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POLLUTION PREVENTION: LESSONS LEARNED

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FACILITIES ENGINEERING
ENVIRONMENT

POLLUTION PREVENTION: LESSONS LEARNED

1. Purpose. The purpose of this Public Works Technical Bulletin (PWTB) is to transmit Training Doctrine Command and Forces Command installation's documented pollution prevention (P2) technologies.

2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.

3. References.

a. Pollution Prevention Act, 1990.

b. Army Regulation (AR) 200-1, *Environmental Protection and Enhancement*.

4. Discussion.

a. The Pollution Prevention Act of 1990 states the national policy as: 1) prevent or reduce pollution at the source whenever feasible; 2) pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible; 3) pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; 4) disposal and/or release into the environment should be employed only as a last result and should be conducted in an environmentally safe manner.

b. AR 200-1, *Environmental Protection and Enhancement* states, "Pollution Prevention is the Army's preferred approach

to maintaining compliance with environmental laws and regulations" (AR 200-1, Para 10-2a). "Pollution prevention will occur at the facility through prevention reduction, reuse, and treatment" (AR 200-1, para 4-2c, 4-2d, and 10-2c).

c. Installations will benefit from the information contained in this PWTB in the following ways:

i. Economic information can be central to your installation's justification for its Environmental Program Requirements (EPRs)

ii. Lessons learned at other installations can assist in problem solving at your installation (points of contact are included where available)

iii. Cost avoidance by learning what works and does not work before making an expensive and possibly unsuccessful investment.

d. Appendix B gives available information on implemented P2 technologies at Forces Command installations. Appendix C gives available information on implemented P2 technologies at Training and Doctrine Command installations.

5. Points of Contact. HQUSACE is the proponent for this document. The POC at HQUSACE is Mr. Malcolm E. McLeod, CEMP-RI, 202-761-0206, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

Questions and/or comments regarding this subject should be directed to the technical POC:

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FOR THE COMMANDER:

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Appendix A: Introduction

1. Background. According to AR 200-1, *Environmental Protection and Enhancement*, "Pollution Prevention is the Army's preferred approach to maintaining compliance with environmental laws and regulations." The Army Vice Chief of Staff on 22 April 1998 directed that Commanders, Program Executive Officers, and Program Managers should program resources to utilize cost-effective P2 methods aggressively in all mission and functional areas to eliminate compliance programs or to reduce current and future operating costs. Seemingly successful P2 technologies, processes, and methodologies used at one installation are often not transferred to another. In addition, many of the P2 investments made by the troop Major Army Commands (MACOMs – U.S. Army Forces Command and U.S. Army Training and Doctrine Command [FORSCOM and TRADOC]) have not been validated as to cost efficiency and effectiveness.

2. Investment Tracking Template.

a. For investment data for funded P2 technologies to be easily accessible to installation environmental personnel, a template format was developed. The draft template was briefed to TRADOC, FORSCOM, and the U.S. Army Environmental Center (AEC) to allow them input to the final product as well as to receive concurrence. To develop the template, current P2 investment data and any ongoing validation studies from TRADOC and FORSCOM installations were reviewed for common data elements, completeness and timeliness, and cost data accuracy. Common data elements that emerged from the review include: Unit Investment Cost, Payback, Regulatory Driver, Major Pollutant, Base Quantity Stream, Annual Unit Pollution Reduction, Annual Unit Energy Savings, Labor Unit Savings, Annual Unit Recurring Cost, and Operations and Maintenance (O&M) Unit Savings. The draft template was briefed to TRADOC, FORSCOM, and AEC and approval for a final template was given.

b. Project funds were not sufficient to collect data at the individual installations. Hence, installation web sites were mined and installation personnel were interviewed. Although there are many great P2 technologies implemented and working well, tracking information either was not readily available or was fragmented to the extent that it was impossible to collect the data within the resource confines of this project. It was decided, however, that having the defined elements available on

the tracking form would assist installations in future data collection/tracking.

3. Leveraged Efforts.

a. TRADOC had funded a parallel effort to document P2 projects at their installations. TRADOC agreed that the data collection would, to the extent possible, include the identified data elements for the final tracking form. Hence the templates provided in Appendix B are slightly different from those of Appendix C; however, the information provided is essentially the same.

b. As a result of this project, FORSCOM provided end-of-year funding to physically collect the fragmented economic data, enhance the tracking form, and create an interactive component for three of their installations: Fort Campbell, Fort Hood, and Fort Carson. The templates for those three installations will also be slightly different; however, it should be noted that the interactive investment form template will be the “norm” for future P2 technology documentation.

Appendix B: Implemented P2 Technologies at FORSCOM Installations

Fort Campbell Composting

Title: Composting
Installation: Fort Campbell, Kentucky
POC: Mrs. Trudy Carr – 270.798.9782

Mission: To enhance mission readiness by diverting large volumes of Fort Campbell's organic Municipal Solid Waste (MSW) stream through composting.

Cost: Estimated $15,000

Environment: Protects the environment by reducing the amount of non-hazardous solid waste generated by the installation. Provides useful soil amendment material for installation use.

Compost Windrow

Description: Compostable materials are delivered to the composting facility through various contract mechanisms. Material is segregated into three different classifications: non-processed, processing and final product. The facility undergoes maintenance once per quarter, where non-processed/processing materials are wind-rowed and previous wind-rows become final product. Wind-rowing can be accomplished with track loaders or similar heavy equipment in lieu of expensive composting machinery. Fort Campbell avoids permitting requirements by restricting the final product to only be used on installation property. Composting is a major contributor to Fort Campbell's solid waste diversion percentage.

Unit Investment Cost: $15,000	**Total Unit Savings:** $50,000
Payback: <1 year	**Years Economical Life:** Indefinite
Regulatory Driver: RCRD	**Waste Unit Savings:** $40,000
Major Pollutant: MSW	**Energy Unit Savings:** $0 @ 0 kWh
Base Qty Stream: 3000 tons	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 2000 tons	**Annual Unit Recur Cost:** $15,000
Annual Unit Energy Savings: $0 @ 0 kWh	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for

Fort Campbell Composting

Total Cost Estimate: $15,000

Law/Regulation:	RCRD	**Compliance Status:**	ESDP
ECAT:	POLP	**Regulatory Driver:**	RCRD Solid Waste Management
Class:	1	**Project Assessment:**	H
Activity/Process:	Recycling	**Must Fund:**	Y
Total Identical Units:		**Years Economic Life:**	Indefinite
Major Pollutant:	MSW		
Base Qty Stream:	3000 tons	**Source:**	Ft. Campbell
Annual Unit Poll Reduction:	2000 tons	**Source:**	Ft. Campbell
Unit Investment Cost:	$15,000	**Source:**	Ft. Campbell
Annual Unit Recur Cost:	$15,000	**Source:**	Ft. Campbell
Annual Unit Energy Savings:	$0 @ 0 kWh	**Source:**	
Total Unit Savings:	$50,000	**Source:**	Ft. Campbell
Waste Unit Savings:	$40,000	**Source:**	Ft. Campbell
Energy Unit Savings:	$0 @ 0 kWh	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings:	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2003				

Narrative: This program is driven by EO 13101 and RCRA-D waste reduction/diversion regulations.

Cost Verification

Assumptions and Facts:

- Processes 2,000 tons/yr of yard and stable waste.
- Produces 1,000 tons/yr of Usable Product (Compost).
- Solid waste disposal costs (as of 01/28/02) are $20/ton.
- Cost of transportation of waste is $32,500/yr.
- Compost facility operational costs are $15,000/yr.
- Avoided topsoil purchases are at $25/ton.

Annual Operating Cost of Diversion and Disposal for Composting

	Disposal	Diversion
Labor and Maintenance	$0	$15,000
Landfill Tipping Fee	$40,000	$0
Transportation/Waste Pickup	$32,500	$32,500
Total Operational Costs:	$72,500	$47,500
Total Recovered Income: (Top Soil for Landfill $25/ton)	$0	$25,000
Net Annual Cost/Benefit:	-$72,500	-$22,500

Economic Analysis Summary:

- Payback period is 0.3 years.
- Composting will always be a cost; however, it proves to be more economically feasible than landfill disposal.
- Analysis does not include initial facility investment costs such as land values, security structures, permit fees (if required) and equipment.
- Landfill tipping fees and transportation costs affect are the biggest contributors to cost avoidance.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. The base material at the facility is thin layer of crushed limestone with organic debris on the surface, which makes access difficult after rain events. Contractors file claims against the Government for delays, equipment issues (getting stuck), etc. and due to the slope of the facility, place material in a manner to compound access problems during these time periods. These issues could be resolved by re-grading and installing new base materials (no. 1/2 and 7/10 aggregate) or by adding contract equipment requirements for the facility.

2. Materials (debris, compost, blown leaves) collect around the fence line on the low side of the facility creating an impermeable membrane. The acidic run-off, from the decomposition process, 'ponds' and creates storm water problems; as well as, foul odors. There should be a mechanism put in place, contractual or Government labor, to occasionally clear debris from the perimeter and perform occasional facility upgrades and repairs.

3. While biodegradable lawn bags provide a convenient method of recycling for post residents, they should not be placed directly into low maintenance compost facilities. Some State Regulatory Agencies may define the facility as a Solid Waste Management Unit (SWMU).

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs.

Economic Analysis for Windrow Composting

Assumptions:

· Amount of material processed:	2000	ton/yr	
· Amount of finished compost produced:	1,000	ton/yr	
· Solid waste disposal costs:	$20	/ton	
· Cost to pickup and haul waste to landfill:	$125	/delivery	260 deliveries/yr
· Operating costs (labor and maintenance):	$15,000	/yr	
· Avoided topsoil purchases:	$25	/ton	

Annual Operating Cost Comparison of Diversion and Disposal for Windrow Composting

	Diversion	Disposal
Operational Costs:		
Labor and maintenance:	$15,000	$0
Landfill costs:	$0	$40,000
Transport/waste pickup costs:	$32,500	$32,500
Total Operational Costs:	$47,500	$72,500
Total Recovered Income (Topsoil Savings):	$25,000	$0
Net Annual Cost/Benefit:	($22,500)	($72,500)

Economic Analysis Summary

Annual Savings for Diversion Method over Disposal:	$50,000	
Capital Cost for Diversion Equipment/Process:	$15,000	
Payback Period for Investment in Equipment/Process:	0.3	years

Fort Campbell GRACO Paint Gun System

Title: GRACO Paint Gun System
Installation: Fort Campbell, Kentucky
POC: Mrs. Patty Lockard – (270) 798-9603

Mission: Enhance mission readiness by installing 4 GRACO paint guns in existing paint booths to decrease CARC paint usage by 1,000 gallons/year and time required to paint equipment.

Cost: $95,000

Environment: Benefits to the environment include a reduced usage of CARC paint, reduced air emissions, and reduced spill potential.

GRACO Paint Gun System©

Description: A High Volume/Low Pressure (HVLP) paint spray system is an efficient technology for the application of paint to specific work pieces. These systems operate at low pressures, which result in the application of paint at low velocities. HVLP paint systems atomize paint by delivery a high volume of air at a low pressure. Because the atomized paint particles are delivered at low velocities to the object being painted, less paint is lost as over spray, bounce, and blowback. This technology also increases the life of paint booth filters.

Unit Investment Costs: $95,000	**Total Unit Savings:** $44,000
Payback: 1.4 years	**Years Economic Life:** 10
Regulatory Driver: CAA, RCRA C/D	**Waste Unit Savings:** $0
Major Pollutant: paint emission/waste	**Energy Unit Savings: $**0
Base Qty Stream: 1,000 gallons	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 1,000 gallons	**Annual Unit Recur Cost:**
Annual Unit Energy Savings:	**O&M Unit Savings: $**0

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Exhibit 2 Data for

Fort Campbell GRACO Paint Gun System

Total Cost Estimate: $95,000

Law/Regulation:	RCRC	**Compliance Status:**	ESDP
ECAT:	POLP	**Regulatory Driver:**	CAA, RCRA C/D
Class:	2	**Project Assessment:**	H
Activity/Process:	Vehicle, eqp painting	**Must Fund:**	Y
Total Identical Units:	1 package of 4 paint guns	**Years Economic Life:**	
Major Pollutant:	Paint emission/ waste		
Base Qty Stream:	1,000 gal	**Source:**	Ft. Campbell
Annual Unit Poll Reduction:	1,000 gal	**Source:**	Ft. Campbell
Unit Investment Cost:	$95,000	**Source:**	Ft. Campbell
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$44,000	**Source:**	Ft. Campbell
Waste Unit Savings:	0	**Source:**	Ft. Campbell
Energy Unit Savings:	0	**Source:**	Ft. Campbell
Labor Unit Savings:	0	**Source:**	Ft. Campbell
O&M Unit Savings:	0	**Source:**	Ft. Campbell
Mel Procure Unit Savings:	$44,000	**Source:**	Ft. Campbell
Other Unit Savings:		**Source:**	Ft. Campbell
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2001	OMA(VEPP)	$60,000		
2002	OMA(VEPP)			
2003	OMA(VEPP)			

Narrative: Install 4 GRACO paint guns in existing paint booths to decrease CARC paint usage 1000 gallons/year. Payback: 1.4 years. Environmental benefits: Reduced usage of CARC paint, reduced air emissions, reduce spill potential. Readiness impact: none.

Cost Verification

Assumptions and Facts:

- Data will be entered here.
- Occasional

Annual Operating Cost Comparison for High Velocity Spray Systems and HVLP Spray Systems

	High Velocity Spray Systems	HVLP Spray Systems
Operational Costs:		
Labor		
Paint		
Waste Disposal		
Total Operational Costs:		
Net Annual Cost/Benefit:		

Economic Analysis Summary:

- Data will be entered here.

Lessons Learned

1. Original concerns were present over worker acceptance of and acclimation to the GRACO system. Labor force rapidly adjusted to the differing spray patterns and maintenance requirements.

2. Clean up requirements appear to be the major drawback. Equipment can take as long as one hour to clean due to the engineering design. We think it may be linked to the waterborne CARC recently adopted. RBC has requested to go back to the old spray system.

3. Replacement parts are unfriendly in the respect of costs and requirements. Some replacement parts only come in 'clusters', which can quickly drive costs to become prohibitory in nature.

Fort Campbell Halon Extinguisher and Equipment Replacement

Title: Halon Extinguisher and Equipment Replacement
Installation: Fort Campbell
POC: Patty Lockard – 270.798.9603

Mission: Provide replacement extinguishers/cylinders and associated equipment for the replacement of Halon extinguishers and equipment at Fort Campbell.

Cost: Estimated at $340,300.

Environment: Switching from Halon 1211 to an approved alternative will reduce the potential for an ozone depleting chemical going into the environment. The switch may also provide a non-global warming agent or one with a lower global warming potential.

Hand Held Halon 1211 Extinguishers

Description: This project is part of the plant o eliminate the use of Class I ODCs at Fort Campbell. Required by DOD Directive 6050.9. DA phase out date for the elimination of Class I ODCs is September 2003. To assist with meeting the DOD Directive, a 'one-for-one' exchange program was established with the Fort Campbell Fire Department. The majority of Halon 1211 portable fire extinguishers found inside buildings can be replaced with dry chemical extinguishers and/or carbon dioxide extinguishers. However, research and implementation is still ongoing to identify replacements for Halon 1211 extinguishers used in weapon system/specialty applications. A substitute compound may not be as effective in extinguishing fire, so a higher concentration or greater quantity of the extinguishing agent may be required. The alternative for any application should be carefully reviewed for applicability to the specific conditions. This project is 95 percent complete.

Unit Investment Cost: $25,000 per year	**Total Unit Savings:** $0
Payback: Lowered Operational Cost	**Years Economic Life:** 10
Regulatory Driver: CAA-Ozone depleting substance	**Waste Unit Savings:** $0
Major Pollutant: HALON	**Energy Unit Savings:** $0
Base Qty Stream: 0 lb/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 0 lb/yr	**Ann Unit Recur Cost:** $0
Ann Unit Energy Savings: 0 kWh/yr	**O&M Unit Savings:** $0

EPR
Exhibit 2 Data for Fort Campbell Halon Extinguisher and Equipment Replacement
Total Cost Estimate: $340,300

Law/Regulation:	CAA	**Compliance Status:**	ESDL
ECAT:	ODCS	**Regulatory Driver:**	CAA- ozone depleting substance
Class:	3	**Project Assessment:**	H
Activity/Process:	Equipment replacement	**Must Fund:**	N
Total Identical Units:	150	**Years Economic Life:**	10
Major Pollutant:	Halon		
Base Qty Stream:	0 lb/yr	**Source:**	Estimation
Annual Unit Poll Reduction:	0 lb/yr	**Source:**	Estimation
Unit Investment Cost:	$ 25,000	**Source:**	Estimation
Annual Unit Recur Cost:	$ 0	**Source:**	Estimation
Annual Unit Energy Savings:	0 kWh	**Source:**	Estimation
Total Unit Savings:	$0	**Source:**	Estimation
Waste Unit Savings:	$0	**Source:**	Estimation
Energy Unit Savings:	$0	**Source:**	Estimation
Labor Unit Savings:	$0	**Source:**	Estimation
O&M Unit Savings:	$0	**Source:**	Estimation
Mel Procure Unit Savings:	$0	**Source:**	Estimation
Other Unit Savings:	$0	**Source:**	Estimation
Latest FY Start:	1999	**Earliest FY Start:**	1995

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1995	OMA(VEPP)	$253,700		$253,700
1998	OMA(VEPP)	$6,600		$6,600
1999	OMA(VEPP)		$25,000	
2000	OMA(VEPP)	$20,000		
2001	OMA(VEPP)	$20,000		
2002	OMA(VEPP)	$20,000		
2003	OMA(VEPP)	$20,000		
2004	OMA(VEPP)	$20,000		

Narrative:

Cost Verification

With the increasing cost of Halon, many of the alternative systems present a cheaper operating cost; however, the economic feasibility of each substitute is highly dependent on the individual application.

Use of pollution prevention funds for replacement of Halon fire-extinguishing systems with non-Halon based systems is not authorized if the reason for conversion is that the existing system has reached the end of its life expectancy.

Lessons Learned

1. Setting the Fort Campbell Hazardous Material Control Center to be the collection and processing station for Halon containing extinguishers drastically increased program participation and efficiency from organizations and units.

2. The DOD ODC Reserve Bank is an excellent destination for removed Halon devices. Over 40,000 pounds of Halon have been turned into the Reserve Bank since the program began in 1994.

Fort Campbell Industrial Shredder

Demonstration/Purchase vs. Lease

Title: Industrial Shredder Demonstration/ Purchase vs. Lease
Installation: Fort Campbell, Kentucky
POC: Mike Davis – 270.798.9767

Mission: Enhance mission readiness by maximizing current on-post landfill life by reducing the volume of Construction and Demolition (C/D) Debris and realize the cost avoidance achieved by shredding and recycling masonry buildings.

Cost: $1,000,000 (leased)

Environment: Protects the environment by reducing the amount of non-hazardous solid waste generated by the installation. Provides usable aggregate for on-post roads and grounds projects.

Shredder In Operation

Description: Due to the construction and improvements planned at Fort Campbell, construction/demolition debris will be generated at an increasing rate. Landfill expansions or new landfills will be needed to accommodate the increased volume. A process must be installed to divert recyclable materials from the landfills to the greatest degree possible. Materials recovered will be recycled. Other debris will be densified to reduce the volume of disposal space needed. Waste reduction is required by the DOD Measures of Merit and will be measured and must be reported to DA and DOD. Over the next 10 to 20 years, Fort Campbell is projected to produce 1.5 million yd^3 of C/D. This does not include additional C/D waste expected from the Barracks and Motor Pool Modernization Programs.

Unit Investment Costs: $1,000,000 (Leased)	**Total Unit Savings:** $550,000
Payback: Immediate (Leased)	**Years Economic Life:** 20
Regulatory Driver: RCRD-Solid Waste Management	**Waste Unit Savings:** $500,000
Major Pollutant: Construction Debris	**Energy Unit Savings:** $0
Base Qty Stream: 400,000,000 lb	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 100,000,000 lb	**Annual Unit Recur Cost:** $200,000
Annual Unit Energy Savings:	**O&M Unit Savings:** $50,000

EPR

Exhibit 2 Data for

Fort Campbell Industrial Shredder Demonstration/ Purchase

Total Cost Estimate: $1,000,000

Law/Regulation:	RCRD	**Compliance Status:**	ESDL
ECAT:	WMIN	**Regulatory Driver:**	RCRD-Solid Waste Management
Class:	3	**Project Assessment:**	H
Activity/Process:	Other	**Must Fund:**	Y
Total Identical Units:	1	**Years Economic Life:**	20
Major Pollutant:	CDD		
Base Qty Stream:	400,000,000 lb	**Source:**	Estimation
Annual Unit Poll Reduction:	100,000,000 lb	**Source:**	Estimation
Unit Investment Cost:	$1,000,000	**Source:**	Estimation
Annual Unit Recur Cost:	$200,000	**Source:**	Estimation
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$550,000	**Source:**	Estimation
Waste Unit Savings:	$500,000	**Source:**	Estimation
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings:	$50,000	**Source:**	Estimation
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0		
Latest FY Start:	1998	**Earliest FY Start:**	1998

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1999	OMA(VEPP)	$200,000	$200,000	
2000	OMA(VEPP)	$400,000		

Narrative:

Cost Verification

Assumptions and Facts:

- Recycle crushed asphalt and concrete on base: 84,000 ton/yr
- Grinding costs: $12/ton (includes labor and crusher rental)
- Percent diversion: 80%
- Grinder maintenance (owner): $300,000/yr
- Labor – 2 FTP: $26/hr
- Landfill costs (inert wastes): $13/ton
- 50,000 tons of usable aggregates produced: $10/ton
- 1,700 tons of recycled steel: $40/ton.

Annual Operating Costs for Disposal and Diversion for Shredding

	Diversion (leased)	Diversion (purchased)	Disposal
Operational Costs:			
Crusher Costs			
(Labor and Maintenance):	$1,008,000	$1,404,000	$0
Waste Disposal:	$218,400	$218,400	$1,092,000
Total Operational Costs:	$1,226,400	$1,622,400	$1,092,000
Total Recovered Income:	$568,000	$568,000	$0
Net Annual Cost/Benefit:	($658,400)	($1,054,400)	($1,092,000)
Payback Period:	Immediate	>25 Years	

Economic Analysis Summary:

- This example yields a payback period of less than one year if the equipment is leased.
- Costs vary greatly depending on demographics.
- Estimations do not include cost avoidance achieved through landfill airspace value, only immediate savings.
- Monetary benefits from recycling/shredding concrete will never be greater than costs; however, recycling/shredding does provide cost avoidance.
- Immediate payback on leased shredder is due to the absence of capital expenditure.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. Material sizing is crucial before attempting to process it through the grinder. A 3'x2'x18" requirement was placed in the installation design guide for all construction and demolition activities.

2. While the shredder can handle structures with high percentages of reinforcing steel (support beams for example) it is suggested, at a minimum, minor separation of the reinforcing steel and structure be accomplished.

