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Editorial

Multi-sectoral and sustainable solutions to enable national carbon neutrality

Carbon neutrality and a carbon-negative economy are important concepts introduced nearly 20 years ago that have become key measures for realising the climate goals of the Paris Agreement. The revised Paris Climate Accords are designed to limit global warming to 'below' 1.5 °C above pre-industrial temperatures. The recently released IPCC AR6 report shows that the realisation of climate goals requires a fundamental transformation of national, regional, and global energy system, including a substantial reduction in overall fossil fuel use, the deployment of low-emission energy sources, the transition to alternative energy carriers such as Hydrogen or Ammonia, and the improvement of energy efficiency and conservation. Over 140 countries have pledged to align their national emissions and abate their targets with these goals that have been reaffirmed in a diverse range of studies on impacts, pathways, technologies, and policies needed in all economies, but in particular in the largest economies of China, the European Union, Japan, and the United States.

With this editorial, we launch a virtual special issue (VSI) to address critical issues under the theme of carbon neutrality, with eight research, review, and perspective articles selected, covering carbon emissions, wastewater treatment, green finance, and the current actions and future perspectives of carbon neutrality in China.

Carbon emissions are the primary concern in achieving carbon neutrality. Two research articles highlight the reduction in emissions of air pollutants and carbon dioxide, with one focusing on reducing the carbon emission of coal-fired power plants by a ready-to-implement measure: roof photovoltaic-assisted power generation combined with sludge co-combustion for power generation systems. The proposed solution shows good economic and carbon reduction benefits, not only making the best use of existing infrastructure but also giving coal-fired power plants a new function to treat municipal solid waste [1]. The other focuses on the potential for synergistic reduction of CO_2 and air pollutants by policy instruments in urban road transportation. It pointed out that shifting transportation modes could be an effective option in the short term and highlighted the importance of a cleaner electricity supply to develop electric vehicles [2]. As another source of anthropogenic CO_2 emissions, land use was highlighted by one article emphasising the spatio-temporal evolution of its carbon emissions through two decades and its coordinated development with GDP [3].

Wastewater treatment plants (WWTPs) serve as an important part of urban sanitation, which also contributes to global GHG emissions with a non-ignorable ratio. In this VSI, the research and perspective articles related to WWTPs are discussed in experimental and conceptual dimensions. One research article reports an autotrophic hydrogen-oxidising bacterium that can synthesise high-value-added biomass from CO_2, which is truly sustainable [4] and inspiring for wastewater treatment [5]. Another perspective article argues that the carbon neutrality of wastewater systems is far beyond the treatment plant boundary [6]. It particularly points out key opportunities within the fence of WWTPs and beyond the plant boundary to facilitate the wastewater industry achieving carbon neutrality.

Green climate finance is also expected to play an important role in a carbon-neutral society. One research article particularly addresses the impact on economics and the environment by implementing green finance-related policies driven in China. Employing the Semi-parametric Difference-in-Differences (SDID), the research shows that overall, China's green finance-related policies have effectively reduced industrial gas emissions in the study period [7].

In addition, three research articles address the short- and long pathways and monitoring indicators for carbon neutrality in China. One research article discusses China's long-term low-carbon transition pathways and strategies at the macro level, from simulations and analyses of energy consumption in end-use and power sectors to scenario analysis, emission trajectories, investment demand, and technology evaluation [8]. From a short-term perspective, an article explores the major focused fields and development strategies for China's 14th Five-Year Plan along with the long-term trajectory of 2060 carbon neutrality, especially in energy transition, new sustainable urban development, and investment priorities [9].

We hope and believe that these articles will contribute to developing new roadmaps and strategies for carbon neutrality and providing valuable references in the economic, technological, and policymaking dimensions in China and worldwide. Taking the present VSI as a starting point, we look forward to more publications on exciting breakthroughs and practical experiences of carbon neutrality in *Environmental Science and Ecotechnology*.

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