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Application of Environmental Accounting to Pollution Prevention Assessments

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Abstract = Environmental accounting represents a major paradigm shift in the way most companies account for costs and benefits. However, it is a change that must be made if pollution prevention is to become institutionalized into the corporate and government mainstream. Pollution prevention investments must be justified on an econonmic basis; without environmental accounting tools, pollution prevention investments cannot show their true profitability. This is because traditional accounting methods only track billable costs, thus ignoring some of the major benefits of pollution prevention investments, which are indirect savings resulting from a lessening of a company's regulatory compliance burden and present and future liabilities. This paper discusses how to apply environmental accounting principles to pollution prevention assessments to improve the outcome of profitability analyses.

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Application of Environmental Accounting to Pollution Prevention Assessments

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Introduction

Pollution prevention (P2), for all of its perceived benefits, has yet to be totally embraced in corporate America and government circles as a sound business practice. Instead of seeking business solutions that avoid or minimize the creation of waste at it source, most businesses and government agencies still put their resources into compliance-driven pollution control technologies and practices (1). One reason for the slow adoption of P2 practices in industry and government is that the costs of pollution and the benefits of prevention are not well understood. Most environmental-related costs are not easily tracked by traditional accounting mechanisms, thus keeping these costs effectively hidden from management. Environmental accounting is a tool that can be used to help uncover environmental costs. This paper reviews some of the key concepts of environmental accounting and shows how environmental accounting can be applied to a P2 assessment to improve the outcome of profitability analyses.

Why Environmental Accounting is Needed

One of the main reasons why acceptance of the P2 philosophy has been slow is that adoption of such a philosophy requires a company to make fundamental changes in the way it does business; equipment must be redesigned, work processes must be changed, and different materials must be used. Such changes cost time and money; therefore, the ability of a P2 investment to show a quick payback often becomes the critical element in whether or not to approve such investment opportunities. However, showing a quick payback is often difficult because many of the benefits of P2, which are to reduce the costs and liabilities associated with pollution control and waste management, are difficult to quantify under existing accounting mechanisms (2). Traditional cost accounting practices only track billable costs; at least half of the costs associated with pollution control and waste management are indirect costs (3). Decision makers in industry and government need to understand the true costs of pollution before they will embrace prevention as a way of doing business.

One of the main tools used at Department of Energy (DOE) facilities during recent years to evaluate P2 alternative practices is the Pollution Prevention Opportunity Assessment (P2OA) (4). The P2OA process is used very successfully to evaluate the first level of P2 investment opportunities; i.e., those that can be implemented with little capital outlay and minor changes to existing processes (such as recycling initiatives). However, the P2OA process has not been as successful in tackling the challenges posed by the next level of P2 initiatives; i.e., the true "prevention" initiatives that require upstream changes in manufacturing or design processes (5). Such P2 projects generally require some type of material substitution or process redesign and are by nature more complex, costly, and of higher risk to the company. Environmental accounting is a tool that can be used in conjunction with the P2OA process to improve the cost/benefit analysis of this next level of P2 investment opportunities. Environmental

accounting differs from traditional cost accounting practices in four primary ways (6):

1. It includes a comprehensive cost inventory, including the incorporation of indirect and less tangible costs, such as regulatory compliance, liability, and image-type costs/benefits.

2. It allocates all costs/benefits directly to the responsible party as opposed to overhead accounts.

3. It uses longer time horizons (usually at least 10 years) to capture mid- and long-term returns to P2 investments.

4. It uses multiple financial indicators, such as net present value and internal rate of return, to capture the full range of P2 benefits.

Four Types of Environmental Costs

Environmental accounting focuses on four types of environmental costs: 1) direct costs, 2) indirect costs, 3) liability costs, and 4) intangible costs (7).

Direct Costs

Direct costs are those costs appearing as discrete items on financial accounting systems. Direct costs include disposal fees and direct labor charges associated with waste management and disposal, but also include many other costs not typically considered to be strictly environmental costs. Table 1 shows a list of typical direct costs to be considered in a P2 assessment (8).

