Cost Analysis for Pollution Prevention

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Pollution prevention can save money on the costs involved in an industrial production process, as well as provide new sources of revenue. Many pollution prevention opportunities cost very little to carry out, and can be quite profitable; others must be analyzed carefully to weigh their profitability. This analysis involves identifying all the major costs involved in a current process and possible pollution prevention alternatives, and then comparing the costs and savings.

Identifying Costs and Savings

Project proposals are often evaluated on the basis of "usual costs" such as capital costs, raw materials, and utilities. Unlike other projects, pollution prevention improvements may offer significant savings in the areas of regulatory compliance, waste disposal and treatment, insurance premiums, and other often overlooked expenses. Recent studies have found that many businesses are making substantial errors in estimating the profitability of environmental projects because they neglect to account for these special costs and savings.

Table 1 on the back of this publication provides a list of important costs to consider when evaluating pollution prevention projects. This table includes blank lines for recording the costs for the current operation as well as a pollution prevention alternative. Start with the easiest costs and keep adding more until you are sure that the project will not be rejected prematurely. In general, the order of increasing difficulty is:

- Usual (production) costs
- Compliance and oversight costs
- Potential liabilities
- Intangible costs

Table 3 provides a form that can be used to summarize these project costs over a 5-year period, to capture the long-term benefits offered by many pollution prevention projects.

Evaluate Economic Feasibility

A number of financial analysis methods are available for this purpose. The two most common techniques are **Payback** and **Net Present Value**. Payback can be a quick method for comparing alternatives. Net Present Value (NPV) offers the advantage of accounting for the time-value of money.

Simple Payback Method

Payback considers the initial investment costs and the resulting annual cash flow. The payback period is the amount of time (usually measured in years) to recover the initial investment in an opportunity. Unfortunately, the payback method doesn't account for savings that may continue from a project after the initial investment is paid back from the profits of the project, but this method is helpful for a "first-cut" analysis of a project.

1. Payback With Equal Annual Savings

If annual cash flows are equal, the payback period is found by dividing the initial investment by the annual savings.

$$\text{Payback Period (in years)} = \frac{\text{Initial Investment Cost}}{\text{Annual Operating Savings}}$$

Consider the example of a shop evaluating the purchase of a still to recycle its waste solvent. The shop manager analyzes both his current operation and the option of using a still. He sees that installation of a still will cost $7,700, but provide a net annual operational savings of $4,634. When the net annual savings is divided into the initial cost, the manager finds that the still will pay for itself in 1.7 years:

$7700 Investment Costs

$4634 Annual Savings

Payback Period = $4634 Annual Savings = 1.7 yrs

2. Payback With Unequal Annual Savings

The previous example assumes that the annual cash flow is the same each year. In reality, there are significant costs such as depreciation and taxes that will cause cash flows to vary each year. If the annual cash flow differs from year to year, the payback period is determined when the accrued cash savings equal the initial investment costs (i.e., when the cumulative cash flow balance equals zero). **Table 2** illustrates the following example:

The initial investment in a pollution prevention project is $10,000. The projected savings is $4,000 for the first year, $4,000 for the second year, $2,500 for the third year, $2,000 in the fourth year, and $2,000 for the fifth year. The payback would be at 2.8 years.

Table 2. Example of Payback With Unequal Annual Cash Flow

Year	Annual Cash Flow	Cumulative Cash Balance
0 (today)	($10,000)	($10,000)
1	$ 4,000	($6,000)
2	$4,000	($2,000)
2.8 = Payback	$2,000	$0
3	$2,500	$500
4	$2,000	$2,500

Information from **Lines 1 and 12** of the project analysis form on **Table 3** can be used to determine the payback period of a project (omit Lines 13 through 16). Line-by-line instructions for using Table 3 are provided on its reverse side.

Net Present Value (NPV) Method

One of the advantages of the Net Present Value (NPV) method is that is accounts for the time-value of money (i.e., the value of a dollar tomorrow is not the same as a dollar today). The NPV method determines the worth of a project over time, in *today's* dollars. Unlike the payback method, NPV also accounts for the savings that occur after the payback period. The greater the NPV value of a project, the more profitable it is. This method can be used to rate and compare the profitability of several competing options.

Table 3 can be used to calculate NPV for a current practice and each pollution prevention alternative. Line-by-line instructions for using Table 3 are provided on the reverse side of the table. Lines 13 through 16 of Table 3 includes the use of *present value factors* to convert annual values to *today's* dollars. **Table 4** provides present value factors that can be used in calculating the NPV. The present value factor selected by a business will depend on what each business has determined to be the most appropriate interest rate for its operation. This interest rate depends on the cost of acquiring capital for that business, and the rate of return they require from an investment in a project. Currently (year 2000), it's about 15–20%.

