



Design for the Environment Printed Wiring Board Project



What Is Design for the Environment?

EPA's Design for the Environment (DfE) Program is a voluntary initiative that forms partnerships with a variety of stakeholder groups in an effort to:

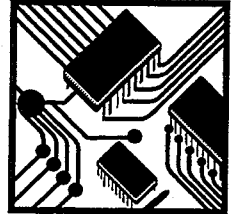
- Encourage businesses to incorporate environmental concerns, in addition to the traditional criteria of cost and performance, into their decisions.
- Effect behavior change to facilitate continuous environmental improvement.

To accomplish these goals, the program uses EPA's expertise and leadership to evaluate the human health and environmental risks, performance, and cost of traditional and alternative technologies, materials, and processes. DfE disseminates information on its work to all interested parties and helps businesses implement cleaner technologies identified through the program.

The program has formed cooperative partnerships with the following industries:

- Printed wiring board
- Computer display
- Printing
- Garment and textile care
- Auto refinishing
- Industrial/institutional laundry

Making the Connection



Why Is EPA Working With the PWB Industry?

Printed wiring boards (PWBs), the underlying link between semiconductors, computer chips, and other electronic components, are an irreplaceable part of many high-tech products in the electronics, defense, communications, and automotive industries. The wet chemical processes used in PWB manufacturing, however, generate a significant amount of hazardous waste, require a substantial amount of water and energy, and use chemicals that pose potential environmental and health risks. In addition, the most commonly used PWB finishing technologies, hot air solder leveling (HASL) and electroplated tin-lead, pose potential health and environmental risks due to their use of lead. These processes also generate excess quantities of solder that must be recycled.

The industry is committed to making pollution prevention a priority; however, many PWB manufacturers are small- to medium-sized businesses that cannot afford to develop independently the data needed to redesign their processes. To facilitate the evaluation and implementation of alternative technologies that reduce health and environmental risks and production costs, EPA's Design for the Environment (DfE) Program entered into a voluntary partnership with the PWB industry and other interested parties.

What Are the Project's Goals?

The DfE PWB Project encourages companies to implement technologies that will improve their environmental performance and competitiveness. The project team, in close cooperation with the Institute for Interconnecting and Packaging Electronic Circuits (IPC), is developing and analyzing technical information on pollution prevention technologies that reduce human and environmental risks, hazardous waste generation, compliance costs, and chemical and natural resource use.

What Work Is Being Conducted?

PWB Project work is focused in three main areas: gathering, generating, and analyzing technical data; communicating project and technical information; and promoting the implementation of cleaner technologies through education and assistance.

Technical Studies

In 1995, the DfE PWB Project Technical Workgroup chose one major step in PWB manufacturing—making drilled through-holes conductive (MHC)—for detailed analysis in a Cleaner Technologies Substitutes Assessment (CTSA). A CTSA is a comprehensive analytical tool used to evaluate health and environmental risks, performance, and costs of alternative materials, processes, and technologies. The draft MHC CTSA was completed in 1997 (see bottom of back page to order).

As part of the MHC CTSA, seven MHC technologies (including the standard nonconveyORIZED electroless copper technology and six alternative direct metallization technologies) were tested for performance characteristics in real-world settings. EPA recruited 26 facilities in the United States and



Europe for testing purposes. Each company processed three standard boards through its MHC process line. The boards were then sent to one site to complete the final manufacturing steps and were tested for electrical and mechanical reliability.

The results demonstrate that when implemented correctly the alternative technologies perform as well or better than the nonconveyorized electroless copper. The alternative technologies also are more economical and use less energy and water. Risk characterization studies conducted as part of the CTSA suggest that the alternative technologies also pose lower occupational risk. Risks could not be assessed, however, for all of the chemicals used in each MHC technology because some suppliers would not provide proprietary formulation data.

In 1997, the project team began a second CTSA to evaluate lead-free alternatives to the most commonly used surface finishing technologies: HASL and electroplated tin-lead. Using HASL as the baseline technology, the second CTSA is evaluating the performance, risk, and cost of HASL and several other technologies, including thick and thin organic solder protectorates, immersion tin, immersion silver, electroless palladium directly over copper, and electroless nickel/immersion gold.

To gauge performance, the alternative surface finishes are applied to test boards containing a variety of circuitry. Next, the board circuit performance is assessed under applicable environmental stresses. The boards also are evaluated through a series of reliability tests including thermal shock, thermal cycle, mechanical shock, and vibration. EPA expects that the study results (scheduled for release in 1999) will generate interest in the implementation of cleaner, cost-effective surface finish technologies by PWB manufacturers.

In addition to the CTSA work, industry partners conducted a survey to obtain information about the use of pollution prevention technologies in the PWB industry (*Printed Wiring Board Pollution Prevention and Control: Analysis of Survey Results*, EPA744-R-95-006). A 1998 survey update report will contain data on waste and chemical use reduction achieved through implementing these technologies. The project team has also compiled information on PWB markets, products, technology trends, and current manufacturing methods (*Printed Wiring Board Industry and Use Cluster Profile*, EPA744-R-95-005) as well as information on federal environmental regulations pertaining to the electronics industry (*Federal Environmental Regulations Affecting the Electronics Industry*, EPA744-B-95-001). All project documents can be obtained by contacting the Pollution Prevention Information Clearinghouse (see below, at right).

Communication Efforts

Throughout the PWB Project, EPA and the project stakeholders have conducted outreach activities to promote awareness of the project and to generate interest in the project's technical and information products. These communication efforts also have helped to identify other pollution prevention opportunities within the industry, in addition to the alternative technologies evaluated in the CTSAs. Stakeholders have given presentations at PWB trade shows, written articles for the PWB trade

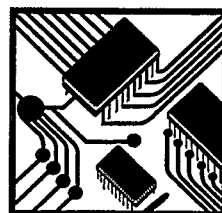
press, distributed DfE information products at booth exhibits, developed project fact sheets, and created a web site for the project. In addition, the Communication Workgroup has produced eight case studies on pollution prevention and environmental management initiatives undertaken by PWB manufacturers. The case studies provide practical information on workplace practices, equipment, technologies, and management systems that result in risk reduction and cost savings. The studies are available from the Pollution Prevention Information Clearinghouse (see below).

Implementation Efforts

The PWB Project Implementation Workgroup provides education and assistance to individual PWB manufacturers and encourages them to consider implementing the cleaner technologies identified in the project. The workgroup has accomplished the following:

- Developed and published a guidance document to help PWB manufacturers implement alternative MHC technologies (*Implementing Cleaner Technologies in the Printed Wiring Board Industry: Making Holes Conductive*, EPA744-R-97-001). The document contains first-hand information about manufacturers' experiences with these technologies.
- Conducted seminars in seven cities nationwide to present the results of the MHC CTSA.
- Developed a web site that contains all documents generated by the project and links to other related industry sites.

The Silicon Valley Toxics Coalition has helped to involve local community and government organizations in the project. In addition, total cost assessment software is being developed to help companies analyze the financial benefits of switching to cleaner technologies. The National Institute for Standards and Technology provided funding to develop the software, which is undergoing beta testing.



How Can I Get More Information?

To obtain project documents or learn more about EPA's DfE Program or DfE PWB Project, contact:

Pollution Prevention Information Clearinghouse
U.S. Environmental Protection Agency
401 M Street, SW. (7409)
Washington, DC 20460
Telephone: 202 260-1023
Fax: 202 260-4659
E-mail: ppic@epa.gov

You may also visit the DfE web site at www.epa.gov/dfe or the DfE PWB Project web site at www.ipc.org/html/framesetpolicy.html.