How to determine cost for P2 savings

$$ MONEY TALKS $$

This is possibly the most important thing to know about the concept of pollution prevention, sustainability, etc. The projects, process changes, product redesigns, material substitutions that actually happen, happen because the **economic benefits are communicated effectively**. The greatest ideas in the world will die on the vine, if an effective economic case does not back that idea up. Fortunately, there are effective tools, techniques and most importantly case studies to back up the economic benefits of doing pollution prevention.

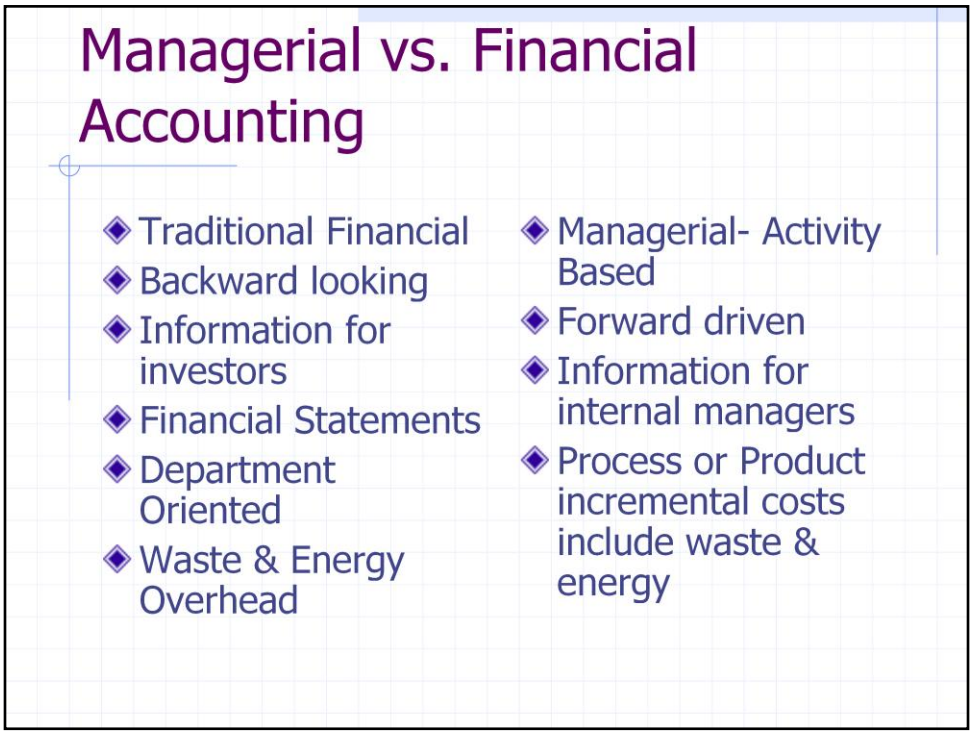
Waste = **Money** down the drain

Wastes, whether they create an environmental or health and safety problem or not, are negative income. Wastes are missed opportunities for some type of input cost to produce income. Wastes may be produced as part of processes, but should not be considered as intended OR unavoidable consequences. Minimizing wastes is an intrinsically profitable enterprise.

Waste costs have been traditionally considered a separate expense item and all have some waste metaphor in their name, “disposal”, “treatment”, “storage” etc. these are all easy to identify as waste costs.

What are not often thought of as waste costs are a lot of the traditionally considered “Overhead” costs that are resultant from either handling, generating, treating, shipping, or disposing of the substance in the first place. These costs are the additional expenses from these activities that are sometimes not identified directly with the product or process which causes them.

This last group are both potential expenses or benefits as a result of more effectively dealing with wastes or the lack there of. Generally businesses will address product rejects and returns as part of their overall quality efforts. Marketable byproducts may be identified through P2 or recycling efforts. Input recovery includes undervalued inputs such as heat, steam, water, and energy. There are potential opportunities to recover and reuse these inputs.



The basic problem with the traditional financial accounting approach for wastes and manufacturing in general is the segregation of costs between departments and products, and the concept of "Overhead" which is treated as an almost independent cost. Waste costs have been traditionally pigeon holed either in an EHS department or spread thinly or heavily over the entire manufacturing process. WASTE COSTS ARE **NOT** FIXED COSTS

No matter the system used, it is CRITICAL to assign waste costs to individual product lines and processes so that they can be measured and hopefully reduced accurately. Small changes such as dealing with a hazardous versus non-hazardous substance has impacts from the procurement stage until final disposal and ultimately beyond with liability and insurance.