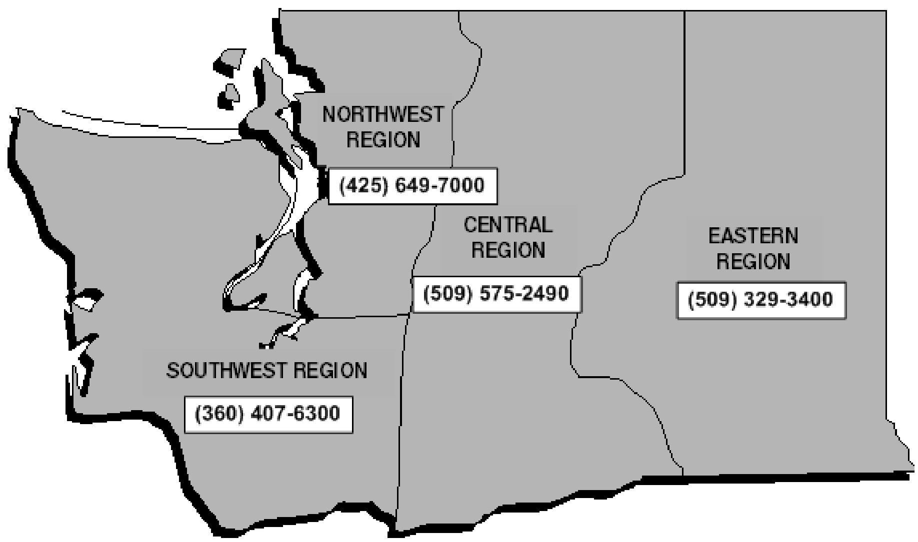
Table 5 shows an example of the use of Tables 3 and 4 to calculate the NPV of the payback example shown in Table 2. (Only selected lines of Table 3 are shown.)

Table 5. Example Use of Form for Calculating Net Present Value (selected lines shown)

Line	Year	Year 0 (today)	End of Year 1	End of Year 2	End of Year 3	End of Year 4	End of Year 5
1	Initial Investment	10,000	0	0	0	0	0
12	Annual Operations Cash Flow	0.00	4,000	4,000	2,500	2,000	2000
13	Total Cash Flow	(10,000)	4,000	4,000	2,500	2,000	2,000
14	Present Value Factor*	1.0000	0.8696	0.7561	0.6575	0.5718	0.4972
15	Total Present Value Annual Cash Flow	(10,000)	3,478	3,024	1,644	1,144	994
16	Net Present Value	$ 285					
	**Assume 15% Discount Rate*						

Resources to Help You

This document provides basic methods and forms for doing a cost analysis. If you have any questions about performing a financial analysis, Ecology has staff in each of its regional offices who can provide free assistance in doing cost analysis for pollution prevention. Contact these staff at your nearest office:



If you need this information in an alternate format, please call the Hazardous Waste and Toxics Reduction Program at 360-407-6700. If you are a person with a speech or hearing impairment, call 711, or 800-833-6388 for TTY.

Table 1. Typical Costs to Consider in Pollution Prevention Economic Analysis

Usual Costs

	Current	Alternative
Depreciable Capital Costs		
Equipment		
Site Preparation		
Installation		
Engineering		
Procurement		
Materials		
Utility Connections		
Facilities		
Operating Expenses		
Direct labor		
Initial raw materials		
Start-up		
Training		
Raw materials		
Supplies		
Utilities		
Maintenance		
Salvage value		
Operating Revenues		
Revenues		
By-product revenues		

Note:
Italicized costs are especially important to include in an economic analysis

Compliance Costs

	Current	Alternative
Receiving Area		
Spill response equipment		
Emergency response plan		
Raw Materials Storage		
Storage facilities		
Safety training		
Secondary Containment		
Right-to-know Training		
Reporting and Records		
Container labels		
Process Area		
Emission control equipment		
Reporting and records		
Sampling and Testing		
Safety equipment		
Right-to-know training		
Waste collection equipment		
Solid and Hazardous Waste		
Disposal fees		
Sampling and Testing		
Containers		
Labels and labeling		
Storage areas		
Transportation Fees		
Air and Water Emissions Control		
Capital costs		
Operating expenses		
Discharge fees		
Permit preparation		
Permit fees		
Recovered materials		
Inspection and monitoring		
Recording and reporting		
Sampling and testing		
Emergency planning		