3. The shredder used in the demonstration was of insufficient size.

4. Generators are cost effective and reliable for temporary power; however, for permanent operations electric service is optimal.

5. Separation of material(s) (i.e., dirt, carpet, and communication wire) is not required at the demolition site for volume reduction; however, these materials inhibit the amount of usable aggregate produced through processing.

6. Tighter demolition contracts requiring point source salvaging would reduce shredder operational costs incurred through source separation at the shredder site.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for Construction and Demolition Material Recycling

Assumptions:

· Recycle crushed asphalt and concrete on base at:	84,000	ton/yr	
· Grinding costs (includes labor and crusher rental):	$12	/ton	
- Percent diversion at:	80%	/yr	
- Grinder maintenance (owner):	$300,000	/yr	
· Landfill costs (inert wastes):	$13	/ton	
- Usable aggregate produced at ($10/ton):	50,000	ton/yr	$10 /ton
- Recycled steel at ($40/ton):	1,700	ton/yr	$40 /ton
- Labor 2 FTP at:	$26	/hour	

Annual Operating Cost Comparison for Diversion and Disposal of Construction and Demolition Wastes

	Diversion (leased)	Diversion (purchased)	Disposal
Operational Costs:			
Grinder Costs (Labor and Maintenance):	$1,008,000	$1,404,000	$0
Waste Disposal:	$218,400	$218,400	$1,092,000
Total Operational Costs:	$1,226,400	$1,622,400	$1,092,000
Total Recovered Income:	$568,000	$568,000	$0
Net Annual Cost/Benefit:	($658,400)	($1,054,400)	($1,092,000)

Economic Analysis Summary

Annual Savings for Recycling:	$433,600	$37,600	
Capital Cost for Diversion Equipment/Process:	$0	$1,000,000	
Payback Period for Investment in Equipment/Process:	Immediate	26.6	

Fort Campbell Replace Halon Fire Suppression Systems (Flight Sims)

Title: Replace Halon Fire Suppression Systems
Installation: Fort Campbell
POC: Patty Lockard – 270.798.9603

Mission: Upgrade fire flight simulator fire suppression system from Halon system to an HCFC system.

Cost: Total cost estimate $2,866,500.

Environment: Switching from Halon 1301 to an HCFC reduces the ozone depletion potential of the extinguishing agent, but does not eliminate it; however, switching to an HFC (all chlorine sites on the carbon molecule are fluorine substituted) or a per fluorocarbon (all available sites on the carbon molecule are fluorine substituted) provides a non-ozone depleting substitute, but also has some global warming potential.

Flight Simulator Halon 1301 Suppression System

Description: Design and contract or replacement of halon fire suppression systems at four flight simulators as required by DOD Directive 6050.9 FY 93 funded for planning/design. FY 95 redesign for use of M200. FY 96 funded but FM200 not approved by ACSIM. Funded in FY99 but installation diverted. This project is part of the plan to eliminate the use of Class I ODCs at Fort Campbell. DA phase out date for the elimination of Class I ODCs is September 2003. Although there are a number of approved alternatives to Halon 1301, it is critical that any alternative's applicability be verified, given the long list of qualifications and use conditions to which each alternative is subject. Some of these compounds are not as effective in extinguishing fire, so a higher concentration of the gas is required. As a result, many of the use conditions require personnel evacuation in 30 seconds or less, a critical and sometimes impossible requirement to meet. Each alternative for any application should be carefully reviewed for applicability to the Use Conditions.

Unit Investment Cost: $1,200,000	**Total Unit Savings:** $0
Payback: None	**Years Economic Life:** 20
Regulatory Driver: CAA- Ozone depleting substance	**Waste Unit Savings:** $0
Major Pollutant: Halon	**Energy Unit Savings:** $0
Base Qty Stream: 0 lb/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 0 lb/yr	**Ann Unit Recur Cost:** $0
Ann Unit Energy Savings: 0 kWh/yr	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for

Fort Campbell Replace Halon Fire Suppression Systems (flight sims)

Total Cost Estimate: $2,886,500

Law/Regulation:	CAA	**Compliance Status:**	ESDL
ECAT:	ODCS	**Regulatory Driver:**	CAA-ozone depleting substance
Class:	3	**Project Assessment:**	H
Activity/Process:	OTHER	**Must Fund:**	N
Total Identical Units:	4	**Years Economic Life:**	20
Major Pollutant:	HALON		
Base Qty Stream:	0 lb/yr	**Source:**	Estimation
Annual Unit Poll Reduction:	0 lb/yr	**Source:**	Estimation
Unit Investment Cost:	$1,200,000	**Source:**	Estimation
Annual Unit Recur Cost:	$0	**Source:**	Estimation
Annual Unit Energy Savings:	0 kWh/yr	**Source:**	Estimation
Total Unit Savings:	$0	**Source:**	Estimation
Waste Unit Savings:	$0	**Source:**	Estimation
Energy Unit Savings:	$0	**Source:**	Estimation
Labor Unit Savings:	$0	**Source:**	Estimation
O&M Unit Savings:	$0	**Source:**	Estimation
Mel Procure Unit Savings:	$0	**Source:**	Estimation
Other Unit Savings:	$0	**Source:**	Estimation
Latest FY Start:	1999	**Earliest FY Start:**	1993

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1993	OMA(VENC)	$25,000	$25,000	$25,000
1995	OMA(VENC)	$36,000	$325,000	$36,000
1996	OMA(VEPP)	$500	$1,200,000	$500
1999	OMA(VEPP)		$653,000	
2000	OMA(VEPP)	$700,000		
2001	OMA(VEPP)	$700,000		
2002	OMA(VEPP)	$700,000		
2003	OMA(VEPP)	$700,000		
2004	OMA(VEPP)	$700,000		
2005	OMA(VEPP)	$25,000		

Narrative:

Cost Verification

Direct drop substitutes or alternatives do not exist for Halon 1301. Thus, the economic feasibility for using a Halon 1301 substitute is highly dependent on the specific application. There are many factors that can affect the cost of using Halon 1301 alternatives. These factors include, but are not limited to:

- Volume of the area to be protected
- Type(s) of equipment being protected
- The ability to use existing delivery, actuation and alarm systems
- Location of the area to be protected
- Cardio sensitivity of personnel to alternatives

The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Lessons Learned

1. Because this is a DOD mandate and there are no Federal Regulatory requirements for this program, obtaining and securing funding is a large challenge.

2. The flight simulators at Fort Campbell are considered to be 'legacy' equipment and electronic replacement parts for this equipment are extremely expensive. This has caused resistance to replacing the Halon suppression system with even approved alternatives.

3. In order to comply with funding restrictions, this project should be broken into multiple phases; such as, research/planning, design, construction and maintenance.

Fort Carson Aerosol Can Puncturing

Title: Aerosol Can Puncturing
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through cost avoidance associate with aerosol can disposal.

Cost: $1,495

Environment: Protects the environment by reducing the amount of hazardous and non-hazardous waste generated by the installation. Decreased VOC emissions.

Aerosol Can Puncturing Apparatus and Activated Carbon Filter

Description: The aerosol can puncturing apparatus threads directly to the two-inch bung of any 30-gallon or 55-gallon drum. The apparatus is equipped with an intrinsically safe carbide-tipped puncture pin. Residual liquids remaining in the aerosol can collect safely in the drum and are transport ready without further material handling. One 55-gallon drum can hold the residual liquids from approximately 4,000 spent aerosol cans. The combination activated carbon filter is connected directly to the ¾" bung of the drum. The base of the filter is the coalescing cartridge. This filter media coalesces microscopic liquids from the escaping propellant and transforms them into droplets, which collect in the reservoir. These droplets can easily be drained, directly into the collection drum, by opening the drain valve on the bottom. Dry propellant is then released through the activated carbon cartridge, which absorbs hydrocarbons and odors. The granules in the colorimetric indicator change pigment to indicate when the filter needs replacing. The process takes five seconds and the result is an empty steel can, with a smooth-edged hole, ready for recycling as scrap steel. This project was initiated due to increasing VOC regulations.

Unit Investment Cost: $1,495	**Total Unit Savings:**
Payback: 2.2 years	**Years Economical Life:** 10
Regulatory Driver: CAA	**Waste Unit Savings:** $0
Major Pollutant: Aerosol Cans	**Energy Unit Savings:** $0
Base Qty Stream: 3 tons/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for

Fort Carson Aerosol Can Puncturing

Total Cost Estimate: $1,495

Law/Regulation:			**Compliance Status:**		
ECAT:			**Regulatory Driver:**		
Class:			**Project Assessment:**		
Activity/Process:			**Must Fund:**		
Total Identical Units:		1	**Years Economic Life:**		
Major Pollutant:		Aerosol Cans			
Base Qty Stream:			**Source:**		
Annual Unit Poll Reduction:			**Source:**		
Unit Investment Cost:			**Source:**		
Annual Unit Recur Cost:			**Source:**		
Annual Unit Energy Savings:			**Source:**		
Total Unit Savings:			**Source:**		
Waste Unit Savings:			**Source:**		
Energy Unit Savings:			**Source:**		
Labor Unit Savings:			**Source:**		
O&M Unit Savings:			**Source:**		
Mel Procure Unit Savings:			**Source:**		
Other Unit Savings:			**Source:**		
Latest FY Start:			**Earliest FY Start:**		
FY	Budget Code:	Required:	Program/Budgeted:	Obligated:	

Narrative:

Cost Verification

Assumptions and Facts:

- Aerosol Can Recycling Unit: $1,495
- 15% of the Aerosol Cans are Classified as Hazardous Waste Prior to Processing
- Aerosol Cans Produced: 3 tons/year
- Labor Rate (WG-9): $30,000/year
- Scrap Metal Market Value: $100/ton
- Disposal Cost for Cans Classified as Hazardous Waste: $2.20/lb
- Liquid Hazardous Waste Disposal Cost: $1.00/lb

Annual Operating Cost of Recycling Aerosol Cans vs. Disposal

	Disposal	Recycling
Labor:	$0	$1,500
Landfill Disposal:	$191	$0
Hazardous Waste Disposal:	$1,980	$250
Total Costs: (not including capital and installation costs)	$2,171	$1,750
Total Income:	$0	$255
Annual Cost/Benefit:	($2,171)	($1,495)

Economic Analysis Summary:

- This example yields a payback period of 2.2 years.
- The percentage of cans determined to be hazardous waste has the largest effect on cost avoidance.
- This example assumed integration of aerosol can recycling into an existing recycling program and the program had no impact on labor requirements associated with solid waste collection and disposal.
- The economics listed here are intended only to be used as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. The system was purchased due to the continuous increase in air-permitting regulations related to VOC emissions. The system has virtually eliminated VOC emissions generated during the recycling of aerosol cans.

2. Daily collection from key generators and daily crushing has reduced the potential for NODs/NOVs associated with Satellite Accumulation Point storage.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for an Aerosol Can Recycling System

Assumptions and Facts:

Aerosol Can Recycling Unit:	$1,495	
Cans Processed:	3	ton/yr
Percentage of Cans Classified as Hazardous Waste:	15%	
- Cost to Dispose Cans Classified as HW:	$4,400	/ton
Recycle Steel Market Value:	$100	/ton
- Percentage of Cans Available For Recycling	85%	
Labor (WG-9 @ 5% utilization):	$1,500	/yr
Hazardous Waste Liquid Disposal Cost:	$250	/30-gallon drum
- Volume of HW Liquid Produced by System:	1	30-gallon drum/yı
Landfill Tipping Fee:	$75	/ton

Annual Operating Cost Comparison for Recycling Aerosol Cans Using an Aerosol Can Puncturing System

	Disposal	Recycling
Operational Costs:		
Labor:	$0	$1,500
Landfill Disposal:	$191	$0
Hazardous Waste Disposal:	$1,980	$250
Total Operational Costs:	$2,171	$1,750
Total Recovered Income:	$0	$255
Net Annual Cost/Benefit:	($2,171)	($1,495)

Economic Analysis Summary

Annual Savings for Aerosol Can Recycling:	$676	
Capital Cost for Diversion Equipment/Process:	$1,495	
Payback Period for Investment in Equipment/Process:	2.2	years

Fort Carson Air Filter Cleaning

Title: Air Filter Cleaning
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of costs associated with air filter procurement and disposal.

Cost: Estimated $80,000

Environment: Protects the environment by minimizing the volume of nonhazardous solid waste entering the landfill.

Air Filter Cleaning Unit Mounted on a Tandem Axle Transportation Trailer

Description: Fort Carson has approximately 500 armored tactical vehicles of various types that require frequent air filter changes and filters cost between $80 and $300 a piece. Typically, there are several filters per vehicle and they must be changed on average 1 to 3 times per year. The V-Packs are the most critical filter in the Army because most of the M1 tanks require them and they are extremely difficult to clean; furthermore, they are bulky and require large amounts of landfill airspace for disposal. Cleaning these filters is an alternate way to further minimize the impact on landfills and reduce costs associated with tipping fees and new filter purchase. Two systems were evaluated during the demonstration period. Air Vak and Sonic Dry Clean both submitted designs and delivered their systems based on their interpretation of the minimum specifications. Both systems performed well in cleaning filters but most soldiers preferred the added mobility the Sonic Dry Clean System offered by being trailer mounted. The Air Vak system was designed for a Palletized Loading System that not all units may possess. The following analysis is based on the Sonic Dry Clean System. This system consists of a 12 kW electric generator, diesel compressor, cleaning wand, and is mounted on a tandem axel trailer (12' x 7.45' x 8.25') with a pindle hook for towing. The entire system has a weight of approximately 2 tons. In most cases the system averages cleaning 6 filters per hour. It is estimated that over $140,000 in procurement and disposal costs can be saved annually by cleaning air filters instead of disposing after use.

Unit Investment Cost: $80,000	**Total Unit Savings:** $100,000
Payback: <1 Year	**Years Economical Life:** 10
Regulatory Driver: RCRC	**Waste Unit Savings:** $0
Major Pollutant: Air Filters	**Energy Unit Savings:** $0
Base Qty Stream: 26,000 lb	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for

Fort Carson Air Filter Cleaning

Total Cost Estimate: $80,000

Law/Regulation:	RCRC	**Compliance Status:**	OTHR
ECAT:	POLP	**Regulatory Driver:**	RCRC-HWManagement
Class:	3	**Project Assessment:**	H
Activity/Process:		**Must Fund:**	N
Total Identical Units:	1	**Years Economic Life:**	10
Major Pollutant:	Metals		
Base Qty Stream:	31,000 lb/yr	**Source:**	ESTIMATION
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$45,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$0	**Source:**	REPORTS
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$87,483	**Source:**	REPORTS
Waste Unit Savings:	$87,483	**Source:**	REPORTS
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:	1999	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2000	131054.20	$200,000	$200,000	$199,933

Narrative: Large air filters being thrown into landfills; unit will clean these approximately 10 times for re-use.

Cost Verification

Because this was a pilot study, much of the information required for a valid economic analysis is still being acquired. The following calculation is of the potential cost avoidance, which could be achieved, using the examined system excluding recurring operational costs.

Assumptions and Facts:

- Air Filter Cleaning Unit: $80,000
- Number of Filters Purchased Annually: 2,176
- Average Price of Filters Purchased: $64.80/filter
- Landfill Tipping Fee: $75/ton
- WG-9 Labor Rate: $30,000

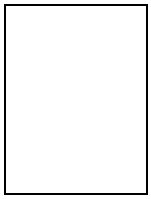
Annual Operating Cost Comparison Between Disposal of Used Air Filters Vs. Cleaning Used Air Filters

	Disposal	Cleaning
Labor:	$0	$6,000
Filter Replacement Cost:	$141,005	$35,251
Filter Disposal Cost:	$979	$245
Total Costs: (not including capital and installation costs)	$141,984	$41,496
Total Income:	$0	$0
Annual Benefit:	($141,984)	($41,496)

Economic Analysis Summary:

- This example provides a cost avoidance of $100,000 with a payback period of less than one year.
- This analysis was performed assuming 25% filter replacement annually.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.



Lessons Learned

1. This project required contractors to provide a design-build system to meet Fort Carson's needs. This proved crucial as one contractor's design required extensive modifications and thus resulted in no additional costs or fees for the Government.

2. The initial testing plan of this project was to have each air filter-cleaning unit tested twice in the field, with two units swapping the equipment. Due to dynamic Army training schedules and a list of unforeseen obstacles, field-testing requirements were modified to last for just one month; however, the equipment was placed in unit motor pools for the continuation of on-site testing.

3. Tank-Armaments and Automotive Command (TACOM) ultimately approve the cleaning of filters for tactical vehicles. Although, TACOM does approve cleaning of most vehicle filters it has NOT approved the cleaning of V-Pack filters for the M1 tank. Work with TACOM before purchasing any air filter cleaning system.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for an Air Filter Cleaner

Assumptions and Facts:

Air Filter Cleaning Unit:	$80,000	
Filters Purchased:	2,176	/yr
Average Price of Filters Purchased:	$64.80	/filter
Lanfill Tipping Fee:	$75	/ton
Average Weight of Filters	12	lbs/filter
Labor (WG-9 @ 20% utilization):	$6,000	/yr
Recurring Operational Costs:	unknown	

Annual Operating Cost Comparison for Recycling Used Air Filters Using an Air Filter Cleaning Unit

	Disposal	**Cleaning**
Operational Costs:		
Labor:	$0	$6,000
Filter Replacement Cost:	$141,005	$35,251
Filter Disposal Cost:	$979	$245
Total Operational Costs:	$141,984	$41,496
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($141,984)	($41,496)

Economic Analysis Summary

Annual Savings for Air Filter Cleaner:	$100,488	
Capital Cost for Diversion Equipment/Process:	$80,000	
Payback Period for Investment in Equipment/Process:	0.8	years

Fort Carson Digital Radiography

Title: Digital Radiography
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of hazardous materials used and hazardous wastes produced during x-ray procedures.

Cost: $40,000 for 4 units.

Environment: Protects the environment by reducing the amount of hazardous wastes generated by the installation. Reduces potential work force exposures to hazardous materials.

Digital X-Ray Photograph

Description: In digital radiography, the information that comprises the image (x-ray) is captured directly via a sensor, a phosphor plate or indirectly by a desktop scanner (with a transparency adapter) and appears as shades of gray that illuminate in tiny boxes-pixels-on the computer. This gray-level information is displayed much like a traditional x-ray film image except that the images are viewed on the monitor. Film-based images, once processed in chemicals, cannot be altered and can only be viewed on a dental x-ray view box. Alternatively, the digital image is displayed on a monitor in a much larger format than possible with radiographic films and images can be enhanced. Digital radiographs can be produced in real-time; thus eliminating the wait for processing. Radiation exposure is reduced as much as 90% from conventional film taking. The cost, labor, and record keeping necessary to maintain a chemical processor and darkroom are eliminated. The purchasing and disposing of film and environmentally hazardous chemicals (silver and chromium) also become unnecessary.

Unit Investment Cost: $40,000 (4 units)	**Total Unit Savings:**
Payback: 1.1 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Ag/Cr	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Digital Radiography
Total Cost Estimate: $40,000

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:	4	**Years Economic Life:**	10
Major Pollutant:	Ag/Cr		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$40,000 (4 units)	**Source:**	
Annual Unit Recur Cost:	$2,400	**Source:**	Fort Carson
Annual Unit energy savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor unit Savings:		**Source:**	
O&M unit savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- 4 Digital Radiography Units: $40,000
- Film Usage: 30,000/year
- X-Ray Technician Labor Rate: $30/hour
- Waste Disposal Costs Include Hazardous Waste Disposal Costs

Annual Operating Cost of 4 Digital Radiographs vs. Using Traditional X-Ray Technology

	X-Ray Film	Digital
Labor Costs:	$47,250	$26,250
Material(s) Cost(s):	$11,700	$4,800
Waste Disposal Costs:	$5,400	$0
Utilities and Maintenance Costs:	$4,800	$2,400
Total Costs: (not including capital and installation costs)	$69,150	$33,450
Total Income:	$0	$0
Annual Cost/Benefit:	($69,150)	($33,450)

Economic Analysis Summary:

- A payback period of <2 years is obtained in this example.
- Number of x-rays produced each year has the largest impact on cost avoidance.
- The $40K ($10K/unit) capital cost includes everything necessary for operation i.e.: computer, software, sensors, monitor, etc.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. Because the process uses digital imagery for x-rays in lieu of silver and chromium, it has drastically reduced the amount of hazardous waste being generated by the dental facilities and providing cost avoidance associated with film processing.

2. At $5,000 each, the sensors are very expensive and the patient can easily destroy one if they bite down incorrectly, so great care must be taken to keep the equipment safe and operational.

3. With this system, the images are not as clear as film x-rays, so in some instances where greater detail is required, film x-ray technology is still being used.

4. Not all other military hospitals have digital capabilities or are using digital radiography, so transfer of digital records to another installation should be of concern.

5. Using Environmental funds to buy equipment for DENTAC can be tricky, great care should be taken to ensure it is performed properly.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for a Digital Radiography System

Assumptions and Facts:

4 Digital Radiography Units:	$40,000	
Film Usage:	30,000	exposures/yı
"Wet Chemistry" X-Ray Film Developing:		
- Utilities Cost:	$3,000	/yr
- Processor Maintenance:	$1,800	/yr
- Material(s) Cost(s):	$11,700	/yr
- Waste Disposal Cost (including hazardous waste):	$5,400	/yr
- Labor Required For Developing	1,575	hrs/yr
Digital Radiography Film Developing:		
- Utilities Cost:	$2,400	/yr
- Material(s) Cost(s):	$4,800	/yr
- Labor Required For Developing	875	hrs/yr
X-Ray Technician Labor Rate:	$30	/hr

Annual Operating Cost Comparison for Radiography Using a Digital Radiography System

	X-Ray Film	Digital
Operational Costs:		
Labor Costs:	$47,250	$26,250
Material(s) Cost(s):	$11,700	$4,800
Waste Disposal Costs:	$5,400	$0
Utilities and Maintenance Costs:	$4,800	$2,400
Total Operational Costs:	$69,150	$33,450
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($69,150)	($33,450)

Economic Analysis Summary

Annual Savings Using Digital Radiography:	$35,700	
Capital Cost for Diversion Equipment/Process:	$40,000	
Payback Period for Investment in Equipment/Process:	1.1	years

Fort Carson Fluorescent Bulb Crusher

Title: Fluorescent Bulb Crusher
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of hazardous waste generated by the installation by crushing and recycling mercury containing fluorescent bulbs.

Cost: $8,160

Environment: Protects the environment by reducing the amount of hazardous and non-hazardous waste generated by the installation.

Bulb Crusher In Use

Description: Fluorescent tubes may be recycled under the Universal Waste rule but can be extremely costly depending on handling practices. Federal and individual State air regulations preclude the release of mercury vapors into the atmosphere and may consider crushing fluorescent bulbs as *treatment* of hazardous waste. The Colorado Department of Public Health and Environment (CDPHE) allows Fort Carson to manage fluorescent tubes as a Universal Waste and currently considers crushing to be a recycling process in lieu of treatment. This particular system crushes fluorescent tubes entirely inside 55-gallon drums to ensure no mercury vapors are released during bulb deformation. Bulb crushing could potentially make the glass used in fluorescent tubes obtain a higher recycle market value.

