

Prospects for the Use of Wood Fuel in the Context of Low-carbon Energy Development

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Abstract — Wood fuel can play an important role as a CO₂-neutral alternative as part of the low-carbon energy transition. Furthermore, given the sanctions imposed recently, the development of the domestic market for wood fuel is extremely relevant for the timber industry of Russia as most of the pellets produced were previously exported. The article examines the current parameters of the development of the biofuel market and provides a comparative analysis of various types of fuel in terms of their economic and environmental performance. We also elucidate the key advantages of wood pellets as a fuel alternative to coal and fuel oil. Thus, the production of wood pellets seems to be very promising both in terms of the development of wood industries and in the context of low-carbon energy development. In the course of the study we identified the factors that act as constraints on the growth of the fuel pellet market, the prospects for overcoming them, and the necessary measures of government support for the industry (most notably, subsidy mechanisms and infrastructure development). The key takeaway from this study is that there are undeniable advantages that come with biofuels, in particular, wood pellets, the use of which in Russia is very promising provided that the economic incentives offered by the government to both manufacturers and residential consumers are in place.

Index Terms: Biofuels, timber industry, fuel pellets, low-carbon energy, pellets, wood fuel.

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I. INTRODUCTION

The development of the timber industry in Russia in recent years has focused on the reorientation of the industry from the export of raw timber to the production of high value-added products. The corresponding goal was outlined in the Strategy for the Development of the Forest Complex to 2030 [1]. One of the promising areas, in the context of the development of high-tech industries, is biofuels, including wood pellets. At the same time, it would be fair to note that the motivation behind building pellet production facilities is more often associated with the obligations of enterprises to dispose of sawmill and wood-processing residues.

Pellet production in Russia is growing steadily both in absolute terms and as a share of global production and export volumes (Fig. 1). According to the Food and Agriculture Organization of the United Nations, in 2012, Russian pellet production was slightly more than 4% of the world volume, and by 2020 it is already more than 6% of world production and almost 8% of world exports [2].

According to Roslesinforg, Russian manufacturers annually produce about 2.7 million tons of pellets. In 2021, 2.4 million tons of pellets were exported, and about 90% were delivered to European countries [3]. The largest producers in the country are the enterprises of Segezha Group (360 thousand tons per year), Ustyansk Timber Plant (300 thousand tons), “Sawmill 25” (160 thousand tons), “Yenisei DOK” (120 thousand tons). Apart from them, there are dozens of medium-sized enterprises, as well as many small enterprises, but the information on the latter is much more difficult to collect.

In April 2022, exports to Europe began to decline under the sanctions imposed, and on July 10 the period for permitting the imports of wood products to the EU countries under old contracts expired, which seriously affected Russian manufacturers. Many enterprises were forced to stop the production of wood fuel. Against the backdrop of the sharp decline in exports, there is a

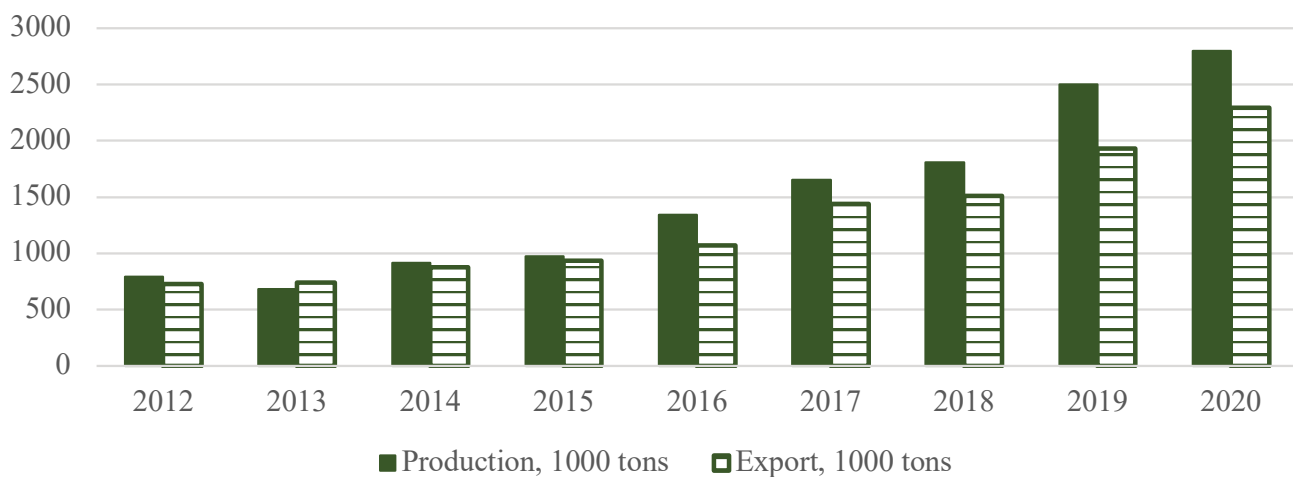


Fig. 1. Volumes of production and export of pellets in Russia in 2012–2020. Source: FAO, 2022.

