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Editorial

Special Issue on "Renewable Energy Technologies and Systems: Technical, Environmental, Economic, Social, and Cultural Challenges"

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Due to the increasing pressures on the environment derived from the intensive use of energy, policy-makers are increasingly aware of the need to design new energy policies capable of addressing those negative impacts on the environment. However, the implementation of these new policies (related to, for example, the deployment of renewable energy sources, the adoption of energy efficiency programs, and the implementation of energy conservation measures) faces technical, environmental, economic, social, and cultural challenges.

Although a vast number of papers have been published on this topic, they tend to focus either on a particular type of challenge or on a single policy or technology. Therefore, in this Special Issue "Renewable Energy Technologies and Systems: Technical, Environmental, Economic, Social, and Cultural Challenges" (https://www.mdpi.com/journal/processes/special_issues/renew_energy_tech (accessed on 15 March 2023)), departing from the idea that the sustainability of energy policy interventions does not stand alone but is derived from changes in techno–socioeconomic structures, we aimed to bring together contributions from scholars working in different energy-related topics with a view to providing a holistic view on how to overcome these challenges and attain sustainable energy systems. This would allow for a more informed energy policy design, contributing to more sustainable and inclusive development as well as reaching a just energy transition, wherein the participation of citizens and communities in the transition process is considered essential.

In the scope of this Special Issue, fifteen papers have been accepted and published, addressing a wide inter-related spectrum of research topics, namely, the sustainable development of the agricultural sector; the sustainable innovation process of manufacturing firms; the reaction of the populace to the use of nuclear energy; a comparison of processes for wastewater treatment; energy efficiency improvements; the renewable energy use–economic growth nexus; the effect of urban sprawl on environmental pollution; the association between health and energy use at the household level; the driving factors of CO_2 emissions; the optimisation of manufacturing processes; a strategic analysis of solar photovoltaic investments; and finally, a review of investment appraisal techniques for renewable investment projects.

Bayasgalankhuu et al. [1] direct their attention to the issue of agricultural sustainable development, emphasising the need to increase productivity while, at the same time, reducing energy consumption and the environmental impact of agricultural activities. To study this relationship, the authors focused on the case of wheat production in Mongolia, employing a Cobb–Douglas production function and annual data from 2005 to 2018. They found that there was a significant rise in energy use in the Mongolian agricultural sector during the period under study. Therefore, there is a need to reduce diesel fuel consumption and fertiliser use in order to achieve the requisite energy savings. They emphasise that it is possible to increase agricultural output by raising the productivity of energy inputs

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and reducing reliance on non-renewable energy sources. To help achieve these goals, the authors claim that some policy measures could be implemented to provide more environment-friendly energy patterns in Mongolian agriculture. Those measures could incentivise the use of innovative and up-to-date technological machinery and equipment; make use of newly tested seeds; expand the use of green manures; and reduce the need for chemical fertiliser.

Focusing also on the sustainable development of the agricultural sector, Luo et al. [2] built a data-driven evaluation and optimisation method for agricultural sustainable development capacity, aiming to better cope with important challenges derived from environmental pollution, the excessive use of inputs, and the growth of agricultural output. They developed an evaluation index system and resorted to data envelopment analysis to quantitatively evaluate the capability for agricultural sustainable development and its changing trend. This approach was applied to the agricultural development of six cities in northern Anhui from 2010 to 2019. Based on the results achieved, the main conclusions of the study can be summarised as follows: some areas in northern Anhui still need to improve their production efficiency; the development of water-saving agriculture and ecological agriculture should be stimulated; the scale and layout of industries that waste resources and cause serious pollution problems should be limited; higher levels of financial and tax support for sustainable development are needed; and the low comprehensive efficiency in most areas of northern Anhui is affected by scale efficiency. The authors claim that their study provides a basis for early warning and regulation for sustainable development, as well as theoretical and methodological support for the improvement and optimisation of agricultural sustainable development capacity.

