Why Promote Green Chemistry?

Green chemistry is an approach to the design, manufacture and use of chemical products to intentionally reduce or eliminate chemical hazards.[1] "While U.S. industry has begun to implement green chemistry principles across a range of chemical applications, U.S. investment in green chemistry training and research lags behind. The U.S. has four fledgling green chemistry university programs[2] but the much smaller United Kingdom has two well-developed regional programs based on providing technical expertise to businesses and advice to government policy decision makers[3], and even Australia boasts a center with over 3.5 million U.S. dollars in funding for 2005[4]. China has multiple green chemistry centers and is actively expanding expertise in this issue. India officially requires green chemistry training for its chemistry students while in the U.S. such students face no requirement even to understand basic toxicology. Although some chemistry programs in the U.S. are beginning to integrate green chemistry principles into their curriculum a concerted effort is still needed to mainstream green chemistry in the United States.

HOW TO PROMOTE GREEN CHEMISTRY

Fund Research

In September 2006, the House of Representatives passed the Green Chemistry Research and Development Act of 2005 (H.R. 1215, formerly H.R. 3970) which would authorize a total of $84 million over three years for green chemistry programs at the National Science Foundation, the Department of Energy, the National Institute of Standards and Technology, and the Environmental Protection Agency.[5]

➤ ACTION ITEM

Did your legislator support this Act?
Find out! If so, encourage their continued support to increase research funding for green chemistry. If not, let them know you think this is an important issue.

Train Tomorrow's Chemists

Green chemistry is being taught in universities around the world but is still not integrated into the majority of chemistry curricula. As a result, graduates have little awareness of how the chemicals they design will affect human health and the environment. Green chemistry courses are becoming more available and more popular but more needs to be done to speed up this change.

Some American universities are beginning to address this deficiency. The University of Scranton in Pennsylvania has developed green chemistry modules that can be integrated in traditional university chemistry classes.[6] The University of Oregon offers a searchable database of educational materials focused on green chemistry.[7] Carnegie Mellon conducts innovative research at the Institute for Green Oxidation Chemistry.[8] The University of Yale now has a Center for Green chemistry and Green Engineering. The American Chemical Society provides a resource guide for faculty; this "Going Green" booklet provides an introduction to green chemistry in education and tools for integrating green chemistry into classes.[9]

➤ ACTION ITEM

Do your local schools include green chemistry?
Talk to your local high school, college or university about using the ACS booklet to introduce green chemistry modules or classes into their curricula.

Enact Policies to Support Green Chemistry

Legislation and public policies can be important drivers for wider adoption of green chemistry. In the face of more stringent regulations such as the new European chemical policy, REACH[10], American businesses need to adopt green chemistry practices in their product design to better compete in the global market. Among the recent policies and proposals addressing green chemistry are the following:

- Maine's Governor created a "Governor's Task Force to Promote Safer Chemicals in Consumer Products" in early 2006. The task force will develop recommendations for a comprehensive chemicals policy for Maine that will: a) require that hazardous chemicals found in consumer products be replaced by safer substitutes; and b) create incentives to develop safer alternatives on a state and regional basis.[11]

Some Higher Education Programs in Green Chemistry		
Carnegie Mellon University	http://www.chem.cmu.edu/groups/Collins/	USA
Monash University	http://www.chem.monash.edu.au/green-chem/	Australia
University of Leicester	http://www.le.ac.uk/ch/greenchem/	UK
University of Oregon	http://www.uoregon.edu/~hutchlab/greenchem/	USA
University of York	http://www.york.ac.uk/res/gcg/index.htm	UK

• Michigan's Governor signed an executive directive titled the "Promotion of Green Chemistry for Sustainable Economic Development and Protection of Public Health" in October 2006.[12] It directs the state's Department of Environmental Quality to establish a Green Chemistry Support Program that will promote safe technologies and innovations aimed at lowering health risks and preventing harmful chemical pollution at the source. It will also help Michigan devise strategies to promote green chemistry and engineering education.

• A report commissioned by the California Senate Environmental Quality Committee and the Assembly Committee on Environmental Safety and Toxic Materials calls for a comprehensive government policy for chemical production and use based on green chemistry to insure California's continued economic competitiveness.[13]

• The New England Green Chemistry Consortium (NEGCC) is a partnership of six land grant universities to "educate, discover, develop, apply and promote green chemistry in all its forms."[14] It was launched in 2004 under the direction of the National Environmental Technology Institute (NETI). This initiative was awarded $500,000 for research by the U.S. Senate as part of an omnibus bill for green research.

• Massachusetts: Safer Alternatives for Toxic Chemicals[15] would establish a pragmatic process to reduce the many toxic chemicals we are exposed to in everyday life if passed. The bill initially targets ten of the worst toxic chemicals in Massachusetts—chemicals that are currently replaceable with feasible, safer alternatives for many uses. It would also mandate a careful process to insure alternatives are safer and replace toxic chemicals with safer alternatives where feasible and stimulate research and development on new technologies and solutions when a safer alternative is not currently feasible. The proposed bill also includes programs to assist workers and businesses in this transition to the safest available alternatives, funded through a fee on toxic chemicals.

