Cost Analysis for Pollution Prevention

Hazardous Waste and Toxics Reduction Program

Washington State Department of Ecology
Olympia, Washington

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Toxics Reduction Team

We provide individually tailored technical services across the state, with staff assigned to each region. Find contact information for your toxics reduction team on our meet our toxics reduction team webpage.[2]

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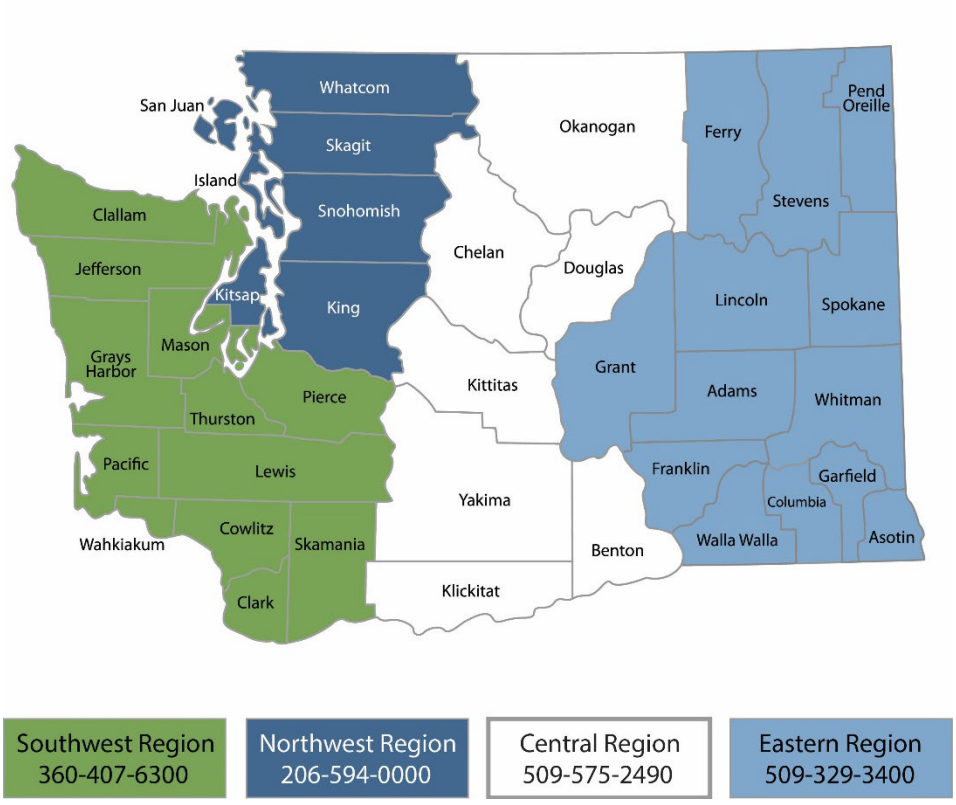
[1] www.ecology.wa.gov/contact
[2] www.ecology.wa.gov/ToxicsReductionTeam
[3] www.ecology.wa.gov/accessibility

Department of Ecology's Regional Offices

Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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DEPARTMENT OF
ECOLOGY
State of Washington

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Introduction

Pollution prevention can help you save money and develop new sources of revenue. Many standard pollution prevention opportunities cost very little to carry out and provide immediate savings. Others are more complex and require a careful analysis of costs and benefits.

This guide can help you identify major costs for your current processes and potential pollution prevention alternatives. It provides basic information about calculating payback while considering:

- Operational costs.
- Environmental compliance requirements.
- Oversight costs.

We have staff who can provide free assistance in pollution prevention cost analysis. Find contact information for your regional team on our meet our toxics reduction team webpage.[4]

Identify Costs and Savings

Project proposals are often evaluated on "usual costs" like capital costs, raw materials, and utilities. Unlike other projects, pollution prevention improvements may offer significant savings in often-overlooked expenses like regulatory compliance, waste disposal, and waste treatment. You need to include these "hidden" costs and savings to make an accurate estimate of an environmental project's profitability.

Consider as much readily available cost data as possible, and keep adding more and updated data as you progress. This will help ensure your project isn't accepted or rejected prematurely.

We listed important costs to consider when evaluating pollution prevention projects. These costs are also incorporated into a costing worksheet. Learn more about it in Appendix A.

Typical pollution prevention economic costs to consider

Usual costs

Depreciable capital costs

- Equipment[5]
- Site preparation[5]
- Installation[5]
- Engineering
- Procurement
- Materials

Operating expenses

- Direct labor[5]
- Initial raw materials[5]
- Start-up training[5]
- Raw materials
- Supplies
- Utilities
- Maintenance
- Salvage value

Operating revenues

- Revenues[5]
- By-product revenues

Utility

- Connections
- Facilities

[4] www.ecology.wa.gov/ToxicsReductionTeam

[5] Costs that are especially important to include in an economic analysis.

