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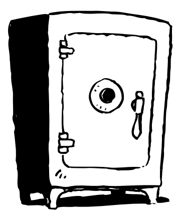
Financial Analysis of Pollution Prevention Projects

Have you ever proposed a pollution prevention (P2) project that was not funded because it didn't meet your company's financial profitability criteria? Don't give up. Pollution prevention projects often have a hard time meeting the necessary financial criteria. But with a little work you can determine if your company should open it's financial safe to your P2 project. Here are three common reasons why these projects are not funded:



- **First, conventional cost accounting systems are not specifically designed to evaluate P2 projects. As a result many of the costs and savings of P2 projects are not included or are underestimated.**
- **Second, conventional cost accounting systems might not evaluate P2 projects over a long enough time period to capture its savings.**
- **Third, a P2 project might not be profitable or as profitable as other projects, even when addressing the above shortcomings.**

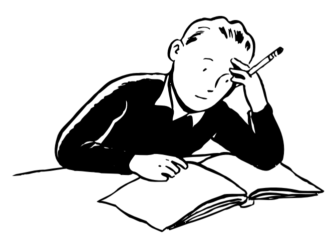
The purpose of this document is to help you overcome these obstacles by accurately determining the economic profitability of your P2 projects. By completing a basic financial evaluation you will be able to improve your P2 project's chances of receiving your company's financial recommendation to proceed with your P2 project.

Collecting cost information on current process costs and proposed project costs

Gathering complete and accurate cost information that has a tangible impact on the decision is the first step of the financial analysis. These costs should be expressed as the differences between the costs of the current process and those of the proposed P2 project. All costs should be converted to total annual amounts in order to perform the financial analysis in a common time period. The following procedures can be used to determine these costs (NEWMOA/OTA,1994):

1. Draft a process flow diagram of the existing process that will be altered by the proposed P2 project. The diagram should include the primary process and other secondary process flows that are related to or affected by the main process.

2. Use the process flow diagram to identify all the inputs and outputs to the process. These would include labor activities, raw materials, utilities, wastes, scrap, and other operating expense items that are involved in the production process and secondary processes. For P2 projects, the most important activities to be aware of are those related to waste/scrap generation and those related to purchasing, handling and using raw materials.



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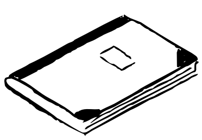
A conventional cost accounting system may hide indirect costs in an overhead account. To determine the full cost of a P2 project, you will want to know all the costs, including the hidden costs, that are attributed to a specific process and what drives those costs. Refer to Table 1, "Potential Operating Costs", on page five for a checklist of potential operating costs, including hidden costs, that should be considered.

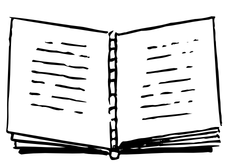
3. Repeat the first two steps for the new process. Refer to Table 2, "Potential Initial Costs" on page five for a checklist of potential initial costs that should be considered. Look carefully for the "hidden" costs and savings.

4. Identify all the places where inputs and outputs are likely to change. For example, labor activities, raw materials, utilities, waste and scrap.

5. Determine the amounts and associated costs of the inputs and outputs for those activities that will change from the current process to the proposed project.

Are you at a loss as to where to find some of the costs or amounts of inputs and outputs? Potential sources of this information include operational and environmental personnel; logs of various activities or materials; records from purchasing, payroll and accounting; receipts and invoices; and vendors.



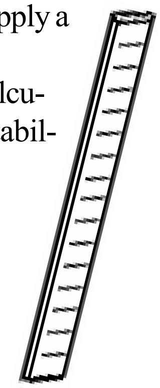


6. Calculate the differences between the current and proposed processes. It may be advantageous to express the costs in after-tax amounts. For example, depreciation of equipment will reduce the taxable income of a company.

