock farms. The other competitor sells long combustion boilers for wood pellets and sells silage (mixed fodder) for cattle and as a source of energy.

An interesting aspect was that during the interview, the owners demonstrated considerable social engagement in their community. The company mentioned the creation of additional (non-production-related) jobs for local villagers as their social duty, as well as providing food baskets for low-income employees and providing employees and villagers with discounts for pellets and chips during the heating season under certain conditions. The company organises quarterly courses through an e-learning platform and tailors the courses based on the employees' positions and professional skills. The company has also supported the employees' children by paying for their university and college education and supporting overseas internships and professional development courses.

4.2. The Company's Business Model Canvas

The company produces solid biofuel in form of processed wood biomass that replaces fossil-based energy resources. It represents a company that produces heat and fuel from biomass, with involvement in both the production of the pellets and the use of the pellets in their heating facilities.

The canvas below summarises the present BM of the wood pellet producer investigated in this study (Table 3).

Table 3. Business model canvas of the wood pellet producer.

Key partnerships Companies selling the raw wood material for the enterprise; The local municipality (which subsidises the raw wood material price); Suppliers (technology, maintenance and services).	Key activities Producing wood pellets and wood chips. Operating a heating plant to distribute heating to local households. Key resources Wood pellets and wood chips; Heating plant; Technology and facilities; Distribution network.	Value proposition The replacement of fossil fuel-based heating and fuel with biomass-based products (pellets and wood chips).	Customer relationships Personal direct sales and short term/long term supply contracts. Channels Word of mouth; Advertisements in social networks and TV; Sales force; Participation in supply tenders. Delivery channels Delivery by trucks; Delivery through local heating infrastructure; Selling products in bags.	Customer segments B2C, B2B and B2G; Enterprises and households (local and foreign) and the local municipality.
Cost structure Raw material costs (raw wood); Investment into the heating plant (depreciation); Equipment and technology costs (the maintenance of boilers and pelletisers); Production costs (all production costs); Distribution costs.			Revenue streams Sales of heat; Sales of pellets and wood chips; Sales of services (logistics).	

Source: The authors' own analysis.

4.2.1. Value Proposition

The company offers wood pellets and wood chips to the local community for heating. They also have a heating plant which allows them to provide heating to local households. The firm has diversified their business, and they have an income from separately selling wood pellets and wood chips for heating and landscape design and supplying direct heating from their heating plant. The owners of the company demonstrated a good understanding of the concept of a BM in the interview and centred the discussion on value proposition around providing the region with heat energy, reducing the effect of carbon dioxide and switching to alternative energy sources, thus setting a local example for transitioning to biomass energy and preserving the environment while developing products from the regional scale to the national scale.

4.2.2. Key Partnerships

The company's essential partners are raw wood suppliers from the same district and other regions. There are also regional firms that maintain and repair the machinery including the pelletizer machine. The local municipality is a key partner and appears in various blocks of the BM. The local municipality subsidises the purchase of raw material, presents the firm's activities at the regional level and negotiates with large firms to procure training and internships for the firm's employees. Additionally, it regulates the heating price for the local population by setting the price ceiling, and it is also a customer.

4.2.3. Key Activities

Since the company is a relatively small enterprise, its main activities are producing wood pellets, providing heating and transferring these products to local markets.

4.2.4. Key Resources

The main resources utilised by the company are biomass (wood pellets and wood chips) and biomass production equipment and technologies. The company considers the heating plant and its facilities (the biomass warehouse) the most valuable resources. The logistics and packaging the pellets are necessary functions of the technological production process. The distribution network provides heat to local households.

4.2.5. Customer Relationships

The company has established very strong ties with the municipal organization through supply contracts to provide heat to local households. Furthermore, the company sells their pellets directly through a physical shop. Local consumers are the key actors in the customer–business relationship.

4.2.6. Customer Segments

The households, local enterprises and local municipality are the main customer segments. Thus, the BM contains all of the main types of markets: B2C (business to customers), B2B (business to business) and B2G (business to government). The B2C and B2B markets can be further divided into local and foreign segments. One aspect that the company emphasised was that they are a bridging business between the local area and bordering areas in Russia. The firm is attempting to build strong ties with the local providers of raw materials (key partners) and to build strong relationships with external market actors.

4.2.7. Customer Channels

The company's channels are represented by their own sales, their participation in tenders and direct connections with the local municipality and heating providers, and enterprises which are carried out through contracts and are regulated by the local municipality. "Word of mouth" is an important marketing channel through which local residents often find the company. The company also uses advertisements on social networks and TV. The company has a direct selling point (the storage of wood pellets and wood chips). The logistics are organised via truck delivery and take-away sales.

4.2.8. Cost Structure

The main costs of processing wood include labour costs, the maintenance of the equipment, the depreciation of the equipment and the transportation of raw materials.