Figure 1: Misallocation of Environmental Costs[4]

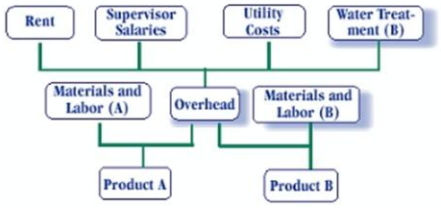
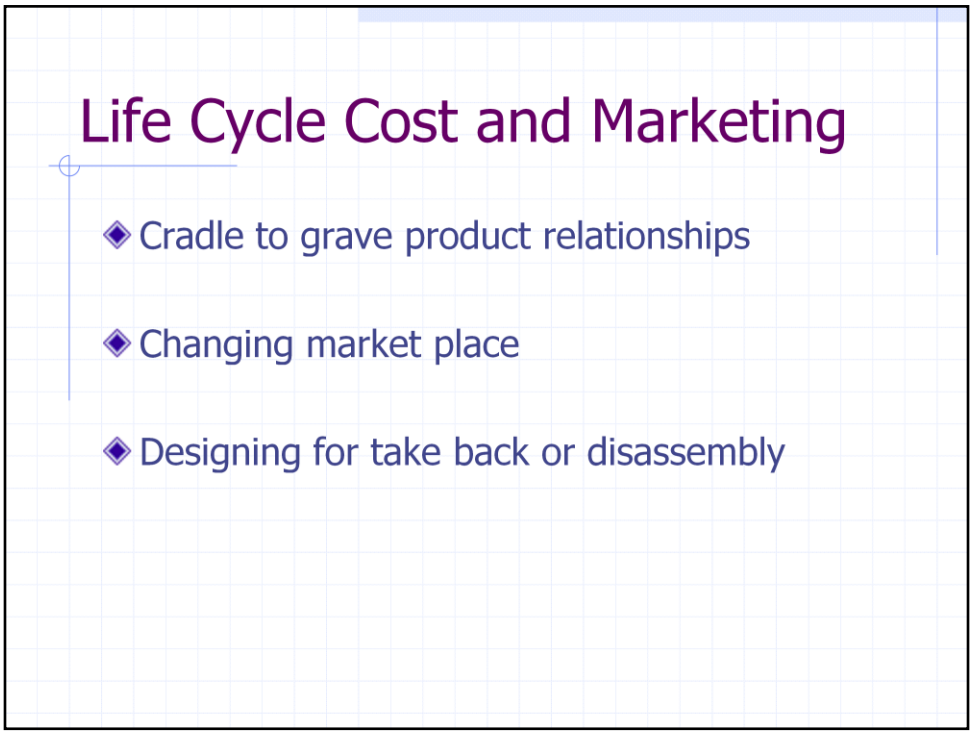


Figure 2: Improved Allocation

This is an example of traditional waste costs applied as "Overhead" to more than one product line. In this case Product B has a waste stream that must be removed with treatment. Knowing more accurately the production cost of B can identify opportunities to effectively reduce costs.

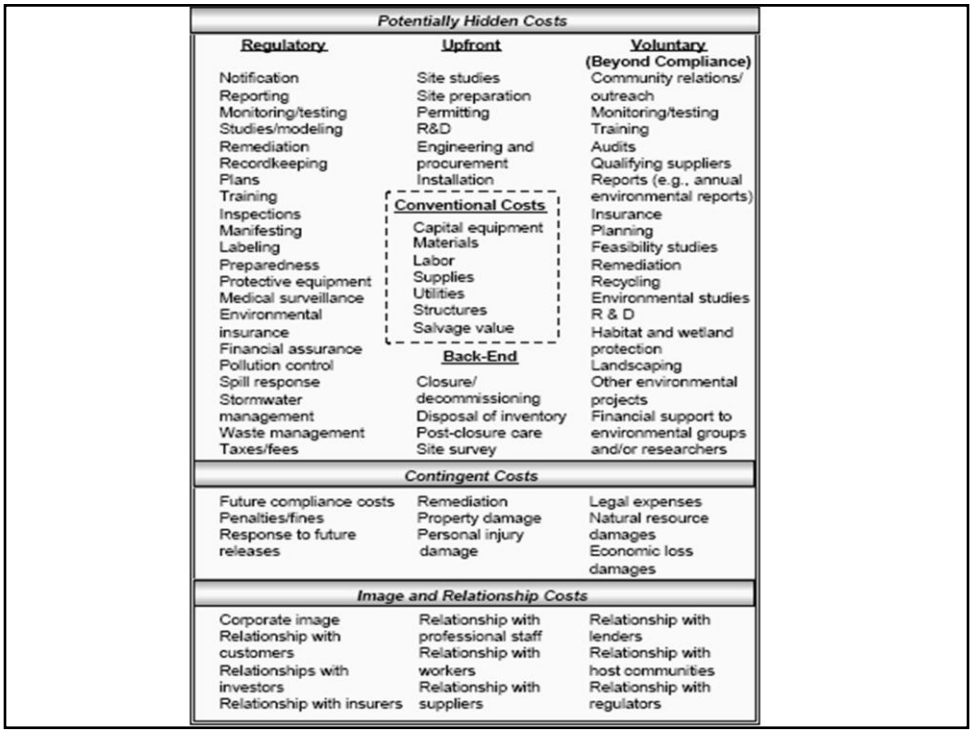


Ultimately a company is associated rightly or wrongly with their product from raw material extraction to final disposal. In California for instance, Computer Equipment has been banned from landfills. This has had a significant impact on the marketplace. The important aspect for manufacturers is that there are market opportunities in this relationship that can be taken advantage of today. Green Government Initiatives, such as Environmentally Preferable Purchasing are becoming more common, also a large portion of the public consistently respond that they will purchase an environmentally preferable product if available.

