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Editorial

Economic Aspects of Energy Production, Distribution and Consumption

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1. Introduction

In a dynamically changing socio-economic environment, the key factors driving the development of the modern economy and social progress are financial aspects, access to markets, technological innovations and ensuring access to energy. Specifically, efficient energy sources are essential not only for sustaining and developing industrial production but also for the uninterrupted functioning of societies. Scientists are continuously exploring the links between economic development and energy issues, providing insights for shaping optimal energy policy under given conditions. This article will provide an overview of the latest results on the economic aspects of contemporary issues related to energy problems, which were submitted to the Special Issue "Economic and Policy Challenges of Energy".

Contemporary energy challenges are extremely complex and involve issues related to the production, distribution and consumption of energy. All of these concerns are interconnected, and solving energy problems requires a comprehensive approach. Hence, effective energy policy requires a holistic approach, considering technological, social and economic aspects.

The key issues linking the economy with energy policy that modern societies should address include the following:

- Energy security—Ensuring stable energy supply with required parameters; the diversification of energy sources and the creation of energy reserves; supporting technological innovations and energy efficiency; integrating the energy market at the national and international levels [1].
- Energy demand management—improving energy efficiency, enhancing energy infrastructure and consumer installations, energy storage and resource planning, technological advancements in real-time consumption monitoring and remote device control, load distribution, cooperation with large energy consumers, tariff programs and demand flexibility [2,3].
- Technological innovations—modern nuclear reactor technologies, hydrogen energy, clean coal technologies and smart grids; the optimization of energy production, distribution and storage processes; the Internet of Things (IoT) and energy consumption monitoring and optimization systems at the individual user level [4–6].
- The evolution of energy systems from centralized to decentralized systems—the development of prosumers; systems supporting energy trading between prosumers; blockchain transaction security in distributed energy production systems [7,8].
- Sustainable development and energy transition—renewable energy sources such as wind energy, solar energy, biomass and geothermal energy; investments in new technologies, infrastructure and changes in the production and use of energy [9,10].

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- Energy storage technologies, stabilizing electricity grids and hydrogen fuel cells (energy storage and electricity generation) [11,12].
- Electromobility and charging infrastructure [13].

The character of the implemented energy policy strongly influences a wide range of economic, social and environmental aspects that determine the development of modern economies and societies. Contemporary energy policy combines economic development with environmental protection, favors cleaner energy sources and promotes efficient resource management. Changes in energy systems can have a significant impact on societal development, influencing social transformations. Properly managing energy policy can be a key element in ensuring long-term economic growth and stability.

The articles gathered in the Special Issue "Economic and Policy Challenges of Energy" are useful for researchers, economists and engineers dealing with energy and economic issues.

2. Review of New Advances

For evident reasons, the articles published in this Special Issue do not cover the entire spectrum of contemporary challenges facing energy policy and energy systems. The issues most widely discussed in this Special Issue are topics related to the production of renewable energy and selected aspects of energy transformation. Contribution 1 presented a comprehensive analysis of the issue of renewable energy in Romania as a key way to combat climate change and reduce dependence on fossil fuels. The energy sector was analyzed from a holistic perspective as a complex adaptive system. The authors treated the energy sector as a cybernetic system and assessed the short- and long-term impacts of greenhouse gas emissions and renewable energy on real GDP per capita. Based on econometric methods, the authors demonstrated that, in the long run, greenhouse gas emissions negatively affect GDP, while increasing the share of renewable energy in the energy mix has a positive impact on GDP. In the short term, both the reduction in emissions and the development of renewable energy had a positive impact on GDP per capita. This study aligns with the trend that sees the greatest challenges of the 21st century in relation to societies, where the main growth factor is greenhouse gas emissions, and climate change destroys ecosystems, destabilizes economies and increases the risk of natural disasters [14].

The issue of using biomass for electricity production was addressed by Contribution 2. Biomass has great potential for electricity production, especially in countries with a developed agricultural and forestry sector. The use of biomass for electricity production has advantages such as the utilization of waste, the renewability of organic waste production, CO^2 emission reduction, improved energy security and contributing to the development of regional economies and the creation of new jobs [15,16]. The disadvantages of this technology include higher costs compared to traditional coal-fired power plants, low energy efficiency, pollution resulting from the combustion process and changes in land use for agriculture [17].

