Economic growth and environmental sustainability from renewable energy applications

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Abstract
The use of fossil fuel causes severe environmental problem such as climate change in the global scale and acid rain in the regional level. Along with its nonrenewable property, renewable and clean energy sources must be explored so as to keep the economy growing sustainably. Nowadays many renewable energy alternatives such as bioenergy, solar power, hydro power, and wind power have been employed, and each of them has their own pros and cons. This special issue focuses on the use of urban and rural wastes in several aspects such as (i) the use agricultural residuals in bioenergy production; (ii) treatments of municipal solid waste in pyrolysis and biochar application; (iii) sewer sludge and other organic matters in renewable energy production; and (iv) plastic materials in wind farm construction and production of solar panels, to assist the production of renewable energy to improve the resource management and maintain the environment.

Keywords
Climate change, Renewable energy development, Resource recycling, Sustainable development

Introduction
Since the world is facing unprecedented threats from climate change and increasing variability, renewable energy that greatly slowing the speed of climate shift has been emphasized among nations. In this context, renewable energy development involves managing energy

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supplies and demands in a fashion that energy needs are met with a maximal effect on climate change mitigation and a nominal resultant contribution to sustainable societal development. In this Special Collection, research papers focus on the role of renewable energy development, which mandates an inter-disciplinary perspective in all articles.

We collected 10 such papers that have analyzed a broad array of topics related to solar energy, bioenergy, wind power, wave energy, and geothermal energy. These papers show the varied applications of renewable energy, climate change, environmental protection, and market responses, while providing insightful policy implications and meaningful decision-making information.

Contribution of collections

In the first article, Yang et al. (2020) examine a long-term performance of the wave energy in the China Sea during 1988 to 2017. By taking the monthly and seasonal variability into account, this study explores the potential of exploitation and stability of wave energy. They show that values of significant wave height and wave power density may considerably differ from months to months, and the wave density in winter can be 9 times greater than that in summer. In terms of regional distribution, the highest wave energy potential is identified in the Northern South China Sea, the East China Sea, the Ryukyu Islands waters, east of the Taiwan Island and the Luzon Strait, and thus more support from the government is necessary to encourage an even greater promotion on this innovative renewable technology.

The second paper by Wang et al. (2020) integrates 3 modes of four-point consecutive voltage and time index and proposes a predictive machine learning method for voltage and lifetime of lead–acid battery under. The training data is recorded in 155 weeks and 105 weeks for examined data. The results indicate that M2 model can successfully predict the battery voltage and lifetime with almost the same performance observed in real-time measurement. But in terms of smoothness of the predicted curves, M3 model performs better than M2 model. This study also points out that the accuracy of prediction is affected both by types and properties of the input parameters.

In the following paper, Liu et al. (2021) first summarize the domestic achievements in the exploration and development of geothermal resources, and then analyze the geothermal potential in China. The results indicate that the annual exploitable geothermal potential accounts for $7 \times 10^9$ tons of standard coal, with a significant portion of this resource underneath at depths of 3–10 km. Therefore, to convert this energy source into real production requires a greater promote geothermal exploration and development of key technologies.

The fourth study by Gong et al. (2021) employs a lifecycle analysis to investigate the power generation potential and emission reduction possibilities of major pyrolysis and gasification technologies in China, and then conduct a sensitivity analysis to explore the most influential factors. The results indicate that the intermediate pyrolysis with rice straw and slow pyrolysis from corn stover could contribute highest emission offset but the net emission reduction is highly dependent on the feedstock used. The authors also point out that while gasification can generate considerable amount of renewable electricity, it does not produce biochar and thus no benefit would be received by the agricultural sector.
The main theme of the fifth paper by Zhang et al. (2021) analyzes the utilization of waste to energy technology to improve Taiwan's energy security. By exploring the investment requirements, possible economic benefits, and effects on climate change mitigation engaged in such an application, the study shows that there is substantial waste-based power generation potential in Taiwan, but the authors also indicate that both the economic and environmental benefits are highly dependent on the composition of the wastes, the transportation costs, and the distribution of regional population, implying that once the historical distribution patterns of waste is altered, the results could vary considerably.

In the next paper, Okoro et al. (2020) propose an environmental and economic friendly demulsifier that eliminates water from crude oil and then use GC-MS profile and NIST018 library of mass spectra to simulate associated economic and environmental consequences from this newly innovated technology. The results indicate that the performance of both demulsifiers increase with increase in volume of the demulsifier, separation time, and operating temperature. Additionally, with the bio-demulsifier application the water separation efficiency is improved from past average of 80.2% to 85.6%.

The central theme of Chen et al. (2020) aims to explore the power potential of 370 proposed wind farm sites in Taiwan. By identifying involved economic components, collecting wind speed information, and estimating power curves of scheduled sites, the authors apply a lifecycle assessment and sensitivity analysis to examine the impact of construction cost, maintenance cost, energy sale, and emission trade on the site selection decision. They point out that most inshore sites pass the profitability test and should be developed; however, variations in construction costs and energy prices that potentially alter the results should still be investigated further.

The next paper by Chen et al. (2020) investigates the economically efficient arrangement of the generating units in the power grid that improves accuracy of power load prediction. In the meanwhile, this study proposes a power load forecasting model to explore safety and stability of the power grid operation under such an arrangement. The results indicate that under the NCSOELM model prediction accuracy is enhanced, with a determination coefficient above 90% and low prediction error. The authors also conclude that by rearranging these generating units there is significant improvement in operation safety of entire energy system.

The ninth paper by Abu-Hamdeh and Alnefaie (2020) performs an energy and exergy analysis of a micro solar tri-generation system. The authors point out that the overall thermal efficiency has been improved to 50.53%, with the extracted energy from hot water more than 3,700 Watt. Additionally, the exergy efficiency is also increased to 36.88%, and the overall exergy extracted by hot water and electrical system is approximately 3,200 Watt. The results also indicate that the variation of regional wind speed and tilt angles should be always taken into account because the energy and exergy efficiencies are significantly affected by these factors.

The main theme of the tenth paper by Fu and Su (2021) is to investigate the wind power potential among 30 Chinese provinces. This study applies the functional clustering analysis to classify the monthly data of wind power generation from 2013 to 2019, and the results show that generally the patterns of wind power generation in Chinese provinces can be classified into three categories. This study explores a new method in data processing. Specifically, by treating data as functions, more information can be discovered that provide
additionally information of renewable energy development to decision makers. With such an application, the authors indicate that the estimation error from information loss can partly be recovered by incorporation of higher-dimensional data.

Conclusions

All the papers in this Special Collection provide insights on how renewable energy can be used, explored, and extracted to sustain our energy future, while also mitigating the impact from unprecedented speed of climate change. While some of the collected articles employ multiple and sometimes complex techniques, their research is not to develop complicated models; instead they are to gain insight into approaches that jointly address sustainable energy, economic growth, and climate change issues. The discourse is considered appropriate to introduce, explain and distribute findings and motivations, and stimulate additional research on this field.

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