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Macroeconomic Analysis and Development Trends of Efficient use of Economic Resources in Chemical Industry Enterprises

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Abstract: The article analyzes how economic resources are used in chemical industry enterprises from a macroeconomic perspective and reveals key global development trends in the sector. It examines the recent evolution of the world chemical market, its structural features and the experience of leading industrial countries. The results show that the chemical industry is a strategic branch of the economy that generates high value added and forms strong multiplier linkages with other sectors. Resource efficiency is closely interconnected with competitiveness, energy performance and the ability to ensure innovation-driven growth. The study also demonstrates that digital transformation, the transition to a green economy and technological modernization act as the main drivers of efficiency improvement. On this basis, the paper proposes an integrated approach to managing economic resources in chemical enterprises, focused on the introduction of resource-saving technologies and modern management tools.

Keywords: Chemical Industry, Economic Resources, Resource Efficiency, Macroeconomic Analysis, Profitability, Energy Intensity, Innovation, Digitalization, Green Economy, Multiplier Effect, Competitiveness

Citation: Salim ugli S. S. Macroeconomic Analysis and Development Trends of Efficient use of Economic Resources in Chemical Industry Enterprises. American Journal of Economics and Business Management 2026, 9(5), 438-442.

Received: 14th Feb 2026

Revised: 20th Mar 2026

Accepted: 23th Apr 2026

Published: 18th May 2026



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1. Introduction

In the contemporary global economy, the chemical industry has become one of the core sectors that form the backbone of industrial production. It simultaneously remains capital-intensive and highly dependent on raw materials and energy, while providing substantial value added [1]. The sector is deeply integrated with agriculture, power generation, metallurgy, pharmaceuticals and a wide range of high-tech industries, which gives rise to strong inter-sectoral multiplier effects. For this reason, the efficiency with which chemical enterprises use economic resources is important not only for individual firms but also for macroeconomic stability and sustainable growth [2].

Over the last decade, the world chemical market has expanded noticeably, and the geography of production has been reshaped in favour of dynamically developing economies. In these conditions, the efficiency of resource use, the speed of technological renewal and the scale of innovation adoption have turned into decisive factors determining long-term competitive advantages. Growing demand for energy carriers and raw materials forces chemical enterprises to reduce specific consumption and to rely on

energy-efficient, resource-saving technologies [3], [4]. At the same time, the spread of digital platforms, automation and data-driven management systems is fundamentally changing approaches to organizing production and managing resources.

Against this background, an in-depth study of resource efficiency in chemical industry enterprises, taking into account both global trends and national development priorities, is of particular scientific and practical relevance [5]. The aim of this research is to reveal macroeconomic patterns in the use of economic resources in the chemical industry and, on this basis, to develop proposals for improving efficiency.

2. Material and Methods

To achieve the stated aim, the study uses a set of complementary research methods. Statistical analysis is applied to assess the dynamics of the world chemical market and the main indicators describing the development of the chemical industry in selected countries and in Uzbekistan. Descriptive and structural analysis are used to identify long-term trends, changes in the regional distribution of production and shifts in the product structure.

Comparative analysis makes it possible to generalize the experience of leading producers – in particular, China, the European Union and the United States – in terms of resource efficiency and technological modernization of the chemical sector. A systems approach is employed to view economic resources of chemical enterprises (material, labour, financial and intellectual) as interrelated components of a single reproduction mechanism. Elements of economic-mathematical analysis are used to summarize quantitative indicators and to evaluate the impact of individual factors on the overall efficiency of resource utilization.

Literature Review

The efficient use of resources in industry has long been at the centre of economic research. Within the theory of competitive advantage, M. Porter links the success of industries to the quality of resource utilization, the intensity of innovation and the coherence of value chains. In capital-intensive branches such as the chemical industry, he emphasizes the importance of technological renewal and clustering of enterprises around modern production and logistics infrastructure.

