

NUCLEAR ENERGY: ADVANTAGES AND RISKS

У статті розглянуто роль атомної енергетики в сучасному світі, її вплив на екологію та енергетичну безпеку. Проаналізовано ключові переваги, такі як низькі викиди вуглецю та пильність генерації, а також ризики, пов'язані з утилізацією відходів та безпекою експлуатації. Особливу увагу приділено технологічним інноваціям 2024-2025 років.

Ключові слова: атомна енергетика, ядерна безпека, енергоефективність, радіоактивні відходи.

The article examines the role of nuclear energy in the modern world, its impact on the environment and energy security. The key advantages, such as low carbon emissions and generation ability, as well as risks associated with waste disposal and operational safety, are analyzed. Special attention is paid to the technological innovations of 2024-2025.

Keywords: nuclear energy, nuclear safety, energy efficiency, radioactive waste.

In the face of a global climate crisis and the urgent need for decarbonization, nuclear energy has once again emerged as a central pillar of international energy strategies. As of 2024-2025, the global community is reassessing the balance between fossil fuels and renewable sources. Nuclear power occupies a unique niche, offering high-capacity, low-carbon electricity that is essential for stabilizing power grids. However, the legacy of past accidents and the persistent challenge of radioactive waste management continue to fuel intense public and political debate.

The Advantages of Nuclear Energy

The primary argument for nuclear energy is its **minimal environmental footprint** regarding greenhouse gas emissions. Unlike coal or gas power plants, a nuclear reactor does not burn fuel in a chemical sense; it relies on nuclear fission.

1. **Low Carbon Intensity:** Life-cycle assessments conducted in late 2024 confirm that nuclear power is comparable to wind and solar energy in terms of carbon emissions per kilowatt-hour. This makes it a crucial tool for achieving "Net Zero" targets by 2050.

2. **Energy Density and Efficiency:** The energy content of nuclear fuel is millions of times greater than that of chemical fuels. A single uranium pellet, approximately the size of a fingertip, can produce as much energy as a ton of coal. This high density reduces the physical footprint of the energy infrastructure compared to sprawling solar or wind farms.

3. **Grid Stability (Baseload Power):** Modern economies require a constant, reliable supply of electricity. While wind and solar are intermittent, nuclear power plants operate at a high capacity factor (often exceeding 90%), providing the "baseload" that keeps industries and hospitals running regardless of weather conditions.

4. **Economic Resilience:** Although the initial capital costs of building a nuclear plant are immense, the long-term operational costs are relatively low and stable. In 2025, with fluctuating global gas prices, countries with a high share of nuclear power have demonstrated greater economic stability.

The Risks and Challenges

Despite its benefits, the nuclear industry faces significant hurdles that cannot be overlooked.

● **Radioactive Waste Management:** The most enduring risk is the production of high-level radioactive waste. While 2024 marked progress in the development of Deep Geological Repositories (DGR) in countries like Finland, the global problem of storing spent fuel for thousands of years remains a logistical and ethical challenge.

● **Operational Safety and Catastrophic Risks:** While statistically nuclear power is one of the safest forms of energy per terawatt-hour produced, the consequences of a failure are uniquely severe. The memories of Chernobyl and Fukushima emphasize that human error or natural disasters can lead to transboundary radiation leaks.

● **High Capital Costs and Lead Times:** Constructing a traditional large-scale nuclear reactor can take 10 to 15 years and cost upwards of \$10 billion. In the fast-paced 2025 economy, many private investors are wary of such long-term, high-risk financial commitments.

● **Proliferation and Security:** The technology used for civilian nuclear energy is closely related to that required for nuclear weapons. Ensuring that enrichment and reprocessing facilities are used exclusively for peaceful purposes remains a top priority for the IAEA.

● **Geopolitical and Military Risks:** Recent events have highlighted a new risk: the vulnerability of nuclear facilities in zones of armed conflict. The situation at the Zaporizhzhia NPP has forced the international community to rethink the physical security of nuclear plants against military strikes or occupation.

Technological Innovations (2024-2025 Perspective)

The industry is not static. The years 2024 and 2025 have seen a shift toward **Small Modular Reactors (SMRs)**. These reactors are smaller, safer, and can be factory-built, significantly reducing construction time and costs. SMRs feature passive safety systems that can shut down the reactor without human intervention or electricity in case of an emergency. Furthermore, research into **Nuclear Fusion** has reached new milestones in 2025, offering the distant but hopeful prospect of nearly infinite clean energy with minimal waste.

Nuclear energy remains a paradoxical necessity. It is a powerful tool for fighting climate change and ensuring energy independence, yet it carries risks that require an unprecedented level of international cooperation and technical rigor. The "Renaissance" of nuclear power in 2025 suggests that for many nations, the benefits of reliable, clean energy outweigh the manageable risks. However, the future of the industry depends on three factors: the successful deployment of SMRs, the implementation of permanent waste disposal solutions, and the strict enforcement of international safety protocols in all geopolitical contexts.