4.2.9. Revenue

The company's revenue mostly comes from distributing heating, selling wood pellets and wood chips and sales of services at a small scale. The revenues are affected by the price regulation that is an instrument of governmental politics in the agricultural and forestry sector of the Republic of Kazakhstan. This regulation also can directly affect the revenue stream of the firm (Law of the Republic of Kazakhstan: On state regulation of the development of the agro-industrial complex and rural areas, 2005) [84].

4.3. Overview of Future Business and Challenges and Opportunities for the Firm

Concerns surrounding global climate change are creating new challenges and new BM opportunities for producers of food, biomass and heat. The interview demonstrated some common and some Kazakh-specific challenges that MSMEs are currently facing. The company emphasised that it makes a positive contribution to the ecology and the environment of the village through the use of biomass energy and wood materials and that there are future possibilities to export materials to major companies involved in landscaping and the production of furniture and wood products. It was mentioned that the decrease in the use of oil, fuel and lubricants in the global market will encourage small companies to explore new opportunities and to provide products and heating in local regions, which have been more dependent on fossil fuel-based energy. In the coming decades, declines in global oil prices and the projected reduction in Kazakhstan's oil production will lead towards a transition to using alternative energy sources, including biomass.

The interview included a discussion on the present and future challenges faced by the company.

These challenges are affected by but not limited to every structural reform and policy in the agricultural or energy sectors. The case studied herein highlighted access to capital and governmental regulations as challenges experienced with such a BM. A scarcity of finances for technological investments in microenterprises and access to or lack of governmental support to purchase and lease machinery, as well as the set quota for heating prices, determine the success of this type of BM. The interviewee mentioned that there are no direct investments from energy companies in the private sector into this kind of business. Only a few investors from the same region are willing to invest in the production of wood pellets. The company has received some support from specific governmental programs in Kazakhstan, and the local municipality subsidises the purchase of raw material for the production of wood pellets.

On the other hand, the interviewee expressed concern about the unprecedented corruption issues that relate to the pricing policies proposed by the municipal authorities and issues in the Kazakh context that are related to the monopoly of major heating suppliers, which impacts opportunities for growth in the present BM.

Fluctuations in sales represent a difficult issue for heat supply enterprises. Furthermore, the sales depend on the seasonal temperature and the level of energy consumption.

Finding new supply chain routes and destinations are the keys to capturing value in this BM. Because of the company's geographical location, there is only one international market, which is the Russian Federation; this results in dependency on the rules and legislation of a foreign country. Despite the Tax Union between Kazakhstan and the Russian Federation, financial barriers exist which have negative effects and are slowing down the business and entrepreneurial climate in the region. The firm's strategy with respect to widening their presence in international markets is still in the planning stage. At this point, they must build their reputation and capital sources and invest resources into diversifying their production, thus adjusting the elements of their BM as they outgrow their present BM.

In the case of this business, future opportunities are identified from new production technologies and an expanding market, as the company seeks out new customers and the development of sustainable and eco-friendly production processes. For example, the interviewee mentioned that the company is exploring new products for the pet industry, outdoor design and landscape architecture; thus, existing resources will provide opportunities to diversify their BM and value proposition.

Kazakhstan must still improve their business ties and support the exploration of a variety of BMs in rural areas and agriculture. The MSMEs require more focus from the government; not only funds but entrepreneurial guidance and connections for business developers as well. Location is also an issue with the supply chain and delivering products. The nature of the product (a bulk product which must be delivered in relatively large quantities) affects the BM as it makes sense to deliver the products to the closest areas due to transportation costs, and this depends on the numbers of orders and their value. The main strategy is to maximise profit by expanding the company's production capacity, sales and pricing policies. Despite financial uncertainties and bureaucracy from the municipal authorities, the opinion was that it is better to continue with the present organizational BM and adapt the model to the current challenges.

5. Discussion

We would classify the developmental trajectory of the company over the last three decades as what Schaltegger et al. [44] describe as BM improvement and BM adjustment. The central premise of the value proposition of the BM is the use of local woody biomass-based products for heating, and this value proposition has remained the same. The shift from the sawmill of the kolkhoz to a private producer of firewood represents an improvement in the BM in which several elements of the BM were modified at the same time. The BM configuration at the time was not viable in the long term. However, some of the original resources, networks and location were later recycled, combined with new resources and used to re-establish the company, with more substantial modifications in the BM undertaken in 2015 as shifts in the external and institutional environments provided a favourable entrepreneurship opportunity. Since then, there have been relatively minor changes that can be described as ongoing BM adjustment.

The BM of the business case studied is a relatively typical for a small-scale wood pellet producer and can be characterised as traditional, mature, cost-related and incremental process-based innovation [47]. The latter lies in applying technology and creating products that are new to the local Kazakh context but not to the wider world. Still, the exploration of this kind of BM and innovation create initial pathways for reducing the dependency on fossil fuel-based energy. This is particularly relevant in the Kazakh context as the abundance of easily accessible and cheap fossil fuels and the economies of scale of fossil fuel-based industries can stifle interest in incremental innovations and local, small-scale solutions.