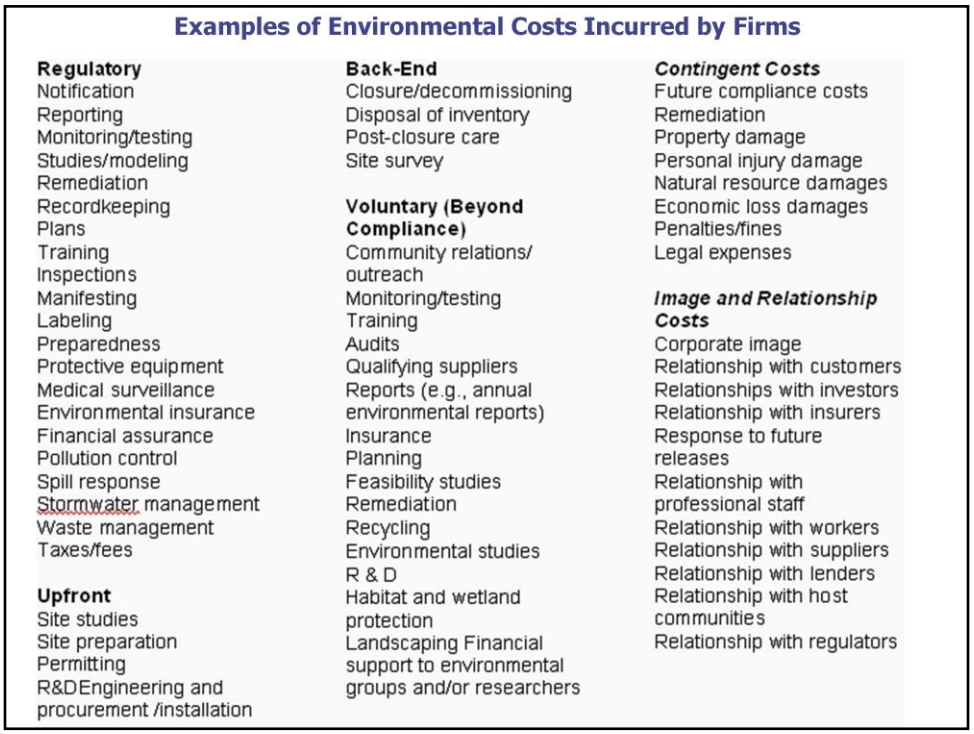
Total Cost Accounting: Environmental Cost Integration

Direct Costs	Indirect or Hidden Costs	Liability Costs
Capital Expenditures • Buildings • Equipment • Utility connections • Equipment Installation • Engineering *Operations and Maintenance Expenses/Revenues* • Raw materials • Labor • Waste disposal • Utilities • Value of recovered materials	*Compliance Costs* • Permitting • Reporting • Monitoring • Manifesting *Insurance* *On-Site Waste Management* *Operations of On-Site Pollution Control Equipment*	*Penalties and Fines* *Personal Injury and Property Damage*

An excellent way to address waste reduction and waste costs is the Total Cost Accounting Method. Although more strenuous to initially implement it holds the potential to allow identification of cost problems and opportunities in individual product lines.

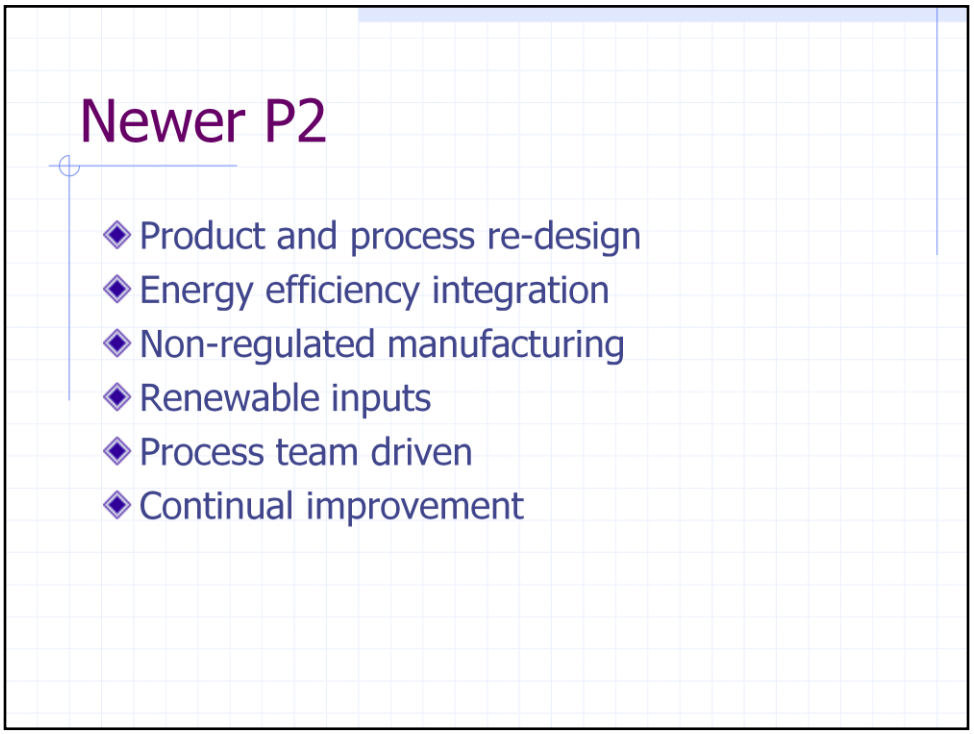


The concept of total cost accounting is to correctly identify, quantify and assign a myriad of potentially hidden costs that are associated with process and product waste.