Table 1. Typical Direct Costs

Disposal	Installation	Utilities
Direct Labor	Equipment Purchases	Planning
Transportation	Raw Materials	Engineering
Containers	Parts/Supplies	Start-Up Costs
Recycling Expenses	Delivery	Sales/Income Tax
Permits	Insurance	Maintenance

When attempting to identify applicable direct costs, a good starting point is to create flow charts of both the current process being evaluated and the P2 alternative. The flow chart provides a good mechanism to visualize each step in the process to see where changes might occur with implementation of the P2 alternative. The flow chart boundaries should spread from initial introduction of a hazardous material (e.g., procurement or specification) to eventual disposal or emission of resulting pollutants into the environment. The flow chart can be supplemented with a material balance of all materials and supplies entering the process, and all products and waste/emissions leaving the process (9). Once all steps and materials/supplies in both the current and alternative process are identified, the corresponding costs can be identified through such tools as labor reports, procurement requisitions, disposal records, work orders, utility bills, etc. Overall savings are identified by comparing the total direct costs of the current process against the total direct costs of the P2 alternative.

Indirect Costs

Indirect costs are primarily administrative and regulatory compliance costs. Indirect costs are considered to be hidden costs, in that they are typically either allocated to overhead rather than their source (i.e., a production process or product) or they are altogether omitted from most financial analyses. Table 2 shows indirect costs typically affected by a P2 investment (8).

Table 2. Typical Indirect Costs

Reporting	Accumulation Management	Training
Recordkeeping	Manifesting	Container Marking/Labeling
Inventory Control	Land Disposal Restrictions (LDR)	Shipping Papers
Medical Monitoring	Waste Packaging	Placarding
Protective Clothing	Sampling/Testing	Regulatory Research
Hazard Communication	Permit Preparation	Inspections
	Monitoring	

Since indirect costs are primarily tied to regulatory compliance, identifying the applicable indirect costs requires a thorough understanding of the compliance obligations tied to the process being evaluated. This includes not only environmental regulatory requirements as regulated under the Resource Conservation Recovery Act (RCRA), Clean Air Act (CAA), Clean Water Act (CWA), the Comprehensive Environmental Response and Recovery Act (CERCLA), and the Toxic Substances Control Act (TSCA), but also hazardous material transportation requirements regulated by the Department of Transportation (DOT) and health and safety issues associated with the use of hazardous materials regulated by the Occupational Safety and Health Act (OSHA). If the process involves radioactive waste and/or emissions, applicable Nuclear Regulatory Commission (NRC) regulations and Department of Energy (DOE) orders also need to be consulted.

Most organizations developed detailed internal procedures that outline the applicable health, safety, and environmental requirements and outline processes to ensure compliance with these requirements. These procedures are a good source of information to help identify indirect costs. A checklist can be developed from company procedures that lists all activities required by the company associated with hazardous material usage, pollution control, and waste management. The evaluated process and P2 alternative can then both be screened against this checklist to determine which activities will be reduced/eliminated if the P2 alternative is implemented. Once the applicable indirect activities are identified, the time/frequency to perform each activity can be determined either through process knowledge or by interviewing the individuals responsible for performing those activities. An annual cost for each activity can be determined by multiplying the totals hours spent on a particular activity by the appropriate burdened labor rate. Assuming the P2 alternative reduces required compliance activities, an annual savings can be estimated.

Liability Costs

Liability costs are contingent costs that may or may not be incurred at some point in the future. Liability costs include the cost of remediation and compensation for future accidental releases of a contaminant into the environment, fines and penalties for future regulatory infractions, and future costs from unexpected or permitted releases. Table 3 lists typical liability costs potentially affected by a P2 investment (8).

Table 3. Typical Liability Costs

Fines/Penalties	Personnel Injury	Spill Cleanup
Legal Fees	Property Damage	Natural Resource Damage Restoration
Remediation Costs	Medical Expenses	

The quantification of liability costs can be difficult and time-consuming. Even if a savings can be estimated, the numbers can be difficult to substantiate as they are usually based on the author's subjective evaluation and many assumptions as to the probability of certain triggering events (e.g., fire, explosion, personal injury, environmental damage) and outcomes (e.g., lawsuit, settlement award, fine or penalty) (2, 10). Also, many companies may resist having their potential liabilities quantified in great detail, as such disclosure may create problems for the company in reporting requirements to the Securities and Exchange Commission (SEC). The SEC requires companies with publicly traded commodities to report their liabilities to stockholders and to accrue enough assets to cover these future costs. The more management knows of its potential liability, the more it has to report (2, 10). Liability disclosure is a delicate balance; too little disclosure risks violating SEC disclosure requirements, and too little disclosure may create liability where none existed before (3). Liability can also be damaging to a company if made public during legal proceedings. For the above reasons and more, detailed liability quantification is not recommended for a P2 assessment (11). However, several alternatives to full quantification are available that can be used in conjunction with a P2OA.

