United States
Environmental
Protection

Office of Enforcement and
Compliance Assurance
Washington, DC 20460

July 1995

EPA 300-B-95-008

EPA

Federal Facility Pollution Prevention Project Analysis:

A Primer for Applying Life Cycle and Total Cost Assessment Concepts

This document was prepared by the Federal Facilities Enforcement Office (2261) in the Office of Enforcement and Compliance Assurance. Consulting assistance was provided by Science Applications International Corporation (SAIC).

For additional copies of this document, please contact:

Pollution Prevention
Information Clearinghouse

U.S. EPA (3404)
401 M Street, SW
Washington, DC 20460

Tel: (202) 260-1023
Fax: (202) 260-0178

ACKNOWLEDGMENTS

EPA's Federal Facilities Enforcement Office, Planning, Prevention, and Enforcement Division gratefully acknowledges the contributions of the following agencies and individuals that provided information and comments:

Department of Defense

Colonel. L. Dean Fox
Major Alec Earle
Major Al Trivette
U.S. Air Force Civil Engineering

Mary Grafton
Defense Analysis and Studies Office

CDR Marc McConahy
Office of Assistant Secretary of Navy
(Installations & Environment)

Dr. Get Moy
Assistant Deputy Under Secretary of Defense
(Pollution Prevention)

David Price
Office of the Chief of Naval Operations

Research Triangle Institute Center for Economics Research

Keith A. Weitz

Tellus Institute for Resource and Environmental Strategies

Dr. Deborah Savage
Dr. Allen White

U.S. Department of Energy

Jane Powers

Staff from Department of Energy Office of Defense Programs,
Idaho National Engineering Laboratory,
Lawrence Berkeley Laboratory, and Sandia National Laboratories

U.S. Environmental Protection Agency

James Bridges
Maryanne Curran
Paul Shapiro
Office of Research & Development/Risk Reduction Engineering Laboratory

Jim Craig
Holly Elwood
Eun-sook Goidel
Dr. Martin Spitzer
Office of Pollution Prevention and Toxics

Maureen Sullivan

Lynn Vendinello
Office of Enforcement and Compliance Assurance

Lee Otis
Region 10

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Chapter 1
INTRODUCTION TO PROJECT ANALYSIS OF POLLUTION PREVENTION PROJECTS

"...Federal facilities will set the example for the rest of the country and become the leader in applying pollution prevention to daily operations, purchasing decisions and policies... By stopping pollution at its source the Federal government can make a significant contribution to protecting the public health and our environment."

President Bill Clinton

BACKGROUND

On August 3, 1993, President Clinton signed Executive Order 12856, entitled *Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements.* This order requires each Federal Agency to:

- Develop an Agency-wide pollution prevention strategy which commits the agency to source reduction and emphasizing pollution prevention as the primary means of achieving and maintaining compliance with Federal, State, and local environmental requirements.

- Establish a voluntary goal to reduce total releases and off-site transfers of toxic chemicals or toxic pollutants by 50 percent.

- Develop facility-level pollution prevention plans.

- *Apply Life Cycle Analysis and Total Cost Accounting principles, to the greatest extent practicable, when evaluating pollution prevention opportunities.*

By signing this Executive Order (EO) and emphasizing the importance of pollution prevention in environmental management, President Clinton has challenged the Federal government to publicly lead by example by applying pollution prevention in the management of its facilities and in its acquisition practices. By preventing pollution, the Federal government not only protects the environment and the public's health, but also saves the taxpayers' money by reducing pollution control costs and long-term liability for expensive cleanups.

PURPOSE OF THIS DOCUMENT

This guidance manual is designed to assist decision makers at Federal facilities in complying with the requirements of Section 4-404 of EO 12856. That section requires Federal facilities to apply Total Cost Accounting and Life Cycle Analysis, to the greatest extent practicable, when evaluating pollution prevention opportunities. Specifically, this manual introduces and describes several analytical tools that can be used to help users identify and quantify the financial and environmental benefits of pollution prevention projects and alternative opportunities. This information can then be used to evaluate and justify pollution prevention projects.

This manual is written primarily for the individual who makes decisions regarding project funding at Federal facilities and for those who recommend and evaluate potential alternatives. However, any Federal employee involved in the procurement process can use the concepts in this manual to more accurately evaluate the full economic and environmental impacts of projects under consideration.

The information provided in this document will help Federal facility managers choose the best pollution prevention practices and support projects amid competing resource demands. The analytical tools to evaluate and support pollution prevention opportunities described in this manual fall into two categories: Economic Analysis and Environmental Analysis. These two categories are discussed separately, but in reality they are two integral components of any project review process.

The financial and environmental techniques discussed in this manual expand upon traditional project analysis to include:

- Associated direct and indirect cost and environmental impacts;

- Associated financial and environmental consequences occurring both "upstream" and "downstream;" and

- The environmental impacts throughout all media (air, water, soil) resulting from competing project alternatives.

Finally, this manual is not intended to be a comprehensive "how-to" text presenting new research on financial and environmental project review concepts. Rather, it provides an introduction and a framework for using these important and evolving tools. Readers who seek more detailed information should refer to the documents listed in Appendix B.

WHAT IS POLLUTION PREVENTION?

Over the past several years, a new environmental protection concept and strategy has been developed that focuses on eliminating or modifying activities that result in adverse environmental impacts. This concept, known as pollution prevention, has gained widespread support, especially in Federal agencies, as a means to meet or exceed environmental goals and standards and to reduce resources being spent to clean up pollution. Pollution prevention is defined in the Pollution Prevention Act of 1990 as:

> *...any practice which reduces the amount of a hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and any practice which reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.*

Pollution prevention, referred to here as source reduction, represents the first step in a hierarchy of options for managing waste. Exhibit 1-1 depicts this Environmental Management Hierarchy. Source reduction is assigned the highest priority because it eliminates or reduces wastes at the source of generation. Recycling is the next preferable approach, because it involves the reuse or regeneration of materials that would otherwise become wastes into usable products. Treatment and disposal are viewed as last-resort measures, since they do not

Exhibit 1-1
ENVIRONMENTAL MANAGEMENT HIERARCHY

SOURCE REDUCTION

RECYCLING

TREATMENT

DISPOSAL

involve the reduction or reuse of wastes.

Pollution prevention refers to the use of materials, processes, or practices that eliminate or reduce the quantity and/or toxicity of wastes at the source of generation. It includes practices that eliminate the discharge of hazardous or toxic chemicals to the environment and protect natural resources through conservation and improved efficiency. Further, pollution prevention encourages reduction in the use of hazardous materials, energy, and water as the best approach to reducing environmental impacts. Exhibit 1-2 lists the major types of pollution prevention activities.

Exhibit 1-2
POLLUTION PREVENTION ACTIVITIES

Process Efficiency Improvements

- Perform the same task with less energy or materials by designing new systems or modifying existing ones.

Material Substitution

- Replace hazardous chemicals with less toxic alternatives of equal performance.

Inventory Control

- Improve materials management practices to prevent product expiration or damage.

Preventive Maintenance

- Routinely check storage areas and containers for leaks and spills.
- Maintain equipment in good working order to extend useful life.

Housekeeping

- Keep work areas neat and organized to reduce the chance of spills or releases of chemicals.

Training

- Train employees in pollution prevention techniques.

Pollution prevention differs from the traditional approach to waste management not only because it seeks to avoid the generation of waste or environmental releases, but also because it stresses the relationship between air, land, and water to view the environment as a whole, rather than as individual segments. Within this framework, pollution prevention aims to eliminate or reduce waste released to land, air, and/or water without transferring or shifting pollutants between environmental media.

BENEFITS OF POLLUTION PREVENTION

Practicing pollution prevention may result in a number of economic benefits These benefits can include fewer Notices of Violation (NOVs) and fewer costs associated with reporting, compliance, penalties, and environmental liability associated with hazardous waste generation and use. Pollution prevention can also reduce the costs associated with waste management. Costs that may be reduced include expenditures for raw materials, waste handling and storage, transportation and disposal, training, management overhead, and emergency response. The likelihood of incurring significant future environmental costs, such as remediation activities, can also be reduced by using pollution prevention approaches.

In addition, pollution prevention can produce positive health and environmental benefits. Minimizing the use of hazardous materials creates a safer work place and reduces the need for expensive health and safety protection devices. A safer work place will also improve employee morale. In addition, the reduction in hazardous materials use can decrease the volume of toxic substances released to the environment from spills, leaks and air emissions that affect human health and the environment. Exhibit 1-3 presents a list of the most significant pollution prevention benefits.

Although pollution prevention techniques can result in many benefits, many Federal facilities have not yet embraced pollution prevention projects. This is due, in part, to facility environmental funding historically being focused upon regulatory compliance activities. In addition, traditional governmental economic and environmental analysis tools do not always consider the total costs, savings, and environmental benefits from pollution prevention. In short, these traditional analysis tools often do not provide adequate justification to recommend pollution prevention opportunities. This manual introduces tools for evaluating and justifying pollution prevention projects to overcome this barrier.

Exhibit 1-3

POLLUTION PREVENTION BENEFITS

Operating Costs

- Reduced waste storage, handling, treatment, and disposal costs
- Avoided costly alternative treatment technologies
- Reduced raw material and feedstock purchasing costs
- Lowered housekeeping costs
- Reduced operating costs through better management and production efficiencies
- Reduced usage of energy, water and other resource needs

Liability/Risk

- Decreased regulatory reporting requirements and compliance costs
- Reduced liability for environmental problems at both on-site and off-site treatment, storage, and disposal locations
- Reduced work related injuries and worker exposure to hazardous materials

Facility Image

- Improved community relations
- Perceived public health/environmental benefits

HOW DO YOU EVALUATE POLLUTION PREVENTION PROJECTS?

This guidance manual introduces Federal facility environmental managers to the tools necessary to more fully evaluate both the environmental effects and economic impacts of current operations, pollution prevention opportunities, and competing project alternatives. Specifically, the manual outlines the key concepts and procedures involved in using economic and environmental project review tools. While these tools can be used to evaluate current operations and virtually any type of project, they are described in this manual in the context of evaluating and supporting pollution prevention projects.

To effectively use the economic and environmental analysis tools described in this document when evaluating pollution prevention opportunities, it is necessary to apply these tools to current operations as well as other project options under consideration. In this way, greater understanding of the financial and the environmental effects can be gained and can be compared on an equal basis.

Estimating Economic Performance

Economic analysis is the most commonly used method to determine how scarce resources should be allocated. An accurate estimate of the costs associated with the development and use of a product or process is central to the internal decision making and strategic planning process. Pollution prevention projects must compete on equal footing with other funding requests.

The easiest and most common economic evaluation is one that compares the up-front purchase price of competing project alternatives. However, the up-front purchase price is typically a poor measure of a project's total cost. Costs such as those associated with maintainability, reliability, disposal/salvage value, and training/education must also be accounted for in the financial decision making process.

This guidance manual provides Federal facility decision makers and their advisors with an introduction to the tools to expand upon traditional economic analysis processes to identify more of the costs associated with a particular operation or process at a facility. The approach discussed in this guidance manual is designed to allow Federal facility managers to expand their traditional economic analysis framework by adding new cost elements to existing modeling techniques. This approach gives flexibility to the economic analysis process and allows each analysis to be tailored in scope and detail to reflect both available data and specific project review needs. Further, basic cost data already embedded in existing facility-level models can be used to minimize the effort needed to secure required data.

Estimating Environmental Consequences

In addition to economic performance, the environmental consequences of current practices and alternative opportunities should be factored into project review processes. When environmental consequences are considered, the pollution prevention alternatives can be assigned appropriate weight. Through this process, project opportunities that reduce one type of pollution by transferring the environmental impacts to another media (e.g., from water to atmospheric releases) can be identified and eliminated.

Environmental analyses can be used to examine environmental impacts along various points in the life cycle of the product, process, or activity. This may include extraction and processing of raw materials, manufacturing, transportation and distribution, use/re-use/maintenance, recycling, and final disposal. Environmental analyses, like economic analyses, can be tailored in scope and detail to reflect both available data and specific project review needs.

FORMAT OF THIS GUIDANCE MANUAL

The remainder of this guidance manual provides more specific guidance and application examples using each of the pollution prevention tools discussed above. Chapter 2 presents economic analyses, and Chapter 3 discusses environmental analyses. Both of these chapters provide an introduction to the basic analysis procedure and include worksheets that illustrate how the concepts can be applied. Chapter 4 discusses incentives, potential challenges and possible solutions to expanding investment analysis practices. A glossary of terms, a list of additional resources, and a reader response survey are located at the end of the manual in Appendices A, B, and C, respectively.

Chapter 2
TOTAL COST ASSESSMENT FOR POLLUTION PREVENTION

INTRODUCTION

This chapter is designed to assist Federal facility managers in identifying a broader and more accurate array of economic costs associated with current operations and with alternative project opportunities. These tools will help uncover areas of cost savings that result from pollution prevention projects that are often overlooked in traditional costing processes. With these tools, managers will be better equipped to answer the questions: "Does pollution prevention pay? And if so, how much?"

