FINDING COST-EFFECTIVE POLLUTION PREVENTION INITIATIVES:

Incorporating Environmental Costs Into Business Decision Making

a primer

Global Environmental
Management Initiative
(GEMI)

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About the Global Environmental Management Initiative (GEMI)

GEMI currently consists of 28 leading companies dedicated to fostering environmental excellence by business worldwide. Through the collaborative efforts of its members, GEMI intends to promote a worldwide business ethic for environmental management performance through example and leadership, and to enhance the dialogue between business and its interested publics. GEMI's current member companies are:

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Preface

In 1992, the Global Environmental Management Initiative (GEMI) introduced the business world to a management concept known as Total Quality Environmental Management (TQEM). TQEM merges the principles of Total Quality Management, espoused by management guru Dr. W. Edwards Deming, and the goals of environmental management. GEMI is committed to TQEM because it emphasizes the continuous improvement of a company's environmental activities. As part of this commitment, GEMI provides guidance on, and serves as a forum for, TQEM ideas.

This primer on "finding cost-effective pollution prevention initiatives" describes an approach that supports TQEM principles by improving an organization's decision making. A process is described for evaluating sustainable pollution prevention initiatives and other investment options by appropriately including environmental[1] costs and savings for each option. The primer is intended to help a broad audience of diverse professionals to improve their decision making using more comprehensive cost information.

1. The term Environmental as used in this primer also refers to environmentally related aspects of health, safety and product stewardship.

Acknowledgments

This primer was developed under the auspices of GEMI's Environmental Management Tools & Methods Work Group. It was written by Dave Mitamura of the Law Companies Environmental Policy Center, with research assistance from Jennifer Olha. In addition, a Peer Review Panel provided valuable comments on the draft primer. The Panel consisted of the following individuals:

Susan B. Hughes for the Institute of Management Accountants
Randy Price for The Business Roundtable
Martin Spitzer, U.S. Environmental Protection Agency
Chris Stinson, University of Texas
Allen White, Tellus Institute

In particular, both Mr. Price and Dr. White provided invaluable guidance in developing the primer.

Michael Fisher (Procter & Gamble), the Chairman of the GEMI Environmental Management Tools & Methods Work Group, directed this project with significant contributions from Work Group members Peter Chatel (The Coca-Cola Company), Kristine Link (Amoco Corporation), and George Nagle (Bristol-Myers Squibb Company). Other Work Group members also provided valuable input:

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Chapter 1.
INTRODUCTION

This environmental cost primer is intended to help the international business community find cost-effective pollution prevention initiatives by incorporating environmental costs into the business decision-making process. The resulting improved decision making reinforces the Total Quality Environmental Management (TQEM) principles advocated by GEMI. This is accomplished by improving a company's decisions on sustainable pollution prevention initiatives and other investment options by appropriately including environmental costs and savings for each option. Many parties with environmental responsibilities are turning to so-called environmental cost accounting approaches to improve their decision making. In fact, the U.S. government's National Performance Review has recommended that all government agencies performing a capital budgeting analysis of potential investments should include environmental cost information for each option.[2]

The approach described in this primer can be applied to all investment alternatives to allow a true and fair economic comparison of potential projects. Historically, capital budgeting evaluations often did not include all environmental costs and savings. Consequently, capital budgeting decisions may have prematurely dismissed pollution prevention projects even though those projects contained considerable environmental cost savings that were frequently overlooked. The importance of considering environmental costs in evaluating all alternatives, not just pollution prevention projects, is an implicit assumption throughout this primer. The primer is meant to raise the economic valuation of pollution prevention projects to a level that is equal to, not greater than, other alternative investments. Evaluating pollution prevention projects on a basis equal to that of other investments allows pollution prevention projects to justly compete for investment dollars.

This primer provides a map to guide the reader through the evaluation process; it is not a comprehensive guide for finding cost-effective pollution prevention initiatives. The target audience for the primer is broad and includes environmental health and safety (EHS) staff, project engineers, site personnel, accounting and

2. *Reinventing Environmental Management,* National Performance Review, Washington, DC, April 1994.

finance personnel, general management, and others within an organization. Performing credible and worthwhile analyses depends on the input of this broad audience. Therefore, the underlying theme of this primer is to facilitate communication among these professionals to establish capital budgeting procedures that provide better cost information for improved decision making. As the reader becomes comfortable with the simple concepts described in this primer, more detailed technical guidance may be consulted.[3]

Simply, this primer is just one step in a continuous process of improvement. TQEM's emphasis on continual process improvement can be complemented by effective use of this primer's approach for finding cost-effective pollution prevention. Using the decision-making tool described in this primer enables companies to deliver sustainable pollution prevention projects, as well as other projects. The specifics of this cost evaluation approach are explored in the balance of this primer:

- Chapter 2 provides a simple description of the process and the definitions of useful terms;

- Chapter 3 discusses an approach to identify environmental costs that a manager must quantify and allocate across appropriate business functions and/or activities;

- Chapter 4 describes an approach for evaluating projects by incorporating environmental costs in standard financial assessment tools; and

- Chapter 5 discusses key components needed to ensure use of this approach and how the approach can be institutionalized.

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3. Several publications provide in-depth technical guidance on the financial analysis of pollution prevention projects. For a more comprehensive application of the approach described in this primer, see Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis (EPA/741/R-92/002), prepared for the U.S. Environmental Protection Agency by the Tellus Institute, May 1992. (Other references may be found in this primer's Bibliography.)

