Sustainable Energy Development

Subjects: Energy & Fuels

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The global COVID-19 pandemic has had strong impacts on national and international freight, construction and tourism industry, supply chains, and has resulted in a rapid decline in the demand for traditional energy sources. In fact, research has outlined that urban areas depend on global supply chains for their day-to-day basic functions, including energy supplies, food and safe access to potable water. The disruption of global supply chains can leave many urban areas in a very vulnerable position, in which their citizens may struggle to obtain their basic supplies, as the COVID-19 crisis has recently shown. Therefore, solutions aiming to enhance local food, water and energy production systems, even in urban environments, have to be pursued. The COVID-19 crisis has also highlighted in the scientific community the problem of people's exposure to outdoor and indoor pollution, confirmed as a key element for the increase both in the transmission and severity of the contagion, on top of involving health risks on their own. In this context, most nations are going to adopt new preferential policies to stimulate the development of relevant sustainable energy industries, based on the electrification of the systems supplied by renewable energy sources as confirmed by the International Energy Agency (IEA). Thus, while there is ongoing research focusing on a COVID 19 vaccine, there is also a need for researchers to work cooperatively on novel strategies for world economic recovery incorporating renewable energy policy, technology and management. In this framework, the Sustainable Development of Energy, Water and Environment Systems (SDEWES) conference provides a good platform for researchers and other experts to exchange their academic thoughts, promoting the development and improvements on the renewable energy technologies as well as their role in systems and in the transition towards sustainable energy systems. The 14th SDEWES Conference was held in Dubrovnik, Croatia. It brought together around 570 researchers from 55 countries in the field of sustainable development. The present Special Issue of Energies,

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1. Introduction

The global COVID-19 pandemic has had strong impacts on national and international freight, construction and tourism industry, supply chains, and has resulted in a rapid decline in the demand for traditional energy sources. In fact, research has outlined that urban areas depend on global supply chains for their day-to-day basic functions, including energy supplies, food and safe access to potable water. The disruption of global supply chains can leave many urban areas in a very vulnerable position, in which their citizens may struggle to obtain their basic supplies, as the COVID-19 crisis has recently shown. Therefore, solutions aiming to enhance local food, water and energy production systems, even in urban environments, have to be pursued. The COVID-19 crisis has also highlighted in the scientific community the problem of people's exposure to outdoor and indoor pollution, confirmed as a key element for the increase both in the transmission and severity of the contagion, on top of involving health risks on their own. In this context, most nations are going to adopt new preferential policies to stimulate the development of relevant sustainable energy industries, based on the electrification of the systems supplied by renewable energy sources as confirmed by the International Energy Agency (IEA). Thus, while there is ongoing research focusing on a COVID 19 vaccine, there is also a need for researchers to work cooperatively on novel strategies for world economic recovery incorporating renewable energy policy, technology and management.

2. Renewable Energy Policy, Technology and Management

Here in 2020, COVID-19 is spreading rapidly all over the world and its impact extends from the global health system to the world economy, including the energy field [1]. Due to the contraction and even disruption of trade, the energy market and the situation of traditional energy resources (oil and natural gas) has been vigorously shocked. Considering energy security [2][3], the exploitation of renewable energy sources has become more important and imperative for countries that lack fossil fuels [4]. Meanwhile, environmental protection and emission reduction are gaining increasing importance around the world [5]. The application of renewable energy sources shows great potential for emission reduction [6][7], thereby more and more countries are promoting their energy strategy by shifting from fossil energy to renewable energy. In 2012, the Office of the European Union (EU) issued an Energy Roadmap [8], providing EU milestones from 2020 to 2050. With the implementation of relevant measures, CO_2 emissions may be reduced by between 80% and 95% in comparison to the reference level in 1990. On the other hand, according to the Statistical Review of World Energy published by British Petroleum [9], the contribution by China, India and other Asian countries may occupy two thirds of the increase in global energy consumption before 2040, thus EU targets do not suffice and emission reductions in Asia must attract the same attention. Of course, with finite resources and competing needs, the development of sustainable energy systems should be achieved in a cost-effective way [10][11].

