Chapter 1

INTRODUCTION

This publication presents the methods and resources needed to conduct a Cleaner Technologies Substitutes Assessment (CTSA), a methodology for evaluating the comparative risk, performance, cost, and resource conservation of alternatives to chemicals currently used by specific industry sectors. The CTSA methodology was developed by the U.S. Environmental Protection Agency (EPA) Design for the Environment (DfE) Program, the University of Tennessee Center for Clean Products and Clean Technologies, and other partners in voluntary, cooperative, industry-specific pilot projects.

This publication is designed for trade associations, businesses, citizen groups, government agencies, or other stakeholders interested in learning about, initiating, or participating in a CTSA. The goal is to provide the CTSA methodology to anyone who can benefit from the increased efficiency and reduced environmental risk that results from using a cleaner product, process, or technology. It presents sources of data, analytical models, and previously published guidance that can be used in a CTSA. A companion publication, Design for the Environment: Building Partnerships for Environmental Improvement *(EPA, 1995a), describes other aspects of DfE industry projects, including how DfE projects are organized and how DfE partnerships disseminate project results.*

The 1990s have ushered in a revolutionary new approach to environmental protection: together with traditional criteria like performance, quality and cost, business leaders are taking the environment into account in the design and redesign of products and processes. This new focus on the environment helps create cleaner products and technologies that minimize environmental impacts throughout their life cycles[1] while fulfilling their function effectively, efficiently, and economically. Businesses are finding that by designing products and processes with the environment in mind, they can reduce the environmental impacts of the products and services our society now enjoys, which improves profitability and the quality of life while strengthening the economy.

An important change has also been taking place in our national strategy for protecting the environment. Through an array of partnership programs, EPA is demonstrating that voluntary goals and commitments achieve real environmental results in a timely and cost-effective way. In addition to traditional, regulatory approaches to environmental protection, EPA is building cooperative partnerships with a variety of groups, including large and small businesses, public-

[1] As referred to here, the life cycle of a product or process encompasses extraction and processing of raw materials, manufacturing, transportation and distribution, use/re-use/maintenance, recycling, and final disposal.

interest groups, state and local governments, universities, and trade associations. Among others, these collaborative partnerships include the DfE Program, the 33/50 Program, WasteWi$e, Green Lights, Energy Star, the Common Sense Initiative, and Project XL.

The results of these efforts are impressive. Thousands of organizations are working cooperatively with EPA to set and reach environmental goals such as conserving water and energy, and reducing greenhouse gases, toxic emissions, solid waste, indoor air pollution, and pesticide risk. Program partners are making pollution prevention a central consideration in doing business and working cooperatively to provide all stakeholders with effective tools to address environmental issues. And these partners are achieving measurable environmental results often more quickly and with lower costs than would be the case with regulatory approaches. EPA views these partnerships as key to the future success of environmental protection.

WHAT IS EPA'S DESIGN FOR THE ENVIRONMENT PROGRAM?

The DfE Program in EPA's Office of Pollution Prevention and Toxics was created in 1991 to promote the incorporation of environmental considerations into the design and redesign of products, processes, and technical and management systems. By developing and providing businesses with information on designing for the environment, the program aims to encourage pollution prevention and efficient risk reduction in a wide variety of activities. Under the DfE Program, EPA works through voluntary partnerships with industry, professional organizations, state and local governments, other federal agencies, and the public, including environmental and community groups.

The DfE Program aims to turn pollution prevention into both a corporate and environmental asset, by helping businesses incorporate environmental considerations into the product or process design and decision-making process. The program has three goals:

- Encourage voluntary reduction of the use of specific hazardous chemicals by businesses, governments, and other organizations through actual design or redesign of products, processes, and technical and management systems.

- Change the way businesses, governments, and other organizations view and manage for environmental protection by demonstrating the benefits of incorporating environmental considerations into the up-front design and redesign of products, processes, and technical and management systems.

- Develop effective voluntary partnerships with businesses, labor organizations, government agencies, and environmental/community groups to implement DfE projects and other pollution prevention activities.

DfE projects include three distinct project types:

- *Institutional projects* are aimed at changing specific aspects of general business practices in order to remove barriers and provide positive incentives for businesses and other organizations to undertake environmental design and pollution prevention efforts. These include environmental accounting, curriculum development, green chemistry, and insurance projects.

