EUROPE'S ENERGY MARKET: LESSONS FROM THE 2021 ENERGY CRISIS AND RECENT SHIFTS

Ph.D., Tatiana GUTIUM
National Institute for Economic Research,
Academy of Economic Studies of Moldova, Republic of Moldova
E-mail: gutium.tatiana@ase.md

Abstract: *The upheavals that struck the energy sector in 2021 were predictable, as early warning signs had begun to emerge three years before the crisis. Each premise alone would not have led to a crisis if other premises had not accompanied it. Prices started to rise in the second half of 2021, because this year there has been a decrease in supply and an increase in demand due to the recovery of production in all sectors of the economy after the isolation caused by the COVID-19 pandemic. Many more factors influenced the decline in supply than the increase in demand. When demand-pull and cost-push inflation occur in the same period, prices increase several times. This study also examines how Europe's transition to green energy occurs. A comparative analysis of the dynamics of green energy before, during, and after the crisis was carried out. This study explores the premises of the crisis and the lessons that Europe has learned. This study uses multiple methods (comparative analysis and time-series analysis) to examine the antecedents and factors that led to the record rise in European natural gas prices and assess the European energy market's current state and trajectory (towards increasing the share of green energy). By examining the current state of the European energy market and overall trends, the study provides a comprehensive understanding of how the market has evolved since the crisis and what challenges remain to ensure long-term energy security and price stability. The article highlights the role of energy diversification, reconsidering EU strategies in stabilizing the market and accelerating the transition to a more sustainable energy system.*

Keywords: *European energy crisis, energy security, energy transition, renewable energy.*
JEL Classification: *Q41, Q42.*

1. Introduction

The energy sector is strategically important for economic and social stability and for the national and energy security of the European Union (EU), which imports key energy resources such as oil and natural gas. The global energy crisis that began in September 2021 and worsened in 2022 has become a severe test for the EU, revealing the vulnerability of the European economy and exacerbating the need for an energy transformation (Eminov et al., 2024). The peculiarity of this crisis is the considerable influence of geopolitical factors on the import structure of energy resources. With the aggravation of the geopolitical struggle, the economies of the countries importing energy resources became most vulnerable. The energy crisis has affected not only the energy sector and the economy, but also trade, competitiveness (Gutium & Postolaty, 2019), human development (Balan, 2024), and the well-being of the population (Gutium, 2021).

Economic recovery after the recession caused by the COVID-19 pandemic is the main factor in increasing demand for energy resources. In 2021, according to the International Monetary Fund, the real GDP of Europe increased by 6.0% (IMF, 2024). At the same time, Germany continued to close nuclear power plants despite the energy crisis and economic growth; only the deadline for closing nuclear power plants was extended. The policy of phasing out nuclear energy in Europe does not guarantee a rapid transition to alternative energy sources. At the same time, there was a decrease in hydroelectricity and an increase in wind energy production in 2022 compared to 2021.

More and more scientists are advocates of the idea of the decarbonization process during the transformation of the energy sector (Gojaeva et al., 2024; Scott, 2022), as well as

the diversification of energy resources, which would balance demand with supply in this market and ensure a reduction in carbon dioxide emissions (De Rosa et al., 2022; Hussain et al., 2023). The prerequisites have been created for the introduction of renewable energy sources (RES) and for "green" investments (Magalhaes, 2021), "however, there has not been a corresponding decrease in demand for fossil fuels" (Alkemade et al., 2023).

The study's relevance is predetermined by the need to study the causes and effects of the energy crisis. It is necessary to identify the economic factors that contributed to the transition of many European countries to the principles of green energy, in addition to such factors as limited sources of acquisition of traditional energy resources. This article aims to provide an in-depth analysis of how the European energy market has responded to external and internal shocks and what the long-term consequences of these shocks are. The article analyzes the structure of the European energy market, examines the causes of the energy crisis, and identifies the main lessons learned from the crisis that had a direct impact on accelerating the transition to green energy in the post-crisis period.