One approach is to simply address the potential liability associated with a certain pollution-generating process from a qualitative perspective. Potential exposure pathways to the environment can be discussed, along with resulting regulatory fines/penalties and/or civil/legal actions to be taken against the company. Although such an approach does not directly affect the cost/benefit equation, good qualitative liability data may tip the balance in favor of an otherwise questionable P2 investment. Some companies have been known to loosen financial performance requirements in light of perceived liability reductions. For example, a company may normally only consider an investment offering a payback of three years or less. To minimize potential liability, a company may increase its payback criteria to five years. A company may also choose to lower its "hurdle rate" for approving investments to minimize its liability. The hurdle rate is the minimum acceptable rate of return on a project investment that a company will accept. This hurdle rate is usually between 15 and 20%; some companies accept investments offering an internal rate of return as low as 10 to 12% if there is a perceived reduction in liability associated with the investment (2).

Another approach is to address liability from the perspective of potential risk. This is the approach adopted by the Washington State Department of Ecology (WDOE) in its P2 planning guidance outlined in the Washington Administrative Code (12). The WDOE has developed a simple scoring system to help determine if the relative risk of the process would increase, decrease, or shift if a P2 alternative is implemented. Table 4 shows the risk table provided by WDOE in its P2 planning guidance (11).

Table 4. Risk Analysis Template

Current Practice		Pollution Prevention Alternative
Score low = 1, med = 2, high = 3	Risk Factors	Score low = 1, med = 2, high = 3
	property contamination	
	accidents	
	health effects	
	compliance violations	
	disposal liability	
	other	
	Total Risk Score	

Intangible Costs

Intangible costs result from the perception that the public, regulators, investors, etc. have of company operations. For example, P2 investments can result in positive publicity, which in turn, can have a positive effect on company profits. Conversely, negative publicity concerning a company's environmental performance can have the opposite effect on the perception of company operations. Table 5 lists several potential intangible factors that can affect costs (8).

Table 5. Typical Intangible Costs

Corporate Image	Insurer Relations	Lender Relations	Product Quality
Customer Relations	Employer Relations	Community Relations	Consumer Relations
Investor Relations	Supplier Relations	Regulator Relations	Employee Health

Intangible costs are the most difficult costs/benefits to identify and quantify. One cannot say with certainty that intangible factors will affect a company's bottom line, but it is certainly reasonable to assume that they may (13). There are no sound methods of directly quantifying an intangible benefit; however, the value of an intangible benefit can be addressed indirectly. As with liability, intangible factors should first be described qualitatively. Then, it can be determined what the dollar value of the intangible benefits would have to be to bring the investment within the required threshold of acceptable payback and/or internal rate of return. For example, assume the investment needs to come up with another $3,000 worth of annual savings to bring the investment below a three-year payback. Once the intangible benefits are identified, company decision makers can subjectively determine whether or not the intangible benefits are worth $3,000 a year to the company. (Note: Many of the approaches for liability savings work equally well for intangible savings, and vice versa).

The Tiered Approach

The four types of environmental costs are typically applied to a P2 assessment using a tiered approach.

Direct costs are placed in Tier 0; indirect costs in Tier 1; liability costs in Tier 2; and intangible costs in Tier 3. The lower the tier, the easier the costs are to identify and quantify; the higher the tier level of costs, the more difficult and time-consuming the costs become to identify and quantify. With the tiered approach, the cost analysis starts at the lowest level (i.e., Tier 0). All Tier 0 costs of the P2 alternative are compared against the same Tier 0 costs of the current process. If the P2 alternative shows itself to be more cost effective, the analysis can stop. If the P2 alternative is not cost effective, the analysis moves to the next higher tier (i.e., Tier 1). The analysis goes through as many tiers as necessary to demonstrate the economic profitability of the P2 project (13). It is advantageous for the P2 project to demonstrate profitability at the lowest tier possible. Quantifying Tier 2 and Tier 3 costs is more judgmental in nature than quantifying Tier 0 and Tier 1 costs. If an analysis has to go to the Tier 2 or 3 level to show profitability, the analysis is more a reflection of subjective corporate policy than precise, scientific calculations (15).