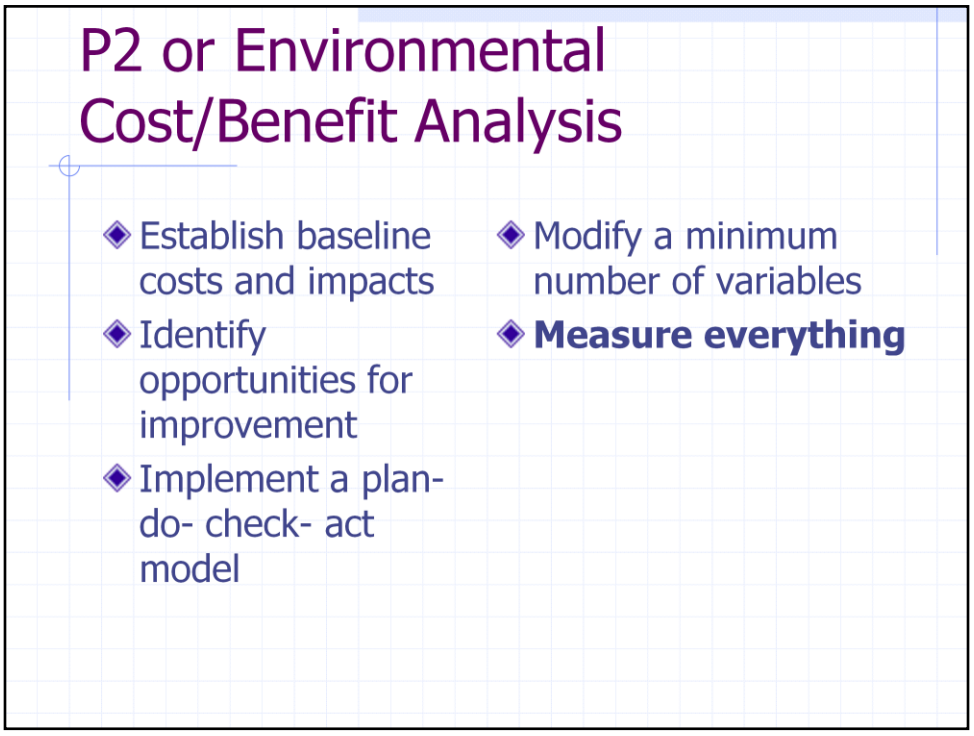


I have segregated these costs to give a better idea of the possible areas to remember when attempting a total cost approach. The reason this is significant, is that almost every effective pollution prevention project yields greater savings than initial estimates. Generally, several of these potential **hidden** costs are involved with that additional savings. Failing to identify significant hidden savings can kill a good P2 project from being selected for implementation.

The past 20 years of pollution prevention/waste reduction have focused on these areas, AND great strides have been made to increase efficiency, quality and profitability.

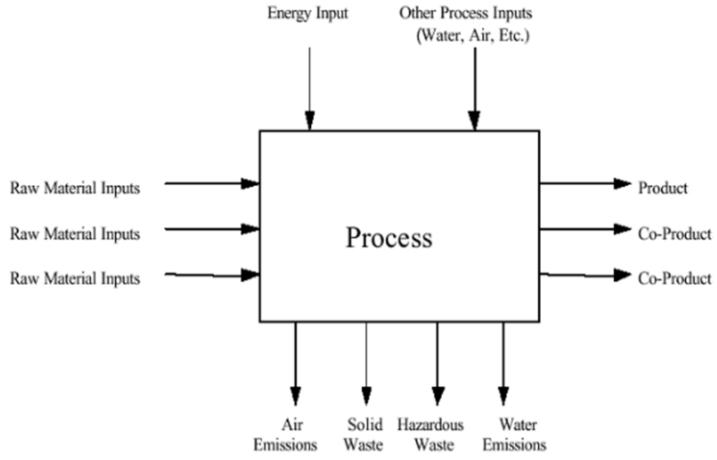


Pollution Prevention has been undergoing rapid change in several exciting and promising areas. A major focus has been to follow the path backward and eliminate wastes, liability and compliance problems in the product design phase. The Quality Management and Environmental Management System movement has given real momentum to evaluating manufacturing performance in a more holistic perspective. If companies are on the path to continually improving financial, quality and environmental performance they stand to capture the future market place. These approaches open additional opportunities to reduce costs and increase revenue.



The basis for making improvements lies in these straightforward steps. By Evaluating performance, identifying opportunities and making continual improvements. Measurement is the key element to this process.

Exhibit 2.3: Block Diagram Model



www.epa.gov/ordntrnt/ORD/NRMRL/Pubs/2001/energy/complete.pdf

This is an example of a simple tool we often use when evaluating manufacturing processes for financial opportunities to reduce wastes and waste costs. The important concept is that every aspect of input and output be considered as **opportunities to make effective change!** Maximizing products and identifying potential co-products can have significant impacts. Every input and output combination should be evaluated to maximize efficiency!

It is critical to correctly evaluate the true **total cost** of the existing state of a process. Carefully identify all input, output and potentially hidden costs with the existing process. By accurately benchmarking what these true existing costs are, you can effectively measure the impact of a P2 project.