TABLE 1. Comparison of parameters of Different Types of Fuel

| Type of fuel | Heating capacity, kcal/kg | Cost, RUB/t | Ash content, % | Shelf life | Sulfur emissions, % | CO ₂ emissions, kg/GJ |
|--------------|---------------------------|-------------|----------------|------------|---------------------|----------------------------------|
| Coal | 5 100 | 2 800 | 4–8 | 6–8 months | 1–3 | 60 |
| Mazut | 9 800 | 17 000 | 1,5 | 5 years | 1–2 | 78 |
| Wood Pellets | 4 500 | 6 400 | 1 | —* | 0,1 | 0* |
| Firewood | 2 500 | 3 000 | 0,5 | 2 years | 0 | 0* |

Note: zero carbon dioxide emissions mean that when the product is burned, the amount of CO₂ released does not exceed the amount that is formed during natural decomposition, and the amount of other harmful emissions is negligible. If stored properly (in a dry place), the shelf life of wood pellets is unlimited.

reason to believe that the domestic market of Russia has significant growth potential. As part of the measures to implement the Strategy for the Development of the Forest Complex to 2030, it was decided to convert about 30% of environmentally inefficient boiler plants from coal and fuel oil to fuel pellets [4]. The above conditions attest to the relevance of studying the prospects for the development of the pellet market in Russia in the context of the low-carbon agenda. This article investigates the possibilities of using wood pellets in the development of low-carbon energy, provides an overview of published research on the challenges and prospects of biofuel use, analyzes the current state of the domestic pellet market in Russia, and outlines the areas to be addressed by government support for the industry that are a prerequisite for the efficient operation of Russian pellet manufactures.

II. LITERATURE REVIEW

There are numerous studies on the advantages of biofuels over other energy sources. In addition, comparisons were made between the efficiency of using different types of biofuels [5]. There is also another alternative: co-firing of coal with wood pellets [6–8].

Pellet production is beneficial for the timber industry as an additional product category that at the same time allows it to fulfill the obligations to both dispose waste and mitigate climate change. Through a case study of the Finnish forest

industry, it has been shown that the sawmill industry should consider introducing new business models for co-production of wood products and biofuels [9].

Speaking of the ways to overcome the restrictions that are currently imposed on Russian pellet producers, one should note the study of region-specific features of the development of low-carbon initiatives. The biofuel market has a fairly high concentration, and the spatial distribution of production is very uneven [10]. Therefore it is advisable to start converting boiler plants to biofuels in those regions where such experience already exists. First of all, these are the regions of the Northwestern and Siberian federal districts.

Furthermore, the transition to biofuels is relevant from the point of view of the climate agenda: in particular, it corresponds to the goals of the Strategy for the Social and Economic Development of Russia with Low Greenhouse Gas Emissions to 2050 [11]. In Russia, the strategies for modernizing the economy in order to move away from the raw material-oriented model and transition to a “green” economy largely coincide [12]. The production of pellets, combining the advantages of using renewable raw materials and a relatively advanced processing, is very promising in this context.

III. RESULTS AND DISCUSSION

The main objective of this study is to evaluate the advantages of pellets in comparison with coal and other

types of fuel, taking into account the focus on low-carbon development of thermal power engineering. Key comparison parameters and specific scores are presented in Table 1.

Since the specifications of these types of fuel differ significantly depending on the grade, it should be pointed out that the average values are given for lignites of the ZBPK grade (large lumps) as the most commonly used for heating private houses, M-100 fuel oil (GOST 10585-2013), wood pellets, and birch firewood with an average moisture content of 50%. Admittedly, even within the same standard grade, characteristics may vary. Obviously, the cheapest way to generate thermal energy is coal, which is the reason for the predominance of this type of heating. At the same time, coal is inferior to wood fuel both in terms of ash content and emissions of pollutants, as well as in terms of its shelf life. Wood fuel is also carbon-neutral, which is a major advantage in terms of low-carbon energy development. In addition, pellets are very convenient for domestic use when heating private houses: the process of feeding and burning in pellet boilers is automated.

