



Comparative Analysis of the Formation of Energy Resource Prices in the Republic of Moldova, Romania and Ukraine

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Abstract: Energy infrastructure plays a crucial role in the economic growth and development of a country or region, it is an essential component of economic development, contributing to production efficiency, innovation, resource diversification, cost reduction and sustainability promotion. The growing attention to natural energy resources is closely related to their limited supply. Natural energy resources such as oil, natural gas and coal are exhaustible. These resources are being extracted from the earth at a faster rate than they can be replenished. One day, these resources will be completely depleted, which will have significant consequences for energy supplies. In this context, the authors decided to study the price formation of these energy resources for the neighboring countries of the Republic of Moldova, Romania and Ukraine. Dependence on imported natural energy resources can make a country or region vulnerable to supply disruptions, such as geopolitical conflicts, energy transport bottlenecks, or problems in import sources. This can affect a country's economic stability and energy security.

Keywords: energy resources; price formation; economic development; energy crisis

JEL Classification: Q1; G0

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1. Introduction

The development of energy infrastructure is of critical importance in the current economic and social context. Energy infrastructure can contribute to economic growth and development in several ways. First, electricity serves as a key factor of production for entities that, research shows, have low substitutability with other factors of production and therefore can limit production when it is not available. Second, the state uses energy to provide key public services, including health and education. Third, electricity consumption can directly improve household welfare and create efficiency gains such as time savings, communication and educational investment. For users to value and use energy, it must be affordable and reliable. Accessibility is determined by infrastructure, including proximity to the network, but also the accessibility of network connections, highlighting the link between high connection rates and low access. Reliability is important to enable households and businesses to plan investments and activities. However, in many lower-income countries, blackouts are common and access to electricity fluctuates throughout the day due to infrastructure, markets and politics. The price of electricity also determines its value and use, which are informed by the costs of supply and the extent to which users pay their bills. Affordability and reliability interact with prices – for example, households may not be willing to pay a certain rate for an unpredictable service. At the same time, the lack of payments or even users could prevent investment in improving services (Jack, 2022).

Economic researchers studying the relationship between energy infrastructure and economic development have found mixed results (Ugur & Ramazan, 2003, pp. 33-37). David I. Stern in *Energy and Economic Growth: The Stylized Facts* published in the *Energy Journal* explored the relationship between energy consumption and economic growth, showing that adequate energy infrastructure is essential to sustaining economic development. Paul Krugman, Nobel laureate in economics, has argued that energy infrastructure plays a critical role in creating a solid foundation for economic growth. He emphasized the importance of investing in modern energy infrastructure to boost competitiveness and innovation in various sectors of the economy. Benjamin Sovacool in “The Political Economy of Energy” analyzed how energy infrastructure can influence sustainable economic development. His studies emphasize the impact of green energy infrastructure on economic growth and the importance of the transition to renewable energy sources to boost the economy without compromising the environment. Robert Ayres in “The Role of Energy in Economic Growth” analyzes the impact of energy on productivity and economic growth. contributed to the understanding of how energy efficiency and adequate infrastructure can increase economic productivity. Ayres pointed out that modernized energy infrastructure reduces operational costs and increases economic efficiency in various industries. Nicholas Stern, known for the Stern Report on the Economics of Climate Change, has argued that investment in clean energy

infrastructure is not only essential to combating climate change, but also to boosting economic growth. The Stern Review on the Economics of Climate Change includes a detailed analysis of how energy infrastructure can boost the economy in the context of an energy transition. Stern emphasized that investments in energy infrastructure can create new jobs and economic opportunities.

His studies point out that an increase in energy consumption is closely related to GDP growth, especially in developing economies. Focusing on the entire infrastructure network can help unlock the potential of energy infrastructure for development. Different parts of the energy infrastructure, and especially the power grid, are strongly connected and interdependent. Every connection must work well; investments in the weakest link can have the greatest transformative impact. For example, targeting transport infrastructure investment in the Philippines found substantial short-term welfare gains. In South Africa, investments in metering infrastructure have been found to have major impacts on consumption, revenue and infrastructure investment by utilities. Energy infrastructure builds on other forms of infrastructure, which can complement each other and help support wider economic development. For example, the cost of building electricity grid infrastructure could be lower where roads already exist. Roads and ports are generally important pieces of infrastructure that help provide energy services, such as the purchase of fuel used in power generation. Other infrastructure influences the prices of other factors of production, which in turn affect the impact of energy infrastructure on growth and development. Energy infrastructure will be more transformative when other markets are also poised for growth, such as well-functioning manufacturing and credit markets and active labor markets¹. Overo, K., Orubu, C. conduct a study examining the impact of transport and electricity infrastructure on economic growth, finding a significant relationship with growth but an insignificant relationship with economic development in sub-Saharan African countries (Overo, Orubu, & Ezi, 2024; Abdikarim & Lai, 2023).