Example: Cost of installing a solvent distillation unit vs. continuous disposal

Let's start with a simple "low hanging fruit" P2 project, such as recovering and reusing solvent versus continuously disposing of it.

solvent.xls [Read-Only] [Compatibility Mode]

	A	B	C	D
3				
4	**Input:**			
5	· Thinner Usage per Year (from purchase records):	200	gal/yr	
6	· Estimated New Thinner Usage with Distillation:	20	gal/yr	
7	· Thinner cost:	$4.00	/gal	
8	· Distillation unit waste sludge (still bottoms) per year:	13.3333333	gal/yr	
9	· Current waste thinner disposal cost:	$2.80	/gal	
10	· Estimated still bottoms disposal cost:	$5.00	/gal	
11	· Thinner distillation unit cost:	$3,500		
12				
13		**Thinner**	**Thinner**	
14		**Distillation**	**Disposal**	
15	**Annual Operating Cost Comparison**			
16	Material:	$80	$800	
17	Waste Disposal:	$67	$560	
18	**Total Operational Costs:**	$147	$1,360	
19				
20	**Economic Analysis Summary**			
21	Annual Savings for Solvent Distillation:	-$1,213		
22	Capital Cost for Purchase of Equipment:	$3,500		
23	Payback Period for Investment in Equipment:	-2.9	year	

http://www.iwrc.org/SBPPC/spreadsheets/solvent.xls

This is an example of one of the many existing P2 calculations that are available on the web from a number of organizations. In this particular case recovering solvent has a significant cost savings and is a “slam dunk” without even looking at the possible hidden costs that may be associated with generating a larger volume of potentially hazardous waste.

Example:
Calculating the true cost of a coating

- Cost is not a per gallon or pound slam dunk!
- Cost is variable based on the system used for preparation, application, curing and clean-up.
- Total costs involve all variables, including energy costs, health and safety costs, liability, waste treatment…….

Often P2 projects are not as straight forward as just recovering a material versus disposing of it. For many areas such as material substitutions, water use reductions, process equipment modifications and others it takes a more sophisticated total cost approach. Since many products receive some type of finish coating, we often are faced with evaluating the true cost of making a coating substitution. First and foremost, is that the cost of a coating is not simply it's cost per gallon or pound from a supplier. It is a function of the amount of surface that a coating can cover to the desired finish and thickness, and the total cost of the application and curing system.

Cost calculation- per unit/part

Critical cost is per volume of paint solids NOT price per gallon

Step 1: Figure Cost of Paint Solids

Example: **If a paint product costs $15 per gallon and contains 33 percent solids then you would divide 15 by .33. 15 divided by .33 = $45.45, the cost per gallon of paint solids.**

Step 2: Figure Paint Cost Per Square Foot

Example: **($45.45 per gallon of solids) x (2 mils finished film thickness) x (0.0006233 conversion factor) = 5.7 cents per square foot, assuming an ideal 100 percent transfer efficiency.**

The preliminary steps are to calculate the cost per unit area (in this case per square foot). This is found by calculating the solids x the cost per gallon to find the coating capability. Remember the finished coating is a solid! Powder coatings are nearly 100% solids.

Cost calculation per part

Step 3: Figure Actual Paint Cost Per Square Foot

Example: **A paint operation has an estimated transfer efficiency of 50%. Take the 5.7 cents calculated for 100% transfer efficiency and divide by .50 to determine actual coating cost. (5.7 cents per square foot) divided by (.50 transfer efficiency) = 11.4 cents per square foot.**

Step 4: Figure Total Cost of Painting Manufactured Product

Example: **A flat panel part has an area of 10 square feet. Multiply your cost per square foot times the square footage of the part. (11.4 cents per square foot) x (10 square feet) = $1.14 per part.**

Secondly you take the cost per unit area and calculate the surface area of the part to be coated. This procedure would be key for a facility to make accurate decisions about the cost savings of making a coating change.

Case Study: Coating Change Cuts Production, Regulatory Costs

A Seattle-based company investigated low-solvent coatings to avoid the Title V Air Operating Permit process. Avoiding the permit and its costs was the primary motivator, but the company did not want increased painting costs either.

The company was using a **$13 per gallon** paint with **35% solids** content and had identified an adequate replacement paint that cost **$20 per gallon** and had **60% solids** content.

The company applied the previous formula, to compare the cost of paint as it is applied to parts rather than compare the cost per gallon. Calculations showed the low-solids paint cost **$2.31 per square foot**, while the high-solids paint would cost only $**2.08 per square foot**. The company paints **50 square feet** of surface area per part. Switching coatings saved the company **$11.50 per part**.

This case study demonstrates the savings that are not obvious by any other method. A 13$ per gallon paint is not necessarily cheaper than a 20$ per gallon paint. This exercise could also be used easily for comparing solvent borne vs water borne. The important thing to remember is to be inclusive of all associated costs when comparing alternatives. **Thinning and cleaning with water often costs much less than thinning and cleaning with organic solvents.**

Cost Analysis Tool

http://www.ecy.wa.gov/pubs/95400.pdf

An example of one of the many tools to not only identify hidden costs, but compare existing conditions to prospective P2 opportunities.

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		

This sheet lists the total costs associated with an existing process/or product. The baseline can be directly compared with the proposed or changed alternative.