Unit Investment Cost: $8,160	**Total Unit Savings:** $5,099
Payback: 1.6 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Fluorescent Bulbs	**Energy Unit Savings:** $0
Base Qty Stream: 5,950 lb/yr	**Labor unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:** $900
Annual Unit energy savings: $	**O&M unit savings:** $

EPR

Exhibit 2 Data for
Fort Carson Fluorescent Bulb Crusher
Total Cost Estimate: $8,160

Law/Regulation:	RCRC	**Compliance Status:**	OTHR
ECAT:	POLP	**Regulatory Driver:**	RCRC-HWManagement
Class:	3	**Project Assessment:**	H
Activity/Process:		**Must Fund:**	N
Total Identical Units:	1	**Years Economic Life:**	10
Major Pollutant:	Hg/P		
Base Qty Stream:	5,950 lb/yr	**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$8,160	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$900	**Source:**	ESTIMATION
Annual Unit energy savings:		**Source:**	
Total Unit Savings:	$8,517	**Source:**	
Waste Unit Savings:	$8,517	**Source:**	REPORTS
Energy Unit Savings:		**Source:**	
Labor unit Savings:		**Source:**	
O&M unit savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:	1999	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1999	131054.20	$10,000		
2000	131054.20	$12,000		$10,720

Narrative: Fluorescent light tube crusher to enhance recycling efforts and save money and time spent on packaging intact tubes for shipping.

Cost Verification

Assumptions and Facts:

- Capital Cost Of A Fluorescent Bulb Crusher: $8,160
- Annual Cost For Waste Sampling: $1,200
- Bulb Recycling Cost: $1.20/lb
- WG-9 Labor Rate: $30,000/yr
- Bulbs Generated: 5,950 lb/yr

Annual Operating Cost Comparison For Recycling Fluorescent Bulbs Using A Crusher

	Not Crushed	Crushed
Electrical Cost:	$0	$300
Labor Cost:	$6,000	$1,500
Recycling Cost:	$11,149	$9,350
Recurring Costs:	$0	$900
Total Costs: (not including capital and installation costs)	$17,149	$12,050
Total Income:	$0	$0
Annual Benefit:	($17,149)	($12,050)

Economic Analysis Summary:

- Crushing provides a cost avoidance of $5,099 with a payback period of 1.6 years in this example.
- Cost associated with waste sampling can vary greatly dependant upon chosen laboratory.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. The biggest hurdle to overcome was convincing the Colorado Department of Public Health and Environment (CDPHE), the Army Western Regional Office, and the EPA that crushing fluorescent bulbs was not treatment of a hazardous waste. Memorandums were written to these agencies thoroughly explaining the process. The memorandums emphasized the fact that the tubes would be crushed entirely inside an enclosed drum precluding mercury vapor release, the filters would be disposed of as hazardous waste, and the process would be performed in a well-ventilated area. Furthermore, hazardous waste determinations were performed on the filtering material and the crushed tubes to determine if the glass could be safely accepted for recycling.

2. Before program implementation fluorescent bulbs had to be carefully individually packed into relatively expensive cardboard drums. Up to 900 bulbs may now be crushed into one metal drum using the crusher.

3. Handling and storing the bulbs as a Universal Waste has also allowed storage for up to 180 days; therefore, only two waste documents need to be drafted each year. This significantly reduced man-hours associated with processing and paperwork.

4. In addition to allowing individuals to turn in bulbs at the hazardous waste bunker, Fort Carson personnel collect bulbs daily at four locations to limit the SAPs across the installation. This daily collection of bulbs at key locations has minimized potential NODs/NOVs associated with Satellite Accumulation Point (SAP) storage.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for A Fluorescent Bulb Crusher

Assumptions and Facts:		
Bulb Crusher:	$8,160	
Bulb Recycling Cost:	$1	/lb
Bulbs Generated:	5950	lbs/yr
Cost Of Shipping Drums (includes disposal):		
- Not Crushed	$2,809	/yr
- Crushed	$1,010	/yr
Waste Sampling Cost:	$1,200	/yr
Energy Costs:	$300	/yr
Recurring Costs:	$900	/yr
Labor (WG-9):		
- Not Crushing	$3,000	/yr
- Crushing	$1,500	/yr

Annual Operating Cost Comparison for Recycling of Fluorescent Bulbs Using a Crusher

	Not Crushed	**Crushed**
Operational Costs:		
Electrical Costs:	$0	$300
Labor:	$6,000	$1,500
Recycling Cost:	$11,149	$9,350
Recurring Costs:	$0	$900
Total Operational Costs:	$17,149	$12,050
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($17,149)	($12,050)

Economic Analysis Summary		
Annual Savings for Fluorescent Bulb Crusher:	$5,099	
Capital Cost for Diversion Equipment/Process:	$8,160	
Payback Period for Investment in Equipment/Process:	1.6	years

Fort Carson Fuel Filtration

Title: Fuel Filtration
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduced disposal of off-specification fuel.

Cost: $38,000

Environment: Protects the environment by reducing the amount of hazardous waste generated by the installation. Preserves natural resources by providing recycled fuel for the installation.

Fuel Filtration Unit Mounted on a Tandem Axle Transportation Trailer

Description: Over 800 gallons of fuel is contaminated and wasted by each battalion on Fort Carson each year. Since the Division of Materials Maintenance Company (DMMC) left Fort Carson, there have been no efficient ways to clean or filter contaminated fuels, so units are currently stockpiling, storing in used oil convaults, or delivering off-specification fuel to the Hazardous Waste Bunker. Fuels are generally contaminated with particulates and/or water; this allows for easy decontamination. The above fuel filtration system was designed with 12 fuel filter/water separators (these filters are rolls of paper towels) able to filter particles down to one (1) micron. Each of the 12 separators holds 3 rolls apiece for a total of 36 rolls used by the system. The system includes a large particle/water separator before the filters, electronic water sensors, and operates at a rate of 48 gallons per minute. The filtering system is mounted on a 7,000 pound, tandem axle trailer with an interchangeable military hitch.

Unit Investment Cost: $38,000	**Total Unit Savings:** $27,550
Payback: 1.4 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Waste Fuel	**Energy Unit Savings:** $0
Base Qty Stream: 12,000 gallons	**Labor unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit energy savings: $	**O&M unit savings:** $

EPR

Exhibit 2 Data for
Fort Carson Fuel Filtration
Total Cost Estimate: $38,000

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	10
Major Pollutant:	Waste Fuel		
Base Qty Stream:	12,000 gal/yr	**Source:**	Fort Carson
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$38,000	**Source:**	Fort Carson
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$27,550	**Source:**	Fort Carson
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- Fuel Filtration Unit: $38,000
- Volume of Waste Fuel Generated Annually: 12,000 gallons
- Fuel Disposal Cost (contracted): $0.40/gallon
- Virgin Fuel Market Value: $0.95/gallon
- Filter Replacement Cost: $0.02/gallon of fuel filtered
- WG-9 Labor Rate: $30,000
- Assumed 95% Filtering Efficiency

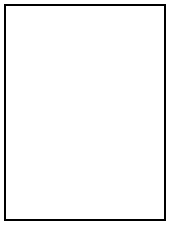
Annual Operating Cost of Fuel Filtration vs. Disposal

	Disposal	Filtration
Labor:	$3,000	$6,000
Filter Replacement Cost:	$0	$240
Fuel Disposal Cost:	$9,370	$240
Fuel Purchase Cost:	$11,400	$570
Total Costs: (not including capital and installation costs)	$23,770	$7,050
Total Recovered Income:	$0	$10,830
Annual Benefit:	($23,770)	$3,780

Economic Analysis Summary:

- This example achieves a 1.4-year payback period.
- Drum costs are included in disposal cost.
- Local market value of virgin fuel should be examined for this analysis and disposal costs can vary greatly from one installation to another.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.



Lessons Learned

1. While the fuel filtration system can filter off-specification fuel for reuse, it can only clean fuel contaminated with dirt and water. Fuel that suffers from serious contamination beyond its filtering capabilities must be disposed of as waste.

2. The filtration system purchased is actually larger than required for the mission it is used to accomplish.

3. The biggest challenge for the Directorate of Environmental Compliance And Management (DECAM) has been making installation personnel aware of the program. The awareness of availability of this system is not comprehensive enough to ensure cleaning of all off-specification fuel generated on the installation.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for a Fuel Filtration Unit

Assumptions and Facts:		
Fuel Filtration Unit:	$38,000	
Fuel Disposal Cost:	$0.40	/gal
Fuel Generated:	12,000	gal/yr
Metal Fuel Drum Cost (for waste or return):	$57	/drum
- Fuel Drum Weight:	400	lbs
- Cost For Shipping:	$1	/lb
- Drums Shipped As Waste:	10	/yr
Virgin Fuel Market Value:	$0.95	/ton
Filtration Filter Replacement Cost:	$0.02	/gal
Labor (WG-9):		
- Managing Fuel As Waste (10% Utilization):	$3,000	/yr
- Filtering Fuel (20% Utilization):	$6,000	/yr

Annual Operating Cost Comparison for Recycling Used Fuel Using a Filtration Unit

	Disposal	**Filtration**
Operational Costs:		
Labor:	$3,000	$6,000
Filter Replacement Cost:	$0	$240
Fuel Disposal Cost:	$9,370	$240
Fuel Purchase Cost:	$11,400	$570
Total Operational Costs:	$23,770	$7,050
Total Recovered Income:	$0	$10,830
Net Annual Cost/Benefit:	($23,770)	$3,780

Economic Analysis Summary		
Annual Savings for Fuel Filtration Unit:	$27,550	
Capital Cost for Diversion Equipment/Process:	$38,000	
Payback Period for Investment in Equipment/Process:	1.4	years

Fort Carson H-Axis Washers

Title: H-Axis Washers
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of expenditures associated with water and energy usage by washing machines.

Cost: $2,572

Environment: Protects the environment by reducing the amount of natural resources consumed during laundry activities.

H-Axis Washers Are Also Known As Front Loading Washers

Description: The Department of Energy (DOE) in cooperation with the Pacific Northwest National Laboratory (PNNL) released a report that recommended using high performance horizontal-axis (h-axis) washers in areas with high usage volumes like barracks. Horizontal-axis clothes washers can save as much as 60% of the electricity and uses one-third of the water used by traditional vertical-axis (v-axis) washers while cleaning the same volume of clothes; furthermore, they can also conserve drying energy by spinning clothes faster than v-axis washers. Also, by eliminating the agitator, horizontal-axis washers also reduce wear and tear on clothes. Because of the baffle design, h-axis washers produce more suds, thus reducing detergent use. Some energy providers are offering rebates on the purchase energy efficient appliances.

Unit Investment Cost: $1,210	**Total Unit Savings:**
Payback: 6.1 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant:	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson H-Axis Washers
Total Cost Estimate: $2,572

Law/Regulation:	PRVN	**Compliance Status:**	ESDF
ECAT:	POLP	**Regulatory Driver:**	RCRC-HWManagement
Class:	2	**Project Assessment:**	H
Activity/Process:		**Must Fund:**	Y
Total Identical Units:	10	**Years Economic Life:**	0
Major Pollutant:	Wastewater		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$2,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$0	**Source:**	REPORTS
Annual Unit energy savings:		**Source:**	
Total Unit Savings:	$1,333	**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:	$419	**Source:**	ESTIMATION
Labor unit Savings:		**Source:**	
O&M unit savings		**Source:**	
Mel Procure Unit Savings:	$657	**Source:**	ESTIMATION
Other Unit Savings:	$256	**Source:**	ESTIMATION
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2001	131054.20	$20,000	$20,000	

Narrative: Place h-axis washers in barracks to reduce the use of detergent and bleaches, plus conserve water and energy. Project is to replace conventional washers as they wear out (10/yr). Information/responsibility turned over to DPW.

Cost Verification

Assumptions and Facts:

- Capital Cost of a H-axis Washing Machine: $1,210
- Water/Sewer Cost: $1.71/Kgal
- Electrical Cost: $0.065/kWh
- Natural Gas Cost: $6.55 Mcf
- Wash Cycles: 2,336/yr

Annual Operating Cost of H-axis Washers vs. V-axis Washers

	V-axis	H-axis
Water/Sewer:	$156	$88
Electricity:	$24	$15
Water Heating:	$127	$71
O&M:	$100	$35
Total Costs: (not including capital and installation costs)	$407	$210
Total Income:	$0	$0
Annual Cost/Benefit:	($407)	($210)

Economic Analysis Summary:

- This example demonstrates a payback period of 6.1 years.
- H-axis cost savings, not captured in this analysis, are reduced drying time, increased washer capacity, and increased life cycle of clothing. Capturing these avoidances would result in a payback period of approximately 5 years.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. Four horizontal-axis washers were purchased and tested in December of 1999 and according to installation research, they saved almost 50% in energy and water usage.

2. During the one-year testing phase, the washer/dryer maintenance contractor received only one work order (maintenance call) for repairs. This resulted in the operations and maintenance cost being ¼ of current budgeted amount for v-axis O&M.

3. Unfortunately, horizontal-axis typically cost up to 3 to 4 times more than the cheapest vertical-axis washers available. While the installation is interested in the cost avoidance, Directorates have yet to approve the significant capital cost required to convert the installation to h-axis washers.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for Horizaontal-Axis Washers

Assumptions and Facts:

H-axis Washing Machine Cost:	$1,210	
Wash Cycles:	2,336	/yr
Water/Sewer Cost:	$1.71	/Kgal
Electrical Cost:	$0.065	/kWh
Natural Gas (water heater) Cost:	$6.55	/Mcf
H-axis Statistics:		
- Water Used Per Cycle:	22	gal
- Gas Used Per Cycle:	0.00467	Mcf
- Electricity Used Per Cycle (does not include drying):	0.0999	kWh
- O&M Cost (estimated):	$35	/yr
V-axis Statistics:		
- Water Used Per Cycle:	39	gal
- Gas Used Per Cycle:	0.0083	Mcf
- Electricity Used Per Cycle (does not include drying):	0.1598	kWh
- O&M Cost (estimated):	$100	/yr

Annual Operating Cost Comparison for Washing Machines Using a Horizontal-axis Washer

	V-axis	H-axis
Operational Costs:		
Water/Sewer:	$156	$88
Electricity:	$24	$15
Water Heating:	$127	$71
O&M:	$100	$35
Total Operational Costs:	$407	$210
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($407)	($210)

Economic Analysis Summary

Annual Savings for H-axis Washers:	$198	
Capital Cost for Diversion Equipment/Process:	$1,210	
Payback Period for Investment in Equipment/Process:	6.1	years

Fort Carson Janitorial Product Substitutions

Title: Janitorial Product Substitutions
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the substitution of hazardous janitorial products with effective environmentally friendlier versions.

Cost: $86,000

Environment: Protects the environment by reducing the amount of hazardous and non-hazardous waste generated by the installation. Reduced potential worker exposures to hazardous materials.

ECOLAB Supply Station

Description: Both Executive Order (EO) 13101 *Greening Government Through Waste Prevention, Recycling and Federal Acquisition* and the Resource Conservation and Recovery Act (RCRA) 6002 require installations to purchase environmentally friendly products and services. Typically, barrack janitorial products are found being stored haphazardly and without Material Safety Data Sheets (MSDSs). This project replaces commercial janitorial products with more environmentally friendly products, which work as well as any other cleaner, and are in general less odiferous. Four products are used for all barracks janitorial needs: general-purpose cleaner, latrine cleaner, glass cleaner, and air freshener. Now, all products are dispensed from 3-gallon jugs (on the rack, in the above illustration) into spray bottles. The MSDS station is placed adjacent to the rack and is easily accessible. Products are reordered by entering the request into the Unit Level Logistics System (ULLS) box and picking them up at the Hazardous Material Control Center (HMCC). The HMCC created local stock numbers for reorders so soldiers would not make the mistake of using the National Stock Number (NSN) to order from the vendor, who only supplies in concentrated bulk containers. The HMCC maintains the concentrate and dilutes it for the soldier. A necessary quantity of each product is maintained at the HMCC so soldiers can receive their order immediately.

Unit Investment Cost: $86,000	**Total Unit Savings:** $36,040
Payback: 2.4 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Cleaning Agents	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Janitorial Product Substitutions
Total Cost Estimate: $86,000

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Cleaning Agents		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- Product Gear Locker (including racks and initial supplies): $355.51
- Gear Lockers Installed: 240
- Rooms Supported By Program: 2,503

Annual Operating Cost Comparison Using Environmentally Friendly Janitorial Products

	Commercial	Environmentally Friendly
General Purpose Cleaner:	$16,096	$1,807
Toilet Bowl Cleaner:	$15,110	$1,725
Glass Cleaner:	$6,775	$575
Air Freshener:	$2,864	$698
Total Costs: (not including capital and installation costs)	$40,844	$4,804
Total Income:	$0	$0
Annual Cost/Benefit:	($40,844)	($4,804)

Economic Analysis Summary:

- This scenario produces a payback period of 2.4 years.
- The economics listed here are intended only to be used as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. Determining the need for environmentally friendlier cleaning products and the actual setup of the system at the barracks were extremely simple; however, enforcement as an installation mandate and education on how to order and use the product were a bit more challenging.

2. After initial installation, soldiers responded favorably to the product; however, even though labels were placed with information on how to reorder and use the products, soldiers failed to reorder and/or attempted reorder improperly. For example, soldiers took empty spray bottles to the HMCC to be refilled instead of the 3-gallon jugs. It was obvious that more education was necessary.

3. Removal of all other cleaning supplies and stocking with post standard products did not prevent continual reorders of commercially available products, so in order to improve project compliance, a command memo was issued which detailed the appropriate regulations, reminded soldiers that the products were safer and cheaper, stated the products were the installation standard, and provided the phone number of the HMCC.

4. Supply Sergeants experienced difficulty with adding new catalog records to their ULLS system. Due to frequent soldier rotations, many Supply Sergeants did not understand the procedure for adding a new local stock numbers.

5. Rack equipment tends to disappear; spray bottles appear to be the most common item.

6. Even after the command memo and extensive training, participation continues to decline. It is estimated that only 5%-10% of the barracks are actually using the cheaper product.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for Janitorial Product Substitutions

Assumptions and Facts:		
Product Gear Locker (including racks and initial supplies):	$355.51	each
Total Gear Lockers:	240	units
Total Number of Rooms Supported:	2,053	rooms/yr
Commercially Available Products:		
- General Purpose Cleaner (24 oz):	$1.96	each
o Average Use Per Room:	4	/yr
- Toilet Bowl Cleaner (24 oz):	$1.84	each
o Average Use Per Room:	4	/yr
- Glass Cleaner (24 oz):	$1.65	each
o Average Use Per Room:	2	/yr
- Air Freshener (24 oz):	$2.79	each
o Average Use Per Room:	0.5	/yr
Environmentally Friendly Substitute:		
- General Purpose Cleaner (24 oz):	$0.11	each
o Average Use Per Room:	8	/yr
- Toilet Bowl Cleaner (24 oz):	$0.21	each
o Average Use Per Room:	4	/yr
- Glass Cleaner (24 oz):	$0.14	each
o Average Use Per Room:	2	/yr
- Air Freshener (24 oz):	$0.34	each
o Average Use Per Room:	1	/yr

Annual Operating Cost Comparison Using Environmentally Friendly Janitorial Products

	Commercial	**Env. Friendly**
Operational Costs:		
General Purpose Cleaner:	$16,096	$1,807
Toilet Bowl Cleaner:	$15,110	$1,725
Glass Cleaner:	$6,775	$575
Air Freshener:	$2,864	$698
Total Operational Costs:	$40,844	$4,804
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($40,844)	($4,804)

Economic Analysis Summary		
Annual Savings Using Environmentally Friendly:	$36,040	
Capital Cost for Diversion Equipment/Process:	$85,322	
Payback Period for Investment in Equipment/Process:	2.4	years

Fort Carson Oil Filter Crusher

Title: Oil Filter Crusher
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction in fees associated with used oil filter disposal by crushing and recycling to the maximum extent feasible.

Cost: $5,546

Environment: Protects the environment by reducing the amount of hazardous and non-hazardous waste generated by the installation. Supports Executive Order 13101.

Oil Filter Crusher In Use

Description: Fort Carson generates approximately 4,800 pounds of used oil filters, destined to be disposed of in the local landfill, each year. The oil filter crusher allows the four basic components of a spent filter (filter media, fluids, steel/metal, and gasket) to be separated for recycling instead of disposal. Fort Carson's crusher can handle all types of filters ranging between 2.5 inches to 8 inches in diameter. The crushing of oil filters also increases the amount of oil recovered for recycling. In fact, crushing can remove up to 96% of the used oil encapsulated in the filter.

Unit Investment Cost: $5,546	**Total Unit Savings:**
Payback: Does Not Provide Cost Avoidance	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Used Oil Filters	**Energy Unit Savings:** $0
Base Qty Stream: 4,800 lb/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Oil Filter Crusher
Total Cost Estimate: $5,546

Law/Regulation:			**Compliance Status:**	
ECAT:			**Regulatory Driver:**	
Class:			**Project Assessment:**	
Activity/Process:			**Must Fund:**	
Total Identical Units:			**Years Economic Life:**	10
Major Pollutant:	Used Oil Filters			
Base Qty Stream:	2,400 filters/yr		**Source:**	Fort Carson
Annual Unit Poll Reduction:			**Source:**	
Unit Investment Cost:	$5,546		**Source:**	Fort Carson
Annual Unit Recur Cost:	$300		**Source:**	Fort Carson
Annual Unit Energy Savings:			**Source:**	
Total Unit Savings:			**Source:**	
Waste Unit Savings:			**Source:**	
Energy Unit Savings:			**Source:**	
Labor Unit Savings:			**Source:**	
O&M Unit Savings			**Source:**	
Mel Procure Unit Savings:			**Source:**	
Other Unit Savings:			**Source:**	
Latest FY Start:			**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- Oil Filter Crusher Cost: $5,546
- Oil Filters Generated: 2,400/yr
- Landfill Tipping Fee: $75/ton
- Oil Disposal Cost: $300/yr
- Labor Grade (WG-9) at 5% Utilization: $1,500/yr

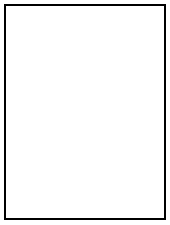
Annual Operating Cost of Recycling Used Oil Filters Using a Oil Filter Crusher

	Disposal	Diversion
Electrical:	$0	$300
Labor:	$0	$1,500
Filter Disposal:	$180	$0
Oil Disposal:	$300	$0
Total Costs: (not including capital and installation costs)	$480	$1,800
Total Recovered Income:	$0	$598
Annual Benefit:	($480)	($1,202)

Economic Analysis Summary:

- In this example, diverting used oil filters from the waste stream using a crusher does not provide cost avoidance even though the oil is reused and the metal sold as scrap.
- This project example would only be implemented based on environmental leadership and uncalculated benefits such as: reduced potential for spills, reduced potential for storage/disposal violations, and long term liability concerns.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.