Investments in energy infrastructure have a positive impact on economic growth in certain Asian countries. This study by Komal, Batool., Muhammad, Akbar recommends focusing on energy and telecommunication sectors to accelerate economic development (Komal & Muhammad, 2023). Govinda, R., Timilsina., David, I., et al find that increasing electricity generation capacity has a positive impact on long-run GDP, especially in developing economies (Govinda, David & Debasish, 2023). The energy field has become a laboratory of international and European governance and international legislation to which the national legal systems of states align. Until recently, the energy sector was almost exclusively a matter of national interest, subject to the domestic legislation of each country. The

¹ Z. Zhiznin. Energy in the modern world and international energy policy. UDC: 620.9: 327: 628.5. Available on page www.kantiana.ru.

increase in the degree of internationalization and globalization of the energy sector, as well as the strengthening of the energy interdependence of individual countries, confirms the thesis that it is impossible to ensure national energy security without solving the problem of international energy security at the regional and global level. At the beginning of the 21st century, two processes mainly influence the development of world energy. On the one hand, in the world energy markets there is growing competition between their main participants - energy-related companies supported by the governments of the states in which they are based, as well as by the associations of these states. On the other hand, interstate interaction and regulation in the global energy sector is significantly activated, which contributes to the development of global and regional energy policy centers. One of the reasons for such interaction is related to the desire of the leading "players" of the global energy field to avoid chaotic and uncivilized competition, as well as to take into account new risks and threats to energy security. The current stage of development of the world economy is characterized by structural qualitative changes. There are various assessments of this process, but a number of experts reach a common opinion about the existence of a system, the causes of which are the basis of the observed global transformations. One of the key components of the sustainable development of the world economy in the 21st century should be the implementation of the so-called "energy transition", or, in other words, the creation of a new efficient fuel and energy complex, which would not be technologically associated with the use of the dominant energy carriers of the previous technical specifications.

Due to the fact that the states of the world differ in the availability of their own energy resources, each state plans and implements its own sets of special measures for the search, extraction and rational use of energy resources. Depending on the availability of natural energy resources, each state independently creates its own energy system, the purpose of which is to obtain, transform, distribute and use all types of energy resources.

Thus, the growing attention to natural energy resources is closely related to their limited supply. Every year, the consumption of energy resources is increasing, which correlates with the growth of the world population. In the last 30 years, energy consumption has increased 1.6 times. The reason for this trend is the globalization process. Global energy consumption has an upward trend, from 1990 to 2019, the value of energy consumption increased by 64%. The correlation of energy consumption with global population growth can be traced when analyzing consumption in a geographical context. The main consuming countries of energy resources in terms of consumption are China, USA, India, Russian Federation, Japan, Germany, Brazil, Canada.

The average value of the growth percentage of global consumption in the period 2000-2018 was 2%. However, according to the Organization for Economic Co-

operation and Development, the increase in global energy consumption in 2019 was 0.6%. At the same time, in 2019, there was an increase in consumption in China (+3.2%), the Russian Federation (+1.8%), India (+0.8%).

Rapid population growth in developing Asian countries and the global economy is expected to increase energy demand by 30% by 2030. While by 2050 the demand for energy resources will increase by 40%. Industry, transport, residential and commercial buildings will remain the main consumer of energy resources (Yu, 2015, p. 28).

Further, the turbulence in global energy markets and the war in Ukraine have given new impetus to the development of renewable energy sources and the achievement of zero carbon emissions. Despite the strengthening international consensus on the energy transition, the associated obstacles are also becoming more apparent.

