

Design for the Environment

A partnership for a cleaner future.

Katherine M. Hart, Deborah L. Boger, and Michael A. Kerr

A PCB shop's ability to react to complex environmental rules, regulations, and regulatory costs can mean the difference between success and failure. To this end, companies in all industrial sectors are responding to current and future environmental considerations and potential tort liability by identifying opportunities to prevent pollution (e.g., eliminating the generation of hazardous waste) and by using safer materials and technologies. Past methods of addressing environmental problems, largely by controlling pollution through end-of-pipe approaches, have proven to be expensive and less effective. Today's successful companies are finding that pollution prevention often results in substantial cost savings and that performance, productivity, and even marketability are often enhanced by adopting environmentally friendly processes and technologies and considering DfE.

What Is DfE?

Design for the environment (DfE) is most commonly viewed as an adaptation of the design for "X" concept, where "X" represents a desired product characteristic (e.g., safety, durability) integrated as a process goal. In DfE initiatives, cost and performance as well as environmental considerations are an integral part of the design or redesign of the product.

The evolution of the pollution prevention philosophy caused many companies to "design for the environment" by directing their environmental efforts earlier in the production cycle, from clean-up and control technologies to better management to product redesign. Decisions made at the design or redesign stage affect a product's impact on worker and consumer safety, the risks and releases to human health and the environment, and the characteristics of the product's waste streams.

The EPA's DfE Program

The EPA's DfE program builds on the industry-pioneered DfE concept by striving to help businesses incorporate environmental considerations in all aspects of plant operation. One way in which the EPA accomplishes this goal is through voluntary partnerships with particular industry sectors in developing the information and tools needed to make environmentally informed choices. The EPA's DfE program also includes broad institutional projects aimed at changing general business practices, which include:

- working with the private sector to develop accounting tools that incorporate environmental costs and benefits into accounting and capital budgeting practices (total cost accounting)
- working with the National Science Foundation to encourage academic research into alternative methods for producing chemicals that reduce or eliminate the use or generation of toxic substances (the Benign by Design program)
- working with the insurance industry to encourage the incorporation of pollution prevention principles in the underwriting and risk management decision-making process
- working with the financial community to facilitate companies in financing pollution prevention initiatives
- establishing a National Pollution Prevention Center at the University of Michigan where curricula are being developed that incorporate pollution prevention, lifecycle analysis, and DfE principles into a variety of disciplines, including business, engineering, accounting, and marketing.

In DfE projects with businesses, trade associations, and stakeholders in specific industry segments, the EPA





helps the industry gather and develop the information and tools necessary to evaluate available or emerging alternative chemicals, processes, and technologies. It does this by taking advantage of the EPA's risk management methods and expertise. The DfE program can also provide other incentives for industry participation, including funding to develop and analyze critical information for individual companies and the general public regarding environmentally beneficial alternatives.

The DfE program is currently working with stakeholders in the PCB fabrication and assembly industries. The project's goals are consistent with the work underway in the EPA's Common Sense Initiative (CSI), a program in which EPA has brought together stakeholders in several other industries to identify opportunities for achieving cleaner, cheaper, and smarter environmental protection in six major areas: current and future environmental regulations, requirements reporting, environmental compliance, permitting, pollution prevention, and environmental technology.

Project Purpose

In April 1993, the research consortium Microelectronics and Computer Technology Corporation (MCC) spearheaded a study entitled "Life Cycle Assessment of a Computer Workstation." In this ground-breaking study, the EPA, the U.S. Department of Energy, and industry partners such as SEMATECH found that the production of PCBs accounts for 79% of the energy used, 95% of the water used, and 95% of the hazardous waste associated with computer manufacturing. The potential for improvement in these areas led the EPA's DfE program to include environmental and public interest groups in its working partnership with the printed circuit board industry.

As the underlying link between semiconductors, computer chips, and other electronic circuitry, PCBs are an irreplaceable part of many high-tech products. In the rapidly changing PCB industry, opportunities abound to integrate environmental objectives into emerging production processes and technologies. However, many manufacturers are small businesses who are unable to invest in expensive environmental analyses and process redesign. To facilitate the evaluation and implementation of affordable and environmentally beneficial alternatives, the EPA entered into a DfE program partnership to provide assistance to the entire PCB industry.

One short-term goal is to generate interest and participation in the DfE PCB project and to disseminate information on viable pollution prevention ideas that the industry can implement immediately. Over the long term, the project seeks to effect behavioral change to improve the competitiveness and environmental performance of PCB manufacturers. To reach these goals, the DfE Project Team will:

- evaluate and develop technical information on pollution prevention technologies that reduce compliance costs, environmental releases, risks to human health, and chemical and natural resource use
- develop industry and regulatory profiles that identify barriers to pollution prevention
- facilitate technology transfer among PCB companies to avoid duplication of effort and cultivate the use of alternatives.