Lessons Learned

1. The biggest challenge for the Directorate of Environmental Compliance And Management (DECAM) has been making installation personnel aware of the program. Soldiers lack the necessary training to bring filters to the Pollution Prevention Center (PPC) or save them at their motor pool for collection.

2. After the residual fluids are drained and collected they are diverted to a used oil burner, which provides heat to the PPC facility.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for An Oil Filter Crusher

Assumptions and Facts:

Oil filter Crusher:	$5,546	
Oil Disposal Cost:	$300	/yr
Filters Generated:	2,400	/yr
- oil filters weigh appoximately 2 lbs	4,800	lbs/yr
Landfill Tipping Fee:	$75	/ton
Energy Costs:	$300	/yr
Labor (WG-9) at 5% Utilization:	$1,500	/yr
Recovered Used Oil Value (used oil burner):	$500	/yr
Recovered Scrap Metal Value:	$41	/ton

Annual Operating Cost Comparison for Recycling Used Oil Filters Using a Crusher

	Disposal	Diversion
Operational Costs:		
Electrical Costs:	$0	$300
Labor:	$0	$1,500
Filter Disposal Cost:	$180	$0
Oil Disposal Cost:	$300	$0
Total Operational Costs:	$480	$1,800
Total Recovered Income:	$0	$598
Net Annual Cost/Benefit:	($480)	($1,202)

Economic Analysis Summary

Annual Savings for Oil Filter Crusher:	($722)	
Capital Cost for Diversion Equipment/Process:	$5,546	
Payback Period for Investment in Equipment/Process:	(7.7)	years

Fort Carson STERRAD Sterilization System

Title: STERRAD Sterilization System
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of hazardous waste generated by the installation and by providing a sterilization method that reduces operator's potential exposures to both hazardous materials and chemicals.

Cost: $98,000

Environment: Protects the environment by reducing the amount of hazardous waste generated by the installation. Reduces potential labor force exposures to hazardous chemicals.

STERRAD Medical Implement Sterilizer

Description: Sterilization may be defined as a process that renders medical devices and surgical instruments devoid of all life forms, including fungi, viruses, active bacteria, and heat/chemical resistant bacterial spores; which otherwise survive the disinfection process. Medical sterilization technology has remained essentially unchanged over the last 40 years or more. One traditional method of low temperature sterilization uses ethylene oxide (EtO) gas, which has been linked to cancer, fetal abnormalities, and chronic medical problems. Additionally, EtO carrier gases are costly and pose safety problems for employees. The STERRAD System is a non-toxic, environmentally friendly sterilization system that uses low-temperature hydrogen peroxide gas plasma technology and produces no toxic residues or emissions. Byproducts from sterilization are oxygen and water vapor. Instruments are typically sterilized in approximately one hour; this is 17 times faster than traditional sterilization methods.

Unit Investment Cost: $98,000	**Total Unit Savings:** $26,380
Payback: 3.7 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Ethylene Oxide (EtO)	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit savings:** $

EPR

Exhibit 2 Data for
Fort Carson STERRAD Sterilization System
Total Cost Estimate: $98,000

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:	1	**Years Economic Life:**	
Major Pollutant:	Ethylene Oxide		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$98,000	**Source:**	Fort Carson
Annual Unit Recur Cost:		**Source:**	
Annual Unit energy savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- STERRAD Sterilization Unit Cost: $98,000
- Extensive Research Was Performed to Identify Supply, Utility, Sterilant and Maintenance Costs Associated With Both Systems

Annual Operating Cost of Sterilization Using EtO vs. STERRAD Technology

	EtO	STERRAD
Supply Costs:	$4,509	$3,162
Utility Costs:	$1,335	$18
Sterilant Costs:	$2,007	$1,646
Maintenance Costs:	$14,995	$8,640
Other Costs Associated With EtO:	$17,000	$0
Total Costs: (not including capital and installation costs)	$39,846	$13,466
Total Income:	$0	$0
Annual Cost/Benefit:	($39,846)	($13,466)

Economic Analysis Summary:

- This example produces a payback period of 3.7 years.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. This system has been a large success for the hospital; significantly reducing ethylene oxide use and implement/equipment sterilization times. Due to the size and configuration of the sterilizer, it can only sterilize certain size equipment; therefore, use of ethylene oxide was not completely eliminated, as it is needed for larger equipment/implements.

2. Using environmental funds to purchase equipment for MEDDAC was tricky. Extra care should be taken to ensure the purchasing is done correctly. Remember, MEDCASE funds are OMA funds and should preclude appropriation problems.

3. The STERRAD system eliminated a product listed as a carcinogen and significantly increased equipment/implement availability.

4. Originally the sterilizer was priced around $106,000; however, with close communication with the company and persistence, they dropped the price to $98,000. This is below the $100,000 ceiling for equipment purchases.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for a STERRAD Sterilization System

Assumptions and Facts:		
STERRAD Sterilization Unit:	$98,000	
Supply Costs:		
- EtO:	$4,509	/yr
- STERRAD:	$3,162	/yr
Utility Costs:		
- EtO:	$1,335	/yr
- STERRAD:	$18	/yr
Sterilant Costs:		
- EtO:	$2,007	/yr
- STERRAD:	$1,646	/yr
Maintenance Costs:		
- EtO:	$14,995	/yr
- STERRAD:	$8,640	/yr
Other Costs Associated With EtO:		
- PPE:	$2,000	/yr
- EtO Recovery:	$5,000	/yr
- Cost of Device Inventory:	$5,000	/yr
- Risk Management:	$5,000	/yr

Annual Operating Cost Comparison for Sterilization Using a STERRAD System in Lieu of EtO

	EtO	**STERRAD**
Operational Costs:		
Supply Costs:	$4,509	$3,162
Utility Costs:	$1,335	$18
Sterilant Costs:	$2,007	$1,646
Maintenance Costs:	$14,995	$8,640
Other Costs Associated With EtO:	$17,000	$0
Total Operational Costs:	$39,846	$13,466
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($39,846)	($13,466)

Economic Analysis Summary		
Annual Savings for a STERRAD System:	$26,380	
Capital Cost for Diversion Equipment/Process:	$98,000	
Payback Period for Investment in Equipment/Process:	3.7	years

Fort Carson Tank Track Reuse

Title: Tank Track Reuse
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction of non-hazardous solid waste generated by the installation, while producing hardened water crossings capable of withstanding elevated traffic pressures.

Cost: Unavailable

Environment: Protects the environment by reducing the amount of non-hazardous solid waste generated by the installation.

Tank Tracks Used for Erosion Control

Description: Rock and occasionally concrete-grouted rock is often used as a fortification to prevent erosion and undercutting of banks. The technical term for this type of erosion control is called riprap (or rip rapping). Procuring materials to be used as riprap is typically quite costly, so the installation began using old/unserviceable tank track in several innovative erosion control applications. The first test application was in 1998 where several thousand pounds of used tank track from the Defense Reutilization and Marketing Office (DRMO) was used to reinforce a ditch line along a closed landfill. With each track section spanning five-feet and weighing 500 pounds, this provided significant cost avoidances associated with track disposal. The second test application was to use the 'recycled' track in the construction of a hardened water crossing able to withstand traffic pressures, watershed impacts, and resist erosion. The crossing consists of 44 strips of 'recycled' tank track each weighing approximately 1,600 pounds. The crossing spans over an area of 2000 square feet and diverted 35 tons of material destined for land filling.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economical Life:** 10
Regulatory Driver: RCRD	**Waste Unit Savings:** $0
Major Pollutant:	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Tank Track Reuse
Total Cost Estimate: $

Law/Regulation:	RCRD		**Compliance Status:**	
ECAT:			**Regulatory Driver:**	
Class:			**Project Assessment:**	
Activity/Process:			**Must Fund:**	
Total Identical Units:			**Years Economic Life:**	
Major Pollutant:				
Base Qty Stream:			**Source:**	
Annual Unit Poll Reduction:			**Source:**	
Unit Investment Cost:			**Source:**	
Annual Unit Recur Cost:			**Source:**	
Annual Unit Energy Savings:			**Source:**	
Total Unit Savings:			**Source:**	
Waste Unit Savings:			**Source:**	
Energy Unit Savings:			**Source:**	
Labor Unit Savings:			**Source:**	
O&M Unit Savings			**Source:**	
Mel Procure Unit Savings:			**Source:**	
Other Unit Savings:			**Source:**	
Latest FY Start:			**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

While the actual dollar savings resulting from this project cannot be accurately calculated, one certain cost avoidance does present itself: disposal savings. Fort Carson faces landfill tipping fees of $75 per ton, not including transportation/handling costs. With approximately 2,000 tons of unserviceable tank track diverted from the landfill, the installation has achieved a cost avoidance of $150,000 in tipping fees alone. This dollar amount would more than likely increase if the procurement cost of materials typically used for riprap were added to the total cost of the project.

The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Lessons Learned

1. This project has diverted a total of almost 2,000 tons of used/unserviceable tank track destined for land filling. In addition to using 'recycled' tank track on Fort Carson, the City of Colorado Springs and the United States Air Force Academy have also expressed an interest in using the surplus for similar purposes. To date, Fort Carson has provided the City of Colorado Springs with approximately 1,000 tons of track for erosion control.

2. Obtaining United States Army Corps of Engineers approval and finding applications, which suited the Environmental Protection Agency, was extremely challenging but rewarding.

Fort Carson Weed Seeker

Title: Weed Seeker
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction in costs associated with installation weed control.

Cost: $22,000

Environment: Protects the environment by reducing the amount of herbicides and pesticides applied to the soils, reduced chemical runoff into waterways and groundwater, and reduces potential worker exposure to hazardous chemicals.

WeedSeeker Mounted on a Mobile Applicator

Description: The Department of the army mandated the reduction of pesticide use on installations. Traditional herbicide application requires either wasteful broadcast spraying or expensive, labor-intensive spot application. With this new technology a chlorophyll-identifying selective spray system mounts to any type of boom sprayer. The system, which employs LED light sources and optical sensors connected to electronically controlled solenoid valves, rapidly controls the operation of each boom nozzle. Nozzles only operate when something 'green' is detected. The system is ideal for spraying large areas with low-weed densities (i.e. parking lots, railroad tracks). Besides being adaptable to existing spray systems, this technology also provides a real-time recording of herbicide use and the system can be used at night. Herbicide use reductions of 40 to 50 percent and labor reductions as high as 50% have been obtained using the WeedSeeker technology. It was projected that Fort Carson would realize a 50 percent reduction on herbicide use and a 60 percent reduction in overall cost with the achieved labor reduction.

Unit Investment Cost: $22,000	**Total Unit Savings:**
Payback:	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant:	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Weed Seeker
Total Cost Estimate: $

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Herbicides		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Due to the lack of real world data gathered from this project, no accurate economic analysis can be generated. In certain cases where the technology is currently in use, it has been reported that a 50% reduction in labor costs and a 75% reduction in herbicide use has been demonstrated. Labor requirements and equipment usage are based on installation mission. These two elements have the largest effect on potential savings associated with weed control.

Lessons Learned

1. The actual equipment works well; however, with severe cuts in entomology funds, manpower, and equipment weed control on the installation was virtually eliminated. Due to these cuts, the WeedSeeker technology was sparsely used.

2. There has been no real-world data gathered on WeedSeeker technology use at Fort Carson.

Fort Carson Xylene/Alcohol Recycling

Title: Xylene/Alcohol Recycling
Installation: Fort Carson, Colorado
POC: Mr. Scott Clark – 719.526.1739

Mission: To enhance mission readiness through the reduction in costs associated with tissue processing by recycling xylene and alcohol, while reducing the amount of hazardous waste generated.

Cost: $13,940

Environment: Protects the environment by reducing the volume of hazardous waste generated by the installation. Reduces potential exposure to hazardous materials and chemicals.

Xylene/Alcohol Distillation Unit

Description: Because of their role in tissue processing ethyl alcohol and xylene are among the most common chemicals used in medical treatment facility laboratories. To prepare tissue samples for viewing, the tissue must be sliced, placed onto slides, and stained. This process involves submerging the tissue in a series of graded ethanol solutions, then xylene, then paraffin. Once a predetermined number of samples have been processed, the used ethanol and xylene, having become contaminated, must then be disposed of as a hazardous waste under the Resource Conservation and Recovery Act (RCRA). As an alternative to disposing of these used chemicals, distillation provides a mechanism to reclaim and reuse them. Distillation separates a liquid from its contaminants by heating the liquid until it vaporizes and the vapors a recollected and condensed while the contaminants are left behind.

Unit Investment Cost: $13,940	**Total Unit Savings:**
Payback: 1.3 years	**Years Economical Life:** 10
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant: Xylene/Alcohol	**Energy Unit Savings:** $0
Base Qty Stream: 384 gallons	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Carson Xylene/Alcohol Recycling
Total Cost Estimate: $13,940

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:	1	**Years Economic Life:**	
Major Pollutant:	Xylene/Alcohol		
Base Qty Stream:	384 gallons	**Source:**	Fort Carson
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$13,940	**Source:**	Fort Carson
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:		**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

- Xylene/Alcohol Distillation Unit: $13,940
- Annual Xylene Consumption: 144 gallons
- Xylene Procurement Cost: $28.92/gal
- Xylene Disposal Cost: $1.74/gal
- Annual Alcohol Consumption: 240 gallons
- Alcohol Procurement Cost: $24/gallon
- Alcohol Disposal Cost: $5.34/gallon

Annual Operating Cost of

	Disposal	Distillation
Solvent Costs:	$9,924	$784
Disposal Costs:	$1,532	$141
Total Costs: (not including capital and installation costs)	$11,457	$925
Total Income:	$0	$0
Annual Cost/Benefit:	($11,457)	($925)

Economic Analysis Summary:

- This example demonstrates a payback period of 1.3 years.
- 95% recovery was assumed for xylene and 90% recovery was assumed for alcohol.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. This project has been a large success by significantly reducing the disposal and purchase costs associated with tissue processing using xylene/alcohol. The hospital only purchases and disposes of a fraction of what was used and disposed of before this system. Paperwork associated with ordering supplies and storage space required has been reduced as well.

2. Using environmental funds to purchase equipment for MEDDAC was tricky. Extra care should be taken to ensure the purchasing is done correctly. Remember, MEDCASE funds are OMA funds and should preclude appropriation problems.

3. One big challenge was determining an appropriate location for the equipment. It was moved three times before its final placement.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for a Xylene/Alcohol Distillation System

Assumptions and Facts:

Xyxlen/Alcohol Distillation Unit:	$13,940	
Xylene Statistics:		
- Consumption:	144	gal/yr
- Procurement Cost:	$28.92	/gal
- Disposal Cost:	$1.74	/gal
Alcohol Statistics:		
- Consumption:	240	gal/yr
- Procurement Cost:	$24	/gal
- Disposal Cost:	$5.34	/yr

Annual Operating Cost Comparison for Recycling Xylene/Alcohol Using a Distillation System

	Disposal	Distillation
Operational Costs:		
Solvent Costs:	$9,924	$784
Disposal Costs:	$1,532	$141
Total Operational Costs:	$11,457	$925
Total Recovered Income:	$0	$0
Net Annual Cost/Benefit:	($11,457)	($925)

Economic Analysis Summary

Annual Savings for a Xylene/Alcohol Distillation System:	$10,532	
Capital Cost for Diversion Equipment/Process:	$13,940	
Payback Period for Investment in Equipment/Process:	1.3	years

Fort Hood Antifreeze Collection Truck

Title: Antifreeze Collection Truck
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness by increasing the overall volume of antifreeze collected and recycled on the installation; therefore, minimizing the potential for spills and leaks associated with antifreeze storage, collection and transportation and increasing available soldier training time.

Cost: $99,000

Environment: Minimizes production and storage of hazardous waste. Protects the environment by reducing the amount of hazardous waste produced. Saves generators hazardous waste disposal costs. Reduces coolant storage, transportation, and purchasing requirements. Reduces hazardous material cleanup costs or soil and groundwater contamination associated with spills and leaks from stored hazardous waste.

Vacuum Pump Truck

Description: Recycling of spent antifreeze solutions is a viable alternative to disposal. Waste antifreeze may be considered a hazardous waste in some states due to the toxicity of the ethylene glycol component, the toxicity of the products of degradation/oxidation of ethylene glycol, and/or the heavy metals content. Some states consider used antifreeze a hazardous waste and therefore recycling could be considered treatment of a hazardous waste. To eliminate costly contracts, Fort Hood's Commanding General issued a policy in 1997 that mandated 100% use of recycled antifreeze products for all tactical vehicles operating on post. As a result, Fort Hood now purchases commercially recycled antifreeze through the Standard Army Retail Supply System. Customers collect and deliver used antifreeze to the Classification Unit, where it is picked up by a local recycler, who in turn recycles the antifreeze and sells it back to Fort Hood.

Unit Investment Cost: $99,000	**Total Unit Savings:** $60,000
Payback: 1.13 (estimated)	**Years Economical Life:** 10
Regulatory Driver: RCRD-Solid Waste Management	**Waste Unit Savings:** $0
Major Pollutant: Antifreeze	**Energy Unit Savings:** $0
Base Qty Stream: 175 tons/yr	**Labor unit Savings:**
Annual Unit Poll Reduction: 175 tons/yr	**Annual Unit Recur Cost:** $31,000
Annual Unit Energy Savings: $0	**O&M Unit Savings:**

EPR

Exhibit 2 Data for
Fort Hood Antifreeze Collection Truck
Total Cost Estimate: $99,000

Law/Regulation:	RCRD	**Compliance Status:**	ESDF
ECAT:	RCYP	**Regulatory Driver:**	OTHER
Class:	2	**Project Assessment:**	H
Activity/Process:	Recycling	**Must Fund:**	Yes
Total Identical Units:	1	**Years Economic Life:**	10
Major Pollutant:	Antifreeze		
Base Qty Stream:	175 tons/yr	**Source:**	FORT HOOD MEAS.
Annual Unit Poll Reduction:	175 tons/yr	**Source:**	ESTIMATION
Unit Investment Cost:	$99,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$31,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$60,000	**Source:**	FORT HOOD MEAS.
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:	2002	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1999	131054.31	$99,000		
2001	131054.31	$99,000		

Narrative: Purchase of an antifreeze-recycling vehicle will increase and decrease the manpower required to process recyclable antifreeze. This money will be used to purchase a 3,000-gallon antifreeze recycling truck to serve as the primary use vehicle for the collection of antifreeze for recycling.

Cost Verification

Recycling economics will vary, depending on whether on-site or off-site recycling is chosen, the selected methodologies for storage, collection, and transportation, and proportional with the amount of spent antifreeze generated. The annual savings achieved by off-site recycling may not always be as great as those achieved through on-site recycling; however, the payback is immediate since off-site recycling requires no capital investment. In general, a one to three year payback can be expected for an average on-site installation.

In this particular situation, the estimated payback period for the purchase of the antifreeze-recycling vehicle is 1 year. This rapid payback is expected due the specific agreement Fort Hood has established with the off-site recycler.

The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Lessons Learned

1. Due to high capital costs associated with purchasing an on-site antifreeze recycling system, attempts should be made to find a local commercial available technology. Allowing an antifreeze recycler to process the installation's antifreeze saves the installation a substantial amount of money and relieves the installation from the burdens and responsibilities associated with equipment operations, maintenance, and upgrades. Also, liability is placed on the recycler to produce recycled antifreeze within military specifications.

2. One example of a method to cut down on program cost is to save containers for dispensing recycled antifreeze. Reuse clean old/new containers to store and deliver recycled antifreeze to activities.

Fort Hood Bio-Remediation Wash Water Treatment and Recycling System

Title: Bio-Remediation Wash Water Treatment & Recycling System
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness by reducing the installation's environmental liability associated with golf course equipment and vehicular wash water.

Cost: $45,000

Environment: Obtain compliance with EO 13123, EO 12902 and 40 CFR 122 (CWA). This project also supports Fort Hood's sustainability program initiatives.

WATERSTAX® Bioremediation System

Description: While being operated, vehicle/golf cars can become contaminated with pesticides and other harmful chemicals. The wash water from vehicle washing operations is currently not contained, allowing for potential runoff into the ground and/or nearby waters of the U.S. The vehicle washing operations at the Fort Hood DPW and golf course facilities are out of compliance with the CWA and inconsistent with EO 13123, section 207 and EO 12902 section 301(b). Installation of a closed-loop wash water recycling systems will eliminate potential discharges into waters of the U.S. and conserve water and support the installations sustainability program.

Unit Investment Cost: $30,000	**Total Unit Savings:** $27,500
Payback: Unknown	**Years Economical Life:** 10
Regulatory Driver: CWA – Water	**Waste Unit Savings:** $0
Major Pollutant: Contaminated Wash Water	**Energy Unit Savings:** $0
Base Qty Stream: 240 tons/year	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 240 tons/year	**Annual Unit Recur Cost:** $1,000
Annual Unit Energy Savings: $0	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for

Fort Hood Bio-Remediation Wash Water Treatment & Recycling System

Total Cost Estimate: $45,000

Law/Regulation:	CWA		**Compliance Status:**	INOV
ECAT:	POLP		**Regulatory Driver:**	CWA – WATER
Class:	1		**Project Assessment:**	H
Activity/Process:	Equipment Washing		**Must Fund:**	Yes
Total Identical Units:	1		**Years Economic Life:**	10
Major Pollutant:	Contaminated Wash Water			
Base Qty Stream:	240 tons/year		**Source:**	ESTIMATION
Annual Unit Poll Reduction:	240 tons/year		**Source:**	ESTIMATION
Unit Investment Cost:	$30,000		**Source:**	ESTIMATION
Annual Unit Recur Cost:	$1,000		**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0		**Source:**	
Total Unit Savings:	$27,500		**Source:**	
Waste Unit Savings:	$0		**Source:**	
Energy Unit Savings:	$0		**Source:**	
Labor Unit Savings:	$0		**Source:**	
O&M Unit Savings	$0		**Source:**	
Mel Procure Unit Savings:	$0		**Source:**	
Other Unit Savings:	$27,500		**Source:**	ESTIMATION
Latest FY Start:	2000		**Earliest FY Start:**	2000
FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2001	131054.50	$30,000	$30,000	$45,000

Narrative: Current vehicle washing operations at the Fort Hood DPW and golf course facilities are out of compliance with the CWA and inconsistent with EO 13123, section 207 and EO 12902 section 301(b). While being operated, vehicle/golf cars can become contaminated with pesticides and other harmful chemicals. Wash water from vehicle washing operations is currently not contained, allowing for potential runoff into the ground and/or nearby waters of the U.S. Closed-loop wash water recycling systems will eliminate potential discharges into waters of the U.S. and conserve water.

Cost Verification

There is no cost verification data available on this application due to the lack of baseline information and this is an extremely new technology chosen to demonstrate leadership in Pollution Prevention.

Lessons Learned

1. This system resulted in a costly operation due to microbiology requirements of the process. Biological media must be frequently purchased in order to ensure properly functioning equipment.

