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Editorial

Sustainable development in period of COVID-19 pandemic

A R T I C L E   I N F O
Handling Editor: Cecilia Maria Villas Boas de Almeida
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A B S T R A C T
COVID-19 pandemic has shown that sustainable development of energy, water and environment systems is essential for the basic life needs of humankind. Logistics problems, shortage of resources and goods, a crisis of traditional energy systems, all these COVID-19 caused problems show that available resources should be used with caution. This paper is an introduction article to the Virtual Special Issue that discusses some of the latest developments in three research topic areas, namely Energy, Water and Environment. These research topics emerged from the four Sustainable Development of Energy, Water and Environment Systems Conferences held in 2020. The purpose of the introduction article is to provide a brief introduction to the field and the articles included in this Journal of Cleaner Production Virtual Special Issue.

1. Introduction
Sustainable development should be based on three pillars of sustainability, namely environmental, economical and social (Jiang et al., 2021a). The task seems challenging enough in the face of climate change, but ongoing COVID-19 pandemics introduced additional complexity in the system. At first, positive effects on the environment were observed through reduced industrial activity and lower energy consumption. In the EU power production from renewable energy sources for the first-time surpassed fossil fuels (Jones and Moore, 2020). However, global supply chains were affected (Magableh, 2021), and consequences are still unveiling and evolving from less resilient systems onwards. Abruptly increased electricity demand led to a revitalisation of coal produced electricity, which increased 43% compared to pre-pandemic time (Jones et al., 2021). The need for fast economic recovery may hamper energy transition, and geopolitical influence over fossil fuels made some countries even reconsider nuclear energy revitalisation since the diversification of supply chains asks for a stable electricity source. All of the mentioned challenges also provide an opportunity for sustainable development on the principles of the circular economy. It has been shown that the waste to the energy industry is highly immune to pandemic shocks (Rordel and Wolniak, 2021), and taking into account the need for supply security, and it has never been more important to minimise production waste and use the waste from one process as an input to other. Also, distributed energy sources are especially appealing today since they have the potential to secure energy independence, especially in light of increased fossil fuel prices and disrupted supply chains (Hoang et al., 2021). An interdisciplinary approach and coordinating global actions, backed by suitable green recovery policies, could transform COVID-19 threats into great opportunities for the world’s sustainability (Mikulčič et al., 2019). This Special Issue (SI) is of interest to the international community, academia and industry experts, policymakers and the general public, which are working in the multidisciplinary research field of sustainable development. The SI is focused on research topics that are of importance to sustainable development and are an extension of the previously generated Sustainable Development of Energy, Water and Environment Systems (SDEWES) knowledge. The papers included in this SI are the result of the integrative approach to sustainability developed jointly by the Journal of Cleaner Production (JCLEPRO) and the SDEWES conference series.

2. Background
In 2020, despite the COVID-19 pandemics, four SDEWES conferences were organised. First, from 9 till 12 February 2020, the 2nd Latin American SDEWES conference edition was held in Buenos Aires, Argentina. The conference brought together 110 scientists, researchers and experts in the field of sustainable development from 26 countries. There were 120 presentations, two invited lectures and a panel on the topic of climate change with some of the most distinguished experts in the field. Due to the outbreak of the COVID-19 pandemic, the other three SDEWES conferences were held virtually. The 1st Asia Pacific SDEWES conference edition was held virtually from 6 till 9 April 2020. In total, 97 presentations were available on-demand to the 134 registered participants from 36 countries, which generated over 1,300 comments in a lively discussion. The 4th South-East Europe SDEWES conference was virtually held from 28 June to 2 July 2020. It brought together 190 scientists, researchers, and experts in the field of sustainable development from 37 countries. There were 130 presentations and four invited lectures during this conference. The last of the four conferences, the 15th SDEWES conference, was virtually held from 1 till 5 September 2020. It brought together around 300 scientists, researchers, and experts in the field of sustainable development from 55 countries. The registered participants were able to listen to over 300 presentations, and four
invited lectures and a Panel on Climate Neutrality in Cities. The four 2020 SDEWES conferences showed that there are many countries that are facing various limitations in natural resources. These limitations in resources have led to a severe energy crisis which has been coupled with the Covid-19 pandemic (Chofreh et al., 2021). The COVID-19 pandemic developed the severest public health event in recent history. Vaccination now offers a way to resolve the COVID-19 pandemic. However, it is critical to recognize the full energy, environmental, economic and social equity (4E) impacts of the vaccination life cycle (Jiang et al., 2021a,b). Furthermore, the vaccination campaign is a multidisciplinary topic incorporating policies, population behaviour, planning, manufacturing, materials supporting, cold-chain logistics and waste treatment (Klemes et al., 2021).

