

Editorial

Economic Analysis and Policies for the Environment, Natural Resources, and Energy

George Halkos 

Laboratory of Operations Research, Department of Economics, University of Thessaly, 28 Octobriou 78,
38333 Volos, Greece; halkos@uth.gr

Blueprinting sustainable development pathways is by no means plain sailing. The conservation of natural resources, investment in sustainable energy development, and the preservation of environmental ecosystems are at the core of state-of-the-art policymaking agendas. However, herein lies the importance of adequate economic analysis through qualitative and quantitative techniques and the provision of suitable region-focused, technology-driven, and human-centered policies. In a nutshell, economic analysis and policies for the environment, natural resources, and energy would pave the way for fruitful advances in sustainable development.

Another significant contribution to the energy sector would be enabled through the alignment of policymaking processes with environment social governance (ESG) strategies and sustainable development goals (SDGs), inter alia, SDGs 7, 9, and 12. ESG might ameliorate the energy sector's productivity performance, as core human-centered values would be covered in the entire governance structure.

This Special Issue has collected outstanding research efforts and publications that showcase advances in human development, renewable energy technologies, natural resource preservation, growth, and degrowth, aiming to bring together novel know-how and expertise based on these papers' contributions to the relevant literature. This has been accomplished through the examination of interactions between economic systems and environmental performance. Moreover, a plethora of policy implications are presented that aspire to promote decision-making processes, innovation, and information technologies.

Various papers were reviewed and selected based on their explicit purpose, contribution to the literature, methodology, and applicability in real-life situations. The results of these papers show new directions that should be followed, providing motives for future scientific studies, enriching existing knowledge, and increasing the effectiveness of relevant decision-making processes.

This Special Issue adds to the broader attempt to achieve a superior performance at the interface of socioeconomic and natural resource systems, maximizing social benefits and sustainability potential. One particular aim of this Special Issue lies in bringing together different approaches under multidisciplinary research efforts investigating the multifaceted character of the economy regarding environmental and energy concerns. Specifically, this economic and policy analysis elaborates on increasingly raised concerns about resource quality, availability, consumption, and market challenges. Natural resources and ecosystem services suffer from (i) intense, (ii) growing, and (iii) competing uses that adversely affect socioeconomic systems. In many cases, ineffective management and unplanned development of natural resources dominate relevant economic activities.

Consequently, an environmentally sound response to limit a system's vulnerability requires concrete scientific steps and long-lasting, robust management plans derived from empirical research. Unwise resource exploitation leads to lowering resource availability. To improve the performance of the whole system, we must improve the relationships among its parts. This is a challenging task if we consider that socioeconomic and natural systems are dynamic and differentiated in space and time under volatile market and economic



Citation: Halkos, G. Economic Analysis and Policies for the Environment, Natural Resources, and Energy. *Energies* **2023**, *16*, 6578. <https://doi.org/10.3390/en16186578>

Received: 17 July 2023

Accepted: 15 August 2023

Published: 13 September 2023



Copyright: © 2023 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

conditions. The multifaceted character of such systemic situations allows for questioning where the limits are and which is the most advantageous way of putting fundamental solutions into practice and resolving issues sustainably in the long run.

Many scientists from different disciplines and under multiple perspectives acknowledge the importance of living, acting, growing, and improving in a safe and healthy environment where business goals and objectives, humans' well-being, and the natural environment interact to form a system, the performance of which extensively regulates our quality of life and business viability. We need a holistic, well-developed, and integrated plan that does not restrict growth and profitability but, at the same time, allows for managing and utilizing the environment and energy sources without depleting natural resources.

