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Finance, Economics, and Industry for Sustainable Development

Proceedings of the 4th International Scientific Conference on Sustainable Development (ESG 2023), St. Petersburg 2023

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Contents

Technological Integration of Environmentally Friendly Industries as a Factor of ESG Transformation

Lyudmila M. Davidenko, Alexander E. Miller, and Ansagan N. Beisembina

Abstract The active phase of scientific research in the field of technological transformations and their impact on the socioeconomic development of complex systems occur due to the factor assessment of the place and role of large companies in the regions where they are located. Effective policy of companies forms the institution of stakeholders, due to the implementation of joint programs in the education system and health care, as well as increases the motivation of the population to environmental literacy. At the same time, ESG transformation determines the specificity of technological integration of integrated economic structures through the interconnection of processes at the level of industrial companies implementing environmentally friendly technologies and striving for a gradual energy transition. The aim of the study is to demonstrate the relationship between the fundamental approaches of ESG transformation of industrial companies and mechanisms of technological integration of cleaner production. For this purpose, synthesis and analysis methods are used, which help to assess the socioeconomic factors that influence the emergence of the main trends of industrial economic transformation due to effective ESG policies. The stated objective implies a comprehensive analysis of the factors of production and sales of products to establish technological linkages in the promotion of environmental branding, as well as the development of recommendations to the participants of green technological integration. The proposed approaches to the technological integration of environmentally friendly industries help to achieve sustainable development rates of economic entities that are in a single value chain, as well as business environment stakeholders from cross-border regions of partner countries.

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Introduction

The global trend toward energy transition and global ESG transformation has signaled to industrial companies the need to strengthen the links of the chain "green" technology—"green" product. This has increased the relevance of research, which has been directed toward the development of mechanisms for the integration of industrial companies that apply clean technologies. The trend toward cluster formations with elements of green economy should gradually contribute to the sustainable development of regions in the context of ESG principles. However, in the current period, ESG transformation of cross-border regions may meet certain barriers. These include shortcomings in the systemic approach of technological integration of environmentally friendly industries and subsequent certification in accordance with global standards. At the same time, there are still weak mechanisms for promoting knowledge about domestic ecological products, low interest of network trade in sales, and setting an adequate price for manufactured products. There is still no unified technology of ecological branding of domestic products and the practice of decision-making.

In this context, the role of scientific approaches in the design and implementation of ESG mechanisms that take into account the level of sustainability of enterprises in shaping their own growth strategy based on environmental, social, and governance indicators is increasing (Saxena et al., 2022). In particular, this is relevant for cases of technological integration in the areas of real-time data transfer and authentication and structuring of management processes and sub-processes. Researchers believe that enterprises shaping business processes for a green economy should be guided by the goal of carbon neutrality. This emphasizes environment, social responsibility, and governance (ESG) and green technology innovation (Zhang & Jin, 2022). The transformation of national green development as well as financial support from government agencies and private foundations can be considered an important element in the energy transition (Li & Pang, 2023). Green credit policies can significantly improve the ESG performance of enterprises that represent the core of industrial regions (Gao & Liu, 2023).

One can agree with the fact that ESG governance awareness needs to be strengthened through investor relations and active cooperation with governmental and non-governmental organizations (Park & Oh, 2022). In parallel, the role of the information and communication technology sector is increasing. IT companies are now contributing to the integration of cleaner industries, thereby potentially improving their ESG rating compared to the level already achieved (Egorova et al., 2022).

Thus, we have formed a hypothesis that technological integration of environmentally friendly industries is capable of being a factor of ESG transformation at the level of industrial enterprises that determine the sustainable development of the regions where their complexes are located.

Materials and Methods

This study uses general scientific methods, including analysis, synthesis, induction, and deduction, analysis of industry statistical information, and comparative and system analysis of the study of domestic and foreign processes of technological integration of industrial complexes that introduce clean technologies and experience ESG transformation.

When analyzing for compliance with ESG principles among large companies that play a global role in the development of the economy of certain states, in particular Kazakhstan, it is advisable to use open information data on Sustainable Development Goals (SDGs). These reports show a number of problems: if the current growth rates are maintained in 2030, renewable energy sources will provide only a small part of the energy supply: about 660 million people will remain without electricity, and about two billion people will continue to use non-ecological fuels and cooking technologies (United Nations, 2023).

