

# Editorial

The concept of green chemistry was created more than 20 years ago, providing a conceptual framework to address a variety of topics. Based on the guide of 12 principles completed by the 12 defined for industrial production, it aspired to create another way of doing chemistry. Today, the challenges of sustainable chemistry are even more prominent and at the heart of the concerns of society as a whole. Among those challenges, the scarcity of resources and the negative impact on climate change are highly visible issues that require urgent and appropriate measures. The development of responsible science and technology is undoubtedly necessary, but notable progress and sustainable results can not come without a collective drive and the active involvement of many actors from the social, economic, policy, cultural and ethical landscape. Innovation is a must in all fields, as we continue to scorch the earth and bring our ecosystem to its limits. Fair access to state-of-the-art science and technologies is key. Not diminishing the value of the science behind, rather the simplicity of its implementation, easily replicable technologies, will make the difference. This is well illustrated in the contribution of **Sparr and coauthors** on water-based micellar chemistry, a technology readily accessible and replicable in all currently existing vessels, at no additional capital investment. Thoughtful design of methodologies and technologies in the appropriate context is indeed a step towards sustainability. This requires continued efforts in such a critical area as catalysis, in all disciplines and areas of application, whether from the fragrance industry as **Saudan** reports, or from the chemical community in general, to address the fundamental question of plastic degradation. Here **Buller and coworkers** relay the power of biocatalysis and protein engineering to facilitate sustainable plastic waste management and potentially become an important stage towards circular plastic economy. **Du and Luterbacher** also demonstrate how all progress will rely on detailed understanding of all critical aspects of the reactions, to develop robust and efficient heterogeneous catalytic systems. **Arenz, Broeckman and coworkers** convey recent developments on the electrochemical conversion of the greenhouse gas CO<sub>2</sub> into products of higher value. These accounts all necessitate the continuous implementation of catalytic reactions in order to reduce waste, solvent and energy, generating a lesser demand onto endangered species which are becoming increasingly difficult to procure due to their low abundance and huge environmental footprint (e.g. noble metals such as Rh, Ru, Pd, Ir). It is true that the change to avoid dependency is difficult. There is now obvious need to change our habits and design systems to avoid dependency, whether for specific endangered elements, molecules or technologies.

The notion of circularity is also illustrated by **Pilloud et al.** who demonstrate that well-developed closed loop recycling can be enabled *via* proper process research and development and lead to significant safety, environmental risk reduction and economic savings.

Key players from the green chemistry arena have until recently been exchanging and communicating mostly at the technical level. While it allowed for the elaboration of a true community, it has, to some extent contributed to isolating this same community, and thus rendered the discipline hermetic to many necessary actors and stakeholders. Faced with the very legitimate rise of ecological concerns, did the green chemistry community cut itself from precious input by neglecting the social, economic, ecological, and political components essential to this process of change in chemistry? It has also led to surrendering the sustainability issues to the green chemistry community, while all scientists actually have a role to play. The task ahead of us requires an interdisciplinary approach with researchers in ecology, economics, and social sciences. This so far limited dialog and understanding of the value placed on communication has resulted in serious misunderstanding, and fear of public opinion from science. Education and proper communication will here be key to success. **Bochet's** account on various aspects of the greenness of photochemical reactions, both in the historical and technical sense, is a perfect example of the necessary critical perspectives that will be more and more required to best guide the scientific community and educate the public opinion. Measuring our performance and that of our syntheses and processes are first steps that bear huge cultural aspects. While the elitism of science tended to make of it a mere quantitative exercise, it turns out to be challenging to do thoroughly and on scale in the context of big portfolio of compounds, for example. In addition, it often lacks the simplicity necessary to reach out to diverse audience. A qualitative metrics therefore imposes itself as complementary and critical to the overall endeavor, touching more societal aspects of the sustainability but more clearly delineating the interconnectivity of all disciplines, such as renewability, toxicology, energy... **Wuitschik and coauthors** and **Gallou and coworkers** describe their recent work on both qualitative and quantitative concepts, along with the impact they had within their organizations.

What can be seen from this special issue is the obvious need for sustained research on green and sustainable chemistry, if we want to have a chance to rapidly reverse some of the challenging trends of potential irreversibility. From the mix of academic and industrial contributions of this special issue, we also wanted to highlight the need for a collective, and collaborative effort, to have a chance to rapidly address our current challenges. There are clear and still not optimally exploited synergies in between academia and industry!

I would like to finish on one provocative notion. MDs take the Hippocratic oath, and thus make a strong commitment to society, while PhDs do not. While we all acknowledge that with our credentials come some ethics and responsibility, would a simple extra-commitment change the way to see and envision our responsibilities as scientists? The notion, mentioned several times already by renowned peers, see for example the latest disclosure by Anastas and Zimmerman (*Green Chem.* 2019, asap DOI: 10.1039/c9gc01293a) has been progressing. What would we have to lose in trying it?

I wish you all an enjoyable learning experience while reading this special issue of Green and Sustainable Chemistry!

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The Editorial Board of CHIMIA warmly thanks Fabrice Gallou for his great efforts in bringing together this interesting collection of articles that demonstrates the progress made in more than 20 years of Green and Sustainable Chemistry and highlights the considerable challenges that lie ahead. The original cover art was created by Catherine Gallou and digitally reworked by Prof. Sachin Handa (University of Louisville, USA).