Chapter 2.
DEFINING THE PROCESS AND TERMINOLOGY

This primer describes an approach for incorporating environmental costs into an organization's internal decision-making process to help find cost-effective pollution prevention initiatives. A schematic of the process used to successfully implement the approach is presented in Exhibit 1. The schematic and its accompanying description are intended to provide context for the reader, as well as to serve as a roadmap for the remaining chapters. In addition, to ensure that the terminology used in this document is easily understood, this chapter provides definitions for the approach and other relevant financial analysis terms.

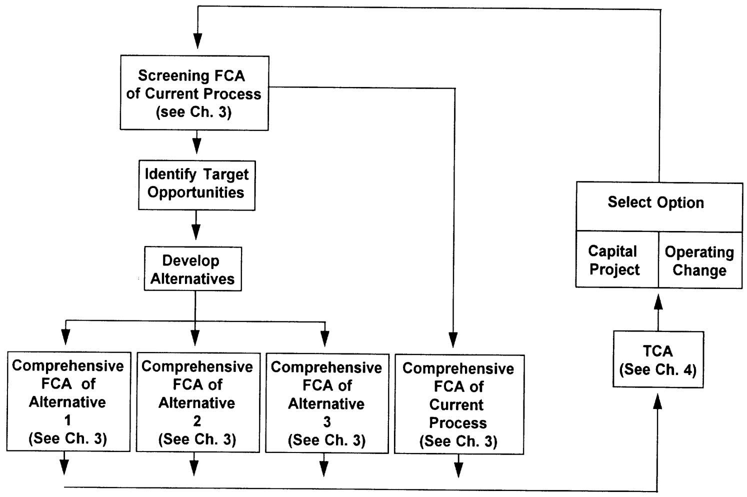
The Process

Finding cost-effective pollution prevention is a simple and straightforward process. Exhibit 1 illustrates that, while incorporating environmental costs into decision making is seemingly complex and demands extensive resources, the process merely enhances the capital budgeting/project evaluation systems already in place in many organizations.

Process Description

The process for finding cost-effective pollution prevention projects, as shown in Exhibit 1 and developed throughout this primer, is one of continuous improvement. It begins with a "screening" stage full cost accounting (FCA) analysis on the process/product in question. The screening stage produces preliminary cost information to help identify target opportunities and alternatives for further evaluation, which involves developing "comprehensive" FCA data and then using the data in a total cost assessment (TCA). The results of the TCA are used to compare alternatives and to select an appropriate option. Once specific improvement projects are implemented, the manager should ensure that the changes have produced the desired results, continue to collect revised FCA data, and look for new opportunities.

Exhibit 1
The Process for Finding Cost-Effective Pollution Prevention



Description of Terms

Full cost accounting (FCA) is a tool used to identify, quantify, and allocate the direct and indirect environmental costs of ongoing operations. FCA helps identify and quantify the following four types of costs for a product, process, or project:

- Direct costs (e.g., capital, raw materials);
- Hidden costs (e.g., monitoring, compliance reporting);
- Contingent liability costs (e.g., remedial liabilities); and
- Less tangible costs (e.g., public relations, good will).

These costs are described in more detail in Chapter 3.

FULL COST ACCOUNTING is a tool used to better understand and track environmental costs of ongoing operations.

FCA may be performed with varying degrees of intensity. In its initial or "screening" stage, FCA involves a preliminary assessment of environmental costs and other traditionally considered costs associated with a current process. This screening step can rely on known and readily available environmental costs, such as direct and obvious hidden costs, to help identify target opportunities for pollution prevention. The "comprehensive" FCA is an expansion of the "screening" activity and will typically involve data gathering and the evaluation of the types of costs listed above.

TCA is used to assess pollution prevention projects using environmental cost data, appropriate time horizons, and standard financial indicators. It is a key component in a capital budgeting system that measures pollution prevention initiatives on a "level playing field" with other capital projects or operating changes. Each company's specific capital budgeting procedures should drive the choice of appropriate financial tools for evaluating investment choices.

TOTAL COST ASSESSMENT evaluates pollution prevention projects using environmental cost data, appropriate time horizons, and standard financial indicators.

Through the capital budgeting process, managers can answer questions such as: "Is a pollution prevention project a better investment than a new training program?" or "What is the best process for achieving the desired pollution prevention result?" In a number of industries, traditional capital budgeting decisions overlook pollution prevention projects because environmental costs are not considered to be significant factor in the evaluation. TCA utilizes FCA techniques to properly assign environmental costs and savings to all competing projects, products, or processes as part of capital budgeting.

Under TCA, decision makers typically will use traditional financial measures in determining the feasibility of an investment project, such as:

- Net present value;
- Internal rate of return;
- Profitability index; and
- Payback period.

These measures are defined below.

Net present value (NPV) is the difference between the cash that a company expects to realize (i.e., inflow) and the cash a company expects to pay out (i.e., outflow) from holding an asset or liability, discounted by an appropriate rate of return.

NPV methodology "discounts," to a present value, the dollars received or paid in future periods by the amount of interest that could be earned today or, more specifically, by a company's required rate of return (i.e., the rate that could be obtained on an investment of comparable risk). These present value cash flows are then summed to determine the project's NPV. In general, a project option with a better NPV is an acceptable investment.

The NPV measure alone, however, is not a strong criterion for selecting the preferred project. Other factors, such as the initial capital investment and the length of the project, also may be considered in making an investment decision. In addition, qualitative factors may be an important consideration. Importantly, each organization must tailor its project evaluation and selection system to meet its needs and objectives.

The **internal rate of return** (IRR) approach calculates the discount rate that equates the present value of a project's expected cash inflows to the present value of a project's outflows.