2. Underlying factors behind the energy crisis: a focus on natural gas price dynamics

The beginning of the 21st century can be called the period of peak globalization, in which food and energy systems are highly concentrated. Naturally, establishing barriers and severing economic and energy ties could not help but lead to a crisis. The energy crisis of 2021-2022 is associated with increased prices for natural gas in Europe. Indeed, over the five years, the price at the TTF gas hub has increased 12.8 times (August 2022 to August 2017), while the spot price at the Henry Hub has increased 3.1 times, and for Liquefied Natural Gas (LNG) (Japan), 2.4 times (Fig. no. 1). During 2021, the highest monthly growth at the European TTF gas hub was recorded in September (by 48.1%), and in 2022, in March (by 55.7%) and July (by 53.0%). The prerequisites for the energy crisis are the emergence of a new player in the natural gas market, namely the United States, and the geopolitical turmoil, which led to severing many economic and logistical ties.

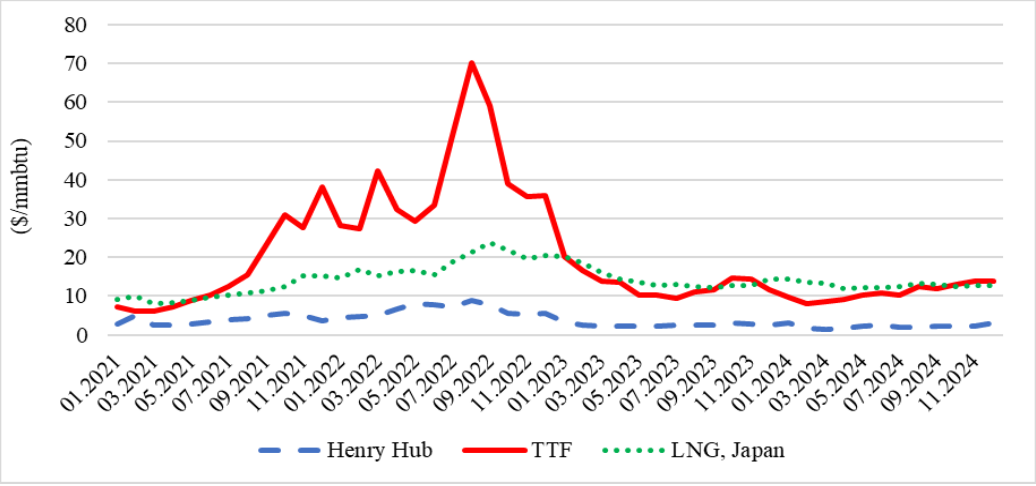

Figure no. 1. Monthly dynamics of natural gas prices

Source: (World Bank, 2024).

Until 2016, the United States was an importer of natural gas. Since 2018, it has been an exporter (Fig. no. 2). In 2017-2022, the export potential of the United States increased significantly, which led to the United States having the opportunity to influence this market to weaken competitors. In 2022, gas exports exceeded imports by 2.3 times. In 2023, US gas exports continued to grow and exceeded imports by 2.6 times.

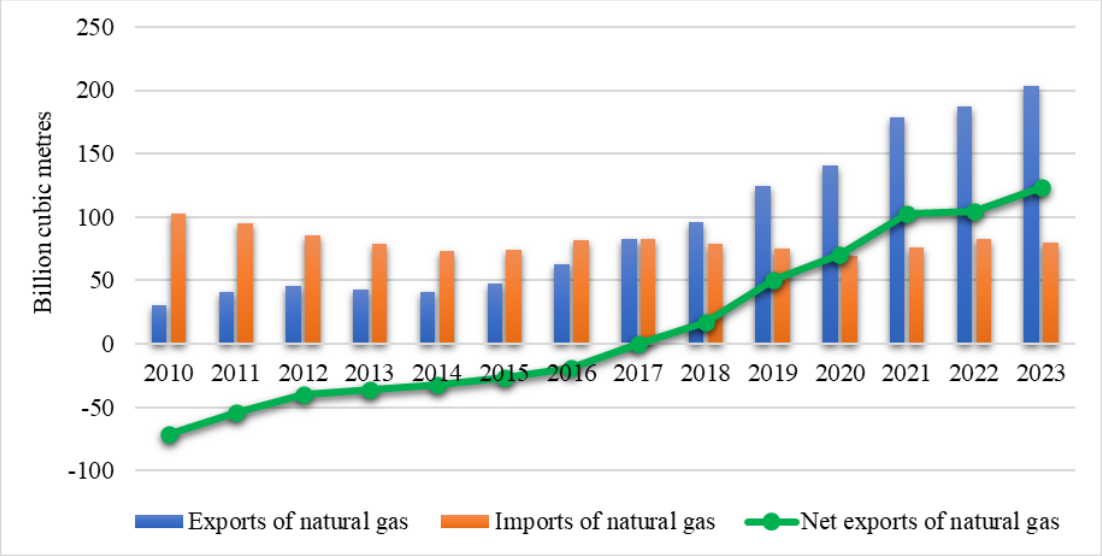

Figure no. 2. Dynamics of US exports and imports of natural gas
Source: (Energy Institute, 2024).