At this moment, the BM has been operationalised via focusing on the main value proposition as a local biomass supplier (wood pellets and wood chips) that provides alternatives to fossil fuels. The value is created from local resources, which are delivered mainly to local residents to meet their needs, in combination with certain social goals for the local community. In terms of the BM typologies suggested by Bröring and Vanacker [6] and Bocken et al. [9], this case could be categorised under the overall type of substitutions with renewables. It does not fit clearly to a specific pattern in the taxonomy of Lüdeke-Freund et al. [10] as it shares some social and economic elements with environmental goals. The social mission does not stem from the value proposition itself, nor did the enterprise explicitly state that their social goals are connected with a specific environmental mission or social innovation; instead, they are based on a more generalised view that their enterprise is embedded in their local community and that they have opportunities to support the community through small-scale actions.

The BM is geographically embedded as the region is rich in forestry resources and heat production in North Kazakhstan is fundamental and crucial due to the climate and its remoteness from other regions. The challenges relating to value capture were that the company is relatively small, which hinders its production volume and business capacity, the region's peculiarity, and access to logistics chains that would provide opportunities to access local and nearby foreign markets but also set limits to the development of the business network. Thus, local market and geographical contexts create opportunities for this kind of BM, but they also limit its reach into further markets, especially as the enterprise's access to capital investments is limited. Challenges relating to logistics, seasonality and economies of scale in the enterprise are common features of the wood pellet production industry, as noted in previous research [64–66].

MSMEs have limited resources and are very dependent on external actors; thus, the enterprise can only survive if it can successfully adjust its BM to take advantage of external actors in value creation, delivery and capture. A distinctive characteristic of the Kazakh context is institutional dependency. The investments required for the re-establishment of the enterprise and the adjustment of its BM were possible because of the direct governmental support scheme for the leasing of machinery and training. The everyday operation of the BM is directly dependent on the local government. The findings from our research demonstrate the roles of different but connected ties between customer demand and the regulatory environment in the local municipality. Setting price controls for public services such as heating for local residents is common across countries and affects value capture in the BM. However, the local government's direct involvement in resource acquisition and its interconnected relationships with other actors and activities relevant for the BM mean that its activities have a considerable impact on value creation in the BM. In this sense, Kazakhstan differs from Western countries. While price regulation guarantees certain prices and markets, thus facilitating the present BM, it can also hinder growth prospects and create specific institutional risks for this kind of BM if the goals of different actors begin to differ too much.

The forestry sector is rapidly growing, and the expansion of MSMEs in this sector shows favourable entrepreneurship opportunities; however, it also represents an increase in competition. In Kazakhstan, the forestry industry is relatively small in comparison to the neighbouring countries (the Russian Federation and China). Only a few companies are working in this field, and most of them are focused on furniture and creating industrial products from wood. This provides an advantage for the BM studied herein.

The BM of the company studied herein can be easily replicated. In the context of developing innovation and production processes, the company is working on wood production and heating supply, and there is no need for very specific "know-how" or technology development. The company represents itself as an environmentally cleaner provider of heating, relating its BM to the wider energy policy context. Carbon footprint and environmental issues with production remain. However, the company's machinery is certified by the European Union, and its waste is less harmful for the environment and ecology of the region in comparison with fossil-based resources. Rural areas in Kazakhstan are still very dependent on agriculture, while they are challenged by a lack of infrastructure, a poor market and poor access to financial support [85]. This kind of microenterprise can provide local alternatives and steps towards more environmentally friendly and localised energy production as well as a more diversified local economy. Based on this research, including an analysis of the firm, their resources, technology and co-operation ties, the BM has been adjusted well to the Kazakh context despite the existing challenges.

The prospects for wood pellets and the business models in the forestry sector of the Republic of Kazakhstan demand a more precise examination. One of the most significant challenges is the development of effective plans to decrease the use of fossil-based resources and to transition towards renewable and eco-efficient sources of bioenergy while also addressing economic and social development goals. Opening new markets and a phased implementation of the concept of transitioning to a more sustainable development strategy will guarantee the growth of new firms specialising in the production of biofuels.

6. Conclusions and Recommendations

The results from the case study show the challenges and opportunities relating to a BM of a microenterprise that is based on woody biomass in rural Kazakhstan. The demand for wood pellets and pellet production volumes are expected to grow in the coming decades with the shift towards bioenergy. The case study on the prospects for wood pellet production in Kazakhstan and the associated BM adjustment provides valuable insights into the potential of this sustainable energy sector in the country and into how a BM is implemented at the enterprise (micro-) level and can be adjusted to adapt to changing environmental conditions. Microenterprises are numerous but have often received limited attention in research on BMs as they commonly implement incremental innovations and small-scale changes in comparison with radical and high-tech transformations that attract more attention. As noted by several authors, the research on bioeconomy and sustainable BMs has been growing, but research gaps exist relating to the understanding of the implementation of BMs and the contexts of specific countries. This research delves into the challenges and opportunities faced by microenterprises in adopting and adapting their BMs to accommodate the production of wood pellets, which are a renewable and environmentally friendly energy source.