The chapter first discusses how traditional project analysis procedures can be expanded upon to more accurately reflect the economic costs and benefits of pollution prevention activities. Next, a worksheet with step-by-step instructions is provided to illustrate how these new concepts can be used. Together, this discussion will provide facility managers with the framework necessary to begin using economic analysis principles to more accurately evaluate the financial viability of pollution prevention projects.

WHAT IS ECONOMIC ANALYSIS?

Economic analysis involves tabulating the financial costs, revenues, and savings that a project is expected to generate. These estimates provide the data necessary to evaluate the economic advantages of competing projects. All Federal agencies require some form of financial performance analysis as part of the investment decision making process.

Unfortunately, economic analysis methods historically have minimized or ignored the economic benefits of pollution prevention projects by incorporating too few cost areas in the analysis and by examining costs over too short of a period of time. Not surprisingly, methods to improve economic justification for pollution prevention projects involve addressing these shortcomings.

Definitions And Terms

Over the last few years, researchers and managers working to promote pollution prevention have been developing techniques to evaluate projects that account for the economic benefits of pollution prevention. Several systems and models have been developed, and numerous terms are currently used to define these systems. These systems and models all involve expanding the traditional project evaluation methods to address the issues stated in this chapter. For the sake of clarity, the following section provides a short description of three approaches currently being advocated in the Federal government. These definitions were developed by the United States Environmental Protection Agency (EPA). Many facility managers may be familiar with these approaches, yet call them by a different name.

Total Cost Accounting. Total Cost Accounting, also referred to as Full Cost Environmental Accounting, is used in management accounting to represent the allocation of all direct and indirect costs to specific products, product lives, or operations.

Total Cost Assessment. Total Cost Assessment has come to represent the process of integrating environmental costs into capital budgeting analyses. It has been defined as the long-term, comprehensive financial analysis of the full range of costs and savings of an investment experienced by the organization making the investment.

Life Cycle Cost Assessment. Life Cycle Cost Assessment represents a systematic process for evaluating the life cycle costs of a product, product line, process, system, or facility from raw material acquisition to disposal by identifying environmental consequences and assigning monetary value.

Additional definitions for commonly used terms can be found in Appendix A.

P2/Finance

P2/Finance is a pollution prevention financial analysis and cost evaluation software program and users guide designed to help managers identify and calculate the costs associated with existing operations and potential investments. The spreadsheets contained within P2/Finance prompt users to enter cost and savings data in a broad range of categories. Once data is entered, P2/Finance calculates and reports cost data, annual cash flows, and projected financial performance using a variety of performance indicators. P2/Finance is designed to run with Lotus 1-2-3., or Excel. The software and users guide is available at no charge to all Federal, state and local government agencies from the EPA's Pollution Prevention Information Clearinghouse (MC 304), 401 M Street SW, Washington, DC, 20460. Phone: (202) 260-1023.

Expanding Cost/Savings Inventories

For pollution prevention projects to compete fairly with pollution control and competing alternatives, more potential costs and savings must be considered. In addition to including direct costs, the cost inventory should also include indirect costs, liability costs, and less tangible benefits. Exhibits 2-1 and 2-2 provide a list of capital and operating costs that environmental managers can use to determine the financial costs and savings associated with a particular project opportunity.

The challenge for any Federal facility decision maker or project analyst seeking to use an expanded cost/savings inventory for investment analysis is that some of the cost data associated with a particular piece of equipment or process may be difficult to obtain. Quantifying some of these costs may be a challenge because they may be grouped with other cost items in existing overhead accounts. For example, waste disposal costs for existing processes are often placed into a facility overhead account, whereas an expanded cost inventory would call for these costs to be directly allocated to the product or process that produces them. Consequently, it is not expected that information for all the cost categories will be identified during analyses. Managers and analysts should use the list of categories contained in Exhibits 2-1 and 2-2 to incrementally expand their existing financial analyses whenever possible.

Total Cost Assessment Pilot Study

The Postal Service recently completed a financial analysis using TCA to evaluate pollution prevention projects for the vehicle painting and oil handling processes at the USPS Vehicle Maintenance Facility in Hartford, CT. Financial data concerning existing and alternative oil handling and painting processes were tabulated and compared. Costs associated with existing painting operations (conventional spray guns and low solids, high VOC paint) were compared to five alternatives using high volume, low pressure (HVLP) spray guns, water-based primers, and/or paints with varying levels of solids and VOCs. Costs associated with existing oil handling practices (using virgin oil and disposing waste oil through a vendor) were compared against alternatives involving using virgin oil and disposing of waste oil via an on-site waste oil burner, and using re-refined oil purchased from a vendor that takes USPS waste oil for re-refining. In both cases, the financial analysis indicated that various alternatives to existing operations could provide substantive economic benefit. The study used ***P2/Finance***, a computerized spreadsheet to help track costs and measure financial performance. Ordering information for **P2/Finance** is contained in Appendix B.

Exhibit 2-1
INVENTORY OF POTENTIAL CAPITAL COSTS[1]

Purchased equipment
- Equipment
- Delivery
- Sales tax
- Insurance
- Price for initial spare parts

Materials
- Piping
- Electrical
- Instruments
- Structural
- Insulation
- Other materials (e.g., painting, ducting)

Utility systems and connections
- General plumbing
- Electricity
- Steam
- Water (e.g., cooling, process)
- Fuel (e.g., gas, oil)
- Plant air
- Inert gas
- Refrigeration
- Sewerage

Site preparation (labor, supervision, materials)
- Site studies
- Demolition and clearing
- Old equipment/rubbish disposal
- Grading, landscaping
- Equipment rental

Construction/Installation (labor, supervision, materials)
- In-house
- Contractor/vendor/ consultant fees
- Equipment rental

Planning/Engineering (labor, supervision, materials)
- In-house planning/engineering (e.g., design, drafting, accounting
- Contractor/vendor/ consultant fees
- Procurement

Start-up/Training (labor, supervision, materials)
- In-house
- Contractor/vendor/ consultant fees
- Trials/manufacturing variances
- Training

Regulatory/Permitting (labor, supervision, materials)
- In-house
- Contractor/vendor/ consultant fees
- Permit fees

Working Capital
- Raw materials
- Other materials and supplies
- Product inventory Protective equipment

Contingency
- Future Compliance Costs
- Remediation

Back-End
- Closure/ decommissioning
- Disposal of inventory
- Site survey

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1 Adapted from An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms, USEPA, and P2/Finance Users Manual, Tellus Institute, Boston, MA. 1993.

Exhibit 2-2
INVENTORY OF POTENTIAL OPERATING COSTS[2]

Direct Materials
- Raw materials (e.g., wasted raw materials costs/savings)
- Solvents
- Catalysts
- Transport
- Storage

Direct Labor
- Operating (e.g., worker productivity changes)
- Supervision
- Manufacturing clerical
- Inspection/QA/QC

Utilities
- Electricity
- Steam
- Water (e.g., cooling, process)
- Fuel (e.g., gas, oil)
- Plant air
- Inert gas
- Refrigeration
- Sewerage

Waste Management (Labor, Supervision, Materials)
- Pre-treatment
- On-site handling
- Storage
- Treatment
- Hauling
- Insurance
- Disposal

Regulatory Compliance (Labor, Supervision, Materials)
- Permitting
- Training (e.g., Right-To-Know training)
- Monitoring/inspections
- Notifications
- Testing
- Labeling
- Manifesting
- Recordkeeping
- Reporting
- Generator fees/taxes
- Closure/postclosure care
- Financial Assurance
- Value of marketable pollution permits (e.g., SOx)
- Avoided future regulation (e.g., Clean Air Act amendments)

Insurance
Future Liability
Fines/penalties
Cost of legal proceedings (e.g., transaction costs)
Personal injury
- Property damage
- Natural resource damage
- Superfund

Revenues
- Sale of product (e.g., from changes in manufacturing throughput, market share, corporate image)
- Marketable by-products
- Sale of recyclables

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2 Adapted from An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms, USEPA., and P2/Finance Users Manual, Tellus Institute, Boston, MA. 1993.

Expanding Time Horizons

Another concept that is helpful in uncovering more of the true economic benefits of pollution prevention projects is to expand the evaluation of costs and savings over a longer time horizon, usually five or more years. This is because many of the costs and savings from pollution prevention take years to materialize, and because the savings from pollution prevention projects often occur every year for an extended period of time. For example, some pollution prevention projects may result in recurrent savings as a result of less waste requiring management and disposal every year. Conventional project analysis, however, often confines costs and savings to a three to five year time period. Often, this time horizon is shorter than the useful life of the item or equipment being evaluated. Using this traditional time frame in project evaluaticn will exclude some of the areas of savings generated by pollution prevention projects.

Comparing Financial Performance

While expanding cost inventories and time horizons can greatly enhance the ability to accurately portray the economic consequences of a single pollution prevention project, financial performance indicators are needed to allow comparisons to be made between competing project alternatives. Three methods of comparison are currently in widespread use: Payback Period, Net Present Value, and Internal Rate of Return.

The simplest and most common approach used by Federal agencies is to conduct a payback analysis that estimates the amount of time it will take to recover the capital expenditures. Net present value, an approach that is gaining popularity among Federal agencies and facilities, is also advocated by many economists as a more accurate approach to project evaluation. Both techniques are useful and offer specific advantages/drawbacks for Federal facility decision makers. The third approach, Internal Rate of Return, is rarely used within the Federal government but is described below for use by readers who encounter it. Analyzing economic impacts using two or more of these approaches will provide even more insight.

Payback Period. Payback period analysis is the investment performance indicator most commonly used by many Federal agencies. The purpose of a payback analysis is to determine the length of time it will take before the costs of a new projects are recouped. The formula used to calculate Payback Period is:

Payback Period (in years) = start up costs / (annual benefits - annual costs)
Payback Period = $800 / ($600 - $400) = 4 years

Those investments that recoup their costs before a set "threshold" period of time (usually 3-5 years) are determined to be projects worth funding. Payback period analysis does not discount costs and savings occurring in future years. In addition, costs and savings are not considered if they occur in years later than the threshold time in which a project must pay back in order to be funded. There are also examples where critical pollution prevention projects may have a payback slightly longer than an established threshold, but have been implemented due to significant intangible benefits.

Use of Payback Period Analysis

The military often uses payback analysis as part of its justification process for evaluating pollution prevention projects. The military typically looks for projects that pay back in 3 years or less. Examples of results from the Air Force using payback analysis to evaluate projects as part of the Tidewater Interagency Pollution Prevention Program initiative are given below:

- Analysis of replacing a solvent parts washing station with a biodegradable detergent system indicated a 7 month payback.
- Analysis of antifreeze recycling system indicated a payback of 2 years based on a recycling rate of 1000 gallons per year.

Net Present Value. The Net Present Value (NPV) method is based upon the concept that a dollar today is worth more than a dollar in the future (commonly referred to as the time value of money). Specifically, this method progressively reduces (discounts) the value of costs and revenues occurring in future years (cash flows). Federal facilities discount projected cash flows by a rate that is periodically determined and published by the Office of Management and Budget[3]. These discounted annual cash flows are then added to calculate the "Net Present Value" of the investment. The higher the NPV, the more attractive the project. Since most Federal Government projects do not result in revenues, the NPV of the most attractive project will have the smallest negative number (closest to zero).

This method is particularly useful when comparing pollution prevention projects against alternatives that result in higher annual waste management and disposal costs. The increased costs of current operations (or of investment options that do not reduce wastes) will tend to lower their net present value. This method easily accommodates the use of an expanded cost inventory when calculating all costs and benefits.

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3 At the time of printing, the appropriate OMB discount rate is 7.3% for 3 year investments, 7.6% for 5 year investments, 7.7% for 7 year investments, 7.9% for 10 year investments, and 8.1% for 30 year investments. Updated rates are available from OMB's Office of Economic Policy at (202) 395-5873.

NPV = Initial investment (expressed as a negative number) + discounted net yearly cash flows

Note: Net yearly cash flow = discounted cash inflows - discounted cash outflows

For example:

$100,000 initial investment (-100,000) + $300,000 discounted savings -$100,000 discounted costs = $100,000

Internal Rate of Return. The Internal Rate of Return (IRR) method is not commonly used in Federal investment decision making. Unlike in Federal NPV calculations, where cash flows are discounted by a rate (determined periodically by OMB) and then added, the purpose of IRR calculations is to determine the interest rate at which NPV is equal to zero. If that rate exceeds the hurdle rate (defined as the minimum acceptable rate of return on a project), the investment is deemed worthy of funding. Federal decision makers using the IRR method should use the discount rate developed by OMB or their specific Agency as the hurdle rate (currently 7.9% for 10 year investments, see footnote 2). Therefore, the IRR equals "r" in the following equation:

$$\text{Initial Cost} + \text{cash flow year } 1/(1+r)^1 + \text{cash flow year } 2/(1+r)^2 + \text{cash flow year } 3/(1+r)^3 \ldots + \text{cash flow year } n/(1+r)^n = 0$$

Use of NPV Analysis

Many private sector companies and some government agencies currently use NPV to analyze financial performance of environmental projects.

