How to Reinvent our Relationship with the Planet at Molecular Scale

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Chemistry is usually defined, conceived, and taught as the science of transformation. To adapt to the circular economy, chemistry must evolve towards being the science (and industry) of reuse. We cannot continue to extract, emit, and dispose at the levels we are doing now without compromising our climate, the environment, and our health. If we want to have a viable industry and a healthy planet, the circular economy cannot be just an aspiration but the key objective of chemistry. [1]

Rethinking chemistry for a circular economy involves profound changes, from the way molecules are conceived to how processes are designed to ensure traceability, recyclability, and reuse [2]. Circularity at the molecular level means turning chemistry toward the reuse of atoms, molecules, monomers, polymers, etc—and represents an opportunity to place chemistry at the center of the new circular economy. [3]

Figure 1 captures how chemistry can adapt from a linear (transformation) to a circular process (reuse) and how this involves designing molecules in a way that they can be disassembled and reconstructed to minimize the production of waste and ensure recyclability.

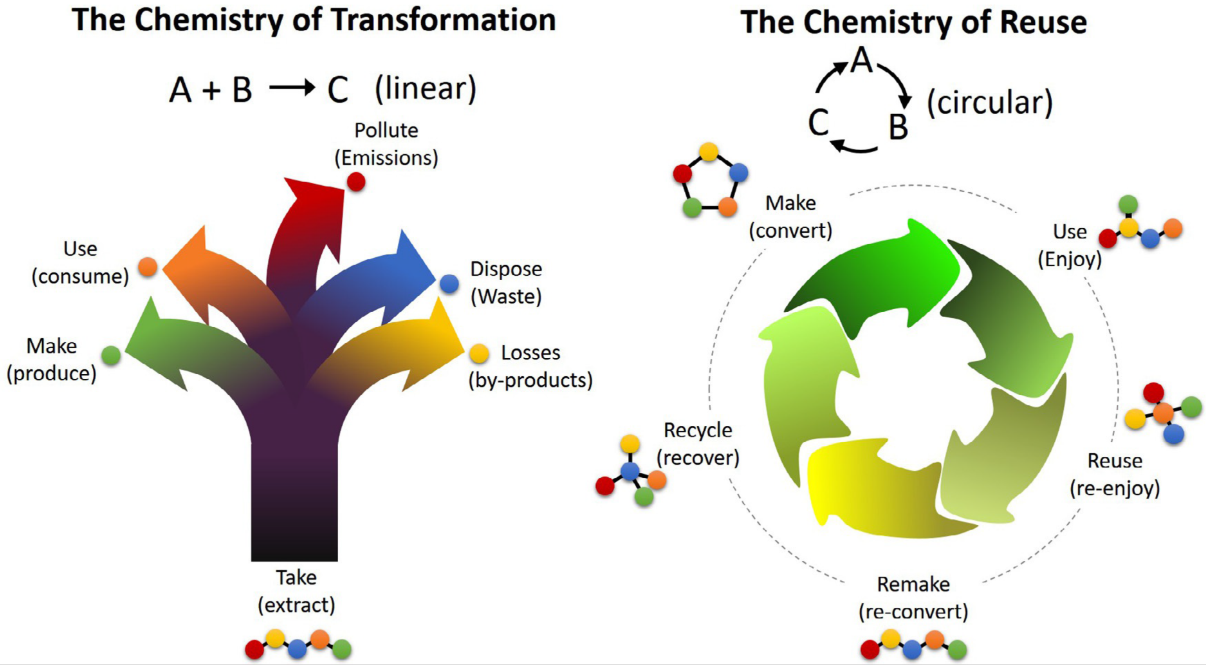

Figure 1. Schematic representation of the two models of chemistry: (left) the old linear concept based on the transformation of raw materials into products and waste and (right) the new chemistry of reuse that involves a close loop system where resources are continuously used and the production of waste is minimized. [2]

Several examples of circular economy will be presented, including the design of a new generation of plastics with break-points [4] or dynamic bonds [5] that allow for their disassembly into their monomers and their reconstruction. This process can be done at ca. 100 % yield and multiple times. These and other examples of circular chemistry will be described in detail and an outlook of the area will be provided.

During my presentation, I will also describe some of the activities that we are carrying out at IUPAC to foster sustainable chemistry education, research, and industry while we accelerate the achievement of the Sustainable Development Goals, as we are celebrating the International Year of Basic Sciences for Sustainable Development.

References

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President of the International Union of Pure and Applied Chemistry (IUPAC), the recognized world authority in developing nomenclature and terminology, verified data, and standards for the advancement of chemistry

His contributions to catalysis, energy, and chemistry have been recognized with some of the most prestigious awards including: 1) Young Global Leader, 2009 – World Economic Forum, 2) Innovator of the Year, 2007 – MIT, 3) Member of the Round Table of Top Entrepreneurs, 2008 – European Commission, 4) Emerging Researcher Award, 2015 and Kathryn C. Hach Award for Entrepreneurial Success, 2018 – American Chemical Society, 5) Premio Rey Jaime I, 2014, 6) Fellow of the Royal Society of Chemistry, 2007, and the American Chemical Society, 2021, and 7) Member of the Council of Emerging Technologies – World Economic Forum.

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