Volodymyr Shevchenko, Candidate of Economic Sciences, Associate Professor
National Taras Shevchenko University of Kyiv
Kyiv, Ukraine
Stefaniia Parubets, Postgraduate Student
Kyiv National Economic University named after Vadym Hetman
Kyiv, Ukraine

DOI: https://doi.org/10.30525/978-9934-26-698-0-37

DIGITAL INNOVATION ASYMMETRY: A CASE OF DATA CENTERS

Global digitalization now is a main area of innovation development and transformation. Digitalization process represent a creation and expansion of new electronic products, technologies, services, industries, organizations, networks.

Data flows and management n now have growing role in global economy and competition along with trade, financial and capital flows.

Modern economy and technologies are in the process of dynamic structural changes. The main factors of such changes are frontier, revolutionary digital innovations that lead to the acceleration of new technologies and industries, driving investment and financial flows. The most dynamic and large-scale are innovations in the field of digital and information technologies are in chips production, computers (quantum computers), data management, artificial intelligence and digital infrastructure (data centers).

Innovations and innovation have a structural imbalance or asymmetry. The authors or owners of innovations have the exclusive rights their intellectual product, such as a monopoly on its disposal. The owners of innovations are in the position to define and manage the terms of innovations application through assign utilization with the sell of a patent and receive economic benefits.

Innovations and digital technologies have such a systemic characteristic as the asymmetry of information and economic rights and responsibilities in the process of production and distribution of digital technologies and services.

Asymmetry in general is a systemic characteristic of phenomena, processes, reflecting the state of inequality, multidirectional changes, non-

equivalence of certain structural parts, qualities, information. Asymmetry can also be a characteristic of development as a state of violation of symmetry, coherence, uniformity. Asymmetry can characterize the multi directionality, multispeed, multi scale nature of certain interconnected processes or components. Typical examples are in the field of economics and business where asymmetry affects the behavior of economic agents and the consequences of their actions. The presence of asymmetry of information among the parties to trade agreements, international trade, financial transactions directly affects their results.

Digital and technological monopoly causes asymmetries of innovations and digitalization as asymmetries of information regarding the parameters and capabilities of innovations and the potential of electronic technologies. This causes relationships of dependence, imbalance of economic processes and inequality of their participants.

The economic consequences of innovation and digital asymmetry can emerge as certain disparities of key technologies comparing certain supporting industries, which hinders the development of core technological and structural shocks and crises.

Data centers are the most dynamic component of modern digital changes, processing large data stocks and the development of artificial intelligence (AI) technologies. The rapid establishing of data centers requires substantial volume of investments and a large number of powerful servers based on advanced chips, their stable operation requires scaled up resources, primarily electricity and water for cooling.

Data centers in terms of accelerating progress, scale and intensity of resource consumption have become the most dynamic and significant factor in economic development and growth in demand for electricity in the USA and developed countries. In the context of rapid digitalization of the economy, the structure of demand for electricity is changing. If earlier the main drivers of its growth were industry, transport and the residential sector, now data centers are gaining increasing importance as the basis of the infrastructure for processing, storing and transmitting data. Their importance is increasing due to the development of artificial intelligence, cloud technologies, machine learning and computing systems, while the US energy infrastructure is inertial and has long investment cycles.

Globally data centers are demanding about 1.5%, or 415 Terawatt-Hours (TWh), of the world's total yearly electricity consumption. Projections indicate that their such demand would increase up to 945 TWh by 2030 [1] due to the substantial growth of accelerating computing capacity mainly for AI technologies.

Data centers concentration requires to oversee transformation of electricity demand in the US energy system in the context of digitalization of the economy. Data centers are specific in terms of energy demand featured high capacity, operational continuation, low elasticity of demand and increased requirements for the reliability of electricity supply. These features distinguish data centers from traditional consumers and form new qualitative challenges for energy systems.

The rapid progress of data centers and AI in the US and Europe leads to technological asymmetries in the digitalization process, which affects imbalances and shortages in electricity supply, rising wholesale electricity prices, the need to increase generation capacity and modernize networks.

International asymmetries of digitalization are manifested in the imbalanced development of data centers in different countries. The US is a leader in the development of data centers and AI, concentrates the largest growth in demand for electricity. The number of data centers in selected countries as of April 14, 2026 is being differentiated and asymmetric: USA has 4189 data centers, United Kingdom – 515, Germany – 514, China – 369, France – 345, India – 296 Indonesia – 185 [4] At the same time, in Asia there is a relatively small number of data centers besides of high Internet penetration, accordingly relatively lover impact on energy consumption.

Electricity consumption by data centers is the most dynamic segment in the United States and accounted to 17% in 2025 and estimated as 45% of global consumption of all data centers [3]. According to IEA forecasts, by 2030 the demand for data centers will grow annually by 10% and the centers will consume 3% of the world's electricity [1; 3].

The demand of data centers stimulates the transformation of the energy systems of the United States and other developed countries:

– data centers have become the main consumer of renewable energy and, for example, in the United States they buy 40% of the total volume of renewable energy [3];

– data centers are influencing decentralized generation and local power grids;

– data centers have concluded a number of contracts for the construction of modular nuclear reactors;

– data centers are using mobile gas turbine capacities based on co-location with the main facilities:

– acquisition of dedicated electricity facilities:

– improving of electricity regulation and elimination industry bottlenecks.

Scaling of data centers is a dynamic trend of the current stage of digitalization, which is accompanied by certain asymmetries. It accelerates a demand for key resources and products such as rare earth minerals, chips, electricity, water. At the same time, such processes should contribute to the transformation of related industries and spheres, primarily energy. This requires comprehensive planning and balancing and the process of investment into digitalization technologies, infrastructure and data centers.

References:

1. Energy and AI (2025). International Energy Agency. Paris. Available at: https://iea.de9dea 13-b07d-42c5-a398 d1b3ae17d866/EnergyandAI.pdf
2. Offutt M. C., Zhu L. Data Centers and Their Energy Consumption: Frequently Asked Questions. Congressional Research Service, USA Congress. Washington. 2025. Available at: https://www.congress.gov/crs-product/R48646
3. Key questions on energy and AI (2026) International Energy Agency. Paris. Available at: https://www.iea.org/reports/key-questions-on-energy-and-ai
4. Number of data centers worldwide as of 14 April 2026 (2026). Statista. Available at: https://www.statista.com/statistics/1228433/data-centers-worldwide-by-country/?srsltid=AfmBOoplijjk9wbUecQBXr75Qtt3Sx8E33tGr0vkmCPtUuai34Cfqvoh
5. Energy performance of data centres (2025). European Commission. Brussels. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive/energy-performance-data-centres_en