In studies devoted to the digital economy, M. Castells and other authors show that the spread of information and communication technologies radically changes the logic of organizing production processes and forms new opportunities for improving resource efficiency. V. Smil, analyzing long-term trends in energy use, draws attention to the fact that the chemical industry remains one of the most energy-intensive segments of the real sector, which makes the reduction of specific energy consumption a strategic task for producers [6], [7], [8].

Within endogenous growth theory, P. Romer considers innovation and knowledge accumulation as the main internal sources of economic growth; increasing R&D activity in the chemical sector, in his view, creates conditions for the production of more complex and high value-added products. Research by CIS and Uzbek economists highlights the role of institutional factors, state industrial policy and the financial stability of enterprises in ensuring efficient use of resources [9]. The general conclusion from the literature is that resource efficiency in the chemical industry is formed under the joint influence of technological, economic, institutional and innovation-related factors, which necessitates an integrated analytical approach.

3. Results and Discussion

The analysis shows that the chemical industry retains a key position in the global industrial structure. It combines high capital intensity and resource dependence with a significant ability to generate value added and to stimulate related industries through

backward and forward linkages [10]. Consequently, rational management of economic resources in chemical enterprises becomes a necessary condition for maintaining macroeconomic balance and strengthening national competitiveness.

According to international estimates, the total volume of the world chemical market exceeded about USD 5.7 trillion in 2023 and, under baseline forecasts, may approach USD 7 trillion by 2030. This expansion is closely connected with the deepening of processing chains, the development of new materials and the growth of demand from agriculture, construction and high-tech sectors [11], [12]. At the same time, the growth trajectory is gradually changing its character: instead of rapid extensive expansion, more attention is being paid to intensive factors – resource saving, energy efficiency and innovation.

An analysis of the global structure of the chemical industry reveals that the majority of production is concentrated in a limited number of leading economies. China accounts for approximately 43% of global chemical output, followed by the European Union (14%) and the United States (13%). This distribution highlights that resource utilization in the sector is shaped by high efficiency, technological superiority, and economies of scale under conditions of intense global competition.

Economic resources in chemical enterprises are multidimensional and include material inputs (raw materials and energy), labor resources, financial capital, and intellectual assets [13]. The efficiency with which these resources are utilized is a key determinant of overall economic performance. According to data from the International Energy Agency, the chemical industry accounts for approximately 10–12% of global industrial energy consumption, confirming its energy-intensive nature and reinforcing the importance of improving energy efficiency as a strategic priority.

Economic resources of chemical enterprises comprise raw materials and energy carriers, labour resources, financial capital and intangible assets [14]. The efficiency of their use determines production costs, profitability and investment opportunities. Data from international organizations show that the chemical industry accounts for a considerable part of global industrial energy consumption, which again underscores the need to reduce energy intensity through technological modernization and process optimization. Studies conducted by the OECD indicate that one unit of value added in the chemical industry generates up to 1.5–2 units of additional output in related sectors, which confirms the strong multiplier effect of the industry.

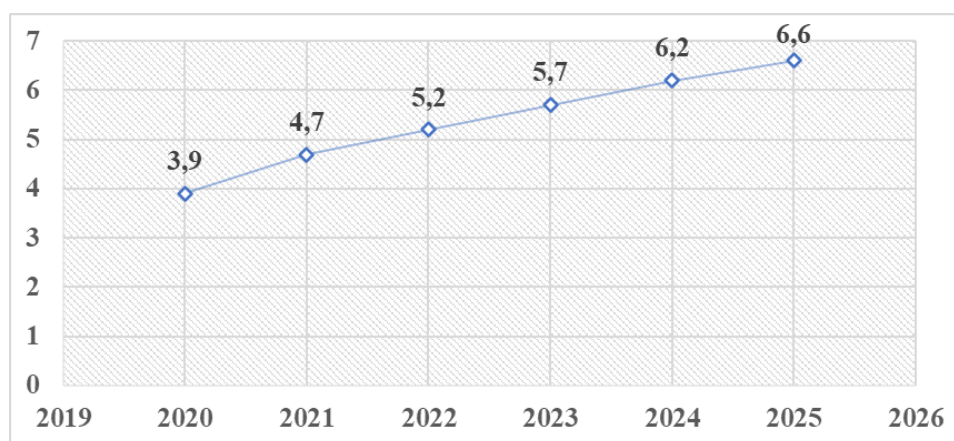


Figure 1. Dynamics of the global chemical industry volume (trillion USD)

