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## GLOBAL TRENDS AND DEVELOPMENT PROSPECTS OF OIL REFINING ENTERPRISES IN A VOLATILE ENVIRONMENT

*The oil refining industry operates in an increasingly volatile environment characterized by market instability, technological transformation, regulatory pressure, and geopolitical uncertainty. These conditions significantly affect investment activity and development trajectories of oil refining enterprises, particularly given the capital-intensive nature and long investment cycles inherent to the refining sector. The purpose of this article is to analyze global trends in the oil refining industry and to assess the development prospects of oil refining enterprises under conditions of heightened uncertainty. The research examines transformations in the downstream segment, changes in the structure of demand for petroleum products, regional shifts in refining capacities, and the growing influence of globalization and the energy transition on investment decision-making.*

**Keywords:** oil refining industry, oil refining enterprises, global trends, investment environment, uncertainty, market volatility, development prospects.

**Problem statement.** The oil refining industry plays a strategically important role in the structure of the global energy system, ensuring the stability of fuel supply, supporting industrial development, and contributing to national energy security. At the same time, oil refining enterprises belong to the most capital-intensive segments of the energy sector, characterized by long investment cycles, high technological complexity, and significant dependence on external market conditions. These features substantially increase the sensitivity of investment decisions to uncertainty and risk. In recent years, the investment environment of oil refining enterprises has become increasingly unstable due to the combined impact of market volatility, technological transformation, regulatory tightening, and geopolitical factors. Fluctuations in crude oil prices, shifts in demand for petroleum products, acceleration of technological innovation, and the growing influence of environmental and sustainability requirements significantly complicate long-term investment planning in the refining sector. As a result, traditional approaches to assessing the development prospects of oil refining enterprises often fail to fully account for the multidimensional nature of uncertainty affecting investment processes. Global analytical reports indicate that the downstream oil and gas sector is undergoing a period of structural transformation, marked by uneven regional development, consolidation of refining capacities, and the need for large-scale modernization of existing facilities. These processes intensify competition for investment resources and increase the importance of accurately assessing both current industry conditions and future development trajectories. Under such circumstances,

insufficient consideration of uncertainty factors may lead to inefficient investment allocation, delayed modernization, or loss of competitive positions by oil refining enterprises.

Despite the growing body of research on the oil and gas industry, there remains a lack of comprehensive analytical studies that systematically combine the assessment of global industry trends, investment conditions, and uncertainty factors specifically in the context of oil refining enterprises. This gap limits the ability to develop evidence-based recommendations for enhancing investment support and ensuring sustainable development of refining companies under unstable external conditions. Therefore, the problem addressed in this study lies in the need for an integrated analysis of the current state and development prospects of oil refining enterprises under conditions of uncertainty, with a particular focus on identifying key trends, investment constraints, and risk factors shaping the investment environment of the refining industry. Addressing this problem is essential for forming a reliable analytical foundation for further development of strategies aimed at improving investment support mechanisms in the oil refining sector.

**Analysis of recent research and publications.** Recent academic research by Ali Y. focuses on practical aspects of forecasting and investment decision-making under uncertainty at the enterprise level, using the case of an oil refining company to demonstrate how uncertainty directly affects strategic and investment choices in the petroleum sector [1]. Recent analytical studies on the oil refining industry primarily focus on identifying global technological, market, and structural trends that shape the development

of downstream oil and gas activities. Academic research by Bickel J. E. and Bratvold R.B. emphasizes the critical role of uncertainty quantification and decision-making frameworks in capital-intensive oil and gas projects, highlighting the growing importance of risk-aware investment approaches in refining-related activities [2]. In parallel, industry-oriented analytical reviews stress the accelerating technological transformation of oil refining enterprises driven by digitalization, process automation, and the implementation of advanced refining technologies, which significantly affect capital requirements and investment decision-making in the sector [3].

A number of publications highlight the growing importance of global refining trends related to capacity restructuring, regional shifts in production, and changes in the structure of demand for petroleum products. According to analytical materials provided by EKT Interactive, the global refining industry is characterized by increasing differentiation between regions with surplus capacities and those facing modernization challenges, which directly influences investment priorities and long-term development strategies of oil refining enterprises [5].