The BM studied herein represents a traditional, environmentally focused, sustainable BM that builds on the use of renewables for a substitute for fossil fuel-based energy in a local context, a conclusion similar to the conclusion reached in [12]. While it does not represent a radically new BM nor a novel operationalisation of sustainable energy production, this kind of microenterprise and its easily replicable BM can provide the first steps towards more a localised and environmentally friendly energy production strategy that is embedded in the local economy and community.

Despite the fact that the share of bioenergy in the total energy production of Kazakhstan remains low, the prospects for its future growth are positive. Kazakhstan has considerable bioresources, and the potential of local resources for the wider production of bioenergy has been underexplored. However, trends in forestry and wood processing show steady growth and favourable prospects for MSMEs that can explore the niches of the production of bioenergy rather than the large-scale fossil-based energy production that Kazakhstan is known for. The general policy of energy production in Kazakhstan must be reviewed by the government with respect to climate change and transitioning to alternative energy sources. One implication for policymakers is that the economic policy that provides support schemes for rural enterprises and investments has been an important facilitator of small-scale bioeconomy investments, and in combination with training it provides useful pathway to stimulate a further transition to a bioeconomy in rural areas.

This research on the prospects for wood pellet production in Kazakhstan and the associated BM adjustment has valuable insights that can be beneficial to a wider group of readers across various sectors and interests, including energy industry professionals, entrepreneurs, researchers, government and policymakers and community stakeholders. The methodological approach was based on qualitative data collection and a BM canvas, which are very common methodologies in the research on bioeconomy BMs. However, this approach worked well for the case study, and it also demonstrated that the research subjects themselves were well aware of it as a useful tool, thus justifying its further use despite the criticism of the subjective nature of this type of research. As a tool, the BM canvas offers practical value for enterprises as it allows them to understand how they implement their BM and how the elements of their BM are aligned. It also helps them to easily visualise and communicate their own BM and to understand the operating logic of the other enterprises in the sector.

The practical implications for local entrepreneurs include providing information about the challenges related to this kind of BM in the local context and the possibilities of adjusting a BM to make use of the entrepreneurial opportunities created by economic, environmental and institutional shifts. The high institutional dependency on local government presents both opportunity and risk as the policies and support schemes determine the success of the BM. The challenges relating to logistics, raw material and production costs and the prices faced by enterprises are also common to the wood processing industry and will impact the growth prospects for the BM, especially for microenterprises that usually have very limited financial and human resources for the optimisation of their supply chains, production systems and networks.

The present study faced several limitations.

The first limitation was that the BM is a simplification, and inevitably its analysis cannot account for all the specific details that make the model successful. Theoretical models developed by scientists and academics do not provide detailed instructions for business development. The study was based on a single company case, and the data are limited in terms of wide-scale conclusions or for painting a large picture of how MSMEs implement and perform their BMs. In future studies, a more detailed focus on the design of BMs, combined with information on company strategies, would create new insights into how to facilitate the transition to the bioeconomy.

Another limitation was that the company had no specific information about market actors, and the local and regional-level data on competitors, wood production volumes and energy consumption were insufficient for making a more detailed comparison and conducting an analysis of market trends. The review of bioeconomy trends and SME data in Kazakhstan also suggests that the information is fragmented; thus, the microenterprises themselves do not have a comprehensive overview of their competitors and market. This could also be used as an indicator that this niche is only partially filled in the context of Kazakhstan and the North Kazakhstan region in particular. It creates avenues for further research for academics, but it also demonstrates the sector's need for easily accessible market information that would provide local enterprises with data on bioeconomy trends and potential growth niches.

The results of this study cannot be extended to a larger sample due to the constraints indicated above, but the data were sufficient for an exploratory analysis and to illustrate a developing phenomenon like the one studied herein. To address the limitation of relying on a single case study, future research based on multiple cases across different regions or countries would provide opportunities to compare the challenges and successes of implementing a bioeconomy BM in different contexts, as well as a more nuanced understanding of the factors influencing BM innovation opportunities.

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References

1. Naddeo, V.; Taherzadeh, M.J. Biomass valorization and bioenergy in the blue circular economy. *Biomass Bioenergy* **2021**, *149*, 106069. [CrossRef]
2. Wang, F.; Harindintwali, J.D.; Yuan, Z.; Wang, M.; Wang, F.; Li, S.; Yin, Z.; Huang, L.; Fu, Y.; Li, L.; et al. Technologies and perspectives for achieving carbon neutrality. *Innovation* **2021**, *2*, 100180. [CrossRef]
3. Yu, S.; Dong, X.; Zhao, P.; Luo, Z.; Sun, Z.; Yang, X.; Li, Q.; Wang, L.; Zhang, Y.; Zhou, H. Decoupled temperature and pressure hydrothermal synthesis of carbon sub-micron spheres from cellulose. *Nat. Commun.* **2022**, *13*, 3616. [CrossRef]
4. Yu, S.; Yang, X.; Li, Q.; Zhang, Y.; Zhou, H. Breaking the temperature limit of hydrothermal carbonization of lignocellulosic biomass by decoupling temperature and pressure. *Green Energy Environ.* **2023**, *8*, 1216–1227. [CrossRef]
5. Yu, S.; Zhao, P.; Yang, X.; Li, Q.; Mohamed, B.A.; Saad, J.M.; Zhang, Y.; Zhou, H. Low-temperature hydrothermal carbonization of pectin enabled by high pressure. *J. Anal. Appl. Pyrolysis* **2022**, *166*, 105627. [CrossRef]

