Chapter 6

Policy Options and the Challenge of Green Design

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Chapter 6
Policy Options and the Challenge of Green Design

Several examples have already been cited in which Federal regulations inject environmental considerations into product design. For instance, the effect of Corporate Average Fuel Economy (CAFE) standards on automobile design is described in appendix 3-A. Should Congress consider taking any further action to encourage green design? While some in industry argue that existing market incentives and environmental regulations are sufficient, the Office of Technology Assessment (OTA) finds that further Federal action is necessary to ensure that the full potential of green design is realized. This chapter examines current incentives for green design and identifies four areas of need that only Congress can address.

CURRENT INCENTIVES FOR GREEN DESIGN

Federal Statutory/Regulatory Incentives

Many health and environmental laws passed by Congress influence the environmental attributes of products (table 6-1).[1] Some, such as the Clean Air Act (CAA), Clean Water Act (CWA), and Resource Conservation and Recovery Act (RCRA) do so indirectly, by raising industry's costs of releasing wastes to the air, water, and land. Others, such as the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), control the use of hazardous chemicals and pesticides directly.[2]

Sometimes, design changes have resulted from "sunshine" laws that simply require the public disclosure of information about industry's use of toxic chemicals. For example, Title III of the Superfund Amendments and Reauthorization Act of 1986 requires manufacturers to report environmental releases of 322 listed chemicals to a public database managed by the Environmental Protection Agency (EPA) called the Toxics Release Inventory (TRI). In several cases, the prospect of public disclosure of these releases stimulated companies to switch to more environmentally sound processes and product formulations.[3] Companies are also reformulating products to reduce potential liability for improper waste disposal under RCRA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund'').4

Of those laws listed in table 6-1, the Clean Air Act Amendments of 1990 may have the largest impact on product design, since they will result in restrictions on volatile organic compounds (Title I), hazardous air pollutants (Title III) and chlorofluorocarbons (CFCs) and other ozone-depleters (Title VI). These chemicals are used widely in manufacturing processes, as well as in paints, coatings, cleaners, pesticides, and household products.[5]

In listing the environmental laws in table 6-1, OTA does not intend to suggest that all environmental impacts of products are already regulated or that existing regulations provide adequate protection for the environment. Rather, the intent is to show the range of Federal laws that already affect product design.

Federal Disincentives?

Critics charge that some Federal regulations provide disincentives to green design. Examples often cited are government procurement policies (e.g., military specifications that require the use of virgin materials, CFC cleaners, and leaded paints where these materials are not necessary for product performance), RCRA regulations that make the

1 For an overview of the influence of Federal laws on the formulation of various chemical products, see Kerr and Associates, Inc., ''Effect of Environmental Statutory/Regulatory Requirements on Product Formulation/Process Design: Information on Solvents, Agricultural Chemicals, Products Containing Heavy Metals, and Related Household Cleaning Products," contractor report prepared for the Office of Technology Assessment, April 1992.

2 Paul R. Portney (cd,), *Public Policies for Environmental Protection* (Washington, DC: Resources for the Future, 1990).

3 For a discussion of how TRI reporting requirements changed the corporate culture at Monsanto and other companies, see Bruce Smart (ed.), Beyond *Compliance: A New Industry View of the Environment* (Washington DC: World Resources Institute, 1992), p. 87.

4 Kerr and Associates, op. cit., footnote 1.

5 As one example, the total U.S. market for coatings in 1990 was $11.9 billion, but only about half of these coatings meet current environmental regulations for volatile organic compounds. Cited in promotional literature for a report by Business Communications Company, Inc. Norwalk, CT, "Environmentally Acceptable Coatings: The Industry," LC-136, May 1991.

Table 6-l—Federal Health and Environmental Laws Affecting Product Design

Statute	Impact on design	Agency
Clean Air Act of 1970 (and Amendments of 1977 and 1990)	Encourages reduction in the use of solvents, volatile organic compounds, and phases out chlorofluorocarbons.	EPA
Clean Water Act of 1977 (and Amendments of 1987)	Encourages reduction in the use of toxic chemicals that become water pollutants.	EPA
Resource Conservation and Recovery Act of 1976 (and Hazardous and Solid Waste Amendments of 1984)	Encourages redesign of products and processes to reduce generation of hazardous solvent, pesticide, and metal-bearing wastes, and to avoid liability for cleanup of wastes improperly disposed.	EPA
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (and Superfund Amendments and Reauthorization Act of 1986)	Encourages reduction in use of listed hazardous substances to avoid reporting requirements for releases of these substances, and liability for cleanup of Superfund sites.	EPA
Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (and Amendments of 1988)	Encourages reformulation of pesticides to ensure safety and efficacy of active ingredients (and to avoid inert ingredients of toxicological concern), through a registration program.	EPA
Toxic Substances Control Act of 1976	Requires manufacturers to obtain approval from EPA (which may require submission of test data) before producing new chemicals that may pose an unreasonable risk to human health or the environment.	EPA
Federal Food, Drug, and Cosmetics Act	Regulates allowable pesticide residues in food, as well as the formulation of various solvent-containing cosmetic products.	FDA
Consumer Products Safety Act of 1978, Federal Hazardous Substances Act, Poison Prevention Packaging Act of 1970	Regulate the use of hazardous substances in consumer products.	CPSC
Occupational Safety and Health Act of 1970	Encourages manufacturers to avoid use of materials or processes that might expose workers to hazardous substances in the workplace.	OSHA

KEY: CPSC—Consumer Product Safety Commission; EPA—Environmental Protection Agency; FDA—Food and Drug Administration; OSHA-Occupational Safety and Health Administration.
SOURCE: Kerr and Associates, "Effect of Environmental Statutory/Regulatory Requirements on Product Formulatiorr/Process Design: Information on Solvents, Agricultural Chemicals, Products Containing Heavy Metals, and Related Household Cleaning Products," a contractor report prepared for the Office of Technology Assessment, April 1992.

recycling of hazardous wastes more costly than disposing of them,[6] and the failure of RCRA regulations to distinguish between high-risk and low-risk chemicals and waste streams.[7] OTA did not attempt to evaluate these claims in this study, but Congress may wish to initiate further research in this area.

Several recent initiatives could help to remove some of the barriers to green design that exist in current Federal rules and regulations. In October 1991, President Bush signed Executive Order 12780, the Federal Recycling and Procurement Policy, which requires Federal agencies to increase recycling and waste reduction efforts and to encourage markets for recovered materials by favoring the purchase of products with recycled content.[8] The order creates a Federal recycling coordinator and a Council on Federal Recycling and Procurement. It also requires each agency to designate its own recycling coordinator. Recently, the Department of Defense issued directives emphasizing waste prevention through the acquisition process and through

6 See testimony of Herschel Cutler, Institute of Scrap Recycling Industries, before the Subcommittee on Environmental Protection of the Senate Committee on Environment and Public Works, June 5, 1991.

7 J-s Bovard, "RCRA: @@of an Environmental Debacle," *Journal of Regulation and Social Costs*, vol. 1, *No. 2,* January 1991, p. 37.

8 *Environmental Quality 1991, 22nd Annual Report of the Council on Environmental Quality* (Washington, DC: U.S. Government Printing Office, March 1992), p. 113.

military specifications and standards. Some 40,000 military specifications requiring the use of hazardous materials are currently under review.[9 10] These initiatives could help to stimulate market demand for green products.

State and Local Laws and Regulations

Many State and local governments are also enacting policies aimed at reducing the environmental impacts of products (table 6-2). These measures include mandatory industry plans to reduce the use of toxic chemicals, requirements for industry disclosure of hazardous chemicals in products, and creation of-standard definitions for advertisers' use of environmental terms such as "recycled." States have also enacted some targeted product control measures such as recycled content requirements for newspaper, bans and taxes on specific packages, mandated manufacturer take-back of batteries, and tax incentives for recycling. In some cases, these laws regulate products and processes more strictly than do Federal laws. Notable examples are California's regulations on auto emissions, permissible volatile organic compound content of products, and labeling requirements for products containing carcinogens and reproductive toxics.[11]

The lack of uniform Federal environmental standards for products is alarming to industry, which fears having to satisfy different regulations in each State.[12 13] This prospect is especially of concern for products that are distributed through national networks. Companies are faced with the choice of redesigning products to meet the most stringent State requirement, or changing their distribution systems. OTA did not evaluate these concerns in this study, but Congress may wish to investigate further the extent to which the diversity of State regulations may impose unnecessary additional costs on industry, and where Federal intervention maybe appropriate to establish national guidelines for environmental product policy (see section on coordination and harmonization below).

Market Incentives

Manufacturers already have a number of economic incentives to move toward green design. By reducing the quantity of materials used in products, they can reduce their manufacturing costs. This incentive partially accounts for the trend toward increasing efficiency of materials use described in chapter 2. Manufacturer's waste disposal costs are also increasing as permitted landfill capacity continues to shrink and waste is shipped greater distances for disposal. This provides an incentive for waste prevention and in-process recycling of scrap.

There are also marketing opportunities to gain the loyalty of environmentally conscious consumers. Surveys indicate that consumer interest in the environmental attributes of products is on the rise, and that a substantial segment is willing to pay a premium for environmentally sound products.[14] Environmental regulations are also creating new market opportunities for small firms with innovative environmental technologies.[15]

Corporate Responses

Manufacturers are responding to these incentives in many ways. For instance, less toxic substitutes for heavy metals have been adopted in such products as inks, paints, plastics, and batteries; the electronics industry has redesigned its manufacturing processes to drastically reduce the use of CFCs; and several companies are redesigning products and packaging to be lighter, more compostable, or to use recovered materials.[16] Environmental advertising is now being used to sell a broad range of products, from gasoline to fabric softener.[17] A growing number of companies

[9] Ibid., p. 157.

[10] See testimony of David J. Berteau, Principal Deputy Assistant Secretary of Defense (Production and Logistics) before the Subcommittee on Oversight of Government Management of the Senate Committee on Governmental Affairs, Nov. 8, 1991.

[11] See Kerr and Associates, op. cit., footnote 1, and Paul R. Portney, op. cit., footnote 2, P. 282.

[12] John Holusha, "States Lead on Environment and Industries Complain," *The New York Times,* Apr. 1, 1991, p. D1.

[13] Gary D. Sesser, "Just Who's in Charge Here?" *Across the Board,* July/August 1991, p. 11.

[14] See, e.g., The Roper Organization, Inc., "The Environment: Public Attitudes and Individual Behavior," a study conducted for S.C. Johnson and Son, Inc., July 1990.

[15] Mark Fischetti, "Green Entrepreneurs," *Technology Review,* April 1992, p. 39.

[16] See, e.g., Bruce Smart (cd.), op. cit., footnote 3.

[17] See, e.g., "Selling Green," *Consumer Reports,* October 1991, p. 687.

Table 6-2—Examples of State or Local Laws Affecting Product Design

Provision	State	Comments
Packaging		
Ban on multilayered aseptic beverage containers.	Maine	No other States have followed Maine's example.
Ban on polystyrene-foam food packaging.	Minneapolis/St. Paul, MN and Portland, OR	These local bans, which have not been enforced, are giving way to recycling mandates.
Ban on the use of toxic heavy metals in packaging.	10 States	These laws are based on model legislation developed by the Coalition of Northeastern Governors.
Volatile organic compounds		
Mandatory reductions in VOC content in consumer products.	California	Reductions may require reformulation costing $100,0OO to $2 million per product.
Environmental labeling		
Regulations on the use of environmental terms, such as "recyclable" or "recycled."	13 States	States vary in the requirements that a product must meet to qualify for use of environmental terms and symbols.
Labeling requirements for products that contain chemicals listed as carcinogenic or causing birth defects.	California	The list of chemicals differs substantially from Federal lists. Products must be labeled even if listed chemicals are present in trace amounts.
Newsprint		
Recycled content requirements for newspapers.	10 States	These requirements have driven substantial industry investment in newsprint recycling equipment.
Batteries		
Limits on mercury in household batteries.	4 States	Mercury has largely been removed from household batteries in recent years.
Requirements for manufacturers to take back and recycle rechargeable batteries.	4 States	Rechargeable batteries currently contain the toxic heavy metals nickel and cadmium.
Requirements for all batteries to be "easily removable" from products.	Connecticut and New York	May require significant design changes.
Toxic use reduction		
Requirements for companies to submit plans for reducing their use of listed toxic chemicals.	5 States	Involves "voluntary" industry goal-setting with public disclosure of progress toward the goals.

SOURCE: Office of Technology Assessment, 1992.

are participating in waste exchanges, where one company's waste becomes another's raw material.[18]

Recognizing that customers and government regulators will be paying greater attention to the environmental attributes of products in the future, numerous industry trade associations, professional engineering and design societies, and consortia are addressing these issues (table 6-3). Activities of these organizations include programs to promote "product stewardship" (manufacturer responsibility beyond the factory gate), standards for labeling of recyclable materials, design concepts for product disassembly, etc.

The existence of these private organizations does not necessarily mean that the participating companies have all taken the environmentalists' agenda to heart. On the contrary, some are participating for defensive reasons, to promote the environmental benefits of current materials and products, or to lobby against new environmental regulations. Nevertheless, the existence of these programs is evidence that the companies believe that increased environmental scrutiny of products and processes is inevitable, and that they are better off taking the initiative rather than merely reacting. In the future, these industry organizations could provide useful forums for information exchange on green design.