LNG exports from the United States increased 6.1 times in 2022 compared to 2017 (when the gas trade balance was zero), while the growth in pipeline gas exports was only 25.9% (Energy Institute, 2024). Naturally, in this situation, it is beneficial for the United States that European countries shift from importing pipeline gas to importing LNG. The structure of European imports changed significantly over the analyzed period. Starting from 2017, there has been a negative trend in the share of pipeline gas, which decreased by 1.1 percentage points compared to 2016, and for 2017-2022 by 32.3 percentage points (Fig. no. 3). This decline was caused by a decrease in pipeline gas imports from the Russian Federation by 54.9%. In 2017-2023, the share of pipeline gas fell by 39.5 p.p., and the reduction in pipeline gas imports from the Russian Federation amounted to 84.1%.

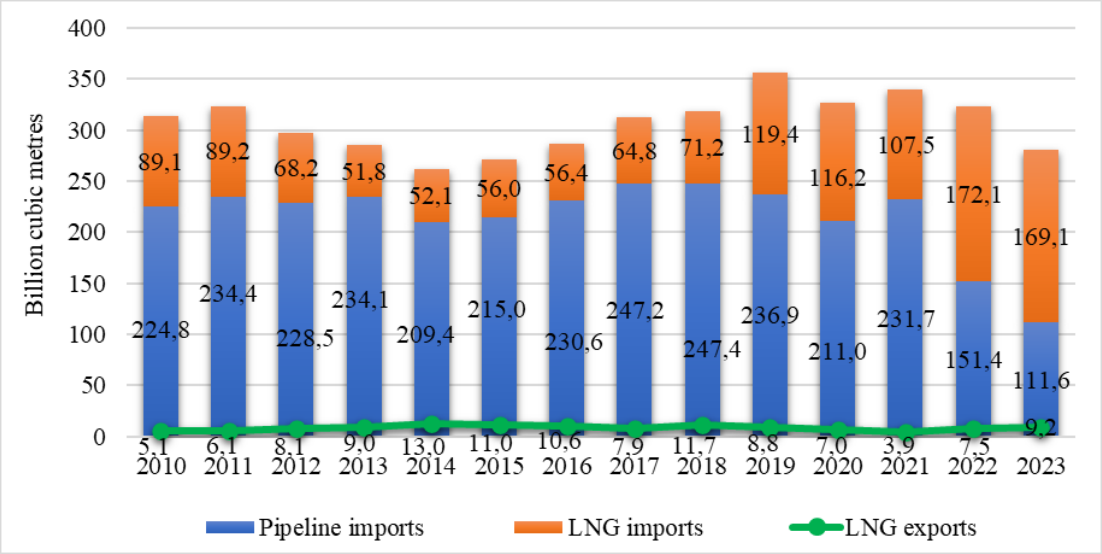

Figure no. 3. Dynamics of European imports and exports of natural gas
Source: (Trading Economy, 2024).

During 2017-2022, European LNG imports increased by 2.6 times, including to EU countries: to Belgium by 9.5 times, to France by 3.2 times, to Spain by 73.5%, to Italy by 72.3%. LNG imports to the UK increased by 3.8 times. At the same time, European LNG exports fell by 5.1%.

Changes influenced the increase in gas prices and the formation of energy prices. The gas pricing mechanism influences the role of natural gas in the country's energy balance. Over thirteen years (2010-2022), changes have occurred in Europe's pricing structure of natural gas. OPE price share decreased from 59.0% in 2010 to 17.4% in 2022, while GOG price share increased from 36.0% to 82.2% (Fig. no. 4). One of the main reasons for the transition of European importing companies from prices tied to crude oil or petroleum products to spot gas prices is the fact that the former exceeded the latter.