Making a connection from the general to the particular, we can state the fact that the awareness of global problems leads to the strengthening of environmental activities. As a proof of this, we can cite the fact that in Kazakhstan in 2021, the Ecological Code was adopted. This document contains a plan to regulate public relations in the field of environmental monitoring. By joint efforts of industrial companies and population, the level of hazardous waste generation is gradually falling (Fig. 1).

As a result of analysis and generalization of publicly available statistical information, it is possible to identify the signs of scientific and technological readiness of domestic industrial enterprises for "green" technological integration. The graphical method is used to visualize the obtained results; the quantification method and the parametric method are evaluation tools that help formalize the procedure for assessing the performance of technological integration of clean industries, combining approaches and participants acting as subjects and objects of integration processes.

Results

Historically, the basis of Kazakhstan's industrial economy is made up of coal, oil, gas, ferrous and nonferrous metal processing, petrochemicals, and power generation. They are organized by the type of cluster formations. As a rule, small- and

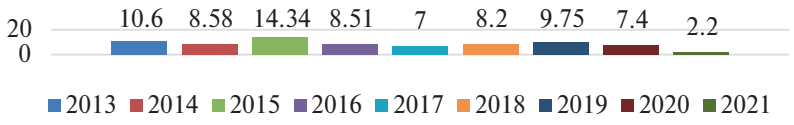

Fig. 1 Dynamics of hazardous waste generation in Kazakhstan per capita, tons (Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2023a)

medium-sized businesses, as well as research and educational institutions of the country and cross-border regions, are territorially connected with large companies. When producing products, industrial enterprises must take into account environmental norms and standards, compliance with which is controlled by the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan.

Analysis of changes in the carbon productivity of the gross domestic product (GDP), which characterizes the amount of GDP per unit of CO_2 emissions, has revealed a decrease in emissions from burning coal, oil, natural gas, and other fuels (Fig. 2).

Based on the analysis of statistical information, it can be concluded that technological integration of environmentally friendly industries is in demand and promising for Kazakhstan and its partners. One of the centers of Kazakhstan industry is Pavlodar region. It belongs to the type of developed cross-border industrial regions with a complex transportation and logistics interchange. Large industrial companies operate in the region. They represent integrated economic complexes with which other entities interact. Large companies include the Eurasian Resources Group (ERG), which produces high-carbon ferrochrome and supplies iron ore and aluminum products to the Eurasian region (Fig. 3).

ERG contribution to Pavlodar region is 11% of the gross regional product. Analysis of the organization of production and technological processes of ERG industrial companies indicates that technological integration of environmentally friendly industries is possible only in conditions of coordination at the level of technological management with compliance with ESG principles (Figs. 4 and 5).

World practice shows that the following measures will contribute to the restoration and reproduction of natural resources: development of linked business models for production and sales of products; joint research and development of technological standards; stimulation of the inflow of "green" investments; replenishment of

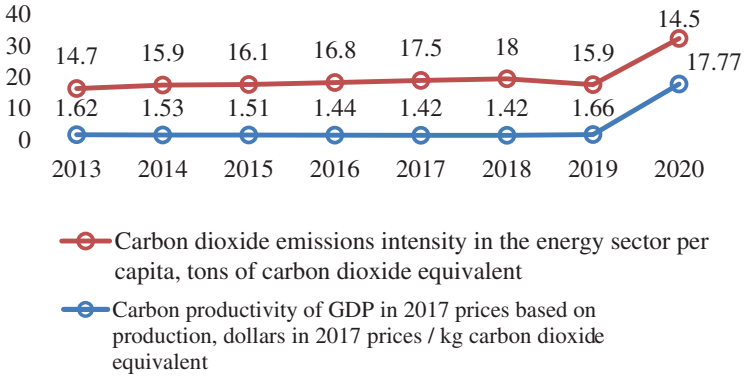

Fig. 2 Carbon productivity and dynamics of CO_2 emission intensity from energy use per capita in Kazakhstan (Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2023b)