Response of Educational Institutions

Although the concept of green design was articulated more than 20 years ago, it has not been integrated into the education and training of designers, engineers, and business managers. A recent survey by the EPA's National Advisory Council on Environmental Policy and Technology found that only 10 to 15 of the nearly 400 engineering schools

[18] Rodney Ho, "WasteExchanges Help More Companies Bag a Treasure From Another's Trash,'' *Wall Street Journal,* Aug. 2, 1991, p. A5B.

Table 6-3—industry and Professional Organizations Concerned With Green Design

Organization	Activities	Comments
Industry Trade Associations and Coalitions[a]		
American Electronics Association/Task Force on Design for the Environment	Holds regular meetings to share information on activities in the member companies, and to develop strategies for green design.	Membership includes the major electronics and computer companies, as well as representatives from aerospace and automotive industries.
Chemical Manufacturers Association (CMA)	Initiated the Responsible Care Program, a code of management practices developing the idea of "product stewardship," which extends company responsibility for a product beyond the factory gate.	Membership includes major manufacturers of chemical products.
Chemical Specialties Manufacturers Association (CSMA)	Promotes waste prevention activities such as product reformulation or process modification. Provides information through brochures and conferences to educate membership and consumers on proper use, storage, recycling, and disposal of products.	Represents companies engaged in the formulation, manufacture, packaging, marketing, and distribution of products to households, institutions, and industries. Membership includes 80 percent of the domestic aerosol industry production capacity.
Council on Plastics and Packaging in the Environment (COPPE)	Promotes waste prevention and recycling of plastic packaging. Sponsors meetings and provides information on plastic packaging and solid waste issues.	Coalition of plastic resin producers, packaging manufacturers and users, and trade associations.
Global Environmental Management Initiative (GEMI)	Promotes a worldwide environmental ethic in business management. Sponsors conferences examining the connections between product design, total quality management, and environmental excellence.	Coalition of 22 leading companies including chemical and consumer product manufacturers.
Institute of Scrap Recycling Industries (ISRI)	Promotes design for recyclability and removal of hazardous materials from products	Represents 1,800 firms involved in all major recycled commodities.
National Paint and Coatings Association (NPCA)	Paint Pollution Prevention Program aims to reduce environmental impacts of paints through efficient material utilization, toxic use reduction, and product stewardship.	National umbrella group for regional paint and coatings associations.
Society of the Plastics Industry (SPI)/Partnership for Plastics Progress (PPP)	Promotes plastic recycling programs. Has developed a labeling system to identify plastics by resin type to facilitate separation for recycling. Is developing design strategies for better management of plastics used in durable goods.	PPP is a task force representing major companies in the plastics industry.
Vehicle Recycling Partnership (VRP)	Sponsors meetings and funds research on methods to enhance auto recycling and better management of materials through better design.	Consists of Ford, Chrysler, and General Motors, as well as materials suppliers, dismantles, and recyclers.

(continued on next page)

Table 6-3-industry and Professional Organizations Concerned With Green Design-Continued

Organization	Activities	Comments
Professional Societies		
American Institute of Architects (AIA)	Developing environmentally sound approaches to the design of buildings. With funding from EPA, is developing an Environmental Resource Guide, containing environmental information on building materials and case studies in green design.	Professional society representing architects.
American Institute of Chemical Engineers (AIChE)	Established the Center for Waste Reduction Technologies, whose goal is to integrate the design of production facilities with waste management requirements. The Center is an umbrella organization to conduct research and education with funding from government, universities, and industry.	Professional society of chemical engineers. Industry sponsors of the Center include chemical companies, manufacturers, and engineering services firms.
Industrial Designers Society of America (IDSA)	Sponsors conferences on product design and the environment, and has devoted several issues of its journal Innovation to discussions of green design.	Professional society representing industrial designers.
Institute of Packaging Professionals (IoPP)	Issued "Packaging Reduction, Recycling, and Disposal Guidelines."	Organization for packaging professionals for consumer, industrial, and military products.
Society of Environmental Toxicology and Chemistry (SETAC)	Sponsored meetings to develop a technical framework for life-cycle assessments.	Professional society of 2,000 members that provides a forum on resource use issues for environmental scientists and engineers from academia, industry, government, and public interest groups.
Society for the Advancement of Material and Process Engineering (SAMPE); Society of Plastics Engineers (SPE); American Society of Mechanical Engineers (ASME); Society of Automotive Engineers (SAE)	All have sponsored conferences on issues related to green design.	Professional societies representing various engineering specialties.

[a] In addition to these purely industry organizations, there are also several hybrid organizations in which industry groups work together with government or environmental groups to promote environmentally sound business practices. Examples include the Coalition of Northeastern Governors (CONEG) Source Reduction Council, which has developed "preferred packaging guidelines," and the Conservation Foundation/World Wildlife Fund, which has developed environmental curricula for use in business schools.

SOURCE: Office of Technology Assessment, 1992.

in the United States offer significant coursework in waste prevention.[19] The Management Institute of Environment and Business has estimated that only about 25 of the 700 schools of management and business have a course on business and the environment, and none requires the course for graduation.[20]

This is beginning to change, though: OTA found that interest in this topic among design, architecture, engineering, and business schools is high, and several schools have begun to integrate environmental issues into their curricula (see table 6-4).

This may be an opportune time to inject an environmental dimension into the educational experience of designers and engineers. Many schools are reevaluating their curricula in light of growing criticism that students are not being prepared in the ''best practice' design techniques used by the most competitive companies.[21,22] This reevaluation process could provide a window of opportunity to add environmental courses or projects.

As part of this study, the American Society for Engineering Education's Engineering Deans Council conducted an informal survey of Engineering School Deans on behalf of OTA (see box 6-A). Fifteen of the twenty respondents indicated that their institution already offers some sort of environmental program for students. In most cases, however, these programs take the form of optional classes on pollution control or "environmental engineering." Only five respondents reported that they are actively incorporating environmental concerns into their standard engineering courses. Lack of funding and lack of faculty training were cited as significant barriers to further progress.

These needs are beginning to be addressed by both Federal and private programs. EPA has funded the National Pollution Prevention Center at the University of Michigan, which is developing waste prevention curriculum materials for colleges and universities, including modules for industrial design and engineering design courses.[23] The center also plans to provide information and education to university faculty through interdepartmental seminars. In another example, the National Wildlife Federation's Corporate Conservation Council has sponsored a pilot program to introduce environmental issues into business school education.[24,25]

Information Resources Available

A variety of information resources relevant to green design are becoming available. These include books that offer general guidelines for green design,[26] as well as information more appropriate for specific industries and manufacturing processes.[27] Experimental computer programs are being developed to assist designers in evaluating their choices according to life-cycle criteria.[28] Information is also available on a variety of related topics, such as how to evaluate design decisions by total cost assessment[29] and how to conduct materials balance assessments and waste stream audits.[30,31]

Electronic Networks

Electronic networks can provide useful forums for information exchange among those interested in

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19 Anthony D. Cortese, "Education for an Environmentally Sustainable Future," *Environmental Science and Technology,* vol. 26, No. 6, 1992, p. 1108.

20 Ibid.

21 John R. Dixon, ''New Goals for Engineering Education," *Mechanical Engineering,* March 1991, p. 56.

22 National Research Council, *Improving Engineering Design: Designing for Competitive Advantage* (Washington, DC: National Academy Press, *1991),* p. 35.

23 Environmental Protection Agency, "Pollution Prevention Resources and Training Opportunities in 1992," EPA/560/8-92-(X12, January 1992, p. 94.

24 James E. Post, "The Greening of Management, ' *Issues in Science and Technology, summer* 1990, p. *68.*

25 At this writing, the Education and Training Committee of EPA's National Advisory Council for Environmental Policy and Technology was completing work on a national strategy to encourage waste prevention education and training.

26 See, e.g., Dorothy Mackenzie, *Design for the Environment (New York, NY:* Rizzoli, 1991), and references cited therein.

27 Environmental Protection Agency, "Pollution Prevention Resources and Training Opportunities in 1992," op. cit., footnote 23, p. 13.

28 The software, called Simapro, is available from PRé Consultants, Amersfoort, The Netherlands.

29 Environmental Protection Agency, "Total Cost Assessment: Accelerating Industrial Pollution Prevention Through Innovative Project Financial Analysis," a report prepared by Tellus Institute, Boston, MA, May 1992.

30 Environmental Protection Agency, "Facility Pollution Prevention Guide," EPA/600/R-92/088, May 1992.

31 Lauren Kenworthy and Eric Schaeffer, ''A Citizen's Guide to Promoting Toxic Waste Reduction,'' published by Inform, Inc., 1990.

Table 6-4-Environmental Education Programs in Design, Engineering, and Business Schools

Institution	Activity
Boston University	Offers graduate business courses on managing environmental issues.
Carnegie Mellon University	A variety of courses and seminars are being developed around the idea of design for the environment, involving the Center for Solid Waste Management Research, the Environmental Institute, and the Engineering Design Research Center.
Grand Valley State University	The Waste Reduction and Management Program is developing engineering curricular materials on green design and provides seminars for engineers and faculty on "cutting edge" design approaches.
Loyola University	Offers graduate business courses on managing environmental issues.
Massachusetts Institute of Technology	The Technology, Business, and the Environment Group offers workshops and seminars for engineers and managers, and works to integrate waste prevention concepts into undergraduate and graduate courses.
Rhode Island School of Design	Incorporates environmental concerns into the industrial design curriculum through course material and projects.
Tufts University	The Tufts Environmental Literacy Institute seeks to incorporate environmental concerns throughout the curriculum; the Center for Environmental Management provides education and training programs for engineering students.
University of the Arts (Philadelphia)	Incorporates environmental concerns into industrial design curriculum through course material and class projects.
University of California at Los Angeles	Integrates environmental concerns throughout engineering disciplines through problem sets and projects.
University of Miohigan	The Pollution Prevention Center for Curriculum Development and Dissemination is developing curriculum modules for undergraduate and graduate courses in engineering, business, and science. Summer workshops and seminars are also offered.
University of Minnesota	Offers graduate business courses on managing environmental issues.
University of Rhode Island	Students in the Chemical Engineering Department evaluate waste prevention opportunities for Rhode Island firms.
University of Wisconsin	The Engineering Professional Development Program offers short courses to engineering students on waste prevention and green design.

SOURCE: Office of Technology Assessment, 1992.

green product design. One existing government-funded network is EPA's Pollution Prevention Information Exchange (PIES), which is part of the Pollution Prevention Information Clearinghouse.[32] PIES contains bibliographic materials, industry case studies, announcements, and an electronic bulletin board that allows users to send messages to one another. Although PIES was not organized specifically with the needs of designers in mind, it contains a considerable amount of relevant information, and in the future it could be expanded to include comparative environmental information on alternative materials, substitutes for toxic chemicals, etc.

Consumer Information

One of the most powerful determinants of product design is consumer preference. Yet unless consumers are able to recognize green products in the store, this potentially powerful incentive for green design is neutralized. To fill this need, several ''green consumer guides' have become available in recent years,[33] though some of the recommendations in these guides have been controversial.[34]

It is especially important to reach the-next generation of consumers early. As authorized by the National Environmental Education Act of 1990,

32 Environmental Protection Agency, "Pollution Prevention Resources and Training Opportunities in 1992," op. cit., footnote 23, p. 100.

33 See, e.g., Joel Makower, John Elkington, and Julia Hades, *The Green Consumer,* Penguin Books, New York, 1990; The Earthworks Group, *50 Simple Things You Can Do To Save the Earth* (Berkeley, CA: Earthworks Press, 1989); Debra Lynn Dadd, "Nontoxic and Natural," Jeremy P. Tarcher, Los Angeles, 1984.

34 EPA withdrew copies of its publication "The Environmental Consumer's Handbook" (EPA/530-SW-90-034B, October, 1990) after industry protested the implication in the report that disposable or multi-material products are environmentally less desirable.

Box 6-A--Survey of Engineering School Deans

On behalf of OTA, the American Society for Engineering Education's Engineering Deans Council undertook a survey of the views of Engineering Deans regarding the need to integrate environmental concerns into engineering school curricula. Of the 20 respondents, 17 considered such integration to be very important, and 16 believed that environmental courses or program would help attract new engineering students.

when the Deans were asked to comment on how their institutions were addressing this issue, 15 cited some form of ongoing environmental program, and several more cited programs being planned. The most common approach was to offer optional courses on environmental topics within chemical, mechanical, or civil engineering programs (11 schools). Seven schools reported that new majors or degree programs were being developed (typically in ''Environmental Engineering' '). Only 5 schools indicated that they are integrating environmental concerns into their standard engineering courses through modules, projects, or problem sets.

The Deans were also asked to comment on what barriers exist to incorporating a stronger environmental perspective into engineering programs. The two most frequently cited responses were the lack of money and the availability of appropriately trained faculty (each cited by five respondents). Other answers included a lack of course materials, and a curriculum already crammed with other topics.