It's possible that by looking for all of the costs associated with a process or project, you might identify more costs than originally anticipated. The additional costs might cause the proposed P2 project to be turned down for funding. This might be discouraging, but remember that your primary goal is to determine if a particular P2 project will reduce waste and save money when compared to a current process. Keep the proposed project on file and try the financial analysis again at a later time when costs and savings figures may have changed.

Applying measures of profitability

Once all the cost information is compiled, the next step in the financial analysis is to apply a measure of profitability. A measure of profitability is a single number that is calculated to characterize the project's profitability in a concise, understandable form.



There are three common methods, or measures of profitability, used to determine if a P2 project will add economic value. These measures include: payback period, net present value (NPV), and internal rate of return (IRR). Each method is briefly explained here, including appropriate uses, advantages and limitations (following NEWMOA/OTA, 1994). You're encouraged to consult the references at the end of the fact sheet for a more detailed explanation of these methods.

If you do not have a background in financial analysis or feel you do not have time to perform numerous calculations, don't despair! If you have identified and collected cost and savings information, you have already done much of the work. Besides, there are numerous spreadsheets, such as P2/Finance, and relatively straightforward computer programs that can do most of the work for you. For more information about P2/Finance see the resource section at the end of the fact sheet.

Payback period analysis (simple payback) measures how long a project will take to return its original investment and ranks projects according to the length of the period. The shorter the period, the more attractive the project. The payback period is the amount of time required for an investment to generate enough cash flow to cover the capital costs for that investment. Cash flow from an investment is the dollars coming to the company (cash inflow) or paid out by the company (cash outflow) resulting from a given investment (White and Savage, 1995).

For example, if the initial investment is $12,000 and the annual cash flow is $15,000, then the payback period is $12,000/$15,000 = 0.8 years.

A payback period analysis has two drawbacks: it ignores the time value of money, and it does not consider costs and savings past the point where the project has paid for itself. A chart that tracks the percentage payback of all cash flows over the life of the project may increase the payback method's usefulness.

Payback analysis provides a useful preliminary assessment of a project's attractiveness. If the payback is very short and the project is relatively simple, payback period analysis may be sufficient. However, this initial assessment should be verified by a Net Present Value analysis.

Net present value (NPV) analysis relies heavily on the concept of the time value of money and is the most powerful tool for assessing profitability over the life of a project. The time value of money recognizes that receiving $100 today is not equivalent to receiving $100 at some point in the future, because the $100 today can be invested to earn a return. Net present value is the present value of the future cash flows of an investment, minus the investment's current cost (White and Savage, 1995).

The time value of money measures the value of money at different points in time as determined by a discount rate. The discount rate is the interest rate that is used to relate the future value of the money to the present value of the money. The discount rate is the rate of interest or return that a business or person can earn on the best alternative use of the money at the same level of risk. The discount rate is a function of what that company must pay to acquire capital (money) and what rate of return for a given level of risk it must earn on the investment to satisfy management and shareholders. Note that discount rates are not inflation rates, although they usually incorporate the projected rate of inflation. An example of how net present value can be calculated is shown in Table 3 on page six.

Net present value analysis should be used when initially evaluating major P2 projects and for the final analysis of most projects. Advantages of net present value analysis are it considers the time value of money and it measures the risk-adjusted value added to the company. Disadvantages include that it is more information and calculation intensive, requires the estimation of cash flows over the life of the project and requires the calculation of a discount rate.

Internal Rate of Return (IRR) is a profitability measure, expressed as a percentage, that is analogous to an average rate of return from an investment. IRR is the discount rate that will yield a net present value of zero for a given stream of cash flows. This method allows a comparison between the IRR of a project and a company's self-determined discount rate. A financial calculator or computer spreadsheet should be used to determine IRR. In general, if the IRR is greater than the discount rate, the project will be accepted. If the IRR is less than the discount rate, the project will be rejected.