Compliance costs

Air and water emissions control

- Capital costs[6]
- Operating expenses[6]
- Discharge fees[6]
- Permit preparation[6]
- Permit fees[6]
- Recovered materials
- Inspection and monitoring
- Recording and reporting
- Sampling and testing
- Emergency planning

Process area

- Emission control equipment[6]
- Reporting and records[6]
- Sampling and testing[6]
- Safety equipment
- Right-to-know training
- Waste collection equipment

Raw materials storage

- Storage facilities[6]
- Safety training[6]
- Secondary containment
- Right-to-know training
- Reporting and records
- Container labels

Receiving area

- Spill response equipment
- Emergency response plan

Solid and dangerous waste

- Disposal fees[6]
- Sampling and testing[6]
- Containers[6]
- Labels and labeling
- Storage areas
- Transportation fees
- Inspection and monitoring
- Recording and reporting
- Sampling and testing
- Emergency planning

Oversight costs

Engineering

- Risk analysis
- Sampling and testing[6]

Finance

- Credit costs[6]
- Tied-up capital

Management

- Penalties and fines[6]
- Legal fees[6]
- Regulatory research
- Information systems
- Insurance

Marketing

- Public relations

Production

- Re-work[6]
- Disposal management[6]
- Employee training[6]
- Emergency planning
- Medical monitoring
- Waste collection
- Inspections and audits

Purchasing

- Inventory control (Governor's Office for Regulatory Innovation & Assistance[7])
- Product/vendor research[6]
- Regulatory impact analysis

[6] Costs are especially important to include in an economic analysis.
[7] www.oria.wa.gov/site/alias__oria/368/Home.aspx

Evaluate Economic Feasibility

You can use many financial analysis methods to determine the economic value of a pollution prevention opportunity. The most common methods are **simple payback method** and **net present value**.

The simple payback method provides a quick comparison, while net present value is more complex but accounts for the time-value of money. We describe **equal** and **unequal annual savings calculations** within the simple payback method below.

We also included additional tools and information in the appendices.

- Appendix A: A worksheet to calculate simple payback for equal annual savings.
- Appendix B: A worksheet about simple payback method and net present value.
- Appendix C: More details about unequal annual savings.
- Appendix D: Information about net present value calculations. Due to low interest rates available to Washington state businesses in 2020 and typically short target payback periods, net present value calculations don't vary greatly compared to simple payback calculations.

Simple payback method

The simple payback method considers your initial investment costs and resulting annual cash flow. The payback period is the amount of time it takes to recover the initial investment (usually measured in years). This method considers annual costs and cash flow that might not continue over the life of the project after the initial investment is paid back.

1. Payback with equal annual savings

If annual cash flows are consistent, you can find a project's payback period by dividing the initial investment by the annual savings.

$$\text{Payback Period (in years)} = \frac{\text{Initial Investment (in dollars)}}{\text{Net Annual Operating Savings (in dollars per year)}}$$

See Appendix A for a spreadsheet we developed that sums up costs and cashflow, and performs payback with equal annual savings.

Example payback with equal annual savings

Consider the example of a shop evaluating the purchase of a still to recycle its waste solvent. The shop manager wants to compare their current approach to the option of using a still. They determine that installing a still costs $7,700, but will save $4,634 each year. When they divide the initial investment cost by the net annual operating savings, they find the still will pay for itself in 1.7 years.

$$\text{Payback Period} = \frac{\$7{,}700 \text{ (initial investment)}}{\$4{,}634 \text{ per year (net annual operating savings)}} = 1.7 \text{ years}$$

2. Payback with unequal annual savings

The previous example assumes the annual cash flow is the same each year. In reality, there are significant costs that will cause cash flows to vary each year, such as depreciation and taxes. If you can give your project that level of detail, see Appendix B for guidance on simple payback for unequal annual savings.

Appendix A: Simple Payback for Equal Savings Worksheet

Visit this publication's summary page[8] to download a simple payback Excel worksheet you can use to provide a quick cost comparison.

For questions about this worksheet, contact your regional team on our meet our toxics reduction team webpage.[9]

[8] https://apps.ecology.wa.gov/publications/summarypages/2204025.html
[9] www.ecology.wa.gov/ToxicsReductionTeam

Appendix B: Evaluating Economic Feasibility Worksheet

Fill out Table 1 to determine if your current practice and each proposed alternative makes economic sense. You can use this form to determine the potential payback period and net present value of a project. See an example of the form filled out in Appendix D.

Table 1: Economic feasibility worksheet.