2. Training of employees and obtaining 100% program commitment was challenging. An aggressive training program with commitment to follow up visits should be initiated to aid with acclimation.

3. Coordination with all involved parties is necessary to ensure a smooth transition into new operating procedures. The user facility and its staff should fully understand monetary, mechanical and operational requirements before accepting responsibility of the system (i.e., MWR was under the impression the environmental shop was going to be responsible for purchasing the biological media).

Fort Hood Centralized Container Washing Facility

Title: Centralized Container Washing Facility
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: Increase mission readiness through the reduction of potential for hazardous material/waste spillage, unauthorized discharges of hazardous material/waste and recycling of metal containers while realizing cost avoidances associated with these activities.

Cost: $56,100

Environment: Compliance with EO 13101 and 40 CFR 262. Eliminating container disposal as a hazardous waste, reducing hazardous waste transportation costs, increased metal recycling, decreased worker exposure to hazardous substances as in manual triple rinsing.

Combination Washer, Shredder, Bailer

Description: In general, drum washers/recyclers wash contaminated metal containers inside an enclosed chamber. Container sizes typically range from 1-quart bottles to 55-gallon drums. According to the U.S. EPA, empty drums that contained hazardous materials are exempt from hazardous waste regulation in 40 CFR Section 261.7. For hazardous wastes that are not "acute" as listed in 40 CFR 261.31, 261.32, or 261.33, "empty" is defined as containing less than three percent of the original contents (by weight) or less than one inch of residue on the bottom. Drums that contained acute hazardous waste are empty after they have been triple rinsed with a solvent (which may be water) capable of removing the product. Rinse water is the only waste stream from this process and it should be tested for hazardous substances to determine the method of treatment required. Damaged or excess metal drums can be conditioned or washed and recycled as ferrous scrap metal. The system designed for Fort Hood is a custom shredder, washer and bailer unit.

Unit Investment Cost: $56,100 + $98,000	**Total Unit Savings:** $60,000/year
Payback:	**Years Economical Life:** 10
Regulatory Driver: RCRD-Solid Waste Management	**Waste Unit Savings:** $0
Major Pollutant: Metal Containers	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:** $0
Annual Unit Energy Savings: $0	**O&M Unit Savings:**

EPR

Exhibit 2 Data for
Fort Hood Centralized Container Washing Facility
Total Cost Estimate: $154,000

Law/Regulation:	RCRD	**Compliance Status:**	INOV
ECAT:		**Regulatory Driver:**	
Class:	1	**Project Assessment:**	H
Activity/Process:	Recycling	**Must Fund:**	Yes
Total Identical Units:	0	**Years Economic Life:**	10
Major Pollutant:	Steel/Plastic		
Base Qty Stream:	123 tons/yr	**Source:**	FORT HOOD MEAS..
Annual Unit Poll Reduction:	123 tons/yr	**Source:**	FORT HOOD MEAS.
Unit Investment Cost:	$56,100	**Source:**	FORT HOOD MEAS.
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:	$0	**Source:**	ESTIMATE
Total Unit Savings:	$60,000	**Source:**	FORT HOOD MEAS.
Waste Unit Savings:		**Source:**	
Energy Unit Savings:	0	**Source:**	
Labor Unit Savings:	0	**Source:**	
O&M Unit Savings	0	**Source:**	
Mel Procure Unit Savings:	0	**Source:**	
Other Unit Savings:	$27,500	**Source:**	FORT HOOD MEAS.
Latest FY Start:	1997	**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative: The self-contained system will be designed, installed and operated to cleanse waste from metal containers and to shred the containers into recyclable metal strips. The container washing facility will accept unwashed, empty metal containers in sizes ranging from 1-quart to 55-gallons. The equipment will contain a collection hopper that will feed empty containers into a metal shredder. The strips will then be rinsed in a solution that removes industrial hazardous waste. The strips will be heat-dried and deposited in metal bins.

Cost Verification

Assumptions and Facts:

•

Annual Operating Cost of Diversion and Disposal For Metal/Plastic Containers

	Disposal	Diversion

Economic Analysis Summary:

- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Lessons Learned

1. Having multiple vendors/contractors performing various parts of the contract requirements further promotes the possibility of obtaining a sub-par product. Find a vender/contractor that can do a turnkey job (i.e., sight preparation, concrete work, equipment assembly, troubleshooting, modifications, etc.).

2. Cost and benefit analysis should include soldier-training time. This technology has drastically reduced the amount of responsibility, liability and, most importantly, time soldiers are faced with when dealing with empty containers. This reduction calculates into big savings for the installation in terms of training dollars (soldier pay).

Fort Hood Clarus® Parts Washers

Title: Clarus® Parts Washers/Environmental Equipment
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: Enhance mission readiness by actively pursuing the use of alternative solvents and parts washers with filtration systems to extend solvent life and reduce soldier contact time, contract costs, and the waste stream.

Cost: $800,000

Environment: Compliance with Federal and State mandated waste minimization goals. Increased user safety and decreased user liability.

PCS-25 Parts Washer

Description: Many vehicle parts require cleaning or degreasing for maintenance and performance enhancement. Parts washing can be performed in a variety of ways including using aerosol solvents and rags, solvent baths or sinks, or by using heated, aqueous parts washers. A typical solvent parts washer is a sink mounted on top of a solvent reservoir drum with a pump that re-circulates the solvent through a hand-held brush. Spent solvent from these units is generally tested annually in accordance with AFI 32-7043 for characterization for disposal. Filtration is applied to the re-circulated solvent to significantly extend its useful life, thus reducing overall hazardous waste generation. Although the spent filters are typically disposed as hazardous waste, Fort Hood uses process knowledge to eliminate this compliance requirement. Only minor amounts of solvent need to be added regularly to make up for evaporation and drag-out. A solvent distillation unit has been purchased to further increase the life of the recycled solvent.

Unit Investment Cost: $400,000/year	**Total Unit Savings:** $200,000/year
Payback: 4 years	**Years Economical Life:** 10
Regulatory Driver: RCRC	**Waste Unit Savings:** $0
Major Pollutant: Solvent	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $0	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for
Fort Hood Clarus® Parts Washers
Total Cost Estimate: $800,000

Law/Regulation:	PRVN	**Compliance Status:**	OTHR
ECAT:	POLP	**Regulatory Driver:**	RCRC
Class:	0	**Project Assessment:**	H
Activity/Process:	Vehicle/Equip. Maintenance	**Must Fund:**	Y
Total Identical Units:	200	**Years Economic Life:**	10
Major Pollutant:	Solvent		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$400,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$50,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$200,000	**Source:**	ESTIMATION
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1996	117054.F5	$100,000	$0	$95,000
1997	117054.20	$75,000	$0	$0
1998	131054.60	$200,000	$200,000	$110,638
1999	131054.60	$100,000	$100,000	$75,378
2000	131054.60	$100,000	$750,000	$695,000
2001	131054.60	$200,000	$200,000	Diverted
2002	131054.60	$200,000	$200,000	
2003	131054.60	$200,000	$200,000	
2004	131054.60	$200,000	$200,000	
2005	131054.60	$200,000	$200,000	
2006	131054.60	$200,000	$200,000	
2007	131054.60	$200,000	$200,000	

Narrative: Implement the following project from the FORSCOM P2 Catalog (see Catalog for detailed data). #4 Parts Washers, 100 in FY02, 100 in FY03, $400K/yr, SK cost $200K/yr, 4-year payback.

Cost Verification

Assumptions and Facts:

•

Lessons Learned

1. The life cycle of the solvent is extremely long; however, as the age of the solvent, and the number of times it has been recycled, increases the color changes from incandescent to opaque. This affected the aesthetics of the product resulting in users to prematurely request product replacement. It is common practice for users to be trained to relate dark solvent to dirty/unusable solvent. Analytical tests were performed on the opaque solvent and results showed the solvent was within its respectable tolerances. Results also proved solvent color had no bearing on its effectiveness. Distillation appears to be the only solution to remove the "dirty" appearance of the solvent. Fort Hood has purchased a distillation unit.

2. Wheel bearing and axel shaft grease greatly decreases the life of the solvent filters. Clarus® Pre-Clean® Shelves were purchased for parts washers in areas where this type of maintenance occurs. This shelf attaches directly to Clarus® system and provides the user a convenient location to "pre-clean" parts before placing them into the washer. This should increase filter and solvent life across the installation.

3. Capital costs associated with purchasing parts washers, in lieu of contracting the service, are extremely high; however, the payback is the equipment will become Government Owned and Government Operated (GOGO). This approach equates to negligible operating costs once the equipment is purchased.

4. Parts washers exposed to direct sunlight tend to use more solvent due to evaporation. Users should make every effort to establish their machines in a climate-controlled environment.

5. Before delivering parts washers, be sure to examine the footprint of the machine and compare the machine's specifications to the electrical and spatial restrictions at the location the machine is going to be used.

Fort Hood Contaminated Soil Remediation/Reuse

Title: Contaminated Soil Remediation/Reuse (biopiles)
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness through cost avoidance obtained by on-site bioremediation of POL contaminated soils.

Cost: Estimated $350,000.

Environment: Protects the environment by reducing the amount of hazardous waste generated by the installation. Converts unusable soil into landfill cover material.

POL-Contaminated Soil Undergoing Biological Treatment

Description: Typically POL contaminated soils are excavated and disposed of as hazardous wastes. Biopiles are used to reduce the concentration of petroleum constituents in excavated soils through the use of biodegradation allowing soils to be reused for applications such as landfill cover. This technology can be performed on-site and involves heaping contaminated soils into piles and stimulating aerobic microbial activity within the soils through the addition of oxygen, minerals, nutrients, and moisture. The enhanced microbial activity results in the breakdown of the petroleum constituents in the soil. In order to prevent the leaching of contaminants into underlying soil or groundwater, biopiles should be constructed on impermeable surfaces. The effectiveness of a biopile system depends on the soil characteristics, petroleum constituent characteristics and climate conditions.

Unit Investment Cost: $200,000	**Total Unit Savings:** $300,000
Payback: 0.6 years	**Years Economical Life:** Undetermined
Regulatory Driver: RCRC	**Waste Unit Savings:** $0
Major Pollutant: Contaminated Soils	**Energy Unit Savings:** $0
Base Qty Stream: 450 tons/year	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 450 tons/year	**Annual Unit Recur Cost:** $100,000
Annual Unit Energy Savings: $	**O&M Unit Savings:** $

EPR

Exhibit 2 Data for
Fort Hood Contaminated Soil Remediation/Reuse
Total Cost Estimate: $350,000

Law/Regulation:	RCRC	**Compliance Status:**	OTHR
ECAT:	POLP	**Regulatory Driver:**	OTHER
Class:	0	**Project Assessment:**	H
Activity/Process:	Equipment Maintenance	**Must Fund:**	Yes
Total Identical Units:	0	**Years Economic Life:**	Undetermined
Major Pollutant:	POL		
Base Qty Stream:	450 tons/yr	**Source:**	FORT HOOD MEAS.
Annual Unit Poll Reduction:	450 tons/yr	**Source:**	FORT HOOD MEAS.
Unit Investment Cost:	$200,000	**Source:**	FORT HOOD MEAS.
Annual Unit Recur Cost:	$100,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$0	**Source:**	
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1999	131054.16	$100,000		$18,000
2000	131054.16	$100,000	$100,000	
2001	131054.16	$100,000	$100,000	
2002	131054.16	$100,000	$100,000	
2003	131054.16	$100,000	$100,000	
2004	131054.16	$100,000	$100,000	
2005	131054.16	$100,000	$100,000	
2006	131054.16	$100,000	$100,000	
2007	131054.16	$100,000	$100,000	

Narrative: Remove sludge from wash rack grit chambers, dry on drying pads. Sample every 50 cubic yards. Transport and spread as cover on landfill. Use as cover saves thousands of cubic yards of landfill space. By reuse of bio soil, Fort Hood has a cost avoidance in excess of the $100,000.

Cost Verification

Assumptions and Facts:

- 2,667 yd^3 of POL contaminated soil treated per year
- 1 yd^3 of soil weighs approximately 338 lbs
- Transportation costs: \$200/10 yd^3
- Disposal costs: \$125/yd^3
- Treatment costs: \$25/yd^3
- Cost for TPH tests: \$25/50 yd^3
- Recurring maintenance costs: \$1,000/yr
- Estimated income from processed soil: \$0

Annual Operating Cost of On-Site vs. Off-Site Treatment for Contaminated Soil

	Off-Site Treatment	On-Site Remediation
Hauling Fee	\$53,340	\$53,340
Disposal Fee	\$333,375	\$0
TPH Tests	\$1,250	\$1,250
Recurring Supply Cost	\$0	\$1,000
Total Costs: (not including capital and installation costs)	\$387,965	\$55,590
Total Income:	\$0	\$0
Annual Cost/Benefit:	(\$387,965)	(\$55,590)

Economic Analysis Summary:

- Payback period for on-site remediation is approximately 0.6 years when capital/installation costs are included in the analysis.
- Transportation costs assumed to be equal between two options.
- Analysis does not include contract labor for facility management.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. Be sure to research the process and obtain the proper permits and operation manuals before initiating the bioremediation process.

2. Develop a program to ensure proper segregation of clean soils from contaminated soils. Treating uncontaminated soil is unnecessary and increases the load on the facility.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for Bioremediation of Contaminated Soil

Assumptions:			
Pounds of contaminated soil generated per year:	900,113		2,667 yd3
1 ft3 of soil:	125	pounds or 1yd3 of soil is:	337.5 pounds
Costs for off-site treatment :			
Cost for hauling:	$200	/10 yd3	
Cost for disposal:	$125	/yd3	
Cost for TPH tests:	$25	/50 yd3	
Number of TPH tests per treatment cycle:	50	tests	
For Bioremediation system:			
Cost of each 50 yd3 load for one TPH tests:	$25	/yd3	
Number of TPH tests per treatment cycle:	50	tests	
Estimated recurring cost for operations:	$1,000	/yr	
Estimated income from on-site bioremediation	$0	/yr	

Annual Operating Cost Comparison for Off-site Treatment and On-site Remediation of Contaminated Soil

	Off-Site Treatment	On-Site Remediation
Capital and Installation Cost:	$0	$200,000
Operational Costs:		
Hauling Fee	$53,340	$53,340
Disposal Fee	$333,375	$0
TPH Tests	$1,250	$1,250
Recurring Supply Cost	$0	$1,000
Total Costs: (not including capital and installation costs)	$387,965	$55,590
Total Income:	$0	$0
Annual Benefit	($387,965)	($55,590)

Economic Analysis Summary

Annual Savings for On-Site Bioremediation:	$332,375	
Capital Cost for Equipment/Process:	$200,000	
Payback Period for Investment in Equipment/Process:	0.6	years

Fort Hood Fixed Fuel Filtration Unit

Title: Fixed Fuel Filtration Unit
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness through the recycling of off-specification JP-8 while providing greater returns on the sales of off-specification JP-8.

Cost: $355,600

Environment: Decreased risk of environmental spills associated with the storage, collection, transportation, and recycling of off-specification JP-8.

Fixed Fuel Filtration Unit

Description: The installation generates approximately 72,000 gallons of off-specification JP-8 annually. Currently, the Department of Public Works (DPW) collects the fuel and coordinates with the Defense Reutilization and Marketing Office (DRMO) for proper disposition. DRMO must offer the fuel, at no cost, to Federal, State, and Local agencies prior to being sold to private entities; consequently, funds generated from the sale of off-specification JP-8 are rare. Occasionally, DRMO will hire a contractor, who purchases the fuel for $0.20/gallon for recycling. By conducting on-site filtration, Fort Hood would be able to reuse the fuel and redirect funds that would otherwise be used to replace the off-specification fuel. The average market value of JP-8 is $0.85/gallon.

Unit Investment Cost: $200,000	**Total Unit Savings:** $65,000
Payback: 4.3 years	**Years Economical Life:** 10
Regulatory Driver: RCRD	**Waste Unit Savings:** $0
Major Pollutant: Off-Specification JP-8	**Energy Unit Savings:** $0
Base Qty Stream: 252 tons/yr	**Labor unit Savings:** $0
Annual Unit Poll Reduction: 252 tons/yr	**Annual Unit Recur Cost:** $10,000
Annual Unit energy savings: $0	**O&M unit savings:** $0

EPR

Exhibit 2 Data for
Fort Hood Fixed Fuel Filtration Unit
Total Cost Estimate: $355,600

Law/Regulation:	RCRC	**Compliance Status:**	ESDP
ECAT:	POLP	**Regulatory Driver:**	OTHER
Class:	1	**Project Assessment:**	H
Activity/Process:	Other	**Must Fund:**	Yes
Total Identical Units:	0	**Years Economic Life:**	10
Major Pollutant:	Off Spec JP8		
Base Qty Stream:	252 tons/yr	**Source:**	FORT HOOD MEAS.
Annual Unit Poll Reduction:	252 tons/yr	**Source:**	ESTIMATION
Unit Investment Cost:	$200,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$10,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$65,000	**Source:**	ESTIMATION
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
MeI Procure Unit Savings:	$65,000	**Source:**	ESTIMATION
Other Unit Savings:	$0	**Source:**	
Latest FY Start:	2000	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1999	131056.16	$100,000	$100,000	$189,000
2000	131056.16	$100,000	$100,000	
2001	131056.16	$50,000	$50,000	$38,600
2002	131056.16	$32,000	$32,000	
2003	131056.16	$32,000	$32,000	
2004	131056.16	$32,000	$32,000	
2005	131056.16	$32,000	$32,000	

Narrative: RCRC – Unit was purchased with P2 funds. Continued operation is HW Management cost.

Cost Verification

Assumptions and Facts:

- Fuel filtration additive unit: $75,000
- Flat bed truck for filtration unit: $25,000
- Site preparation: $89,000
- Volume of contaminated JP-8 generated: 72,000 gallons/year
- DRMO recycled JP-8 contract price: $0.20/gallon
- Average market value of JP-8: $0.91/gallon
- Maintenance costs (vehicle and FAU): $7,000/year
- Labor: $25,000

Comparison of Annual Benefits Between DRMO and Fuel Filtration of Off-specification JP-8

	DRMO	Fuel Filtration
Labor:	$24,960	$24,960
Maintenance:	$0	$7,000
Total Operational Costs (minus capital expenditures):	$24,960	$31,960
Total Recovered Income:	$14,400	$65,520
Net Annual Cost/Benefit:	($10,560)	$33,560

Economic Analysis Summary:

- Payback period is 4.3 years
- Labor costs are considered equal between both options
- Market value of JP-8 experiences a moderate fluctuation rate
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application

Lessons Learned

1. Collection is achieved from 500-gallons fuel pods in the motor pools. The installation was experiencing an alarmingly high volume of recycled JP-8 failing flashpoint requirements. Researched revealed MOGAS was entering the JP-8 fuel pods and also that 1-gallon of MOGAS contaminates 10,000-gallons of JP-8. Proper segregation of POL at the user level (source) is crucial for the program to be successful.

2. The purchased filtering system will act as a polisher and remove water and particulate matter; however, large volumes of particulates and water are still suspended and able to reach the filters and decrease filter life. A centrifuge will be added to the beginning of the process to aid with removing water and particulate matter.

3. Having multiple vendors/contractors performing various parts of the contract requirements further promotes the possibility of obtaining a sub-par product. Find a vender/contractor that can do a turnkey job (i.e. sight preparation, concrete work, equipment assembly, etc.).

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Fuel filtration additive unit:	$75,000		
o Flat bed truck for filtration unit:	$25,000		
o Site preparation:	$89,000		
Volume of contaminated JP-8 generated:	72,000	gal/yr	
DRMO recycled JP-8 contract price:	$0.20	/gal	
Average market value of JP-8:	$0.91	/gal	
Maintenance costs (vehicle and FAU):	$7,000	/yr	
Labor:	40	hrs/week or	2080 hrs./yr.
- Labor Rate:	$12	/hour	

Annual Operating Cost Comparison for DRMO Recycling and Fuel Filtration Unit Recycling

	DRMO	Fuel Filtration
Operational Costs:		
Labor:	$24,960	$24,960
Maintenance:	$0	$7,000
Total Operational Costs (minus capital expenditures):	$24,960	$31,960
Total Recovered Income:	$14,400	$65,520
Net Annual Cost/Benefit:	($10,560)	$33,560

Economic Analysis Summary

Annual Benefit Using JP-8 Filtration:	$44,120	
Capital Cost for Diversion Equipment/Process:	$189,000	
Payback Period for Investment in Equipment/Process:	4.3	years

Fort Hood Fuel Tanker Purging Facility

Title: Fixed Fuel Tanker Purging Facility
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness by decreasing soldier training time required during fuel tanker/pod purging operations and decreasing environmental compliance liabilities related to the Clean Water Act (CWA).

Cost: $858,211

Environment: Protects the environment by reducing water usage and contaminated point source discharges.

Tanker Purging Facility

Description: Before implementation of this new technology, over-the-road (OTR) tankers were being cleaned and purged manually using troop labor, water, and purging chemicals. This process is extremely inefficient from a labor and water usage standpoint. The new technology is an automatic, fully enclosed, electrically powered modular system with a closed-loop vacuum system capable of product recovery and wash solution recovery and reuse and is also a portable drying system. It can clean/purge eight 5,000 tankers/day and only requires two people to operate the equipment. This is accomplished by wash solution is pumped from the main tank, sending it through a heat exchanger to the tanker. Jetting action from the wash heads situated in the tanker directs the wash solution to the inner surface where residual material is blasted loose and the surface is cleaned. The wash solutions, volatiles, and residues are then returned by vacuum to the main tank.

Unit Investment Cost: $858,211	**Total Unit Savings:** $
Payback: 2.98 years (estimated)	**Years Economical Life:** 10
Regulatory Driver: Other	**Waste Unit Savings:** $0
Major Pollutant: Mil-spec fuel	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:** $
Annual Unit Energy Savings: $0	**O&M Unit savings:** $0

EPR

Exhibit 2 Data for
Fort Hood Fuel Tanker Purging Facility
Total Cost Estimate: $858,211

Law/Regulation:	CWA	**Compliance Status:**	ESDF
ECAT:	POLP	**Regulatory Driver:**	OTHER
Class:	2	**Project Assessment:**	H
Activity/Process:	Tanker Purging	**Must Fund:**	Yes
Total Identical Units:	0	**Years Economic Life:**	10
Major Pollutant:	Fuel		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$858,211	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$0	**Source:**	
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$0	**Source:**	
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
1995	117056.F0	$60,000		$60,000
1996	117054.F5	$295,000	$295,000	$1,000
1997	117054.50	$295,000	$0	$0
2000	131054.50	$350,000	$350,000	$797,211

Narrative: Tactical fuel tankers required to support armored division operations are 5,000-gallon tankers that frequently require purging to remove water and other contaminants. There are over 200 vehicles used to haul fuel that require purging in order to perform any maintenance. This project would provide a specialized facility designed for that purpose to minimize the risks of fuel spills.

Cost Verification

There is no cost verification data available on this application due to the lack of baseline environmental information and this is an extremely new technology chosen to demonstrate leadership in Pollution Prevention.