When asked what the Federal Government could do to help engineering schools incorporate environmental concerns into engineering education and research, 10 of the respondents indicated that more Federal funding was necessary (research funds, scholarships, training). Seven indicated that Federal assistance with curriculum development, course development, or new program would be beneficial. Other suggestions included having the Federal Government increase national awareness and concern regarding green design, to establish new research centers through the National Science Foundation, to create a competitive award to highlight work in this area, and to identify more clearly the Nation's most pressing environmental problems.

SOURCE: ASEE Engineering Deans *council survey* for *OTA.*

EPA has established an Office of Environmental Education to

> . . . foster an enhanced environmental ethic in society by improving the environmental literacy of our youth and increasing the public's awareness of environmental problems.

The primary focus will be on grade levels K-12. EPA has also established an agencywide National Pollution Prevention Environmental Education Task Force to develop educational materials for students and teachers in grades K-12.[35]

Ongoing Activities

Finally, OTA identified a number of ongoing Federal activities that will provide additional information for designers in the near future (table 6-5). EPA is the agency most directly involved; for example, EPA's Office of Research and Development is supporting the development of a Life Cycle Design Guidance Manual, which is intended to explore how designers can incorporate life cycle assessment into their designs. EPA also has a project underway with the American Institute of Architects to develop an Environmental Resource Guide, to assist architects in making environmentally sound choices of construction materials. Table 6-5 also identifies several relevant projects in other agencies, including the Department of Energy and the National Science Foundation.

In the Pollution Prevention Act of 1990, Congress required that manufacturers who report their releases of toxic chemicals for the TRI must also report how these releases were affected by waste prevention activities, including product and process redesign. When these data become available (probably some time in 1993), they could provide valuable insight into an area where little information currently exists: how product design choices affect industrial waste streams.

CONGRESSIONAL ROLE

These ongoing activities suggest that green design is a concept that is gathering momentum. Even if Congress takes no further action, the incentives

35 Environmental Protection *Agency,* Pollution Prevention Resources and Training Opportunities in 1992, op. cit., footnote 23, p. 95. See also Environmental Protection Agency, "Environmental Education Materials for Teachers and Young People (Grades K-12)," 21K-1OO9, July 1991.

Table 6-5-Federally Funded Programs Related to Green Design

Agency/Office	Program/activity	Comments
Department of Energy		
Office of Industrial Technologies	Industrial Waste Reduction Program	A research and development program to identify priority industrial waste streams, assess opportunities for addressing these waste streams through redesigning products and production processes, and assess technology transfer from national laboratories.
Environmental Protection Agency		
Office of Research and Development	Environmental Resource Guide	Contracted to the American Institute of Architects, this project will provide information to architects on the life cycle environmental impacts of construction materials.
	Life Cycle Assessment Methodology	Contracted to Battelle and Franklin Associates, Ltd., this project will develop standard methodologies for conducting product life-cycle assessments.
	Clean Products Case Studies	Contracted to IN FORM inc., this project will provide case studies of green design, especially the reduced use of toxic substances in products.
	Safe Substitutes	Contracted to the University of Tennessee, this project will identify priority toxic chemicals and evaluate possible substitutes.
	Life Cycle Design Guidance Manual: Environmental Requirements and the Product System	Contracted to the University of Michigan, this manual will explore how designers can incorporate life-cycle information in their designs.
	National Pollution Prevention Center	Located at the University of Michigan, this center is developing waste prevention information modules for industrial and engineering design courses.
	American Institute for Pollution Prevention	in association with the University of Cincinnati, the institute serves as a liaison to a broad cross-section of industry, with projects involving four aspects of waste prevention: education, economics, implementation, and technology.
Office of Pollution Prevention and Toxics	Design for the Environment	Scheduledtobe launched in September 1992, this program will gather, coordinate, and disseminate information on green design.
National Science Foundation	Engineering Design Research Center	Located at Carnegie Mellon University, the center is organizing a program to explore methods for green design.

SOURCE: Office of Technology Assessment, 1992.

discussed above can be expected to continue in the future. Implementation of tougher emissions standards under the Clean Air Act Amendments of 1990 will increase pressures on companies to reduce their use of hazardous solvents and other volatile organic compounds. New regulations requiring liners and leachate collection systems in landfill construction will increase the costs of solid waste disposal and provide increased incentives for waste prevention.[36] Various States will no doubt continue to pass legislation to regulate the environmental attributes of products and waste streams. And as consumers become more attuned to environmental concerns, they will increasingly demand that manufacturers take more responsibility for the environmental impacts of their products.

Despite these incentives, though, OTA finds there are four areas where congressional action is needed to maintain existing momentum and foster further progress:

- *Research.* At present, designers and policymakers don't know what materials or waste streams are of greatest concern, or how product designs might be changed to address them most effectively. Private companies have little incentive to conduct this research.
- *Credible information for consumers. Surveys* show that consumers are interested in green products, but most don't know what is 'green." As discussed in chapters 3 and 4, defining what's green is a multidimensional problem. In the absence of Federal action to establish consistent ground rules defining terms and measurement methods, the growing interest of consumers could become dissipated in confusion and skepticism.
- *Market distortions and environmental externalities.* Most observers agree that the prices of materials and energy do not reflect their true environmental costs. Failure to internalize these environmental costs into design and production decisions can make environmentally sound choices seem economically unattractive. Further, they argue that some government policies, such as subsidies for the extraction of virgin materials, also distort prices.
- *Coordination and harmonization.* OTA found that several research projects related to green design are being sponsored by various Federal agencies and offices (table 6-5), but that there is little or no coordination among them. And unlike its major competitors, the United States has no institutional focus at the Federal level for addressing environmental product policy (see chapter 5).

These issues are discussed in greater detail below, and options for addressing them are presented. The chapter concludes with a short list of relatively quick and inexpensive options Congress could choose to encourage green design.

RESEARCH NEEDS

To take full advantage of the potential of green design, both designers and policymakers need more information about where the major opportunities lie and the most cost-effective ways of addressing them. This information must be developed through research. Below, OTA discusses research needs in two categories: technical research and applied social science research. In this study, OTA has made no attempt to evaluate how much additional funding may be necessary to fully address these needs.

Technical Research

Setting Priorities Based on Risk

Beyond certain obvious imperatives such as avoiding the use of CFCs, designers and policymakers have little information as to what materials and waste streams pose the greatest health and environmental risks. Current lists of hazardous substances subject to various State and Federal regulations contain hundreds of chemicals, each having different uses and posing different risks to health and the environment.

Several research efforts funded by the Department of Energy (DOE) and EPA are attempting to identify priority products and waste streams (see table 6-5). Congress could require EPA and DOE to jointly identify a short list of products and production processes that appear to pose the greatest health and environmental risks. This would be consistent with EPA's stated goal of reevaluating its priorities

[36] EPA's final rule specifying minimum Federal criteria for municipal solid waste landfill design was published in the *Federal Register,* vol. *56, No. 196,* Oct. *9,* 1991, and becomes effective on October 9, 1993.

based on riskassessment.[37][38] In the case of chemicals, a possible starting point might be the list of 17 categories of chemicals that EPA has targeted in its 33/50 Program.[39] Armed with this information, designers can find appropriate substitutes and avoid dissipative uses of these materials.

Safe Substitutes

To reduce overall environmental risks, the risk tradeoffs of switching from one chemical to another must be understood. Currently, designers may be substituting regulated chemicals of relatively known risk with unregulated chemicals of unknown risk. The assumption is often made that the new chemicals are safer, but this may not be the case. Although the Toxic Substances Control Act of 1976 requires EPA to consider the net risk of chemical substitution in regulating chemicals, most chemicals have been tested on a one-at-a-time basis.[40] Congress could direct EPA to evaluate the risks of the priority chemicals in "use clusters"—groups of chemicals that can substitute for one another (e.g., solvents or coolants) .41 This comparative information could then be made available to designers through such mechanisms as EPA's Pollution Prevention Information Exchange.

Understanding Materials Flows

Policymakers need better models of how various materials and wastes of concern flow through the economy and into the environment. These models can help identify the major sources of environmental pollutants and the most cost-effective ways of reducing them. Without this information, resources may be diverted to address the most visible problems, rather than the most serious ones. For instance, 10 States have banned the use of toxic heavy metals in packaging, yet this source contributes only a few percent of heavy metals in landfills and incinerators.[42][43] As another example, there has been considerable concern expressed about the release of mercury from the incineration of municipal solid waste, yet these releases may be small compared with mercury releases from coal combustion in power plants.[44]

These examples underline the need for detailed "materials balance" analyses that quantitatively track materials of special concern through initial production, use in industrial processes and products, and disposal.[45] Preliminary materials balance studies have been carried out for several hazardous substances,[46][47] but a more systematic approach is needed. For the short list of high-risk materials identified above, Congress could direct EPA and

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37 William Reilly, "Taking Aim Toward 2000: Rethinking the Nation's Environmental Agenda," *Environmental Law*, vol. 21, No. 4, 1991, p. 1359. For a discussion of the limitations of risk reduction as a strategy for the future, see also John Atcheson, "The Department of Risk Reduction or Risky Business," ibid., p. 1375.

38 Techniques for evaluating environmental risks are still evolving. EPA's Risk Assessment Forum is sponsoring several case studies that could help to establish a framework for ecological risk assessment. Preliminary results are expected in 1994. See "Environmental Agency Launches a Study in Ecological Risk Assessment," *Science, Mar. 20,* 1992, p. 1499.

39 The goals of the 33/50 Program are t. reduce industry releases of the 17 target chemicals 33 percent by 1993 and 50 percent by 1995, based on 1988 levels. In selecting these chemicals, EPA started with the list of 322 TRI chemicals and employed a screening process based on volume of production, volume of releases, and hazardous properties. See Environmental Protection Agency, "Pollution Prevention Resources and Training Opportunities in 1992," op. cit., footnote 23, p. 84.

40 Michael Shapiro, "Toxic Substances Policy, " in Paul R. Portney, op. cit., footnote 2, p. 224.

41 EPA's Office of Pollution Prevention and Toxics has announced plans to employ the "use cluster" concept for evaluating substitutes for hazardous chemicals in the future. Jean E. Parker, Office of Pollution Prevention and Toxics, personal communication August 1992.

42 These laws are based on model legislation developed by the Source Reduction Council of the Coalition of Northeastern Governors (CONEG).

43 The dominant source of lead and cadmium in municipal solid waste is in batteries, especially lead-acid automobile batteries. Some 38 States now have laws regulating the disposal of batteries. Another major source is consumer electronics, whose disposal is generally not regulated. See Franklin Associates, Ltd., "Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970-2000," a report prepared for the Environmental protection Agency, January 1989.

44 According t. one estimate, about 65 percent of anthropogenic mercury emissions to the atmosphere is due to coal burning, and another 25 percent is due to waste incineration. F. Slemr and E. Langer, "Increase in Global Atmospheric Concentrations of Mercury Inferred From Measurements Over the Atlantic Ocean," *Nature*, vol. *355,* Jan. *30,* 1992, p. *436.*

45 This is not a new idea, but it has never been pursued systematically. See Allen V. Kneese, Robert U. Ayres, and Ralph C. d'Arge, "Economics and the Environment: A Materials Balance Approach" a monograph published by Resources for the Future, Washington, DC, 1970.

46 R.U. Ayres et al., "Industrial Metabolism, the Environment, and Application of Materials-Balance Principles for Selected Chemicals," International Institute for Applied Systems Analysis, RR-89-11, Laxenburg, Austria, 1989.

47 David T. Allen, "Wastes as Raw Materials," presented at the National Academy of Sciences Workshop on Industrial Ecology/Design for the Environment, Woods Hole, MA, July 16, 1992.

DOE to conduct detailed materials balance studies showing how these materials flow through the economy and into the environment.

A significant barrier to better modeling of materials flows is the quality of data on industrial waste streams. More than 20 national sources of data are available (e.g., the TRI, or the biennial survey of hazardous waste generators required by RCRA).[48] These databases, which were established for different purposes, cover different waste generators, waste types, and time periods. This makes it difficult to get a coherent picture of materials flows, whether one is interested in tracking specific materials or the performance of specific industrial sectors. Congress could direct EPA, DOE, and the Department of Commerce (DOC) to jointly explore how existing waste stream reporting requirements might be harmonized to provide a more coherent picture of waste flows.[49]

A Scientific Basis for Better Materials Management

OTA found few examples of research relating to better materials management at the Federal level. Instead, most Federal research projects relating to green design appear to be oriented toward preventing the release of toxic or hazardous materials (see, for instance, table 6-5). This is also reflected in the solid waste dichotomy defined by RCRA, in which ''hazardous' solid waste is regulated by the Federal Government, while responsibility for "non-hazardous' solid waste management is delegated to the States.

To improve the connectivity between product design and waste management, Congress could establish a grant program for joint research and demonstration projects having both a design component (e.g., to develop principles of design for remanufacturing, disassembly, compostability, etc.) and a waste management component (e.g., to develop improved recycling, comporting, and incineration technologies). Examples of the fruits of this research might be adhesives, paints, or coatings that do not inhibit recycling processes; mixed materials that can be co-recycled without sacrificing the properties of the finished product; or materials that generate fewer toxic residues when incinerated. Materials derived from biological sources are another important category; this could lead to a class of renewable materials that might be extremely durable or fully biodegradable.