Cao et al. [3] focused on the sustainable innovation process of Chinese manufacturing firms. Their reasoning is that sustainable innovation is no longer the result of individual decision-making; rather, it is a process that involves different stakeholders. Their study explored the path and mechanism of a boundary-spanning search affecting firms' sustainable innovation, verified the mediating effect of capability reconfiguration, and clarified the regulatory role of information technology governance. Additionally, they proposed an integrated model promoting a firm's sustainable innovation process. From their study, they reached the following conclusions: the boundary-spanning search positively and significantly impacted firms' sustainable innovation process; capability reconfiguration is the intermediary bridge between the boundary-spanning search and the firms' sustainable innovation; information technology governance exhibits a positive moderating effect on the relationship between the boundary-spanning search and capability reconfiguration. The authors claim that their findings enrich the understanding of the sustainable innovation process, providing theoretical guidance by which firms can improve their sustainable innovation performance by effectively using boundary-spanning search strategies.

Contu et al. [4] analysed the impact of the announcement of the connection to the grid of a nuclear plant reactor in the United Arab Emirates using social media data. In particular, the authors analysed the comments on Facebook posts from local and international media, as well as those written in response to a post from a social media influencer. Although recognising that this approach has several limitations, the authors argue that the research undertaken provides important findings. Their comparing of local media, international media, and social media influencer-produced posts allows for the provision of initial recommendations in terms of the communication around nuclear energy projects. According to the authors, the results obtained from the sentiment analysis indicate the presence of mixed views regarding nuclear energy when the focus is on comments posted on international media posts and that of the social media influencer, but they were very positive when the focus was on comments directed at local media. Their main conclusions are follows: nuclear waste and previous nuclear accidents represent important concerns for most people commenting on the posts in question; solar energy is often highlighted as a viable energy source for the United Arab Emirates; and communication in the area

of nuclear energy needs to build trust, taking into account the role of the emotions of the stakeholders and properly contextualising potential risks.

In the paper by Li et al. [5], an experimental study based on a simplified pipeline simulation model was conducted to understand the flow characteristics and internal mechanisms of the fire-extinguishing agent released into the pipeline by the fire-extinguishing bottle of an aircraft. With this study, it was possible to optimise the design of the aircraft fire-extinguishing system and promote the reasonable weight reduction of the aircraft. Based on the simulation model, the flow and release processes of the extinguishing agent along the pipeline were analysed, with a focus on the changes in the liquid and gaseous extinguishing agents in the flow process. From the experiments performed, the following results were obtained. Firstly, the release process of Halon 1301 along the pipeline can be divided into three phases: rapid filling of the pipeline; concentrated release of liquid-based extinguishing agent; and gas release along the pipeline, with an obvious gasification phase transition in the first two phases. Secondly, with the increase of the filling pressure, the gasification ratio of the extinguishing agent decreases, and the release duration of the liquid extinguishing agent and the total release time of the extinguishing agent are shortened, whereas the average mass flow rate of the extinguishing agent increases monotonically. Finally, under the same filling pressure, the gasification ratio of the extinguishing agent, the release duration of the liquid extinguishing agent, and the total release time of the extinguishing agent increase with the increase of the filling amount of the extinguishing agent, while the average mass flow rate of the extinguishing agent decreases with the increase of the filling amount of the extinguishing agent.

Wang et al. [6] focused their attention on the problem of wastewater treatment, a pressing issue considering the ongoing industrialisation process of many countries and the rapid urbanisation of societies. In their study, the authors, from a sustainable development perspective, compared and analysed the emergy yield ratio, the environmental load rate, and the emergy sustainability development index of two wastewater management systems (Anaerobic Baffled Reactor + Anaerobic-Anoxic-Oxic and Anaerobic Baffled Reactor + Cyclic Activated Sludge System), using the emergy theory, to facilitate the selection of a more suitable wastewater treatment process. They found that the ABR + A2/O process had higher economic efficiency with the same wastewater treatment capacity. However, the ABR + CASS process was less damaging to the environment, had lower economic input, better sustainability, and ecological economy. They claim that more favourable economic policies can make it more widely promoted, and that their study brings important insights to improving the urban ecological environment, achieving the sustainable development of the economy, and improving residents' quality of life.