The IRR can provide a convenient way of examining the return that a project will generate. Using the NPV and the IRR approaches result in the same alternative being chosen because these approaches are essentially the same. IRR shows the rate of return that a project generates, while NPV shows the present day dollar value of the return that a project generates. However, IRR analysis ignores the impact of the scale of a project. For example, a project that requires an investment of $100 and returns $125 in one year will have the same IRR as a project that requires a $200,000 investment and returns $250,000 in one year. IRR should only be used to judge if a project is profitable, not for prioritizing projects. Use NPV for prioritizing and comparing projects because it yields consistently valid results.

Net present value is generally the most valuable, problem-free measure of profitability. Other indicators that consider the time value of money, such as internal rate of return, are also useful. Payback should be used only for small projects, for a first-cut rough screening analysis, or to complement NPV and IRR information. (White and Savage, 1995)

If you have accurately estimated cash flows and selected the appropriate discount rate, all projects with a positive NPV are profitable and may be worth implementing. If you have several projects competing for funding, or more than one P2 option, choose the alternative with the highest NPV, not the highest IRR.

An appropriate time horizon

You've identified all the costs and selected the measure of profitability you'll use to evaluate your project, now what? Now it's important to determine what time horizon you'll use for your project. Just because your company uses a standard time horizon doesn't mean its appropriate for your project. Remember many P2 project will need longer time horizons (for example the economic life of the project) to capture all their savings.

Considering less tangible costs

What if you've identified all the costs and used an appropriated profitability measure, but your project is not as profitable as other projects? Don't give up, even these projects can be funded if they are linked to qualitative issues that your company views as important.

Qualitative issues such as product quality, productivity, market share, stakeholder relations, employee health and safety, public image, a proactive environmental strategy, and criminal and financial liability can be very important criteria in the analysis of a P2 project. Potential liability categories include disposal, storage, transportation, real property damage, civil actions, toxic tort suits, fines, penalties and criminal liability. These issues can influence managers but are difficult to quantify; however, they may still have strategic significance.

Decide which issues have a strategic significance to your company and which issues are related to your particular P2 project. Assess the possible impacts of those issues and include the issues and the assessment in your presentation of the P2 project to your management. More detailed discussion of how to evaluate qualitative issues and how to communicate their importance in a P2 project is presented in "Improving Your Competitive Position: Strategic and Financial Assessment of Pollution Prevention Projects" (NEWMOA/OTA, 1994).

Closing

If your funding request is not successful on your first attempt, try to determine the reasons for rejection and critically review and revise the proposal. Remember that changes in cost accounting methods (including all the costs and savings of a P2 project) and careful consideration of the qualitative aspects of the project may be new ways of thinking about capital budgeting for the decision makers. You might want to try this approach on one small project to demonstrate the benefits of a different approach to thinking about costs of a P2 project.

Some P2 projects are not approved during their first review. Revise your proposal and submit it again. You might also want to consider technical and financial assistance available from Ohio EPA and the State of Ohio to strengthen your proposal.

Table 1. Potential Operating Costs[1]

Materials
- direct product materials
- catalysts and solvents
- wasted raw materials
- transport
- storage

Utilities
- electricity
- steam
- cooling & process water
- refrigeration
- fuel (gas or oil)
- plant air & inert gas
- sewerage

Direct Labor
- operating labor & supervision
- manufacturing clerical labor
- inspection (QA & QC)
- worker productivity changes

Indirect Labor
- maintenance (materials & labor)
- miscellaneous (housekeeping)
- medical surveillance

Regulatory Compliance
- monitoring
- manifesting
- reporting
- notification
- recordkeeping
- training (right-to-know, safety, etc.)
- training materials
- inspections
- protective equipment
- labeling
- penalties/fines
- lab fees
- insurance
- R&D to comply with regulations
- handling (raw materials and waste)
- closure & post-closure care

Waste Management (Materials & Labor)
- pre-treatment
- on-site handling
- storage
- hauling
- insurance
- disposal

Revenues
- sale of product
- marketable by-product
- manufacturing through-put change
- change in sales from:
  - increased market share
  - improved corporate image

Future Liability
- fines & penalties
- personal injury

Table 2. Potential Initial Costs[1, 2]

