

**Thomas E. Graedel**  
**School of Forestry and Environmental Studies**  
**Yale University**  
**New Haven, CT 06511**

Curriculum Vitae  
July 20, 2006

B.S. (Chem. Eng.), Washington State University, 1960; M.A. (Physics), Kent State University, 1964; M.S., Ph.D. (Astronomy), University of Michigan, 1967, 1969. Member of Technical Staff, AT&T Bell Laboratories, 1969-1984. Distinguished Member of Technical Staff 1984-1996. Professor of Industrial Ecology, of Chemical Engineering, and of Geophysics, Yale University, 1997-. Research history: solar physics (1967-1969); chemical kinetic modeling of gases and droplets in Earth's atmosphere (1970-1995); corrosion of materials by atmospheric species (1973-1996); atmospheric change (1979- ); industrial ecology and sustainability science (1990- ). Author/coauthor of 13 books (with total sales of more than 35,000 copies) and over 300 technical papers in various scientific journals.

### **Summaries of Technical Accomplishments**

#### *1. Industrial Ecology*

Industrial ecology is an evolving view of industrial operations in which one seeks to design processes and manufacture products in such a way as to minimize and optimize their environmental interactions. Graedel's professional journal articles and senior-authored textbook (*Industrial Ecology, 2<sup>nd</sup> edition, 2003*) provide much of the perspective and practical techniques that are helping to make this revolutionary approach to industrial practice become reality. A review of the textbook says "The book definitely breaks new ground, and it is intellectually alive and daring, chapter after chapter". He is also the senior author on four related books, *Greening the Industrial Facility*, *Design for Environment*, *Industrial Ecology and the Automobile*, and *Streamlined Life-Cycle Assessment*. Graedel's environmental assessment matrix, developed while assessing AT&T products, is now a standard industrial tool for streamlined life cycle assessments of the environmental impacts of products, processes, and facilities.

#### *2. Materials Use, Loss, and Recycling*

The historical reservoir for the materials used by our technological society has been virgin stocks (ore bodies, mineral deposits, and the like). Those stocks may become inadequate or unavailable at some times or places in the future, the profligate use of energy for acquiring virgin materials is increasingly problematic, and the loss of resources by dissipation or discard is often an environmental challenge. These issues can be addressed by developing cycles for the stocks and flows of materials of interest, particularly if the cycles are temporally and spatially resolved. Graedel and colleagues have characterized regional and global cycles, current and historic, for copper, chromium, zinc, lead, and silver, determining the stocks available in different types of reservoirs and the related flows. Ongoing work treats a number of other metals, including iron, nickel,

stainless steel and tungsten. The work provides a new basis for assessments of resource sustainability, environmental implications, and related policy initiatives.

### *3. Atmospheric Composition and Global Change*

Long term trends in atmospheric composition are important to regional and global air quality, rates of atmospheric interactions with materials, and, ultimately, the sustainability of the planet. Graedel worked with Jean McRae of Bell Labs to demonstrate that carefully selected urban carbon dioxide data mimicked the long-term trends seen in remote areas. They then studied trends in urban methane and CO concentrations, and were the first (in 1979) to warn of their increase. Methane and CO are now regarded as significant contributors to the warming of Earth caused by human activities. In the mid-1990s, Graedel and Nobel Laureate atmospheric chemist Paul Crutzen wrote both an undergraduate textbook (*Atmospheric Change: An Earth System Perspective*) and a related volume for the lay public (*Atmosphere, Climate, and Change*). A 1994 review of the former in the British journal *Nature* states that the book "does an amazing job of introducing the reader to the large-scale issues of today and the future". The latter won the American Meteorological Society's Louis J. Battan Author's Award in 1995.

Perhaps one of the best measures of the impact of a scientist's work is the degree to which his or her publications are cited by others. As of the end of 2005, Graedel's papers and books have been cited more than 3900 times, placing his citation record among the upper 1/3 of 1% of those of all active scientists.

### **Principal Current Professional Activities**

- Member, Sustainability Round Table, National Academy of Sciences
- Chair, New Member Selection Peer Committee, US National Academy of Engineering
- Chair, Advisory Committee on Environmental Management, Yale University

### **Selected Past Professional Activities**

- Member, Executive Committee, Institute on Industrial Ecology and Global Change, Snowmass, CO, August (1992)
- President, Atmospheric Sciences Section, American Geophysical Union (1996-1998)
- Inaugural Chair, Gordon Research Conference on Industrial Ecology (1998)
- Inaugural President, International Society for Industrial Ecology, 2003-2004

### **Selected Past Governmental Advisory Activities**

- Member, National Research Council Board on Atmospheric Sciences and Climate, 1987-1993; Executive Committee, 1989-1993.
- Chair, National Research Council Panel on the Atmospheric Effects of Stratospheric Aircraft, 1993-1994, and principal author of the panel report *Atmospheric Effects of Stratospheric Aircraft*, National Academy Press, 1994.

- Chair, National Research Council Committee on Grand Challenges in Environmental Sciences, 1999-2000 and principal author of the committee report. This report set the stage for the National Science Foundation's "Biocomplexity and the Environment" initiative in 2001-2006.
- Member, Advisory Committee on Environmental Research and Education, National Science Foundation, 2002-2004, and contributing author to *Complex Environmental Systems: A 10-Year Outlook for the National Science Foundation*, 2003, and *Complex Environmental Systems: Pathways to the Future*, 2005.
- Chair, Committee to Review the U.S. Climate Change Science Program Strategic Plan, National Research Council. The committee provided formal review (issued February, 2003) of the draft plan and a second review of the plan's revision (issued February, 2004). Graedel testified before the U.S. Senate Commerce Committee on the work of the committee.

### **Selected Invited Presentations**

- "Teaching Industrial Ecology from an Industrial Perspective", Engineering Deans Institute, Tucson, AZ, 1995.
- "Design for Environment Activities in Electronics Manufacturing", 2nd Intl. Conf. On Ecobalance, Tsukuba, Japan, 1996.
- "Environmentally-Responsible Processes", Second Korean Clean Technology Conference, Seoul, Korea, 1997.
- "The Multiscale Cycle of Copper", Gordon Research Conference on Industrial Ecology, New London, NH, 2002.
- "Green Chemistry and Sustainable Development", International Green Chemistry Conference, Swansea, Wales, 2001.
- "Lessons from the Cycles of Metals", World Engineering Congress, Shanghai, China, 2004.

### **Honors and Awards**

- Named Distinguished Member of Technical Staff, AT&T Bell Laboratories, June, 1984.
- Co-recipient with Paul J. Crutzen, Louis J. Battan Author's Award of the American Meteorological Society, 1995 for "their book entitled Atmosphere, Climate, and Change, an authoritative and beautifully illustrated introduction to the role of the atmosphere in global change".
- Elected as Fellow, American Geophysical Union, March, 1995, "for extensive works in atmospheric chemistry, for his insight in analyzing trends of greenhouse gases, and for outstanding leadership and service to the atmospheric science community".
- Who's Who in America, 1997-present
- Elected as Fellow, American Association for the Advancement of Science, September, 1998, "for outstanding contributions to the environmental sciences and the new discipline of industrial ecology".
- Elected to U.S. National Academy of Engineering, 2002, "for outstanding contributions to the engineering theory and practice of industrial ecology, particularly for improved methods of life-cycle analysis".