The impact of external market factors on the stability of investment processes in oil refining is also addressed in applied and policy-oriented studies. Chow E. and Elkind J. analyze the interaction between global energy markets and regional economic conditions, emphasizing that geopolitical factors and cross-border energy dependencies significantly affect investment stability in downstream energy sectors [4]. Complementing this view, Keystone Energy Tools points out that volatility in energy markets, regulatory uncertainty, and geopolitical tensions substantially increase investment risks, particularly for capital-intensive refining projects that require long payback periods and stable demand forecasts [6].

Comprehensive market outlooks presented by Mordor Intelligence provide a detailed assessment of the downstream oil and gas market, emphasizing the uneven pace of industry growth and the rising investment pressure associated with modernization, environmental compliance, and efficiency improvement. These studies underline that uncertainty in market dynamics remains one of the key constraints for sustainable investment activity in the oil refining sector [7]. In addition, applied research by Nazari I., Alroaia Y., and Bahraminasab S. focuses on decision-making tools for evaluating investment alternatives in oil refining and distribution, demonstrating the relevance of multi-criteria approaches for managing investment uncertainty in complex industrial systems [8].

Future-oriented aspects of petroleum refining development are examined in educational and analytical materials prepared by Pennsylvania State University, which focus on long-term technological and structural changes in refining processes, including the integration of cleaner technologies and adaptation to evolving fuel standards, further increasing the complexity of investment planning under uncertain conditions [9]. Moreover, analytical insights from Rystad Energy emphasize that the

global oil refining market is entering a phase characterized by slowing capacity expansion and a shift toward selective investment in high-efficiency and high-complexity refineries, reinforcing the need for adaptive investment strategies aligned with long-term market signals [10].

Overall, the reviewed studies demonstrate a growing scholarly and analytical interest in the transformation of the oil refining industry and its investment environment. However, existing publications predominantly examine individual aspects of industry development, such as technological change, market dynamics, or investment decision-making, without providing an integrated assessment of how uncertainty simultaneously affects the current state and future prospects of oil refining enterprises, which substantiates the relevance of further comprehensive research in this field.

**Purpose and objectives of the article.** The purpose of this article is to analyze the current state and development prospects of oil refining enterprises under conditions of uncertainty, with a focus on identifying key global industry trends, investment constraints, and risk factors that shape the investment environment of the oil refining sector.

**Presentation of the main research material.** The global oil refining industry is currently undergoing profound structural and technological transformations that significantly affect the functioning of the downstream segment and the investment behavior of refining enterprises. These changes are driven by a combination of market, technological, regulatory, and geopolitical factors, which together increase the level of uncertainty in the development of the refining sector.

One of the key trends is the transformation of the downstream segment of the oil and gas industry. Analytical reviews indicate that oil refining is increasingly characterized by higher complexity of production processes, greater integration of digital technologies, and the modernization of existing facilities aimed at improving efficiency and environmental performance. The downstream segment is gradually shifting from extensive capacity expansion toward intensive development based on technological upgrading and optimization of operational costs, which requires substantial and well-justified investment resources [3].

Another important trend is the change in the structure of demand for petroleum products. Global consumption patterns are evolving due to economic restructuring, improvements in energy efficiency, and the gradual development of alternative energy sources. These changes affect the composition of refined products, increasing demand for higher-quality fuels and petrochemical feedstocks while reducing growth rates in traditional fuel segments. Such demand restructuring complicates investment planning for oil refining enterprises, as it requires flexible production systems and adaptive investment strategies [8].

Regional shifts in refining capacities also play a crucial role in shaping the global landscape of the oil refining industry. According to industry analyses, refining capacity growth is increasingly concentrated in regions with rapidly developing economies, while mature markets face capacity stagnation or consolidation. This uneven

regional development leads to intensified competition, relocation of investment flows, and increased pressure on existing refineries to enhance efficiency and technological sophistication in order to maintain competitiveness [4].