In addition to the uncertainty of the pace of development and implementation of technologies, four issues stand out in particular:

- restoring the priority importance of energy security for states;
- lack of consensus on the desirable and possible pace of the transition, due in part to the disruption of economic activity it may cause;
- growing tensions between advanced and developing states regarding the priorities of such a transition;
- obstacles to increasing production and building supply chains for the resources needed to achieve zero emissions.

In the past few years, the topic of the need for energy security has largely fallen by the wayside. However, the energy shock, subsequent economic difficulties, skyrocketing energy prices unimaginable two years ago, and geopolitical conflicts have combined to force many governments to rethink their strategies, so that it has been recognized that the energy transition must be inextricably linked with energy security, i.e. the availability of a sufficient amount of energy at affordable prices. This will help build public support and avoid major economic shocks that could have dangerous political implications.

The current global energy crisis did not begin with the invasion of Ukraine in February 2022, but in the late summer of 2021. The economic recovery that followed the lifting of the lockdowns related to COVID-19 led to an increase in global energy consumption. In the second half of 2021, the balance in the oil, natural gas and coal markets tightened, driving prices higher as demand collided with an already apparent lack of supply. In November 2021, three months before the invasion, the U.S. government announced the first sale of oil from the strategic reserve. It has become clear that “premature under-investment” prevents the development of new oil and gas fields in adequate quantity. There are a number of reasons for underinvestment,

including government policies and regulations, investor concerns about environmental, social and governance factors, low yields associated with two price crashes in seven years, and uncertainty about future demand. The reduction in investment was premature because of the mistaken assumption that sufficient alternatives to oil and gas would already be available by now. Some call what is happening the “first energy crisis of the energy transition”, meaning the result of a mismatch between supply and demand. If it turns out to be the first of many, it will create uncertainty, cause acute economic problems and undermine public support for the energy transition (Yergin, 2022, pp. 10-11).

The factors indicated above are perfectly applicable to the energy field of the Republic of Moldova, in the context in which the Republic of Moldova is not a closed state - it exists and develops only in correlation with other states in the world and, especially, with those in the region. The economy of the Republic of Moldova is a small open economy, the degree of openness of which was 74.9% in 2018 (Gutium, 2019).

In particular, I consider that there are several main factors that influence, at the moment, the energy field of the Republic of Moldova:

- the almost total absence of conventional energy resources, in the context in which the energy system of the Republic of Moldova is functionally based on the use of conventional energy resources (fossil fuels);
- the insufficient technical state of the energy infrastructure, especially with regard to natural gas and electricity infrastructure;
- the insufficient preparation of the energy sector of the Republic of Moldova for new technologies, which would allow the use of the natural resources that the Republic of Moldova has at its disposal (sun and wind);
- insufficient opening of the natural gas market and the electricity market, including the existence of monopoly / duopoly conditions in certain sectors of the markets;
- the influence of the political factor on the energy field, including cases where the choice of a development vector influences the market behavior of some strategic suppliers (such as PAO Gazprom / Russian Federation)

In such conditions, fluctuations on the international energy market have an immediate and direct influence on the energy field in the Republic of Moldova, for example, by drastically increasing the purchase prices of energy resources and decreasing security of supply.

The expert in the energy field, Călin Negură mentions that energy security is a complex concept, the achievement of which must aim to achieve the balance between the three dimensions on which it is based. With certainty, the laws of cyclical development are also applicable to energy systems. Under the conditions of an

ambitious world energy transition agenda, with the involvement of a large number of endogenous and exogenous factors, it is not surprising that the functioning mechanisms of the markets cannot and will not be perfectly adapted to all possible types and sources of influence. However, small nations with limited capacities are the most disadvantaged in the face of disruptions. The solution is national adaptation, alignment and integration into larger and more modern regional systems, relying on solidarity and mutual support.