In the 21st century, fossil fuels are still the primary energy supply, which cover almost 80–85% of world energy demand. Serious environmental problems have emerged, thus efforts to replace fossil fuels with sustainable energy have become more imperative. The energy policy for sustainable development is not conceived as a technical process. However, it can promote application from socio-technical aspects. Burke and Stephens [12] categorized the applied policies to four socio-technical transitions. Lee and Min [13] analyzed the effect of firm construction on sustainable energy development based on manufacturing aspects. Wei et al. [14] predicted that over 4 million jobs related to renewable energy products will be created when keeping the aggressive sustainable development measures. Hartwig et al. [15] clarified that a positive impact on renewable energy development can be found after promoting employment through energy efficiency policy.

On the other hand, the technical developments always show intuitive promotion on energy conservation and emission reduction systems. Biomass energy application has shown great importance in the energy sector for green development. Bert et al. [16] developed a patented reactor using metal-enriched poplar biomass from contaminated soil. Vicente and Alves [17] reported various types of stoves and boilers for different types of biomass sources. Aghaalikhani et al. [18] first proposed the gasification process of plant-assisted bioremediation biomass and analyzed the impact after poplar biomass was contaminated. Soltero et al. [19] highlighted that the heat loss, heat storage and energy sources integration have become the key concerns, which are very challenging and should be focused by researches.

In the building environment, the energy utilization efficiency is limited and a high energy saving potential exists. Mazzarella [20] discussed various typical energy-saving measures for different levels of building applications. Ferrari and Riva [21] studied and evaluated the utilization of a vapor barrier on the inner side of an envelope, which can help for warming insulation. Blázquez et al. [22] investigated different ventilation system scenarios and developed an energy-saving criterion considering the thermal comfort and energy efficiency. Salem et al. [23] suggested replacing existing double-glazed windows with triple-glazed ones, which can notably reduce the heat loss of UK hotel buildings.

Usually, the variation of renewable energy sources in time, e.g., solar and wind, impedes their efficient utilization, and thereby strongly impact the supply fluctuation in power plant and electric systems. Hence, the energy storage system has been regarded as the most promising candidate solution to bridge the mismatch between the energy supply and demand. Hast et al. [24] studied the application of thermal energy storage apparatus in a direct heating system, which can produce much more renewable electricity as well as reduce the impact of the fluctuation of the electricity supply. Xu and Wang [25] built a single-stage thermal storage cycle, composed of charging and cooling subsystems. The system could improve the concentration glide at fixed operating temperature. Xu et al. [26] proposed the basic structure of multi-microgrid systems and studied the interactions between sub-grids and main grids. Lund et al. [27] introduced and emphasized the development of smart energy systems, including an individual energy sector and coupling sectors between electrification and storage.

3. Conclusions

The topic of energy policy is crucial in order to achieve the goals of a sustainable development and decarbonization established by many countries. In this framework, the use of suitable energy planning strategies, aiming at determining the optimal configurations of the novel energy strategies and the optimal mix of technologies to be used for future energy scenarios. In this context, biomass is one of the most attractive renewable energy sources, due to the large availability of this resource all over the world and due to the plurality of technologies presently available to convert biomass in energy or byproducts, such as anaerobic digestion, gasification, energy crops and many others. Another important key point to be addressed in order to achieve the goals of sustainable energy development is represented by the optimization of fossil fuel-based power plants.

In fact, the transition to a fully renewable energy system will pass through the improvement of the efficiency of power plants, reducing the consumption of fossil fuels and also reducing greenhouse emissions. In this field, the integrated gasification combined cycle is probably the most attractive technology for its capability to use low-quality solid fuels, at extra-low greenhouse gases emissions. In addition, a sustainable development of nuclear power plant is also expected to enhance the environmental impact of electricity production, due to the null greenhouse gas emissions of nuclear power plants. Finally, the reduction in building energy consumption is also crucial in order to reduce fossil fuel consumption and greenhouse gases emissions. In fact, in Europe, buildings account for over 40% of the total energy consumption. The goal of reducing building energy consumption may be primarily achieved by using novel and efficient HVAC systems, such as ground-source heat pumps, and/or integrating renewable technologies (mainly solar PV panels [28], solar thermal collectors [29] or PV thermal collectors [30]) in the building energy system.

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