Hyde Tools Company used NPV analysis to document over $15,000 in benefits from a pollution prevention project that involved a rinse water recycling project.

Tektronix Corporation used NPV calculations to document over $90,000 in benefits from a process modification to its painting system that dramatically reduced paint consumption.[4]

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4 Summary of Pollution Prevention Case Studies with Economic Data (by SIC Codes) EPA/OPPTS Document # 742-S-94-001 January 1994.

In practice, IRR is usually calculated using a process of trial and error, where different interest rates are tried until the correct internal rate of return is found. That rate is then compared to the hurdle rate.

In many instances, decision makers at Federal facilities may have little choice concerning which of the above methodologies to use. The choice of payback, NPV, or IRR may be dictated by either policy or common practice. Whichever method is used, the challenge for decision makers is to expand the content of their analysis to reflect the true costs and savings as accurately as possible.

GETTING STARTED

The concepts discussed in this chapter can be used to help identify, calculate, and demonstrate the economic benefits that result from pollution prevention projects. They can be used to provide a fair and more complete comparison of two or more competing project alternatives, or can be used to compare proposed projects to the costs of existing operations.

As discussed earlier, managers seeking to expand their existing economic analysis methods to better capture the benefits of pollution prevention should incorporate as many of the concepts discussed in this chapter as practical. Managers who cannot isolate and quantify all of the items they have identified in their expanded cost inventory should nevertheless research and include cost data on all of the items for which they can collect reliable information. Similarly, the time horizon for the analysis should be extended as far as possible, given available data and the type of project evaluation method in use at their facility. Incorporating these concepts is often an incremental process. Even small steps toward expanding inventories and extending time horizons can result in funding approval for pollution prevention projects that would otherwise face rejection.

A worksheet has been provided at the end of this chapter to illustrate the use of these concepts. This and similar worksheets can help the reader analyze the costs and benefits associated with current operations, pollution prevention projects, and alternative project opportunities. The worksheet demonstrates ways of capturing more cost categories by better allocating costs to specific activities, expanding the cost areas included in the analysis, and expanding the time horizon over which the project is analyzed. Note that the lists of potential costs and revenues have been abbreviated for ease of use. Facility decision makers likely will need to revise this worksheet to include items relevant to their own analysis.

The worksheet also provides for the calculation of two measures of financial performance, a simple payback analysis and a net present value calculation (which incorporates the time value of money). Both of these calculations can help in making comparisons between competing project options or in comparing a proposed project against current operations. IRR calculations are not included on the spreadsheet due to the infrequent use of IRR in the Federal government. Readers wishing to make use of a worksheet incorporating IRR should refer to *P2/Finance* (see Appendix B).

INSTRUCTIONS FOR COMPLETING THE PROJECT ANALYSIS WORKSHEET

The following instructions are designed to assist managers in completing the project analysis worksheet. When completing the worksheet, recognize that data might not be available to complete all requested information. By completing only a few sections of the worksheet with data that otherwise would not have been collected, the accuracy in evaluating project opportunities will be enhanced.

Begin by determining the purpose of the analysis, the audience to whom it will be directed, the facility or Agency's decision making criteria, and the format in which the analysis must be presented. This information will be critical in ensuring that the scope of the analysis is appropriate, and that the completed analysis will be presented in a readily understood and accepted manner. If these worksheets will be used to compare project alternatives, or to compare a potential project to current operations, a separate worksheet should be completed for each option under consideration.

Sections 1-3 Identify the economic consequences associated with the activity under review. The specific items (i.e., categories of cash outflows) mentioned in the worksheet may not represent a complete list of costs incurred at your facility. If so, add new categories as appropriate. Refer to Exhibits 2-1 and 2-2 for lists of capital and operating cost categories. If you are conducting a payback analysis, completing information for only the initial year is acceptable provided that data are available to describe annual costs and annual savings. If you plan to analyze the financial performance of the investment using a NPV calculation, you need to estimate future costs and benefits. NOTE: IT IS NOT NECESSARY TO MAKE ADJUSTMENTS FOR INFLATION. THESE CALCULATIONS WILL BE ADDRESSED THROUGH THE USE OF THE OMB NOMINAL DISCOUNT FACTOR.

To allow comparisons with other project options, two measures of economic performance are included in the worksheet. To conduct a payback analysis, refer to section 4. To conduct a net present value analysis, refer to sections 5 through 8.

Section 4	This section calculates the number of years that it will take to recoup the initial capital expenditure. This value is obtained by dividing the initial investment to establish the project by the net annual benefits (obtained by subtracting the expected annual cash outflows from the expected annual cash inflows). If only a payback analysis is needed, skip the following steps.
Section 5	For each year included in the evaluation, calculate the annual net cash flow by subtracting the capital expenditures (Section 1) and annual cash outflows (subtotals from Sections 3,4,5) from the annual cash inflows (Section 2).
Section 6	Calculating the NPV requires determining the value of future cash flows today. To do this, present value factors are used to discount future cash flows. As of January 1995, OMB recommends using a 7.9% nominal discount factor for evaluating performance of 10 year investments. Therefore, the present value (PV) factors assume a 7.9% rate. For more current information, refer to OMB Circular A-94, call OMB at 202/395-5873, or contact the cost analysis office in your organization. OMB's nominal discount rate for investments of various duration are included in Table 1.
Section 7	Multiply the net cash flows (Section 7) by the PV factors (Section 8) to determine the present value today of the cash flow in each year.
Section 8	Add all the annual discounted cash to determine the Net Present Value of the process. If the value is positive, the project is cost-beneficial. If more than one investment is being analyzed, the project with the greatest NPV is the most cost-beneficial.

Table 1 PRESENT VALUE FACTORS FOR NOMINAL DISCOUNT RATES (OMB JANUARY 1995)					
	7.3%	7.6%	7.7%	7.9%	8.1%
Year 1	0.93197	0.92937	0.92851	0.92678	0.92507
Year 2	0.86856	0.86372	0.86212	0.85893	0.85575
Year 3	0.80947	0.80272	0.80048	0.79604	0.79163
Year 4		0.74602	0.74325	0.73776	0.73231
Year 5		0.69333	0.69012	0.68374	0.67744
Year 6			0.64078	0.63368	0.62668
Year 7			0.59496	0.58729	0.57972
Year 8				0.54429	0.53628
Year 9				0.50444	0.49610
Year 10				0.46750	0.45893
Year 11					0.42454
Year 12					0.39273
Year 13					0.36330
Year 14					0.33608
Year 15					0.31090
Year 16					0.28760
Year 17					0.26605
Year 18					0.24611
Year 19					0.22767
Year 20					0.21061
Year 21					0.19483
Year 22					0.18023
Year 23					0.16673
Year 24					0.15424
Year 25					0.14268
Year 26					0.13199
Year 27					0.12210
Year 28					0.11295
Year 29					0.10449
Year 30					0.09666

After completing the analysis, write a narrative to accompany the analysis that explains the results. Be sure to include a discussion of the economic benefits of the proposed pollution prevention projects that were not able to be quantified, and a discussion of the non-economic benefits that may tip the scales in favor of the pollution prevention project if the economic analysis is too close to call.

Electronic versions of the spreadsheet on the next page are available on disk in Lotus 1-2-3 or Excel format from EPA's Pollution Prevention Information Clearinghouse (see Appendix B for contact information).

PROJECT ANALYSIS WORKSHEET

	Section		ESTIMATED CASH FLOW IN EACH YEAR										
			Start-Up	1	2	3	4	5	6	7	8	9	10
CASH OUTFLOWS	1	CAPITAL COSTS											
		Equipment											
		Utility Connections											
		Construction											
		Engineering											
		Training											
		Other											
		Subtotal Section 1											
	2	OPERATING COSTS											
		Materials											
		Labor											
		Utilities											
		Waste Mgmt.											
		Compliance											
		Liability											
		Other											
		Subtotal Section 2											
CASH INFLOWS	3	REVENUES											
		Sale of products											
		Sale of by-products											
		Sale of recyclables											
		Other											
		Subtotal Section 3											

4 **PAYBACK** ____ years Equals Section 1 divided by (Section 2 - Section 3) **NOTE, USE THE VALUES FROM THE SHADED BOXES ABOVE**

5 **CASHFLOW**

Cash flow is calculated by subtracting Cash Outflows from Cash Inflows during each year of the investment (i.e., Sec. 3 minus Sec. 2 minus Sec 1)

6 **PV FACTORS**

1.0000	0.9268	0.8589	0.7960	0.7378	0.6837	0.6337	0.5873	0.5443	0.5044	0.4675

Note, the PVs indicated above are for evaluating the performance of 10 year Investments. For investments of other durations, refer to the accompanying text

7 **CFxPV**

8 **NET PRESENT VALUE** ____ Equals the sum of all values in Section 7

Chapter 3
ESTIMATING ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

Historically, the project review process has considered only those environmental impacts that could be easily translated into financial terms (e.g., permitting costs and pollution control equipment costs). Consequently, these financially-based budgeting tools often did not fully capture the benefits of pollution prevention opportunities, particularly those that reduce environmental concerns for the present and future. Without the tools to completely document environmental benefits, pollution prevention opportunities have often been difficult to support when competing against more easily-quantified environmental projects such as end-of-pipe controls, and non-environmental investments such as remodeling or plant expansion.

Therefore, managers require analytical tools that accurately and comprehensively account for the environmental consequences and benefits of competing projects. These environmentally-based project review tools must be flexible, easy-to-use, and require limited resources (e.g., staff and funding) so that they can be easily incorporated into the review process.

Many public and private organizations in the United States and abroad actively promote Life Cycle Assessment (LCA) as a means to evaluate environmental consequences and impacts. LCA is a procedure to identify and evaluate "cradle-to-grave" natural resource requirements and environmental releases associated with processes, products, packaging, and services. LCA concepts can be particularly useful in ensuring that identified pollution prevention opportunities are not causing unwanted secondary impacts by shifting burdens to other places within the life-cycle of a product or process. LCA is an evolving tool undergoing continued development. Nevertheless, LCA concepts can be useful in

> **LIFE CYCLE**
>
> Over the past 20 years, environmental professionals have become more aware that the consumption of manufactured products and services can adversely affect supplies of natural resources and the quality of the environment. These effects occur at all stages of the life cycle of a product, beginning with raw materials extraction, continuing through materials manufacture and product fabrication, and concluding with product consumption and disposal.

gaining a broader understanding of the true environmental effects of current practices and of proposed pollution prevention opportunities.

This chapter begins with an introduction to LCA and a discussion of its components. Next, tools are presented to help Federal facility decision makers begin to apply LCA concepts to existing and potential projects. The LCA descriptions are adapted from existing LCA reference documents. The abbreviated discussion in this user's manual is intended to provide Federal facility managers with a concise, easy to follow introduction to incorporating environmental considerations into the project review process. For a detailed discussion on conducting a comprehensive life cycle assessment, consult EPA's *Life Cycle Assessment: Inventory Guideline and Principles* and other LCA reference documents provided in Appendix B.

WHAT IS A LIFE CYCLE ASSESSMENT?

A life cycle assessment (LCA) is a tool to evaluate all environmental effects of a product or process throughout its entire life cycle. This includes identifying and quantifying energy and materials used and wastes released to the environment, assessing their environmental impact, and evaluating opportunities for improvement. Exhibit 3-1 illustrates the possible life stages that can be considered in a LCA and the typical inputs/outputs measured.

The unique feature of this type of assessment is its focus on the entire "life cycle," rather than a single manufacturing step or environmental emission. The theory behind this approach is that operations occurring within a facility can also cause impacts outside the facility's gates that need to be considered when evaluating project alternatives. Examining these "upstream and downstream" impacts can point out benefits or drawbacks to a particular opportunity that otherwise may have been overlooked. For example, examining whether to invest in washable/reusable cloth towels or disposable paper towels in a vehicle maintenance facility should include a comparison of all major impacts, both inside the facility (e.g., disposing of the paper towels) and "outside the gate" (e.g., wastewater discharges from the off-site washing of the reusable towels).

MAJOR LCA CONCEPTS

LCA is a tool to evaluate the environmental consequences of a product or activity across its entire life.

An LCA can consist of the following components: Goal Definition and Scoping, Inventory, Impact and Improvement Analyses.