One mechanism for funding such joint projects may be the National Science Foundation's Engineering Research Centers.[50] Another avenue maybe the Advanced Materials and Processing Program, an interagency materials research initiative for materials science and engineering announced by President Bush in 1992.[51]

Applied Social Science Research

A 1990 National Research Council workshop concluded that EPA's waste reduction research program emphasizes technical issues to the exclusion of applied social science research.[52] The workshop participants singled out three categories of special need: measurement techniques for evaluating progress, institutional and behavioral barriers, and the need for more analysis of policy incentives. OTA finds that these same research needs apply to green design, as discussed below.

Measurement Techniques

Measuring what is "green" is one of the most difficult challenges facing designers and policymakers. Designers must have targets for weight reduction, and substitution for toxic chemicals. Public interest groups need criteria against which to evaluate industry progress, and companies need criteria to be able to claim credit for legitimate environmental improvements.

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48 Jack Eisenhauer and Richard Cordes, "Industrial Waste Databases: A Simple Roadmap,' *Hazardous Waste and Hazardous Materials*, vol. 9, No. 1, 1992, p. 1.

49 Preliminary work along these lines is currently being funded by the Department of Energy's Office of Industrial Technologies. See Alan Schroeder, "Industrial Waste Sources in the U. S.A.," in the *Proceedings of Global Pollution Prevention—'91*, Washington, DC, Apr. 3-5, 1991, p. 229.

50 The Engineering Design Research Center at Carnegie Mellon *university* is developing an industry consortium interested in exploring principles of design for disassembly and recycling.

51 EPA has proposed a project on Environmentally Benign Materials and *Processes as* part of the fiscal year 1993 enhancements to the Advanced Materials Processing Program. See ''Advanced Materials and Processing: the Fiscal Year 1993 Program,'' a report by the Federal Coordinating Council for Science, Engineering, and Technology's Committee on Industry and Technology, Office of Science and Technology Policy, April 1992.

52 National Research Council, Committee on Opportunities in Applied Environmental Research and Development, *Waste Reduction: Research Needs in Applied Social Sciences, a Workshop Report* (Washington, DC: National Academy Press, 1990).

As discussed in chapter 4, green design always involves making tradeoffs. In principle, a comprehensive life-cycle analysis (LCA) of a product or process can indicate how to make these tradeoffs.[53] A challenge for the future is to develop streamlined LCA methods that focus on a few critical parameters. It may also be possible to develop narrower design rules of thumb or "green indicators' for use by designers for specific products or facilities (e.g., a tire design might be evaluated based on its expected service life divided by its weight) .54 These green indicators would be expected to vary for different products.

A central measurement issue for policymakers is how to measure the waste prevention attributes of a product. Whereas recycling rates or recycled content are *relatively* easy to measure, quantifying waste prevention is notoriously difficult.[55]56 Yet if waste prevention is indeed preferred to recycling in the solid waste management "hierarchy," as stated both by EPA and by Congress in the Pollution Prevention Act of 1990, it is important that mechanisms be found to credit waste prevention in government procurement programs and legislation that aim to increase recycling rates.

Finally, to support system-oriented product design (see chapter 4), new macro-level metrics will be required that can characterize the environmental performance of alternative production and consumption systems (e.g., alternative ways of providing the same service), rather than just alternative *products.* Suggestions for such metrics include dematerialization (reductions in the weight of materials used to provide a given level of goods and services), decarbonization (reduction in the quantity of fossil fuels consumed to provide a given level of goods and services), and input-output analysis of production systems, accounting for both products and waste streams.[57]

Many of these measurement issues are controversial, and are probably best addressed through a consensus-building process involving government, industry, universities, and public interest groups. Congress could provide funding to EPA to convene a series of consensus-building workshops involving all interested stakeholders to resolve these measurement issues.[58]

Institutional and Behavioral Research

To explore the full potential of green design, a better understanding is needed of how companies manage the design function and how design decisions vis-a-vis the environment are affected by such factors as type of product, company size, and corporate culture. For example, barriers to green design arise from cost accounting procedures[59] and other institutional or behavioral factors. Research is also needed to understand how companies shape and are shaped by customer needs. In particular, this research could include how individual consumers and large-volume commercial buyers view environmental risks and make decisions to purchase environmentally preferred products (see below).

Congress could provide funding through EPA, the National Science Foundation (NSF), or the National Institute for Standards and Technology (NIST) for a series of industry case studies to analyze how institutional and behavioral factors influence design decisions vis-a-vis the environment in a variety of industry settings (including

53 See the upcoming report, "Product Life-Cycle Assessment: Inventory Guidelines and Principles,' a study prepared for EPA's Office of Research and Development by Battelle and Franklin Associates, Ltd.

54 D. Navin chandra, ''Design for Environmentability,'' in proceedings *of the ASME Design Theory and Methodology Conference,* American Society of Mechanical Engineers, Miami, FL, 1991.

55 U.S. Congress, Office of Technology Assessment, Serious Reduction *of Hazardous Waste: For Pollution Prevention and Industrial Efficiency,* OTA-ITE-317 (Washington, DC: U.S. Government Printing Office, September 1986), p. 124.

56 For instance, should prevention be measured by comparison with other comparable products, or by comparison with the same product in SOme previous base year? Using a base year as a standard of measurement may discriminate against companies that had already made significant reductions in product weight or toxicity before the base year, and reward those who did not.

57 See Jesse H. Ausubel, 'Industrial Ecology: Reflections On a Colloquium, " *Proceedings of the National Academy of Sciences,* vol. *89,* February 1992, p. 879; and Faye Duchin, "Industrial Input-Output Analysis: Implications for Industrial Ecology," p. 851 in the same volume.

58 One example is the ''Pellston-~e" workshop organized by the Society of Environmental Toxicology and Chemistry in August 1990 to develop guidelines for life-cycle assessment methodology. See Society of Environmental Toxicology and Chemistry, "A Technical Framework for Life-Cycle Assessment," a workshop report, Washington, DC, January 1991.

59 A review of the role of environmental factors in traditional cost accounting systems isprovidedby Rebecca Todd, ''Accounting for tie Environment: Zero-Loss Environmental Accounting Systems," presented at the National Academy of Engineering's Workshop on Industrial Ecology/Design for the Environment, Woods Hole, MA, July 13-17, 1992.

both industrial and engineering design). These case studies could provide excellent course materials for business schools and design schools.

Policy Research

Although many policy options have been suggested to control the environmental impacts of products, little is known about the costs and benefits of these options--especially the costs of monitoring and enforcement. In Germany, for example, requirements for manufacturers to take responsibility for recovering and recycling their packages appear to have been passed with little cost-benefit analysis.[60] Yet the costs may vary greatly depending upon the kind of product, its distribution network, and the waste management infrastructure. Congress could require that EPA identify some of the more promising proposals being discussed around the world and analyze their likely costs and benefits.

As indicated at the beginning of this chapter, the existing regime of environmental regulations, Federal and State procurement policies, and military specifications already have a profound influence on design decisions. A useful starting point might be for Congress to direct EPA to coordinate a comprehensive review of how existing Federal and State regulations affect materials management decisions in the United States. This could help consolidate reviews already ongoing in various agencies and provide a basis for government-wide administrative changes.

As shown in table 6-2, many States have initiated innovative programs to control the health and environmental impacts of products, including taxes on hard-to-dispose products, labeling requirements, and outright bans (e.g., Maine's ban on aseptic beverage containers). As these State programs develop, Congress could direct EPA to evaluate their results. Congress may also wish to have EPA investigate the extent to which compliance with the growing diversity of State environmental initiatives is imposing a serious financial burden on industry, with a view toward identifying areas where national standards are desirable.

CREDIBLE INFORMATION FOR CONSUMERS

The second unique role that the Federal Government can play in supporting green design is to ensure that consumers have reliable information about the environmental attributes of products, and to ensure that its own procurement of goods and services is consistent with environmental concerns. A significant fraction of consumers prefer to buy environmentally sound products,[61] and manufacturers are responding by touting the environmental benefits of their products, using terms like "recyclable," "biodegradable," and "ozone-safe."[62 63] But because the impacts of products on the environment are complex and multidimensional, there is tremendous potential for consumers to be confused by these diverse environmental claims.[64] In principle, LCA techniques can be used to determine the overall environmental quality of a product, but these techniques are still at an early stage of development, and it seems unlikely that definitive LCA results will be available for most products in the foreseeable future.

In general, two kinds of customers can be distinguished: individual consumers, and large-volume buyers for commercial firms, institutions, or government agencies. Options to address the information needs of these two groups are discussed below.

Individual Consumers

Environmental Advertising Claims

There is now a broad consensus on the part of industry, States, and environmental groups that Federal standards or guidelines of some sort are needed to regulate environmental advertising.[65] Industry wants national guidelines that prevent

60 See "Environmentalism Runs *Riot," The Economist,* Aug. *8, 1992,* p.11.

61 According to a survey conducted in 1990 by the Roper Organization for S.C. Johnson and Son (op. cit., footnote 14), 29 percent of participants reported purchasing a product because advertising or labeling said the product was environmentally safe.

62 "Selling Green," *Consumer Reports,* op. cit., footnote 17.

63 According t. one survey, 26 percent of the 12,000 new household items launched in 1990 made some environmental claim. See Jaclyn Fierman, "The Big Muddle in Green Marketing," *Fortune,* June *3,* 1991, p. 91.

64 A survey b, Environmental Research Associates of Princeton, NJ found that 47 percent of consumers dismiss environmental claims as "mere gimmickry." Jaclyn Fierman, ibid.

65 For a good overview of the issues, see Ciannat M. Hewett, "The 'Green Labeling' Phenomenon: Problems and Trends in the Regulation of Environmental Marketing Claims,' *Virginia Environmental Law Journal, vol.* 11, spring 1992, p. 401.

deceptive claims and bring more uniformity to the current patchwork of State environmental labeling regulations.[66] However, industry generally opposes any regulations that would go beyond requirements for factual and verifiable statements about environmental attributes. Environmental groups want to establish a' 'floor' of Federal standards for advertisers' use of environmental terms that can be exceeded by States desiring to impose higher standards.[67] The underlying debate is between those who would treat environmental claims in the same way as any other form of advertising, and those who see it as a public policy tool for changing the behavior of manufacturers and consumers.[68]

In May 1991, a task force of 11 State attorneys general called for Federal standards for environmental advertising and recommended interim guidelines for use by manufacturers.[69] The task force recommended that environmental claims be as specific as possible, substantive (not trivial or irrelevant), and reflect current waste management options.

Also in May 1991, the Federal Trade Commission (FTC) published proposed guidelines for environmental advertising and held hearings in July to receive public comment. EPA published proposed guidelines for use of the terms "recyclable" and "recycled' and the use of the recycling emblem,[70] which industry critics charge go well beyond preventing deception. The FTC also joined with EPA and the U.S. Office of Consumer Affairs to form the Federal Interagency Task Force on Environmental Labeling, to coordinate Federal efforts.

In July 1992, the FTC issued final guidelines for environmental marketing claims.[71] The guidelines are intended to prevent deceptive environmental advertising, and are based on the principles that claims of environmental benefits must be factual and verifiable. The guidelines are not intended to preempt State regulation of environmental advertising claims.

These FTC guidelines are an important step, especially because they encourage manufacturers to qualify broad claims of environmental benefits so as to be specific and verifiable. But Congress may wish to go beyond preventing deception; even if a claim is not overtly deceptive, it still may not convey sufficient information to enable consumers to evaluate the environmental benefits of the product or package. One criticism of FTC guidelines is that they do not provide standard definitions of environmental terms based on scientific criteria.[72] Critics argue that in any case, the FTC does not have the scientific expertise to evaluate such claims, and that the technical expertise of EPA is needed to develop credible scientific definitions.[73] Congress could require that EPA work with the FTC to develop "official" definitions of environmental terms based on the best scientific information available. In OTA's view, it is especially important to decide how terms relating to waste prevention (e.g., "source-reduced") should be defined and communicated to consumers.

Another criticism of the FTC guidelines is that they do not challenge manufacturers to make continuous improvements in order to be able to claim environmental benefits. Congress could require EPA to develop minimum standards for unrestricted use of environmental terms in advertising. For example, a product labeled as "recycled" might have to contain at least 10 percent post-consumer material.[74] These minimum standards could then be ratcheted up over time.

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66 In the absence of Federal standards, some 13 States have developed their own regulations on the use Of environmental terms.

67 See, e.g., testimony of the Environmental Defense Fund on environmental labeling and S. 615 before the Subcommittee on Environmental Protection of the Senate Committee on Environment and Public Works, July 31, 1991.

68 Ciannet M. Hewett, op. cit., footnote 65, p. 460.

69 "The Green Report II: Recommendations for Responsible Environmental Advertising," May 1991.

70 Environmental Protection Agency, "Guidance for the Use of the Terms 'Recycled' and 'Recyclable' and the Recycling Emblem in Environmental Marketing Claims," *Federal Register*, vol. 56, No. 191, Oct. 2, 1991, p. 49992.

71 Federal Trade Commission, "Guides for the Use of Environmental Marketing Claims," July 1992.

72 For example, a term like "degradable" might be defined differently by different manufacturers, giving consumers little information about the rate of degradation or the nature of the end products.

73 Environmental Defense Fund, op. cit., footnote 67.

74 This is the definition of "recycled" that has been adopted in California. EPA is seeking comment on a similar proposal. &x EPA Guidelines, Op. cit., footnote 70.