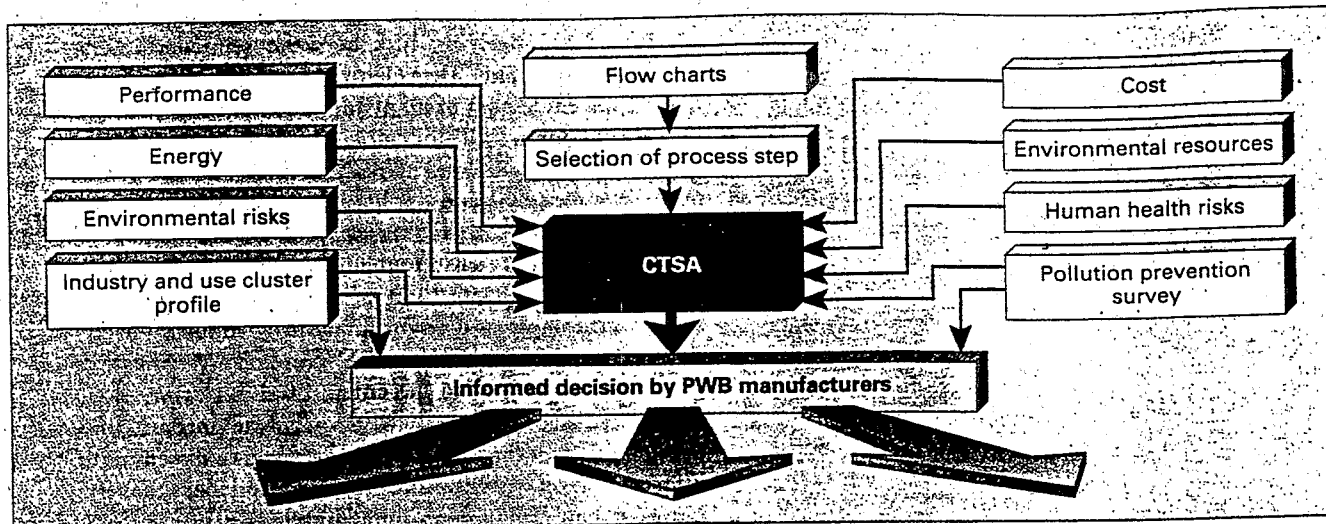
Successfully accomplishing these project tasks will help to increase the international competitiveness of the industry through enhanced efficiency and streamlined operations—two common by-products of pollution prevention.

Subject Areas

DfE's work with the PCB industry and other stakeholders is conducted within three project areas—technical studies, communication efforts, and implementation activities.

Technical Studies. In late 1994, the DfE Technical Workgroup mapped out the major steps in PCB fabrication and chose four major functional areas for further evaluation, each of which includes several process steps. The Workgroup then identified the chemicals used in existing and emerging process alternatives for each of the functional areas and conducted a preliminary assessment of environmental and human health risks associated with each area.

The DfE Project Team selected the functional area of making holes conductive (PTH) for detailed analysis in a Cleaner Technologies Substitutes Assessment (CTSA), to be conducted by the EPA and the University of Tennessee's Center for Clean Products and Clean Technologies. A CTSA contains information not only about the environmental impacts (e.g., releases to the



Information and tools that contribute to environmentally informed choices.

environment, hazardous waste generation, water and energy use, and comparative risk) of existing and emerging alternatives but also examines their cost and performance. As part of the assessment, performance demonstrations will be carried out to test the effectiveness of alternative technologies in real-world settings, providing crucial information about the cost and performance of the alternatives under various conditions. The information in the CTSA and other project documents will allow the PCB industry decision-makers to evaluate their existing processes and practices and identify viable, cost-effective pollution prevention options. The printed circuit board CTSA is expected to be completed by the summer of 1996.

The PCB Project Workgroup is also developing a number of other tools for use by the industry. The "Industry and Use Cluster Profile" contains information about the current economic status of the industry and the current methods by which PCBs are manufactured. It describes industry demographics, board types, market size, international trends and other industry characteristics. It also describes basic manufacturing steps and alternative technologies for each major process step.

A "Pollution Prevention Survey," being conducted by industry participants, will contain an in-depth analysis of pollution prevention technologies currently being used in the industry and data on chemical use, waste reductions, and the savings that have resulted from implementing the technologies. The EPA has also developed a document to help the industry assess the regulatory implications of current and alternative technologies titled, "Federal Environmental Regulations Potentially Affecting the Computer Industry".

Communication Efforts. Throughout the project, the EPA and project stakeholders will conduct outreach activities to promote the awareness of the project and to generate interest in the project's technical and information products. The Project Team has given

presentations at PCB trade shows, written articles for the trade press, distributed DfE information at booth exhibits, and created project fact sheets. The strategy developed by the Communications Workshop includes developing pollution prevention case studies that will provide practical information on substitute materials processes, technologies, and work practices. Based on CTSA information and successful pollution prevention experiences, the first two case studies are expected to be completed by May 1995.

Implementation Activities. An Implementation Workgroup will be established to provide assistance, and a certification program will be formed for individual PCB manufacturers who implement the alternative technologies identified in the CTSA. This Workgroup may also conduct additional demonstration projects and workshops, create videotapes, and develop other training materials.

How Can I Get More Information?

The DfE Project Team encourages all interested parties to participate in the project, either by joining the Technical or Communications Workgroups, by attending project meetings, or by asking that the EPA include them on the project mailing list. The next project meeting will be held in San Diego on May 4, 1995, in conjunction with IPC-Expo.

For more information about the DfE program, the DfE PWB Project, or to be added to the mailing list, contact EPA's Pollution Prevention Information Clearing House (PPIC), U.S. Environmental Protection Agency, 401 M St., S.W. (3404), Washington D.C. 20460. Tel. 202/260-1023, fax -0178.

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Katherine M. Hart and Deborah L. Boger are environmental protection specialists with EPA's Design for the Environment Staff, Washington D.C. Michael A. Kerr is the environmental safety & health manager at Circuit Center Inc., Dayton OH.