The **profitability index,** also known as the benefit-cost ratio, is the present value of a project's cash flows (i.e., NPV plus the initial capital investment) divided by the initial capital investment. This index modifies the NPV criterion by incorporating the size of the initial investment into the decision. The highest index is preferable in most cases.

The **payback period** is the expected number of years that a project must continue to operate before it recovers its original investment. The project with the shortest payback period is preferable. The payback period, however, is not a recommended stand-alone measure of a project's feasibility.

Other Terms

Two additional terms — life cycle analysis and life cycle cost analysis — have meaning for accounting and capital budgeting of environmental costs. While these terms have only a peripheral relationship to this primer, they are included for reference purposes but are not examined in detail.

Life cycle analysis (LCA) is a system-oriented approach that estimates the environmental inventories (i.e., waste generation, emissions, and discharges) and energy and resource usage associated with a product, process, or operation throughout all stages of the life cycle. LCA is often used to compare the environmental effects and resource usage of alternative products or processes. It is not cost accounting.

Through a **life cycle cost analysis,** managers assign a cost to each impact quantified in the LCA and sum these costs to estimate the net environmental cost of a product, process, or project. Life cycle cost analysis differs from total cost assessment because it may include private (internal) and social (external) costs and benefits of an investment.

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Chapter 3.
FULL COST ACCOUNTING (FCA): IDENTIFYING AND QUANTIFYING ENVIRONMENTAL COSTS

To implement a successful total cost assessment (TCA), as outlined later in Chapter 4, the reader must first identify and quantify environmental costs associated with ongoing operations. The accurate identification and quantification of these costs, known as **full cost accounting** (FCA), is a fundamental step in evaluating sustainable pollution prevention initiatives. To continually improve and successfully manage environmental considerations, a company must be able to measure progress. FCA is also the ongoing measurement aspect of TCA.

FCA, however, has barriers to its implementation that should be noted. The most prominent barrier to obtaining environmental costs is uncertainty. This process goes beyond traditional project financial analysis by requiring managers to think beyond traditional, fully-understood costs. With no or limited experience to guide the process, a great deal of uncertainty enters the analysis. This uncertainty may drive a manager to ask: “Am I considering all of the potential types of costs? What is an environmental cost? In what periods do these costs occur? How much data is enough? How can I be sure that my cost estimates are accurate?”

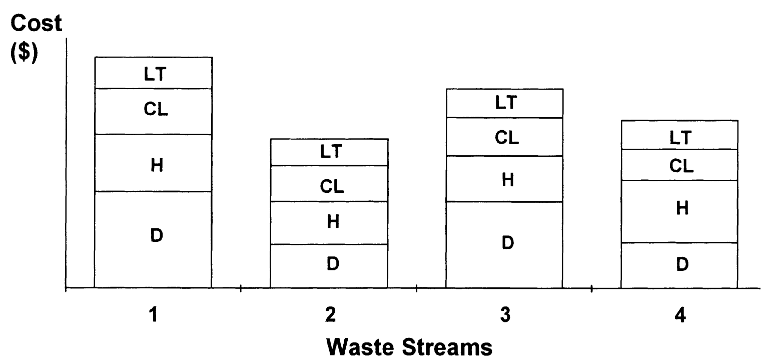
FCA is not a precise science. It can be constrained by data limitations. Such limitations primarily affect the quantification of hidden regulatory costs, contingent liability costs, and less tangible costs; they also may present obstacles to identifying and allocating direct costs. Periodically, decision makers must determine whether the benefits of collecting environmental data outweigh the costs of doing so.

Cost information will improve as FCA is implemented and refined with time. Organizations should not be swayed from incorporating environmental costs merely because the approach does not immediately add significant value to investment decision making or immediately provide cost-effective pollution prevention initiatives.

As stated earlier in Chapter 2, the process for finding cost-effective pollution prevention begins with a "screening" FCA. The purpose of this screening is to provide a quick snapshot of a roduct/process to help in identifying target opportunities for pollution prevention initiatives. The "screening" FCA results, as illustrated in Exhibit 2, in a compilation of relatively significant, more obvious environmental costs. These costs can then be analyzed to identify target opportunities. In Exhibit 2, waste streams 1 and 3 appear to be the best opportunities to initially evaluate for improvement.

Exhibit 2

Screening Full Cost Accounting Output



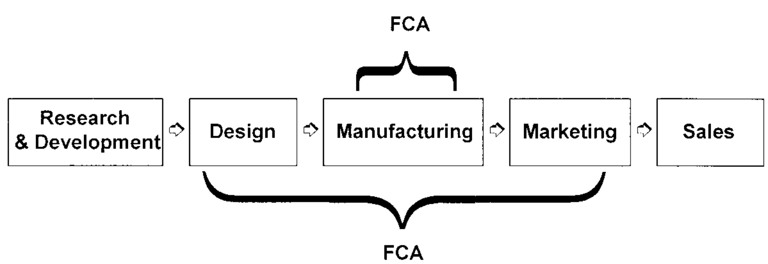
D - Direct Costs **CL - Contingent Liability Costs**
H - Hidden Costs **LT - Less Tangible Costs**

The tendency in many organizations is to either skip the "screening" FCA altogether or to turn it into a detailed accounting process. Risks are associated with each of these choices. By skipping the screening and starting the process by identifying target opportunities, the reader may overlook the most promising opportunities due to a lack of pertinent information. Alternatively, if an organization decides to implement the "screening" FCA in a detailed fashion, the individual responsible for finding cost-effective pollution prevention initiatives may see the approach as burdensome and costly. Thus, the approach may not be implemented.

