# Environmentally sustainable chemistry

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## PERSPECTIVE

The notion of "green chemistry" was established in the scientific community in the early 1990s and quickly adopted by the mass-media as a new approach to chemistry in contrast to the pollute-and-then-clean-up strategy deemed conventional industrial technique. The concept quickly gained popularity, and numerous research institutes, books, and journals employ it, though not always in the same way. The US Environmental Protection Agency (EPA) defines "green chemistry" as "the use of chemistry for pollution control and the design of chemical products and processes that are more environmentally friendly." The EPA has identified the following key areas for green chemistry. Use of alternative synthetic pathways (for example, natural processes like photochemistry and biomimetic synthesis, or alternative feedstock's like biomass that are more benign and renewable). Alternative reaction conditions (for example, the use of solvents with a lower impact on human health and the environment), or increased selectivity with lower wastes and emissions.

Design of environment friendly chemicals (less toxic than current alternatives or inherently safer with regard to accident potential). "Sustainable chemistry" is a term that is sometimes opposed to and confused with "green chemistry." The terminologies differ significantly: while green chemistry implies the existence of a non-hazardous and polluting chemical manufacturing process, the sustainable chemistry notion connects eco-efficiency, economic growth, and quality of life in terms of a cost/benefit analysis. The sustainable chemistry approach emphasizes the concept of long-term risk, implying that there is no such thing as excellent "green chemistry" in contrast to dirty chemistry, but rather that any chemical process has a risk associated with it. The role of chemists and engineers is to limit this danger and lower the environmental damage to a level that the environment can support, ensuring a good quality of life. When one examines the changes that have occurred in the chemical industry over the previous two decades, it is clear that all new processes launched were motivated by a desire to reduce environmental effect or hazardous hazards, as well as achieve greater resource use.

However, none of the modifications would have been possible without improved process economics, which included environmental and social factors in the cost calculation. Some instances of eco-efficient alternatives to standard processes are provided, along with the relevant terms features of the processes in terms of sustainable and environment. Environmental protection does not have to be at odds with economic growth, but the application of new and improved chemical technologies is required to combine these two aspects, which would otherwise be at odds. R&D is thus essential for long-term development. Furthermore, recent examples show that innovative efficient and environmentally processes can provide organizations with the possibility to achieve new position in the market.

Catalysis is an essential and crucial instrument for accomplishing social and economic goals. Atom economy is the basic concept of green chemistry and a synthetic efficiency parameter. Sheldon's E factor (environmental factor) notion would be preferred. The E factor is the ratio (kg/kg) of by-products to products, defined as everything except the desired product. Oil refining (around 0.1), bulk chemicals (1–5 range), and medicines are examples of typical values (up to 100). By multiplying the E factor by an environmental Quotient (Q) based on the type of the waste, a weighted factor that allows the degree of "green chemistry" content of a chemical product to be identified can be obtained. This is a common concept in the "green chemistry" world, although it is not very exact. It is better to employ more stringent approaches, such as the CTSA procedure described above. Because these qualities correspond to an improvement in process economics, industrial processes have evolved from the beginning to make better use of resources and improve selectivity. The synthesis of maleic anhydride is an example of this method. Around 15–20 years ago, the benzene-based catalytic process was changed with one dependent on butane.

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