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

The next sheet allows you to see the future cash flows and value from making the process or product change.

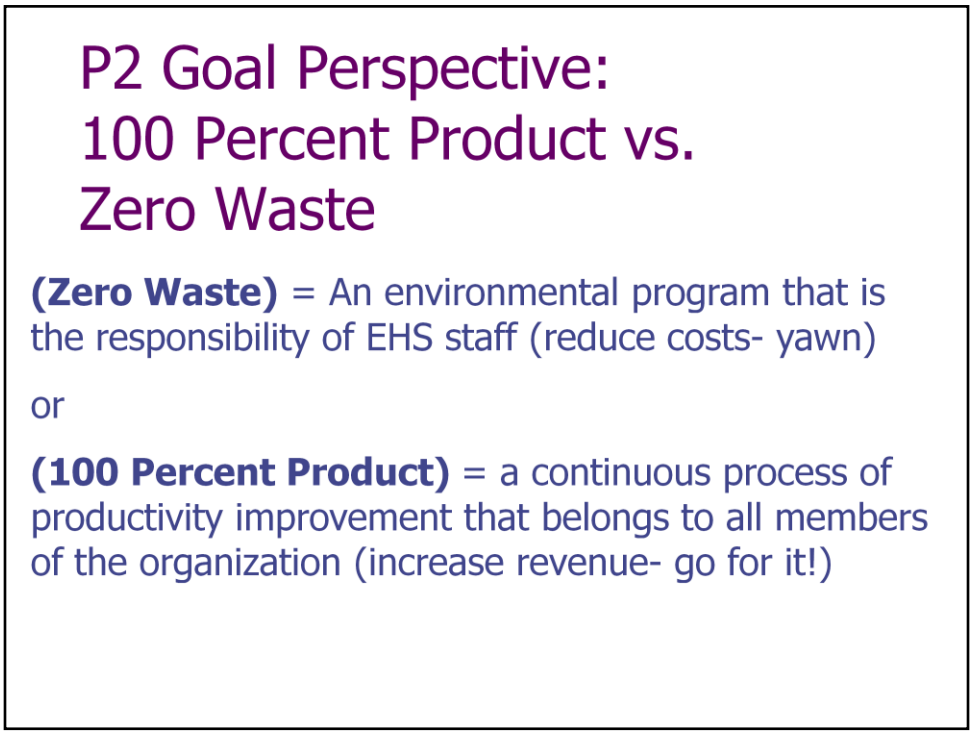
Return on Investment (ROI)

$$\frac{\text{Return* (\$ cost savings and additional revenue)}}{\text{Investment * (\$ cost of process change)}} \times 100 = \text{ROI}$$

Simple Payback

$$\frac{\text{Investment* (\$ cost of process change)}}{\text{Return* (\$ savings \& revenue per year)}} = \text{payback years}$$

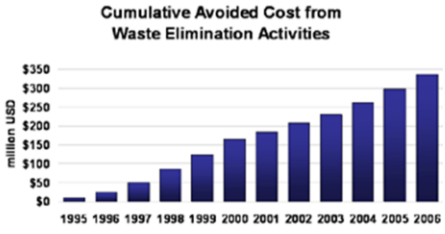
I have included a couple of the "ballpark" type calculations that many managers initially look at when evaluating potential P2 projects. Often companies will have windows such as 2 year payback or a set return percentage that they expect. By carefully evaluating the **total** cost savings and potential revenues of the project, you will be most likely to be successful at getting a P2 project implemented.

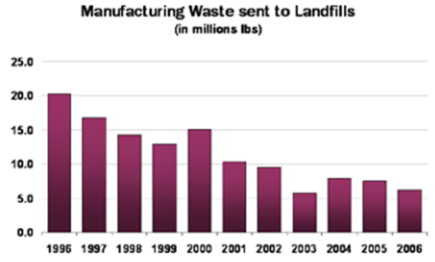


A brief perspective on selling process improvements within organizations. Remember that what you say is greatly impacted by how you say it. The perspective of P2 within an organization can be of minor or major importance depending on upper management support. If P2 is a system that is viewed to maximize profits and productivity, it will be strongly supported. If P2 is something that is the purview of a few individuals and is considered an environmental burden, it will probably not be enthusiastically supported. P2, Sustainability, Lean Manufacturing etc. are systems to maximize the true efficiency and effectiveness of an organization. By representing P2 as being integral to overall quality and productivity, it is much easier to gain management support.

Interface Carpet

a leader in this area, reducing manufacturing waste by 70 percent since the mid-1990s and saving over $300 million while doing it.