Closed loop tanker purging facilities can be specifically designed and sized to meet the specific needs of the requesting facility. System design varies based on the type of tankers being purged, average number of tankers being purged daily, and local environmental regulations at the specified facility. Consequently, the purchase, installation, and operational costs of a closed loop tanker purging system vary significantly from one application to another.

Lessons Learned

1. Projects of this nature have the tendency to easily become over engineered. Keep the research and development process, and especially the equipment, as simple as possible.

2. An operator for the facility was not included in reoccurring costs. Be sure to coordinate with installation personnel to determine which shop will be operating the equipment after the installation and training phase is complete.

3. Fuel and filters must be removed from fuel tankers before arriving at the facility. It is absolutely crucial for users of the facility to have established SOPs specifically for their operation(s).

4. The opening sizing on tankers is not the same for 5 ton mounted 600-gallon pods as it is for 2,500/5,000-gallon OTR tankers, so these pods cannot be purged at the facility. Due to the lack of universal design across equipment, you must choose specific applications as they relate to mission requirements.

5. Have contracting go out with RFP on how to ‘do’ requirements.

6. As with all environmental projects, staff coordination is absolutely necessary across all arenas of environmental concerns to ensure compliance with all applicable rules and regulations. A few examples of such unknowns Fort Hood faced were: water back-flow preventers, waste water flow meters, air program requirements and utilities metering.

Fort Hood Glass Pulverizing System

Title: Glass Pulverizing
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness through landfill and material procurement cost avoidance.

Cost: $62,020

Environment: Compliance with EO 13101 and DODI 4715.4. Due to increased safety hazards, proper personal protective equipment including gloves, eye protection, respiratory protection, and hearing protection should be used.

Andela Glass Pulverizer

Description: Glass pulverizing converts any waste glass into usable aggregate products. The consistency of these products may range from coarse sand to fine gravel. Pulverized glass can be used as an aggregate substitute for gravel and sand, as well as for glassphalt, turf and soil amendment, decorative landscaping, water filtration media, and even sandblasting. Pulverized glass can also be used on-site for several applications, including road base, fill, and as a substitute for sand in other applications (e.g. golf course sand traps). Pulverized glass also is a convenient form for storing and transporting glass for recycling. Typical glass pulverizer systems consist of a glass pulverizer, trommel screen/separator, and metering surge hopper. The capacity of the glass pulverizer ranges from less than one to 20 tons per hour. The system pulverizes glass and separates caps, metal, or plastic from the glass material. Glass pulverizing produces no new waste streams.

Unit Investment Cost: $50,000	**Total Unit Savings:** $12,000
Payback: 6.63	**Years Economical Life:** 10
Regulatory Driver: RCRD	**Waste Unit Savings:** $0
Major Pollutant: Glass Items	**Energy Unit Savings:** $0
Base Qty Stream: 115 tons/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 115 tons/yr	**Annual Unit Recur Cost:** $4,500
Annual Unit Energy Savings: $	**O&M Unit savings:** $

EPR

Exhibit 2 Data for
Fort Hood Glass Pulverizing System
Total Cost Estimate: $55,000

Law/Regulation:	RCRD	**Compliance Status:**	ESDF
ECAT:	RCYP	**Regulatory Driver:**	OTHER
Class:	2	**Project Assessment:**	H
Activity/Process:	Recycling	**Must Fund:**	Yes
Total Identical Units:	0	**Years Economic Life:**	10
Major Pollutant:	Glass Items		
Base Qty Stream:	115 tons/yr	**Source:**	ESTIMATION
Annual Unit Poll Reduction:	115 tons/yr	**Source:**	ESTIMATION
Unit Investment Cost:	$50,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$4,500	**Source:**	ESTIMATION
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$12,000	**Source:**	ESTIMATION
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
MeI Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$12,000	**Source:**	ESTIMATION
Latest FY Start:	2000	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2000	131054.31	$50,000	$50,000	$62,020
2001	131054.31	$5,000		

Narrative: Currently, Fort Hood DPW-Recycle only collects sorted glass because collecting sorting and processing glass at current market prices, which are in a downward trend, is not cost effective. With the proposed system there would be no need to sort colors, remove labels or plastic and metal caps. This system would make our glass recycling operation more efficient and potentially profitable, while diverting glass from the landfill. In the absence of market demand, Fort Hood proposes to pulverize its glass into "sand" for use as sand and gravel substitute in glassphalt, as drainage or fill material, specifically in golf course sand traps, or as decorative landscaping.

Cost Verification

Assumptions and Facts:

- Glass pulverizer: $62,020
- Solid waste disposal fee: $30/ton
- Savings on sand/gravel purchases: $10,000/yr
- Processes 300 tons/yr
- Energy usage: $500/yr
- Maintenance: $1000/yr
- Labor 4 hr/wk at $40/hr

Annual Operating Cost of Diversion and Disposal For Glass Pulverizing System

	Disposal	Diversion
Electrical Costs:	$0	$500
Labor:	$0	$8,320
Landfill Disposal Costs:	$9,000	$0
Maintenance:	$0	$1,000
Total Operational Costs:	$9,000	$9,820
Total Recovered Income:	$0	$10,000
Net Annual Cost/Benefit:	-$9,000	$180

Economic Analysis Summary:

- Payback period is 6.8 years.
- Transportation costs assumed to be equal between two options.
- Labor for disposal assumed to be covered under refuse contract.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application.

Lessons Learned

1. The provided material feeding system requires operators to dump glass by hand onto the conveyor. This exposes the equipment operator to unnecessary potential of an OSHA related injury. System should allow 'hopper' dumping to decrease exposure to sharp material.

2. The footprint of the entire equipment setup should be compared against selected location for operations. Expansion and modification should also be considered before equipment installation.

3. Market research should be conducted in order to identify possible uses for the pulverized material(s).

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for Glass Pulverizing System

Assumptions and Facts:

Glass pulverizer:	$62,020		
Solid waste disposal costs:	$30	/ton	
Savings on sand/gravel purchase:	$10,000	/yr	
Process:	300	tons/yr	
Energy (be sure to use your energy rates):	$500	/yr	
Maintenance:	$1,000	/yr	
Labor:	4	hrs/week or	208 hrs./yr.
- Labor Rate:	$40	/hour	

Annual Operating Cost Comparison for Diversion and Disposal of Glass Using a Pulverizer

	Disposal	Diversion
Operational Costs:		
Electrical Costs:	$0	$500
Labor:	$0	$8,320
Landfill costs:	$9,000	$0
Maintenance:	$0	$1,000
Total Operational Costs:	$9,000	$9,820
Total Recovered Income:	$0	$10,000
Net Annual Cost/Benefit:	($9,000)	$180

Economic Analysis Summary

Annual Savings for Glass Pulverizer:	$9,180	
Capital Cost for Diversion Equipment/Process:	$62,020	
Payback Period for Investment in Equipment/Process:	6.8	years

Fort Hood JP-8 Collections Truck

Title: JP-8 Collections Truck
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To enhance mission readiness by increasing the overall volume of off-specification JP8 collected and recycled on the installation; therefore, minimizing the potential for spills and leaks associated with fuel storage, collection and transportation and increasing available soldier training time.

Cost: $99,000

Environment: Protects the environment by reducing the amount of hazardous waste generated by the installation. Reduces fuel storage, transportation, and purchasing requirements. Reduces hazardous material cleanup costs or soil and groundwater contamination associated with spills and leaks from stored hazardous waste.

POL Collection Vehicle

Description: Recycling of off-specification JP-8 is a viable alternative to disposal. Currently, the installation generates approximately 100,000 gallons of off-specification JP-8 annually. The JP-8 collections truck would improve the JP-8 recycling efforts on the installation by allowing for more frequent collections from high volume generators and increasing program visibility. Furthermore, the collections truck would allow for more JP-8 accumulation point inspections; therefore, decreasing the volume of contaminated JP-8 and potential violations relating to fuel storage.

Unit Investment Cost: $99,000	**Total Unit Savings:** $350,000
Payback: < 1 Year	**Years Economical Life:** 10
Regulatory Driver: RCRD-Solid Waste Management	**Waste Unit Savings:** $350,000
Major Pollutant: JP-8	**Energy Unit Savings:** $0
Base Qty Stream: 175 tons/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 175 tons/yr	**Annual Unit Recur Cost:** $31,000
Annual Unit Energy Savings: $0	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for
Fort Hood JP-8 Collections Truck
Total Cost Estimate: $99,000

Law/Regulation:	RCRD	**Compliance Status:**	ESDL
ECAT:	RCYP	**Regulatory Driver:**	RCRD
Class:	3	**Project Assessment:**	H
Activity/Process:	Vehicle Maintenance	**Must Fund:**	No
Total Identical Units:	1	**Years Economic Life:**	10
Major Pollutant:	JP-8		
Base Qty Stream:	175 tons/yr	**Source:**	FORT HOOD MEAS.
Annual Unit Poll Reduction:	175 tons/yr	**Source:**	ESTIMATION
Unit Investment Cost:	$99,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$31,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:	$350,000	**Source:**	ESTIMATION
Waste Unit Savings:	$350,000	**Source:**	ESTIMATION
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$20,000	**Source:**	FORT HOOD MEAS.
Latest FY Start:	2000	**Earliest FY Start:**	1999

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2001	131054.31	$99,000	$99,000	

Narrative: Purchase of used JP-8 collection vehicle will increase proceeds from sales of JP-8 and decrease manpower required to process recyclable JP-8. This money will be used to purchase a 4,000-gallon JP-8 collection truck to serve as the primary use vehicle for collection of JP8 for recycling. Increase revenue from recycling and sale of JP-8 $20,000 per year.

Cost Verification

Assumptions and Facts:

- Vacuum Truck Capital Cost (one time expenditure): $99,000
- Maintenance: $6,000/year
- Operator: $25,000/year
- Volume of contaminated JP-8 generated: 100,000 gallons
- JP-8 disposal cost (DRMO): $0.25/lb

Comparison of Annual Benefits Between Collection and Disposal of Off-specification JP-8

	Collection	Disposal
Labor (collection):	$25,000	$0
Maintenance:	$6,000	$0
JP-8 Disposal:	$0	$187,000
Total Operational Costs (minus capital expenditures):	$31,000	$187,000
Total Recovered Income:	$81,000	$0
Net Annual Cost/Benefit:	$50,900	($187,000)

Economic Analysis Summary:

- This example yields a payback period of less than one year.
- Market value of JP-8 has a moderate fluctuation rate and will affect cost avoidance.
- The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Click Here to customize this economic analysis for your installation and/or application

Lessons Learned

1. Use a GSA contracting vehicle to obtain the equipment.

2. Have your contracting office issue a delivery order against the GSA contracting office. This saves fees and the delivery order goes directly to vendor instead of channeling through GSA.

3. Place a factory-training requirement in the contract. Require training be performed by truck manufacturer; as well as, vacuum/tank manufacturer.

Interactive Economic Analysis Spreadsheet

Double click the spreadsheet to make adjustments to fit your specific needs

Economic Analysis for a JP8 Collection Vehicle

Assumptions:		
Vehicle Cost (capital investment)	$99,000	
o Annual Maintenance	$6,000	
Vehicle Operator	$25,000	/yr
Volume of Contaminated JP8 Generated Annually	100,000	gallons
o Multiply by 7.48 lbs/gal to Convert to lbs	$748,000	lbs
Cost of Disposal Through DRMO	$0.25	/lb
Increased Volume of JP8 Available for Recycling (10% unsuitable)	90,000	gallons
o Current Market Value of JP8	$0.91	/gallon

Annual Operating Cost Comparison for Collection and Disposal of Off-Specification JP8

	Collection	**Disposal**
Operational Costs:		
Labor (collection):	$25,000	$0
Vehicle Maintenance	$6,000	$0
JP8 Disposal :	$0	$187,000
Total Operational Costs:	$31,000	$187,000
Total Recovered Income:	$81,900	$0
Net Annual Cost/Benefit:	$50,900	($187,000)

Economic Analysis Summary		
Annual Savings for Collection:	$237,900	
Capital Cost for Diversion Equipment/Process:	$99,000	
Payback Period for Investment in Equipment/Process:	0.42	years

Fort Hood Mobile Kitchen Trailer (MKT) Wash Facility

Title: Mobile Field Kitchen Trailer (MKT) Wash Facility
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: Enhance mission readiness by decreasing soldier time required during MKT cleaning procedures and reducing compliance liabilities related to the Clean Water Act (CWA).

Cost: $125,000

Environment: Protects the environment by reducing contaminated point source and non-point source discharges.

MKT Wash Facility

Description: To clean MKT, and related equipment, mess personnel are required to remove all equipment from the trailer before cleaning and sanitization. Cleaning consists of washing the trailer with a warm mixture of detergent and water. Sanitation is achieved by rinsing with water of at least 170^{o} Fahrenheit for 30 seconds or immersion for 1 minute in an approved chemical sanitizing solution. Common chemicals used during the cleaning process are: scouring powder, dry cleaning solvent, food service disinfectant, and corrosive prevention chemicals. Because discharging pollutants from point sources to water is a violation of Texas Regulations and the water used in washing MKTs was going directly into the storm water drainage system, Fort Hood constructed a four bay MKT Wash Facility to regain compliance. The facility design is very similar to a standard POV car wash. Effluent from the MKT wash facility is piped into the sanitary sewer system after pretreatment by the Oil/Water separator.

Unit Investment Cost: $	**Total Unit Savings:** $
Payback:	**Years Economical Life:**
Regulatory Driver:	**Waste Unit Savings:** $0
Major Pollutant:	**Energy Unit Savings:** $0
Base Qty Stream:	**Labor Unit Savings:** $0
Annual Unit Poll Reduction:	**Annual Unit Recur Cost:**
Annual Unit Energy Savings: $0	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for
Fort Hood MKT Wash Facility
Total Cost Estimate: $125,000

Law/Regulation:	CWA	**Compliance Status:**	OTHR
ECAT:	POLP	**Regulatory Driver:**	CWA
Class:	0	**Project Assessment:**	H
Activity/Process:	Equipment Maintenance	**Must Fund:**	Y
Total Identical Units:	0	**Years Economic Life:**	10
Major Pollutant:			
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:	$0	**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$0	**Source:**	
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Assumptions and Facts:

-

Lessons Learned

1. The bays of the facility were designed of insufficient size. Original plans were for the facility to accommodate servicing 4 MKTs at one time; however, sizing calculations did not include the material inside the MKT. Therefore, during washing, one bay holds the MKT and one bay holds the material in the MKT. Extra diligence should be exercised during the design phases to ensure product development tailored to the specified problem.

2. Due to inadequate facility sizing, soldiers occasionally wash equipment outside of bays, causing regulatory concern. Studies are now being performed to explore sloping the facility hardstand toward the wash water drainage grates; however, this could lead to unnecessary rainwater entering the sanitary sewer system.

4. Be certain to effectively and efficiently protect interior equipment and piping from elements specifically encountered in the area of use.

5. In order to allow easier rolling of hoses, swivels should be used for attaching the hose to the spray nozzle. This will preclude hose memory from affecting the storage process of the equipment.

Fort Hood Wash Water Recycling System

Title: Wash Water Recycling System
Installation: Fort Hood, Texas
POC: Mr. Randy Doyle – 254.287.1099

Mission: To support mission readiness by reducing the installation's environmental liability associated with civilian vehicular wash water.

Cost: $60,000

Environment: Obtain compliance with EO 13123, EO 12902 and 40 CFR 122 (CWA) by reducing the quantity and cost of water used to wash vehicles and equipment, reducing the quantity and cost of detergent used to wash vehicles and equipment, and reducing wastewater loading on wastewater treatment plants.

Picture Needed

Description: While being operated, vehicles can become contaminated with fuel, oils, metals, pesticides and other harmful chemicals. The wash water from vehicle washing operations is currently not contained, allowing for potential runoff into the ground and/or nearby waters of the U.S. The vehicle washing operations at the Fort Hood DPW and golf course facilities are out of compliance with the CWA and inconsistent with EO 13123, section 207 and EO 12902 section 301(b). Installation of a closed-loop wash water recycling systems will eliminate potential discharges into waters of the U.S. and conserve water and support the installations sustainability program.

Unit Investment Cost: $30,000	**Total Unit Savings:** $27,500
Payback:	**Years Economical Life:** 10
Regulatory Driver: CWA-Water	**Waste Unit Savings:** $0
Major Pollutant: Contaminated Wash Water	**Energy Unit Savings:** $0
Base Qty Stream: 240 tons/yr	**Labor Unit Savings:** $0
Annual Unit Poll Reduction: 240 tons/yr	**Annual Unit Recur Cost:** $1,000
Annual Unit Energy Savings: $0	**O&M Unit Savings:** $0

EPR

Exhibit 2 Data for
Fort Hood Wash Water Recycling System
Total Cost Estimate: $60,000

Law/Regulation:	CWA	**Compliance Status:**	INOV
ECAT:	POLP	**Regulatory Driver:**	CWA-WATER
Class:	1	**Project Assessment:**	H
Activity/Process:	Washing	**Must Fund:**	Yes
Total Identical Units:	2	**Years Economic Life:**	10
Major Pollutant:	Contaminated Wash Water		
Base Qty Stream:	240 tons/yr	**Source:**	ESTIMATION
Annual Unit Poll Reduction:	240 tons/yr	**Source:**	ESTIMATION
Unit Investment Cost:	$30,000	**Source:**	ESTIMATION
Annual Unit Recur Cost:	$1,000	**Source:**	ESTIMATION
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$27,500	**Source:**	ESTIMATION
Waste Unit Savings:	$0	**Source:**	
Energy Unit Savings:	$0	**Source:**	
Labor Unit Savings:	$0	**Source:**	
O&M Unit Savings	$0	**Source:**	
Mel Procure Unit Savings:	$0	**Source:**	
Other Unit Savings:	$27,500	**Source:**	ESTIMATION
Latest FY Start:	2000	**Earliest FY Start:**	2000

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
2001	131054.50	$60,000	$60,000	

Narrative: Current vehicle washing operations at the Fort Hood DPW and golf course facilities are out of compliance with the CWA and inconsistent with EO 13123, section 207 and EO 12902 section 301(b). While being operated, vehicle/golf cars can become contaminated with pesticides and other harmful chemicals. Wash water from vehicle washing operations is currently not contained, allowing for potential runoff into the ground and/or nearby waters of the United States. Closed-loop wash water recycling systems will eliminate potential discharges into waters of the United States and conserve water.

Cost Verification

Closed loop wash racks are specifically sized to meet the needs of the facility. System design varies on the number and types of vehicles, equipment, and/or aircraft cleaned at the specific facility. Consequently, the purchase, installation, and operational costs of a closed loop system vary significantly from one application to another. The following is a brief list of factors that should be included in the economic analysis:

- Is there an existing facility that can accommodate an above ground wash water recovery system,
- The cost of water including treatment and disposal,
- The cost if energy and the rate of energy consumption,
- Cost of installing and operating the system,
- Maintenance costs,
- Approximate types and numbers of vehicles/aircraft washed each month,
- System specifications (e.g., percent drag out and percent fresh rinse water needed),
- Detergent costs (based on selected system specifications).

The economics listed here are intended to be used only as general guidance and are not meant to be strictly interpreted. Actual economic benefits will vary depending on the factors involved.

Lessons Learned

1. Staffing and coordination is key to the success of any project of this nature. All crucial team members should be researched and included in the initial project development stage(s) and continue to be involved with compliance and operations once the project is complete.

2. All necessary equipment should be purchased in order for the facility to operate correctly. Be sure to coordinate purchasing between involved procuring elements to ensure a properly executed project.

Fort Bragg Air Emissions Inventory

Title: Air Emissions Inventory
Installation: Fort Bragg
POC: Joe Stancar

Mission: Provide insight on actual emissions and their potential impact on the environment.

Cost:

Environment: An Annual Air Pollutant Emissions Inventory is performed as a part of the Clean Air Act, Title V requirements. The air emissions inventory addresses all pollutants specified in the North Carolina Administrative Code for Control and Permitting of Toxic Air Pollutants, as well as any applicable federal hazardous and criteria air pollutants.

Description: Fort Bragg has over 40 permitted active sources that are inspected and monitored on the installation. Typical operations that are monitored include facility boilers, emergency generators, incinerators, paint spray booths, degreasers, abrasive blasting, and large hot water heaters.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver: Clean Air Act, Title V	**Waste Unit Savings:**
Major Pollutant: Air Emissions	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for Fort Bragg
Air Pollutant Emissions Inventory

Law/Regulation:	CAA	**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:	Air emissions inventory	**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Air pollutants from industrial activities		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Bragg Hazardous Waste Office

Title: Public Works Business Hazardous Waste Office
Installation: Fort Bragg
POC:

Mission: Promote proper and efficient management of hazardous waste.

Cost:

Environment: In 1997 Fort Bragg's Public Works Business Center Hazardous Waste Office (HWO) handled almost one million pounds of HW.

Description: Hazardous Waste from military and tenant activities are handled on an appointment basis. At turn-in appointments, individual generators package their waste using containers and labels supplied by the HWO. The HWO also supplies personal protective equipment required during packaging procedures. The HWO issues required paperwork (DD Form 1348-1) for disposal of waste to the Defense Reutilization and Marketing Office (DRMO). The unit generating the waste transports it to the Fort Bragg DRMO.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant:	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for Fort Bragg Hazardous Waste Office

Law/Regulation:			**Compliance Status:**	
ECAT:			**Regulatory Driver:**	
Class:			**Project Assessment:**	
Activity/Process:			**Must Fund:**	
Total Identical Units:			**Years Economic Life:**	
Major Pollutant:				
Base Qty Stream:			**Source:**	
Annual Unit Poll Reduction:			**Source:**	
Unit Investment Cost:			**Source:**	
Annual Unit Recur Cost:			**Source:**	
Annual Unit Energy Savings:			**Source:**	
Total Unit Savings:			**Source:**	
Waste Unit Savings:			**Source:**	
Energy Unit Savings:			**Source:**	
Labor Unit Savings:			**Source:**	
O&M Unit Savings:			**Source:**	
Mel Procure Unit Savings:			**Source:**	
Other Unit Savings:				
Latest FY Start:			**Earliest FY Start:**	
FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Bragg UST Management

Title: Underground Storage Tank Management
Installation: Fort Bragg
POC: Edward Schwacke

Mission: To comply with current Federal and State Regulations concerning USTs.

Cost:

Environment: The Fort Bragg Program currently has 53 federally regulated USTs, all meeting the current requirements of Title 40 of the Code of Federal Regulations, Section 280 and the State of North Carolina Administrative Code Title 15A Subchapter 2N. Since 22 Dec 88, Fort Bragg removed over 403 regulated USTs and upgraded or newly installed 53 mission critical USTs to meet the deadline.