In implementing this approach at the "screening" stage or in a more comprehensive manner, the reader must first decide to what extent the analysis will apply. That is, at which stages in the business cycle will the analysis be conducted? And, which business functions will be included in the analysis?

To answer these questions, the reader must first determine both the customer and the objective of the analysis. That is, the reader must determine the scope of the analysis. In many cases, FCA might be implemented to encompass only the manufacturing stage. An organization, however, should carefully consider expanding the analysis to avoid missing other opportunities that may be present. In practice, regardless of whether the approach is performed only through the manufacturing stage or from R&D to sales, the fundamentals of the analysis remain constant (see Exhibit 3).

Exhibit 3
Full Cost Accounting Can Encompass Any Combination of Business Functions



Following the "screening" FCA, target opportunities are identified and pollution prevention alternatives are developed. Since it is assumed that the reader is able to use preliminary FCA data to identify target opportunities and develop alternatives, this primer does not discuss these steps in detail.

After alternatives are developed, a comprehensive incorporation of environmental costs for each alternative and the current practice is in order. To measure the environmental costs of a pollution prevention alternative, a FCA for a specific process is conducted before the pollution prevention initiative would be implemented. This approach is then conducted for the same process as if the pollution prevention initiative had been implemented. The difference in cash flows between the two analyses represents the costs and savings of the pollution prevention investment. These costs and savings can be evaluated using the TCA approach described in Chapter 4. The hypothetical example presented at the end of this chapter provides an illustration of how FCA can play out.

The successful identification and quantification of environmental costs under FCA often requires the input of a multi-functional team, including EHS staff, accounting and finance staff, and others. For example, emerging environmental laws and regulations could affect a project's costs and savings over time. The input of a regulatory affairs specialist would provide additional valuable information into the project's FCA. Also, this approach might entail the reallocation of some costs from a general overhead account to an appropriate cost driver. Accounting and EHS staff should work together to properly allocate overhead costs.

Through FCA, managers identify and quantify the following four categories of costs associated with environmental concerns:

- Direct costs (e.g., capital, raw materials);
- Hidden costs (e.g., monitoring, reporting);
- Contingent liability costs (e.g., remedial liabilities, fines); and
- Less tangible costs (e.g., public relations, good will).

These costs are discussed below. Each discussion is intended to serve as a catalyst for the reader to begin thinking about the types of costs that might be included in an FCA.

Direct Costs

Direct costs are directly linked with a project, product, or process. These costs can include the following:

- *Capital Expenditures/Depreciation:*
  Buildings
  Equipment
  Utility connections
  Equipment installation
  Project engineering

- *Operating and Maintenance Expenses:*
  Materials
  Labor
  Waste management
  Utilities

To properly identify and quantify direct costs, the reader may look to traditional data sources. By definition, direct costs are identified through business activity. Many organizations, however, have not established sophisticated cost accounting systems that allow easy identification and quantification of direct costs. Therefore, some organizations may need to review their cost accounting systems to determine whether they are adequate for collecting the cost information required to support FCA and TCA.

To organize and simplify the analysis of direct costs, the reader may want to prepare a cost worksheet. A cost worksheet provides a consistent method for documenting cost information and simplifying the financial calculations.[4]

Hidden Costs

Hidden costs refer to regulatory compliance or other costs that are "hidden" or lumped into a general account. Very frequently, managers assign the costs of complying with environmental regulations (e.g., reporting and monitoring) to an "overhead" account, along with non-assignable costs such as rent, photocopying facilities, and secretarial labor. In addition, hidden costs include costs that are identified and recorded in the accounting system but are not typically used in capital budgeting. Lost opportunity costs also may be included in a comprehensive FCA.

Despite the typical lack of focus on specifying and quantifying hidden costs, they can be significant and, thus, could affect the economic analysis of a pollution prevention alternative. In fact, government regulation has increased the cost of managing waste and has instituted other environmental controls on business. As a result, many companies are looking to reduce waste at the source (i.e., pollution prevention) rather than treating it end-of-pipe. Therefore, hidden costs play an essential role in the financial analysis of pollution prevention investments.

The following short list of hidden regulatory costs indicates the extent to which they can impact environmental cost accounting analyses.[5] The list is by no means limited to:

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4. EPA's *Waste Minimization Opportunity Assessment Manual,* 1988, pages A-25 through A-27, and *Pollution Prevention Benefits Manual,* 1989, Appendix A, provide handy, easy-to-use worksheets for documentation of costs.
5. For an exhaustive listing of hidden costs for selected regulations, see U.S. EPA, *Pollution Prevention Benefits Manual,* Volume II, Appendix B, October 1989.

- ❖ Compliance reporting
- ❖ Monitoring
- ❖ Legal support
- ❖ Sampling and testing
- ❖ Education and training
- ❖ Notification
- ❖ Waste management

Identifying and quantifying hidden regulatory costs involves the following simple two-step process. Step 1 involves identifying environmental laws and regulations that are applicable to the site/process. Step 2 involves estimating as accurately as possible the capital cost and operation and maintenance costs of complying with the regulations, both now and in the future. This estimate should be made for current practice and for any investment alternatives. Moreover, the cash flow projections for future periods might anticipate future probable legislative and regulatory activity that might affect cash flows. A pollution prevention project is highly sensitive to environmental laws and regulations. Forecasting probable legislative and regulatory activity, however, introduces uncertainty into the evaluation. Thus, the importance of utilizing a multi-functional team to implement FCA and TCA becomes apparent.

