ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ЗАМКНУТЫХ СИСТЕМ В РОССИЙСКОЙ ЛЕСНОЙ ПРОМЫШЛЕННОСТИ: БАРЬЕРЫ И СТИМУЛЫ

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В условиях санкций, потери традиционных экспортных рынков и необходимости технологического суверенитета российская лесная промышленность сталкивается с острой проблемой низкой глубины переработки древесины. На основе данных за 2020–2025 годы в данной статье количественно оцениваются экономические потери от неполного использования отходов лесозаготовки и деревообработки, достигающих в некоторых регионах 60% биомассы. В отличие от исследований, сосредоточенных исключительно на технологическом потенциале циркулярной экономики, в данной работе анализируются провалы рынка, региональные диспропорции и эффективность существующих мер государственной поддержки. Предлагается набор приоритетных инструментов политики, включающий дифференцированные экспортные пошлины, субсидируемое кредитование кластерных проектов и углеродное регулирование сжигания отходов. Показано, что переход к замкнутым системам в лесной промышленности приносит не только экологические, но и прямые фискальные и экономические выгоды.

Ключевые слова: замкнутые системы, лесная промышленность, экономическая эффективность, провалы рынка, глубокая переработка древесины, региональные диспропорции.

ECONOMIC EFFICIENCY OF CLOSED-LOOP SYSTEMS IN THE RUSSIAN TIMBER INDUSTRY: BARRIERS AND INCENTIVES

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Under sanctions, loss of traditional export markets, and the need for technological sovereignty, the Russian timber industry faces the acute problem of low wood processing depth. Based on 2020–2025 data, this article quantifies economic losses from incomplete use of logging and woodworking waste, reaching up to 60% of biomass in some regions. Unlike studies focusing solely on the technological potential of circular economy, this paper analyzes market failures, regional disparities, and the effectiveness of existing government support measures. A set of priority policy instruments is proposed, including differentiated export duties, subsidized lending for cluster projects, and carbon regulation of waste burning. It is shown that the transition to closed-loop systems in the timber industry yields not only environmental but also direct fiscal and economic benefits.

Keywords: closed-loop systems, timber industry, economic efficiency, market failures, deep wood processing, regional disparities.

The period 2020–2025 has become a time of profound transformation for the Russian timber industry, driven by both external shocks and structural internal constraints. Key production indicators for the

timber industry during this period are presented in Table 1, which clearly demonstrates the scale of negative trends.

Table 1 – Key production indicators of the timber industry in 2021–2025

Product	2021	2024	2025
Lumber	44.2 million m³	39.6 million m³	24.4 million m³
Plywood	4.6 million m³	3.5 million m³	2.7 million m³
Pellets	3.2 million t	1.5 million t	1.1 million t
Particleboard	—	9.6 million m³ (9 months)	9.5 million m³ (9 months)
Pulp	—	7 million t (9 months)	6.9 million t (9 months)

Source: author's calculations based on data from the Federal Forestry Agency and industry reviews.

As follows from the data presented, total timber harvested decreased from 217 to 182 million m³, lumber production fell by 38%, and pellet output declined by 27%. The main reasons for the decline are the EU ban on imports of Russian timber since spring 2022, logistical constraints, falling demand in China (a reduction in lumber consumption by 30 million m³ in 2020–2024), as well as high borrowing costs, which have radically reduced the number of new investment projects. Relative stability has been maintained only by producers of wood-based panels and enterprises in the pulp and paper industry.

However, behind these macroeconomic indicators lies a systemic problem, namely the extremely low economic efficiency of using already harvested wood. According to expert estimates, in Siberia and the Far East up to 60% of harvested biomass remains at logging sites or is burned without energy recovery. In the global practice of leading timber-producing countries, the introduction of circular models has long become a standard of economic efficiency. The purpose of this article is to identify the economic and institutional barriers that hinder the realization of circular potential, to quantify the associated losses, and to develop targeted government policy instruments.