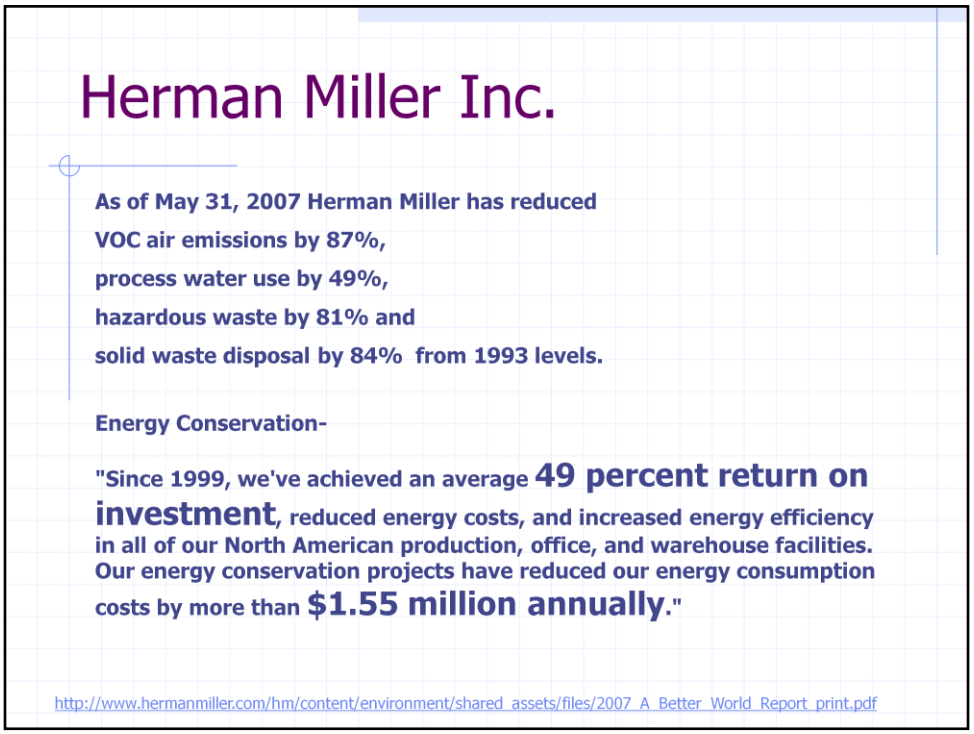




"The cumulative avoided costs from waste elimination activities since 1995 have totaled over $336 million."

http://www.interfacesustainability.com/metrics.html

Doesn't sound very convincing? Consider what is happening in every major manufacturing sector around the globe. Companies that are taking this total cost view and applying it to product and process change are making extraordinary improvements in waste reduction, revenues, market position, and security in terms of future input and energy costs.



Why does cost accounting mean so much to company success. Inaccurately valuing a design or process leads companies down less productive paths. A new mantra among business leaders has become “100% product” which implies maximizing saleable products from all inputs. The previous campaigns of “Zero waste” implies effort to avoid negative consequences vs. an effort to maximize productivity. Most managers can easily agree to devote effort to increasing productivity.

Toyota Motor Engineering & Manufacturing North America, Inc.

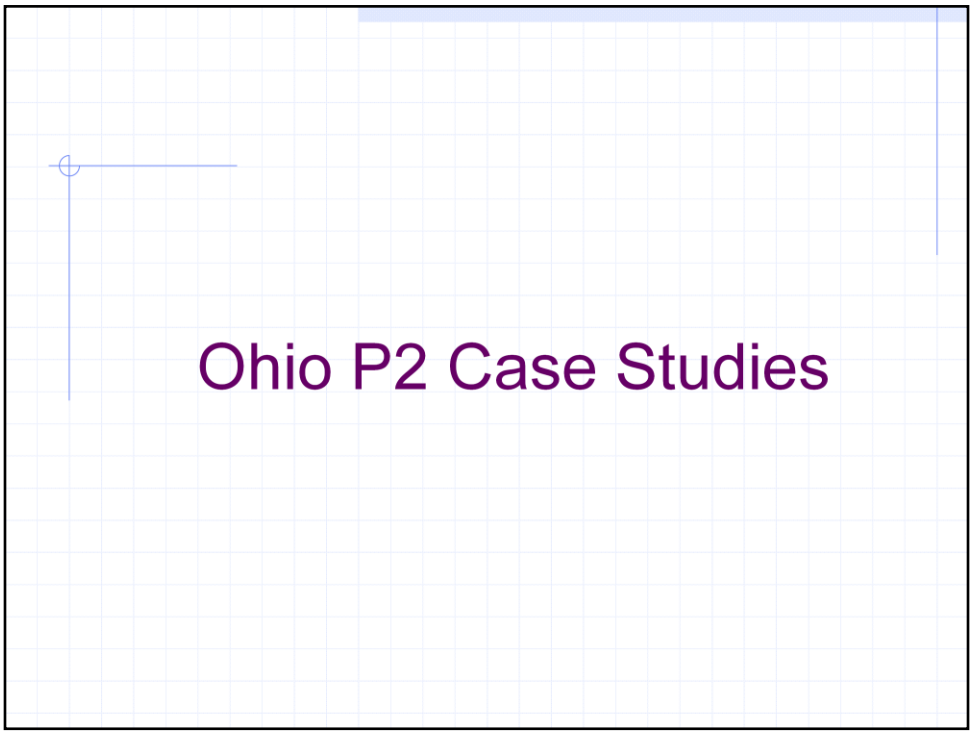
Erlanger, Kentucky

an absolute reduction of nearly 4 percent in the amount of energy required to power its operations during 2007, with overall reductions of **16 percent per vehicle** in the last 4 years, all while building new plants.

including performing 15 "**treasure hunts**"-a successful plant energy self-assessment process-with 60 different suppliers to identify efficiency opportunities.

The short and long term effects of integrating P2 process improvements is overwhelmingly important to the future of a business.