In their study, Xu et al. [7] explore the potential of woody biomass as a source of energy, which can be a substitute for fossil fuels with fewer environmental impacts. To accomplish their purpose, they compare the thermal degradation behaviours and kinetic mechanisms of a typical hardwood (beech wood) and softwood (camphorwood) by employing a thermogravimetric analyser at multiple heating rates in the air. The Kissinger–Akahira–Sunose approach was employed to attain the apparent activation energy and the Coats–Redfern approach was used to estimate the kinetic mechanisms. The main findings of the experimental study were as follows: the softwood decomposition began and ended at lower temperatures than that of the hardwood in air atmosphere, and the maximal reaction rate of the hardwood was larger than that of the softwood; the mean activation energy value of the hardwood was larger than that of the softwood during the whole decomposition process; the values of ignition temperature, peak temperature, and burnout temperature for both the hardwood and the softwood exhibited an increasing trend with the increased heating rate; finally, under the same external conditions (heating rate and atmosphere), the combustion performance of the hardwood was superior to that of softwood.

Xiao et al. [8] proposed an improved optimum design method of blank dimensions guided by a business compass in the machining process. In this method, energy consumption and time are set as optimisation objectives, and the processing parameters of the

equipment are variables. The proposed method is based on the inverse calculation of the machining process parameters under given production conditions guided by a business compass. Therefore, the designed blank dimensions could meet a firms' energy consumption and efficient requirements under given conditions. The method provides energy-saving and a highly efficient blank-dimension design for firms in the actual production process. Based on simulation results, the authors concluded that the energy consumption and time–objective diagram were similar to an exponential function.

The relationship between the use of renewable energy sources (RES) and economic growth for BRICS countries (Brazil, Russia, India, China, and South Africa) is addressed by Fu et al. [9], using different econometric techniques (e.g., "Cross Dependency" test, the unit root test, cross-sectional augmented IPS, dynamic ordinary least square, and fully modified ordinary least square). They argue that the contribution of their paper to the literature stems from the fact that these econometric approaches are rarely applied in tandem and in BRICS countries. The major results of the study are that the existence of the bi-directional relationship between the use of renewable energy and economic growth is mainly indicated by the increase in GDP; the conservation hypothesis was proven by the existence of a unidirectional causality relationship between the use of renewable energy and CO_2 emissions; and the increase in CO_2 emissions is of major concern for BRICS countries, leading them to increase the production of renewable energy. Based on the results achieved, the authors highlight that RES producers can take advantage of incentives such as green certifications, standardisation of green portfolios, and application of feed-in tariffs to accelerate the shift in investment from fossil fuels to RES. Moreover, some policy recommendations include the formation of public–private partnerships, steps for the development of the market for alternative energy sources, tax incentives, and providing interest-free or low-interest financing to encourage RES projects.

The effect of urban sprawl on environmental pollution for a sample of Chinese cities has been analysed by Tao et al. [10]. This is a relevant issue since China has experienced a huge increase in its urban population in the last four decades, and this process of rapid and mass urbanisation poses important environmental challenges. Based on a mediating effect model to test the mediating role of vehicle ownership in the impact of urban sprawl on air pollution, the authors reached the following results. Firstly, urban sprawl has a significant positive effect on air pollution. Secondly, urban sprawl indirectly affects air pollution through the partial mediating effect of vehicle ownership. Thirdly, the higher the level of air pollution, the weaker the mediating effect of vehicle ownership and the stronger the direct effect of urban sprawl on air pollution. The authors suggest two policy implications: land use control might be an important measure to address the problem of air pollution derived from the urban sprawl; and local government may need to invest more in public transportation to reduce the use of private cars.

Lima et al. [11] shed new light on the association between health and energy use at the household level for the Portuguese case, using data from the Household Budget Survey (HBS) database. The authors used a two-part model to estimate health expenditures based on energy-related expenditures, controlling for other socioeconomic variables. The results obtained propose energy expenditures as a relevant explanatory variable for health expenditures and suggest that health gains and medical cost reductions might be key factors to consider in the assessment of the economic viability of energy efficiency projects in buildings. They emphasise that this result is particularly relevant for elderly people and low-income segments of the population, who often suffer from energy poverty. The authors claim that these health-related findings should be taken into account by policy-makers in the future design of energy efficiency policies, as well as the usual economic and environmental impacts.