In global practice, several key models of the circular economy applicable to the timber industry are distinguished: regeneration (Regenerate), optimization (Optimize), looping (Loop), virtualization (Virtualize), and exchange (Exchange). In practice, circular practices are most actively implemented in the pulp and paper industry (PPI) and at large integrated enterprises. A comparative efficiency of the pulp and paper industry in different countries is presented in Table 2.

Table 2 – Comparative efficiency of the pulp and paper industry in different countries

Indicator	CMPC (Chile)	Suzano (Brazil)	Russian PPI
Forest certification	100% FSC/PEFC	1.7 million ha plantations + 1.1 million ha conservation	Developing
Chemical recovery	96–98%	n/a	Partial
Share of energy from biomass	73% (61% black liquor + 12% biomass)	Low carbon footprint (<1/3 of sector average)	Below global leaders
Waste processing	Reduction by 88.7% (2018→2024)	99.8% waste utilization at VIDA hub	Significant potential

Source: author's calculations based on data from the Federal Forestry Agency and industry reviews.

As follows from Table 2, the Russian pulp and paper industry lags significantly behind global leaders in key indicators of circular efficiency. If the economic potential of waste processing is so significant, the question arises: why does private business not invest in it sufficiently? The analysis allows us to identify three types of market failures.

The first is a price failure. Transport tariffs for roundwood are often artificially low, making it economically more advantageous to leave or burn waste than to collect and process it. The market price of waste does not reflect its potential value as secondary raw material.

The second is a financial failure. With lending rates of 16–20% per annum, the internal rate of return of a typical waste processing project (6–10%) is below the alternative cost of capital. Illustrative is the case of Krasnoyarsk Krai, where a plant for processing sawmill waste into thermowood coal became possible only with 70% subsidization of capital costs from the regional budget.

The third is an institutional failure. The Russian Federation lacks a ban on open burning of waste without energy utilization, mandatory certification of chemical recovery systems for new enterprises, as well as tax incentives for circular equipment. Furthermore, there are deep regional disparities: in Siberia, more waste is generated than the local market can process, while in the European part there is a deficit.

Based on the analysis, the following priority government policy instruments can be proposed. First, a differentiated export duty: the duty on roundwood exports remains high, while duties on waste processing products (wood chips, pellets, charcoal) are set at zero, creating a direct economic incentive for exporters. Second, regional carbon regulation: introducing a fine for open burning of waste, with the proceeds directed to funds subsidizing processing capacities. Third, subsidized lending for timber industry clusters with closed technological chains (interest rate of 3–5% per

annum) with investment insurance through VEB.RF. Fourth, mandatory certification of chemical recovery systems for all newly constructed pulp and paper mills.

Scenario modeling shows that under an inertial scenario, annual losses from underutilization of waste will remain at the level of 30–35 billion rubles, and employment in the timber industry will further decrease by 12–15 thousand people. Under a circular scenario (implementation of the proposed package of measures), additional tax revenues will amount to 8–10 billion rubles per year, 4–6 thousand new jobs will be created in regions with deep processing, and total losses will be reduced to 10–12 billion rubles by 2030. The payback period for investments in waste processing under adequate policy is 3–5 years.

The Russian timber industry has significant potential for implementing circular economy models; however, the current level of integrated use of wood raw materials remains low, with losses at the harvesting and processing stages reaching 60% in some regions. Economic losses amount to at least 30 billion rubles per year in direct revenue losses. The main barriers are institutional and financial market failures, as well as regional disparities. The transition to a circular model requires scaling up cascading processing technologies, developing timber industry clusters with closed loops, and stimulating domestic demand for deep-processed products. Key government policy instruments should include differentiated export duties, regional carbon fines, and subsidized cluster lending. If these conditions are met, the Russian timber industry will not only overcome the current crisis but also generate a direct fiscal and economic effect with a payback period for investments in waste processing of 3–5 years.

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