6. Bröring, S.; Vanacker, A. Designing Business Models for the Bioeconomy: What are the major challenges? *EFB Bioeconomy J.* **2022**, *2*, 100032. [CrossRef]
7. Nielsen, C.; Lund, M.; Montemari, M.; Paolone, F.; Massaro, M.; Dumay, J. *Business Models: A Research Overview*; Routledge: London, UK; New York, NY, USA, 2018. Available online: https://learning.oreilly.com/library/view/business-models/9781351232258/ (accessed on 18 March 2022).
8. Teece, D.J. Business Models, Business Strategy and Innovation. *Long Range Plan.* **2010**, *43*, 172–194. [CrossRef]
9. Bocken, N.M.P.; Short, S.W.; Rana, P.; Evans, S. A literature and practice review to develop sustainable business model archetypes. *J. Clean. Prod.* **2014**, *65*, 42–56. [CrossRef]
10. Lüdeke-Freund, F.; Carroux, S.; Joyce, A.; Massa, L.; Breuer, H. The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. *Sustain. Prod. Consum.* **2018**, *15*, 145–162. [CrossRef]
11. Reim, W.; Parida, V.; Sjödin, D.R. Circular Business Models for the Bio-Economy: A Review and New Directions for Future Research. *Sustainability* **2019**, *11*, 2558. [CrossRef]
12. D'Amato, D.; Veijonaho, S.; Toppinen, A. Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. *For. Policy Econ.* **2020**, *110*, 101848. [CrossRef]
13. Salvador, R.; Puglieri, F.N.; Halog, A.; de Andrade, F.G.; Piekarski, C.M.; De Francisco, A.C. Key aspects for designing business models for a circular bioeconomy. *J. Clean. Prod.* **2021**, *278*, 124341. [CrossRef]
14. Weiss, G.; Hansen, E.; Ludvig, A.; Nybakk, E.; Toppinen, A. Innovation governance in the forest sector: Reviewing concepts, trends and gaps. *For. Policy Econ.* **2021**, *130*, 102506. [CrossRef]
15. Atakhanova, Z.; Howie, P. Women in Kazakhstan's Energy Industries: Implications for Energy Transition. *Energies* **2022**, *15*, 4540. [CrossRef]
16. Askarova, A.; Zamorano, M.; Martín-Pascual, J.; Nugymanova, A.; Bolegenova, S. A Review of the Energy Potential of Residual Biomass for Coincineration in Kazakhstan. *Energies* **2022**, *15*, 6482. [CrossRef]
17. Karatayev, M.; Clarke, M.L. A review of current energy systems and green energy potential in Kazakhstan. *Renew. Sustain. Energy Rev.* **2016**, *55*, 491–504. [CrossRef]
18. Lüdeke-Freund, F.; Gold, S.; Bocken, N.M.P. A Review and Typology of Circular Economy Business Model Patterns. *J. Ind. Ecol.* **2019**, *23*, 36–61. [CrossRef]
19. De Giacomo, M.R.; Bleischwitz, R. Business models for environmental sustainability: Contemporary shortcomings and some perspectives. *Bus. Strat. Environ.* **2020**, *29*, 3352–3369. [CrossRef]
20. Engelken, M.; Römer, B.; Drescher, M.; Welpe, I.M.; Picot, A. Comparing drivers, barriers, and opportunities of business models for renewable energies: A review. *Renew. Sustain. Energy Rev.* **2016**, *60*, 795–809. [CrossRef]