- Cooperative *industry projects* are joint efforts with trade associations, businesses, public-interest groups, and academia to assist businesses in specific industries to select more environmentally-sound products, processes and technologies, especially through provision of easily-accessible information on the comparative risks, performance, and costs of alternatives to currently used chemicals.

- Cooperative *government projects* are joint efforts with government organizations to promote the use of environmentally-preferred products by organizations. The General Services Administration Products Project is one such project to help implement the President's Executive Order 12873: "Federal Acquisition, Recycling and Waste Prevention."

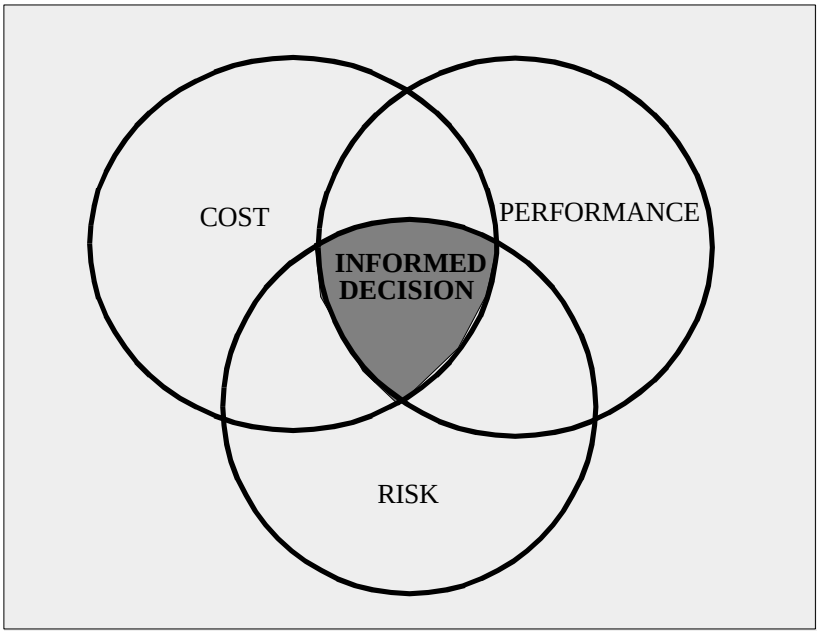
This publication describes methods for performing the technical work of DfE industry projects.

WHAT IS A CLEANER TECHNOLOGIES SUBSTITUTES ASSESSMENT?

The CTSA *methodology* is a means of systematically evaluating the comparative human health and environmental risk, competitiveness (e.g., performance, cost, etc.) and resource conservation of traditional and alternative chemicals' manufacturing methods and technologies. A CTSA *document* is the repository for the technical information developed by a DfE industry project, including risk, performance, cost, and resource conservation data. Project partners in DfE pilot projects with the printing, dry cleaning, and printed wiring board industries have focussed the project's technical work and the CTSAs for these industry sectors by evaluating a particular group of traditional and nontraditional (i.e., unusual, new, or novel) substitutes or alternatives that can be used to perform a key function within a given industrial process. In DfE terminology, such a project focus area is called a *use cluster*. A use cluster is a product- or process-specific application in which a set of chemical products, technologies, or processes can substitute for one another to perform a particular function.

A CTSA does not recommend alternatives. Instead, the goal is to promote informed business decisions that integrate risk, performance, and cost concerns by providing businesses with easily accessible information (Figure 1-1). The DfE project team uses data from the CTSA to develop fact sheets and summary reports designed to reach individual users and suppliers who may not have the resources to develop the information on their own.