The influence of globalization remains a significant factor in the development of the oil refining industry. Global value chains, international trade in petroleum products, and cross-border investment activities continue to shape the strategic decisions of refining enterprises. At the same time, globalization exposes the industry to external shocks, including market volatility and geopolitical instability, which further increase uncertainty and investment risks in the downstream sector [5].

In parallel, the energy transition has become an increasingly influential driver of structural change in oil refining. Stricter environmental regulations, decarbonization policies, and the promotion of cleaner energy sources require refineries to invest in emission reduction technologies, process efficiency improvements, and product diversification. Market outlooks emphasize that these requirements significantly raise capital intensity and extend payback periods of investment projects, thereby complicating investment decision-making under uncertain long-term demand scenarios [7].

Moreover, analytical assessments suggest that the global oil refining market is approaching a phase of moderated growth, characterized by selective investment in high-efficiency and high-complexity facilities rather than large-scale capacity expansion. According to Rystad Energy, this shift reflects growing uncertainty regarding future demand dynamics and reinforces the importance of strategic investment prioritization in the refining sector [10].

Overall, the identified global trends (tabl. 1) indicate that the oil refining industry operates in an increasingly complex and uncertain environment. The transformation of the downstream segment, changing demand patterns, regional disparities in capacity development, and the combined effects of globalization and the energy transition collectively shape the current state of the industry and define the framework within which oil refining enterprises must make investment decisions.

The investment environment of the oil refining industry is shaped by the high capital intensity of refining operations, long investment cycles, and strong dependence on external market and regulatory conditions.

Investment decisions in this sector require substantial financial resources and long-term planning horizons, which makes oil refining enterprises particularly sensitive to uncertainty in global energy markets and technological development.

Analytical assessments indicate that current investment activity in the downstream oil and gas sector is increasingly focused on modernization and efficiency improvement rather than large-scale expansion of refining capacities. According to Mordor Intelligence, investment priorities are shifting toward upgrading existing facilities in order to comply with stricter environmental standards, enhance operational efficiency, and improve product quality. These trends significantly increase the financial burden on refining enterprises and raise the importance of reliable investment support mechanisms under volatile market conditions [7]. The transformation of development programs in the oil refining industry is also closely linked to technological innovation. Industry reports emphasize that investments are increasingly directed toward digital solutions, process optimization, and advanced refining technologies aimed at reducing costs and improving flexibility. CIO Coverage highlights that the implementation of breakthrough technologies requires not only significant capital expenditures but also higher levels of investment risk due to technological uncertainty and rapidly changing industry standards [3].

Market volatility remains one of the key constraints affecting the investment environment of oil refining enterprises. Keystone Energy Tools notes that fluctuations in crude oil prices, uncertainty in demand for refined products, and geopolitical instability complicate the evaluation of investment project profitability and extend payback periods. Under such conditions, investment programs are often revised, postponed, or implemented in stages, reflecting a cautious approach to capital allocation in the refining sector [5].

Regional differences in investment activity further complicate the overall investment landscape of the oil refining industry. EKT Interactive points out that while some regions continue to attract investment due to growing demand and supportive regulatory frameworks, others experience declining investment attractiveness caused by market saturation, aging infrastructure, and regulatory pressure. These disparities influence the spatial distribution

Table 1

#### Key global trends in the oil refining industry and their investment implications

Global trend	Description	Investment implications for oil refining enterprises	Source
Downstream transformation	Shift from capacity expansion to modernization and efficiency improvement	Growth of capital expenditures for upgrading existing facilities	[3], [7]
Change in demand structure	Increasing demand for high-quality fuels and petrochemical feedstocks	Need for flexible refining configurations and selective investments	[9]
Regional capacity shifts	Concentration of new capacity in developing regions	Redistribution of global investment flows	[4], [10]
Energy transition pressure	Stricter environmental and fuel standards	Rising investment costs and longer payback periods	[7], [9]

Source: developed by the author

of investment flows and contribute to uneven development of refining capacities worldwide [6].

In addition, long-term development programs of oil refining enterprises are increasingly influenced by expectations related to the energy transition. Educational and analytical materials provided by Pennsylvania State University emphasize that refineries are required to adapt their investment strategies to evolving fuel standards, environmental regulations, and changes in consumption patterns. This adaptation necessitates complex investment planning under conditions of uncertainty, as future regulatory and market trajectories remain difficult to predict [8].