Another significant hidden cost item is the value of lost or degraded materials. For example, a firm may recover some value from recycling waste, but that value is typically only a fraction of the full value if the potential waste or recycled material could be sold as primary product. Another example could involve the production of an FDA-regulated product such as cough medicine, which involves strict cleanup requirements between batches to ensure high quality. A typical method for clean-outs may simply involve pumping tanks with the material and sewering the balance of the tank “heel.” This incurs not only the cost for treatment, but a cost equal to the lost product value as well. Identifying an alternative process to recover/reuse most of the tank “heel” could reduce disposal and direct product costs.

Contingent Liability Costs

Contingent liability costs are associated with liabilities that may result from waste and materials management. Because pollution prevention projects are aimed at reducing or eliminating pollution, the savings from lower contingent liabilities could provide significant benefits that may otherwise be ignored. Contingent liability costs can be divided into two categories: (1) costs associated with accidental releases; and (2) legal damages and settlements for remedial action, personal injury, or property damage. Contingent liability costs are difficult to quantify because liability events are not a certainty and their attendant costs and frequency are difficult to estimate.

The reader can estimate the probability and dollar amount of contingent liabilities by:

- Reviewing plant experience related to environmental liabilities, such as remedial action or releases to air or water;

- Reviewing environmental liabilities occurring at other plants within the company or industry, or in another industry with similar operations; and

- Forecasting future liability based on past experience.[6]

The estimated costs of contingent liability to include in the analysis can be calculated by multiplying the estimated probability of occurrence by the estimated cost of contingent liability. In general, however, no one accepted method of estimating contingent liabilities is best.

The reader should recognize that the estimation of contingent liability costs is controversial, particularly for public companies. The U.S. Securities and Exchange Commission requires that public firms publicly disclose probable and reasonably quantifiable liabilities and set aside assets to cover these potential costs. Therefore, liability estimates could have serious implications for the economic flexibility of a firm (i.e., the ability to use cash for purposes other than to cover potential liabilities).

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6. For a more scientific approach, the reader may want to turn to predictive modeling approaches that use simulation models to estimate liability costs from past experience.

The reader may also rely on alternatives to the quantification of contingent liabilities. For example, a qualitative assessment of potential liabilities could provide a relative ranking for each investment option. This additional information might then improve decision making, despite its non-quantitative input.

The contingent liability cost estimates can now be incorporated into the capital budgeting step (described in Chapter 4) along with direct costs and hidden costs to complete the TCA. If decision makers require still more information before making the investment decision, the reader may want to proceed with an FCA that includes not only direct, hidden, and contingent liability costs, but also incorporates less tangible costs into the equation.

Less Tangible Costs

While hidden costs and contingent liability costs may seem difficult to quantify, less tangible costs are even more troublesome, though not impossible, to estimate. When an organization undertakes a pollution prevention initiative, it may realize benefits, including economic, that derive from improved corporate image, customer acceptance, and community goodwill. These benefits are difficult to quantify, but they should be considered in the analysis.

One example of a less tangible cost involves permitting and community relations. A company might enjoy an easier, and less costly, permitting process because the community believes that a pollution prevention initiative will benefit the area's environment while demonstrating the company's environmental stewardship. Consequently, this goodwill results in a savings because the community eases the permitting process for the company.

Less tangible costs typically look beyond the economics of a process/product. The key to quantifying these costs is to relate an outcome to an economic consequence. For example, a company may target a reduction in Toxic Release Inventory discharges for a public relations benefit. In an FCA, the benefit may be quantified in terms of increased sales, less expenditures on public education, etc.

In the past, less tangible costs were difficult, if not impossible, to quantify. Recent experience — and a growing awareness of the benefits of pollution prevention — may provide essential insight into estimating these costs and savings. For example, companies may be better able to gauge the impact of favorable publicity through experience with other Total Quality programs, such as the Malcolm Baldridge award. Even better, some government agencies have established awards for businesses that implement pollution prevention initiatives. Managers can use the experience obtained from such initiatives to estimate less tangible costs and benefits.

Identifying and quantifying less tangible costs is subjective and far from precise. As such, a manager might want to reverse the analytical process for less tangible costs during the capital budgeting step (to be discussed in the next chapter). Rather than estimating such costs, and subsequently evaluating the viability of the pollution prevention project, the manager may determine the amount of less tangible costs that would make the project viable and then decide whether less tangible costs are potentially equal to that amount.

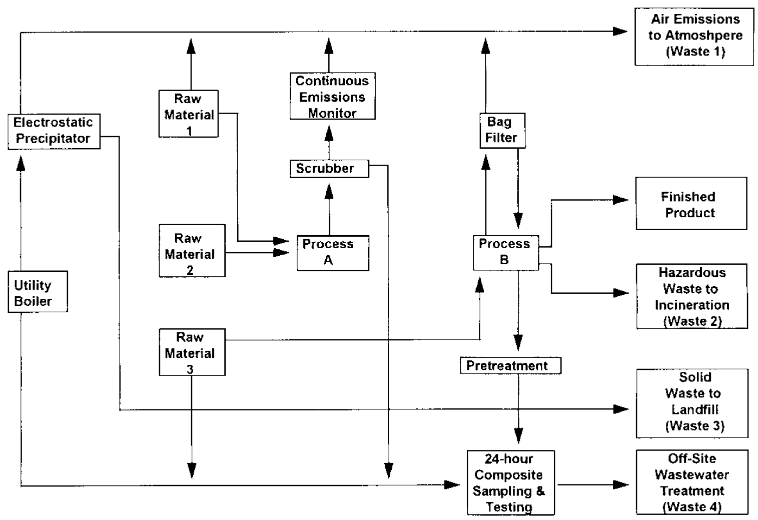
Now that the full costs have been identified and quantified, the next step in the process is to perform a profitability analysis, which evaluates the viability of a project over a longer period of time using a technique to "discount" the value of the dollar over that time.