Oversight Costs

	Current	Alternative
Purchasing		
Inventory control		
Product/vendor Research		
Regulatory impact analysis		
Engineering		
Hazard analysis		
Sampling and testing		
Production		
Re-work		
Disposal management		
Employee training		
Emergency planning		
Medical monitoring		
Waste collection		
Inspections and audits		
Marketing		
Public relations		
Management		
Penalties and fines		
Legal fees		
Regulatory research		
Information systems		
Insurance		
Finance		
Credit costs		
Tied-up capital		

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Worksheet for Using Tables 3 and 4

Table 3. Financial Analysis Form

This form can be photocopied and filled out to document and analyze the economic feasibility of a current practice and each proposed alternative. This form can be used in determining both the potential payback period and Net Present Value of a project. Line-by-line instructions are given on the back of this sheet.

Line	Cost Element (refer to Table 1)	Year 0 (today)	End of Year 1	End of Year 2	End of Year 3	End of Year 4	End of Year 5
1	**Initial investment**						
	Operating Costs:						
2	Revenues						
3	Usual Costs						
4	Compliance Costs						
5	Oversight Costs						
6	Operating Income (subtract lines 3,4,5 from 2)						
7	Depreciation of Equipment						
8	Total Taxable Income (subtract line7 from 6)						
9	Taxes						
10	Net Income After Taxes (subtract line 9 from 8)						
11	Depreciation of Equipment						
12	Annual Operations Cash Flow (add lines 11 and 10)	0.00					
13	Total Cash Flow (subtract line 1 from line 12)						
14	Present Value Factor (see Table 4)	1.0000					
15	Total Present Value Annual Cash Flow (multiply lines 13 and 14)						
16	Net Present Value (sum annual values in line 15)		← Net Present Value for Project				

Table 4. Present Value Factors

Discount Rate	Year 1	Year 2	Year 3	Year 4	Year 5
5 percent	0.9524	0.9070	0.8638	0.8227	0.7835
10 percent	0.9091	0.8264	0.7513	0.6830	0.6209
15 percent	0.8696	0.7561	0.6575	0.5718	0.4972
20 percent	0.8333	0.6944	0.5787	0.4823	0.4019

Instructions For Using Tables 3 and 4

Line 1: Enter the expected initial investment for the project. Year 0 is the time the first investment/installation is made; all other costs are counted at the end of each succeeding year.

Line 2: Enter the expected revenue from the process for each year. Be sure to include any revenues from off-site recycling. If it is difficult to assign a revenue value to an individual process and revenues are not expected to vary between the options being analyzed, leave this line blank.

Line 3: Enter the expected annual costs for "usual" expenses listed in Table 1. *Note that this category includes equipment lease payments.*

Line 4. Enter the expected compliance costs for each year (see Table 1). Compliance costs are those necessary to comply with environmental, safety, or health regulations. If a business can be penalized for not spending the money, it is a compliance cost.

Line 5. Oversight costs are general environmental a safety management costs incurred because a facility uses hazardous or regulated substances or generates waste or emissions. (See Table 1.)

Line 6. Subtract operating expenses (lines 3, 4, and 5) from revenues (line 2) to calculate the annual operating income.

Line 7. Enter the annual depreciation of process equipment. Consult your tax accountant for the appropriate depreciation method to use, as well as tax benefits allowed under Section 179 of the U.S. tax code. If the total equipment expense is less than the allowed yearly deduction, then add the investment to that year's operating expenses and enter "0" for depreciation in line 7.

Line 8. Subtract depreciation (line 7) from operating income (line 6) to get taxable income.

Line 9. Calculate and enter the amount of business taxes on taxable income (line 8).

Line 10. Subtract taxes (line 9) from total taxable income (line 8) to determine after-tax income.

Line 11. Enter the depreciation amount again (as in line 7).

Line l2. Add lines 10 and 11 to determine the annual operations cash flow. A negative number indicates a net outlay of money that year for operating costs.

Add Lines 13 through 16 on Table 3 for calculating Net Present Value:

Line 13. Total annual cash flow equals annual operating costs (line 12), minus depreciable initial investments (line 1). A positive number indicates a net income for that year.

Line 14. Choose a discount rate to decide the value of future cash flows today. Using the Present Value Factor table at the bottom of the form, enter the discount factor for the chosen rate.

Line 15. Multiply the total cash flow (line 13) by the Present Value Factor (line 14) to find the value of the year's total cash flow in today's dollars.

Line 16. Sum all of the adjusted annual cash flows on line 15 to see the Net Present Value of the project. This is how much the project is worth to you over the next five years, in today's dollars.