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*Editorial*

# Sustainable Development Processes for Renewable Energy Technology II: An Overview

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This Special Issue, titled "Sustainable Development Processes for Renewable Energy Technology II: An Overview", presents a collection of papers in the field of sustainable development in the mineral resource sector, detailing the "seamless" process of transforming energy production into the use of renewable sources. This field of research is of high importance for the achievement of the Sustainable Development Goals set by the United Nations [1,2], as well as for lean energy producing and transmission and consumption technologies [3,4].

The very process of the development of energy production from renewable sources occurs in parallel with the innovative development of fossil energy source extraction [5], the best technologies of which also see themselves utilized in renewable energy production, such as in the production of geothermal [6] and tidal [7] energy.

The transition to a low-carbon economy is associated with an increase in labor productivity and the diffusion of the unmanned technologies of Industry 4.0 (Mining 4.0 [8], Oil and Gas 4.0 [9,10], with the formation of a public demand for accessible and cheap energy and with the development of interaction between local communities and enterprises, as well as with universities, innovative entrepreneurs, and governments ("Triple and Quadruple Helix") [11–13]. Taking this into account, the aim of this Special Issue was to create a global discussion platform for the diffusion of advanced ideas of sustainable development by both the scientific community and the public interested in issues concerning innovative development in renewable and traditional energy production.

Today, the role of interdisciplinary research in the field of sustainable development processes cannot be underestimated [14,15]. This combines work in the fields of energy; mining machinery and equipment; open-pit, underground, and construction geotechnology; oil and gas technology; the economics of production and marketing of renewable energy systems; and information and cognitive technologies [16]. This was the motivation behind the collection of the scientific articles gathered in this Special Issue of the *Processes* journal.

This current Special Issue, much like its predecessor, seeks to involve new participants in the discussion concerning the transition from traditional to renewable energy as a key element of sustainable development. Below, we present a summary of each article included, which were selected by the Guest Editors after careful review and were obtained from publications devoted to innovative technologies in fossil energy extraction and production from renewable and non-renewable sources.

The issues of improving equipment for the production of mineral resources in order to achieve a "seamless" transition from non-renewable energy sources to renewable energy technology have been given much attention in the scientific literature, i.e., in [17–19]. Specifically, in the article by D. Szurgacz in this Special Issue, which is devoted to the study of the productivity factors of a hydraulic actuator in powered roof support in mines,

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**Citation:** Zhironkin, S.; Rybar, R. Sustainable Development Processes for Renewable Energy Technology II: An Overview. *Processes* **2024**, *12*, 846. https://doi.org/10.3390/pr12050846

Received: 10 February 2024
Revised: 17 April 2024
Accepted: 19 April 2024
Published: 23 April 2024

an original approach to the analysis of acoustic power developed by a hydraulic drive under the influence of dynamic load is provided [20]. Given that under conditions of high loads and unfavorable external influences in the hydraulic actuator of the roof support, special requirements must be placed on the design of the safety valve, this forces us to look for innovative methods to ensure safe operation. In this regard, the author presents the results of field tests of a device that ensures reliable operation of the safety valve via analysis of the acoustic signal, in contrast to existing models operating on the basis of pressure drop. These results showed that acoustic power analysis can form the basis for new safety standards for the operation of powered roof support in mines in conditions of their saturation with information technologies, such as machine vision and neural networks. Improving labor safety in coal mines is a step towards the sustainable development of energy production, especially in a slow transition scenario from fossil fuels to renewable energy sources. Therefore, the method proposed in the article for ensuring the safe operation of the hydraulic actuator of the roof support allows one to objectively and accurately measure acoustic power parameters based on dynamic tests and impact energy. The results of the study can be extended not only to the extraction of fossil energy sources but also to construction, which enhances the significance of the results for ensuring occupational safety in the context of achieving sustainable development goals.

The works of many authors today emphasize the leading role of renewable thermal energy in meeting the needs cities have for cheap energy supply, i.e., [21–23]. In this regard, in their article in this Special Issue, Ľ. Gabániová and D. Kudelas note that the use of thermal energy from the earth is an important source for heating buildings and is completely renewable; at the same time, the development of such systems itself must meet the requirements of environmental safety, as well as technological and economic efficiency [24]. Therefore, the article proposes a method for modeling an underground reservoir in ANSYS in order to determine its optimal geometry, which makes the design cheaper and easier to install compared to the traditional design scheme (meander). The authors present an original collector model (a vertical spiral with a diameter of 6.8 and 10 m), which seeks to make heat pump use for heating in cities and metropolitan areas cheaper and more energy efficient (the losses are less than 8%), taking a significant step towards future sustainable development in so doing. The authors proved their hypothesis stating that the power and efficiency of a ground-coupled heat exchanger are influenced not only by soil type and humidity but also by geometry and spatial distribution. The original (spiral) proprietary geometry of the collector makes it possible to reduce its area without decreasing efficiency, reducing the area of disturbed land. The authors express optimism regarding further research in the field of collector geometry and its modeling, which will make it possible to transfer the heating of cities and megacities to renewable geo-energy sources.