21. Magretta, J. Why business models matter. *Harv. Bus. Rev.* **2002**, *80*, 86–92. [PubMed]
22. Osterwalder, A.; Pigneur, Y.; Tucci, C. Clarifying business models: Origins, present, and future of the concept. *Commun. Assoc. Inf. Syst.* **2005**, *15*, 1–43. [CrossRef]
23. Shafer, S.M.; Smith, H.J.; Linder, J.C. The power of business models. *Bus. Horiz.* **2005**, *48*, 199–207. [CrossRef]
24. Porter, M.E. Strategy and the Internet. *Harv. Bus. Rev.* **2001**, *79*, 62–164.
25. Linder, J.C.; Cantrell, S. Changing Business Models: Surveying the Landscape. *Accent. Inst. Strateg. Chang.* **2000**, *15*, 72–88.
26. Al-Debi, M.M.; El-Haddadeh, R.; Avison, D.E. Defining the business model in the new world of digital business. In Proceedings of the Fourteenth Americas Conference on Information Systems, Toronto, ON, Canada, 14–17 August 2008.
27. Hedman, J.; Kalling, T. The business model concept: Theoretical underpinnings and empirical illustrations. *Eur. J. Inf. Syst.* **2003**, *12*, 49–59. [CrossRef]
28. Stähler, P. *Geschäftsmodelle in der Digitalen Ökonomie. Merkmale, Strategien und Auswirkungen*; MCM. University of St. Gallen HSG: St. Gallen, Switzerland, 2001.
29. Morris, M.; Schindehutte, M.; Allen, J. The entrepreneur's business model: Toward a unified perspective. *J. Bus. Res.* **2005**, *58*, 726–735. [CrossRef]
30. Fielt, E. Conceptualising Business Models: Definitions, Frameworks and Classifications. *J. Bus. Model.* **2013**, *1*, 85–105. [CrossRef]
31. Gordijn, J.; Akkermans, H. Designing and evaluating e-business models. *IEEE Intell. Syst.* **2001**, *16*, 11–17. [CrossRef]
32. Osterwalder, A.; Pigneur, Y. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*; John Wiley & Sons: Hoboken, NJ, USA, 2010.
33. Voigt, M.; Plattfaut, R.; Ortbach, K.; Malsbender, A.; Niehaves, B.; Becker, J. Evaluating Business Modeling Tools from a Creativity Support System Perspective–Results from a Focus Group in the Software Development Industry. 2013. Available online: https://aisel.aisnet.org/pacis2013/155 (accessed on 18 March 2022).
34. Osterwalder, A. The Business Model Ontology—A Proposition in a Design Science Approach. Ph.D. Dissertation, University of Lausanne, Lausanne, Switzerland, 2004.
35. Belz, C.; Bieger, T.; Kundenvorteile für Unternehmenserfolge. *Kundenvorteile für Unternehmenserfolge. Customer Value: Kundenvorteile schaffen Unternehmensvorteile*; Verlag Thexis, Universität St. Gallen, 2004; pp. 37–142. Available online: https://www.zvab.com/servlet/BookDetailsPL?bi=909910525&searchurl=an%3Dchristian%2Bbelz%26sortby%3D20%26tn%3Dcustomer%2Bvalue%2Bkundenvorteile%2Bschaffen&cm_sp=snippet-_-srp1-_-title2 (accessed on 18 March 2022).
36. Chesbrough, H.; Rosenbloom, R.S. The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Ind. Corp. Chang.* **2002**, *11*, 529–555. [CrossRef]