After the careful selection procedure, 41 invitations have been sent to the SDEWES 2020 authors to prepare articles, out of which, after thorough reviewing procedures, 11 have been finally accepted for the JCLEPRO VSI SDEWES 2020. The VSI team believes that the selected and after demanding peer-reviews approved and published paper will contribute to continuing progressive development of JCLERO Journal.

3. This Virtual Special Issue papers

The Water and wastewater theme consists of two papers in this VSI. Integrated water resource management for a city’s sustainable development, aiming to improve social, economic, and environmental conditions, has been studied by Okumura et al. (2021). The unconventional system of a small wastewater treatment plant with some modifications that are generating ecological profits, mainly the fertiliser, biomass or peat substitution, has been analysed by Kamizela et al. (2021).

The Energy systems topic has been analysed by five papers. A comprehensive assessment involving techno-economic, sensitivity, and exergetic factors of two biorefinery configurations for butanol production have been studied by Meramo-Hurtado et al. (2021). The development and adaptation of an air biotreatment technology in the trickle-bed bioreactor used in the painting industry have been analysed by Kasperczyk et al. (2021). A novel dynamic simulation approach for the energy, economic, and environmental analysis and optimisation of island communities has been presented by Barone et al. (2021). The processing and upgrading of offshore natural gas by using supercritical separators in some gas processing steps, namely: (i) water dew-point adjustment; (ii) hydrocarbon dew-point adjustment; and (iii) carbon dioxide abatement; has been demonstrated by Wiesberg et al. (2021). The dynamic analysis of an anaerobic digestion plant, in which concentrating photovoltaic/thermal collectors are used to match a part of both heating and power demand of the process, has been investigated by Calise et al. (2021).

The Environmental assessment research topic has been studied in four papers. The environmental performance and the redesign of the production process of two types of mouthwash, namely an alcohol-based product and a polyol-based product, has been described in the study by de Moraes et al. (2021). Evaluation of Fischer-Tropsch synthesis to light olefins over Co- and Fe-based catalysts using an artificial neural network has been studied by Garona et al. (2021). The Material Passport method, which evaluates the recycling potential and environmental impact of materials embedded in buildings, has been demonstrated by Honic et al. (2021). A data-driven comparative analysis of national adaptation pathways for Sustainable Development Goals has been presented by Sebestyén and Abonyi (2021).

4. Conclusions

This VSI introduction paper addresses a selection of research studies from the four SDEWES conferences in 2020. The studies included in this VSI investigated topics that can be classified into three categories: Water and wastewater; Energy systems, and Environmental assessment. The solutions to the studied problems represent a knowledge gain and further increase in public awareness on the need for an environmentally responsible economic development, especially now in the period of the COVID-19 pandemic. The Guest Editors believe that the papers selected for this VSI will be of interest to JCLEPRO readers.

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Hrvoje Mikulčić
Xi’an Jiaotong University, Department of Thermal Engineering, Xi’an, Shaanxi, China
University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Zagreb, Croatia
Zhien Zhang
West Virginia University, Department of Chemical and Biomedical Engineering, Morgantown, WV, USA
E-mail address: zhien.zhang@mail.wvu.edu.