Industry generally objects to the idea of minimum standards, arguing that they could actually result in less information for consumers. For instance, if a product contains recycled content but does not quite meet the standard, manufacturers might be prevented from communicating this information to consumers. Environmental groups counter that this problem can be avoided if standards are applied only to *unqualified* use of terms; attributes not meeting minimum standards would have to be described in specific detail on the label (e.g., "This product contains 5 percent recycled industrial scrap and 5 percent post-consumer material.").

Eco-Labels

Even if consumers fully understand the environmental claims made by manufacturers, they are still faced with the problem of how to trade off one environmental benefit or cost versus another. For instance, it may be impossible for consumers to decide whether a product that contains "20 percent recycled content" is better for the environment than a similar one that uses 10 percent less packaging.' Ideally, green products would carry a single indicator of overall environmental quality .75

According to the Organization for Economic Cooperation and Development, at least 22 countries are expected to develop green product labeling schemes by 1993.[76] As discussed in chapter 5, Germany, Canada, and Japan award an "eco-label" to products that are judged to have reduced environmental impact compared with competing products .77 Properly constructed, environmental labels can provide consumers with an indicator of a product's overall environmental quality. Most analysts now agree that a properly constructed labeling program should be based on a life-cycle perspective (see chapter 4), rather than on a single environmental attribute such as recycled content. Initial efforts have focused on collecting an inventory of resource inputs and waste outputs. These inventories can provide useful insights, but the scope and interpretation of inventories completed so far have been controversial.[78] Nevertheless, at least the qualitative perspective of evaluating the entire life cycle of a product seems essential.

Although EPA once proposed the establishment of a U.S. national eco-label, it has since dropped the idea.[79] Instead, it is supporting research to develop LCA methods (see table 6-5). Two private sector labeling efforts, Green Seal and Scientific Certification Systems, are underway in the United States.[80] These efforts are still quite small, and at the present rate at which labeling guidelines are being developed, consumers should not expect to see eco-labels on a wide range of products in the near future.[81]

Congress could appoint a blue-ribbon commission to oversee the establishment of an independent, national eco-labeling program. A well-funded national program could accelerate the delivery of environmental information to consumers, especially if it borrowed the best from the experiences of existing programs around the world. A single national program would also have the credibility of the Federal Government behind it. As an alternative, Congress could require EPA to develop standards for the certification of the product evaluation methods used by private eco-labeling programs. A certification process would avoid the expense and bureaucracy of a national eco-labeling program, and avoid preempting private efforts that are already underway. For example, eco-label programs that are based on a legitimate life-cycle approach might receive government certification, while those based on a single environmental attribute might not.

By themselves, eco-labels are not likely to have a large impact on environmental quality. Indeed, only a small fraction of all products are likely to be

75A 1990 survey of 1-,514 consumers conducted by *Advertising Age* and the Gallup organization found that 34 percent indicated that an eco-label program would have a great impact on their purchasing decisions. Cited in Cianna t M. Howatt, op. cit., footnote 65, p. 451.

76 Catherine Arnst, "Some 22 Nationals Could Have 'Green Label' Schemes by '93," Toronto *Star*, Nov. 6, 1991, p. D6.

77 In most countries, the label is awarded by a nongovernmental, independent institute according to strict national rules.

78 Consumer *Reports*, op. cit., footnote 17.

79 Hannah Holmes, "The Green Police: In the Environmental Holy War, Who Can Tell the Good Guys From the Bad Guys?" *Garbage*, September-October 1991, p. 44.

80 Amy Lynn Salzhauer, "Obstacles and Opportunities for a Consumer Ecolabel," *Environment*, vol. 33, No. 9, November 1991, p. 10.

81 Ibid., p. 36.

considered for an eco-label.[82] There is also a question about the extent to which manufacturers of environmentally harmful products will be motivated to redesign products and processes to become eligible for a label. Nevertheless, eco-labels may provide public policy benefits that reach beyond the labeled products themselves. A highly visible eco-labeling program could become a useful educational tool to raise consumer awareness about the environment that could spill over to other purchasing decisions.

Institutional, Commercial, and Government Buyers

OTA estimates that over 40 percent of all goods and services (by value) produced in the U.S. economy are ''intermediate' goods and services (e.g., industrial equipment, chemicals, etc.) that are purchased by businesses, institutions, or government agencies, rather than by individual consumers.[83] Therefore, these large-volume buyers are an important target for environmental information.

While the "green preferences" of individual consumers have been the subject of numerous studies, OTA is unaware of any systematic studies on how environmental concerns are factored into the purchasing decisions of commercial or institutional buyers. This is an important area for further research (see section on institutional and behavioral research above).

There is anecdotal evidence that these large-volume buyers are beginning to request more information about the environmental attributes of products and packaging. But since these intermediate goods are not advertised in the same way as consumer goods, eco-labels or environmental advertising standards may not be appropriate. In the case of chemicals, EPA has studied the possibility of increasing information to users of TRI chemicals by expanding Material Safety Data Sheets to include environmental hazards,[84] or requiring manufacturers to provide "product stewardship" information to their customers.[85] In Europe, the idea of requiring manufacturers to provide a' 'product environmental profile" to their customers is being explored (see chapter 5).[86]

These proposals should be evaluated carefully and full advantage should be taken of voluntary industry efforts that are already ongoing.[87] Federal regulations requiring the transmission of additional environmental information between suppliers and manufacturers could create additional paperwork without addressing the specific concerns of individual buyers. However, it is important that the Federal Government incorporate environmental criteria into its own purchasing decisions.

Government Procurement

About 20 percent of the purchases of all U.S. goods and services is made by government at the Federal, State, and local levels. Section 6002 of RCRA requires EPA to establish procurement guidelines for government agencies to purchase products made with recovered materials. At this writing, EPA had published guidelines for paper products, lubricating oils, retreaded tires, building insulation, and cement or concrete containing fly ash. Several more guidelines are expected in 1992.[88] Congress could require EPA to identify additional product categories and establish deadlines for issuance of "green" procurement guidelines.

To date, government procurement guidelines for green products have been based almost exclusively on recycled content. In the future, it will be important to broaden these guidelines to include other environmental attributes, especially waste prevention (toxicity reduction, energy efficiency, etc.). Congress could require that EPA undertake

82 In 1991, after 13 years in operation, Germany's Blue Angel program had awarded eco-labels to some 3,600 products in 66 product categories. However, more than half of the labels awarded fall into only four product categories.

83 This estimate was obtained from the Department of Commerce's Use of Commodities Table of 1987. Dividing total intermediate use by total commodity output yields a ratio of 43.6 percent.

84 Required by the Occupational Safety and Health Administration.

85 David Hanson, "EPA Develops Product Stewardship, Hazard Communication Regulations," *Chemical and Engineering News, Nov. 19,* 1990.

86 A product profile is a qualitative description of the life-cycle environmental impacts of a product, intended for use by professional buyers, rather than individual consumers.

87 See, e.g., Janice R. Long, "Standard for Material Safety Data Sheets in the Offing," *Chemical and Engineering News, May 18, 1992,* p. 7,

88 Testimony of Richard D. Morgenstern, Acting Assistant Administrator, Office of Policy Planning and Evaluation, EPA, before the Subcommittee on Oversight of Government Management, Senate Committee on Governmental Affairs, Nov. 8, 1991.

studies to determine how procurement guidelines might be broadened to account for waste prevention.

In response to congressional pressure, the General Services Administration (GSA) has begun to highlight the environmental attributes of products in its regular supply catalogs.[89] This has helped to ensure that procurement agents in various agencies have access to environmental information on the products they buy. Congress could formalize this process by requiring that all Federal procurement catalogs contain information on environmental attributes alongside performance and cost information.

MARKET DISTORTIONS AND ENVIRONMENTAL EXTERNALITIES

The third major area in which Congress can encourage green design is by shaping environmental policies that better account for the environmental impacts of products throughout their life cycle. Providing better information to designers and consumers on the environmental impacts of materials and processes is important, but if this information is not backed up by appropriate price signals, environmental concerns are likely to be overwhelmed by many other design requirements and consumer demands.

Economists have long argued that efficient use of energy and resources requires that the prices of goods and services reflect their true social (and environmental) costs.[90]91 These costs are partially accounted for through health and environmental laws such as those in table 6-1. For example, emissions control technologies required by the Clean Air Act raise the price of electric power and automobiles. Nationwide, it is estimated that compliance with pollution control laws costs industry and consumers $115 billion per year.[92]

But most observers agree that many environmental costs remain external to economic transactions, and in some cases government policies distort market price signals. On the production side, there are government subsidies or special tax treatment for the extraction of virgin materials (e.g., below-cost timber sales and mineral depletion allowances);[93] and many "non-hazardous' industrial solid wastes (e.g., mine tailings or manufacturing wastes that are managed on-site) with significant environmental impacts are not regulated at the Federal level.[94] On the consumption side, consumers often do not pay the full environmental costs of products that are consumed or dissipated during use (e.g., fuels, cleaners, agricultural chemicals),[95] or the full cost of solid waste disposal.[96]

There are two general policy mechanisms for internalizing environmental costs: regulations and economic instruments. Historically, the basis of environmental policy in the United States has been regulation (see, for example, table 6-1). But in recent years, there has been a growing interest in the use of market-based incentives such as pollution taxes, tradable pollution permits, and deposit-refund systems, that can—in principle at least—provide the same environmental protection as regulations at less cost.[97] Table 6-6 presents a menu of regulatory and market-based incentives that have been proposed to internalize the environmental costs associated with the flow of goods and materials through the economy. These options are organized according to their point of greatest impact on the materials life cycle. Each could have an impact on product design, but an

89 See, e.g., GSA Supply Catalog, May 1992. See also "Buying Green: Federal Purchasing Practices and the Environment," a hearing of the Subcommittee on Oversight of Government Management of the Senate Committee on Governmental Affairs, Nov. 8, 1991.

90 For a recent review, see William D. Nordhaus, "The Ecology of Markets, " *Proceedings of the National Academy of Science,* vol. 89, February 1992, p. 843.

91 For a highly readable discussion of environmental policy instruments to protect the environment from an economist's perspective, see Frances Cairncross, Costing *the Earth: The Challenge for Governments, the Opportunities for Business* (Boston, MA: Harvard Business School Press, 1992).

92 Environmental Protection Agency, "Environmental Investments: The Costs of a Clean Environment," EPA 230-12-90-084, December 1990.

93 Jessica Matthews, "Oh, Give Me a Home Where the Subsidies Roam," *Washington Post,* Oct. 3, 1991.

94 Us. Congress, Office of Technology Assessment, *Managing Industrial Solid* wastes From *Manufacturing, Mining, Oil and Gas Production, and Utility Coal Combustion—Background Paper, OTA-BP-O-82* (Washington, DC: U.S. Government Printing Office, February 1992).

95 See, e.g., Harold M. Hubbard, "The Real Cost of Energy," *Scientific American,* vol. 264, No. 4, April 1991, p. 36.

96 A. Clark Wiseman, "Impediments to Economically Efficient Solid Waste Management," *Resources,* fall 1991, p. 9.

97 Robert W. Hahn and Robert N. Stavins, "Incentive-Based Environmental Regulation: A New Era From an Old Idea?' Energy and Environmental Policy Center Discussion Paper, John F. Kennedy School of Government, Harvard University, August 1990.

analysis of the design implications of all of them is beyond the scope of this report. Here we focus especially on those options that would affect product design directly: i.e., options primarily affecting the manufacturing stage of the life cycle. Many of these instruments have been discussed in detail elsewhere.[98]

Recycled Content

With the proliferation of State and local recycling collection programs in recent years, cities are collecting recyclable at a pace that far exceeds the use of these recovered materials in new products. Cities are now faced with increasing costs of managing recovered materials at a time when they are already strapped financially.[w] As more and more large cities implement collection programs, the volume of recovered materials can be expected to increase; without new markets for these materials, prices will drop. This has led to increasing pressure on Congress to enact legislation to create markets for recovered materials through recycled content requirements.

Recycled content requirements can help to solve the immediate problem of the lack of markets for recyclable. But by creating markets for recovered materials through regulation, policymakers are imposing a predetermined solution to the solid waste problem that ignores market forces.[100] This solution may be inefficient for several reasons:

- With many thousands of products likely to be covered by such regulations, the transaction costs of administration, monitoring, and enforcement on a per-product basis may be unacceptably high.
- Across-the-board content requirements do not account for the fact that some companies may be able to incorporate recycled content more cheaply than others, or that costs may vary significantly by geographical region.
- Finally, by focusing exclusively on a single environmental attribute, recycled content requirements may preclude environmentally preferred designs, especially those featuring waste prevention.

Congress could choose not to address this problem, in which case many communities may be forced to curtail their recycling collection programs until stronger markets for these materials develop. If Congress does choose to pursue recycled content requirements, either in government procurement programs or as part of RCRA, it can address the inefficiencies noted above in several ways.