FIGURE 1-1: THE DfE PROCESS PROMOTES INFORMED BUSINESS DECISIONS THAT INTEGRATE RISK, PERFORMANCE, AND COST CONCERNS



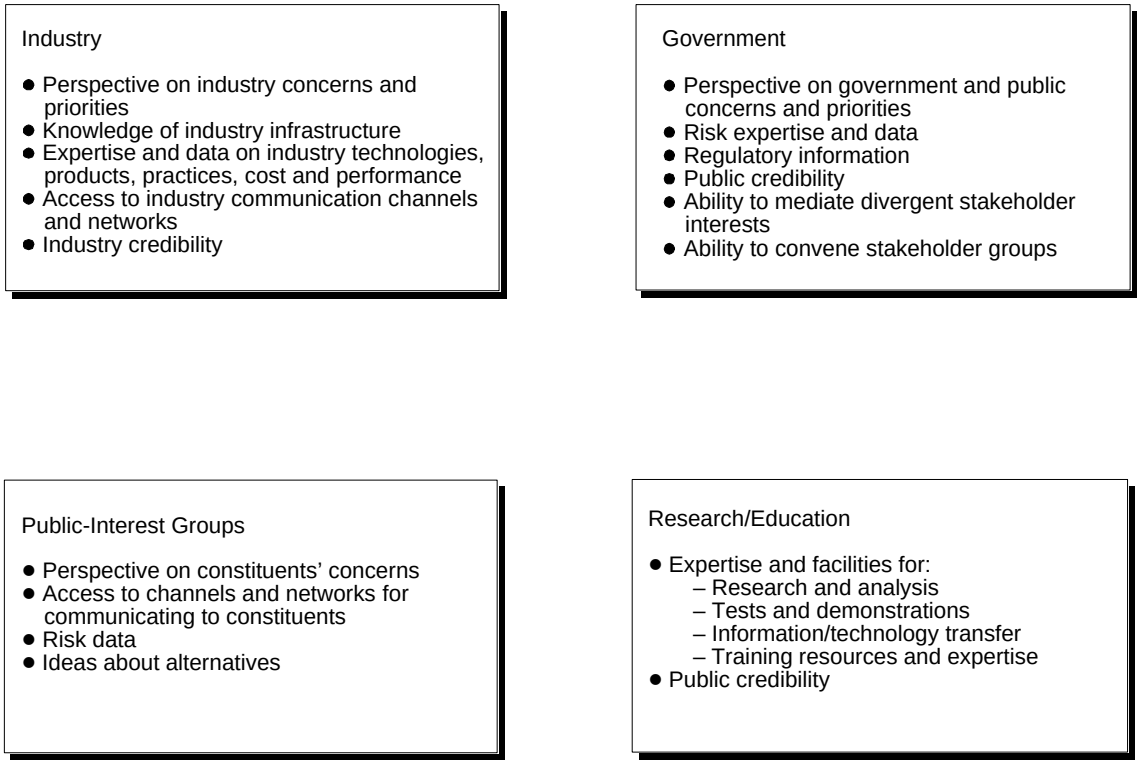
WHO PARTICIPATES IN A CLEANER TECHNOLOGIES SUBSTITUTES ASSESSMENT?

The DfE process catalyzes voluntary environmental improvement through stakeholder partnerships. The technical work of a DfE industry project typically involves participants from various stakeholder communities, including industry (users and suppliers of chemical products, equipment or technologies), government (federal, regional, state, local), public-interest groups (environmental, environmental justice, labor, consumer, etc.), and research and education organizations (non-profit research centers, universities, technical schools, etc.). Each of these stakeholder communities brings unique and valuable resources and perspectives to the project (Figure 1-2). By involving representatives from each of these stakeholder communities, a DfE technical workgroup can accomplish the following:

- Gain the necessary expertise to perform the technical work.
- Ensure the quality, credibility, and utility of the projects technical results.
- Provide a solid foundation for long-term continuous improvement.

Stakeholder partnerships promote consensus options or solutions to address complex environmental problems that are far more effective and productive than those obtained by any group acting alone.

FIGURE 1-2: CONTRIBUTIONS OF DfE PARTNERS



Source: Design for the Environment: Building Partnerships for Environmental Improvement (EPA, 1995a).

Past CTSA project teams have been convened by EPA together with trade associations, industry research organizations, or other concerned representatives of the business community seeking to reduce the environmental impacts of their products and manufacturing processes. A goal of this publication, however, is to provide businesses, public-interest groups, and other stakeholders the information they need to perform comparative evaluations with or without the direct participation of EPA.

WHY PARTICIPATE IN A CLEANER TECHNOLOGIES SUBSTITUTES ASSESSMENT?

In the U.S. the problems with chemical pollution became particularly notable at the end of World War II when petroleum supplies were plentiful and the development of new products and technologies flourished. By the 1960s it was apparent that unchecked industrial and municipal discharges were seriously degrading the country's natural resources. The U.S. Congress responded to the increasing environmental degradation by passing the Clean Water Act in 1970, the same year EPA was formed. Smog-filled cities prompted Congress to pass the Clean Air Act the next year. These statutes led to other such statutes (Resource Conservation and Recovery Act [RCRA], Toxic Substances Control Act [TSCA], etc.) and a regulatory system focussed on single environmental medium (air, water, land), end-of-pipe, command-and-control environmental protection.

