Why Definitions Matter in Sustainable Chemistry

The value of clear definitions in sustainable chemistry

- Sets a vision
- Allows accountability and measurement
- Enables consistency
- Limits misuse

Massachusetts Toxics Use Reduction Act - 1989

- Toxics use reduction means: ''in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risks to the health of workers, consumers, or the environment, without shifting risks between workers, consumers, or parts of the environment.”

Anastas and Warner

- Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances throughout their lifecycles: design, manufacture, use, and end of life. Green chemistry is a growing field of practice that builds on conventional chemistry and engineering by applying 12 fundamental principles that guide the molecular design of sustainable chemical products and processes.
- Inherently lower toxicity is a hallmark
- Adhering to these principles prevents pollution and waste, leads to synthesis of chemicals in less hazardous and more efficient ways, promotes the use of renewable feedstocks, and leads to the design of safer chemicals.

S. 2879 – U.S. Sustainable Chemistry R&D Act

The term ‘‘sustainable chemistry’’ means the design, development, demonstration, and commercialization of high quality chemicals and materials, chemical processes and products, and manufacturing processes that eliminate or reduce chemical risks to benefit human health and the environment across the chemical lifecycle, to the highest extent practicable, through—

(A) increasing the use of more sustainable, renewable, or recycled substances and materials;

(B) increasing the use of substitutes for rare substances;

(C) promoting safe and more efficient manufacturing;

(D) minimizing lifecycle impacts, including environmental and health impacts;

(E) optimizing product design and encouraging the reduction of waste and the reuse or recycling of chemicals and materials to account for the end of life or the final disposition of the product; or

(F) increasing the design and use of safe molecules, chemicals, materials, chemistries, and chemical process

OECD Sustainable Chemistry Definition

- Sustainable chemistry is the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes. Within the broad framework of sustainable development, government, academia and industry should strive to maximise resource efficiency through activities such as energy and non-renewable resource conservation, risk minimisation, pollution prevention, minimisation of waste at all stages of a product life-cycle, and the development of products that are durable and can be reused and recycled

http://www.oecd.org/env/ehs/risk-management/29361016.pdf

Green **Chemistry** vs. Sustainability

Sustainable Chemistry

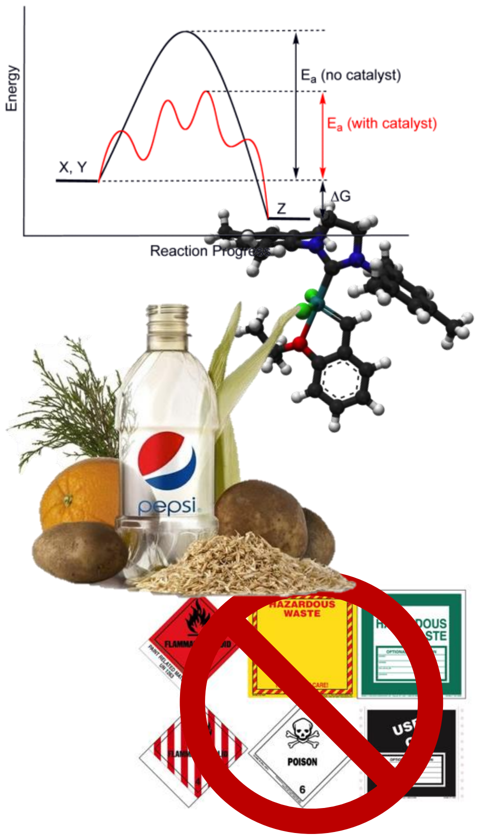
Chemistry applied towards a sustainable end

- Solar cells
- Water purification
- Remediation technologies
- Compostable plastics
- Hydrogen fuel cells
- Environmental monitoring
- Materials compatible with the circular economy

Green Chemistry

Chemistry performed in a sustainable way

- Benign solvents
- Efficient catalysts
- Renewable feedstocks
- Less-toxic waste
- Reduced energy use
- Fewer byproducts



Some companies have programs in both….

Green chemistry and sustainable chemistry are not:

- Better chemicals management – sound management of chemicals
- Pollution control
- Risk reduction activities (emissions controls etc)
- Clean up of hazardous materials (unless green chemistry used to achieve this goal)
- Responsible care

- But sustainable chemistry is broader focused than green chemistry

Rio Declaration – Agenda 21

- 19. SAFER USE OF TOXIC CHEMICALS Seeks objectives such as: full evaluation of 500 chemicals before the year 2000; control of chemical hazards through pollution prevention, emission inventories, product labelling; use limitations, procedures for safe handling and exposure regulations; phase-out or banning of high-risk chemicals; consideration of policies based on the principle of producer liability; reduced risk by using less-toxic or non-chemical technologies; review of pesticides whose acceptance was based on criteria now recognized as insufficient or outdated; efforts to replace chemicals with other pest-control methods such as biological control; provision to the public of information on chemical hazards in the languages of those who use the materials; development of a chemical-hazard labelling system using easily understandable symbols; control of the export of banned or restricted chemicals and provision of information on any exports to the importing countries.

Clarity is needed

- Innovation oriented forward looking – new chemistries and chemical processes that are through their lifecycles:
  - Less toxic
  - Less resource intensive
  - Use renewable feedstocks
  - Have lower energy use/carbon footprint
- Should minimize trade-offs between these different impacts
- Going beyond goals of thirty years ago – sound management of chemicals which is still needed in many places
- Strong definition but don’t be dogmatic – eg focus on it is or isn’t green chemistry or sustainable chemistry.

Questions for discussion

- Are chemistries that help achieve sustainability goals but may have negative toxicity consequences/trade-offs – sustainable chemistry?
- Are there big differences between sustainable chemistry and green chemistry and can we be clear about these? Do we need to be clear about these?
- If so, how will we define sustainable chemistry more clearly (chemistry to meet sustainability objectives) and distinguish it from green chemistry?