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Editorial

The Power of the United Nations Sustainable Development Goals in Sustainable Chemistry and Engineering Research

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In 2015, the United Nations (UN) unveiled an ambitious plan, the Sustainable Development Goals (SDGs), aimed at providing guidelines, applicable universally to all nations, for equitable and responsible development, respectful of humans and ecosystems.[1] The SDGs plan sets a clear agenda to be achieved by 2030 (Agenda 2030), composed of 17 goals and 169 targets, that promotes economic growth, environmental protection, social inclusion, and human well-being.[2] This framework has been adopted by many governmental agencies, foundations, and companies in order to articulate specific actions in the broader context of sustainable development.[3,4] The global scientific community has also established connections to the SDGs, highlighting the central role that sustainable chemistry and engineering must play to realize them.[5,6] In particular, the SDGs are a powerful way to focus on how chemicals are used.[7] The central role and impact of advanced technologies on global well-being and sustainability are further recognized by the declaration of a United Nations International Year of Basic Sciences for Sustainable Development in 2022.[8]

Time-bound action based on specific policies in different regions is critical for achieving Agenda 2030. For example, the successes of India, China, and Brazil, among the most populous countries, in achieving the SDGs will hugely contribute to the global outcomes. Efforts are underway to quantify progress, such as the SDG India Index.[9] Directed actions to achieve the SDGs will be region specific. For example, it has been suggested that combating environmental pollution will be key in achieving the SDGs in China.[10] Advances in science, technology, and education are critical to successfully address the various challenges and achieve the SDGs.

Within *ACS Sustainable Chemistry & Engineering* (*ACS SCE*), we encourage authors to connect their research to the SDGs (Figure 1), identifying societal, environmental, and health-related benefits within submitted manuscripts where appropriate. The editors of *ACS SCE* are currently publishing a series of editorials on effective practices to incorporate sustainability assessments in submitted papers.[11] We believe that the SDGs offer an opportunity to assess reported discoveries in a uniform and easily recognizable way. Specifically, sustainability advances reported in manuscripts can be used to benchmark progress against published 2030 SDG targets. This approach provides a framework to guide and trigger advances in sustainable chemistry and engineering, in a way similar to the 12 Principles of Green Chemistry[12] and the 12 Principles of Green Engineering.[13] It must be noted that all these

Figure 1. United Nations Sustainable Development Goals (SDGs).

frameworks call for a holistic view of sustainability, whereby advances should lead to progress in all criteria, not in just one or a few at the expense of others. We encourage authors to adopt such an approach when critically assessing their reported advances.

We also welcome perspective-type manuscripts on the topic of the SDGs in the context of chemistry and engineering research, education, chemistry enterprise, public agencies, etc. While several such articles have appeared since the launch of the SDGs, the global crisis caused by the COVID-19 pandemic is reinforcing the urgency to work toward these goals. COVID-19 has had a major impact on human health and well-being (Goal 3) globally, yet the difference in the abilities of nations to effectively respond to the pandemic is revealing disparities across the globe in a number of SDG areas such as poverty (Goal 1), hunger (Goal 2), education (Goal 4), clean water and sanitation (Goal 6), and economic growth (Goal 8). Our ability to produce and consume responsibly has been drastically affected by disrupted supply chains, impaired mobility for people and goods, and increased reliance on disposables (Goal 12). The use of disposable masks, alongside already widespread use of single use plastics, is impacting habitats both on land and in the ocean (Goals 14 and 15). Some governments have seized this opportunity to cast ambitious plans for a post pandemic economic recovery to provide a boost to clean and affordable energy (Goal 7),

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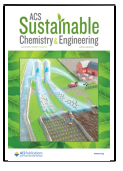

industry, innovation, and infrastructures (Goal 9), sustainable cities and communities (Goal 11), and climate change research (Goal 13). Similar to the strategy required to combat the global challenges posed by COVID-19, the achievement of Agenda 2030 also calls for a systemic, holistic, concerted, and global effort.