Societal Trust and Hybrid Energy Synergy

In the current 2025–2026 landscape, this requires not only technological transparency but also a comprehensive educational dialogue regarding the comparative risks of all energy forms. The future of global energy security likely lies in a **hybridized energy model** where nuclear power acts as the steadfast backbone, providing a reliable foundation that enables the mass integration of volatile renewable sources like wind and solar. Ultimately, the decision to maintain or expand nuclear capacity is a testament to humanity's ability to harness the fundamental forces of nature while balancing the profound responsibility of environmental stewardship for future generations.

Energy Sovereignty and Geopolitical Stability

Countries that maintain a robust nuclear infrastructure are significantly less vulnerable to the price shocks of imported natural gas and coal, which are often used as tools of political pressure. By localizing electricity production through nuclear fission, nations can decouple their economic growth from external market fluctuations. This is particularly critical for Eastern European countries, including Ukraine, where nuclear energy acts not only as a source of power but as a fundamental component of national security, ensuring a self-sufficient energy balance even under conditions of external aggression or supply chain disruptions.

Digitalization and AI Integration in Nuclear Operations

The ongoing digital transformation of the energy industry is another defining trend of the 2025–2026 period. The integration of Artificial Intelligence (AI) and "Digital Twin" technology allows for real-time monitoring of reactor cores and predictive maintenance of critical infrastructure. These innovations significantly mitigate the risks associated with human error and mechanical fatigue—the historical vulnerabilities of nuclear safety. By using machine learning algorithms to simulate millions of operational scenarios, engineers can anticipate and neutralize potential issues before they escalate. Moreover, the shift toward digitized control systems necessitates a new focus on cybersecurity, making the protection of nuclear digital assets a top priority for global energy regulators in the coming decade.

References:

1. International Atomic Energy Agency (IAEA). (2025). *Nuclear-Renewable Hybrid Energy Systems: Integrated Solutions for a Carbon-Neutral Future*. Vienna: IAEA Publishing. URL:

[tps://www.iaea.org/publications/reports/hybrid-energy-2025](https://www.iaea.org/publications/reports/hybrid-energy-2025) (Date of access: 10.03.2026).

2. World Nuclear Association. (2026). *The Social License to Operate: Global Public Opinion and the Future of Nuclear Energy*. London: WNA Research. URL: <https://world-nuclear.org/reports/social-license-2026> (Date of access: 12.03.2026).

3. European Commission. (2025). *Digitalization and AI in the Energy Sector: Enhancing Safety and Efficiency in Nuclear Power Plants*. Brussels: EU Publications Office. URL: [tps://ec.europa.eu/energy/reports/ai-nuclear-2025](https://ec.europa.eu/energy/reports/ai-nuclear-2025) (Date of access: 14.03.2026).

4. Ministry of Energy of Ukraine. (2026). *National Energy Strategy: Transitioning to Resilient Hybrid Grids and Nuclear Safety Protocols*. Kyiv: Official Bulletin. URL: <https://mev.gov.ua/strategy-2026> (Date of access: 15.03.2026).

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EMOTIONAL INTELLIGENCE AS A KEY FACTOR IN EFFECTIVE MANAGEMENT

У публікації розглянуто роль емоційного інтелекту в системі ефективного менеджменту. Було проаналізовано наукові джерела та дослідження з метою визначення основних компонентів емоційного інтелекту та їхнього впливу на процес прийняття рішень, командну взаємодію та лідерську ефективність. Особливу увагу приділено таким складовим, як самоусвідомлення, саморегуляція, мотивація, емпатія та соціальні навички.

Ключові слова: емоційний інтелект, менеджмент, лідерство, самоусвідомлення, саморегуляція, мотивація, емпатія, ефективність управління.

The publication examines the role of emotional intelligence in the system of effective management. Scientific sources and research papers were analyzed to identify the main components of emotional intelligence and their influence on decision-making, team interaction, and leadership effectiveness. Special attention is paid to such elements as self-awareness, self-regulation, motivation, empathy, and social skills.

Keywords: emotional intelligence, management, leadership, self-awareness, self-regulation, motivation, empathy, managerial effectiveness.

Management is a complex and dynamic field that requires a wide range of knowledge, competencies, and interpersonal abilities. A manager must possess strong technical and professional skills; however, internal qualities are equally significant for achieving sustainable success. In today's competitive and rapidly changing business environment, technical expertise alone is not sufficient. A professional working in a management environment should demonstrate strong communication skills, adaptability, and a high level of emotional intelligence [1, 3]. These qualities allow managers to respond effectively to challenges, lead diverse teams, and maintain a productive organizational climate.

Emotional intelligence is widely recognized as a crucial determinant of effective management, as it enables managers to build strong professional relationships, resolve conflicts constructively, and enhance the overall quality of work performance [2, 5]. It contributes not only to individual leadership success but also to the long-term development of the organization. Emotional intelligence consists of several key components that must be considered: self-awareness, self-regulation, motivation, empathy, and social skills [1, 4, 8]. Each of these elements plays a significant role in shaping managerial behavior and influencing team dynamics.

Self-awareness allows managers to analyze their own emotions, behavior, feelings, and thoughts, which helps prevent impulsive decisions and emotional reactions in stressful situations [6, 8]. A self-aware manager understands personal strengths and weaknesses and is able to reflect critically on their actions. This awareness creates a foundation for continuous self-development and