The types of opportunities we are looking for are these, plus any other costs that are identified from the previous steps. Sometimes these can be significant, such as labor if wastes have to be segregated by hand, or permit fees, if the level of a waste can be reduced below the level requiring a permit.



what some Ohio manufacturers have been able to accomplish by implementing P2 cost accounting.

Neaton Auto Parts Manufacturing, Inc.

- Eaton, Ohio
- 700 employees
- Steering wheels, instrument panel components,trim parts, air bag covers

Neaton

- Processes include "reaction injection molding" (RIM), vacuum forming, die casting, assembly, painting
- Large quantity generator (LQG) and Title V facility
- Use "Kaizen" P2 approach

Neaton

- Investigated paint line improvements to air bag cover line
- Redesigned robots, installed humidity controls, added blow-off stations
- Saved $333,000 in reduced paint use
- Reduced VOCs by 8 tons per year

Neaton

- Installed enclosed paint gun cleaners and a solvent distillation unit in RIM Department
- Reduced hazardous waste generation by more than 41,000 lbs./yr.
- Saving more than $42,144 annually

Neaton

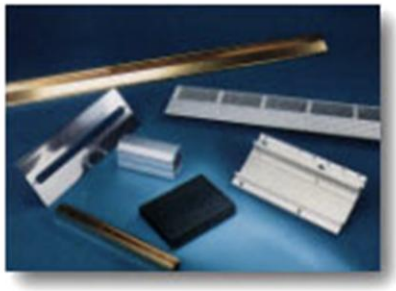
- Substituted color resin substrates for dash board panels
- Reduced VOCs by 13 tons per year
- Part of $745,325 total first year savings for molded plastics department.

Neaton

- Re-examined mold cleaning schedule
- Changed from cleaning once a shift to once a day
- Reduced scrap from 60 parts a day to 20 parts day
- Saved over $124,454 in materials
- Reduced solid waste by over 59,000 lbs./yr.

General Extrusions, Inc.

- Youngstown, Ohio
- 300 employees
- Extrudes, fabricates and finishes aluminum parts
- Includes anodizing, painting



GEI

- Participant in Ohio Prevention First (OPF)
- Achieved and exceeded OPF 50% reduction goals

GEI

- Replaced lead cathodes with aluminum cathodes in anodizing
- Substituted non-Cn, Cr6, Ni alternatives in conversion coating and anodizing
- Reduced hazardous waste generation by 90%

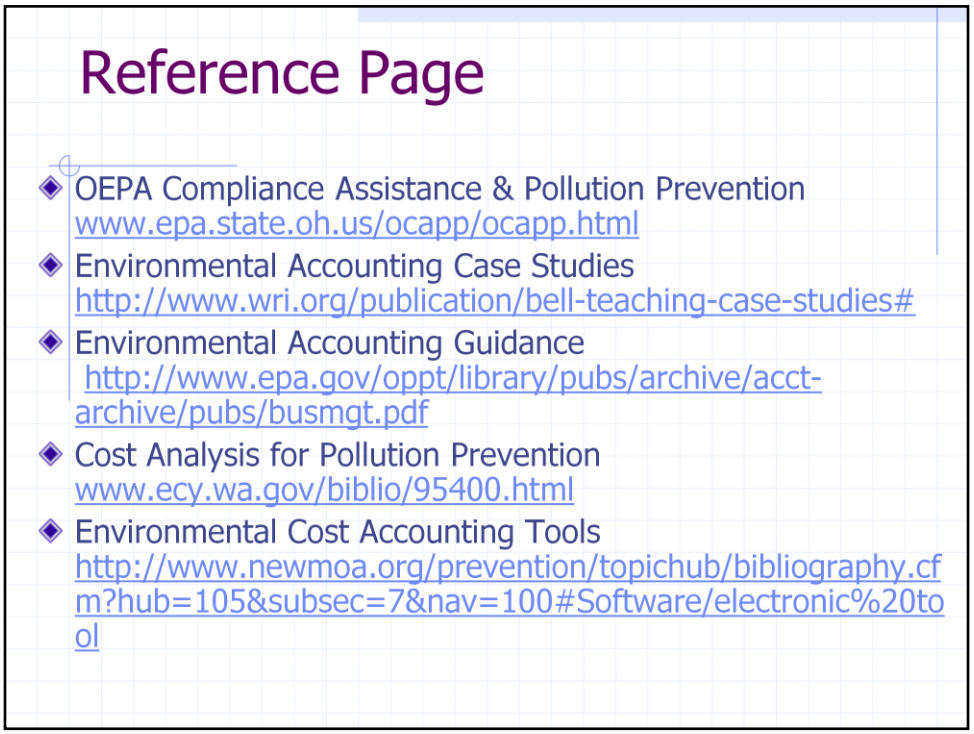
GEI

- Replaced VOC paint line with new powder coating line
- Eliminated 14,000 pounds of hazardous waste annually
- Eliminated 4,000 lbs. VOCs annually
- $1,000,000 capital investment

GEI

- Implemented "Water Reduction Program" for 1991-1994
- Installed flow meters, flow controls, counter-flow rinsing, recirculation units
- Reduce waste use from 250 gpm to 50 gpm
- Saved over $1.4 million from 1990-1998

Where can you find more information: OHIO EPA OCAPP Main Page



Where to find tools and case studies.

If we can assist you in any way don't hesitate to contact us.

Thank you!