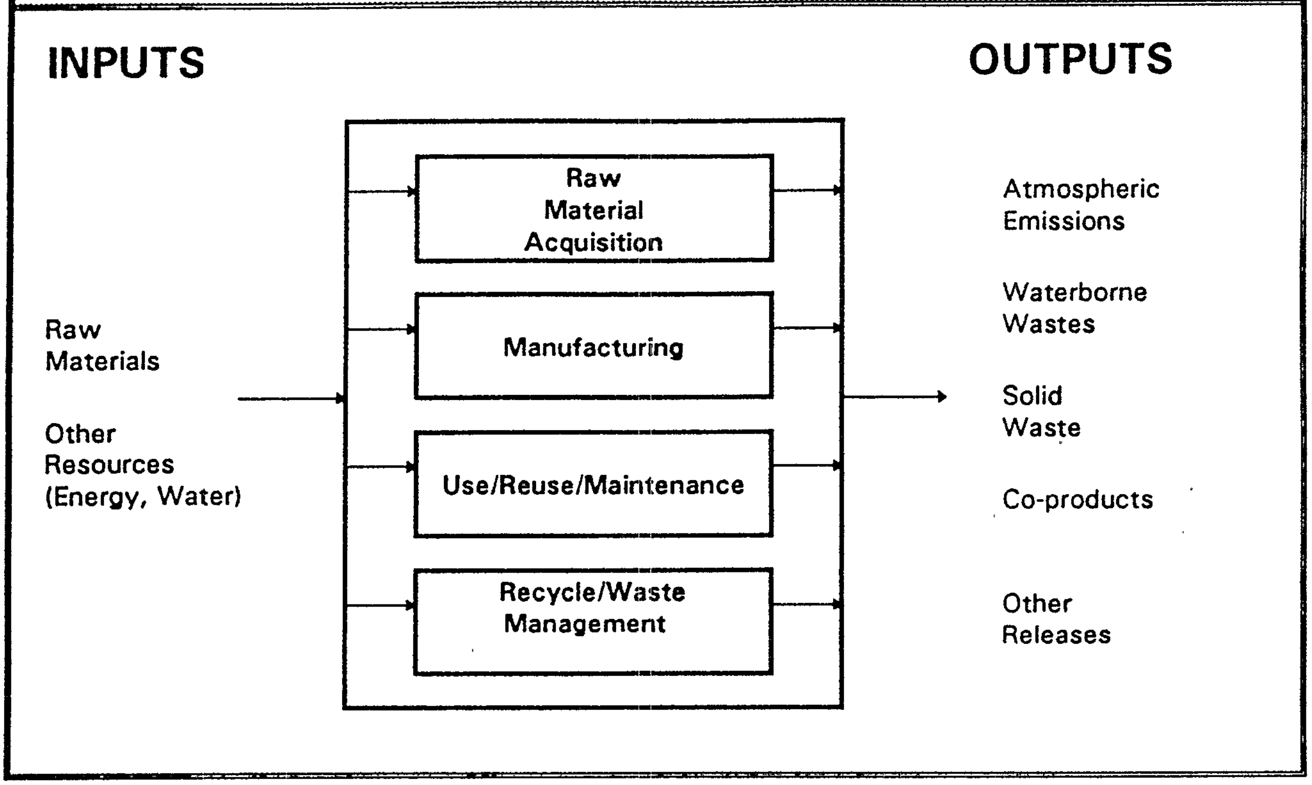
LCA can be used in process analysis, material selection, product evaluation, product comparison, and policy-making.

LCA can be used by acquisitions staff, new product design staff, and staff involved in investment evaluation.

Unlike the financial analysis techniques described in the previous chapter, LCA's provide data on environmental releases and their effects. Some LCA proponents advocate further efforts to assign costs to LCA data. This is often described as a Life Cycle Cost Assessment (LCCA). This chapter will focus on LCA. Those readers interested in finding out more about LCCA should refer to Appendix B.

Exhibit 3-1

LIFE CYCLE STAGES



In general, LCA is a process which includes the following components.

Goal Definition and Scoping: This is a screening process which involves defining and describing the product, process or activity; establishing the context in which the assessment is to be made; and identifying the life cycle stages to be reviewed for the assessment.

Inventory Analysis: This process involves identifying and quantifying energy, water and materials usage, and the environmental releases (e.g., air emissions, solid waste, wastewater discharge) during each life cycle stage.

Impact Assessment:	This process is used to assess the human and ecological effects of material consumption and environmental releases identified during the inventory analysis.
Improvement Assessment:	This process involves evaluating and implementing opportunities to reduce environmental burdens as well as energy and material consumption associated with a product or process.

APPLICATIONS OF A LIFE CYCLE ASSESSMENT

LCA provides vital information on the environmental consequences associated with pollution prevention projects and competing alternatives. Using LCA can provide Federal facility decision makers with another ranking criterion to use when evaluating and prioritizing competing project opportunities. For instance, LCA can provide information to assist in addressing decisions, such as:

- Does it make environmental sense to replace a solvent degreaser with a caustic cleaner? Does the elimination of VOC emissions resulting from this change off-set the discharge of heavy-metal laden caustic cleaner to the wastewater treatment plant?
- What are the environmental trade-offs associated with disposable vs. reusable dinnerware in the cafeteria? How does the solid waste impact of disposable dinnerware compare with the increased water needed to wash reusable plates and utensils?
- Does replacing paper towels in the restrooms with reusable cloth or hand dryers increase or decrease the total impact on the environment?

Facility managers can also use a LCA approach to verify that a project that effectively solves one particular pollution problem does not result in cross-media shifting of pollution to another media (e.g., from waterborne to atmospheric releases). By examining all resource inputs (e.g., energy, materials, water) and environmental releases (e.g., air, water, and solid waste) across the entire life cycle of the product, process, or activity, a LCA can identify cross media transfers and transfers of pollutants to other life cycle stages.

BEGINNING TO APPLY LCA CONCEPTS IN PROJECT ANALYSIS

Gaining a complete understanding of a proposed project's environmental effects requires identifying and analyzing inputs and releases from every life cycle stage. However, securing and analyzing this data can be a daunting task. In many cases Federal facility decision makers may not have the time or resources to examine each life cycle stage or to collect all pertinent data.

Therefore, the remainder of this chapter will discuss the steps required to begin applying LCA concepts and principles to project analysis. Examples will demonstrate steps within selected life cycle stages. These stages will generally begin when materials and equipment enter Federal facility property, in recognition of the fact that data on materials and releases occurring outside Federal facility fencelines may be difficult to obtain. Tools are presented that will help decision makers with limited resources begin to use LCA concepts.

Before beginning to apply LCA concepts to projects under review, facility managers must first determine the purpose and the scope of the study. In determining the purpose, facility managers should consider the type of information needed from the environmental review (e.g., Does the study require quantitative data or will qualitative information satisfy the requirements?). Once the purpose has been defined, the boundaries or the scope of the study should then be determined. What stages of the life cycle are to be examined? Are data available to study the inputs and outputs for each stage of the life cycle to be reviewed? Are the available data of an acceptable type and quality to meet the objectives of the study? Are adequate staff and resources available to conduct a detailed study? Exhibit 3-2 lists some of the major LCA definitions and scoping issues.

The definition and scoping activity links the purpose and scope of the assessment with available resources and time and allows reviewers to outline what will and will not be included in the study. In some cases, the assessment may be conducted for all stages of the life cycle (i.e., raw materials acquisition, manufacturing, use/reuse/maintenance, and recycling/waste management). In many cases, the analysis may begin at the point where equipment and/or materials enter the facility. In other cases, primary emphasis may be placed on a single life cycle stage, such as identifying and quantifying waste and emissions data. In all cases, managers should ensure that the boundaries of the LCA address the purpose for which the assessment is conducted and the realities of resource constraints. Whenever possible, include in the analysis all life-cycle stages in which significant environmental impacts are likely to occur.

Exhibit 3-2 ISSUES TO BE RESOLVED IN DEFINING AND SCOPING A LIFE CYCLE ASSESSMENT
Have the boundaries of the assessment been determined (i.e., have the life cycle stages been identified)?
Are data sources available to describe the inputs and outputs for these stages?
Is the available data of an acceptable type and quality to meet the objectives of the assessment (e.g., is the data verifiable enough to be used in justifying capital budgeting investments)?
Is a life cycle checklist appropriate for reviewing the project or is a more detailed life cycle assessment needed?

Determining the purpose and scope of the study will help to identify the type of environmental analysis that should be conducted. This chapter provides an introduction to two tools that are useful when applying LCA concepts: 1) Life Cycle Checklist and 2) Life Cycle Assessment Worksheet. For more detailed information on conducting a comprehensive life cycle analysis, consult the reference documents listed in Appendix B.

Life Cycle Checklist

Conducting a LCA that includes all life-cycle stages will provide decision makers with the most complete understanding of environmental consequences. However, if resources are limited and an in-depth, quantitative analysis is not practical, a Federal facility manager may consider using a simple checklist to identify and highlight certain environmental implications associated with competing projects. A checklist using qualitative data instead of quantitative inputs can be very useful when available information is limited or as a first step in conducting a more thorough LCA. In addition, a Life Cycle Checklist should include questions regarding the environmental effects of current operations and/or potential projects in terms of materials and resources consumed and wastes/emissions generated. Exhibit 3-3 provides a sample checklist.

The checklist used by an individual facility can be tailored to emphasize areas of specific concern. For example, a facility in an area of the country where landfill space is limited may want to emphasize the collection and evaluation of solid waste generation data. Similarly, a facility located in arid or semi-arid areas may want to collect and evaluate information relating to water consumption.

Exhibit 3-3
SAMPLE LIFE CYCLE CHECKLIST

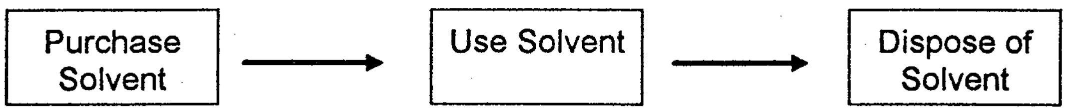
Issue	Question	Yes	No
Material Usage	Does the project minimize the use of raw materials?		
Resource Conservation	Does the project minimize energy usage?		
	Does the project minimize water usage?		
Local Environmental Impacts	Does the project eliminate or minimize impacts to the local environment (i.e., air, water, land)?		
Global Environmental Impacts	Does the project eliminate or minimize impacts known to cause global environmental concerns (e.g., global warming, ozone depletion, acid rain)?		
Toxicity Reduction	Does the project improve the management of toxic materials and/or processes which result in human/ecological exposure?		

Using a life cycle checklist has specific advantages and disadvantages when compared to the other forms of life cycle assessment. The principle advantage is that completion of a checklist is relatively easy to perform and requires limited resources. On the other hand, a life cycle checklist does not provide a detailed or complete assessment of the environmental consequences associated with the activity under review. Instead, this method only provides general qualitative data.

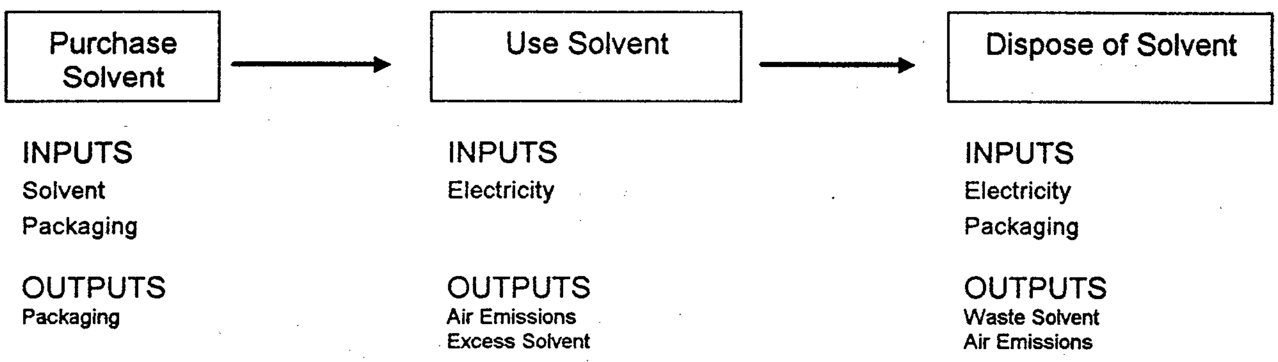
Conducting A More Detailed Project Review

If more detailed information concerning the environmental consequences of pollution prevention projects is required, an environmental manager may consider conducting a more in-depth analysis to identify and evaluate the resource and material inputs and the environmental releases associated with each life cycle stage. This is a more resource intensive operation than using a life cycle checklist. Therefore, defining and scoping the analysis to fit available resources while including all significant areas of environmental impact is very important.

The first step in identifying and evaluating the inputs and outputs associated with life cycle stages under review is to describe and understand each step in the process. One common method to do this is to construct a system flow diagram for the product, process, or activity being studied. Each step within the relevant life cycle stages is represented by a box. Each box is connected to other boxes that represent the preceding and succeeding step. A simple example of a process flow diagram is illustrated below. In this example, the life cycle stages covered within the diagram begin at the point a solvent is purchased for use and enters a Federal facility property. Each of these boxes can be further divided into detailed process flow steps.



When all relevant steps for each stage of the product, process, or activity under review have been identified, the flow diagram should be expanded to identify the specific energy and material inputs, and the specific environmental releases associated with each box on the diagram. This step is of crucial importance, because data on these identified inputs and releases will be collected later, and will form the basis for all findings and conclusions. The diagram below illustrates the inputs and releases for each step in the sample flow diagram.



Once a flow diagram has been developed, personnel conducting the LCA should identify sources of information that will describe and quantify the material and energy inputs, and the environmental releases associated with each box in the process flow diagram. Possible sources of information for each stage are presented in Exhibit 3-4.

