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Editorial

Special Issue on "The Process and Modelling of Renewable Energy Sources"

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The worldwide use of renewable energy sources has been growing significantly year by year, accompanied by continuous technological development. In addition to addressing resource scarcity, increasing energy demand, and pollution as global challenges, the aim is to increase the efficiency of energy production and optimise energy systems from multiple perspectives. In the case of renewable energy production and use, it is important to integrate and examine economic, social, and environmental aspects. In addition to developing specific renewable energy sources and single technologies, applying concepts such as the circular economy in a wide range of economic sectors is vital to making the entire system more sustainable. In addition to economic feasibility, methodological and modelling issues are of great importance in identifying opportunities and accelerating future deployment. In addition to the need to ensure energy security, the practical application of research in this area also has benefits such as environmental protection, energy import substitution, and employment. The attitudes of different segments of society towards renewable energy sources and related areas are crucial for a sustainable future.

The Special Issue entitled "The Process and Modelling of Renewable Energy Sources" focuses on the technological, economic, and methodological aspects of renewable energy applications and systems, and on advances in complex energy and circular systems. This Special Issue is primarily dominated by research papers on renewable energy devices and systems with a technological and economic focus, but also includes studies on methods that assess the impact of factors affecting energy production (e.g., weather), procedures, and sustainability indicators for dealing with external disturbances in different industrial plants. This issue also includes a review of the main characteristics and development directions of circular supply chains. Various aspects of the use of renewable energy technologies and devices were examined by Zsiborács et al. [1], Hegedűsné Baranyai et al. [2], Siddiqui & Almitani [3], Aleksiejuk-Gawron et al. [4], Pater [5], and Adeyeye et al. [6], while Yimen et al. [7], He et al. [8], Di Pretoro et al. [9], and Lengyel et al. [10] focused on the operation, design issues, and other aspects of various energy, industrial, and circular systems.

The study of Zsiborács et al. [1] deals with a particular type of photovoltaic energy utilisation equipment, the concentrator photovoltaics (CPV) technology, which can even reach an efficiency rate of over 40% under laboratory conditions by concentrating sunlight on high-efficiency solar cells by certain optical components. In their work, the positioning characteristics of CPV modules compared to the focus points were investigated. The performance of CPV modules mounted on a dual-axis tracking system was analysed as a function of their orientation and inclination. The results explicitly obtained for CPV

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technology help determine the level of accuracy that solar tracking photovoltaic systems require to keep the loss in power yield under a certain level. Moreover, this power yield loss also demonstrated that the performance insensitivity thresholds of the CPV modules did not depend on the directions of the alterations in azimuthal alignment. A further analysis was carried out to compare the yield of CPV to other conventional photovoltaic technologies under real Central European climate conditions. It was shown that CPV needs a sun tracking accuracy of at least 0.5° in order to surpass the yield of other PV technologies.

Hegedűsné Baranyai et al. [2] focused on solar energy utilisation, especially the Hungarian status of small-scale photovoltaic power plants, which is the most common type of solar power plant in Hungary. The novelty of this study is that it examined the number and power of these small-scale power plants at the settlement level within the service areas of the various distribution companies by also considering the economic and infrastructural dimensions of the settlements. The paper seeks answers to the questions of whether there are any significant relationships between the number and the power of power plants of this type and the indicators of the settlements, and if so, how strong they are.

Siddiqui & Almitani [3] investigated energy and exergy performances of a solar thermal power plant, where the supercritical carbon dioxide (S-CO_2) Brayton cycle is used for the conversion of heat to work. In their study, a recompression Brayton cycle with partial cooling and improved heat recovery (RBC-PC-IHR) configuration was considered, driven mainly by solar energy from 8 a.m. to 4 p.m. The analysis was conducted for Riyadh (the capital city of Saudi Arabia), and the solar energy was collected from a radially staggered heliostat field. The authors calculated the optical efficiencies of the generated field and implemented a sun-tracking method in order to calculate the characteristic angles of each heliostat in the field. The S-CO_2 Brayton cycle was simulated in commercial software. The cycle is mainly powered by solar energy but assisted by an auxiliary heater to maintain a constant net power input of 80 MW to the cycle. The heliostat field was generated and was composed of 1207 rows, providing 475 watts per unit heliostat's area to the central receiver. According to the results, heat losses from the central receiver due to natural convection and radiation are significant, with an average annual loss of 10 percent in the heat absorbed by the receiver. The heat collection rate at the central receiver revealed that the maximum support of auxiliary heat is needed in December, at nearly 13% of the net input energy. Exergy analysis showed that the highest exergy loss occurs in the heliostat field, with nearly 42.5% of incident solar exergy.