Accounting for Longer Time Horizons

Many P2 investments take longer to show profitability than conventional types of investments. For this reason, the time horizon for evaluating P2 investment often needs to be expanded beyond the traditional one-to three-year period. Otherwise, many of the potential costs/benefits associated with a P2 investment will be lost (2). For example, traditional cost evaluation techniques often don't capture costs/savings occurring beyond the first couple of years after the investment, such as permit renewal costs, equipment upgrade/maintenance costs, and escalating waste management/disposal costs. However, lengthening the time horizon presents a new problem that the analysis needs to account for; i.e., a dollar in the future is not worth as much as a dollar today. Since costs/savings are worth more the sooner they are realized, future costs and savings need to be discounted and be expressed in terms of their "present value" to account for inflation and the lost opportunity costs of interest (14). Therefore, the simple payback criteria traditionally applied to P2 investments is an inadequate indicator when evaluating investments over a longer time period. The most common financial indicators to use in evaluating a P2 investment over a longer time period are the net present value (NPV) and the internal rate of return (IRR) (13). The NPV shows the worth of the P2 investment over the entire life of the project as a present value sum. It is expressed as follows:

$$NPV = \sum F_n/(1 + i)^n$$

where,

F = cash flow at time "n"
i = discount rate
n = years past initial investment

The discount rate is a function of interest and inflation. It reflects the company's cost of borrowing money and accounts for both the rate of inflation and the opportunity cost of capital (i.e., what return the money could have earned elsewhere). The Office of Management and Budget publishes annual discount rates to be used for investment analyses (15). The IRR is described as the discount rate value that results in an NPV of zero. The higher the IRR, the better the investment. Generally, a company will deem an investment worthy of funding if the IRR exceeds the company's internally established investment hurdle rate. The IRR is best calculated through an iterative process of substituting increasingly higher discount

rates into the NPV equation until the NPV reaches a number very close to zero (13).

Application Project

The concepts of environmental accounting were tested on an application project at the Hanford Site. A P2OA was performed at a small sign-making shop that used screen printing to make signs. The screen printing process used hazardous materials that resulted in hazardous waste generation. One of the investment opportunities identified through the P2OA process was to replace the screen printing process with a computerized sign-making system. The new computer system would completely eliminate the sign shop's hazardous material inventory while improving worker efficiency. However, the new computer system would cost close to $40,000 to bring online, and the estimated annual waste avoidance costs were only $2,500 (using the DOE indexed waste disposal rate of $10 per kg). Using traditional cost accounting methods, this investment would not have been considered because the payback period exceeded three years. The investment was recalculated using environmental accounting techniques with help of a spreadsheet-based P2 cost evaluation program developed for the Environmental Protection Agency (EPA) by the Tellus Institute called P2Edge (16). Table 6 compares the results of the P2/Finance evaluation as compared to the standard evaluation. Use of environmental accounting techniques lowered the payback of the investment from 3.2 years to 0.2 years. The NPV of the investment was almost $132,000 after just one year, and about $1.5 M after 10 years.

Tables 7 and 8 provide more detailed breakdowns of implementation costs and annual savings as considered under both the standard analysis and the environmental accounting technique. Major savings were realized by including such things as indirect regulatory compliance costs, floor space, increased labor efficiency, and increased revenues to be gained by improving the efficiency of the sign-making process.

Table 6. Analysis Comparison

	Standard Analysis	P2/Finance
Implementation Costs	$39,370	$50,500
Annual Savings	$12,150	$309,800
Payback	3.2 years	0.2 years
ROI	10.8%	286% (IRR)
NPV	na	$131,700 (1 year) $1.5 M (10 years)

Conclusions

The application project supported the claim that environmental accounting is a useful tool to be used in conjunction with P2OAs. Environmental accounting principles allow a wider range of costs/benefits to be considered, thus putting P2 investments on a level playing field when competing for limited capital resources. Better identification of environmental costs/benefits, including the identification of liability and intangible benefits, provides management with better information for making P2 investment decisions. Better identification of environmental costs/benefits will improve the acceptance of P2 as a cost-effective alternative to compliance-driven pollution control practices.

Table 7. Implementation Cost Breakdown

Item	Standard Analysis	P2/Finance
Equipment (sign-making system, scanner, memory, software, sales tax, delivery)	$27,400	$27,400
Computer cartridges	$2,500	$2,500
Removal of old equipment	na	$1,150
Disposal of unusable chemicals	na	$800
Resale of equipment/chemicals	na	($6,000)
Installation	$390	$390
DOE overhead adders	$7,500	$7,500
Training	$1,200	$8,100
Total Cost	$38,990	$50,540
Salvage value (10 years	na	($5,000)

Table 8. Annual Savings Breakdown

Item	Standard Analysis	P2/Finance
Material/chemicals	$9,587	(24,880)
Waste management	$2,560	$530
Utilities	na	$455
Labor	na	$75,470
Floor space	na	$15,000
Regulatory compliance	na	$33,250
Revenues	na	$210,000
Total Annual Savings	$12,150	$309,825
Routine equipment upgrades (every 3 years)	na	$2,000

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