Hypothetical FCA Example

The hypothetical FCA analysis presented on the following pages demonstrates how cost information can be organized for easy assessment of pollution prevention opportunities. In addition to full cost information, the analysis identifies waste outputs as another variable for consideration in making a final investment decision. The example analyzes and compares four waste streams under a "screening" FCA (see Exhibit 4).

In the hypothetical analysis, a manufacturing plant produces a finished product from three raw materials. Raw materials 1 and 2 are inputs to process A. Processes A and B are powered by electricity generated by a utility boiler. The boiler is equipped with an electrostatic precipitator (ESP) which precipitates solids for landfilling. Process A uses a scrubber to reduce air emissions. Output from process A and raw material 3 are inputs to process B. Process B uses a bag filter to reduce air emissions. Outputs from process B are the finished product, hazardous waste sent to an incinerator, and a wastewater stream sent to a pretreatment facility. The non-hazardous solids from wastewater pretreatment are sent to a landfill. Wastewater from the utility boiler, wastewater from the process A scrubber, pretreated wastewater from process B, and spills or leaks from storing raw material 3 are sent off-site for wastewater treatment. The flowchart presented in Exhibit 4 illustrates these processes.

Exhibit 4
Hypothetical Manufacturing Process



This case study has four major waste streams: one each for air emissions, hazardous waste, solid waste, and wastewater. Each of these major waste streams has a number of sub-items that can contribute to its wastes and costs, as indicated in Exhibit 5.

Exhibit 5
Percent of Total Waste/Costs per Waste Stream

	Costs				Wastes for
	Direct	Hidden	Liability	Less Tang.	Disposal
Waste #1 - Air Emissions	18	12	—	?	15
—Boiler ESP Operating and Maintenance	3				7
—Process A Scrubber Operating and Maintenance	8				6
—Scrubber CEM Operating and Maintenance		3			
—Process B Bag Filter Operating and Maintenance	2				1
—Cost Raw Material #1		2			1
—Unpopular Raw Material #3					
—Air Emission Permitting		3			
—Capital Depreciation	5				
—Site Environmental Staff		4			
Waste #2 - Hazardous Waste	8	4	3	—	15
—Off-site Incineration	8		1		9
—H/W Storage Facility Operating and Maintenance		1	1		
—H/W Facility Inspection		1	1		
—Lost Finished Product		1			1
—Site Environmental Staff		1			1
Waste #3 - Solid Waste	12	7	2	?	50
—Off-site Landfill	4				49
—S/W Facility Inspection		2	1		
—Boiler Ash Handling	2	2	1		
—Lost Intermediate Product		1			1
—Unpopular Landfill					
—Capital Depreciation	6				
—Site Environmental Staff		2			
Waste #4 - Wastewater	27	5	2	?	25
—Off-site W/W Treatment	19		2		23
—Process B Pre-treatment Operating and Maintenance	5				
—Sampling & Testing		1			
—Lost Raw Material #3		1			2
—Wastewater Permitting		2			
—Capital Depreciation	3				
—Site Environmental Staff		1			
Total Waste Streams	**65**	**28**	**7**	**?**	**100**

As shown in Exhibit 5, the cost per ton of waste disposed often varies widely; as a result, reducing wastes does not always reduce costs linearly. For example, solid wastes (i.e., waste 3) account for 50 percent of total waste, but only 21 percent of the total cost, while 15 percent of total waste and 30 percent of total costs are due to air emissions (i.e., waste 1). One conclusion drawn from this data is that the best opportunity to reduce cost may be to address wastewater direct costs. Once the broad opportunities are defined, the pollution prevention practitioner must then identify the alternative projects, conduct a comprehensive FCA for the current process and alternatives, and apply the TCA techniques described in the next chapter.

Chapter 4.
TOTAL COST ASSESSMENT (TCA): EVALUATING POLLUTION PREVENTION INVESTMENTS

The next step in finding cost-effective pollution prevention is to evaluate the long-term effects of the pollution prevention or other investment on a company's cash flows. This evaluation will be used to compare projects which must compete for investment dollars. Equipped with the comprehensive cost and savings information compiled through the approach described in Chapter 3, the reader is able to compare the financial feasibility of a pollution prevention investment with more typical investments, such as building a new plant.

Total cost assessment (TCA) expands traditional capital budgeting techniques to encompass all costs and savings associated with an investment. Often, traditional investment analyses do not fully consider the costs and benefits associated with environmental activities. TCA, however, uses environmental costs and benefits as inputs to an investment evaluation equal to the costs and benefits of other, more traditional cost items, such as the cost of equipment, materials, and labor. One key to a successful TCA is to evaluate investments over an appropriate timeframe. The same timeframe must be used for evaluating all competing investments.

TCA may utilize standard financial indicators to compare investments. An organization's specific capital budgeting procedures will drive the choice of financial tools for evaluating investment choices. The pollution prevention practitioner should work closely with an organization's financial and business managers to select the appropriate tool(s) for analysis.

Net Present Value

One effective tool for performing a TCA is a concept known as net present value (NPV). As defined in Chapter 2, the NPV method assumes that a dollar received today is more valuable than a dollar received at a later time. NPV methodology "discounts" to a present value the dollars received in future periods by the rate of return that a company could obtain on an investment with comparable risk. For example, consider a scenario in which the current annual rate of return is 10 percent. A dollar received today would be worth $1.10 by the next year. Therefore, a dollar received now is worth more (i.e., 10 cents more) than the dollar received a year later.