Exhibit 3-4

SOURCES OF INFORMATION

Raw Materials Acquisition

- Data specific to a particular materials processor
- Government, academic, trade association, or industry studies of aggregate data
    - ⇒ U.S. Department of Commerce, Census of Manufacturers
    - ⇒ U.S. Bureau of Mines, Census of Mineral Industries
    - ⇒ U.S. Department of Energy, Monthly Energy Review
    - ⇒ Encyclopedia of Chemical Technology, Kirk-Othmer

Manufacturing

- Data specific to a particular materials processor
- Government, academic, trade association, or industry studies of aggregate data

Use/Reuse/Maintenance

- Engineering studies
- Facility process flow diagrams
- Environmental studies and reports
    - ⇒ Hazardous waste (state Annual reports or Federal biennial reports)
    - ⇒ Toxics Release Inventory reports (as of 1994)
    - ⇒ Compliance assessment reports
    - ⇒ Routine testing and monitoring data (e.g., air emissions, waste water discharge)
    - ⇒ Solid waste disposal records
- Utility bills
- Supply and acquisitions databases of materials used on-site
- Equipment suppliers
- Facility staff or contractors performing maintenance or operations work

Recycle/Waste Management

- Facility staff or responsible contractors, equipment vendors
- Data specific to a particular waste management firm
- Government, academic, trade association, or industry studies of aggregate data

Although quantitative data are preferable (and are necessary to accurately and completely conduct an impact assessment), qualitative data may be acceptable in cases where quantitative data are lacking.

A worksheet and instructions are provided to help readers complete a sample process flow diagram. The intent of this worksheet is to acquaint Federal facility managers with a form that can be completed for each project option or process change under consideration. This life cycle-based worksheet is organized into three sections. The first section asks for a flowchart of the process steps/activities to be included in the analysis. The second section asks for inputs (i.e., raw materials, energy, and water), and the third section asks for outputs (i.e., products, air, water, and land releases). The worksheet provides space for four process steps. If more than four process steps are to be examined, continue the analysis on a copy of the original form.

Using this or any other life cycle worksheet has specific advantages and disadvantages when compared to conducting a complete LCA. The principle advantage is that it provides a more detailed analysis of the process than the checklist, and it is easier to conduct than a complete LCA. On the other hand, it does not encompass the full environmental impacts of a process or activity life cycle stage.

INSTRUCTIONS FOR COMPLETING THE LIFE CYCLE ASSESSMENT WORKSHEET

The following instructions are designed to assist managers in completing the life cycle assessment worksheet. The worksheet is intended to help Federal facility managers gain a more complete understanding of the life cycle environmental consequences associated with existing processes, potential pollution prevention projects, and competing project alternatives. When completing the worksheet, do not worry if data are not available to complete all requested information. Even by just completing a few sections of the worksheet, the information on each individual line can still be useful in evaluating and comparing the environmental performance of existing processes and potential projects. However, be aware that completing only certain sections of the worksheet may provide misleading results. For example, completing sections on solid wastes and releases to air without entering data on releases to water may bias the analysis toward projects whose primary environmental consequences result from water pollution. Similarly, collecting and analyzing data on a limited number of life cycle stages may bias the analysis toward projects whose primary environmental effects occur upstream or downstream from stages under analysis.

The information requested on the worksheet can be indicated either numerically or by description only. Descriptive information is often the only information available. Specific instructions follow:

Line 1: Indicate the process steps that are to be reviewed. For example, a life cycle analysis of a solvent degreaser tank system might examine the following three activities: acquisition of solvent, use of tank, and disposal/recycling of waste materials.

Line 2a: For each of the process steps indicated in Line 1, identify the raw materials used. Examples of typical materials include chemicals, parts, and minerals. Do not forget to include associated packaging materials such as cans, cardboard, and plastic wrap.

Line 2b: Indicate the energy involved with operating the process activity. Three common energy source categories have been included (i.e., electricity, natural gas, and fuel). Include other categories if needed. If numerical data are available, it is possible to sum together all entries from the same energy source (i.e., electricity usage from each of the process steps examined).

Line 2c: Indicate the quantity of water consumed in each of the process steps being evaluated. Note that water could be coming from surface sources (e.g., pumped in from a nearby river), from a well, or from purchased city water.

Line 2d: Indicate other inputs, as needed. Some process steps that can generate additional inputs include pre-process cleaning, process cleaning and maintenance supplies required in the upkeep of the process.

Line 3a: For each process step, indicate the products that result. Be aware that the products often become the inputs to the next step in the sequence.

Line 3b: Indicate numerically or by description the air releases associated with the process step. Examples of typical releases from an industrial process include particulates/dust and solvent vapors. Numerical records of air emissions can often be found on permitting applications or in engineering records. If numerical data is not available, provide a narrative list of emissions.

Line 3c: Indicate the wastewater discharges and liquid hazardous wastes associated with each process step

Line 3d: Identify the solid waste generated from each process step. If possible list the type/quantity of solid waste and how it is managed (e.g., 10 pounds of cardboard that are recycled or 5 cubic yards of sludge that is landfilled).

Electronic versions of the spreadsheet on the next page are available on disk in Lotus 1-2-3 or Excel format from EPA's Pollution Prevention Information Clearinghouse (see Appendix B for contact information).

LIFE CYCLE ASSESSMENT WORKSHEET

I PROCESS STEPS

II INPUTS

2a *Raw Materials (units)*

2b *Energy Usage*

Electricity (kW-hr) ____ + ____ + ____ + ____ = ____

Natural Gas (cubic ft.) ____ + ____ + ____ + ____ = ____

Fuel (gallons) ____ + ____ + ____ + ____ = ____

Other ____ + ____ + ____ + ____ = ____

2c *Water Usage (gallons)* ____ + ____ + ____ + ____ = ____

2d *Other Inputs (units)*

III OUTPUTS

3a *Products, Useful By-Products (item and amount)*

3b *Releases to the Air (including gaseous wastes)*

3c *Releases to the Water (including liquid wastes)*

3d Solid Wastes

Chapter 4
INCENTIVES AND CHALLENGES TO EXPANDING PROJECT ANALYSIS PRACTICES

INTRODUCTION

This section discusses various incentives given to Federal facility decision makers to expand upon project analysis models and to incorporate broader inventories (both economic and environmental) and expanded time horizons. In addition, some common challenges and barriers to incorporating these principles are discussed, along with some ideas on ways to overcome the obstacles.

EXISTING INCENTIVES

Many Executive branch, legislative, and agency-specific policies and mandates are in effect that encourage and/or require Federal facilities to incorporate the principles discussed in this report into the project review process. Many of these policies and mandates were developed to encourage Federal agencies to develop an understanding of the true cost of government activities, as well as acknowledge the value of promoting pollution prevention activities in reducing future government liabilities. Further discussion of key policies, initiatives, and examples of Agency activities are provided below.

Executive Branch Initiatives

Executive guidance, in the form of Executive Order 12856, *Federal Compliance With Right-To-Know Laws And Pollution Prevention Requirements*, was signed August 3, 1993. Among other provisions, this EO requires all Federal facilities to implement total cost accounting and life cycle analysis principles in the review of all current and planned activities (including pollution prevention programs and initiatives). The goal of this EO is to encourage pollution prevention activities by promoting the use of a budgeting analysis tool that will accurately reflect the true costs of current operations and the sometimes hidden benefits offered by pollution prevention.

Office of Management and Budget Guidance

As the lead agency responsible for establishing standardized Federal budgeting procedures, the Office of Management and Budget (OMB) has issued a memorandum encouraging Federal facilities to use total cost assessment principles. This September 1991 memorandum from the Director of OMB to Senior Agency Procurement Executives stated that Federal facilities need to use "life cycle" cost analysis principles to reflect the indirect and hidden costs not generally addressed in the traditional budgeting process. This memorandum suggested that factors such as energy conservation, reduction of waste streams, and product substitution required more emphasis in agency acquisition plans and encouraged agencies to take advantage of existing life cycle costing training curricula. In November 1992, OMB established a position on total cost assessment by preparing a policy directive entitled, *Procurement of Environmentally-Sound and Energy-Efficient Products and Services*. As part of this directive, OMB recommended that each Agency "employ life cycle cost analysis, whenever feasible and appropriate, to assist in making product and service selections."

Specific Agency And Facility Initiatives

Some Federal agencies have issued their own policies and guidance documents to further emphasize the importance and value of implementing an expanded concept of project analysis and review. Examples of the types of initiatives some agencies have pursued are described below.

Department of Defense

The Department of Defense (DoD), through the broad-based Directive 4210.15, *Hazardous Material Pollution Prevention*, stated that its policy is to select, purchase, use and manage hazardous materials over their life cycle so that the DoD incurs the lowest cost to protect human health and the environment. A key component of this policy is to eliminate hazardous materials or substitute less hazardous materials in processes and products rather than simply managing or treating the hazardous waste created. For DoD facilities, meeting this intent can be accomplished by incorporating total cost assessment and life cycle analysis principles into the budgeting and procurement process.

Department of the Interior

The Department of Interior (DOI) also has a procurement policy which encourages the use of comprehensive economic and environmental investment reviews rather than simple comparisons of purchase prices in the evaluation of procurement alternatives. Several DOI bureaus have supplemented the efforts of DOI headquarters by establishing their own policies. For example, the National Park Service (NPS) developed an Integrated Solid Waste Alternative Program (ISWAP) in March, 1991 which instructs the national parks and associated offices to purchase products based on life cycle principles.

United States Postal Service

The U.S. Postal Service (USPS) has issued various policy directives that address a wide range of waste reduction programs including life cycle based costing models. At USPS, procurement costs are now calculated using total cost accounting analytical techniques that take into consideration long-term effects such as: savings in labor and raw materials, transportation needs, storage concerns, operating costs, environmental factors concerning waste handling, treatment and disposal costs, regulatory compliance costs, and potential liability.

OVERCOMING EXISTING CHALLENGES

Although various incentives have been issued to encourage Federal facility decision makers to implement comprehensive project review practices, not all facilities are currently using these review practices for pollution prevention. Facilities that have experimented with using these concepts instead of traditional budgeting principles have encountered challenges that have required the development of innovative solutions. The following sections highlight some of the challenges facility personnel have encountered and discusses possible solutions. For further information, refer to EPA's *Pollution Prevention Benefits Manual* and other reference documents listed in Appendix B.

Proper Allocation of Cost Categories

Compared with the traditional project analysis processes, expanding the analysis to include broader cost inventories requires a more detailed data tracking system. Currently, many government agencies utilize tracking systems that group together many inventory categories into facility-wide overhead accounts. These types of tracking methods make it very difficult to identify all of the discreet costs that will be impacted by proposed project alternatives. Pollution prevention activities, in particular, are at a disadvantage because many of the savings that result from these projects (such as energy, sewage, water, permitting, and waste disposal) often occur in areas lumped into overhead accounts.

To overcome this challenge, staff performing project analyses must first identify the exact data needs for the project under review. Then, a comparison can be made to information available from traditional recordkeeping systems in order to identify information gaps resulting from items being lumped together or reported on a facility-wide basis. To eliminate the data gaps, one of several approaches can be employed:

- For the simplest of challenges where several inventory categories have been combined, a review of the input data developed by each department in a facility may reveal the data for the particular project in question. For example, while the accounting department indicates on its books only the total quantity of copier paper used at the entire facility, a review of department specific expenses would likely reveal a more detailed account of paper use by location.

- For categories that are aggregated for the whole facility and not by specific project (e.g. water usage), engineering estimates or a facility walk through may be used to generate an estimate allocation to specific projects.

- For aggregated categories that cannot be easily allocated on a project specific basis by either of the above two methods, it may be useful to discuss the data needs both with the vendors that supplied the original equipment to see if any baseline consumption data exist and/or auditing professionals to identify what types of measurement devices or meters could be located at the specific project to meet the data needs.

Placing Value On Future Costs And Benefits

Estimating future costs and benefits can become a difficult task for anyone conducting project analyses. Quantitatively estimating future costs for items such as property clean-up and environmental compliance upon facility decommissioning can be a very difficult task. A useful approach is to group future costs into one of two categories; recurring costs, or contingent costs.

Recurring costs include items that are currently incurring costs and are anticipated to continue incurring costs into the foreseeable future based upon regulatory requirements. These include permits, monitoring costs, and compliance with regulatory requirements. The first step in estimating the future costs of these items is to determine how much the facility is currently paying. Then estimate how much the cost can reasonably be expected to escalate in the future. For example, if monitoring costs are currently $100 and are expected to rise with inflation, a conservative estimate would be a 4% annual increase. Consequently, the monitoring costs for the following year would be estimated at $104, assuming that monitoring requirements do not become more stringent. Note that when using the Economic Worksheet in Chapter Two, it is not necessary to escalate these values because the worksheet already takes inflation into account when calculating present values.