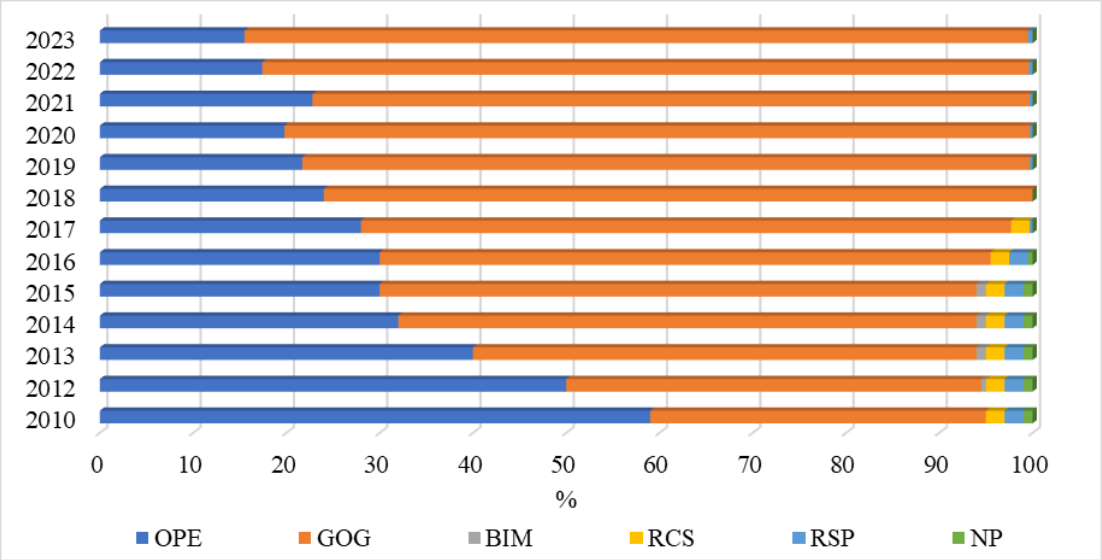

Figure no. 4. Gas price structure in Europe (consumption), %

Source: (International Gas Union, 2024).

Note: OPE – oil price escalation; GOG – gas-on-gas competition; BIM – bilateral monopoly; RCS – regulation price: cost of service; RSP – regulation price: social and political; NP – no price.

It should be noted that each pricing mechanism has both positive and negative sides. One of the disadvantages of setting gas prices in European hubs is that they are not sufficiently volatile and cannot function as a reliable pricing mechanism immune to manipulation by prominent exporting actors seeking to advance their interests.

The growth in global gas demand in 2021 amounted to 4.3% compared to the previous year, reaching 3913 billion cubic meters (International Gas Union, 2024). If a similar increase in supply does not meet the increase in demand, this leads to an increase in price. Economic growth after the recession caused by the COVID-19 pandemic is one of the factors in the rising demand for energy resources. In 2021, according to the International Monetary Fund, the real global GDP increased by 6.3%, that of advanced economies by 5.6%, emerging market and developing economies by 6.9%, and Europe by 6.0%. (IMF, 2024). In 2022, real GDP growth continued, but at a lower rate than in 2021. The higher the level of a country's development and the degree of industrialization of its national economy, the higher the consumption of energy resources and, consequently, the greater the demand.

Other reasons for the increase in demand are the cold front called "Beast from the East 2" that hit Europe at the beginning of 2021, and the increased need for indoor air conditioning in the summer due to the persistent heat. Naturally, as gas prices increased, the prices of other energy resources also rose: coal (South African) - by 3.1 times, Dubai oil - by 93.8%, Brent oil - by 91.9%, West Oil Texas Intermediate (WTI) – by 90.7% (August 2022 to August 2017) (Fig. no. 5). This price increase is inferior to the growth recorded in natural gas prices in Europe.