The dynamics of the global chemical market over the period 2020–2025 show a stable upward trajectory. The market size increased from USD 3.9 trillion in 2020 to USD 6.6 trillion in 2025. However, while absolute growth continued, relative growth rates gradually declined, indicating a transition from a phase of rapid expansion to a stage of

more stable and mature development. This reflects structural stabilization and the gradual saturation of the market.

Table 1. Share of leading regions in the global chemical industry (%)

Year	China	Europe	USA	Others
2020	40	16	14	30
2021	41	15	14	30
2022	42	15	13	30
2023	43	14	13	30
2024	44	14	12	30
2025	45	13	12	30

Table 1 shows that over 2020–2025 the regional configuration of the global chemical industry has undergone a gradual but consistent transformation. China’s share in world chemical output increased from 40% to 45%, which reflects the expansion of production capacities, the implementation of large-scale investment projects and the steady improvement of resource and energy efficiency in this country. During the same period, the combined share of the European Union and the United States declined from 30% to 25%, mainly due to rising production costs, stricter environmental regulations and the relocation of a number of energy-intensive processes to other regions [15].

The proportion of “other countries” remained virtually unchanged at around 30%, indicating that, despite the growing dominance of several industrial leaders, global chemical production still rests on a relatively diversified base. However, the continuous increase in China’s share and the gradual contraction of the positions of Europe and the USA point to a long-term shift of the “centre of gravity” of the chemical industry toward Asia, where the advantages of scale, lower specific costs and active state support play a decisive role. For developing economies, including Uzbekistan, these trends mean both stronger competitive pressure and new opportunities to integrate into global value chains through targeted policies aimed at improving resource efficiency and modernizing production.

The steady and consistent growth observed in the sector, without sharp fluctuations, highlights the importance of long-term and systemic factors such as efficient resource utilization, targeted investment, technological modernization, and improvements in management efficiency. The moderation of growth rates in the period 2023–2025 further indicates the emergence of structural stability, improved risk management, and a transition to a qualitatively new stage of development driven by intensive rather than extensive growth factors.

Finally, the analysis of modern development trends demonstrates that the process of resource utilization in the chemical industry is undergoing profound transformation under the influence of digitalization, green economy principles, and innovative technologies. For example, in the European Union, improvements in energy efficiency have led to a reduction in energy consumption by approximately 25% over the period 1990–2020. This clearly illustrates the strong interconnection between resource efficiency, environmental sustainability, and economic performance.

4. Conclusion

The conducted research confirms that the efficient utilization of economic resources is one of the key factors determining the competitiveness and sustainable development of chemical industry enterprises. Rational use of material, labour, financial and intellectual resources allows producers to lower production costs, increase value added and strengthen the multiplier impact of the sector on the national economy.

In current conditions, further progress in resource efficiency in the chemical industry is inseparable from technological modernization, digital transformation and the consistent introduction of green-economy principles. In this context, it is advisable to:

accelerate the implementation of resource- and energy-saving technologies in basic production processes;

expand the use of digital tools (MES, ERP, advanced analytics) for monitoring and optimizing resource flows;

stimulate innovation activity and R&D aimed at developing new materials and low-carbon technologies;

improve institutional and financial mechanisms supporting investment in energy-efficient and environmentally friendly projects.

The proposed integrated approach to managing economic resources may be used as a methodological basis for developing sectoral programmes and corporate strategies aimed at improving resource efficiency in chemical industry enterprises.

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