The access of national producers to cheap renewable energy determines the future quality of life and the state of the environment, and this has been convincingly proven in a number of works, i.e., [25–27]. This Special Issue follows this trend; for example, in their article, A. Pacana, D. Siwiec, L. Bednárová, and J. Petrovský take environmental factors into account along with quality in modeling a product and its life cycle [28]. As presented by the authors, the most important phase in the design phase of a product directly related to renewable energy, such as photovoltaic panels, is to determine the environmental effect for each production alternative, ranking the environmental significance of each alternative and predicting future quality and environmental product characteristics. The article also presents the results of determining the functions of photovoltaic panels that are of the greatest importance to consumers, along with functions that are the most environmentally friendly. The authors rightly note that taking environmental factors into account when designing photovoltaic panels significantly complicates the adoption of investment, production, and marketing decisions, which has a particularly negative impact on small- and medium-sized businesses. Therefore, environmentally oriented modeling of the life cycle of equipment for renewable energy production will allow, on the one hand, the consumer

to make an optimal choice and, on the other hand, manufacturers to reduce the costs of production and promotion in the market. To this end, the authors adapted the model presented in the article for different options for the development process of photovoltaic panels, taking changes in environmental factors and energy requirements into account. Along with this, the model developed by the authors for designing both a product and its life cycle (taking environmental requirements into account) can be successfully applied in various industries that are modernizing in accordance with stricter environmental requirements and growing consumer demand for nature-like technologies.

The use of Industry 4.0 information technologies for the parallel development of renewable and non-renewable energy in the context of tightening environmental requirements and growing global demand for cheap energy is the subject of research by many authors, i.e., [29–31]. In an article by F. Abu-Abed, K. Pivovarov, V. Zhironkin, and S. Zhironkin in this Special Issue, the results of developing software to improve the sustainable operation of wells during oil and gas production are presented, which not only allow for reduction in environmental damage from accidents and man-made disasters but also optimization of the production of fossil energy resources and their more careful consumption [32]. Natural gas, in turn, links the transition from the extraction of fossil fuels to the use of renewable energy; therefore, the ultra-precise modeling of wells based on logging data using the software developed by the authors in the LogPWin system will not only allow for monitoring the current state of wells in real time but also for predicting their technical condition in the future, including determining the investment need for the development of the well network. The 3D model presented by the authors, along with the ability to rotate and scale modeled wells, contains a color palette reflecting the physical parameters of the well walls, which can be changed depending on the incoming data. At the same time, the software presented in the article can be used in the oil, gas, and mining industries, as well as when drilling wells for any other purpose. The article presents code fragments of the software for the 3D visualization of acoustic logging data from a profiler, in addition to shader code, with additional data that allow for further modification and optimization of the visual representation of the well and the physical and technical characteristics of the host rock.

Recently, the economic benefits of the transition to renewable energy sources at each stage of this process have been widely analyzed, especially in relation to countries with a long history of fossil fuel production, i.e., in [33–35]. In their article in this Special Issue, S. Kuzevic, M. Tausova, K. Culkova, L. Domaracka, and D. Shyp note that the "energy of the future" is the sustainable energy currently being developed that takes sectoral priorities into account, such as increasing the self-sufficiency of regions to generate affordable green energy and control its production, as well as distribute it themselves under conditions of energy market instability and global political instability [36]. Using the Slovak Republic as an example, the authors analyzed the energy- and economy-related benefits of transitioning to renewable energy sources (photovoltaic and solar thermal technologies) via heat pumps and solar collectors for buildings, using the 3E approach. It was concluded that detailed energy efficiency calculations for specific buildings can improve the methodology utilized for selecting the best projects for renewable energy use in various regions; this could form the basis for developing green energy transition plans for local governments and communities.

To conclude, we sincerely thank all the participants of the reviewing and editing process of this Special Issue who contributed to the selection of the best articles and the clear expression of scientific thought. We are confident that the collective work of the scientists who contributed to this Special Issue from different countries across the globe will bring about the rise of clean and affordable energy in the future.

**Conflicts of Interest:** The author declares no conflicts of interest.

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