Contingent costs include catastrophic future liabilities such as remediation and clean-up costs. While current activities can lead to these future costs, quantitative estimates of these liabilities are difficult to obtain. Often the only way to include these future liabilities in the budgeting process is to qualitatively describe estimated liabilities, without attempting to define these costs using dollar amounts. If a pollution prevention option is being considered, a comparison highlighting the areas in which future liability would be reduced by implementing the pollution prevention option should be included. For example, this approach could be used to describe the future benefit of switching from lead-based paint to water based paint. Most likely, the best option may be to fully describe the potential liability if the change is not made and, if possible, document the remediation cost that could result if a liability event occurred today.

Availability of Process Specific Resources

Although most agencies are now incorporating the principles described in this chapter at some level, resources remain scarce. Some managers have been able to utilize existing costing software programs, while others have been able to refer to private sector experience. It may also be useful to identify other facility managers within your own agency that have recently implemented pollution prevention projects to discuss the budgeting techniques they used. In June 1995, EPA published a document titled "Incorporating Environmental Costs and Considerations into Decisionmaking: A Review of Available Tools and Software." This document is listed in Appendix B and can be ordered through EPA's Pollution Prevention Information Clearinghouse.

Appendix A
GLOSSARY OF TERMS

Discount Rate: The interest rate (sometimes called the Present Value Factor) used to discount future cash flows to their present values. This represents the rate of return that could be earned by investing in a project with risks comparable to the project being considered. Federal facilities generally use a discount rate determined by the Office of Management and Budget.

Hurdle Rate: In Internal Rate of Return calculations, the minimum rate of return that a project must generate in order to be considered worthy of investment. Federal facilities usually use the discount rate determined by the Office of Management and Budget as the hurdle rate. Projects that provide a rate of return below this rate will not be pursued.

Internal Rate of Return (IRR): The discount rate at which the net savings (or NPV) on a project are equal to zero. The IRR of a project can be compared to the hurdle rate to determine economic attractiveness. The General IRR rule is:
If IRR > or = hurdle rate then accept project.
If IRR < hurdle rate then reject project.

Life Cycle Assessment: A method to evaluate the environmental effects of a product or process throughout its entire life cycle, from raw material acquisition to disposal. This includes identifying and quantifying energy and materials used and wastes released to the environment, assessing their environmental impact, and evaluating opportunities for improvement.

Life Cycle Costing: A method in which all costs are identified with a product, process, or activity throughout its lifetime, from raw material acquisition to disposal, regardless of whether these costs are borne by the organization making the investment, other organizations, or society as a whole.

Net Present Value (NPV): The present value of the future net revenues of an investment less the investment's current and future cost. An investment is profitable if the NPV of the net revenues it generates in the future exceeds its cost, that is, if the NPV is positive.

Payback Period: The amount of time required for an investment to generate enough net revenues or savings to cover the initial capital outlay for the investment.

Pollution Prevention: Any practice that reduces the amount of environmental and health impacts of any pollutant released into the environment prior to recycling, treatment, or disposal. Pollution prevention includes modifications of equipment and processes; reformulation or redesign of products and processes; substitution of raw materials; and improvements in housekeeping, maintenance, training, or inventory control.

Total Cost Assessment (TCA): A long-term comprehensive financial analysis of the full range of costs and savings of an investment that are or would be experienced directly by the organization making or contemplating the investment.

Appendix B
ADDITIONAL INFORMATION SOURCES

The following government publications are available to assist Federal facility environmental managers conduct an investment analysis of pollution prevention projects. Also included is a list of guidance manuals to assist environmental managers identify and develop pollution prevention projects. Finally, a list of various Federal and State agencies which provide direct technical assistance on pollution prevention topics and projects is provided on the pages that follow.

Project Analysis Guidance Documents

1. *Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis, with applications to the Pulp and Paper Industry*
   EPA/600-R-92-002
   U.S. Environmental Protection Agency
   Pollution Prevention Information Clearinghouse (PPIC)
   401 M Street, SW
   Washington, DC 20460
   202-260-1023

   This document outlines and justifies a total cost assessment approach to evaluate pollution prevention opportunities. This report applies a TCA method to analyze several actual investments in the pulp and paper industry. It also reviews several TCA methods.

2. *Environmental Accounting Resource Listing*
   EPA/742-F-94-004
   U.S. Environmental Protection Agency
   Pollution Prevention Information Clearinghouse (PPIC)
   401 M Street, SW
   Washington, DC 20460
   202-260-1023

   This resource listing presents selected information sources organized in the following categories (1) Activity-based costing, (2) Bibliographies, curricula, and definition of terms, (3) Corporate environmental accounting, (4) Federal government, military and logistics applications, (7) Pollution prevention, and (8) Quality costs.

3. *A Primer for Financial Analysis of Pollution Prevention Projects*
   EPA/600-R-93-059
   The Center for Environmental Research Information (CERI)
   26 West Martin Luther King Drive
   Cincinnati, OH 45628
   513-569-7562

   This document introduces the time value of money concept into analysis of pollution prevention investments.

4. *Life-Cycle Assessment: Inventory Guidelines and Principles*
   EPA/600-R-92-245
   U.S. Environmental Protection Agency
   Office of Research and Development
   26 West Martin Luther King Drive
   Cincinnati, OH 45268
   513-569-7562

   This document describes the environmental aspects of a life cycle assessment. The major life cycle stages and data gathering techniques are discussed.

5. *A Technical Framework for Life-Cycle Assessment*
   Society of Environmental Toxicology and Chemistry and SETAC Foundation for Environmental Education, Inc.
   1101 14th Street, NW
   Suite 1100
   Washington, DC 20005

   This document provides information about product, process, and activity life-cycle assessments.

6. *Life Cycle Assessment*
Z760-94
Canadian Standards Association
178 Rexdale Boulevard
Rexdale (Toronto), Ontario
Canada M9W 1R3

This manual provides technical guidance on conducting life cycle assessments and reporting assessment results.

7. *Guidelines for Assessing the Quality of Life-Cycle Inventory Analysis*
EPA/530-R-95-010
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse (PPIC)
401 M Street, SW
Washington, DC 20460
202-260-1023

This document identifies the issues and challenges confronting LCA practicioners as they seek to gather quality data for Life Cycle Inventories. The document outlines a possible framework for assessing and documenting data quality and discusses specific techniques to support the data quality assessment process.

8. *Life Cycle Assessment: Public Data Sources for the LCA Practicioner*
EPA/530-R-95-009
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse (PPIC)
401 M Street, SW
Washington, DC 20460
202-260-1023

This document provides LCA practitioners with potentially useful public data sources for preparing LCAs.

9. *Development of a Pollution Prevention Factors Methodology Based on Life-Cycle Assessment: Lithographic Printing Case Study*
EPA/600-R-94-157
U.S. Environmental Protection Agency
Office of Research and Development
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7562

This report describes a preliminary pollution prevention factors methodology which was developed using a streamlined life-cycle assessment approach. The lithographic printing industry was selected as the test industry.

10. *United States Postal Service Hartford Vehicle Maintenance Facility Waste Minimization/Pollution Prevention Study*
U.S. Postal Service
Northeast Area Office

This report provides a financial analysis of alternatives to the vehicle painting and oil handling processes used at the Hartford Vehicle Maintenance Facility. Data collection and analysis for the Total Costs Assessment was performed with the use of **P2/Finance**, a flexible spreadsheet developed by Tellus Institute.

11. *Life Cycle Design Guidance Manual: Environmental Requirements and The Product System*
EPA/600-R-92-226
U.S. Environmental Protection Agency
Office of Research and Development
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7562

This report promotes the reduction of environmental impacts and health risks through a systems approach to design by integrating environmental, performance, cost, cultural, and leagal requirements in effective designs.

12. *Federal Agency Environmental Management Program Planning Guidance*
EPA/300-B-95-001
U.S. Environmental Protection Agency
Office of Enforcement and Compliance Assurance
401 M Street, SW
Washington, DC 20460

This document discusses the data elements that will be reported to EPA under the A-106 process and provides insight into the rationale underlying those data elements.

13. *Survey of Resources Available for Estimating the Environmental Costs of Major Defense Acquisition Programs*
DASW903-94-C-0043
Office of the Director
Program Analysis & Evaluation
1800 Defense Pentagon
Washington, DC 20301-1800

This report is the first from the Survey of Resources Available for Estimating the Environmental Costs of Major Defense Acquisition Programs. It identifies existing environmental management (EM) cost estimating methods, data bases, engineering case studies, and management systems to determine their usefulness for estimating EM costs for major defense acquisition programs.

14. *Survey of Resources Available for Estimating the Environmental Costs of Major Defense Acquisition Programs*
DASW903-94-C-0043
Office of the Director
Program Analysis & Evaluation
1800 Defense Pentagon
Washington, DC 20301-1800

This report is the second from the Survey of Resources Available for Estimating the Environmental Costs of Major Defense Acquisition Programs. It presents a cost breakdown structure and a cost driver category structure for environmental management.

15. *Evaluation of Environmental Management Cost-Estimating Capabilities for Major Defense Acquisition Programs*
MDA903-94-C-0043
Office of the Director
Program Analysis & Evaluation
1800 Defense Pentagon
Washington, DC 20301-1800

This report, which is the last from the Survey of Resources Available for Estimating the Environmental Costs of Major Defense Acquisition Programs, provides assessments of the most promising cost analysis tools based on testing their capabilities against the cost breakdown structure developed earlier in the project

Pollution Prevention Planning Documents

16. *Federal Facility Pollution Prevention: Tools for Compliance*
EPA/600-R-94-154
U.S. Environmental Protection Agency
Office of Research and Development
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7562

17. *Pollution Prevention in the Federal Government: Guide for Developing Pollution Prevention Strategies for Executive Order 12856 and Beyond*
EPA/300-B-94-007
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse
401 M Street, SW
Washington, DC 20460
202-260-1023

18. *Federal Facility Pollution Prevention Guide*
EPA/300-B-94-013
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse
401 M Street, SW
Washington, DC 20460
202-260-1023

19. *Facility Pollution Prevention Guide*
EPA/600-R-92-008
U.S. Environmental Protection Agency
Office of Research and Development
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7562

20. *Pollution Prevention Directory*
EPA/742-B-94-005
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
202-260-9801

21. *Abstracts of Pollution Prevention Case Study Sources*
EPA/742-B-94-001
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse
401 M Street, SW
Washington, DC 20460
202-260-1023

22. *Summary of Pollution Prevention Case Studies With Economic Data (By SIC Codes)*
EPA/742-S-94-001
U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse
401 M Street, SW
Washington, DC 20460
202-260-1023

Agency Guidance Documents

23. *Navy Shore Installation Pollution Prevention Planning Guide*
Doc. #OPNAV-P45-120-10-94
Office of Chief of Naval Operations
2000 Navy Pentagon
Washington, DC 20350
703-602-5334

24. *U.S. Air Force Installation Pollution Prevention Program Manual*
United States Air Force
Air Force Center for Environmental Excellence (AFCEE)
AFCEE/ESP
8106 Chennault Road
Building 1161
Brooks AFB, TX 78235-5318
1-800-233-4356

25. *Army Pollution Prevention Plan Manual: A Guide for Army Installations*
Army Environmental Policy Institute
430 10th Street, NW
Suite 5105
Atlanta, GA 30318
404-875-6813

26. *Guidance for Preparation of Site Waste Minimization and Pollution Prevention Awareness Plans*
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
301-427-1570

Technical Assistance Programs

1. Pollution Prevention Information Clearinghouse (PPIC)
   U.S. Environmental Protection Agency, PM 211-A
   401 M Street, SW
   Washington, DC 20460
   202-260-1023

   The Pollution Prevention Information Clearinghouse (PPIC) is a free, nonregulatory, information and referral service of the U.S. EPA. PPIC includes a repository of pollution prevention information and a telephone reference and referral hotline.

2. Enviro$ense (ES)
   EPA Systems Development Center
   200 N. Glebe Road
   Arlington, VA 22203
   703-908-2092 (modem)
   http://wastenot.inel.gov/envirosense

   ES is a free, 24-hour electronic network accessible by personal computer equipped with a modem or direct connect through Internet WWW. ES consists of message centers, bulletins, electronic documents, technical databases, case studies and issue-specific conference listings.

3. Federal Agency Mini-Exchange (FAME)
   EPA Systems Development Center
   200 N. Glebe Road
   Arlington, VA 22203
   703-506-1025 (modem)

   FAME is a database on the Pollution Prevention Information Exchange System which provides information on pollution prevention/recycling efforts at Federal facilities.

4. Defense Environmental Network and Information Exchange (DENIX)
   DECIM Office
   Hoffman 2, Room 12S49
   200 Stovall Street
   Alexandria, VA 22332
   1-800-642-3332
   703/325-0002

   DENIX is a Department of Defense communications platform for the dissemination and exchange of environmental information across all DOD components.

5. PRO-ACT
   AFCEE
   8106 Chennault Road
   Building 1161
   Brooks AFB, TX 78235-5318
   1-800-233-4356
   (210) 536-4214
   DSN 240-4214

   PRO-ACT is an environmental information clearinghouse and hotline provided by the Air Force Center for Environmental Excellence (AFCEE). PRO-ACT services are provided free of charge to all Air Force personnel.