In this context, the following priorities are imposed for energy policies in the Republic of Moldova:

- Continuation of consumer protection measures by rethinking and optimizing the compensation system for household and business consumers.
- Amplification of efforts to improve the resilience of the natural gas system and the diversification of supply sources by creating a national operative group for close cooperation with the respective group at the European Union level, for participating in the common platform for the purchase of natural gas and facilitating the transition to a heterogeneous internal market of gas, based on a mix of gas supply contracts, characteristic of a competitive wholesale market.
- Improving the resilience of the power system by combining the efforts of the Ministry of Infrastructure and Regional Development, ANRE and Moldelectrica Î.S. for the creation of a working group dedicated to the implementation of the wholesale electricity market and the facilitation of regional integration; facilitating the development of the electricity market study; facilitating the updating of the Electric Transmission Networks Development Plan with the examination of the opportunity to carry out other investment projects to improve the resilience of the electricity transmission system; facilitating the reorganization of Moldelectrica Î.S. and improving its corporate governance; the adoption of a pro-active role of ANRE and the operators of the transport and distribution systems in order to improve the administrative and technological processes of integration into the network of new capacities based on renewable energy sources.
- Appropriate prioritization and sizing of efforts to improve energy efficiency and capitalize on renewable energy sources by strengthening the institutional framework responsible for implementing policies in the field and mobilizing a volume of resources appropriate to the ambitions of rapidly reducing dependence on fossil resources (Negura, 2022).

The purpose of this section is to present a general analysis of the way energy resource prices are formed in the Republic of Moldova, compared to neighboring states such as Romania and Ukraine.

1.1. The Electricity Market

As will be indicated in the next chapter, at the moment, the electricity market of the Republic of Moldova applies:

- negotiated prices, resulting from demand and supply on the electricity markets; and
- regulated prices and tariffs, which include:
 - regulated prices for electricity and thermal energy produced by urban heating power plants;
 - regulated tariffs for the electricity transport service, including input and output tariffs;
 - the regulated tariffs for the electricity distribution service, including differentiated tariffs according to the voltage level of the electricity distribution networks;
 - the regulated prices for the supply of electricity by the supplier of last option and the universal service supplier, including binomial tariffs and differentiated prices according to consumption hours;
 - regulated tariffs for auxiliary services provided by the transmission system operator and the distribution system operator, including connection tariffs, energization tariffs and reconnection tariffs;
 - the regulated tariff for the electricity market operation service;
 - the regulated price for electricity supplied by the central electricity supplier.¹

In Romania, the electricity and natural gas markets operate in accordance with the European regulations on the internal energy market, which establish requirements related to the development of energy from renewable sources, environmental policy, the integration of balancing markets, as well as the interconnection of energy systems. The National Energy Regulatory Authority does not have the right to regulate the final price of electricity or natural gas, and its intervention in setting it is prohibited. Prices are formed on the basis of supply and demand, as a result of competitive mechanisms. Suppliers are free to set the price at which they supply electricity and/or natural gas. The National Energy Regulatory Authority has the obligation to establish only the tariffs for the transport, system and distribution services of electricity and natural gas and not the final prices.²

¹ Art. 86 of Law no. 107 of May 27, 2016 “on electricity”.

² ANRE – Electric energy market: <https://www.anre.ro/ro/energie-electrica/informatii-de-interes-public/info-piata-energie-electrica>.

However, by way of derogation from this rule, Emergency Ordinance no. 27 of March 18, 2022 establishes, given the situation determined by the price increase on the electricity markets, ceiling prices for electricity consumers:

- a maximum of 0.68 lei/kWh, including VAT, in the case of household customers whose average monthly consumption at the place of consumption in 2021 is less than or equal to 100 kWh;
- a maximum of 0.8 lei/kWh, including VAT, in the case of household customers whose average monthly consumption at the place of consumption in 2021 is between 100 kWh and 300 kWh inclusive;
- maximum 1 leu/kWh, including VAT, for non-household customers.
- maximum 0.31 lei/kWh, including VAT, in the case of household customers;
- a maximum of 0.37 lei/kWh, including VAT, in the case of non-household customers whose annual consumption of natural gas achieved in 2021 at the place of consumption is no more than 50,000 MWh, as well as in the case of thermal energy producers.¹

In Ukraine, the transformation process of the electricity industry began in 2019. The main changes affected the electricity sales mechanisms. Today, the purchase and sale of goods is carried out through electronic auctions, which ensure equal access for all participants in the electricity market. In addition, fundamentally new principles for the formation of the cost of electricity were formed in Ukraine, which depend only on the demand and supply existing in a certain period. To date, wholesale electricity trade is conducted in the form of electronic auctions through the trading system of the Energy Exchange of Ukraine.