In another paper, flat plate solar collectors were investigated and presented as examples of a heat exchanger with two input signals, solar radiation intensity and temperature of working medium on the input and one output signal, and the temperature of a working medium on the output. In their research work, Aleksiejuk-Gawron et al. [4] analysed the dynamics of heat exchange for two models of a flat plate solar collector: (1) an analogue one using a thermoelectric analogy, and (2) a digital one determined experimentally in online mode using the parametric identification method. The characteristics of both models were compared in terms of their step and frequency response for selected construction and operational parameters. The phenomenon of temperature oscillation at the collector outlet suggests the need to introduce a new physical quantity in the thermoelectric analogy-thermal inductance. Such an assessment of the dynamics of the solar collector can be useful for proper designing (construction parameters simulation) and diagnostics (operational parameters simulation) of the device.

In a moderate, transitory climate, anti-freezing fluids are commonly used to prevent freezing outdoor pipes and collectors in solar thermal systems. Pater [5] investigated the opportunities of using water without any additives as a solar thermal fluid in such a climate. The article presents the long-term results of thermal performance and anti-freeze protection of a solar heating system with heat pipe evacuated tube collectors with water as a solar thermal fluid. The operation of the system under real conditions was analysed for five years in southern Poland. The research covered the monthly efficiency of the solar collectors and the energy consumption (7–13% of the heat generated) of the anti-freeze protection system.

Consequently, it is possible to use water without any additives as a solar thermal fluid in a moderate, transitory climate.

In their study, Adeyeye et al. [6] focused on low wind speed areas of the African continent. In their research, they developed a techno-economic model for wind energy cost analysis for a novel Ferris wheel-based wind turbine. The model was used to techno-economically analyse the siting of wind turbine sites in low wind speed areas. That model was validated for 21 African cities and showed that the Ferris wheel-based design is very competitive with four current commercial wind turbines, as well as with other sources of energy. Hence, the new wind turbine could provide the economic, clean, renewable energy that Africa needs.

Hybrid renewable energy systems (HRESs) have been touted as an appropriate way to supply electricity to remote and off-grid areas in developing countries, especially in sub-Saharan Africa, where rural electrification challenges are the most pronounced. Yimen et al. [7] proposed a two-step methodology for optimising and analysing a stand-alone photovoltaic/wind/battery/diesel hybrid system to meet the electricity needs of an off-grid and remote village in northern Nigeria. The first step used the MATLAB environment to run simulations and optimise the system via the genetic algorithm. Then, techno-economic and emission analysis was carried out in the second step to compare the proposed system to the existing traditional modes of rural electrification in sub-Saharan Africa, namely, the grid extension and diesel generator. Among the details discussed, the authors calculated the break-even distance parameter, the payback period, the net present value, and furthermore the carbon dioxide emissions of the proposed system compared to the grid extension and the diesel generator. The study highlighted the role that solar PV-based HRESs could play in the sustainable electricity supply in rural areas, especially in sub-Saharan Africa.

He et al. [8] proposed a renewable energy scenario generation method based on a conditional generation countermeasure network and combination weighting method (CWM-CGAN), in which the combination of AHP and the entropy weight method was used to analyse the meteorological factors, the weather classification was defined as the condition label in the conditional generation countermeasure network, and the energy scenario was generated by the conditional generation confrontation network. After testing the proposed method with actual PV data, the results showed that the proposed model could describe the uncertainty of PV more accurately.

The main purpose of the analysis carried out by Di Pretoro et al. [9] was to outline a simple but effective procedure to account for perturbations in the assessment of the optimal number of stages in the petrochemical industry. According to their results, appropriate investments could lead to a unit design that could mitigate the higher duty requirements when external perturbations occur. The results highlighted that the optimal number of stages varies when uncertainty is considered, and with low computational effort, this can be effectively quantified by employing the applied methodology. Furthermore, the same approach has also been used for sustainability indicators in the uncertain domain. In those cases, when more stages corresponded to more flexible equipment, the environmental impact was positively affected, and a double benefit could be observed.

The study of Lengyel et al. [10] shows the most important characteristics and trends of research in circular supply chain management, taking into account the impact of COVID. In addition, the similarities and differences between the basic concepts often used as synonyms for sustainability were also presented. In the field of supply chains, the connection to the term sustainability emerged in 2012, while a circular approach emerged after 2017 along with a significant share of research, mainly thanks to relevant EU policies. Although the role of the US has been decisive in the field, the European research bases of previous years have increasingly been replaced by Far Eastern dominance. The study also presents the most important journals of research work related to circular supply chain management. It is expected that more effective policy implementation and the fight against COVID in

the development of supply chains are also likely to spread the circular economic model in the future.

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