Overall, existing investment programs in the oil refining industry reflect a growing emphasis on selective, efficiency-oriented investments rather than extensive growth. The combination of technological requirements, market volatility, regional disparities, and energy transition pressures creates a challenging investment environment in which oil refining enterprises must balance the need for modernization with heightened levels of risk and uncertainty.

The development of oil refining enterprises is increasingly influenced by a complex system of risk and uncertainty factors that significantly affect investment decision-making and long-term strategic planning. The capital-intensive nature of refining activities, combined with long investment cycles, makes the sector particularly vulnerable to fluctuations in external conditions and amplifies the consequences of inaccurate risk assessment.

One of the most significant sources of uncertainty in oil refining development is market volatility, primarily associated with fluctuations in crude oil prices and changes in demand for petroleum products. Analytical reviews emphasize that price instability directly affects revenue predictability and complicates the evaluation of investment project profitability. Under such conditions, oil refining enterprises often face difficulties in forecasting cash flows, which increases the likelihood of postponing or scaling down investment projects [5].

Technological uncertainty also represents a critical risk factor for oil refining enterprises. Rapid technological progress in refining processes, digitalization, and environmental technologies requires continuous modernization of production facilities. According to industry analyses, investments in advanced refining technologies involve high upfront costs and the risk of technological obsolescence, as new solutions may quickly replace existing ones. This uncertainty complicates the selection of optimal investment strategies and increases the overall risk profile of refining projects [3; 8].

Regulatory and environmental uncertainty further intensifies investment risks in the oil refining industry. Stricter environmental standards, fuel quality regulations, and climate-related policies impose additional requirements on refining enterprises, often without clear long-term regulatory trajectories. Market outlooks indicate that compliance with evolving environmental regulations substantially increases capital expenditures and extends investment payback periods, thereby reducing investment attractiveness under uncertain regulatory conditions [6; 8].

Geopolitical factors constitute another important dimension of uncertainty affecting oil refining development. Global supply chain disruptions, trade restrictions, and geopolitical tensions influence both the availability of raw materials and access to export markets. Industry trend analyses note that geopolitical instability increases operational risks and may alter regional investment priorities, forcing oil refining enterprises to revise development programs and reassess investment feasibility [5].

Structural uncertainty related to regional disparities in refining capacity development also plays a significant role. Analytical assessments show that uneven regional growth, consolidation of refining assets, and shifting investment flows contribute to increased competitive pressure on existing enterprises. These structural changes require oil refining companies to adapt investment strategies to region-specific conditions while operating in a globally interconnected market environment [4; 9].

Overall, the combination of market, technological, regulatory, geopolitical, and structural uncertainties creates a highly complex risk environment for oil refining enterprises. These factors not only constrain investment activity but also increase the importance of systematic risk identification and assessment as a prerequisite for sustainable development. Understanding the nature and interaction of these uncertainty factors provides a necessary analytical basis for evaluating development prospects and formulating effective investment support strategies for oil refining enterprises under unstable external conditions.

**Conclusions.** The conducted analysis demonstrates that the oil refining industry currently operates under conditions of heightened uncertainty, which significantly affects the investment environment and development prospects of refining enterprises. The global refining sector is undergoing structural transformation characterized by a shift from extensive capacity expansion toward modernization, efficiency improvement, and technological upgrading of existing facilities.

Table 2

Factors Shaping the Investment Environment of Oil Refining Enterprises

Factor	Impact on investment decisions	Nature of uncertainty
Oil price volatility	Unstable cash flows, delayed investment decisions	Market uncertainty
Technological innovation	High upfront costs, risk of obsolescence	Technological uncertainty
Environmental regulation	Increased capital intensity	Regulatory uncertainty
Regional market conditions	Uneven investment attractiveness	Structural uncertainty

Source: developed by the author using [3; 5; 7; 8; 9]

The results of the study confirm that changes in the structure of demand for petroleum products, together with regional shifts in refining capacities, create an uneven and highly competitive investment landscape. Refining enterprises are increasingly required to adapt their investment strategies to regional market conditions while maintaining flexibility in response to evolving global demand patterns.