The results of research on the potential use of selected biomass waste for the production of solid biofuels were presented in Contribution 3. The authors demonstrated that torrefaction pretreatment can improve the physicochemical properties of raw biomass to a level comparable to coal and can be useful in converting biomass into valuable solid biofuel. Generally, biomass conversion (pelletizing, briquetting, pyrolysis, gasification) aims to transform raw biomass into fuels with higher energy density, which increases its energy efficiency and facilitates the transportation and storage of fuels [18,19].

The research presented in Contribution 4 addressed the issue of the economic conditions for investments in wind energy. The authors emphasized the need to maintain support mechanisms for wind energy to reduce uncertainty related to the variability in

market conditions and climate factors. The main factors affecting the economic efficiency of wind energy investments are the location of the turbine, technical conditions (turbine height, installed capacity, lifespan, efficiency, rotor diameter, operating time, construction time), economic aspects of the investment (investment costs, operation and maintenance costs, depreciation, land lease, avoided energy costs), political conditions (interest rates and taxes, energy sale price, inflation, financing conditions) and climatic conditions (wind speed, temperature, air pressure, air density) [20].

Consumers of energy services in emerging economies typically pay high rates of return to transmission system operators, which results from the method used to estimate the cost of equity. Contribution 5 deliberated an alternative methodology for calculating the cost of equity based on a multifactor model to explain changes in the rates of return from the portfolios of electricity companies. The issue of assessing the economic cost of generating and delivering electricity in the context of investments in renewable and low-emission energy sources, as well as the limitations on electricity consumption in industry following the COVID-19 pandemic and their impact on the liquidity of energy companies, was discussed in Contribution 6.

Some authors suggest that the stability of electricity systems primarily depends on the installed capacity of power plants, the ability to import electricity and the condition of the distribution network in relation to the widespread adoption of renewable energy. Increasing load peaks will continue to pose greater challenges for electricity generation and the electricity grid in the future [21]. The outcome of the Contribution 7 suggested the need for a transformation of modern energy systems towards local, resilient energy supplies to ensure energy security.

A component of optimizing electricity systems is the management of energy generation and consumption [22,23]. Contribution 8 presented the results of considerations on the issue of limiting excessive growth in electricity consumption and improving the distribution of electricity infrastructure at the regional level in the context of economic development. Contribution 9 showed the rationalization of energy consumption in pick-and-place operations performed by robots. The energy consumption planning process using cost optimization based on short-term fluctuations in electricity prices was demonstrated by Contribution 10. The researchers addressed the issue of managing energy consumption through production planning by shifting energy-intensive processes to periods of favorable electricity prices.

Contribution 11 showed the results of research on the effects of implementing sustainable strategic management in methane projects in one of the largest mining companies in the EU. The key outcome of the project was the initiation of self-generated energy production based on methane emitted by the mines.

An important theoretical and practical issue is the essence of the concept of energy security considered by Contribution 12. In a dynamically changing environment, the concept of energy security undergoes systematic changes. The authors treated their review article, based on a narrative review of the scientific literature, as a platform for debate on the essence of energy security, its components, theoretical frameworks and its future evolutionary directions. The research showed that energy security concepts focusing on supply-side aspects of energy are giving way to ideas where energy is perceived as a factor initiating deep transformations of society through reducing energy consumption by imposing energy efficiency standards and environmental standards and changing consumption patterns.

3. Conclusions

The articles published in the Special Issue "Economic and Policy Challenges of Energy" discuss various aspects of energy generation, distribution and consumption in the context of the latest challenges facing not only energy systems but also entire societies. The presented issues are interdisciplinary, covering technological, economic, environmental and social aspects. The authors referred to the ongoing energy transition, viewing it not only as a change in energy production technologies but also as energy management and consumption practices. The articles emphasize that contemporary challenges facing energy systems and societies require not only adaptation to new technologies but also cooperation at both international and local levels to ensure sustainable development and energy security.

The articles collected in the Special Issue "Economic and Policy Challenges of Energy" enable the reader to gain a better understanding of the discussed issues, assess their consequences and anticipate future trends, while also indicating directions for future research that are essential for the development of modern energy systems.

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