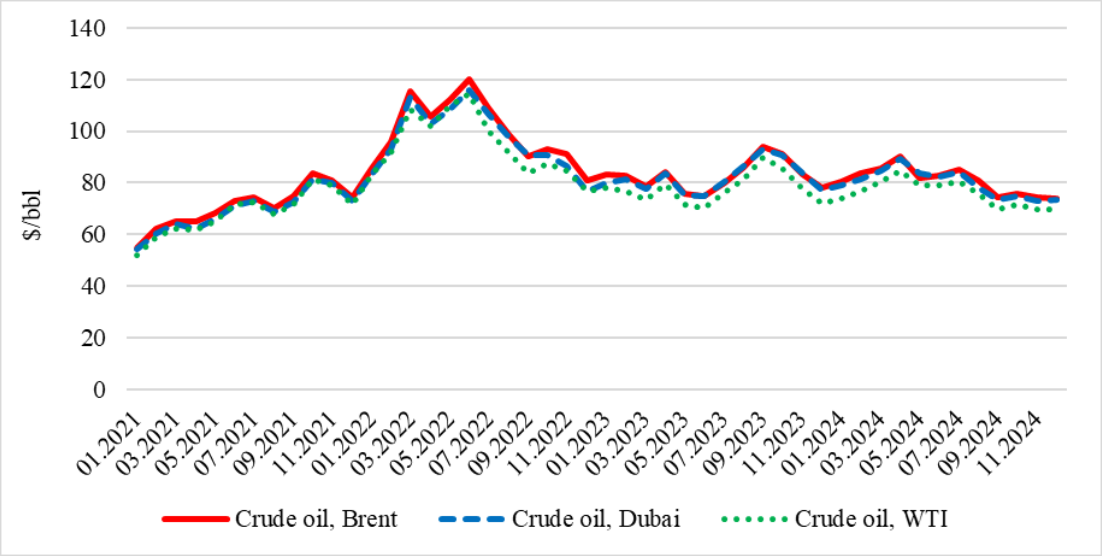

Figure no. 5. Monthly dynamics of oil prices

Source: (World Bank, 2024).

The change in the structure of the natural gas supply is due to several reasons. Firstly, European countries began to reduce the volume of pipeline gas purchases and abandon long-term contracts in favor of purchasing gas from hubs. Secondly, uncontracted volumes of liquefied gas were redirected to the Asian market, where the price was higher than in Europe. For example, in February 2021, the price of liquefied natural gas in the Asian market was 1.6 times higher compared to the price at the TTF hub, and by May 2021, both prices were almost equal.

Starting from June 2020, a rising trend in gas prices in Europe was registered during the analyzed period. According to ICE exchange data Futures, on August 26, 2022, the following maximum of natural gas futures was set at the TTF hub, for 339.20 euros per MWh (Trading Economy, 2024). One of the reasons is the low level of gas reserves in European storage facilities, which were at historical lows. According to the Aggregated Gas Storage Inventory, as of September 1, 2021, 752.534 TWh of gas had been stored in Underground Gas Storage (UGS), with storage capacity filled to 67.85% (Aggregated Gas Storage Inventory, 2024). The mistakes made in the previous year were considered, and by September 1, 2022, the gas storage level was higher, reaching 80.73%.

3. Energy transition in Europe: during the energy crisis and recent shifts

Any progress takes time; it is not feasible to abruptly abandon traditional energy sources without first ensuring the stability of green energy. Such a decision contributed to a reduction in the electricity supply. Nuclear and coal-fired power plants were closed, and calm weather for several months in northwestern Europe prevented wind energy production in 2021. Green energy is vulnerable, depending on the number of sunny and windy days. Ensuring round-the-clock and daily stable operation of a wind and solar power plant is impossible. At the same time, it should be noted that this type of energy is relatively green since today, there are no effective methods for recycling solar panels and blades from wind turbines.

The weather is unpredictable and brings surprises. Drought in the southern United States, for the first time in 10 years, caused hydroelectric generation to decline to a minimum. As a result, the Edward Hyatt power plant had to be closed, although it was the fourth-largest power plant in California. To provide the required amount of electricity, a decision was made to use coal and gas power plants more intensively, which led to an increase in carbon dioxide emissions in the United States and an increase in the price of coal.

As noted above, in 2021, in Europe, winters were comparatively colder and summers were hotter, while the period of calm was prolonged. Thus, the electricity demand increased, and the supply fell during this period. As a result, the UK was forced to reactivate the mothballed West Burton coal-fired power station instead of promoting green energy. If we compare natural gas with coal, the former is a relatively more environmentally friendly fuel.

As noted above, modern green energy is not as harmless as initially thought. Firstly, the frequencies generated by a wind turbine are harmful to the ecosystem, especially to birds, bats, and their habitats. Secondly, they create noise that harms humans in a specific sound spectrum. Thirdly, the blades are made of composite materials; today, no harmless technologies exist for their production. Instead of recycling, they are buried, which causes irreparable damage to the environment.

A similar situation is with solar panels, which are placed over large areas, can affect the climate, disrupting the natural temperature regime, and contain harmful substances such as lead, arsenic, copper, cadmium, gallium, etc. Solar panels are not yet sufficiently cost-effective; their cost is high. In addition, their service life is only 20-30 years. However, this period is not the limit; service life depends on the quality and production technology. For comparison, amorphous silicon modules (the first generation of thin-film technologies) have a service life of seven years or more, and monocrystalline solar modules have a service life of 30 years or more. Not only the production, but also the disposal of solar panels harms the environment.