CMA Heat Plant 48K UST Removal

Description: All military operated fuel sites were removed. The Readiness Business Center and DFSC coordinated and constructed two contractor owned, contractor operated (COCO) fuel sites on Fort Brag, consolidating refueling locations and fuel inventory. All AAFES service stations were upgraded with, state of the art, inventory controls; new fuel USTs; and Stage 1 Vapor Recovery systems. One AAFES site was permanently closed and the USTs removed. All USTs used to provide fuel to back-up generators were updated and retrofit with cathodic protection, spill and overfill controls, and inventory equipment. All unit level used oil USTs were removed and replaced with UL-142 or UL-2085 approved, double walled above ground tanks. All used oil tanks and oil/water separator are pumped via service order. Units are required by FB Reg 200-2 and 200-3 to clean residue from outside of tanks and remove debris from strainer baskets. All used antifreeze USTs were removed and replaced with contract provided 150-gallon aboveground receptacles. Fort Bragg has begun RBA Initial phase 1 investigations into former UST sites impacted by product contamination. Fort Bragg has a plan approved by the North Carolina Department of Environment and Natural Resources, Fayetteville Regional Office to address clean-up of former UST sites.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver: 40 CFR 280; NCAC Title 15A (2N)	**Waste Unit Savings:**
Major Pollutant:	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for
Fort Bragg UST Management

Law/Regulation:	40 CFR 280; NC Admin. Code Title 15A Subchapter 2N	**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:			
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Lewis Centralized Silver Recovery

Title: Centralized Silver Recovery
Installation: Fort Lewis
POC: Terry Austin

Mission: Reduced risk of Dental and Medical x-ray systems creating wastewater contaminated with silver from x-ray film developing. This will reduce solider time currently required to manage an environmental regulated waste stream. This will ensure uninterrupted medical and dental service to ensure troop readiness.

Cost: The implementation of this system had a payback period 1.2 years. The investment of $19,762 for implementation will result in an annual operational savings of $17,267 per year.

Environment: Compliance with Federally Owned Treatment Works (FOTW) effluent discharge standards was achieved and maintained at all medical and dental photo developing operations at Fort Lewis. 40-50 pounds of silver have been reclaimed annually for beneficial reuse.

Description: Photographic development occurs at various medical and dental clinics throughout Fort Lewis. These operations generate spent fixer solution that contains ionic silver in concentrations greater than 5 milligrams per liter (mg/L). When discharged this waste failed to meet FOTW discharge standards resulting in a 1994 citation from the state for improper disposal of spent fixer. The implementation of this system will collect spent fixer centrally for silver recovery. The process of silver recovery consists of the use of electrochemical reduction to reduce ionic silver (Ag^{2+}) in spent fixer to metallic silver. The ionic silver, which is soluble in water, becomes insoluble as its valence is reduced form “2+” to “0” and becomes metallic which can be reclaimed for beneficial reuse.

Unit Investment Cost: $20,000	**Total Unit Savings:** $17,700
Payback: 1.2 years	**Years Economic Life:** 10 yr
Regulatory Driver: RCRA-C	**Waste Unit Savings:** $34,400
Major Pollutant: HW- silver in spent fixer	**Energy Unit Savings:** (-$23)
Base Qty Stream: 11,000 gal/yr	**Labor Unit Savings:** ($17,000)
Annual Unit Poll Reduction: 10,800 gal	**Ann Unit Recur Cost:** $3,000
Ann Unit Energy Savings: +635 kWh	**O&M Unit Savings:**

EPR Exhibit 2 Data for
Silver Recovery at Medical and Dental Clinics
Total Cost Estimate: $20,000

Law/Regulation:	RCRC	**Compliance Status:**	ESDP
ECAT:	RCYP	**Regulatory Driver:**	RCRA-C
Class:	2	**Project Assessment:**	H
Activity/Process:	Medical testing	**Must Fund:**	Y
Total Identical Units:	1	**Years Economic Life:**	15
Major Pollutant:	Ethanol, xylene (hw)		
Base Qty Stream:	400 gal	**Source:**	Ft. Lewis validation
Annual Unit Poll Reduction:	640 lbs xylene, 2500 lb ethanol	**Source:**	Ft. Lewis validation
Unit Investment Cost:	$12,000	**Source:**	Ft. Lewis validation
Annual Unit Recur Cost:	$1,400	**Source:**	Ft. Lewis validation
Annual Unit Energy Savings:	+1526 kwh	**Source:**	Ft. Lewis validation
Total Unit Savings:	$12,300	**Source:**	Ft. Lewis validation
Waste Unit Savings:	$6,000	**Source:**	Ft. Lewis validation
Energy Unit Savings:	($60)	**Source:**	Ft. Lewis validation
Labor Unit Savings:	$1,600	**Source:**	Ft. Lewis validation
O&M Unit Savings:	$700	**Source:**	Ft. Lewis validation
Mel Procure Unit Savings:	$4300	**Source:**	Ft. Lewis validation
Other Unit Savings:	$700		
Latest FY Start:	+2	**Earliest FY Start:**	0

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:
+1	OMA(VEPP)	**20,000**	20,000	20,000
+2	OMA(VEPP)			
+3	OMA(VEPP)			

Narrative: Install centralized silver recovery unit to extract silver from spent photographic fixer. Small, decentralized silvery recovery units commonly in use at the point of generation have inadequate capacity, are difficult to maintain properly, and often fail to meet FOTW discharge standards. This results in the requirement to dispose of spent fixer as hazardous waste. Payback is 1.2 years. Environmental impact: HW reduction 11,000 gal; HM use reduction 477 lb; risk of FOTW infractions eliminated.

Readiness impact: None

Cost Verification

Lessons Learned

Several key factors contribute to the maintenance and operation of a successful silver recovery operation. These key factors are listed below.

- Do not use DRMO supplied silver recovery systems. The original silver recovery systems were supplied by DRMO and had inadequate capacity and created additional labor time to ensure proper operation.

- Do not decentralize silver recovery systems. DRMO-supplied silver recovery equipment was decentralized and required the photo development operators at remote location to monitor and change silver recovery columns. They were labor-intensive and their operation resulted in regulatory non-compliance. Use a central silver recovery center with an operator who is dedicated, organized, and qualified.

- Use silver recovery cells with adequate capacity. DRMO-supplied silver recovery equipment was inadequate.

Keep good records that are easily maintained and audited.

Appendix C: Implemented P2 Technologies at TRADOC Installations

Fort Benning Aerosol Can Management

Title: Aerosol Can Management
Installation: Fort Benning
POC:

Mission: To ensure the proper disposal of aerosol cans at Fort Polk.

Cost:

Environment: Aerosol cans are considered by the Georgia Environmental Protection Division to be hazardous waste, regardless of their contents, if any pressure or liquid remains within the can. Aerosol cans, due to the presence of compressed flammable gases, are considered both ignitable and reactive substances carrying EPA waste codes D001 and D003.

Description: Units and activities on Fort Benning have two options for the proper disposal of aerosol cans.

1) The unit may sort the aerosol cans by individual stock number, package them according to DOT standards, and then turn them into DRMO as hazardous waste. While costs for disposal varies, individual turn-in documents must be prepared for each National Stock Number. This is a tedious process.

2) Units are strongly advised to purchase and use aerosol can depleters. These devices attach to a steel drum. Aerosol cans are placed on the device, which punctures the can, evacuates the contents, allowing the pressure to be released and the waste to drain into the drain. Air emissions are filtered through a charcoal filter. The residual liquid in the drum must then be managed as a hazardous waste in accordance with RCRA requirements. The drum must be labeled with a hazardous waste label and treated as a satellite accumulation point.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver: Georgia Envir. Prot. Div.	**Waste Unit Savings:**
Major Pollutant: Aerosol cans	**Energy Unit Savings:**
Base Qty Stream:	**Labor unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit energy savings:	**O&M unit savings:**

EPR Exhibit 2 Data for Fort Benning
Aerosol Can Management

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Aerosol Cans		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Benning Fluorescent Tube Management

Title: Fluorescent Tube Management
Installation: Fort Benning
POC: Wendy Duffy

Mission: To prevent environmental and health hazards through management of fluorescent tube disposal.

Cost:

Environment: Most fluorescent tubes on the market contain mercury, a substance that can cause damage to the nervous system as well as birth defects. Breaking fluorescent tubes can be quite dangerous as it releases mercury into the air and poses an environmental and health hazard. At the workplace, fluorescent tubes must be managed as a hazardous waste.

Description: The DRMO sends Fort Benning's fluorescent tubes to an off-post recycler where the mercury and other chemicals are reclaimed.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant: Fluorescent Tubes	**Energy Unit Savings:**
Base Qty Stream:	**Labor unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit energy savings:	**O&M unit savings:**

EPR Exhibit 2 Data for Fort Benning
Fluorescent Tube Management

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Fluorescent Tubes		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Benning Used Oil Management

Title: Used Oil Management
Installation: Fort Benning
POC: Wendy Duffy

Mission: Ensure that all used oil, unless contaminated, is used for energy recovery in Fort Benning's central heating plants.

Cost:

Environment: The central heating plants at Fort Benning are not allowed to burn anything other than used oil.

Description: Units are required to collect their used oil. The oil collected must not be mixed with any other substances. This oil is in turn recovered for use at the central heating plants.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant: Used Oil	**Energy Unit Savings:**
Base Qty Stream:	**Labor unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit energy savings:	**O&M unit savings:**

EPR Exhibit 2 Data for
Fort Benning Used Oil Management

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Used Oil		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Polk HazMart Center

Description: The user will be responsible for identifying hazar
and the HazMart for meeting those requirements. The hazardo
stocked at a central location, and satellite storage facilities whe

Environment:

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant:	**Energy Unit Savings:**
Base Qty Stream:	**Labor unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit energy savings:	**O&M unit savings:**

EPR Exhibit 2 Data for
Fort Polk HazMart Center

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:			
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Polk Landfarm Operations

Title: Landfarm Operations
Installation: Fort Polk
POC:

Mission: Utilize a treatment process by which waste is mixed with the surface soil and is degraded, transformed or immobilized.

Cost:

Environment: Fort Polk operates two wastewater treatment plants; one at North Fort Polk and one at South Fort Polk. Together the plants have 22 digested sludge drying beds. The combined annual production of digested sewage sludge from both treatment plants is approximately 525 tons. Compared to other land disposal treatments such as landfills and surface impoundment, landfarming has the potential to reduce monitoring and maintenance costs, as well as clean up liabilities.

Description: The Fort Polk Landfarm has been in operation since 1986. The landfarm area is 4.1 acres, subdivided into four working plots separated by a terrace, which prevents the migration of material during the degradation process. All runoff water diverted by the terraces is collected in a common grass waterway and flows to an impoundment. This surface impoundment is designed to retain rainfall/runoff from the landfarm and serves as an irrigation water supply source. The permit for this facility allows a weekly application of various wastes (oily wastes- 429 lb/acre and dried sludge- 1.9 cubic yard/acre). The surface soil is used as the treatment medium and the process is based primarily on the principle of aerobic decomposition of organic wastes. Treated soil is currently permitted to be used on the closure cap of a nearby solid waste landfill. This minimizes soil migration and improves the integrity of the capped areas, and provides an amended topsoil, which enhances vegetative growth.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant: Digested Sludge	**Energy Unit Savings:**
Base Qty Stream: 525 tons annually	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit savings:**

EPR Exhibit 2 Data for Fort Polk Landfarm Operations

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Digested Sludge		
Base Qty Stream:	525 tons annually	**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Polk Lithium Battery Recovery and Reuse

Title: Lithium Battery Recovery and Reuse Program
Installation: Fort Polk
POC:

Mission: To help in the reduction of battery expenditures and waste disposal costs. Achieve an overall goal of 50% reduction in the cost of battery procurement.

Cost: The BA 5590 batteries cost $65.00 each; the disposal cost as a hazardous waste is $9.22 each. Through increased management of lithium BA 5590 batteries the JRTC has realized over $45,000 in cost avoidance during each monthly rotation. The JRTC has averaged 11 rotations annually during the past 2 years.

Environment: The benefits in the environment include environmental compliance, waste reduction, and worker health and safety.

Description: Use of the BA 5590 is a 12-volt lithium battery, with 10 lithium cells and weighs approximately 2.5 pounds ahs increased dramatically over the past 18 months. The following materials are being used for management of the BA5590 lithium batteries: BA 5590 Lithium sulfur dioxide batteries (NSN:6135-01-36-3495) $65.00 each, Energage LS 94 State-of-Charge Tester (NSN:6625-01-370-8278), standard multimeter (Voltmeter), small flat tip screwdriver or similar device, paint pen or permanent marker, tracking form, well ventilated storage area. Batteries are first placed on the state of charge tester to determine their life span. Those batteries determined to have more than 70% of their life span remaining are stored and issued out upon request. Batteries with readings less than 70% are then further processed. Batteries (older versions) which do not have a complete discharge device (CDD) are disposed of as a hazardous waste, for ignitability (D001) and reactivity (D003). Batteries having a CDD are then activated.

Unit Investment Cost: $65.00 each	**Total Unit Savings:** $45,000 monthly
Payback:	**Years Economic Life:**
Regulatory Driver: Army Regulation	**Waste Unit Savings:**
Major Pollutant: Lithium	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for Fort Polk
Lithium Battery Recovery and Reuse

Law/Regulation:	Army Regulation	**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:	Lithium		
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:	$65.00 each	**Source:**	Ft. Polk validation
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:	$45,000 monthly	**Source:**	Ft. Polk Validation
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Polk Solvent Management

Title: Solvent Management
Installation: Fort Polk
POC:

Mission: Reduction of the amount of hazardous waste generated in routine operations.

Cost:

Environment: Fort Polk had an initial assessment of their hazardous waste stream as a potential for reduction in 1994. It was reported that 66-77% of their hazardous waste tonnage was produced through the solvent waste stream. The installation's industrial operations include vehicle and aviation maintenance, facilities maintenance, and utilities and waterworks operations.

Description: Fort Polk took three steps to manage their solvent waste. First all excess machines were removed from the installation (the number of contract solvent machines lowered from 234 in 1992 to 107 in 1998). Next, the time between solvent exchanges was extended. These administrative changes caused a decrease of 27 tons ($33,000 in cost savings) in 1995 and an additional decrease of 18 tons in 1996 ($59,000 in cost savings). The third change was to acquire additional funding for parts washer and solvent procurement this will realize considerable cost savings in the future.

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant:	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for
Fort Polk Solvent Management

Law/Regulation:	EO 12856	**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:			
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Lee Hazardous Material Management Program

Title: Hazardous Materials Management Program (HMMP)
Installation: Fort Lee
POC:

Mission: To centralize hazardous materials management, identify less hazardous and more environmentally friendly substitutes and, where possible promote processes that do not require the use of hazardous materials. The goal of the HMMP is to reduce the acquisition and disposal costs of hazardous materials and associated hazardous wastes, reduce inventory levels, eliminate wastes due to shelf-life expiration, reduce releases to the environment, improve regulatory compliance, and improve the health and safety for workers.

Cost:

Environment:

Description:

Unit Investment Cost:	**Total Unit Savings:**
Payback:	**Years Economic Life:**
Regulatory Driver:	**Waste Unit Savings:**
Major Pollutant:	**Energy Unit Savings:**
Base Qty Stream:	**Labor Unit Savings:**
Annual Unit Poll Reduction:	**Ann Unit Recur Cost:**
Ann Unit Energy Savings:	**O&M Unit Savings:**

EPR Exhibit 2 Data for Fort Lee
Hazardous Materials Management Program

Law/Regulation:		**Compliance Status:**	
ECAT:		**Regulatory Driver:**	
Class:		**Project Assessment:**	
Activity/Process:		**Must Fund:**	
Total Identical Units:		**Years Economic Life:**	
Major Pollutant:			
Base Qty Stream:		**Source:**	
Annual Unit Poll Reduction:		**Source:**	
Unit Investment Cost:		**Source:**	
Annual Unit Recur Cost:		**Source:**	
Annual Unit Energy Savings:		**Source:**	
Total Unit Savings:		**Source:**	
Waste Unit Savings:		**Source:**	
Energy Unit Savings:		**Source:**	
Labor Unit Savings:		**Source:**	
O&M Unit Savings:		**Source:**	
Mel Procure Unit Savings:		**Source:**	
Other Unit Savings:			
Latest FY Start:		**Earliest FY Start:**	

FY	Budget Code:	Required:	Program/Budgeted:	Obligated:

Narrative:

Cost Verification

Lessons Learned

Fort Knox Alternative Fuel Vehicles Initiative

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Compressed Natural Gas (CNG) Initiative for Alternative Fuel Vehicles (AFV)
Implementation Date: FY00
Funding Source(s): OMA(VEPP)
Project Goals: • Reduce air emissions from non-tactical motor vehicles. • Comply with the AFV mandates required under the Energy Policy Act and E.O. 12844 (superseded by E.O. 13031).
Description of Project: This project provided funds to support the fueling infrastructure for the Fort Knox Alternative Fuels Initiative. The funding provided for the leasing of an interim "fast fill" CNG compressor station for refueling the 200 CNG-fueled sedans, vans, and pickup trucks at Fort Knox.

Ford F-150 CNG Light Duty Pickup Truck

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY00
KNOX980012	CNG Refueling Station Support	$95,000
	Total Unit Investment Cost:	**$95,000**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY01
KNOX980012	Annual Lease for CNG Compressor Station ($7,000/month)	$84,000
	Total Recurring Annual Cost:	**$84,000**

Annual Savings*
Base Quantity Stream: 300,000 lbs./yr

Savings in:	Quantity (units)	Savings ($)
Transportation Fleet Lease Savings	No data	$151,200
Internal Savings & Fuel Revenue	No data	$16,800
External Savings & Fuel Revenue	No data	$103,100
Total Reductions/ Savings:		**$271,100**

*Annual savings derived from the Fort Knox 5-year Benefit estimate.

Summary Data

A	**Total Unit Investment Cost:**	$95,000
B	**Total Annual Savings:**	$271,100
C	**Total Annual Recurring Costs:**	$84,000
D	**Return on Investment (Line B – Line C):**	$187,100

E	**Payback Years (Line A ÷ Line D)**	0.5

Pollutant Reductions/Environmental Benefit*

Estimated Annual Reductions	**Quantity (Units)**
Hazardous Materials Usage	N/A
Hazardous Waste Disposal	N/A
Solid Waste Disposal	N/A
Air Emissions	150,000 lbs./yr.
Wastewater Generation	N/A
TRI Chemical Usage	N/A
TRI Chemical Release	N/A

*Estimate from EPR Exhibit 2 Report.

EPR Exhibit 2 Report for KNOX980012

Law/Reg Area	CAA	Compliance Status:	ESDL
ECAT:	POLP	Regulatory Driver:	CAA-HAZARDOUS AIR POLLUTANT
Class:	3	Project Assessment:	H
Activity/Process:	Other	Must Fund:	N
Total Identical Units:	No data	Years Economic Life:	No data
Major Pollutant:	No data		
Base Quantity Stream:	300,000 lbs./yr.	Source:	ESTIMATION
Annual Unit Poll Reduction:	150,000 lbs./yr.	Source:	ESTIMATION
Unit Investment Cost:	$125,000	Source:	ESTIMATION
Annual Unit Recurring Cost:	$125,000	Source:	ESTIMATION
Annual Unit Energy Savings:	150,000 kwh/yr.	Source:	ESTIMATION
Total Unit Savings:	$124,425	Source:	ESTIMATION
Waste Unit Savings:	No data	Source:	No data
Energy Unit Savings:	No data	Source:	No data
Labor Unit Savings:	No data	Source:	No data
O&M Unit Savings:	No data	Source:	No data
Mtl Procure Unit Savings:	No data	Source:	No data
Other Unit Savings:	No data	Source:	No data
Latest FY Start:	1999	Earliest FY Start:	1998

Project Narrative:

A command objective at Fort Knox is making military life the best it can be, which includes keeping the air clean by using alternative fuel vehicles (AFV). The concept of "total quality management" to reach this objective includes building a fleet of compressed natural gas (CNG) vehicles, as well as providing an infrastructure to support them. The Fort Knox Alternative Fuel Vehicles (CNG) Initiative was proposed and approved by the Fort Knox Commander in 1998. The program was developed to meet air quality standards, energy policy goals, and Executive Orders and assist in reaching goals for reduction in the dependence on foreign oil supplies, averting future air pollution problems, and achieving higher efficiencies in operation and maintenance.

The initiative is a three-phase effort that includes (1) the conversion of the non-tactical fleet from conventional fuel to alternative fuel, (2) partnering with the State and local communities, and (3) providing an alternative fuels station. Fort Knox has already purchased 200 CNG-fueled sedans, vans, and pickup trucks since 1999, and efforts continue to convert the entire non-tactical fleet to alternative fuels. Fort Knox is a member of the Central Kentucky Clean Cities Coalition, and in 1999, the command at Fort Knox signed a partnership effort with the state, local governments, and community leaders to foster cooperation in the alternative fuels effort.

The funds from this project provided the alternative fuels station. A "fast fill" compressor station is being temporarily leased to provide fuel to the current fleet until a third party fuel provider can be brought on board to provide alternative fuels. A lease with a third party will provide alternative fuels for Fort Knox and its community partners at no infrastructure costs to the Army. In addition, the station will facilitate the availability of AFV infrastructure in central Kentucky. The goal for the completion of the alternate fuels station was FY 2001.

Lessons Learned:

The Army and Air Force Exchange Service (AAFES) was asked to join the project and build and operate a new fuel station on Fort Knox that would sell CNG as well as conventional fuel. Fort Knox would receive EPA/DOE funds with the stipulation that the alternative fuel would be available to the public. AAFES has blocked the progress on this initiative to date because of the unresolved issue of selling CNG to the public.

Fort Knox committed to the success of the AFV program and initiative by issuing a directive to all operators of alternative fuel vehicles that these vehicles are mandated to operate on alternative fuels only. However, the current refueling station is inadequate for the fleet fuel needs.

Assumptions:

Annual savings were derived from the Fort Knox 5-year Benefit estimate.
Air emissions reductions are estimates from the EPR Exhibit 2 Report.

Risk/Compliance Reductions:

- Supports the AFV requirements of E.O. 13031.

Data Sources:

EPR Exhibit 2 Report
Fort Knox Nomination for Secretary of the Army Pollution Prevention Award FY2000
Fort Knox Alternative Fuels Initiative Status Briefing
Clean Cities Coalition Convention 1999 Table Talk Discussion, Dr. Richard E. Shore, Natural Gas Advocate, U.S. Army Armor Center and Fort Knox
Clean Cities Conference Keynotes, *Alternative Fuel News*, Vol. 3. No. 2, August 1999, U.S. Department of Energy

Vendor Information:

No data.

Fort Knox Antifreeze Recycling

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Antifreeze Recycling
Implementation Date: FY96 and FY97
Funding Source(s): OMA(VEPP)
Project Goals: • Reduce the quantity and cost of purchase, storage, use, and disposal of an EPCRA Section 313 chemical (ethylene glycol).
Description of Project: This project funded the antifreeze recycling program at Fort Knox.

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY96	FY97
KNOX960019	Antifreeze Recycling	$20,590	
KNOX960019	Antifreeze Recycling		$1,464
	Total Unit Investment Cost:		**$22,054**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY99	FY00	FY01
KNOX960019	Contract for antifreeze recycling	$600	$600	$600
	Total Recurring Annual Cost:	$600	$600	$600

Annual Savings
Base Quantity Stream: 10,000 gal./yr.