37. Rentmeister, J.; Klein, S. Geschäftsmodelle—Ein Modebegriff auf der Waagschale. In *Die Zukunft des Electronic Business*; Gabler Verlag: Wiesbaden, Germany, 2003; pp. 17–30.
38. Kaplan, R.S.; Norton, D.P. The strategy map: Guide to aligning intangible assets. *Strat. Leadersh.* **2004**, *32*, 10–17. [CrossRef]
39. Payne, A.; Frow, P.; Eggert, A. The customer value proposition: Evolution, development, and application in marketing. *J. Acad. Mark. Sci.* **2017**, *45*, 467–489. [CrossRef]
40. Chesbrough, H.; Lettl, C.; Ritter, T. Value Creation and Value Capture in Open Innovation. *J. Prod. Innov. Manag.* **2018**, *35*, 930–938. [CrossRef]
41. Sorescu, A. Data-driven business model innovation. *J. Prod. Innov. Manag.* **2017**, *34*, 691–696. [CrossRef]
42. Massa, L.; Tucci, C.L. Business model innovation. *Oxf. Handb. Innov. Manag.* **2013**, *20*, 420–441.
43. Baden-Fuller, C.; Haefliger, S. Business Models and Technological Innovation. *Long Range Plan.* **2013**, *46*, 419–426. [CrossRef]
44. Schaltegger, S.; Freund, F.L.; Hansen, E.G. Business cases for sustainability: The role of business model innovation for corporate sustainability. *Int. J. Innov. Sustain. Dev.* **2012**, *6*, 95. [CrossRef]
45. Wirtz, B.W.; Pistoia, A.; Ullrich, S.; Göttel, V. Business Models: Origin, Development and Future Research Perspectives. *Long Range Plan.* **2016**, *49*, 36–54. [CrossRef]
46. Kumar, R.; Strezov, V.; Weldekidan, H.; He, J.; Singh, S.; Kan, T.; Dastjerdi, B. Lignocellulose biomass pyrolysis for bio-oil production: A review of biomass pre-treatment methods for production of drop-in fuels. *Renew. Sustain. Energy Rev.* **2020**, *123*, 109763. [CrossRef]
47. Tzelepi, V.; Zeneli, M.; Kourkoumpas, D.-S.; Karampinis, E.; Gypakis, A.; Nikolopoulos, N.; Grammelis, P. Biomass Availability in Europe as an Alternative Fuel for Full Conversion of Lignite Power Plants: A Critical Review. *Energies* **2020**, *13*, 3390. [CrossRef]
48. Nunes, L.; Causer, T.; Ciolkosz, D. Biomass for energy: A review on supply chain management models. *Renew. Sustain. Energy Rev.* **2020**, *120*, 109658. [CrossRef]
49. Gonzalez-Salazar, M.A.; Kirsten, T.; Prchlik, L. Review of the operational flexibility and emissions of gas- and coal-fired power plants in a future with growing renewables. *Renew. Sustain. Energy Rev.* **2018**, *82*, 1497–1513. [CrossRef]
50. Brack, D. *Woody Biomass for Power and Heat: Impacts on the Global Climate*; Chatham House: London, UK, 2017; pp. 3–4, 31–36.
51. Liu, S.; Lu, H.; Hu, R.; Shupe, A.; Lin, L.; Liang, B. A sustainable woody biomass biorefinery. *Biotechnol. Adv.* **2012**, *30*, 785–810. [CrossRef] [PubMed]
52. United Nations Environment Programme. Renewables 2021: Global Status Report. p. 107. Available online: https://www.ren21.net/wp-content/uploads/2019/05/GSR2022_Full_Report.pdf (accessed on 18 March 2022).
53. United Nations Framework Convention on Climate Change. *Long-Term Low Greenhouse Gas Emission Development Strategy of the European Union and Its Member States*; UNFCCC: Bonn, Germany, 2020; Volume 2019, pp. 1–7. Available online: http://www4.unfccc.int/submissions/INDC/PublishedDocuments/Latvia/1/LV-03-06-EUINDC.pdf (accessed on 25 May 2022).
54. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC. Official Journal of the European Union L 140/16. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0028&from=EN (accessed on 18 March 2022).
55. European Commission. Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL Amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as Regards the Promotion of Energy from Renewable Sources, and Repealing Council Directive (EU) 2015/652. Brussels, 14.7.2021 COM (2021) 557 Final. 2021. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0557&from=EN (accessed on 18 March 2022).
56. Gehrmann, H.J.; Mätzing, H.; Nowak, P.; Baris, D.; Seifert, H.; Dupont, C.; Defoort, F.; Peyrot, M.; Castagno, F. Waste wood characterization and combustion behaviour in pilot lab scale. *J. Energy Inst.* **2020**, *93*, 1634–1641. [CrossRef]
57. Lucadamo, L.; Gallo, L.; Corapi, A. Power plants: The need for effective bio-monitoring of the contribution of bio(wood) fuelled stations to atmospheric contamination. *Atmos. Pollut. Res.* **2019**, *10*, 2040–2052. [CrossRef]
58. Glittenberg, D. Starch-Based Biopolymers in Paper, Corrugating, and Other Industrial Applications. *Polym. Sci. A Compr. Ref.* **2012**, *10*, 165–193. [CrossRef]
59. Goh, C.S.; Junginger, M.; Cocchi, M.; Marchal, D.; Thrän, D.; Hennig, C.; Heinimö, J.; Nikolaisen, L.; Schouwenberg, P.-P.; Bradley, D.; et al. Wood pellet market and trade: A global perspective. *Biofuels Bioprod. Biorefining* **2013**, *7*, 24–42. [CrossRef]
60. Mabee, W.E.; Mirck, J. A Regional Evaluation of Potential Bioenergy Production Pathways in Eastern Ontario, Canada. *Ann. Assoc. Am. Geogr.* **2011**, *101*, 897–906. [CrossRef]
61. Mekala, N.K.; Potumarthi, R.; Baadhe, R.R.; Gupta, V.K. Current Bioenergy Researches: Strengths and future challenges. In *Bioenergy Research: Advances and Applications*; Elsevier: Amsterdam, The Netherlands, 2014; pp. 1–21.
62. Zimon, D.; Wozniak, J.; Domingues, P.; Kus, H. PROPOSITION OF IMPROVING SELECTED LOGISTICS PROCESSES OF PELLET PRODUCTION. *Int. J. Qual. Res.* **2021**, *15*, 387–402. [CrossRef]
63. Vitale, I.; Dondo, R.G.; González, M.; Cóccola, M.E. Modelling and optimization of material flows in the wood pellet supply chain. *Appl. Energy* **2022**, *313*, 118776. [CrossRef]
64. Carlsson, D.; Rönnqvist, M. Supply chain management in forestry—Case studies at Södra Cell AB. *Eur. J. Oper. Res.* **2005**, *163*, 589–616. [CrossRef]