6. Center for Environmental Research Information (CERI)
   Dorothy Williams
   U.S. Environmental Protection Agency
   Center for Environmental Research Information (CERI)
   26 West Martin Luther King Drive
   Cincinnati, OH 45268
   513-569-7562

   CERI serves as the exchange of scientific and technical environmental information produced by EPA in brochures, capsule and summary reports, handbooks, newsletters, project reports, and manuals.

7. Center for Waste Reduction Technologies (CWRT)
American Institute of Chemical Engineers
345 East 47th Street
New York, NY 10017
212-705-7407

CWRT was established in 1989 by the American Institute of Chemical Engineers to support industry efforts in meeting the challenges of waste reduction through a partnership with industry, academia, and government.

8. The National Pollution Prevention Roundtable
David Thomas
218 D Street, SE
Washington, DC 20003
202-543-7272

The Roundtable is a group of pollution prevention program at the State and local level in both the public and academic sectors. The member programs are engaged in activities including multi-audience training and primary to post-secondary pollution prevention education.

9. Northeast States Pollution Prevention Roundtable (NE Roundtable)
Terri Goldberg, Program Manager
Northeast States Pollution Prevention Roundtable / Northeast Waste Management Officials' Association
85 Merrimac Street
Boston, MA 02114
617-367-8558

The NE Roundtable was initiated in 1989 by the Northeast Waste Management Officials' Association to assist State programs, industry, and the public in implementing effective source reduction programs.

10. Pacific Northwest Pollution Prevention Research Center
Madeline Grulich, Director
Pacific Northwest Pollution Prevention Research Center
411 University Street, Suite 1252
Seattle, WA 98101
206-223-1151

The Pacific Northwest Pollution Prevention Research Center is a non-profit public-private partnership dedicated to the goal of furthering pollution prevention in the Pacific Northwest.

11. Waste Reduction Institute for Training and Applications Research, Inc. (WRITAR)
Terry Foecke
Waste Reduction Institute for Training and Applications Research
1313 5th Street, SE
Minneapolis, MN 55414-4502
612-379-5995

WRITAR is designed to identify waste reduction problems, help find their solutions, and facilitate the dissemination of this information to a variety of public and private organizations.

12. Waste Reduction Resource Center for the Southeast (WRRC)
Gary Hunt
Waste Reduction Center for the Southeast
3825 Barrett Drive
P.O. Box 27687
Raleigh, NC 27611-6787

WRRC was established to provide multimedia waste reduction support for the eight states of U.S. EPA IV (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee).

Federal Facility Pollution Prevention Contacts

Department of Agriculture
William Opfer
Environmental Health Engineer
Department of Agriculture
P.O. Box 96090
Washington, DC 20090-6090
202-205-0906

Central Intelligence Agency
Larry McGinty
Chief, Environmental and Safety Group/OMS
Central Intelligence Agency
Washington, DC 20505
703-482-4533

Coast Guard
T. J. Granito, Environmental Compliance and Restoration Branch
P2 and Recycling Coordinator
U.S. Coast Guard
USCG (G-ECV-1B)
2100 2nd Street, SW
Washington, DC 20593
202-267-1941

Department of Commerce
Jack Murphy
Environmental Compliance Officer
Office of Management Support
U.S. Department of Commerce
Room 6020
14th and Constitution Avenue
Washington, DC 20230
202-482-4115

Department of Energy
Susan C. Weber
Waste Minimization Division
Office of Waste Management (EM-334)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
301-903-1388

Department of the Interior
Connie Kurtz
Environmental Protection Specialist
Division of Hazardous Materials Management
Department of the Interior, MS 2340-MIB, Room 2349
Office of Environmental Affairs
1849 C Street, NW
Washington, DC 20240
202-208-7554

Department of Justice
Marvin Fink
Safety and Health Manager
Security and Emergency Planning Staff
U.S. Department of Justice, Room 6525
10th and Constitution Avenue, NW
Washington, DC 20530
202-514-5076

Department of Transportation
Janet Krause
Environmental Engineer
Office of the Secretary
Department of Transportation
400 7th Street, SW
Washington, DC 20590
202-366-0038

Department of the Treasury
William McGovern
Chief, Environmental Compliance Division
Department of the Treasury
Treasury Annex
1500 Pennsylvania Avenue, NW
Washington, DC 20220
202-622-0043

Department of Veterans Affairs
John Staudt
Chief, Hazardous Materials Management Division
Department of Veterans Affairs, 138C-4
810 Vermont Avenue, NW
Washington, DC 20420
202-233-7863

Economic Development Administration
Dr. Frank Monteferrante
Senior Environmental Specialist
U.S. Department of Commerce
Herbert C. Hoover Building, Room 7019
Washington, DC 20230
202-482-4208

Federal Aviation Administration
Tom Halloway
Manager of Hazardous Materials and Special Projects Staff
Federal Aviation Administration, AEE-20
800 Independence Avenue, SW
Washington, DC 20591
202-267-8114

Food and Drug Administration
Dr. Naresh K. Chawla
Chief, FDA Safety Office (HFA-205)
Food and Drug Administration
7500 Standish Place
Rockville, MD 20855
301-594-1718

General Services Administration
Karone Peace
Safety and Environmental Division
Environmental Branch (PMS)
General Services Administration, Room 4340
18th and F Streets, NW
Washington, DC 20450
202-501-3518

National Aeronautical Space Administration
Olga Dominguez
Environmental Management Division
National Aeronautics and Space Administration
NASA Headquarters, Code JE
Washington, DC 20546
202-358-1093

National Oceanic and Atmospheric Administration
I. Sam Higuchi, Jr.
Senior Environmental Compliance Officer
National Oceanic and Atmospheric Administration
SSMC-2/OA3X1 Room 4434
1325 East West Highway
Silver Spring, MD 20910
301-713-0845

National Security Agency
Barbara Krupiarz
Project Manager, Pollution Prevention Program
Environmental Service Division
National Security Agency, (APS-13), Room AT200
Department of Defense
9800 Savage Road
Fort Meade, MD 20755-6000
410-684-7305

Postal Service
Bernie Denno
Environmental Specialist
U.S. Postal Service, Room 6830
475 L'Enfant Plaza, SW
Washington, DC 20260-2810
202-268-6014

Tennessee Valley Authority
Paul Schmierbach
Environmental Compliance Department
Tennessee Valley Authority
400 Summit Hill Drive
Knoxville, TN 37902
615-632-6644

State Pollution Prevention Programs

ALABAMA

Alabama Waste Reduction and Technology Transfer (WRATT) Program
Daniel E. Cooper, Chief
Special Projects
Alabama Department of Environmental Management
1751 Congressman William L. Dickinson Drive
Montgomery, AL 36130
205-260-2779

ALASKA

Pollution Prevention Office
David Wigglesworth, Chief
Pollution Prevention Office
Alaska Department of Environmental Conservation
P.O. Box O
Juneau, Alaska 99811-1800
907-465-5275

Waste Reduction Assistance Program (WRAP)
Kristine Benson
Alaska Health Project
1818 West Northern Lights Boulevard
Suite 103
Anchorage, AK 99517
907-276-2864

ARIZONA

Arizona Waste Minimization Program
Sandra Eberhardt, Manager
Pollution Prevention Unit
Arizona Department of Environmental Quality
3033 North Central Avenue, Rm. 558
Phoenix, AZ 85012
602-207-4210

ARKANSAS

Arkansas Pollution Prevention Program
Robert J. Finn
Hazardous Waste Division
Arkansas Department of Pollution Prevention and Ecology
P.O. Box 8913
Little Rock, AR 72219-8913
501-570-2861

CALIFORNIA

Department of Toxic Substances Control
Mr. Kim Wilheim
Department of Toxic Substances Control
Pollution Prevention, Public and Regulatory Assistance Division
400 P Street
P.O. Box 806
Sacramento, CA 95812-0806
916-322-3670

Tony Eulo
Local Government Commission
909 12th Street
Suite 205
Sacramento, California 95814
916-448-1198

California Integrated Waste Management Board
8800 Cal Center Drive
Sacramento, California 95826
Recycling Hotline: 800-553-2962
General Public Information: 916-255-2289

COLORADO

Pollution Prevention and Waste Reduction Program
Kate Kramer, Program Manager
Pollution Prevention Waste Reduction Program
Colorado Department of Health
4300 Cherry Creek Drive South
Denver, CO 80220
303-692-3003

Michael Nemeck
Colorado Public Interest Research Group (COPIRG)
1724 Gilpin Street
Denver, Colorado 80218
303-355-1861

CONNECTICUT

Connecticut Technical Assistance Program (CONNTAP)
Andrew Vecchio
Connecticut Technical Assistance Program (ConnTAP)
Connecticut Hazardous Waste Management Service
900 Asylum Avenue
Suite 360
Hartford, Connecticut 06105-1904
203-241-0777

Connecticut Department of Environmental Protection
Liz Napier
Bureau of Waste Management
Connecticut Department of Environmental Protection
165 Capitol Avenue
Hartford, Connecticut 06106
203-566-5217

DELAWARE

Delaware Pollution Prevention Program
Philip J. Cherry
Andrea K. Farrell
Pollution Prevention Program
Department of Natural Resources and Environmental Control
P.O. Box 1401
Kings Highway
Dover, DE 19903
302-739-5071/3822
Herb Allen
Department of Civil Engineering
University of Delaware
Newark, DE 19716
302-451-8522/8449

DISTRICT OF COLUMBIA

Office of Recycling
Evelyn Shields, Recycling Coordinator
D.C. Department of Public Works
65 K Street, NE
Washington, DC 20002
202-727-5887

George Nichols
Department of Environmental Programs
Council of Governments
777 North Capitol St., NE
Suite 300
Washington, DC 20002-4201
202-962-3355

Kenneth Laden
Environmental Policy Division
D.C. Department of Public Works
2000 14th St., NW
Washington, DC 20009
202-939-8115

Ms. Ferial Bishop, Administrator
Environmental Regulation Administration
D.C. Department of Consumer and Regulatory Affairs
2100 MLK Avenue, SE
Suite 203
Washington, DC 20020
202-404-1136

FLORIDA

Waste Reduction Assistance Program (WRAP)
Janeth A. Campbell, Director
Waste Reduction Assistance Program
Florida Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, Florida 32399-2400
904-488-0300

GEORGIA

Georgia Multimedia Source Reduction and Recycling Program
Susan Hendricks, Program Coordinator
Environmental Protection Division
Georgia Department of Natural Resources
4244 International Parkway, Suite 104
Atlanta, GA 30334
404-362-2537

HAWAII

Hazardous Waste Minimization Program
Jane Dewell
Waste Minimization Coordinator
State of Hawaii Department of Health
Solid and Hazardous Waste Branch
Five Waterfront Plaza, Suite 250
500 Ala Moana Blvd.
Honolulu, HI 96813
808-586-4226

John Harder
Department of Health
Office of Solid Waste
5 Waterfront Place, Suite 250
500 Ala Moana Blvd.
Honolulu, HI 96813
808-586-4373

IDAHO

Division of Environmental Quality
Joy Palmer
Katie Sewell
Division of Environmental Quality
Idaho Department of Health and Welfare
1410 North Hilton Street
Boise, ID 83720-9000
208-334-5879

ILLINOIS

Illinois Hazardous Waste Research and Information Center (HWRIC)
Dr. David Thomas, Director
Illinois Hazardous Waste Research and Information Center
One East Hazelwood Drive
Champaign, IL 61820
217-333-8940

Office of Pollution Prevention
Mike Hayes
Illinois Environmental Protection Agency
Office of Pollution Prevention
2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276
217-785-0533

INDIANA

Office of Pollution Prevention and Technical Assistance
Joanne Joice, Director
Charles Sullivan, Environmental Manager
Office of Pollution Prevention and Technical Assistance
Indiana Department of Environmental Management
105 South Meridian Street
P.O. Box 6015
Indianapolis, IN 46225
317-232-8172

Indiana Pollution Prevention Program
Rick Bossingham, Coordinator
Jeff Burbrink, Agricultural Pollution Prevention Coordinator
Environmental Management and Education Program
2129 Civil Engineering Building
Purdue University
West Lafayette, IN 47907-1284
317-494-5038

IOWA

Iowa Waste Reduction Center (IWRC)
John Konefes, Director
Kim Gunderson, Environmental Specialist
Iowa Waste Reduction Center
University of Northern Iowa
Cedar Falls, IA 50614-0185
319-273-2079

Waste Management Authority Division
Tom Blewett, Bureau Chief
Scott Cahail, Environmental Specialist
Waste Management Authority Division
Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319
515-281-8941

KANSAS

State Technical Action Plan (STAP)
Tom Gross, Bureau Chief
State Technical Action Plan
Kansas Department of Health and Environment
Forbes Field, Building 740
Topeka, KS 66620
913-296-1603

Kansas State University RITTA Program
Lani Himegarner, Program Manager
Engineering Extension Programs
133 Ward Hall
Kansas State University
Manhattan, KS 66506-2508
913-532-6026