Crediting Waste Prevention

Congress can exempt products from recycled content requirements that feature waste prevention.[101] This would provide more flexibility to manufacturers, but the viability of this option depends on developing criteria for measuring waste prevention. For instance, how should the various aspects of waste prevention (e.g., weight or volume reduction, toxicity reduction, and energy efficiency) be factored in? And what should be the baseline for measuring reductions? A system of complicated exemptions for waste prevention could make recycled content regulations administratively unworkable, especially if applied on a per-product basis. One alternative would be to offer companies the option of avoiding per-product regulations by committing to companywide reductions, and

98 See, e.g., Resource Conservation Committee, "Choices for Conservation," Final Report to the President and Congress, SW-779, July 1979 (available from the U.S. EPA Engineering Research Center Library, Cincinnati, OH); Robert N. Stavins, Project Director, "Project 88, Harnessing Market Forces To Protect Our Environment: Initiatives for the New President," Washington, DC, December 1988; Robert N. Stavins, Project Director, "Project 88-Round II, Incentives for Action: Designing Market-Based Environmental Strategies," Washington, DC, May 1991; Environmental Protection Agency Science Advisory Board, "Reducing Risk: Setting Priorities and Strategies for Environmental Protection," (especially Appendix C), EPA-SAB-EC-90-021C, September 1990, U.S. Environmental Protection Agency, "Economic Incentives: Options for Environmental Protection," PM-220, Washington, DC, March 1991; Organisation for Economic Cooperation and Development, "Environmental Policy: How To Apply Economic Instruments," Paris, 1991.

99 The National Solid Wrote -merit Association noted in a recent survey of the nation's cities that solid waste management costs are second only to education in public expenditure of funds. David Ruller, Recycling Coordinator for the City of Alexandria, VA, personal communicaton, August 1992.

100 "How To Throw Things Away," *The Economist,* Apr. 13, 1991, p. 17.

101 The Massachusetts Public Interest Research Group (MASSPIRG) has developed legislation proposing that packaging be considered "green" if it met one of several alternative criteria: made from a specified percentage of recovered material, made from a material that was recycled at a specified rate, or reduced in weight or volume by a specified percentage. Such "MASSPIRG bills" have been introduced in several States, and the idea became part of the RCRA reauthorization debate in the 102d Congress.

Table 6-6-Policy Options That Could Affect Materials Flows

Life-cycle stage	Regulatory Instruments	Economic instruments
Raw material extraction and processing	Regulate mining, oil, and gas non-hazardous solid wastes under the Resource Conservation and Recovery Act (RCRA). Establish depletion quotas on extraction and import of virgin materials.	Eliminate special tax treatment for extraction of virgin materials, and subsidies for agriculture. Tax the production of virgin materials.
Manufacturing	Tighten regulations under Clean Air Act, Clean Water Act, and RCRA. Regulate non-hazardous industrial waste under RCRA. Mandate disclosure of toxic materials use. Raise Corporate Average Fuel Economy Standards for automobiles. Mandate recycled content in products. Mandate manufacturer take-back and recycling of products, Regulate product composition, e.g., volatile organic compounds or heavy metals. Establish requirements for product reuse, recyclability, or biodegradability. Ban or phase out hazardous chemicals. Mandate toxic use reduction.	Tax industrial emissions, effluents, and hazardous wastes. Establish tradable emissions permits. Tax the carbon content of fuels. Establish tradable recycling credits. Tax the use of virgin toxic materials. Create tax credits for use of recycled materials. Establish a grant fund for clean technology research.
Purchase, use, and disposal	Mandate consumer separation of materials for recycling.	Establish weight/volume-based waste disposal fees. Tax hazardous or hard-to-dispose products. Establish a deposit-refund system for packaging or hazardous products. Establish a fee/rebate system based on a product's energy efficiency. Tax gasoline.
Waste management	Tighten regulation of waste management facilities under RCRA. Ban disposal of hazardous products in landfills and incinerators. Mandate recycling diversion rates for various materials. Exempt recyclers of hazardous wastes from RCRA Subtitle C. Establish a moratorium on construction of new landfills and incinerators.	Tax emissions or effluents from waste management facilities. Establish surcharges on wastes delivered to landfills or incinerators.

SOURCE: Office of Technology Assessment, 1992.

requiring them to document compliance with these agreements in publicly available databases.[102]

Tradable Recycling Credits

Another option for reducing the burden of industry compliance with recycled content requirements would be to couple them with a tradable recycling credit mechanism similar to the emissions trading program for sulfur dioxide under the Clean Air Act Amendments of 1990.[103] Manufacturers would be required either to use a specified percentage of recycled content in their products, or to purchase recycling credits from other manufacturers who exceed the percentage requirement.

Such tradable recycling credit mechanisms encourage those manufacturers that can incorporate recovered materials most cheaply to do so. However, due to the administrative costs of setting up and monitoring these programs, they are not feasible for all of the many thousands of products on the market.[104] Rather, they may be most suitable for a limited number of materials or waste streams of special concern, e.g., old newspapers, used oil, or

102 Model legislation developed by the Source Reduction Task Force of the Coalition of Northeastern Governors (CONEG) would allow companies to avoid all packaging recycling requirements by committing to reduce packaging on a companywide basis by 15 percent between 1988 and 1996. See CONEG Source Reduction Task Force-Model Legislation, "An Act Concerning Reduction in Packaging Waste," Feb. 11, 1992.

103 See "Project 88—Rod II," op. cit., footnote 98, p. 55.

104 For a discussion of the appropriate use of marketable permits, see Organisation for Economic Cooperation and Development, op. cit., footnote 98.

automobile batteries.[105] Congress could mandate that EPA set up a limited number of pilot tradable recycling credit programs to evaluate the effectiveness of this approach.

A Market-Based Alternative

The extraction of raw materials and their initial processing are two of the most environmentally destructive phases of a product's life cycle.[106] Yet many of these environmental costs are not reflected in the price of materials. As an alternative to recycled content requirements, Congress may wish to move toward a system of indirect incentives aimed at internalizing the environmental costs of virgin materials use, thus making virgin materials more expensive and the use of recovered materials more economically attractive.[107] This might include eliminating subsidies and special tax treatment for the extraction of virgin materials, taxing the production of virgin materials of special concern, or regulating more strictly the wastes and other environmental impacts of extractive industries.[108]

Such a market-based strategy has the advantage that it does not impose a predetermined solution on the solid waste problem, and would begin to internalize the costs of some of the most environmentally destructive practices. However, the size of its impact on the solid waste problem and the timing of that impact is much less predictable. Several studies suggest that simply removing government subsidies for virgin materials is unlikely to change the price of processed materials by more than a few percent.[109] [110] Attempting to replicate the incentives of recycled content requirements through taxes on virgin materials might require taxes to be so high as to cause significant economic disruption in the domestic materials extraction industries, with serious implications for U.S. resource security. Nevertheless, given that current policies were established at a time when the goal was to encourage the exploitation of resources,[111] it is appropriate for Congress to reevaluate these policies in light of current concerns about the environmental impacts of resource use and ecological sustainability.

Use of Hazardous Chemicals

Since the 1940s, when the chemical industry began an era of explosive growth, more than 60,000 chemical substances have been synthesized, and more than 1,000 new chemicals are proposed for manufacture each year.[112] These chemicals are responsible in large part for the high standard of living in industrialized countries, and for many of the conveniences of modern life. Contemporary food production, medicines, building materials, and many consumer products (e.g., nylon hosiery and laundry detergents) depend on use of these chemicals.

This dramatic growth in chemical use has also raised health and environmental concerns. For the most part, these chemicals pass through the economy quickly, whether in the form of industrial wastes or products.[113] Some have very long lifetimes in the environment (e.g., CFCs and polychlorinated biphenyls (PCBs)) and may become distributed globally.[114] In some cases, a hazardous substance may achieve widespread use before its health or environmental implications are realized; for example, CFCs were believed to be quite safe at the time they were introduced. Toxic substances initially released in low concentrations may also become reconcentrated in sediments or through bioaccumu-

105 Legislation to establish tradable recycling credit programs for old newspapers, tires, used oil, and automobile batteries was introduced in the 102d Congress by Representative Esteban Torres. See, e.g., H.R. 872.

106 John E. Young, "Tossing the Throwaway Habit," *World Watch*, May-June 1991, p. 26.

107 Steven Kraten, "Market Failure and the Economics of Recycling," *Environmental Decisions*, April 1990, P. 20.

108 The advantages and disadvantages of these options are discussed extensively in the references of footnote 98.

109 For a brief discussion of the impact of virgin material subsidies on recycling, see U.S. Congress, Office of Technology Assessment, *Facing America's Trash: What Next for Municipal Solid Waste, OTA-O-424* (Washington, DC: U.S. Government Printing Office, October 1989), p. 200.

110 Other observers counter, though, that the largest government subsidies go to the energy and transportation sectors, not to v@@ materials Per se.

111 For example, the law that governs the extraction of gold, silver, and other "hardrock" minerals is the General-g Law of 1872. Bills to reform the Mining Law were introduced in both the House and Senate in the 102d Congress.

112 Michael Shapiro, "Toxic Substances Policy," in *Public Policies for Environmental Protection*, Paul R. Portney (cd.), op. cit., footnote 2, p. 195.

113 Robert U. Ayres, "Industrial Metabolism," *Technology and Environment* (Washington DC: National Academy Press, 1989), p. 23.

114 Curtis C. Travis and Sheri T. Hester, "Global Chemical Pollution," *Environmental Science and Technology*, vol. 25, No. 5, 1991, p. 814.

lation to levels that pose significant risks to human health.[115]

In 1976, Congress passed the Toxic Substances Control Act (TSCA) to address these concerns. Yet little is known about the long-term implications of the dissipative use of these substances for human health and the environment. Toxicity data are lacking on many, if not most of the chemical products used in the United States.[116] In 1991, GAO reported that 15 years after the enactment of TSCA, EPA had received test results for only 22 chemicals, and had assessed the results for only 13 of the 22.[117]

Manufacturers have begun to respond to these health and environmental concerns in a variety of ways, such as the "Responsible Care" program of the Chemical Manufacturers Association (see table 6-3). As of February 1992, 734 companies had joined EPA's 33/50 Program, pledging to reduce their releases of 17 toxic materials by 50 percent (relative to 1988) by 1995.[118] But in spite of these efforts, large volumes of hazardous chemicals continue to flow through the economy into the environment. According to data collected in 1990 on industrial use of hazardous substances in the State of New Jersey, for example, at least 83 percent of the cadmium, 92 percent of the nickel, and 99 percent of the mercury used by industry was converted into products (e.g., paints, coatings, plastics, and batteries), not released as wastes.[119] These heavy metals are released to the environment when these products are discarded; however, these environmental releases are not addressed by programs such as the 33/50 program, which is concerned only with industrial waste streams. This example illustrates that if we are concerned about the dissipation of hazardous materials into the environment, we must be concerned not only with industrial wastes, but with the use of these materials in products as well.

Toxics Use Reduction

Recognizing the importance of toxic materials flows in products as well as in industrial wastes, environmental groups are promoting reduction in industry use of toxic chemicals in the frost place.[120] The rationale is that once toxic materials are introduced into the economy, they are likely to be released into the environment. Therefore, environmental groups argue, the best way to prevent toxic releases is to limit the use of these materials from the outset. Some advocates envision a world in which certain toxic materials would be "sunsetted" or phased out entirely.[121]

The distinction between waste minimization and toxics use reduction is important because toxics use reduction is a much more radical concept than waste minimization (box 6-B). Whereas Federal policy has long been concerned with protecting the environment from the release of hazardous and nonhazardous wastes by industrial generators (e.g., EPA's 33/50 Program), the choice of what materials should be used in products has usually been a private sector decision. Thus, toxics use reduction implies government intrusion into areas that have traditionally been considered the province of private industry. In other words, toxics use reduction involves a more prescriptive approach to product design than does waste minimization.

Policy Approaches

The use of hazardous or toxic chemicals must be understood in the context of risks and benefits.[122] Clearly, the environmental risks of using some materials are so great that they outweigh any possible benefits, and they must be banned-as in

115 For example, mercury volatilized by fossil fuel burning or municipal solid waste incineration remains in the atmosphere for about a year. After mercury from the atmosphere is deposited in lakes, it is methylated and bioaccumulates in fish as methyl mercury, the form most toxic to humans. About 15 percent of Michigan lakes, 30 percent of Wisconsin lakes, and 50 percent of Florida lakes contain fish with mercury levels exceeding State health standards. Curtis C. Travis and Sheri T. Hester, op. cit., footnote 114, p. 816.

116 Michael Shapiro, op. cit., footnote 112, p. 221.

117 U.S. Congress, General Accounting Office, Toxic Substances: *EPA's Chemical Testing Program Has Not Resolved Safety Concerns*, GAO/RCED-91-136 (Washington, DC: U.S. Government Printing Office, 1991), p. 2.

118 Environment Protection Agency, "33/50 Program Pledges on the Rise," *Pollution Prevention News*, March/April 1992, p. 1.

119 Data supplied by Andrew Opperman, New Jersey Department of Environmental Protection and Energy, personal communication, August 1992.

120 See, e.g., testimony of Hillel Gray, National Environmental Law Center, before the Subcommittee on Transportation and Hazardous Materials of the House Committee on Energy and Commerce, Mar. 10, 1992.

121 Jeffrey A. Foran, "The Sunset Chemicals Proposal," *International Environmental Affairs*, vol. *2, No. 4,* fall 1990, p. 303.