Using the decomposition approach, Hu et al. [12] analysed the factors that most contribute to explaining the evolution of CO_2 emissions in the case of the Chinese automotive industry. The results of the extended logarithmic division index (LMDI) method have shown that the investment intensity effect is the main driving factor behind increases in

CO_2 emissions, while R&D intensity and energy intensity are the two main drivers of CO_2 emission reduction. From the results obtained, the authors propose the following policy recommendations to push forward the sustainable and high-quality development of China's automotive industry: to optimise the energy structure and promote energy consumption with low emission factors; to accelerate the adjustment of product structure and optimise the management structure of the automotive industry; to accelerate the development of the energy-saving and new energy automobile industry; to improve technological research and innovation capability of firms; to promote the automotive industry cluster; and to realise the integration of the production supply chain.

The work of Al-harkanet al. [13] is focused on optimising the scheduling of a set of jobs on unrelated parallel machines subject to release dates, sequence-dependent setup times, and additional renewable resource constraints. In the computational calculations performed, the performance of different algorithms (e.g., modified harmony search (MHS), variable neighbourhood search (VNS), two-stage hybrid variable neighbourhood search with simulated annealing (TVNS-SA), simulated annealing, SA, and genetic algorithm (GA)) was compared. The authors concluded that the proposed MHS algorithm was able to outperform the other four algorithms in different features; specifically, whether the parameter was significant or not with respect to the average relative percentage deviation, whether a large number of jobs was considered, or regarding the CPU time taken.

Wang et al. [14] undertook a SWOT analysis to identify the internal strengths and weaknesses and the external threats and opportunities closely related to the development of solar PV power in the ASEAN (Association of Southeast Asian Nations) countries. Given the high rate of economic growth in these countries, enormous pressure is felt upon energy consumption, and this is particularly acute due to the long-term dependence on fossil fuel energy and its environmental impact. To overcome this problem, ASEAN countries have established an ambitious target for the deployment of renewable energy sources in order to ensure energy security, accessibility, affordability, and sustainability. From the SWOT analysis undertaken, the authors concluded that there is great potential for the development of solar PV power plants in ASEAN countries, especially if adequate policy measures are implemented and proper actions are taken. Some of these are highlighted by the authors, and include enhancing the awareness of sustainable development among citizens; the adoption and implementation of coherent, reliable, predictable, and systematic incentive policies; the fostering of solar PV technology to ensure sustainable development; and the seeking of opportunities via international cooperation.

Finally, Delapedra-Silva et al. [15] presented the results of a literature review conducted on the methods for evaluating renewable energy sources (RES) investment projects. Although recognising that the financial evaluation of RES projects is well explored in the literature, the authors emphasise that since many different methods can be found in the literature, it is important to understand if and how these methods have been changing over time and what factors may have driven new approaches. The time span of their analysis was 2011–2020, and they grouped the methods for evaluating RES projects into four categories: (i) traditional discounted cash flow methods (e.g., net present value, internal rate of return) and payback period; (ii) levelised cost of electricity; (iii) return on investment approach; and (iv) real options analysis (ROA). From the quantitative analysis undertaken, it was possible to perceive that (i) the most widespread RES projects are related to wind and solar energy; (ii) the most traditional evaluation tools are more popular in solar energy, while more complex approaches such as ROA are more widespread in studies related to wind energy; (iii) the most traditional techniques are more common in publications from countries such as the USA, Italy, Spain, and Germany, while Asian countries, such as China and South Korea, have higher scientific production involving the technique based on ROA. Regarding the content analysis of the five most cited articles in each category, it was possible to conclude that the more traditional methods are still widely used for the financial evaluation of RES projects. However, approaches based on the levelised cost and ROA have been growing in importance as agents seek to tackle the complex features of financial

evaluation and the comparison of RES projects. For those authors, additional research is required to address promising new RES technologies or emerging enabling technologies. For these innovative projects, risk- and flexibility-related approaches are particularly relevant, and ROA can bring important insights. However, the use of ROA is still limited, which may derive from the perceived complexity of application and interpretation.

We thank all the contributing authors, reviewers, and members of the journal's editorial team. This Special Issue would not have been without them. Our hope is that this Special Issue will further promote additional research into the technical, environmental, economic, social, and cultural challenges that the adoption of renewable energy technologies and systems continues to involve.

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