But, how does "discounting" relate to a pollution prevention or other investment? The same concept applies because an investment that yields one dollar in savings today is preferable to an investment that yields one dollar next year, all other things being equal. A company can "invest" the one dollar in current savings and, for example, earn a year of interest that cannot be realized by the investment that yields a one dollar savings a year later.

From the cost information compiled from the FCA, the reader can work with accounting and finance professionals to calculate a project's NPV and evaluate competing investments. Input that must be obtained from these professionals includes project life, discount rate, and tax considerations.

In simple terms, the NPV of an investment is calculated by summing the present value cash flows of each period.[7] Several projects competing for limited investment dollars can then be compared on an equal basis. The investment decision can be based on a variety of measurements, including NPV, internal rate of return, profitability index, and payback period. All of these measurements are described in Chapter 2. An organization should use the indicator that best fits into its capital budgeting system.

TCA Case Study

This section provides an illustration of how TCA can improve investment decisions by introducing environmental costs into the analysis. A simple case study illustrates the difference between the financial analyses of a pollution prevention project performed originally without TCA and then subsequently with TCA. The hypothetical manufacturing process described at the end of Chapter 3 will be used as the basis for the case study. The comparison of results from

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7. Due to the scope, this primer does not describe an NPV calculation. A company's accounting and finance staff can provide more detailed guidance on calculating the NPV for a project.

each analysis demonstrates the value of TCA in finding cost-effective pollution prevention initiatives.

Pollution Prevention Alternative

After determining that wastewater treatment has a high cost, management considers reducing environmental costs by substituting 30 percent of raw material 3 with a new raw material 4. Process modifications would be required in process B to use the substituted material. These process modifications would result in an estimated capital investment of $1.7 million and changes in operating costs.

Financial Analysis

The company's original analysis (i.e., without TCA) consists of: (1) the capital investment of $1.7 million; and (2) only those operating costs and savings that the company typically includes in financial analyses for projects of this type, namely:

- An increase in raw material cost of $180,000 per year;
- Energy and chemical use for new equipment of $200,000 per year;
- Reduction in wastewater treatment fees of $500,000 per year; and
- An increase in labor costs of $2,000 per year.

The pollution prevention project affects neither waste streams that require on-site management or disposal nor any regulatory compliance activities at the site. In addition, revenue will not be affected since neither product quality nor production rates are expected to change. Management, however, expects the plant changes to enhance the company's image by lowering Toxics Release Inventory (TRI) releases as a result of reducing both the waste sent off-site for disposal and air emissions. Management also expects to avoid future liability at the plant by reducing waste sent off-site.

In addition to costs included in the original analysis, TCA contains other operating costs and savings, as derived from the FCA performed in Chapter 3. The TCA includes the following estimates of savings:

1) A reduction in fresh water usage of one million gallons per day, and a commensurate reduction in cost of fresh water

treatment and pumping, for a savings of approximately $100,000 per year;

2) A reduction in energy use for fresh water heating amounting to a savings of approximately $300,000 per year;

3) A reduction in wastewater generation of approximately one million gallons per day, for a savings of approximately $52,500 per year in wastewater pumping and $68,000 per year in wastewater pretreatment maintenance costs; and

4) Enhanced company image, although the exact value in terms of savings is difficult to quantify. The company, however, estimates a 10 percent reduction in its TRI releases as a result of this project. The company further estimates that, in addition to less tangible benefits, an improved TRI could reduce future permitting costs by $50,000 per year.

Future liabilities resulting from current off-site treatment range from zero to $3 million. The probability of incurring future liability is very low due to extensive monitoring and control procedures already in place.

Exhibit 6
Comparison of Financial Analysis Methodologies

	Original Analysis ($M)	TCA ($M)
Capital Costs	1,700	1,700
Net Operating Savings/(Costs):*		
a. Raw materials	(180)	(180)
b. Waste management	500	620
c. Utilities	(200)	200
d. Labor	(2)	(2)
e. Other	0	50
Total Operating Savings/(Costs)	118	688
Future Liability	0	0
Financial Indicators:		
NPV (10 yrs)	(1,340)	523
NPV (15 yrs)	(1,316)	830

Assumptions:
Discount rate = 15%
NPV calculated on a continuous compounding basis
Miscellaneous period expense (i.e., maintenance taxes, insurance) = 4% of capital
UCC Indirect = 5.8% of capital
Capitalized interest = 5.9% of capital
Asset depreciated over 10 years for tax purposes

*Before interest and taxes

The comparison presented in Exhibit 6 indicates that the NPV increased under the TCA approach. Because the TCA analysis included more comprehensive financial data (i.e., it included environmental costs and savings), it can be considered more appropriate for finding cost-effective pollution prevention. Without the use of TCA, the pollution prevention project may have been prematurely dismissed as an alternative.

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Chapter 5.
INSTITUTIONALIZING TCA

Chapters 1 through 4 primarily focused on finding cost-effective pollution prevention. Although these chapters also defined terms, described the steps, and illustrated the process of FCA and TCA, they did not identify methods for institutionalizing this approach within an organization. If decision makers are not made aware of TCA's application to TQEM tenets and its role in providing better cost information, then this approach will carry little weight in the decision-making process. This chapter discusses the key components needed to ensure the consideration of environmental costs in project evaluation.

Commitment from the Top

This approach is intended to provide decision makers with better information, and the concepts described in this primer are the first phase in that process. The successful implementation of TCA, however, is partly dependent on an organization's dedication to Total Quality principles.