The current state of the domestic pellet market in Russia is characterized, first of all, by the issues related to product sales. In the regions most affected by the EU ban on Russian exports, various support programs are already being implemented related to the reorientation to the domestic market. For example, in the Republic of Karelia, large producers of fuel pellets, including Segezha Group enterprises, previously supplied their products mainly to European countries. In June 2022, the Plan was approved to provide support measures to enterprises of the timber industry complex, within the framework of which it was proposed to use wood pellets in the energy sector of the republic – in particular, to convert to biofuels about 15 boiler plants, which today provide heating to social sector facilities. Representatives of the timber industry enterprises also express their readiness to facilitate such a transition as part of the so-called «Northern delivery». Segezha Group Vice President Nikolay Ivanov estimated the possible supply of wood pellets to the Far North at 250 thousand tons annually, which could ensure full manufacturing capacity utilization of not only the group's enterprises («Tairiku-Igirma Group» LLC of Segezha Group produces up to 100 thousand tons per year), but also those of other manufacturers of pellets in the regions of Siberia.

There are also known successful cases of conversion of boiler plants to biofuels in the Krasnoyarsk region. For example, in the town of Kodinsk, Kras-Eko JSC is implementing a pilot project to modernize an electric boiler plant with a partial conversion of thermal power production to the use of biofuels. In the Boguchansky district of the region, 10 heat sources were put into operation by Les-service LLC, where boiler equipment was modernized to accommodate the use of wood pellets. Thanks to this, the volume of biofuels used in the region increased by 8 thousand tons of fuel pellets per year. Experts note that the use of wood pellets is 20–30% more economical than conventional coal and fuel oil [13].

The Russian Pellet Union, which unites manufacturers that together account for more than 60% of the production and exports of wood pellets in Russia, notes that the low consumption of fuel pellets in this country is due to the initial orientation of the Russian energy sector towards district heating. Moreover, there is a lack of effective energy-efficiency and resource-saving programs at industrial heating facilities. In addition to the transition of large boiler plants to biofuels, it is necessary to consider the possibility of promoting the use of wood pellets for heating private houses, the members of the Union believe [14]. A promising incentivizing tool could be providing subsidies to households for the purchase of pellet boilers and wood fuel.

A key limitation for the development of the industry is the lack of a national certification system for fuel pellets. In 2022, almost all certificates for pellets previously issued to Russian manufacturers expired, including the FSC (Forest Stewardship Council) and SBP (Sustainable Biomass Program) certificates. Taking into account the indicated growth potential, the domestic market will need the established quality standards for wood pellets, and subsequently the demand for certified products will also build up within the country.

The prospect of a partial reorientation of exports to the markets of Southeast Asia may also be attractive, provided that certain conditions are in place. Japan and the Republic of Korea have previously been major importers of wood pellets from Russian manufacturers. The implementation of plans to increase the share of renewable energy sources in the global energy balance could lead to an increase in their industrial consumption of biofuels. Wood pellets are not exported to China due to the ban on the imports of several types of solid waste into the country, including sawdust and sawdust products. Unfortunately, the Japanese market was closed to Russian pellet exporters due to another package of sanctions adopted, so South Korea remained the only available destination. At the same time, we can expect re-exports of Russian products, since foreign countries facing severe shortages may look for any available ways to procure wood fuel. Russian enterprises are able to meet the demand in this segment, but the lack of infrastructure and the high cost of transport are the key concerns. Thus, a successful reorientation of sales to the countries of the Asian region is possible only with the government support in the form, for example, of subsidizing the transport of pellets and the creation of the necessary infrastructure in the seaports of the Russian Far East.

IV. CONCLUSION

Wood pellets certainly have a number of advantages over other fuels in the context of low-carbon energy development. CO₂ neutrality, low ash content, and low pollutant emissions speak in favor of the environmental friendliness of this type of biofuels and its ease of use. All these advantages can form the core message to be communicated as part of the promotional campaign for the

use wood fuel use by households, and economic support measures will serve as a significant incentive to switch from coal and fuel oil to wood pellets. In the current conditions that prove challenging for the timber industry, government support is urgently needed. Furthermore, simultaneously achieving the goals of the low-carbon development strategy and the strategy for the development of the forest complex by heating up the domestic market for wood pellets is a very attractive prospect.

Despite these benefits, converting boilers to biofuels can take a long time, whereas the industry needs support right now. In addition, the cost it takes to convert a coal-fired boiler to wood fuel is comparable to the cost of building a new boiler. Thus, the relevance of government support for both producers and consumers of wood fuel in the domestic market is extremely high. Among the possible support measures, the most attractive initiatives are state subsidy programs, regulation of tariffs for producers and exporters of wood pellets, as well as the creation and development of the infrastructure necessary for the industry to operate.

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