As for the retail electricity market, prices remain regulated. Thus, the regulatory authority in the field of energy in Ukraine (National commission, *șko veche* state regulation in the spheres of energy and utilities) sets the prices for non-household consumers as follows:

- from January 1, 2023 – 380.28 UAH/MWh;
- from April 1, 2023 – 430.25 UAH/MWh;
- from July 1, 2023 – 485.1 UAH/MWh.

Also, a separate tariff for electricity transmission services is established for green electrometallurgical enterprises – 209.42 UAH/MWh.² Fixed prices for household

¹ Art. 1 Emergency Ordinance no. 27 of March 18, 2022. The act can be consulted at: <https://legislatie.just.ro/Public/DetaliiDocumentAfis/257154>.

² Ukrainian Energy Exchange. Principles of formation of the cost of electricity in Ukraine: <https://www.ueex.com.ua/rus/presscenter/news/printsiy-formirovaniya-stoimosti-elektroenergi-v-ukraine>.

consumers were set at 1.44 UAH/kWh (up to a volume of up to 250 kW) and at 1.68 UAH/kWh (up to a volume of more than 250 kW).

1.2. The Natural Gas Market

The following applies to the natural gas market in the Republic of Moldova:

- negotiated prices, resulting from demand and supply on the natural gas market; and
- regulated prices and tariffs, which include:
 - regulated tariffs for the natural gas transport service, including the harmonized entry/exit tariffs;
 - regulated tariffs for the natural gas distribution service, including differentiated tariffs according to the level of pressure in the natural gas distribution networks;
 - regulated tariffs for the natural gas storage service;
 - regulated prices for the supply of last option, for the supply of natural gas to certain categories of final consumers in the context of fulfilling the public service obligation;
 - regulated tariffs for auxiliary services provided by the transmission system operator and the distribution system operator, including connection tariffs and reconnection tariffs.

In Romania, the basic rule remains similar to the one applicable to the electricity market - prices are formed on the basis of demand and supply, as a result of competitive mechanisms. Suppliers are free to set the price at which they supply natural gas. The National Energy Regulatory Authority has the obligation to establish only the tariffs for natural gas transport, system and distribution services and not the final prices.¹ However, under the conditions of the current energy crisis, the Emergency Ordinance no. 27 of March 18, 2022, which sets the final price billed by gas suppliers at:

- maximum 0.31 lei/kWh, including VAT, in the case of household customers;
- a maximum of 0.37 lei/kWh, including VAT, in the case of non-household customers whose annual consumption of natural gas achieved in 2021 at the place of consumption is no more than 50,000 MWh, as well as in the case of thermal energy producers.²

¹ Decision of the Government of Ukraine no. 483 of June 5, 2019. The act can be consulted at: <https://zakon.rada.gov.ua/laws/show/483-2019-%D0%BF#n365>.

² Art. 98 of Law no. 108 of May 27, 2016 "on natural gas".

According to the Law of Ukraine on the natural gas market, the natural gas market operates on the basis of free fair competition, with the exception of the activities of natural monopolies, and on the principles, in particular, of ensuring a high level of protection of the rights and interests of natural gas consumers, including ensuring the primary interest of security of natural gas supply, free trade in natural gas and equality of natural gas market subjects regardless of the state under whose legislation they are established, free choice of natural gas supplier. The law provides, on the one hand, the state regulation of monopoly markets (transport, distribution, storage of natural gas), and on the other hand, the development of free and fair competition on the commodity market of natural gas. That is, the free price principle should apply to wholesale and retail natural gas markets. Thus, starting from March 1, 2023, the annual tariff for 1 cubic meter of natural gas for domestic consumers varies (depending on the supplier) between UAH 7.96 and UAH 9.99. For non-household consumers this tariff varies between UAH 22.26 and UAH 34.55.

1.3. The Oil Products Market

At the moment, in the Republic of Moldova, the prices of the main petroleum products are regulated by ANRE establishing the maximum prices for main petroleum products, the methodology for calculating and applying the prices of petroleum products, approved by ANRE Decision no. 446 of October 12, 2021. In 2021, with a sharp and continuous increase in the retail prices of petroleum products, ANRE returned to setting maximum prices for main petroleum products (but not for liquefied petroleum gas). Thus, on November 30, 2021, a new methodology for calculating and applying prices for petroleum products entered into force, approved by ANRE Decision no. 446 of October 12, 2021, which is still in force today. The maximum retail prices of the main standard petroleum products are published by ANRE every working day until 12:00, being in force starting at 00:01 of the following day in which it was established.