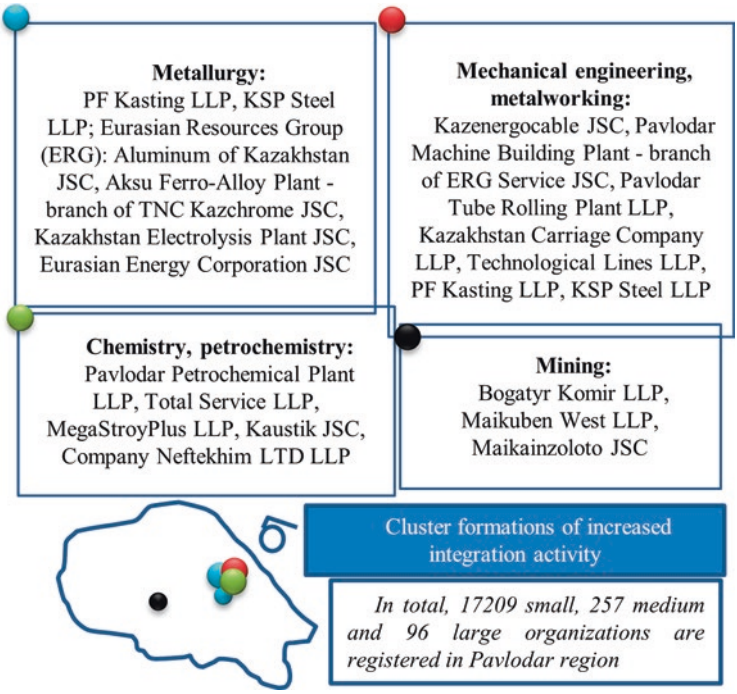

Fig. 3 Sectoral diversification of economic entities of Pavlodar region, Kazakhstan

Fig. 4 Model of ESG transformation of the technology management system in Eurasian Resources Group companies. Regulatory and legal block (Eurasian Resources Group, 2021)

the joint bank of the best available techniques, resource-saving technologies, and practices; and reduction of the volume and hazard level of waste generated.

Scientists are continuously conducting research, searching for mutually beneficial solutions in the field of systematization of approaches to the technological

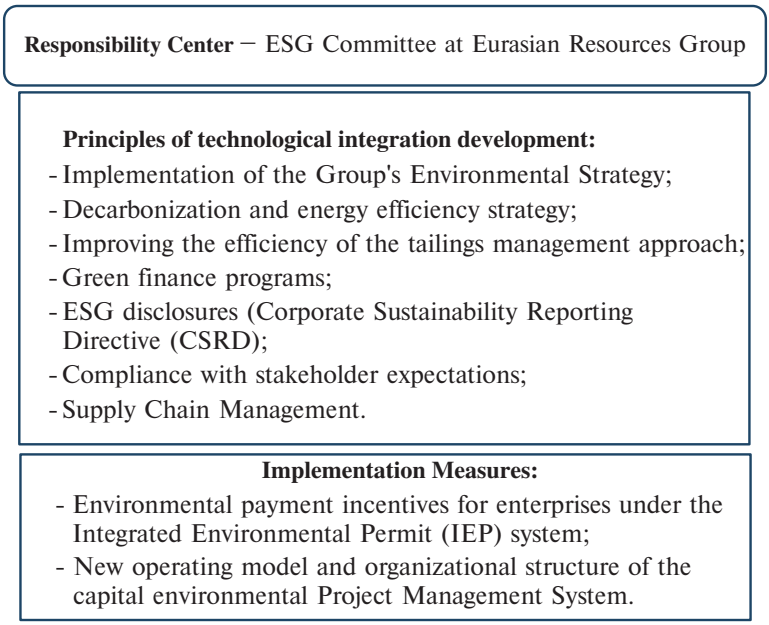

Fig. 5 Model of ESG transformation of the technology management system in Eurasian Resources Group companies. Block of technology integration (Eurasian Resources Group, 2021)

integration of environmentally friendly production in order to successfully pass certification in accordance with international standards in the future.

We have conducted a systematization of scientific works, which helped to summarize the approaches to technological integration on the "green" type. Enterprises can use this information to choose effective tools for integrated production management based on compliance with ESG principles (Table 1).