122 This principle is at the root of the Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act, which regulate chemicals and pesticides on the basis of "unreasonable risk" to health or the environment.

Box 6-B—Toxics Use Reduction vs. Waste Minimization

Waste minimization and toxic use reduction are related concepts, but they are not identical. Waste minimization refers to all activities that reduce the quantity or toxicity of waste released from a facility to the environment As such it is concerned with reducing the waste outputs of industrial processes. Toxic use reduction refers to reducing the *inputs* of toxic materials into industrial processes, thereby avoiding their release as wastes *or* ***in*** *products,*

Industry has been generally supportive of the idea of waste minimization, at least in principle. Companies object strongly, though, to government requirements for toxic use reduction. They argue that society's legitimate concern is with the release of toxic materials, not their use *per se.* For example, two toxic chemicals can react to produce a nontoxic product; and toxic solvents can be recovered and reused many times. Thus, they argue, the mere use of a toxic material may not affect the environment, Furthermore, companies argue that the term ''toxic' is imprecise because most substances are toxic in sufficient concentrations, while some highly toxic chemicals can be beneficial in low concentrations. Finally, industry argues that regulations restricting the use of materials would hurt their international competitiveness, since the same restrictions would not apply to their competitors overseas.

Environmentalists counter that industry cannot be entrusted with protecting the environment from toxic materials, especially when it is not profitable to do so. They point to historical examples of polluted rivers and abandoned toxic waste dumps. And even if toxic materials are released in small quantities, they may persist for a long time in the environment **and** become reconcentrated in sediments or through bioaccumulation. Little is known about the risks of long-term exposure to low concentrations of toxic chemicals.

These two views-waste minimization **and** toxic use reduction--illustrate the clash between two of the philosophical paradigms discussed in chapter 3. Waste minimization, with its concern with industrial waste outputs, arises from the environmental protection paradigm, Toxic use reduction, on the other hand, with its precautionary emphasis on resource inputs, reflects the eco-development paradigm.

soURCE: Office of Technology Assessment, 1992.

the case of CFCs. For most chemical substances, though, more flexibility is appropriate. Products that use toxic materials can perform socially useful functions or even have (comparative) environmental benefits. For instance, the recently discovered high-temperature superconductors could potentially lead to more efficient power generation and transmission, resulting in less pollution from power plants. Yet the synthesis of these superconductors involves use of toxic chemicals, and the materials themselves contain a variety of toxic heavy metals; for instance, the compound currently with the highest critical transition temperature is based on thallium, a highly toxic heavy metal.[123]

On the other hand, it must be recognized that there is considerable uncertainty about the health and environmental impacts of the dissipative use of hazardous or toxic materials. As noted above, information on the toxicity and long-term health effects of most chemicals is sketchy at best, and the environmental risks to ecosystems have hardly been considered. These uncertainties suggest that a precautionary policy that encourages designers to avoid the dissipative use of hazardous materials (insofar as possible) is warranted.

More than a dozen States have enacted laws that promote toxics use reduction or related approaches.[124] The Massachusetts Toxics Use Reduction Act, which is widely agreed to be the most aggressive, requires industrial facilities to develop toxics use reduction plans and document progress toward self-set goals. The overall goal of the legislation is to reduce the use of listed toxic chemicals by 50 percent by 1997. To protect proprietary information, the plans themselves are confidential, although the plan summaries and the goals are to be made public.[125]

123 U.S. Congress, office of Technology Assessment, ***High-Temperature Superconductivity in Perspective,*** OTA-E-440 (Washington, DC: U.S. Government Printing Office, April 1990).

124 William Ryan and R.ichard Schrader, "An Ounce of Toxic Pollution Prevention: Rating States' Toxic Use Reduction Laws," available from the Center for Policy Alternatives, Washington, DC, Jan. 17, 1991, p. 1.

125 Ken Geiser, "The Greening of Industry," ***Technology Review,*** August/September 1991, p. 68.

California has tried another approach aimed at informing consumers of the use of toxic chemicals in products. Under the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), products that contain even minute amounts of any of 420 chemicals determined to be carcinogenic or posing reproductive toxicity must be labeled with warnings.[126] This has stimulated some companies to reformulate products to avoid the labeling requirements.[127] However, because so many chemicals are covered, and in such low concentrations, the effect of the labeling requirements may be to desensitize consumers to actual risks.[128]

In addressing health and environmental concerns relating to toxic or hazardous chemical use in products, Congress can choose a variety of options, ranging from further research to mandatory toxics use reduction requirements. By initiating a research program to identify high-risk materials and products, and to model the flows of these materials through the economy (see research discussion above), Congress can ensure that regulations result in cost-effective risk reduction.

Congress can act to increase available information about the flows of toxic materials by expanding industry's reporting requirements under TRI to include additional facilities, industrial sectors, and chemicals not covered under the original law. The 1986 Superfund Amendments and Reauthorization Act requires manufacturers in 20 manufacturing industries to report annually to EPA on their releases of 322 chemicals or chemical categories. However, many environmental releases of these chemicals are not covered under TRI. Not included are nonmanufacturing sources such as mines, waste treatment plants, public utilities, farms, and government facilities. Manufacturers with fewer than 10 employees or using less than 10,000 pounds of TRI chemicals annually are exempted from reporting. Critics also charge that hundreds of chemicals listed as toxic under other environmental laws are excluded from the TRI reports.[129]

Congress could expand facilities' reporting requirements under TRI to include the ***use*** of toxic materials, not just their releases to the environment. This "materials accounting" approach could lead to a valuable database on toxic chemical flows.[130] However, comprehensive reporting on the use of hundreds of chemicals for thousands of facilities would involve a huge paperwork burden, both for companies and for EPA reviewers.[131] Unless these requirements are narrowly targeted on chemicals or materials of special concern, they would significantly increase industry's reporting costs, and might not result in a significant reduction of environmental risk.

Congress could mandate a national requirement for industry toxics use reduction plans, modeled on the Massachusetts Toxics Use Reduction Act. Again, however, the law would have to be carefully structured to make the paperwork burden manageable. If Congress does decide to pursue mandatory toxics use reduction, it may wish to consider market-based incentives such as tradable toxic use permits to achieve reductions at the lowest cost to industry.[132] This approach was used successfully in the phase-out of leaded gasoline

126 William S. Pease, "Chemical Hazards and the Public's Right to Know: How Effective Is California's Proposition 65?" Environment, vol. 33, No. 10, December 1991, p. 12.

127 For example, Gillette reformulated its Liquid Paper product to remove trichloroethylene, one of the listed chemicals. The substitute was 1,1,1 trichlorethane, which is not on the list. Robert Healey, Gillette, personal communication, August 1992.

128 The law states that listed chemicals in foods must not be present at a level greater than one one-thousandth of the level at which there are 110 observable health effects. Industry representatives claim that this is too restrictive, arguing, for example, that ethyl alcohol, one of the listed chemicals, is naturally present in soft drinks, carrots, ice cream, and bread at levels that would trigger a warning under Reposition 65. See Conrad B. Mackerron, "Industry Is Learning To Live With Proposition 65," *Chemicalweek*, July 12, 1989, p. 19.

129 According to one estimate, TRI excludes 140 chemicals regulated as hazardous under RCRA; 64 substances listed as hazardous under the Clean Air Act; 56 priority pollutants under the Clean Water and Safe Drinking Water Acts; 69 special review pesticides under FIFRA; and hundreds of probable carcinogens and reproductive toxicanta listed by scientific authorities and government agencies. See Hillel Gray, op. cit., footnote 120.

130 For example, New Jersey's Worker and Community Right to Know Act of 1983 requires industry to report inputs and outputs of 165 hazardous chemicals, all of which are on the TRI list. These materials accounting data are necessary to track the flows of these chemicals through the economy and into the environment, whether in the form of products or waste streams.

131 The petroleum industry, for instance, argues that crude oil contains millions of different hydrocarbons and other naturally occurring compounds that are never fully separated during the manufacturing process. Petroleum products such as gasoline, fuel oil, and others are also complex mixtures that donothave standard compositions. Accounting for all of these chemicals would be impractical. See testimony of the American Petroleum Institute before the Subcommittee on Transportation and Hazardous Materials of the House Committee on Energy and Commerce, Mar. 10, 1992.

132 Molly K. Macauley and Karen L. Palmer, "Incentive-based Approaches to Regulating Toxic Substances," *Resources*, summer 1992, p. 5.

during the early 1980s.[133] Finally, if new bans are deemed necessary, they can be targeted on specific products, rather than generic materials. This can help to target specific risks, while not foreclosing the economic and environmental benefits that these materials may have in other applications.

Product Taxes

Environmental product fees or taxes are-in principle, at least—an efficient way to encourage designers and consumers to make greener choices.[134] Taxes can be applied to hard-to-dispose products or to products that pose special risks as a result of their use. The best example in the United States is the excise tax on CFCs, which is intended to remove windfall profits as the production of these chemicals is phased down under a marketable permit system.[135] As discussed in chapter 5, several European countries impose hefty taxes on nonreturnable beverage containers and other packaging to encourage returnable and reusable packaging. Several countries in Europe impose a tax on leaded gasoline (with a corresponding subsidy for unleaded gasoline), which has resulted in a significant decline in demand for leaded gas.[136]

More often, fees are imposed on products to raise finds for recycling or safe disposal programs, and are too small to influence product design decisions. Several States have fees on products that cause special waste problems, such as tires, batteries, and used oil. At this writing, Florida is the only State with an advance disposal fee on packaging.[137]

Industry has lobbied heavily to quash proposals for new environmental product taxes, arguing that taxes on narrow categories of products (e.g., packaging) are unfair, while taxes on a large number of different products could involve unacceptable administrative costs. There is, however, widespread agreement among industry and environmentalists that weight- or volume-based trash disposal fees provide an excellent incentive for consumers to send less trash to the landfill-provided they have access to curbside recycling programs (for which no disposal fee is charged). An increasing number of communities have implemented these pay-per-can programs.[138] However, while these programs may encourage the separation of trash for recycling, they seem unlikely to influence consumer buying habits (and thus product design) in a dramatic way, because solid waste disposal costs are relatively small compared with the price of most products.[139]

In the short term, Congress could set up a national waste disposal fee that would fund a grant program for research, demonstration, and education projects for clean manufacturing technologies and green product design in universities, national laboratories, and industry. For example, a Federal charge of $1 per ton of municipal solid waste delivered to landfills and incinerators would raise on the order of $100 million annually. Such a charge would not discriminate against specific products, and the infrastructure for collecting the charge already exists in most states, so collection costs would likely not be prohibitive.[140]

In the longer term, if Congress decides to address energy conservation and global warming concerns through an environmental tax on fossil fuels, this could have a dramatic impact on product design, since fuels are consumed at every stage of the product life cycle. Such a tax could encourage not only the design of more energy-

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133 R. Hahn and G. Hester, "Marketable Permits: Lessons for Theory and Practice," *Ecology Law Quarterly,* vol. 16, No. 2, 1989.

134 Terry Dinan, "Solid Wrote: Incentives That Could Lighten the Load," *EPA Journal,* vo1. 18, No. 2, May/June 1992, p. 12.

135 David Lee, "Ozone LOSS: Modern Tools for a Modem Problem," *EPA Journal,* May/June 1992, p. 16.

136 See Environmental Resources Ltd., "Environmentally Sound Product Design: Policies and Practices in Western Europe and Japan," contractor report prepared for OTA, July 1991, p. 45.

137 The fee is $0.01 per container by 1992 unless the container material reaches a 50 percent recycling rate.

138 &x, e.g., Environmental Protection Agency, "Economic Incentives: Options for Environmental Protection op. cit., footnote 98, p. 2-7.

139 Consider a famil, of four that annually purchases $10,000 of goods requiring disposal. Annual discards (at a rate of 4 pounds per person per day, the national average) amount to 2.92 tons of trash. At a weight-based fee of $100 per ton, this amounts to an annual trash bill of $292, about 3 percent of purchases. By careful shopping for recyclable and light-weight products and packaging, consumers might save 10 percent on their trash bill (about $30 per year), or 0.3 percent of total purchases.

140 D.nmark imposes a national tax on the weight of solid wastes delivered to landfills and incinerators. The tax is e armarked to pay for recycling and environmental research programs.

141 As one example, building aircraft with new, light-weight composites can significantly improve their fuel efficiency, but with the decline of real jet fuel prices since the late 1970s, the higher initial cost of composites compared with aluminum cannot be recouped through fuel savings.

efficient products, but more material-efficient products as well.[141]

Manufacturer Take-Back

Take-back regulations give manufacturers responsibility for recovering and recycling the products they produce. By shifting the burden of solid waste management from beleaguered municipal governments to industry, the costs of solid waste management are internalized and manufacturers have direct incentives to design products that are recyclable. As discussed in chapter 5, Germany has established a take back program for packaging, and is considering the idea for a variety of durable goods as well. The takeback idea appears to be gathering momentum throughout Europe,[142] and many observers believe its introduction in the United States is just a matter of time.[143]

Manufacturer take-back regulations have considerable intuitive appeal. By assigning manufacturers the responsibility for recovering their own products, rather than telling them how to do it, manufacturers have some flexibility to find the least-cost solution. This may involve collecting and recycling the product themselves, or paying a third party to do so.

