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EDITORIAL NOTE

# Soft Solutions for the Race to Net Zero and the 2023 Best Paper Award

**Santanu Bandyopadhyay[1] · Dominic C. Y. Foo[2] · Raymond R. Tan[3]**

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The world is now barely one human generation away from the target year for achieving global carbon neutrality. The upward trend in anthropogenic greenhouse gas (GHG) emissions that can be traced back to the Industrial Revolution must be reduced, stopped, and reversed to net zero by the middle of the twenty-first century to prevent catastrophic climate change in the ensuing decades (IPCC 2022). Despite the grim news about 2023 being the warmest year on record to date and COP28 failing to make a definitive statement about fossil energy, there are promising signs that a global decarbonization movement is gaining momentum. Net zero pledges by many developed and developing economies provide a top-down political framework for massive decarbonization. Technology has evolved to the point that GHG emissions reduction measures can be taken seriously by the private sector. Renewable energy generation is increasing in many parts of the world, coupled with the current boom in the sale of electric vehicles. Start-ups have taken the initial steps in commercializing critical technologies such as carbon dioxide ($CO_2$) capture, utilization, and storage (CCUS) as well as negative emissions technologies (NETs). Policy impetus and carbon markets have emerged to put a price tag on GHG emissions and provide incentives for clean-up measures. The international scientific community has also been galvanized into action, providing a steady stream of new ideas and candidate technologies in a global pipeline of climate solutions. The *process integration* research community's central role here is to provide models and algorithms to enable the rational scale-up of different decarbonization techniques. Three decades ago, the implications of *pinch analysis* on industrial emissions reduction were first recognized by Dhole and Linnhoff (1993); today, process integration models can be used to determine how different climate solutions can be stacked as envisioned by Pacala and Socolow (2004) to achieve deep decarbonization.

Meanwhile, even if the world manages to achieve the target of net zero emissions by 2050, adaptation measures will still be needed to contend with the effects of climate change caused by GHGs already in the atmosphere (IPCC 2022). One potential risk is that changes in precipitation patterns will wreak havoc with water resources needed to sustain human civilization. Again, there is a long history of use of process integration techniques for optimizing industrial water conservation measures (Takama et al. 1980; Wang and Smith 1994). Our choice of this journal's best paper in 2023 continues this tradition with a contribution entitled "A fuzzy mathematical model with group decision-making to solve the water allocation problem: Tunisian case" (Elleuch et al. 2023). The authors apply the versatile framework of fuzzy optimization to the water allocation problem and consider the complications resulting from the presence of multiple goals and multiple decision-makers. The work provides an excellent example of the main subject area of this journal: How models can be used to tackle complex sustainability problems.

We are also welcoming five new experts to our editorial board to build the journal's strength in areas such as artificial intelligence, industrial decarbonization, and supply chains optimization. Readers may see their profiles on the "Journal updates" section of our journal page (https://link.springer.com/journal/41660/updates).

✉ Dominic C. Y. Foo
dominic.foo@nottingham.edu.my

✉ Raymond R. Tan
raymond.tan@dlsu.edu.ph

[1] Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Mumbai, India

[2] Centre for Green Technologies, Department of Chemical and Environmental Engineering, University of Nottingham Malaysia, Broga Road, 43500 Semenyih, Selangor, Malaysia

[3] Department of Chemical Engineering, De La Salle University, Manila, Philippines

## References

Dhole VR, Linnhoff B (1993) Total site targets for fuel, co-generation, emissions, and cooling. Comput Chem Eng 17:S101–S109

Elleuch MA, Euchi J, Haddar B, Frikha A (2023) A fuzzy mathematical model with group decision-making to solve the water allocation problem: Tunisian case. Process Integr Optim Sustain 7:439–472

IPCC (2022) Summary for policymakers. In: Shukla PR, Skea J, Slade R et al (eds) Climate change 2022: mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge

Pacala S, Socolow R (2004) Stabilization wedges: solving the climate problem for the next 50 years with current technologies. Science 305:968–972

Takama N, Kuriyama T, Shiroko K, Umeda T (1980) Optimal water allocation in a petroleum refinery. Comput Chem Eng 4:251–258

Wang YP, Smith R (1994) Wastewater minimization. Chem Eng Sci 49:981–1006