KENTUCKY

Kentucky Partners - State Waste Reduction Center
Joyce St. Clair, Executive Director
Kentucky Partners - State Waste Reduction Center
Ernst Hall, Room 312
University of Louisville
Louisville, KY 40292
502-588-7260

LOUISIANA

Louisiana Department of Environmental Quality
Gary Johnson, Waste Minimization Coordinator
Louisiana Department of Environmental Quality
P.O. Box 82263
Baton Rouge, LA 70884-2263
504-765-0720

MAINE

Maine Waste Management Agency
Gayle Briggs
Maine Waste Management Agency
State House Station 154
Augusta, ME 04333
207-287-5300

MARYLAND

Waste Management Administration
James Francis
Hazardous Waste Program
Waste Management Administration
Maryland Department of the Environment
2500 Broening Highway, Building 40
Baltimore, MD 21224
410-631-3344

Maryland Environmental Services
George G. Perdikakis, Director
Maryland Environmental Services
2020 Industrial Drive
Annapolis, MD 21401
301-974-7281

Technical Extension Service
Travis Walton, Director
Technical Extension Service
Engineering Research Center
University of Maryland
College Park, MD 20742
301-454-1941

MASSACHUSETTS

Office of Technical Assistance for Toxics Use Reduction
Barbara Kelley, Director
Richard Reibstein, Outreach Director
Massachusetts Department of Environment
Office of Technical Assistance
100 Cambridge Street
Boston, MA 02202
617-727-3260

Toxics Use Reduction Institute
Jack Luskin
Director of Education and Outreach
Toxics Use Reduction Institute
University Avenue
Lowell, MA 01854
508-934-3262

MICHIGAN

Office of Waste Reduction Services
Nan Merrill, Manager
Office of Waste Reduction Services
Environmental Services Division
Michigan Departments of Commerce and Natural Resources
116 West Allegan Street
P.O. Box 30004
Lansing, MI 48909-7504
517-335-1178

MINNESOTA

Minnesota Office of Waste Management
Kevin McDonald, Sr., Pollution Prevention Planner
Minnesota Office of Waste Management
1350 Energy Lane
Suite 201
St. Paul, MN 55108-5272
612-649-5750/5744

Minnesota Pollution Control Agency (MPCA)
Eric Kilberg, Pollution Prevention Coordinator
Environmental Assessment Office
Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155
612-296-8643

Minnesota Technical Assistance Program (MNTAP)
Cindy McComas, Director
Minnesota Technical Assistance Program
Environmental Health School of Public Health
University of Minnesota
1313 5th Street, S.E., Suite 207
Minneapolis, MN 55414
612-627-4555/4646

MISSISSIPPI

Mississippi Waste Reduction/Waste Minimization Program, Mississippi Technical Assistance Program (MISSTAP) and Mississippi Solid Waste Reduction Assistance Program (MSSWRAP)
Dr. Caroline Hill
Mississippi Technical Assistance Program/
Mississippi Solid Waste Reduction Assistance
P.O. Drawer CN
Mississippi State, MS 39762
601-325-8454

Thomas E. Whitten, Director
Waste Reduction/Waste Minimization Program
Mississippi Department of Environmental Quality
P.O. Box 10385
Jackson, MS 39289-0385
601-961-5171

MISSOURI

Waste Management Program (WMP)
Becky Shannon, Pollution Prevention Coordinator
Hazardous Waste Program
Division of Environmental Quality
Missouri Department of Natural Resources
205 Jefferson Street
P.O. Box 176
Jefferson City, MO 65102
314-751-3176

Environmental Improvement and Energy Resources Authority
Steve Mahfood, Director
Tom Welch, Assistant for Planning and Project Development
Environmental Improvement and Energy Resources Authority
225 Madison Street
P.O. Box 744
Jefferson City, MO 65102
314-751-4919

MONTANA

Solid and Hazardous Waste Bureau
Dan Fraser
Water Quality Bureau Chief
Department of Health and Environmental Sciences
Room A-206
Cogswell Building
Helena, MT 59620
406-444-2406

Jeff Jacobsen
Montana State University Extension Service
807 Leon Johnson Hall
Bozeman, MT 59717-0312
406-994-5683

NEBRASKA

Hazardous Waste Section
Teri Swarts, Waste Minimization Coordinator
Hazardous Waste Section
Nebraska Department of Environmental Control
301 Centennial Mall South
P.O. Box 98922
Lincoln, NE 68509
402-471-4217

NEVADA

Business Environmental Program
Kevin Dick, Manager
Business Environmental Program
Nevada Small Business Development Center
University of Nevada - Reno
Reno, NV 89557-0100
702-784-1717

Doug Martin
Bureau of Waste management
Division of Environmental Protection
123 West Nye Lane
Carson City, NV 89710
702-687-5872

Nevada Energy Conservation Program
Curtis Framel, Manager
Nevada Energy Conservation Program
Office of Community Services
Capitol Complex
201 South Fall Street
Carson City, NV 89710
702-885-4420

NEW JERSEY

New Jersey Pollution Prevention Program
Jean Herb, Director
Office of Pollution Prevention
New Jersey Department of Environmental Protection
CN-402
401 East State Street
Trenton, NJ 08625
609-777-0518

New Jersey Technical Assistance Program (NJTAP)
Kevin Gashlin, Director
New Jersey Technical Assistance Program
New Jersey Institute of Technology
Hazardous Substance Management Research Center
Center for Environmental and Engineering Sciences
323 Martin Luther King Boulevard
Newark, NJ 07102
201-596-5864

NEW YORK

Bureau of Pollution Prevention
John Ianotti, Director
Bureau of Pollution Prevention
Division of Hazardous Substances Regulation and the
Division of Solid Waste
New York State Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-7253
518-457-7276

NORTH CAROLINA

Pollution Prevention Program
Gary Hunt, Director
Stephanie Richardson, Manager
Pollution Prevention Program
Office of Waste Reduction
North Carolina Department of Environment, Health, and Natural Resources
P.O. Box 27687
Raleigh, NC 27611-7687
919-571-4100

OHIO

Ohio Technology Transfer Organization (OTTO)
Jeff Shick, State Coordinator
Jackie Rudolf
Ohio Technology Transfer Organization
Ohio Department of Development
77 South High Street, 26th Floor
Columbus, OH 43255-0330
614-644-4286

Ohio Environmental Protection Agency
Roger Hannahs
Michael W. Kelley
Anthony Sasson
Pollution Prevention Section
Division of Hazardous Waste Management
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, OH 43266-0149
614-644-3969

OKLAHOMA

Pollution Prevention Technical Assistance Program
Chris Varga
Hazardous Waste Management Service, 0205
Oklahoma State Department of Health
1000 Northeast 10th Street
Oklahoma City, OK 73117-1299
405-271-7047

OREGON

Waste Reduction Assistance Program (WRAP)
Roy W. Brower, Manager
David Rozell, Pollution Prevention Specialist
Phil Berry, Pollution Prevention Specialist
Hazardous Waste Reduction and Technical Assistance Program
Hazardous and Solid Waste Division
Oregon Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, OR 97204
503-229-6585

PENNSYLVANIA

Department of Environmental Resources
Meredith Hill
Assistant to Deputy Secretary
Office of Air and Waste Management
Pennsylvania Department of Environmental Resources
P.O. Box 2063
Harrisburg, PA 17105-2063
717-772-2724

Center for Hazardous Materials Research
Roger Price
Center for Hazardous Materials Research
University of Pittsburgh Applied Research Center
320 William Pit Way
Pittsburgh, PA 15238
412-826-5320
1-800-334-CHMR

Pennsylvania Technical Assistance Program (PENNTAP)
Jack Gido, Director
PENNTAP
Penn State University
110 Barbara Building II
810 North University Drive
University Park, PA 16802
814-865-0427

RHODE ISLAND

Hazardous Waste Reduction Program
Richard Enander, Chief
Janet Keller
Office of Environmental Coordination
Rhode Island Department of Environmental Management
83 Park Street
Providence, RI 02903-1037
401-277-3434

Eugene Pepper, Senior Environmental Planner
Hazardous Waste Reduction Section
Office of Environmental Coordination
Rhode Island Department of Environmental Management
83 Park Street
Providence, RI 02903
401-277-3434

SOUTH CAROLINA

Center for Waste Minimization
Ray Guerrein
Center for Waste Minimization
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
802-734-4715

SOUTH DAKOTA

Waste Management Program
Wayne Houtcooper
Department of Environment and Natural Resources
Joe Foss Building
523 E. Capitol Avenue
Pierre, SD 57501-3181
605-773-4216

TENNESSEE

Department of Health and Environment
Paul Evan Davis
Bureau of Environment
Tennessee Department of Health and Environment
14th Floor, L & C Building
401 Church Street
Nashville, TN 37243-0455
615-741-3657

Waste Reduction Assessment and Technology Transfer Training Program (WRATT)
George Smelcer, Director
Waste Reduction Assistance Program
Cam Metcalf (Suite 606)
Center for Industrial Services
University of Tennessee
226 Capitol Boulevard Building
Nashville, TN 37219-1804
615-242-2456

Carroll Dugan, Section Manager
Waste Reduction and Management Section
Tennessee Valley Authority
Mail Code HB 2G-C
311 Broad Street
Chattanooga, TN 37406
615-751-4574

TEXAS

Center for Hazardous and Toxic Waste Studies
John R. Bradford, Director
Center for Hazardous and Toxic Waste Studies
Texas Tech University
P.O. Box 4679
Lubbock, TX 79409-3121
806-742-1413

UTAH

Department of Environmental Quality
Sonja Wallace, Pollution Prevention Co-Coordinator
Stephanie Bernkopf, Pollution Prevention Co-Coordinator
Office of Executive Director
Utah Department of Environmental Quality
168 North 1950 West Street
Salt Lake City, UT 84114-4810
801-536-4480

VERMONT

Pollution Preventior Program
Gary Gulka
Pollution Prevention Division
Vermont Department of Environmental Conservation
103 South Main Street
Waterbury, VT 05676
802-244-8702

Paul Maskowitz, Chief
Recycling and Resource Conservation Section
Vermont Department of Environmental Conservation
103 South Main Street
Waterbury, VT 05676
802-244-8702

VIRGINIA

Waste Minimization Program
Sharon Kenneally-Baxter, Director
Waste Minimization Program
Virginia Department of Waste Management
Monroe Building, 11th Floor
101 N. 14th Street
Richmond, VA 23219
804-371-8716

WASHINGTON

Waste Reduction, Recycling and Litter Control Program
Stan Springer
Joy St. Germain
Peggy Morgan
Waste Reduction, Recycling and Litter Control Program
Washington Department of Ecology
Mail Stop PV-11
Olympia, WA 98504-8711
206-438-7541

WEST VIRGINIA

Pollution Prevention and Open Dump Program (PPOD)
Richard Ferrell, Environmental Analyst
Waste Management Section
West Virginia Division of Natural Resources
1356 Hansford Street
Charleston, WV 25301
304-558-4000

WISCONSIN

Department of Natural Resources
Lynn Persson, Hazardous Waste Reduction and Recycling Coordinator
Kate Cooper, Assistant Recycling Coordinator
Bureau of Solid and Hazardous Waste Management
Wisconsin Department of Natural Resources
P.O. Box 7921 (SW/3)
Madison, WI 53707-7921
608-267-3763

WYOMING

Department of Environmental Quality
David Finley, Manager
Pat Gallagher, Senior Environmental Analyst
Solid Waste Management Program
Wyoming Department of Environmental Quality
122 West 25th Street
Herschler Building
Cheyenne, WY 82002
307-777-7752

Appendix C
READER FEEDBACK SURVEY

This manual has been developed to make analysis of pollution prevention projects easier to understand and implement. We would appreciate your feedback on this manual to improve future editions and to be able to supply additional support as needed. Please take the time to respond to the questions below, and send it back using the address given at the end of this survey. Thank you.

1. Will the methodologies discussed in this manual be helpful to you? Why or why not?

2. Are you currently using any of the financial analysis concepts described in this manual? If so, what kind of success have you had?

3. Are there cost elements of your particular projects that are not covered in this manual that need to be addressed?

4. What topics covered in this manual would you like to see explained in greater detail?

5. Does your facility or operation use any type of software program that automates the cost accounting process for pollution prevention or other projects? If so, please describe.

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6. Additional comments:

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If you are interested in receiving an electronic copy of the spreadsheets contained within this manual, please fill in your name, address and preferred spreadsheet format below. In addition, EPA intends to make electronic versions of the manual and spreadsheets available through the Enviro$ense bulletin board (703- 908-2092)and World Wide Web site on the Internet(http://wastenot.inel.gov/environsense).

Please send me electronic versions of the manual spreadsheets in the following format:

Excel ______ Lotus 1-2-3 ______

Name:

Address:

E-Mail Address:

MAIL/FAX TO: Mr. Rick Brenner
U.S. Environmental Protection Agency
Federal Facilities Enforcement Office
401 M Street, SW (OE-2261)
Washington, DC 20460
202-260-6177 (telephone)
202-260-9437 (facsimile)