Growth in the demand for resources has led to significant shifts in the way that individuals/society and nature interact, the scale at which this occurs, and most notably, the schemes through which these resources are harvested to ensure a sustainable and shared future. No one would deny that the ultimate goal is to reach a state of environmental and human well-being, or at least to aim towards this by establishing a relevant, flexible business character (culture) and employing methods, tools, and techniques to transform scientific knowledge into applicable and viable business plans encompassing a holistic, systemic vision of growth and development. We need to resolve the problem of environmental degradation within the economic system. We do not want the problem to resurface after a decade due to a lack of willingness or resilience to symptomatic solutions.

Prerequisites that form a structured approach for combating the depletion and degradation of natural resources are based on the lessons learned from previous (i) quick fixes or suggestions; (ii) outstanding and well-justified research efforts, (iii) proper analysis and communication of results; (iv) expert judgment; (v) enhancement of a win-win approach among diverse users; (vi) financial assistance and support; and (vii) interdisciplinary projects. Measurements and indicators that forecast natural resource and economic systems' performance will greatly assist in reducing time-consuming processes, overbudgeting, discrepancies, restoration expenditures, and user dissatisfaction.

In light of such arguments, receiving the full benefits of natural systems without losses of resources, money, or time would find all crucial stakeholders satisfied and environmentally sensitive. Scientists, policymakers, spatial planners, local society, governments, investors, and entrepreneurs form and shape an "organization" that learns and is composed of multiple needs and wants, preferences and demands, pursuits, and expectations.

The main goal of this Special Issue lies in enhancing the never-ending pursuit for optimal outcomes within the limits set by natural dynamics and socioeconomic forces. It provides arguments for making sound decisions on the sustainable use of natural resources with unique characteristics and under various research schemes. The unwise use of resources or, even worse, inefficiency in allocating resources, leads to dysfunctions and discrepancies that affect natural systems. All core and dominating fields that profoundly encompass the meaning of sustainability have suffered, more or less, from market failure phenomena.

To keep the momentum active, the concept of sustainable energy and environmental management should be directly integrated into holistic approaches to managing natural resources while at the same time acting as an economic stimulus for various target beneficiaries: individuals, society, entrepreneurs, and industry.

Our contribution to these concepts and analyses lies in systemically considering natural resource management, environmental quality, improvements, and investments alongside the increasingly scarce ecosystem services in real-life circumstances. Accordingly, the arguments presented in this Special Issue can be elaborated upon and incorporated into additional analyses. Studies attempting to do so may benefit from the relevant research and knowledge presented herein.

Within this framework, this Special Issue, “Economic Analysis and Policies for the Environment, Natural Resources and Energy”, considers economic analysis alongside up-to-date, sophisticated empirical and theoretical methods applied to various environmental, resource, and energy issues. Notably, it features sustainable policy performance measurements put into hypothetical and analytical practice. It presents meticulous research on sustainable energy policy development; provides energy policy initiatives targeted at achieving socioeconomic goods/benefits, capturing sustainability obstacles, and overcoming negative environmental impacts; and highlights links and interactions between economic and environmental systems. The anticipated outcomes include setting targets, recommending models for sustainable growth and energy policies, and analyzing policy interactions.

This Special Issue presents a collection of high-impact and high-leverage research papers concerning major strands in the literature. Results differ based on the group of countries investigated, the econometric models adopted, the data format, the time frames due to data availability, and the proxies used to conceptualize, *inter alia*, energy, environmental degradation, and economic growth. All studies demonstrated practical implications for optimizing resources and processes in terms of a better quality of life and meeting the social demands of the sustainable development goals.

The natural environment is not treated like other common goods and services in real markets. It has unique characteristics that we should take into account before exploiting ecosystem services such as energy. Science employs dependable approaches to decode how nature’s dynamics are linked to market conditions and real-life situations. The use of such resources and goods impacts the economy depending on how we perceive, act, and behave. To sum up, it is time to act and think wisely and use our expertise and knowledge to gain environmental benefits in the long run.