The most vulnerable to the energy crisis are countries that do not have the necessary energy resources, cannot negotiate, and are economically dependent on donors such as the World Monetary Fund. The rise in prices for natural gas triggered increasing prices for other energy resources. Against the backdrop of worsening geopolitical confrontations and the exchange of sanctions, logistics ties were severed, which led to a shortage of energy resources, especially in importing countries.

A comparative analysis of the dynamics of the price of natural gas and the share of renewable energy in total net electricity production showed that the share of green energy did not increase during the energy crisis. In the months with a peak increase in the price of natural gas, the share of green energy fell. For example, in August 2022, the gas price was $ 70.04 / mmbtu, which is the highest price, 4.5 times higher than the price in August 2021. The share of renewable energy in August 2022 fell by 1.9 percentage points compared to August 2021 (Fig. no. 6). This decrease was caused by a decline in hydro electricity production by almost 18% and wind electricity by 14% in the analyzed period. In the post-crisis period, the share of green energy increased. It amounted to 51.6%, meaning more than half of the electricity produced, which is 10.2 p.p. higher than in August 2022. This growth was driven by a 1.5-fold increase in solar power generation, a 36% increase in wind power, and a 16% increase in hydropower.

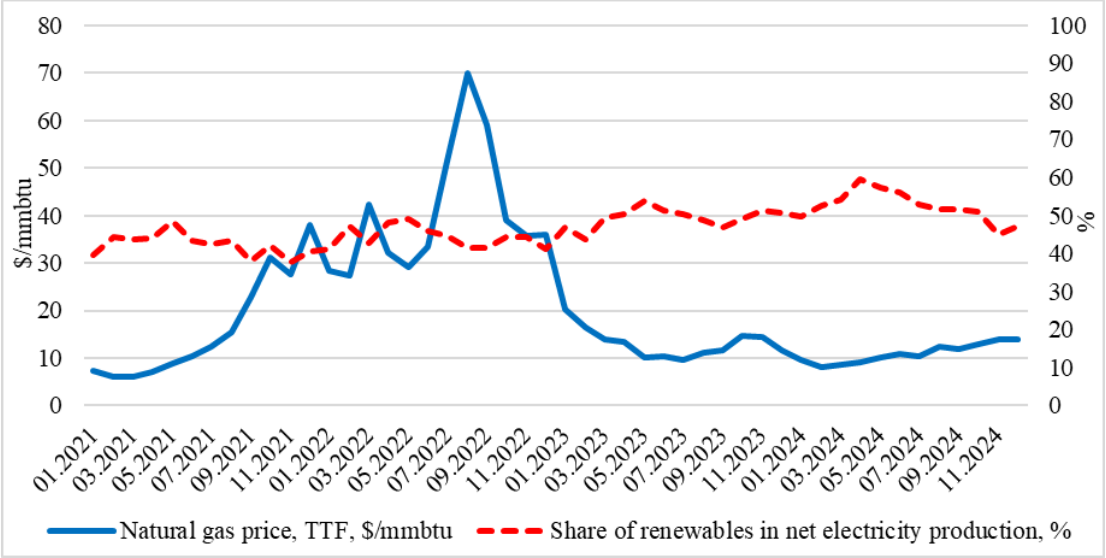

Figure no. 6. Monthly dynamics of natural gas prices (TTF) and the share of renewables in net electricity production (in OECD-Europe)

Source: (World Bank, 2024).

Note: Renewables include hydro, wind, solar, geothermal, other renewables, and combustible renewables.

4. Conclusions

A study of the European energy market has shown that the energy transformation that began long before the energy crisis slowed down during the crisis, but in the post-crisis period, the transition to green energy accelerated. This is because a lack of available capital for investment became evident in the European economy during the COVID-19 pandemic and the energy crisis, and energy transformation requires investment. In January 2021, hydropower accounted for the largest share of renewable energy sources, while in December 2024, wind power held the largest share, surpassing the share of electricity generated from natural gas.

Strategic recommendations for accelerating the energy transition in Europe: increasing investments in green energy and especially in energy storage; supporting research, development, innovation, and large-scale deployment of green energy technologies; effective implementation of the Net Zero Industry Act; increasing energy resilience through green energy diversification.

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