Line	Cost Element	Instructions	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	Enter expected initial investment.[10]		N/A[11]	N/A	N/A	N/A	N/A
2	Revenue	Enter expected revenue from the process for each year.[12]	N/A					
3	Usual costs	Enter expected usual costs for each year.[13]	N/A					
4	Compliance costs	Enter expected compliance costs for each year.[14]	N/A					
5	Oversight costs	Enter expected oversight costs for each year.[15]	N/A					
6	Annual operating income	Subtract operating expenses (lines 3, 4, and 5) from revenues (line 2).	N/A					

[10] Year 0 is the time the first investment or installation is made; all other costs are counted at the end of each succeeding year.
[11] N/A means **not applicable**.
[12] Include revenues from off-site recycling. If it's difficult to assign a value to an individual process and you don't expect revenues to vary between options being analyzed, leave this line blank.
[13] This includes equipment lease payments.
[14] These are necessary costs to comply with environmental, safety, or health regulations. If you can be penalized for not spending the money, it's a compliance cost.
[15] Oversight costs are general environmental safety management costs incurred when using hazardous or regulated substances, or generating waste or emissions.

Line	Cost Element	Instructions	Year 0 (today)	End of Year 1	End of Year 2	End of Year 3	End of Year 4	End of Year 5
7	Depreciation of equipment	Enter the annual depreciation of process equipment.[16]	N/A					
8	Total taxable income	Subtract depreciation (line 7) from operating income (line 6).	N/A					
9	Taxes	Calculate and enter the amount of business taxes on taxable income (line 8).	N/A					
10	Net income after taxes	Subtract taxes (line 9) from total taxable income (line 8).	N/A					
11	Depreciation of equipment	Enter the depreciation amount again (line 7).	N/A					
12	Annual operations cash flow	Add net income after taxes (line 10) and depreciation of equipment (line 11).[17]	N/A					
13	Total cash flow	Subtract initial investment (line 1) from annual operations cash flow (line 12).[18]						
14	Present value factor	Choose a discount rate.[19] Using Table 2, enter the discount factor for the rate you chose.	1.0					
15	Total present value annual cash flow	Multiply total cash flow (line 13) by present value factor (line 14).[20]						

Your **net present value** for the project is the sum of annual values in line 15. This is how much the project is worth to you over the next five years, in today's dollars.

[16] 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.

[17] A negative number indicates a net outlay of money that year for operating costs.

[18] A positive number indicates a net income for that year.

[19] This will determine the value of future cash flows today.

[20] This will show you the value of the year's total cash flow in today's dollars.

Table 2: Present value factors based on discount rates.

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

Discount rates are the estimated factor of cash depreciation over time.

Present value factors are used to calculate the present value of future cash flow. Using discount rates, these factors are calculated by a formula that allow you to estimate future cash flow in today's dollars to account for the time value of money. As a rule of thumb, today's cash flow is typically worth more than cash flow in future years.

The present value factor you select will depend on what you determine as the most appropriate interest rate for your operation. This interest rate depends on the cost of acquiring capital and the rate of return you require from a project investment.

Appendix C: Simple Payback Method with Unequal Annual Cash Flow

If your annual cash flow changes from year to year, determine the **payback period** by looking at when the accrued cash savings equals the initial investment costs (in other words, when the cumulative cash flow balance equals zero). **Table 3** provides an example.

Table 3: 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 equals payback	$2,000	$0
3	$2,500	$500
4	$2,000	$2,500

In this 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.

The payback period would be 2.8 years.

You can use information from **Lines 1–12** of Table 1 in Appendix B to determine the payback period of a project (leave out lines 13–15).

Appendix D: Net Present Value Method

The net present value (NPV) method determines the worth of a project over time, in today's dollars. Benefits to this method include:

- It accounts for the value of money over time (the value of a dollar tomorrow isn't the same as a dollar today).
- It accounts for savings after the payback period (the greater the NPV value of a project, the more profitable it is).
- It allows you to rate and compare several competing options.

Use **Table 1** in Appendix B to calculate NPV for your current practice and each pollution prevention alternative. Lines 13–15 include the use of present value factors to convert annual values to today's dollars.

Refer to **Table 2** in Appendix B to use present value factors when calculating the NPV.

- The present value factor you select will depend on what you determine to be the most appropriate interest rate for your operation.
- This interest rate depends on the cost of acquiring capital and the rate of return you require from an investment.

See **Table 4** (below) for an example of how to use **Tables 1** and **2** to calculate the NPV of the payback example shown in **Table 3** in Appendix C.

Table 4: Example—calculating net present value.[21]

Line	Cost Element	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	$2,000
13	Total cash flow	$(10,000)	$4,000	$4,000	$2,500	$2,000	$2,000
14	Present value factor[22]	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

Net present value[23]: $284

[21] We only included selected lines of Table 1 for this example.
[22] In this example we assumed a 15% discount rate.
[23] To calculate the net present value, add together the total present value annual cash flow (line 15) for every year of the project, including year 0.