Engineering/Contractor (in-house & external)
- planning
- engineering
- procurement
- consultants
- design
- drafting
- accounting
- supervision

Site Preparation
- demolition, clearing etc.
- disposal of old equipment, rubbish
- walkways, roads, and fencing
- grading, landscaping

Installation
- vendor
- contractor
- in-house staff
- construction/installation
- labor & supervision
- taxes & insurance
- equipment rental

Utility Connections and New Systems
- electricity
- steam
- cooling & process water
- refrigeration
- fuel (gas or oil)
- plant air
- inert gas
- general plumbing
- sewerage

Start-up & Training
- vendor/contractor
- in-house
- trials/manufacturing variances

Materials
- piping
- electrical
- instruments
- structural
- insulation
- building construction materials
- painting materials
- ducting materials

Purchased Equipment
- equipment
- sales tax
- price for initial spare parts
- process equipment
- monitoring equipment
- preparedness/protective equipment
- safety equipment
- storage & materials handling equipment
- laboratory/analytical equipment
- freight, insurance

Permitting - Fees & In-House Staff

Initial Charge for Catalysts and Chemicals

Working Capital
(raw materials, inventory, materials/supplies)

Salvage Value

1 - This list is from NEWMOA/OTA, 1994, as adapted from material published by the Tellus Institute.

2 - Many of these costs may or may not be capitalized depending upon the judgment of a company's financial staff.

Table 3. Net Present Value Calculation

Present Value of an Investment

What is the value of future cash flows today? For example, what amount of money invested now at 10 percent will equal $130 in two years?

$$PV = FV / (1 + r)^T$$
$$PV = \$130/(1 + 0.1)^2$$
$$PV = \$130/1.21$$
$$PV = \$107.44$$

PV = Present value, the value of the money received today (PV = $107.44)
FV = Value that will be received in the future, when invested at r (FV = $130)
r = The rate at which funds received today could be invested (r = 10 percent)
T = The number of time periods in which interest is earned (T = 2)

Receiving $130 in two years is equivalent to receiving $107.44 today and investing it for two years at 10 percent.

Net Present Value Analysis

Net present value (NPV) analysis compares the PV of the cash inflows to the initial investment. How do these present values relate to the initial cash outlays? For example, in the present value analysis above, we could ask whether a projected income of $130 in two years is worth an initial investment of $100. To determine if this is a worthwhile investment, we subtract the initial investment from the PV of the cash received in year 2, as shown here.

$$NPV = PV\ (\text{cash inflows}) - PV\ (\text{cash outflows})$$
$$NPV = \$107.44 - \$100$$
$$NPV = \$7.44$$

The NPV indicates how much extra return a project generates above the percent return that is required by a firm's owners or managers. In this example, the investment generates $7.44 in excess of the 10 percent return that is required.

If NPV is greater than zero, the project should be accepted. If NPV is less than zero, the project should be rejected. If NPV equals zero, the project generates exactly the return that's required.

NPV can be calculated for investments that cover different time periods. Present value tables are also available that calculate PV factors for different discount rates and years. Refer to the document, "Improving your competitive position: Strategic and financial assessment of pollution prevention projects" (NEWMOA/OTA, 1994) for more information.

Tiz's Door Sales, Inc.

Case Study (Graff etal, 1998)

The Tiz Door Inc. (TIZ) of Everett, Washington, currently coats wood products by applying a coat of color stain and two coats of petroleum-based lacquer. After the first lacquer coat, the wood pieces sit for 10 minutes to dry, and after the second, they sit for 20 minutes. The lacquer costs $10 per gallon and loses 70 percent of its volume to evaporation during the coating process, which generates air emissions and exposes workers to vapors.