Durable goods may be especially good candidates for take-back programs, because they are inherently longer lasting, are generally made from higher value materials, and often consist of "knowledge-intensive' components that command a high recovery value. Indeed, some manufacturers of leased office equipment have already initiated design for recycling and remanufacturing programs (see chapter 3). Products that pose special solid waste disposal problems, such as batteries and tires, may also be good candidates for take-back regulations.

However, take-back requirements may not be cost-effective for all products. Requiring manufacturers of many nondurable goods to take back and recycle their products could simply impose additional costs without clear corresponding environmental benefits. For instance, it would probably not be efficient to collect and recycle potato chip bags; doing so would be likely to cause more pollution from transporting the bags to a recycling facility than would result from landfilling or incinerating them. And of course, take-back schemes could not be applied to products that are consumed or dissipated during their use.

Take-back requirements have several other limitations. In effect, they impose a predetermined solution (recycling) to the problem of solid waste. They elevate the solid waste aspects of the product above other environmental and performance attributes that may be relevant. If there are design tradeoffs between recyclability and waste prevention, or recyclability and energy efficiency, design decisions may be biased in favor of recyclability, to the detriment of the environment.

Manufacturer take-back programs appear to be moving forward in Europe without any serious attempt at cost-benefit analysis.[144] OTA suggests that while take-back schemes may be a good option for some products, further research on the costs and benefits for a range of products is needed before they are implemented in the United States (see the discussion of policy research needs above). These studies should consider the relative merits of market-based incentives such as deposit-refund systems or tradable recycling credit programs as alternatives to take-back regulations.

COORDINATION AND HARMONIZATION

The final area where Congress has a unique role is in coordination and harmonization of policies affecting green design. Green design involves bringing together two policy objectives (industrial competitiveness and environmental protection) that in the past have been seen as separate or even conflicting. It is not surprising, then, that the Federal Government is poorly organized to take advantage of opportunities such as green design. For example, EPA is organized around regulatory responsibilities for protecting air, water, and land; it does not address industrial competitiveness in a natural way, and its technical expertise in design and manufacturing is minimal. The Department of Commerce, on the other hand, is concerned with the competitiveness of industrial sectors, but has little environmental expertise. DOE's national laboratories have a wide range

142 Frances Cairncross, "How Europe's Companies Reposition to Recycle," *Harvard Business Review,* March-April 1992, p. 34.
143 Several States are enacting take-back laws, such as New Jersey's take-back requirement for rechargeable nickel-cadmium batteries.
144 "Environmentalism Runs Riot," Op. Cit., footnote 60.

of technical capabilities that could be brought to bear on improving design for energy efficiency and solid waste recycling processes, but environmental quality has not traditionally been a part of DOE's mission.

Throughout this report, a number of areas have been cited where green design could benefit from a stronger, more coherent Federal approach:

- *Coordinating research.* Projects related to green design are underway in several agency offices (e.g., EPA's Office of Research and Development, Office of Solid Waste, and Office of Pollution Prevention and Toxics; DOE's Office of Industrial Technology; and the National Science Foundation's Engineering Research Centers, see table 6-5), but OTA found that the efforts sponsored by different offices and agencies have often been undertaken independently with little or no coordination among them.
- *Promoting system-oriented design solutions.* Taking advantage of the opportunities for system-oriented green design requires that the economic performance and environmental impact of industries or sectors be viewed in an integrated way. Individual companies have little incentive to promote an overall greener vision of their sector. A greener transportation sector, for example, may involve not only improved vehicle fuel efficiency, but better management of materials used in automotive, rail, and aviation applications, as well as changes in urban design. A coordinated, interagency perspective could spur a more holistic analysis of total sectoral issues, through forums, grant programs, etc.
- *Harmonizing State and Federal environmental product policies. In the* absence of Federal guidance, State and local governments have passed a diverse array of laws affecting the environmental attributes of products (table 6-2). Industry objects to the prospect of having to comply with a different environmental regime in each State or county, arguing that this is inefficient and inhibits interstate commerce.[145] Environmentalists generally defend the right of each local community to set environmental standards as it sees fit. An interagency forum for discussion and policy development could help define the circumstances under which Federal standards preempting State and local environmental laws may be justified, and where they are not.
- *Coordinating policy development on international aspects of the environment, technology, and trade.* At present, responsibility for development of U.S. policy in these areas is not clearly defined, and each Federal agency has its own agenda.[146]

New Institutions for Environmental Technologies

In Japan, the Ministry of International Trade and Industry (MITI), which has responsibility for both trade and competitiveness, is also involved in implementing Japan's new recycling law. MITI's involvement is expected to be a strong inducement for companies to comply in a timely way.[147] In 1992, a new MITI-run laboratory, the Research Institute for Innovative Technology (RITE) was launched to promote new technologies for improving environmental quality.[148,149] In the United States, however, there is no comparable institution that can address trade, competitiveness, and the environment in a coherent way.

Recently, several proposals have been made to establish anew institutional focus within the Federal Government for integrating environmental and tech-

145 For example, the Chemical Specialties Manufacturers Association has filed suit in California alleging that California's label@ requirements under Proposition 65 should be preempted by Federal precautionary labeling requirements of the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Hazardous Substances Act.

146 William A. Nitze, "Improving U.S. Interagency Coordination of International Environmental Policy Development" *Environment,* vol. 33, No. 4, May 1991, p. 10.

147 Environmental Resources Limited, op. cit., footnote 136.

148 Jamb M. Schlesinger, "Thinking Green: In Japan, Environment Means an Opportunity for New Technologies," *Wall Street Journal,* June 3, 1992, p. Al.

149 RITE's research objectives include development of biodegradable plastics, bioproduction of hydrogen fuels, new metal recovery methods, and new carbon dioxide fixation processes.

nological concerns.[150] These include creating a new Office of National Environmental Technologies within EPA, an independent National Environmental Technologies Agency, a National Institutes of the Environment (analogous to the National Institutes of Health), and a National Environmental Technologies Laboratory within DOE's national laboratory system.[151]

A new institutional focus within the Federal Government for environmental technology could help coordinate Federal efforts to promote various aspects of green design, and provide a home for promising new fields of research such as industrial ecology (see chapter 4), that do not fit readily within any agency's mission. However, OTA does not foresee that a separate institution dedicated exclusively to green design would be appropriate. By its nature, green design is problem-oriented: the appropriate design choices depend on the specific environmental problems to be addressed, and on the particular requirements of various products and industries. For example, packaging designers, auto designers, pesticide formulators, and architects have different information requirements, and operate under different constraints. These would be difficult to address through a single, generic institution.

Interagency Groups

Interagency task forces and committees also provide a mechanism for improving Federal coordination in areas such as environmental policy where no single agency has jurisdiction. In recent years, several interagency groups have been formed to address environmental concerns,[152] for example: the Council on Federal Recycling and Procurement Policy (created in October 1991 to oversee agency recycling actions); the Federal Interagency Task Force on Environmental Labeling (EPA, FTC, and the U.S. Office of Consumer Affairs); the Ad Hoc Committee on Risk Assessment (established in 1990 to harmonize risk assessment approaches among Federal agencies); the Interagency Committee on Environmental Trends (ICET was reactivated by the Council on Environmental Quality in 1991 to coordinate the environmental information activities of various Federal agencies); and the Interagency Task Force on Trade and Environment (led by the Office of the U.S. Trade Representative (USTR)). In 1990, the White House established a subcabinet-level Environmental Policy Review Group under the Domestic Policy Council to review domestic policy issues and improve coordination.[153]

Some relevant interagency collaborations are also being formed on an ad hoc basis. For instance, EPA is working with the Department of Agriculture to promote waste prevention in agricultural chemical use. EPA, DOE, and DOC are collaborating in a joint grant program with States to fund research on reducing the environmental impacts of industrial processes.[154]

Congress could establish a permanent cabinet-level council charged with the responsibility of ensuring that environmental concerns are integrated into all Federal policies. This might take the form of an expanded Council on Environmental Quality, or a new Environmental Policy Council with its own permanent staff.[155] [156] To be taken seriously, though, such a council would have to enjoy the full support of the President.

Alternatively, Congress can use its oversight powers to ensure that the activities of existing interagency groups are consistent with green design. For example, it can ensure that: waste prevention is incorporated into procurement initiatives developed by the Council on Federal Recycling and Procurement Policy; mechanisms for coordinating Federal data collection on toxic materials flows are considered by the Interagency Committee on Environmental Trends; and that the USTR-led Task Force on Trade and the Environment has adequate

150 See "Senate, House Members Craft Bills To Push Federal 'Green' Technology Policy,'* *Inside EPA, July 3,* 1992, p. 17; Helen Gavaghan, "Green Research Gains Ground in America," *New Scientist,* Apr. 18, 1992, p. 8; Braden Allenby, AT&~ "Why We Need a National Environmental Technology Laboratory (And How To Make One),' unpublished draft.

151 At this writing, these and other proposals were under review by the Task Force on Environmental Research and Development of the Carnegie Commission on Science, Technology, and Government, and National Academy of Sciences' Committee on Environmental Research.

152 Council on Environmental Quality, op. cit., footnote 8.

153 William A. Nitze, op. cit., footnote 146, p. 32.

154 The program is called National Industrial Competitiveness through Efficiency: Energy, Environment, Economics (NICE^3).

155 Alvin L. Alm, "A Need for New Approaches," *EPA Journal,* May/June 1992, p. 7.

156 U.S. Environmental Protection Agency, Science Advisory Board, op. cit., footnote *98,* appendix C, p. 56.

policy guidance in international negotiations on environmental product policies.[157]

Technology With a Green Lining

Regardless of whether Congress creates any new environmental technology institutions, OTA believes it makes sense to integrate environmental concerns more thoroughly into each agency's ongoing programs. One recent study has developed a list of ''environmentally critical technologies. ''158 But ideally, there should be an environmental component to each of the "critical" technologies on the lists already assembled by the Office of Science and Technology Policy, the Department of Commerce, and the Department of Defense. The goals of waste prevention and better materials management could be integrated thoroughly into NIST's Advanced Technology Program,[159] the recently announced Manufacturing Technology Initiative,[160] and the Advanced Materials and Processing Program.[161] Congress can use its oversight powers to ensure that both new and existing technology development programs have an environmental dimension.

In the end, the institutional details are less important than a recognition on the part of Congress and the Administration that Federal leadership is needed to take advantage of opportunities like green design that do not fall neatly within the mission of any single agency.

A STARTING POINT

Many of the options discussed above would not immediately affect the way products are designed. Research to define environmental risks and understand life-cycle materials flows will take time. Changes in the curricula of design and engineering schools will affect the next generation of designers. And changes in the tax code to internalize the environmental costs of materials and energy use and product disposal do not appear to be on the political horizon, particularly in an era of concern about economic growth and U.S. industrial competitiveness.

OTA believes that such long-term changes are essential if the United States is to be a world leader in green design. But a shorter-term strategy is also important to ensure that existing momentum is not lost. The following is a package of options Congress might consider that could be implemented relatively quickly, and would not be very expensive:

- Require all Federal agencies to conduct a thorough review of their regulations and procurement policies (including military specifications) that may discourage waste prevention and better materials management, and make recommendations for changes. These changes would be consistent with the Federal Recycling and Procurement Policy (Executive Order 12780) and would not require any new legislative authority.
- Provide funding to EPA to expand the Pollution Prevention Information Exchange System to include all Federal and State activities relevant to green design in a single place. An electronic network would stimulate cross-fertilization of current projects and help eliminate duplication of effort.
- For products with significant environmental impacts (e.g., autos, paper, pesticides, etc.), provide funding through the appropriate agencies for intensive workshops that would bring together professionals associated with various phases of a product's life cycle (e.g., designers, suppliers, manufacturers, distributors, consumer advocates, and waste management providers) to discuss opportunities for coordinated action for waste prevention and better materials management.

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157 U.S. Congress, Office of Technology Assessment *Trade andEnvironment: Conflicts andOpportunities,* OTA-BP-ITE-94 (Washington, DC: U.S. Government Printing Office, May 1992).

158 George R. Heaton, Jr. et al., "Backs to the Future: U.S. Government Policy Toward Environmentally Critical Technology," World Resources Institute, Washington, DC, June 1992.

159 The ATP program is primarily oriented toward enhancing U.S. competitiveness. Ofthe27ATPgrants awarded in 1992, several are indirectly related to environmental concerns, though only one is directly related (a project on plastics recycling).

160 ''Technology Initiative Initiated,'' Science, vol. 255, Mar. 13, 1992, p. 1350.

161 A number of environment-related projects are proposed in Advanced Materials and Processing: the Fiscal Year 1993 Program, Op. cit., footnote 51.

- provide funding for a national green design competition and establish a prestigious National Green Design Award similar to the Malcolm Baldridge National Quality Award.[162] [163]

A design competition and national award would generate new ideas for designers across the country, and give consumers a better sense of the possibilities.

162 U.S. congress, Office of Technology Assessment, *Facing America's Trash*, op. cit., footnote 109, p. 24.

163 The Malcolm Baldridge Award does include criteria such as waste prevention, but the environment is not a central focus. See "Malcolm Baldridge National Quality Award, 1992 Award Criteria," available from the U.S. Department of Commerce, Technology Administration, Washington DC, 1992.