A TQEM system, such as TCA, requires a commitment to continuous improvement. It becomes an evolution in the culture of an organization. The reader must remember that it is best to begin with small steps, building support and a record of success. Therefore, the reader should not expect TCA to immediately pay off by rationalizing pollution prevention investments over other investments. This approach does not promote pollution prevention, but merely supports an evaluation of its full costs and benefits on a basis equal to alternative investments.

The most important factor in institutionalizing TCA as a decision-making tool is the commitment of top management. The reader must convince top management that this process is a worthwhile undertaking that results in better decision making. To do so, the reader might emphasize to top management that incorporating environmental costs in project evaluations supports two important objectives: TQEM and pollution prevention. In addition, top management must be made aware of the three phases of TCA described below. That is, it goes beyond pollution prevention projects to consider environmental costs throughout the ongoing operations of a business.

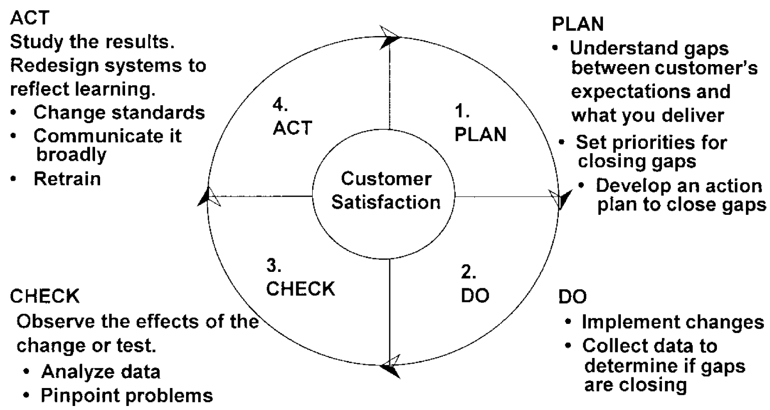
If top management is committed to the use of TCA, the prospects for institutionalizing it within the organization are much greater. TCA's ultimate usage, however, depends on acceptance from pollution prevention managers, line managers, accountants, and others. To institutionalize FCA and TCA and improve cost accounting information, a cross-functional dialogue must be promoted. Companies should formalize the involvement of EHS staff in the capital budgeting process. Accounting and finance staff should work with EHS staff to refine accounting systems to provide appropriate cost information. A multi-functional approach to this process will facilitate its institutional durability.

TCA is a three-phase process. First, it will help identify the "low hanging fruit" (i.e., investments that are easy to pick). Second, this approach becomes a tool for providing a comprehensive evaluation of an investment. Third, TCA can be used to prescribe process changes and develop designs for the future. This approach, then, increases in value as a tool over time.

This continual process can be represented graphically using the PDCA cycle, which is a tool for developing a Total Quality action plan. PDCA is shorthand for Plan, Do, Check, and Act, as illustrated in Exhibit 7. The PDCA cycle is a systematic method for continual process improvement based on the principle that a situation or process must be fully understood before it can be improved.

Exhibit 7

The P-D-C-A Cycle



Step 5. Repeat Step 1, with knowledge accumulated.
Step 6. Repeat Step 2; etc.

A manager can easily adapt the PDCA cycle for developing an action plan for TCA. A PDCA cycle which incorporates FCA and TCA might resemble the following:

- PLAN. Understand gaps between decision makers' (i.e., management) cost information needs and what information is viewed as necessary and/or currently available. Using data from FCA, set priorities and develop an action plan for closing the gaps (e.g., identifying appropriate environmental costs associated with an investment will provide valuable information to the decision maker). A manager should focus on analyzing the current situation or process, determining customer/decision maker (i.e., internal management) needs, and developing a plan of action to improve the process.

- DO. Implement pollution prevention project, if justified by the total cost assessment and supported by management.

- CHECK. Observe the effects of the pollution prevention project and determine if desired results have been achieved.

- ACT. Evaluate and communicate the results of the pollution prevention project. Determine if the additional cost information provided meaningful input into investment decisions. Improve the process by changing cost information identification, quantifcation, or allocation, or by expanding the assessment to include additional cost information.

- REPEAT. Repeat the PDCA cycle by incorporating the knowledge gained. Continue the cycle, and deliver ongoing pollution prevention projects which continuously reduce costs and wastes.

TCA also supports an organization that strives for pollution prevention in all of its activities. By including environmental costs and benefits in the analysis, TCA measures pollution prevention initiatives in parallel with other investments. As a result, pollution prevention investments are given a fair chance to compete for investment dollars. In the past, pollution prevention projects were placed at a disadvantage vis-a-vis other investments because their full costs (i.e., including both environmental costs and benefits) were not considered.

Other Considerations

Other considerations may play a role in institutionalizing FCA and TCA within an organization. At GEMI's 1994 conference, Environmental Management in a Global Economy, participants were asked to identify the most important factors, or "drivers," in institutionalizing this approach. The results of this survey are presented in Exhibit 8.

Exhibit 8

Percentage of Respondents Identifying Specific Drivers for Institutionalizing FCA and TCA

Driver	Percent
Control Costs	88
Voluntary Initiatives	50
Investor Demands	42
Market Pressure	35
Public Reporting	27
Public Relations	27
Government Relations	15
Others	15
Employee Considerations	4

Source: GEMI, Business Environmental Cost Accounting Practices Survey, 1994.

As an organization begins to institutionalize FCA and TCA concepts and uses this primer or another document as a guide, it should be aware that the approach described on these pages is not universal or absolute. A cross-functional team should work with the concepts described in this primer to tailor an approach that is most suitable to its needs and goals.

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