TIZ was considering an ultraviolet (UV) coating process to replace its conventional petroleum-based process. The UV process, whereby wood lacquer is cured by UV light rather than by air drying, would have lower operating costs and would generate less pollution, but would require a large initial capital investment. The UV investment would place a curing oven at the end of the coating line. Immediately after coating, the wood pieces would enter the oven where they would cure in seven seconds (as opposed to 10 or 20 minutes). The UV-curable lacquer costs $25 per gallon, but will lose virtually none of its volume because it does not evaporate during the coating process. Therefore, it would significantly reduce the air emissions from the process. To accommodate the new lacquer, new distribution lines would have to be installed to carry the lacquer from the storage area to the process line, and the spray-gun nozzles would have to be modified slightly.

Another benefit of the UV-cured lacquer is that it does not discolor (yellow) when exposed to sunlight. The yellowing process occurs over an extended period of time, but can have a direct effect on TIZ's operations; TIZ had recently paid a settlement to a customer because of yellowing problems. Eliminating this problem would not only eventually eliminate future settlements, it would also improve the quality of TIZ's products, and thus represent a competitive advantage. Because the effect of eliminating yellowing was difficult to quantify, it was not included in the financial analysis, but it was weighed as an important less tangible, qualitative factor. The benefit to employees who would no longer be exposed to potentially hazardous vapors was similarly considered to be important, but not quantified.

The investment in a conversion to a UV process was evaluated using a net present value (NPV) analysis, using a 6 percent discount rate. The initial investment costs ($190,000) include not only equipment, materials and installation, but also utility connections, site preparation and savings in permitting costs and insurance. The savings would results from reduced toxic emissions that would eliminate the need for an air permit and would lower explosion risk.

Cost Considerations	
	Year One Savings
Permits/Insurance	$4,300
Materials	$124,000
Labor	$44,800
Equipment	$3,300
Tax	$11,900
Total Savings	**$188,300**
	Year One Costs
Utilities	$3,000
Rework	$48,000
Total Costs	**$51,000**

Since the conversion would not affect many of TIZ's operation costs, the analysis focused only those costs that would change as a result of the investment. These costs included utilities and rework, and savings in lacquer costs, labor and equipment replacement. In addition, the tax savings from the equipment depreciation were included.

Different scenarios were calculated to reflect different potential cash flow streams. Each allowed for different equipment costs, insurance savings, rework costs (with the new system, pieces that are coated improperly cannot be reworked and must be scrapped) and depreciation tax savings. Each scenario was run for both a five-year and a ten-year project life. Across all scenarios, the NPVs ranges from $240,420 to $1,817,834 for which the investment would pay for itself, on a discounted basis, in one or two years.

Acknowledgements

Much of the information for this fact sheet was modified and directly quoted from the Northeast Waste Management Officials Association and the Massachusetts Office of Technical Assistance publications, "Improving Your Competitive Position: Strategic and Financial Assessment of Pollution Prevention Projects," Training manual and Instructor's guide (two separate publications). We appreciate their assistance with this fact sheet.

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U.S. Environmental Protection Agency's Environmental Accounting Project. The project goal is to encourage and motivate businesses to understand the full spectrum of their environmental costs and integrate these costs into decision making. Contact: Kris Pierre, (202) 260-3068 or www.epa.gov/opptintr/acctg/

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P2/FINANCE Version 3.0, Pollution Prevention Financial Analysis Cost Evaluation Spreadsheet Software Application. This is a spreadsheet system for conducting financial evaluations of current and potential investments. P2/FINANCE differs from conventional capital budgeting tools because it expands the cost and savings inventory to include indirect and less tangible environmental costs and uses profitability indicators and time horizons that capture the longer-term savings typical of pollution prevention investments. Available from the Pollution Prevention Information Clearinghouse (202) 260-1023 or downloadable at: www.epa.gov/opptintr/acctg/download/p2finan.htm

www.epa.state.oh.us/opp

The Office of Pollution Prevention was created to encourage multi-media pollution prevention activities in Ohio to reduce risk to public health, safety, welfare and the environment. Pollution prevention stresses source reduction and, as a second choice, environmentally sound recycling while avoiding cross media transfers. The Office develops information related to pollution prevention, increases awareness of pollution prevention opportunities, and can offer technical assistance to business, government, and the public.

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