65. Psathas, F.; Georgiou, P.N.; Rentizelas, A. Optimizing the Design of a Biomass-to-Biofuel Supply Chain Network Using a Decentralized Processing Approach. *Energies* **2022**, *15*, 5001. [CrossRef]
66. Baghizadeh, K.; Zimon, D.; Jum'a, L. Modeling and Optimization Sustainable Forest Supply Chain Considering Discount in Transportation System and Supplier Selection under Uncertainty. *Forests* **2021**, *12*, 964. [CrossRef]
67. State of Forest Genetic Resources in the Central Asian Region, Country Report of the Republic of Kazakhstan. Available online: https://www.fao.org/publications/card/en/c/e8176521-1cf0-464c-9a1c-6ddf4649f2d2 (accessed on 18 March 2022).
68. Wood Products in Kazakhstan. OEC. Available online: https://oec.world/en/profile/bilateral-product/shaped-wood/reporter/kaz (accessed on 16 December 2022).
69. Karatayev, M.; Hall, S.; Kalyuzhnova, Y.; Clarke, M.L. Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy. *Renew. Sustain. Energy Rev.* **2016**, *66*, 120–136. [CrossRef]
70. Our World in Data Based on BP Statistical Review of World Energy. 2022. Available online: https://ourworldindata.org/grapher/low-carbon-share-energy?tab=chart&country=~KAZ (accessed on 16 December 2022).
71. Message of the President of the Republic of Kazakhstan—The Leader of the Nation Nursultan Nazarbayev to the People of Kazakhstan "The Strategy "Kazakhstan-2050": A New Political Course of the Established State". Available online: https://www.akorda.kz/ru/events/astana_kazakhstan/participation_in_events/poslanie-prezidenta-respubliki-kazahstan-lidera-nacii-nursultana-nazarbaeva-narodu-kazahstana-strategiya-kazahstan-2050-novyi-politicheskii- (accessed on 18 March 2022).
72. UNDP. Forests of Kazakhstan: A Natural Treasure to Safeguard and Nurture for Future Generations. 2022. Available online: https://www.undp.org/kazakhstan/stories/forests-kazakhstan-natural-treasure-safeguard-and-nurture-future-generations#:~:text=Kazakhstan%20is%20a%20country%20with,half%20of%20them%20are%20saxaul (accessed on 16 December 2022).
73. The Largest Companies in Kazakhstan: Forestry and Logging. Available online: https://kazdata.kz/04/2017-otrasl-lesovodstvo-lesozagotovki-kompanii-311.html (accessed on 18 March 2022).
74. Gherghina. C.; Botezatu, M.A.; Hosszu, A.; Simionescu, L.N. Small and Medium-Sized Enterprises (SMEs): The Engine of Economic Growth through Investments and Innovation. *Sustainability* **2020**, *12*, 347. [CrossRef]
75. Obi, J.; Ibidunni, A.S.; Tolulope, A.; Olokundun, M.A.; Amaihian, A.B.; Borishade, T.T.; Fred, P. Contribution of small and medium enterprises to economic development: Evidence from a transiting economy. *Data Brief* **2018**, *18*, 835–839. [CrossRef] [PubMed]
76. Ndiaye, N.; Razak, L.A.; Nagayev, R.; Ng, A. Demystifying small and medium enterprises' (SMEs) performance in emerging and developing economies. *Borsa Istanb. Rev.* **2018**, *18*, 269–281. [CrossRef]
77. Eurostat. EU Small and Medium-Sized Enterprises: An Overview. 2022. Available online: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20220627-1 (accessed on 16 December 2022).
78. Financing SMEs and Entrepreneurs 2020: An OECD Scoreboard Kazakhstan. Available online: https://www.oecd-ilibrary.org/sites/20ee7990-en/index.html?itemId=/content/component/20ee7990-en (accessed on 18 March 2022).
79. Gummesson, E. *Qualitative Methods in Management Research*; Sage: Thousand Oaks, CA, USA, 2000.
80. Bradford, S.; Cullen, F. *Research and Research Methods for Youth Practitioners*; Routledge: London, UK, 2012.
81. Flick, U. *Designing Qualitative Research*; SAGE Publications: Thousand Oaks, CA, USA, 2018.
82. Choak, C. Asking questions: Interviews and evaluations. In *Research and Research Methods For Youth Practitioners*; Bradford, S., Cullen, F., Eds.; Routledge: London, UK, 2012; pp. 90–112.
83. Antikainen, R.; Dalhammar, C.; Hildén, M.; Judl, J.; Jääskeläinen, T.; Kautto, P.; Koskela, S.; Kuisma, M.; Lazarevic, D.; Mäenpää, I.; et al. *Renewal of Forest Based Manufacturing towards a Sustainable Circular Bioeconomy*; Finnish Environment Institute (SYKE): Helsinki, Finland, 2017; ISBN 9789521146831.
84. Law of the Republic of Kazakhstan on State Regulation of the Development of the Agro-Industrial Complex and Rural Areas. 2005. Available online: https://online.zakon.kz/Document/?doc_id=30015652&pos=1;-12#pos=1;-12 (accessed on 16 December 2022).
85. Strengthening Agricultural Co-Operatives in Kazakhstan. Available online: https://t4.oecd.org/eurasia/competitiveness-programme/central-asia/Strengthening-agri-cooperatives-in-KZ.pdf (accessed on 18 March 2022).