How can we describe environmental and energy resources properly? Undoubtedly, this can be achieved through the complexity and intricacy of system dynamics. These natural systems experience intense pressures from various driving forces causing fundamental problems such, as resource use conflicts and the depletion and degradation of these resources. Consequently, the performance of natural and socioeconomic systems is declining. By understanding the local and regional dynamics of social–ecological systems, transition processes towards sustainability can be put into practice. We can keep pace with this green transition by incorporating several dimensions, such as spatiotemporal patterns of resource and energy use, the economic and social sectors, habitats, and legislations. Integrated and sustainable solutions related to environmental problems and energy demand, production, and consumption issues reflect the classical path of innovation. This is a well-known path that incorporates scientific research and new products to service society’s needs. This scientific theme has sparked debate on aspects related to the following:

- Addressing environmental problems;
- Decreasing environmental pressures;
- Mitigating environmental risks;
- Identifying barriers limiting progress and business investment;
- Decoding environmental limits that restrict growth.

This endeavor is reinforced by combining concepts from a broad range of sectors and fields in light of developing and deploying practices for effective environmental and energy management. Thorough scientific analyses with robust policy implications are elaborated in the following discussion.

One core research field covered in this Special Issue is testing the Environmental Kuznets Curve (EKC) hypothesis. Ekonomou and Halkos [1] provided an overview of trends and developments concerning two significant strands in the literature: the EKC hypothesis and the energy-growth nexus. This paper reviews contemporary research articles that elaborate on the relationships between all pillars of sustainability, *i.e.*, economy, society, and the environment. Specifically, this review underlines the first research attempts in the context of the EKC hypothesis made by Halkos [2] and how these attempts were improved

in the following years (Halkos [3]). This review aimed to discover less visible or untested explanatory variables and their impacts on environmental degradation levels. Given the importance of tourism globally, researchers could test the EKC hypothesis in the context of high-impact, dynamic, profitable, and relevant market segments with noticeable predictive power. Also, the authors elaborated on the energy-growth nexus by offering a robust empirical and reference framework within environmental economics. This review aimed to investigate how a wide range of economic determinants and other control variables impact energy use and provide evidence for how the natural environment can be sustainably managed and utilized considering future energy outlooks and causalities with economic growth. All reviewed and selected articles enrich the relevant literature and provide new motives for future research efforts at the socioeconomic system and environment interface. Low rates of environmental performance can be avoided or significantly limited if the countries under investigation achieve sustainable economic growth while limiting CO₂ emissions. This review indicates that these countries should alter their energy mix by increasing the share of renewables. Moreover, one point highlighted by the authors is the energy efficiency concept, which helps limit relevant demand without compromising the outcome or task.

Mar'I et al. [4] investigated the role of fiscal policies in preventing environmental degradation regarding G20 countries. They investigated whether selected economy-related variables affect environmental quality levels in terms of CO₂ emissions. The growth variables used covered a wide range of the economic system. They adopted the traditional metric of GDP in addition to financial development and a financial index for government spending and tax revenues. Financial development was conceptualized as the degree of development of financial institutions and markets. Government spending was contextualized as government expenditure in a given year as a percentage of GDP, whereas tax revenue was defined as compulsory transfers to the central government for public purposes as a percentage of GDP. The authors also considered the total number of patent applications as an additional explanatory variable, known as the technology factor. A panel data analysis was carried out for the G20 countries. This study adopted the autoregressive distributed lag of pooled mean group (ARDL-PMG) approach to analyze the proposed model. Specifically, two models were analyzed using the ARDL approach with three estimators: MG (Mean Group), PMG (Pooled Mean Group), and DFE (Dynamic Fixed Effect). The results confirm an inverted U-shaped correlation between economic development and CO₂ emissions. The research findings also reveal that financial development is inversely proportional to carbon dioxide emissions, whereas technology combats CO₂ emissions since technological progress leads to decreased CO₂ emissions. Interestingly, the study found fiscal policy does not help reduce carbon dioxide emissions. Considering these results, the authors indicate considerable practical implications. Fiscal policies ought to be reviewed and redirected to limit CO₂ emissions. Furthermore, governments should advance policies that support environmentally friendly technological advancements.