The Substitution Principle and Green Chemistry: A Winning Combination

Governments can also provide a positive push for companies to use safer chemicals by embedding the *Substitution Principle* within legislation and planning processes. Simply put, the substitution principle is the requirement to use safer alternatives for any hazardous chemicals when a safer alternative is available. The European Union has just finalized an overhaul of their chemicals policy to promote substitution planning. Without such policy the development of safer chemicals in the lab may never see commercial development and use.

➤ ACTION ITEM

Does your state or region have initiatives that support green chemistry?
Find out! Let your elected officials know this is an important issue.

Adopt Green Procurement Guidelines

Green Procurement guidelines can recognize and provide a market stimulus to encourage efforts by leading companies to screen out hazardous chemicals and seek continuous improvement through adoption of green chemistry principles. Kaiser Permanente, for instance, the largest nonprofit health provider in the U.S. has mandated safer chemicals as well as a list of chemicals they are asking their suppliers to avoid.[16]

Individual consumers can also make a difference by demanding information from companies about their chemicals policy. Many cosmetics[17] and computer manufacturers,[18] for instance, now post information on their websites prompted by campaigns to make this information transparent. The Green Chemistry and Consumer Network publishes free on-line newsletters that showcase new developments in consumer products.[19]

➤ ACTION ITEM

Do the companies you buy products from have a chemicals policy focused on the research and use of safer chemicals?
Find out! If so, congratulate them and encourage them to make it public. If not, let them know if their competitors already have one or are moving in that direction and that it will influence where you spend your money.

Support campaigns that demand greater transparency on product ingredients from product manufacturers. Three examples:

- **The Safe Cosmetics Campaign: *www.safecosmetics.org***
- **Health Care Without Harm: *www.noharm.org/us/chemicalpolicy/issue***
- **The Greenpeace Green Electronics Guide: *http://www.greenpeace.org/international/campaigns/toxics/electronics/how-the-companies-line-up***

RESOURCES

- Anastas, P. T., and J. C. Warner (1998) *Green Chemistry: Theory and Practice* Eds. Oxford University Press: Oxford, UK.
- Canadian Green Chemistry Network, *http://www.greenchemistry.ca/index.htm*
- Carnegie Mellon Institute for Green Oxidation Chemistry, *http://www.chem.cmu.edu/groups/Collins/*
- Green Chemistry and the Consumer Network, *http://www.chemsoc.org/networks/gcn/industry.htm#consumer*
- Green Chemistry Institute, *http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=greenchemistryinstitute%5Cindex.html*
- University of Massachusetts Lowell Center for Green Chemistry, *http://www.greenchemistry.uml.edu/*
- University of Scranton Greening Across the Chemistry Curriculum, *http://academic.scranton.edu/faculty/CANNM1/dreyfusmodules.html*
- US EPA, Green Chemistry, *http://www.epa.gov/greenchemistry/index.html*
- Worldwide Universities Network's Green Chemistry Partnership, *http://www.wun.ac.uk/greenchem/index.htm*

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ENDNOTES

1 Anastas and Warner, *Green Chemistry: Theory and Practice*, 1998

2 These are at Yale, Carnegie Mellon, Scranton and Oregon.

3 At the universities of Leicester and York

4 Estimate based on 22% of funding coming from the Australian Research Council in the amount of 9,867,000 Australian dollars. See 2005 Annual Report at *http://www.chem.monash.edu.au/green-chem/pdfs/CGCreport2005.pdf*

5 See *http://www.cbo.gov/showdoc.cfm?index=5381&sequence=0*

6 See *http://academic.scranton.edu/faculty/CANNM1/dreyfusmodules.html*

7 See *http://greenchem.uoregon.edu/gems.html*

8 See *http://www.chem.cmu.edu/groups/Collins/*

9 ACS "Going Green," *http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=education/greenchem/intergrating_green_curriculum.html*

10 REACH stands for Registration, Evaluation and Authorization of Chemicals. Info at *http://ec.europa.eu/environment/chemicals/news/updates.htm*

11 See the Executive Order at *http://www.maine.gov/tools/whatsnew/index.php?topic=Gov_Executive_Orders&id=21193&v=Article*

12 See *http://www.michigan.gov/gov/0,1607,7-168-36898-153806–,00.html*

13 Wilson, Chia and Ehlers (2006) Green Chemistry in California. A Framework for Leadership in Chemicals Policy and Innovation, *http://www.berkeley.edu/news/media/releases/2006/03/14_greenchemicals.shtml*

14 See New England Green Chemistry Consortium at *http://chemistry.umeche.maine.edu/Green.html* for more information.

15 *http://www.healthytomorrow.org/PDF/Safer%20Alternatives%20Bill%20Fact%20Sheet.pdf*

16 Health Care without harm website at *www.noharm.org* and Healthy Business Strategies for Transforming the Toxic Chemical Economy at *www.cleanproduction.org/Publications.php*

17 The Safe Cosmetics Campaign, *http://www.safecosmetics.org/*

18 Greenpeace's Toxics Campaign, *www.greenpeace.org/usa/campaigns/toxics*

19 Green Chemistry and the Consumer Network, *http://www.chemsoc.org/networks/gcn/industry.htm#consumer*