Clearly, many good practices have already been implemented, and progress is beginning to have a demonstrable impact. For example, eliminating open defecation by 2020 and providing clean water on tap (Goal 6) for every home in India by 2024, directly impacting the lives of 1.39 billion Indians, will be heartening accomplishments in this direction. At the global scale, the realization of water and sewage treatment methods will be essential to secure supplies of potable water. The chemical industry is not only the enabler of clean water, it also delivers many of the platform products that our daily lives depend upon, such as fertilizers (Goal 2), medicines (Goal 3), and materials for clothing and buildings (Goals 11 and 12). Thus, it will play a central role in meeting the SDGs. The growing global population, associated with fast urbanization, has contributed to some of the world's important challenges. The demand for everyday products is expected to double by 2030,[14] and the resulting expansion in chemical manufacturing must not worsen the environment's well-being and human health. At present, industry relies almost exclusively on fossil-based carbon sources for raw materials and energy. Its energy consumption results in greenhouse gas emissions that are approximately a third of those emitted by the transportation sector.[15] To lessen this burden, it is imperative that the chemical industry also deploys renewable and recycled carbon sources, both for raw materials and energy. Efforts toward such a transition are already underway. Examples include the use of biomass as feedstocks and, more recently, the electrification of the industry using renewable power[16] and plastics upcycling.[17] Chemical manufacturing is also accompanied by generation of end-of-use wastes, which must be reused or recycled to implement a circular economy.[18] Examples include converting the wastes into energy and materials,[19] which contribute to decarbonization (Goals 7 and 11). *ACS SCE* welcomes manuscripts that address advances on these topics, in the areas of catalysis (including photo- and electro-catalysis), energy materials, biomaterials, and resource-efficient chemical transformations.

Sustainability education (Goal 4) is essential to achieving the SDGs. Teaching chemistry and engineering from a systems thinking perspective will enable future chemists and engineers to consider the consequences of the choices they make in designing chemical products and processes from the beginning,[20] rather than deal with unintended consequences after their manifestation. Sharing examples of green chemistry and engineering applications of the SDGs with students as well as the general public will demonstrate that science and engineering can provide the solutions to global challenges. This has been exemplified by the rapid development of safe and effective COVID-19 vaccines. Equally important to the attainment of the SDGs is a workforce trained to embrace diversity, equity, and inclusion, as well as in collaborative partnerships to tackle the grand sustainability challenges of our times.

As we reflect on the role of the journal, *ACS SCE*, in advancing the SDGs, we should reflect on the role of chemistry and engineering itself. It was perhaps first said by Ronald Breslow[21] that "Chemistry is the central science." If that is indeed true, then we need to ask ourselves, "Central to what?" Is it merely central because it interacts with other disciplines? Is it central because it interconnects with other industry sectors? Or is it something bigger? Is chemistry central to our ability to understand and solve the greatest challenges of our generation, the same challenges that have been outlined by the UN's SDGs? In other words, sustainable chemistry and engineering are not merely important to the more obviously applicable SDGs such as production and consumption but rather also equally indispensable to those essential but less obviously related goals such as equity, equality, and justice. Achieving the broad range of goals will require building metaphorical bonds between the elements of our scientific and technological discoveries in catalysis, materials, and solvent systems to the humanitarian elements of education, economics, and social policy.[22] Through this approach, we can recognize that our technical understanding and creativity needs to link to broader societal mechanisms if we are to meet these important humanitarian goals at a global scale.

At *ACS SCE*, we strongly believe that sustainable chemistry and engineering will play a central role and serve as a hub to connect other disciplines in achieving Agenda 2030 in a holistic way. We are pleased to contribute to this mammoth effort.

Paul Anastas, Chair, Editorial Advisory Board orcid.org/0000-0003-4777-5172

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Audrey Moores, Associate Editor orcid.org/0000-0003-1259-913X

AUTHOR INFORMATION

Complete contact information is available at: https://pubs.acs.org/10.1021/acssuschemeng.1c03762

Notes

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