Additionally, the concept of green growth is fundamental in our modern world. Green growth is deeply interrelated with using renewable energy sources and the concept of energy efficiency. From this perspective, Kwon et al. [5] claim that one solution to reducing electricity consumption is to replace the existing power system with a hybrid energy system that uses renewable energy, given that it passes technological and economic feasibility tests. The authors also claim that hybrid systems generally use several technical devices to respond to output fluctuations, whereas they can benefit from main electric power systems. Notably, this research enriches the relevant literature since it expands the application of hybrid energy systems adapted to private areas such as department stores and amusement parks. In the context of renewables, Stamopoulos et al. [6] investigated the role of renewable energy as a determinant of growth. The country of interest was Greece, and the authors explored whether the broader effects of this transition could offset the negative impacts due to the targeted phasing out of lignite plants by 2028. They used input-output analysis to estimate the net effects of a series of monetary shocks corresponding to Greece's phase-out

investment plan. Research findings suggest that though lignite power production still contributes considerably to the country's economy, investing in renewable energy sources constitutes a significant opportunity for value-added energy production and job creation. Moreover, Zhou et al. [7] examined the impacts of outward foreign direct investment (OFDI) on host country energy consumption and home country energy efficiency based on a Belt and Road perspective. The country of interest was China. The research findings indicate that the impact of China's OFDI on energy consumption in host countries has been lower than that in neighboring countries and increased significantly after 2014. Additionally, the research disclosed that the space network of energy consumption in Belt and Road countries has a strict hierarchical structure. Furthermore, identified reverse spillover effects concerning OFDI, FDI, domestic R&D absorptive capacity, human capital, and financial development levels could improve energy efficiency levels in China, contrary to regional professionalism, which has the opposite effect.

What is the relationship, however, between green growth and ESG in the energy sector? Green fiscal policy and ESG performance might enable policymakers to achieve the greatest productivity performance possible. Nevertheless, Miao et al. [8] showcased the possibility of green growth amelioration, however, at the cost of ESG performance. The analysis focused on Chinese A-share listed companies via the staggered difference-in-difference method. It was concluded that green growth strategies could reduce the ESG performance, and even worse, this negative impact accelerates over time. Moreover, Nitlar and Mayakul [9] examined the relationships between ESG and the triple—people, business, and technology—transformation. A mixed-methods approach was utilized in the analysis through the combination of (i) fuzzy-set qualitative comparative analysis (fsQCA) and (ii) structural equation modeling (SEM). As a result, the triple transformation has ushered in positive ESG performances, making it possible for those businesses which adopt ESG strategies to outperform their competitors. Overall, the one study showed that the adoption of ESG might lead to greater environmental degradation; nevertheless, based on the other study, the energy sector businesses which utilize an ESG agenda might surpass their rivals.

Managing natural resources remains a contemporary issue for research. Kulisz et al. [10] used an artificial neural network to forecast the water quality index of groundwater. The research findings reveal that using selected physicochemical parameters of water is a convenient approach to modeling the water quality index with satisfactory and appropriate accuracy, aiding water treatment and management. Another interesting research topic in the context of this Special Issue was covered by Bampatsou and Halkos [11]. The authors elaborated on non-parametric computational measures for the analysis of resource productivity. This study mainly aimed to identify best practices that can be included in decision-making processes to reduce productivity loss. The results indicate weak areas of individual countries and suggest improvements concerning productivity by considering the main driving force behind productivity and technical efficiency change. The core implications of this research highlight the need to use relevant technological developments effectively. Based on their research, the authors assert that these developments are important determinants of relevant strategic information for ensuring managerial performance. Furthermore, Iverson et al. [12] investigated the effectiveness of subnational jurisdictions in collectively enacting greenhouse gas abatement strategies. The primary purpose was to construct a model to investigate relevant conditions to achieve agreement among subnational jurisdictions within a country to considerably lower carbon emissions according to a national policy determined through majority rule.