Discussion

Practice shows that approaches to the technological integration of environmentally friendly production facilities may be unique, as well as opportunities to promote environmental branding of manufactured products. This is influenced by differences in the models of corporate governance and technological management, the degree of diversification at the industry and regional levels, and the possibility of attracting cheap sources for the transition to "green" technologies. Nevertheless, it is possible to come to common logical solutions to manage the processes of green economy. It should start with the use of saving technologies in the process of extraction and processing of raw materials and organization of the production process and end with eco-branding of industrial products. The desire of Kazakhstan companies to

Table 1 Classification of approaches to green technology integration in the context of ESG transformation

Approaches to enhance technology integration	Subjects and objects of "green" integration	Commitment to ESG principles
Stimulating corporate environmental innovation	Companies—Initiators of "green" innovations and patents for "green" inventions	"Green" transformation of emerging markets and improving ESG rating systems (Khan & Liu, 2023; Wang et al., 2023)
Integration of industrial and investment capital	Companies—Participants of the stock market of "green" shares, ESG investors, financial analysts	Developing theories of ESG pricing and ESG investment promotion (Chen et al., 2023) A multi-criteria portfolio optimization model (Cesarone et al., 2022) Linking corporate responsibility and market signals in investment portfolio construction (Leins, 2020)
Sustainable development of enterprises based on digitalization	Digital business platforms to promote innovation through "green" processes and "green" products	Enterprise performance transformation using strategic alignment model (SAM) and ESG indicators (Zhao et al., 2023)
"Green" economy of the closed cycle	Related parties of the "green" blockchain, placing economic demands on individual transactions and supply distribution	Supply chains based on industrial Internet of Things and blockchain technology under the ESG concept (Qian et al., 2023; Subramoniam et al., 2022)
Establishing a correlation between ESG objectives and financial performance of companies	Industrial and technological sector companies, research and development centers	Stimulate research interest in economic sustainability and ESG (Cheng et al., 2023; Xia, 2022) Flexibility, transparency, and automation of data collection processes for ESG reporting (Cerchiaro et al., 2021)
Optimization of ESG benchmarking methods in real estate investments	Institutional investors, real estate fund managers, consultants, real estate investment trust (REIT) participants	ESG benchmarking (asset/fund levels, listed real estate, supply, reporting, and internal benchmarking) (Newell et al., 2023)
Tax incentives	Industrial companies, government agencies	Regulatory function of taxes and levies on emissions and pollution, raising environmental awareness, promoting green technological innovation to achieve sustainable development (Li & Li, 2022)

produce products in demand in the global economy is accompanied by the development and implementation of innovative management approaches, including compliance with ESG principles (Kaiyrgaliyeva et al., 2023; Sherimova et al., 2022). Russian scientists share our opinion that technological integration is inextricably linked to a set of social and environmental parameters that are important to rank by risk level, which helps to manage them effectively (Keresten et al., 2023). An

important component of a cleaner production organization is transportation corridors that ensure just-in-time supply chain continuity (Miller & Davidenko, 2022). Over the past 30 years, the Chinese industry has undergone an accelerated rise, which can be sustained through intellectual property protection and an increase in the number of patents for "green" inventions (Xu et al., 2021).

An important addition to the study of the problems of organizing environmentally friendly production is the activities of "smart" infrastructure construction. "Smart" cities are a factor of social transformation for centers of industrial concentration (Barykin et al., 2023). A unifying strategy is to link all sectors of the economy to the energy sector. In turn, companies in the energy sector are becoming leaders in the transition to new clean technologies to achieve the goals of sustainable development of connected systems (Nitlarp & Kiattisin, 2022).

Conclusion

In the course of the conducted research, it is possible to confirm the hypothesis that technological integration of environmentally friendly industries can be a factor of ESG transformation at the level of industrial enterprises. First of all, this conclusion applies to city-forming enterprises and high expectations of the residents, and the states are placed on them. The integration system includes banks, institutional investors, and fund managers. Together, they participate in the realization of the growth strategy under different external circumstances, for example, volatility or economic activity of the sectoral market through portfolio diversification and environmental/climatic conditions. In the near future, a trend toward the formation of a new asset class—"climate" infrastructure—should become apparent. According to scientists, such projects can form a system of ecological pricing taking into account carbon emissions into the atmosphere. The new trend toward a "green" economy has manifested itself in the development of a system of financial instruments to address the problems of "climate" sustainable economic growth. This contributes to the conservation of natural landscapes and capacity building of "ecosystem" services, including eco-branding of industrial products that meet high environmental standards. In the future, experts and scientists will have to solve the problems of insufficient subsidies for green technologies, as well as to nurture a common environmental culture among the stakeholders of industrial companies.

As an effective measure, it can be suggested that experts work together to create an innovative ecosystem of "green" technologies. For this purpose, it is important to use state support, increasing environmental culture and awareness of people, which is the main resource for the development and implementation of all progressive technologies.

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"Development of technology and promotion of ecological branding of the industrial complex of the region").

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