It has been established that investment activity in the oil refining industry is constrained by a combination of market volatility, technological uncertainty, regulatory pressure, and geopolitical risks. These factors increase capital intensity, extend investment payback periods, and complicate long-term planning, thereby limiting the effectiveness of traditional investment decision-making approaches.

At the same time, the analysis indicates that the development prospects of oil refining enterprises are

increasingly associated with selective and strategically oriented investments. Priority is given to projects aimed at technological modernization, digitalization of refining processes, and compliance with environmental standards, which enhance operational efficiency and long-term competitiveness under uncertain external conditions.

Overall, the findings suggest that sustainable development of oil refining enterprises under conditions of uncertainty requires a comprehensive assessment of global industry trends, investment constraints, and risk factors. Such an assessment provides a necessary analytical foundation for improving investment support mechanisms and for formulating adaptive investment strategies in the oil refining sector. The obtained results create a basis for further research focused on the development of practical tools and strategies for enhancing investment support of oil refining enterprises under uncertain and volatile external environments.

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## ГЛОБАЛЬНІ ТЕНДЕНЦІЇ ТА ПЕРСПЕКТИВИ РОЗВИТКУ НАФТОПЕРЕРОБНИХ ПІДПРИЄМСТВ В УМОВАХ НЕВИЗНАЧЕНОСТІ

*Нафтопереробна промисловість функціонує в умовах зростаючої волатильності зовнішнього середовища, зумовленої ринковою нестабільністю, технологічними трансформаціями, посиленням регуляторних вимог та геополітичною невизначеністю. Зазначені чинники істотно впливають на інвестиційну активність і траєкторії розвитку нафтопереробних підприємств, зважаючи на високу капіталомісткість галузі та тривалі інвестиційні цикли. Метою статті є аналіз глобальних тенденцій розвитку нафтопереробної галузі та оцінка перспектив розвитку нафтопереробних підприємств в умовах волатильного зовнішнього середовища. Дослідження ґрунтується на аналітичному узагальненні сучасних міжнародних галузевих звітів і ринкових досліджень, присвячених функціонуванню та розвитку нафтопереробної промисловості в глобальному вимірі. Застосування системного та структурно-аналітичного підходів дало змогу ідентифікувати ключові структурні, технологічні та ринкові тенденції, що визначають трансформаційні процеси в downstream-сегменті нафтогазової галузі та безпосередньо впливають на інвестиційні умови діяльності нафтопереробних підприємств. У межах дослідження здійснено комплексний аналіз змін у технологічній організації нафтопереробного сегмента, трансформації структури попиту на нафтопродукти з урахуванням якісних та екологічних характеристик продукції, а також регіональних зсувів у розміщенні та завантаженні виробничих потужностей. Особливу увагу приділено оцінці впливу глобалізаційних процесів, інтеграції світових ринків нафтопродуктів і тенденцій енергетичного переходу на*

*формування інвестиційних рішень, стратегічних пріоритетів і довгострокових програм розвитку нафтоперобних підприємств. Результати дослідження свідчать, що перспективи розвитку нафтоперобних підприємств дедалі більше залежать від реалізації вибіркових, стратегічно орієнтованих інвестицій, спрямованих на технологічну модернізацію, підвищення операційної ефективності та відповідність екологічним стандартам. Водночас ринкова волатильність, технологічна та регуляторна невизначеність, а також геополітичні ризики істотно ускладнюють довгострокове інвестиційне планування та зумовлюють необхідність комплексної оцінки ризиків. Отримані результати формують аналітичне підґрунтя для вдосконалення інвестиційних рішень і розроблення стратегій забезпечення сталого розвитку нафтоперобних підприємств в умовах нестабільного зовнішнього середовища.*

**Ключові слова:** *нафтоперобна промисловість, нафтоперобні підприємства, глобальні тенденції, інвестиційне середовище, волатильність, невизначеність, перспективи розвитку.*

*Дата надходження статті: 14.01.2026*

*Дата прийняття статті: 08.02.2026*

*Дата публікації статті: 02.03.2026*