Considering all of the above, the good ecological status of the natural environment offers a wide range of benefits to humans. As a result, we need to measure, monitor, and control emissions, research and develop relevant strategies, gather information, and disseminate scientific knowledge related to environmental protection. At the top of the policy agenda ought to be the advanced methodologies aiming at natural resource and energy management to safeguard the provision of environmental goods and services. Most importantly, the policy agenda must ensure that these goods and services are non-rivalrous

and non-excludable in the long run in terms of quality and sustainability. This assurance of quality would enable the non-restricting viability of the economic system. This is the balancing point all of us—having different viewpoints within academia and the business world—should strive to achieve, with an outlook for future generations.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Ekonomou, G.; Halkos, G. Exploring the Impact of Economic Growth on the Environment: An Overview of Trends and Developments. *Energies* **2023**, *16*, 4497. [\[CrossRef\]](#)
2. Halkos, G.E. Environmental Kuznets Curve for sulfur: Evidence using GMM estimation and random coefficient panel data models. *Environ. Dev. Econ.* **2003**, *8*, 581–601. [\[CrossRef\]](#)
3. Halkos, G.E. Exploring the economy—environment relationship in the case of sulphur emissions. *J. Environ. Plan. Manag.* **2013**, *56*, 159–177. [\[CrossRef\]](#)
4. Mar'i, M.; Seraj, M.; Tursoy, T. The Role of Fiscal Policy in G20 Countries in the Context of the Environmental Kuznets Curve Hypothesis. *Energies* **2023**, *16*, 2215. [\[CrossRef\]](#)
5. Kwon, S.; Gil, H.; Baek, S.; Kim, H. Optimal Solution for a Renewable-Energy-Generation System at a Private Educational Institute in South Korea. *Energies* **2022**, *15*, 9430. [\[CrossRef\]](#)
6. Stamopoulos, D.; Dimas, P.; Sebos, I.; Tsakanikas, A. Does Investing in Renewable Energy Sources Contribute to Growth? A Preliminary Study on Greece's National Energy and Climate Plan. *Energies* **2021**, *14*, 8537. [\[CrossRef\]](#)
7. Zhou, X.; Guo, Q.; Zhang, M. Impacts of OFDI on Host Country Energy Consumption and Home Country Energy Efficiency Based on a Belt and Road Perspective. *Energies* **2021**, *14*, 7343. [\[CrossRef\]](#)
8. Miao, S.; Tuo, Y.; Zhang, X.; Hou, X. Green Fiscal Policy and ESG Performance: Evidence from the Energy-Saving and Emission-Reduction Policy in China. *Energies* **2023**, *16*, 3667. [\[CrossRef\]](#)
9. Nitlar, T.; Mayakul, T. The Implications of Triple Transformation on ESG in the Energy Sector: Fuzzy-Set Qualitative Comparative Analysis (fsQCA) and Structural Equation Modeling (SEM) Findings. *Energies* **2023**, *16*, 2090. [\[CrossRef\]](#)
10. Kulisz, M.; Kujawska, J.; Przysucha, B.; Cel, W. Forecasting Water Quality Index in Groundwater Using Artificial Neural Network. *Energies* **2021**, *14*, 5875. [\[CrossRef\]](#)
11. Bampatsou, C.; Halkos, G. Non-Parametric Computational Measures for the Analysis of Resource Productivity. *Energies* **2021**, *14*, 3114. [\[CrossRef\]](#)
12. Iverson, T.W.; Burgess, J.C.; Barbier, E.B. Are Sub-National Agreements for Carbon Abatement Effective? *Energies* **2020**, *13*, 3675. [\[CrossRef\]](#)

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.