An unforeseen consequence of command-and-control regulation is that pollutants are often shuffled from one environmental medium to another, with little net environmental improvement. In other cases, regulation has caused industry to substitute materials which in turn may become subject to regulation. While our current regulatory system has reduced risk and improved the environment, it has in some cases been inefficient and unnecessarily costly in achieving environmental goals.

As a result, despite billions of dollars spent on pollution control equipment, in 1992 U.S. industries still released over three billion tons of toxic chemicals to the environment and spent $30 billion on environmental compliance. These persistent problems and costs have led many in industry to make voluntary changes to prevent pollution and to re-evaluate the processes and materials they use and the products they manufacture. DfE partnerships developed the CTSA methodology described in this publication to help business decision-makers achieve the tangible benefits that result from using a cleaner product or technology:

- *CTSA results can improve businesses' bottom line:* A CTSA provides a systematic methodology for evaluating voluntary changes to prevent pollution and reduce risk. Pollution prevention often lowers cost by reducing the amount of materials used in production processes, the amount of waste streams that must be treated and disposed, and by improving worker health and safety. A CTSA provides the necessary information for companies to make informed business decisions that may reduce their regulatory burden

or potential liability costs or avoid regulation altogether. Also, companies that make voluntary changes to prevent pollution or reduce risk may enjoy increased acceptance and market share from environmentally conscious consumers.

- *CTSA projects promote effective, efficient change through constructive partnerships:* Businesses that participate in voluntary DfE initiatives demonstrate their commitment to continuous environmental improvement. The result is effective and efficient change founded in the requisite expertise to identify innovative solutions. Company employees involved in day-to-day operations ensure the project team understands the process constraints that need to be considered in the design of environmentally preferable options. Stakeholder communities outside the company provide unique perspectives and ideas to broaden the evaluation beyond standard industry concerns.

  Environmental evaluation and setting priorities for change involve value judgements. No simple metric exists that encompasses the range of environmental issues or addresses the concerns of all stakeholders. By bringing together stakeholders who represent different interest groups, a project team better ensures the credibility and acceptability of CTSA results. Instead of being adversaries, DfE stakeholders work together to find common ground and achieve shared, mutually beneficial goals. This leverages the resources that enable DfE partners to accomplish far more together than would be possible working separately.

- *CTSA results promote environmental competitiveness in a global marketplace:* Companies and businesses throughout the world are not practicing proactive environmental improvement to remain competitive in today's global marketplace. In addition to the benefits of an improved company image, businesses are finding that they can no longer afford to waste energy or other precious resources or pollute the environment.

  For example, the German government has undertaken an aggressive regulatory program to ensure that German industries remain competitive in today's marketplace. Klaus Töpfer, Germany's Environment Minister, recently outlined some of the thinking that lies behind the German "take-back" policies.[2] Töpfer suggests that the markets of the future will be for products that minimize energy use and waste production. Germany is attempting to stimulate industry to develop the technology that will be needed for these future markets by sending economic signals to industry that cause industry to internalize environmental costs (Center for Clean Products, 1995).

  In short, government, industry, and public interest groups alike are recognizing that voluntary changes to reduce risks by preventing pollution are good for business *and* good for the environment.

[2] "Take-back" regulations would require the manufacturer of certain products to take their products back from the consumer at the end of their useful lives and recycle the materials, preferably into new products.

WHAT IS IN THIS PUBLICATION?

This publication is organized into two parts. Part I contains three chapters that provide an overview of the CTSA process. Following this introduction, Chapter 2 describes the preparatory steps that a DfE project team should perform before embarking on a CTSA. Chapter 3 outlines the types of data and analyses performed in a CTSA.

Part II of this publication describes in detail each of the data sets collected and the analyses conducted in a CTSA, including the following:

- Goals or uses of the data.
- Basic steps to collect the data or complete an analysis.
- Flow of information into and out of each analysis.
- References for data sources, analytical models, and previously published guidance.

Chapter 4 describes in more detail the types of information contained in Part II. Chapter 5 describes the data sets and analyses concerning basic chemical properties and the products or process description. Chapter 6 describes the risk-related analyses. Chapter 7 presents evaluation criteria traditionally related to competitiveness, such as performance and cost. Chapter 8 addresses conservation issues, including energy impacts, and resource conservation. Chapter 9 discusses additional environmental improvement opportunities, including how to conduct a pollution prevention opportunities and control technologies assessment. Chapter 10 describes how all of this information is brought together to evaluate the trade-off issues and provide interpretive decision information summaries that enable businesses to choose among alternatives.