In Romania,¹ the field of distribution of petroleum products is at a strong competitive level, in continuous development and includes both the state network of SNP Petrom and a multitude of other networks belonging to well-known foreign or domestic private companies (SHELL, MOL, LUKOIL, OMEGA, OMV, AGIP, NOVA,² etc.)

As for Ukraine, in May 2022 the Cabinet of Ministers decided to abandon state regulation of fuel prices. Now fuel operators will set the price of petrol and diesel independently. Previously, there was a clause in force that established a maximum level of commercial margin for petroleum products in the amount of a maximum of

¹ Romanian Ministry of Finance: Energy Sector: <https://www.mfinante.gov.ro>.

² ANRE – Electric energy market: <https://www.anre.ro/ro/energie-electrica/informatii-de-interes-public/info-piata-energie-electrica>.

7 UAH (including VAT), which is added to the average cost of 1 liter of diesel fuel, and a maximum of 6.5 UAH (including VAT), which is added to the average cost of 1 liter of gasoline.¹ The decision to cancel the maximum trading margin for gas stations was made so that market operators could saturate the Ukrainian oil market with the required amount of fuel in the face of war shortages.²

The development of energy infrastructure is timely and necessary to address global energy and climate challenges, to stimulate sustainable economic growth and to ensure equitable access to energy for all segments of society (Gribincea, Kara, Şargu & Valeeva, 2021, pp. 191-208). We believe that these reasons contribute to the development of the energy infrastructure.

Increasing global energy demand: As the global population grows and economies continue to develop, the demand for energy is constantly increasing. The development of energy infrastructure is essential to meet this demand efficiently and sustainably, thereby preventing possible energy crises that can have destabilizing effects on economies.

Transition to clean energy: Climate change and the negative impact of carbon emissions have heightened the need for a transition to renewable and clean energy sources such as solar, wind and hydropower. Developing the necessary infrastructure for these sources is essential to reduce dependence on fossil fuels and to meet international targets for reducing greenhouse gas emissions.

Energy security: Development of energy infrastructure helps diversify energy sources and reduce dependence on foreign imports, which increases a country's energy security. Modernized and well-maintained infrastructure reduces vulnerability to supply disruptions, including those caused by political or economic instability in energy-producing regions.

Economic efficiency and competitiveness: An efficient and modern energy infrastructure can reduce production costs for businesses, which allows them to be more competitive in global markets. Investments in energy infrastructure can also stimulate technological innovation, which helps create new industries and jobs.

Access to energy and poverty reduction: The development of energy infrastructure is crucial to expand access to electricity in disadvantaged or rural regions, thereby contributing to improving the quality of life and reducing poverty. Access to energy is a determining factor for economic and social development, facilitating access to education, health and other basic services.

¹ NERC: Natural gas prices for domestic consumers <https://www.nerc.gov.ua/sferi-diyalnosti/prirodnij-gaz/pobutovi-spozivachi/cini-na-gaz-prirodnij-dlya-pobutovih-spozivachiv>.

² Ministry of Finance of Ukraine: Tariffs for natural gas: <https://index.minfin.com.ua/tariff/gas/prom/>.

Digitization and smart infrastructure: Technological progress in digitization and the development of smart grids require a modernized energy infrastructure that can integrate and efficiently manage various energy sources and improve the reliability and resilience of energy systems.

Economic and climate resilience: A robust energy infrastructure contributes to economic resilience, enabling economies to better withstand external shocks such as natural disasters or energy market fluctuations. A well-developed infrastructure can also play a vital role in adapting to climate change, reducing the vulnerability of communities to its impacts.

Investment attraction: Countries with modern energy infrastructure are more attractive for investment because they offer a stable and predictable environment for doing business. This can stimulate economic growth and generate new development opportunities.

There is a significant increase in interest in renewable energy resources and energy conservation measures. These approaches can help to diversify energy supply, reduce environmental impact and ensure long-term energy supply. Ensuring long-term energy supply requires an integrated and strategic approach that includes diversifying sources, improving infrastructure, increasing energy efficiency and security, and promoting technological innovation. By implementing these measures, we can create a more secure, sustainable and resilient energy system capable of supporting long-term economic growth and societal well-being.

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