Savings in:	Estimated Annual Savings	
	Quantity (units)	Savings ($)
Materials purchase	No data	
Waste disposal (ethylene glycol)	10,000 gal.	$6,000
Labor for disposal	No data	
Transportation for disposal	No data	
Testing	No data	
Pollution controls maintenance	No data	
Pollution controls supplies	No data	
Protective equipment	No data	
Training labor	No data	
Recordkeeping labor	No data	
Process labor	No data	
Other	No data	
Total Reductions/ Savings		$6,000

Summary Data

A	**Total Unit Investment Cost:**	$22,054
B	**Total Annual Savings:**	$6,000
C	**Total Annual Recurring Costs:**	$600
D	**Return on Investment (Line B – Line C):**	$5,400

E	**Payback Years (Line A ÷ Line D)**	4

Pollutant Reductions/Environmental Benefit

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage	No data
Hazardous Waste Disposal (ethylene glycol)	10,000 gal.
Solid Waste Disposal	No data
Air Emissions	No data
Wastewater Generation	No data
TRI Chemical Usage	No data
TRI Chemical Release	No data

EPR Exhibit 2 Report for KNOX9600019

Law/Reg Area	RCRD	Compliance Status:	ESDL
ECAT:	RCYP	Regulatory Driver:	No data
Class:	3	Project Assessment:	H
Activity/Process:	Other	Must Fund:	N
Total Identical Units:	No data	Years Economic Life:	No data
Major Pollutant:	No data		
Base Quantity Stream:	No data	Source:	
Annual Unit Poll Reduction:	No data	Source:	
Unit Investment Cost:	No data	Source:	
Annual Unit Recurring Cost:	No data	Source:	
Annual Unit Energy Savings:	No data	Source:	
Total Unit Savings:	No data	Source:	
Waste Unit Savings:	No data	Source:	
Energy Unit Savings:	No data	Source:	
Labor Unit Savings:	No data	Source:	
O&M Unit Savings:	No data	Source:	
Mtl Procure Unit Savings:	No data	Source:	
Other Unit Savings:	No data	Source:	
Latest FY Start:	No data	Earliest FY Start:	No data

Project Narrative:

Vehicle maintenance operations at Fort Knox generate approximately 10,000 gallons of used antifreeze (ethylene glycol) each year. Since FY99, ethylene glycol is recycled off-post under a contract. The contract for antifreeze recycling requires only transportation costs. The transportation costs for quarterly pick-up is $600. The previous pick-up, removal, and disposal for used antifreeze cost the installation up to a maximum of $0.60 per gallon.

Lessons Learned:

Recycling this antifreeze on the installation was reviewed as an alternative; however, the low volumes generated made contract recycling much more economical.

Assumptions/Calculations:

Cost to recycle used antifreeze: $600/yr
Disposal cost for used antifreeze: $0.60/gal X 10,000 gal/yr = $6,000/yr

Risk/Compliance Reductions:

- Reduce the quantity of used antifreeze disposed of as hazardous waste.

Data Sources:

EPR Exhibit 2 Report
Fort Knox Nomination for Secretary of the Army Pollution Prevention Award FY2000

Vendor Information: No data.

Fort Knox Electric Armor Moving Target System

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Replace Hydraulic Armor Moving Target System (AMTS) with Electric Armor Moving Target System
Implementation Date: FY99
Funding Source(s): OMA(VEPP)
Project Goals: • Reduce the quantity and costs to purchase and use of hydraulic fluid and to clean-up contaminated soils. • Eliminate substantial environmental liability due to leaking hydraulic fluid on the ranges.
Description of Project: This project funded the replacement of hydraulic AMTS on three ranges: the Yano Range (12 AMTS), the Cedar Creek Range (3 AMTS), and the St. Vith Range (4 AMTS). The old hydraulic target movers were a source of releases of hydraulic fluid due to system ruptures and leaks. Clean-up of releases were very costly and caused lost training time due to range closures for repair and clean-up. To eliminate the persistent leakage problems, the hydraulic AMTS were replaced with new electro-mechanical AMTS that do not require hydraulic fluid for target operation.

Electric Armor Moving Target System

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY99
KNOX970033	19 target movers @ $48,250 each	$916,750
KNOX970033	Utility construction (3 interfaces @ $2,716 each)	$8,148
KNOX970033	Construction (4 people X 40 hr @ $19.14/hr)	$3,062
KNOX970033	Training (4 people X 30 hr @ $19.14/hr)	$2,297
	Total Unit Investment Cost:	**$930,257**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY00	FY01
	None	$0	$0
	Total Recurring Annual Cost:	$0	$0

Annual Savings*
Base Quantity Stream: 750 gal/yr

Savings in:	FY00*		FY01*	
	Quantity (units)	Savings ($)	Quantity (units)	Savings ($)
Materials (50 gal. hydraulic fluid X 15 releases @ $2/gal)	750 gal	$1,500	750 gal	$1,500
Materials (replacement hoses @ $100 each)	15 hoses	$1,500	15 hoses	$1,500
Materials (track replacement @ $200,000 per track)	4 tracks	$800,000	4 tracks	$800,000
Waste Disposal (contaminated soil @ $300 per load)	27 loads	$8,100	27 loads	$8,100
Waste Management Labor Cost (3 people X 15 releases/yr X 6 hr/release @ $19.14/hr)	270 hr	$5,168	270 hr	$5,168
Waste Management Labor Cost (4 people X 4 tracks/yr X 40 hr/track @ $28.00/hr)	640 hr	$17,920	640 hr	$17,920
Pollution Control Labor Cost (15 hose replacements X 1 person X 3 hr/replacement @ $19.14/hr)	45 hr	$861	45 hr	$861
Process Labor (training downtime for 90 people X 6 hr/release X 15 releases @ $27.73/hr)	8,100 hr	$224,613	8,100 hr	$224,613
Recordkeeping labor (1 person X 3 hr/ release X 15 releases @ $19.14/hr)	45 hr	$861	45 hr	$861
Total Reductions/ Savings:		$1,060,523		$1,060,523

* Estimate based on 15 releases per year and replacement of 4 tracks per year.

Summary Data

A	**Total Unit Investment Cost:**	$930,287
B	**Total Annual Savings:**	$1,060,523
C	**Total Annual Recurring Costs:**	$0
D	**Return on Investment (Line B – Line C):**	$1,060,523

E	**Payback Years (Line A ÷ Line D)**	0.9

Pollutant Reductions/Environmental Benefit

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage (hydraulic fluid)	5,475 lbs.
Hazardous Waste Disposal	N/A
Solid Waste Disposal (POL contaminated soil)	No data
VOC Air Emissions	N/A
Wastewater Generation	N/A
TRI Chemical Usage	N/A
TRI Chemical Release	N/A

EPR Exhibit 2 Report for KNOX97033

Law/Reg Area	PRVN	Compliance Status:	ESRO
ECAT:	POLP	Regulatory Driver:	CWA – WATER
Class:	3	Project Assessment:	H
Activity/Process:	OTHER	Must Fund:	N
Total Identical Units:		Years Economic Life:	No data
Major Pollutant:	Hydraulic Fluid		No data
Base Quantity Stream:	500 lbs/yr	Source:	ESTIMATION
Annual Unit Poll Reduction:	500 lbs/yr	Source:	ESTIMATION
Unit Investment Cost:	$930,257	Source:	ESTIMATION
Annual Unit Recurring Cost:	$35,910	Source:	ESTIMATION
Annual Unit Energy Savings:	No Data	Source:	No data
Total Unit Savings:	$1,060,523	Source:	ESTIMATION
Waste Unit Savings:	$35,910	Source:	ESTIMATION
Energy Unit Savings:		Source:	
Labor Unit Savings:	$224,613	Source:	ESTIMATION
O&M Unit Savings:	No data	Source:	No data
Mtl Procure Unit Savings:	No data	Source:	No data
Other Unit Savings:	$800,00	Source:	ESTIMATION
Latest FY Start:	1999	Earliest FY Start:	1998

Project Narrative:

This project funded the replacement of hydraulic AMTS on three ranges: the Yano Range (12 AMTS), the Cedar Creek Range (3 AMTS), and the St. Vith Range (4 AMTS). Each of the hydraulic AMTS travels on railroad type rails for a distance of 900 feet and used hydraulics to operate the target. The hydraulic system held 50 gallons of hydraulic fluid operated under 2,000 psi. Prior to the replacement of the hydraulic AMTS, there had been 45 ruptures of the hydraulic system. When the hydraulic system ruptured, the hydraulic fluid was released in a spray that covered the entire 900-foot distance of the track. The clean-up of these areas has been time-consuming and required closure of the ranges, which had a negative impact on the training mission due to lost training days.

There were also potential negative impacts on the environment. The Yano and Cedar Creek Ranges are located in environmentally sensitive areas. Yano Range has a designated wetland and river located on it and Cedar Creek is a waterway that passes through the Cedar Creek Range. The continued leaking of hydraulic fluid would potentially pollute these sensitive areas and place the installation in a position of substantial liability.

Although numerous attempts were made to modify and replace various components of the hydraulic systems, none of the modifications were successful. In order to eliminate the persistent leakage problems, the hydraulic systems were replaced with electro-mechanical AMTS that fully integrated with the existing target operation and scoring systems supporting the ranges.

Risk/Compliance Reductions:

- Eliminate use of hydraulic fluid for Armor Moving Target Systems at 3 ranges.
- Eliminate POL contamination of soils at ranges from release of hydraulic fluid from ruptured hydraulic lines and subsequent surface water contamination from run-off.

Assumptions:

Weight of hydraulic fluid: 7.3 lb./gal.

Data Sources:

EPR Exhibit 2 Report
Fort Knox Pollution Prevention Project Analysis Worksheet
Fort Knox Pollution Prevention ROI for Electric Targets and Project Description: "Replace Hydraulic Armor Moving Target Systems (AMTS) with Electric AMTS"

Vendor Information:

Caswell International Corporation
Phone (612) 379-2000
http://www.caswellintl.com

Fort Knox Electric Utility Vehicles

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: ODC Use Reduction or Elimination Products
Implementation Date: FY00
Funding Source(s): OMA(VEPP)
Project Goals: • Reduce air emissions by replacing gas engine vehicles with electric vehicles. • Reduce dependency on fossil fuels.
Description of Project: Fort Knox purchased ten electric vehicles to replace gasoline engine vehicles to accomplish energy savings, meet Clean Air Act goals by reducing the emissions of ozone precursors, and reduce dependency on fossil fuels. The electric vehicles purchased included six rough terrain vehicles (RTV) for range maintenance, one aircraft mover, two vehicles for Military Police family housing patrol, and one vehicle for engineer maintenance.

Electric Utility Vehicles

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY00	Totals
KNOX990006	10 Electric Carts	$208,400	$208,400
	Total Unit Investment Cost:		**$208,400**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY01
KNOX990006	Electric Energy Costs	$853
	Total Recurring Annual Cost:	**$853**

Annual Savings
Base Quantity Stream:

Savings in:	FY01	
	Quantity (units)	Savings ($)
Materials purchase (fuel for vehicles)	7,808 gal.	$8,276
Waste disposal	N/A	
Maintenance and operations	No data	
Transportation for disposal	N/A	
Testing	N/A	
Pollution controls maintenance	N/A	
Pollution controls supplies	N/A	
Protective equipment	N/A	
Training labor	N/A	
Recordkeeping labor	N/A	
Process labor	N/A	
Other	N/A	
Total Reductions/ Savings:		$8,276

Summary Data

A	**Total Unit Investment Cost:**	$208,400
B	**Total Annual Savings:**	$8,276
C	**Total Annual Recurring Costs:**	$853
D	**Return on Investment (Line B – Line C):**	$7,423

E	**Payback Years (Line A ÷ Line D)**	28

Pollutant Reductions/Environmental Benefit

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage	N/A
Hazardous Waste Disposal	N/A
Solid Waste Disposal	N/A
Air Emissions (Ozone precursors: HC, CO, NOx)	3,925 lbs.
Wastewater Generation	N/A
TRI Chemical Usage	N/A
TRI Chemical Release	N/A

EPR Exhibit 2 Report for KNOX990006

Law/Reg Area	CAA	Compliance Status:	ESRO
ECAT:	ODCS	Regulatory Driver:	CAA - OZONE DEPLETING SUBSTANCE
Class:	3	Project Assessment:	H
Activity/Process:	OTHER	Must Fund:	N
Total Identical Units:	10	Years Economic Life:	No data
Major Pollutant:	Ozone precursors, Oxides, NO		
Base Quantity Stream:	No data	Source:	No data
Annual Unit Poll Reduction:	No data	Source:	No data
Unit Investment Cost:	$208,400	Source:	VENDOR
Annual Unit Recurring Cost:	$10,000	Source:	VENDOR
Annual Unit Energy Savings:	72,000 kWh/yr	Source:	ESTIMATION
Total Unit Savings:	$72,000	Source:	ESTIMATION
Waste Unit Savings:	No data	Source:	No data
Energy Unit Savings:	No data	Source:	No data
Labor Unit Savings:	No data	Source:	No data
O&M Unit Savings:	No data	Source:	No data
Mtl Procure Unit Savings:	No data	Source:	No data
Other Unit Savings:	No data	Source:	No data
Latest FY Start:	2001	Earliest FY Start:	2000

Project Narrative:

Fort Knox purchased ten electric vehicles to replace gasoline engine vehicles to accomplish energy savings, meet Clean Air Act goals by reducing the emissions of ozone precursors, and reduce dependency on fossil fuels. Ozone is the major component of smog, which is an urban air quality problem. Ozone is not emitted directly but is formed in the atmosphere through a complex set of chemical reactions involving hydrocarbons, oxides of nitrogen, and sunlight. Hydrocarbons and nitrogen oxides come from a variety of industrial and combustion processes, but at least half of these pollutants in typical urban areas come from the exhaust from cars, buses, trucks, and other mobile sources burning fossil fuels. Electric vehicles have zero tailpipe and evaporative hydrocarbon and nitrogen oxide emissions. The savings in fuel and the cleaner environment, particularly in the Army family housing areas, made this a highly desirable initiative.

Assumptions/Calculations:

Avoided Fuel (Gasoline) Costs:
Six Range Maintenance RTVs: 8,640 mi/yr ÷ 30 mpg = 288 gal/yr X $1.06/gal = $305/yr
One Aircraft Mover: 24,000 mi./yr ÷ 40 mpg = 600 gal/yr X $1.06/gal = $636/yr
Two Military Police Patrol Vehicles: 134,400 mi/yr ÷ 20 mpg = 6,720 gal/yr X $1.06/gal = $7,123/yr
One Engineer Maintenance Truck: 3,600 mi/yr ÷ 18 mpg = 200 gal/yr X $1.06/gal = $212/yr
Totals: 7,808 gal/yr X $1.06/gal = $8,276/yr
Miles = 170,640 mi/yr

Electric Energy Costs:
1/2 cents per mile X 170,640 mi/yr = $853/yr

Air Emissions Reductions (Estimate based on nontampered basic exhaust emission rates for low-altitude light-duty gasoline powered late model vehicles for mileage up to 50,000 miles):
Hydrocarbons (HC): 0.544 grams/mi = 0.001 lb/mi X 170,640 mi/yr = 171 lb/yr
Carbon monoxide (CO): 9.387 grams/mi = 0.021 lb/mi X 170,640 mi/yr = 3,583 lb/yr
Nitrogen oxides (NOx): 0.593 grams/mi = 0.001 lb/mi X 170,640 mi/yr = 171 lb/yr
Total air emissions reductions = 3,925 lb/yr.

Lessons Learned:

Risk/Compliance Reductions:

- Reduced air emissions from fueling and use of gasoline for motor vehicles.

Data Sources:

EPR Exhibit 2 Report
Fort Knox Pollution Prevention Investment Fund Summary Information
Exhaust Emission Rates for Low Altitude Light Duty Gasoline Powered Vehicles, Volume II: Mobile Sources (AP-42), pending 5th edition, U.S. EPA
Planet Electric Inc.

Vendor Information:

Planet Electric Inc.
16760 Schoenborn St.
North Hills, CA 91343
1-800-614-1234
http://www.planetelectric.com

Fort Knox Laboratory Distillation Equipment

INSTALLATION: Fort Knox, Kentucky

POC: Donna Schneider, Department of Pathology, Ireland Army Community Hospital
Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Laboratory Distillation Equipment for Formalin, Alcohol, and Americlear (xylene substitute) Recycling
Implementation Date: No data
Funding Source(s): MEDDAC
Project Goals: • Reduce the quantity and cost of purchase, storage, use, and disposal of hazardous materials.
Description of Project: The hospital laboratory uses alcohol, formalin, and Americlear (a xylene substitute) for staining, tissue processing and cover-slipping. This project funded the purchase of two distillation units that recover these chemicals for reuse. The PureForm 2100 is used to recycle formalin. The 9700 ProCycler is used to recycle the xylene substitute and alcohol, reducing the amount of new chemicals used by more than 99%.

ProCycler 9700 and PureForm 2100 Laboratory Distillation Equipment

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY
N/A	PureForm 2100 and ProCycler 9700	$25,000
	Total Unit Investment Cost:	**$25,000**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY
N/A	Laboratory Chemicals	$192
	Total Recurring Annual Cost:	**$192**

Annual Savings
Base Quantity Stream: 780 gal./yr.

	Estimated Annual Savings	
Savings in:	Quantity (units)	Savings ($)
Materials purchase	776 gal.	$37,248
Waste disposal	776 gal.	No data
Labor for disposal	No data	
Transportation for disposal	No data	
Testing	No data	
Pollution controls maintenance	No data	
Pollution controls supplies	No data	
Protective equipment	No data	
Training labor	No data	
Recordkeeping labor	No data	
Process labor	No data	
Other	No data	
Total Reductions/ Savings		**$37,248**

Summary Data

A	**Total Unit Investment Cost:**	$25,000
B	**Total Annual Savings:**	$37,248
C	**Total Annual Recurring Costs:**	$192
D	**Return on Investment (Line B – Line C):**	$37,056

E	**Payback Years (Line A ÷ Line D)**	0.7

Pollutant Reductions/Environmental Benefit

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage	776 gal.
Hazardous Waste Disposal	776 gal.
Solid Waste Disposal	N/A
Air Emissions	N/A
Wastewater Generation	N/A
TRI Chemical Usage	N/A
TRI Chemical Release	N/A

EXAMPLE EPR Exhibit 2 Report

Law/Reg Area	RCRC	Compliance Status:	No data
ECAT:	POLP	Regulatory Driver:	RCRC
Class:	No data	Project Assessment:	No data
Activity/Process:	Hazardous Material Management	Must Fund:	No data
Total Identical Units:	No data	Years Economic Life:	No data
Major Pollutant:	Formalin, alcohol, Americlear		
Base Quantity Stream:	780 gal/yr	Source:	Estimation
Annual Unit Poll Reduction:	776 gal/yr	Source:	Estimation
Unit Investment Cost:	$25,000	Source:	Estimation
Annual Unit Recurring Cost:	$192	Source:	Estimation
Annual Unit Energy Savings:	No data	Source:	
Total Unit Savings:	$37,248	Source:	Estimation
Waste Unit Savings:	No data	Source:	No data
Energy Unit Savings:	No data	Source:	
Labor Unit Savings:	No data	Source:	
O&M Unit Savings:	No data	Source:	
Mtl Procure Unit Savings:	$37,248	Source:	Estimation
Other Unit Savings:	No data	Source:	
Latest FY Start:	No data	Earliest FY Start:	No data

Project Narrative:

The Ireland Army Community Hospital laboratory uses alcohol, formalin, and Americlear (a xylene substitute) for staining, tissue processing, and coverslipping. The laboratory was using 30 gallons every six weeks of each chemical for its processes, for a total of 780 gallons each year. The spent chemicals were disposed of as hazardous waste. In order to reduce the quantity of chemicals used and wastes generated, the MEDDAC funded the purchase of two distillation units that recover these chemicals for reuse. The PureForm 2100 is used to recycle formalin and the 9700 ProCycler is used to recycle the xylene substitute and alcohol. Since implementing this project, the amount of new chemicals required by the laboratory has been reduced to approximately 4 gallons per year.

Assumptions/Calculations:

Quantity of chemicals (formalin, alcohol, and Americlear) used before recycling:
30 gal of each product used every 6 weeks
5 gal/wk X 52 weeks/yr X 3 products = 780 gal/yr

Quantity of new product used for recycling:
1 gal of each product used every 9 months
1.33 gal/yr X 3 products = 4 gal/yr

Estimated cost for new chemicals: $48/gal
Cost to dispose of spent chemicals: No data

Lessons Learned:

- The recovered product may need to be buffered.
- A minimal amount of waste is produced from the distillation process.

Risk/Compliance Reductions:

Reduce the quantity of hazardous waste.

Data Sources:

Donna Schneider, Department of Pathology, Ireland Army Community Hospital

B/R Instrument Corporation
Fisher Scientific

Vendor Information:

B/R Instrument Corporation
9119 Centreville Road
Easton, MD
1-800-922-9206
http://www.brinstrument.com/

Fort Knox Parts Washer Filters

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Install Filters on Parts Washers
Implementation Date: FY97
Funding Source(s): OMA(VEPP)
Project Goals: • Reduce quantity of solvents used for parts washers.
Description of Project: This project provided funds to install filters on solvent parts washers. The filters extend the life of the solvent thus reducing the quantity of solvent purchased and disposed.

Breakdown of Unit Investment Costs (Capital Costs)

Project Number(s)	Item(s)	FY97
KNOX970009	Install filters on parts washers	$28,800
	Total Unit Investment Cost:	**$28,800**

Breakdown of Recurring Annual Costs (Annual Operating Costs)

Project Number(s)	Item(s)	FY98	FY99	FY00	FY01
KNOX970009	Filter replacement and maintenance	No data	No data	No data	No data
KNOX970009	Replacement solvent	No data	No data	No data	No data
	Total Recurring Annual Cost:	No data	No data	No data	No data

Annual Savings
Base Quantity Stream: No data

Savings in:	FY	
	Quantity (units)	Savings ($)
Materials purchase (replacement solvent)	No data	
Waste disposal (used solvent)	No data	
Maintenance and operations	No data	
Transportation for disposal	No data	
Testing	No data	
Pollution controls maintenance	No data	
Pollution controls supplies	No data	
Protective equipment	No data	
Training labor	No data	
Recordkeeping labor	No data	
Process labor	No data	
Other	No data	
Total Reductions/ Savings:		

Summary Data

A	**Total Unit Investment Cost:**	$28,800
B	**Total Annual Savings:**	$0
C	**Total Annual Recurring Costs:**	$0
D	**Return on Investment (Line B – Line C):**	$0

E	**Payback Years (Line A ÷ Line D)**	

Pollutant Reductions/Environmental Benefit

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage	No data
Hazardous Waste Disposal	No data
Solid Waste Disposal	No data
Air Emissions	No data
Wastewater Generation	No data
TRI Chemical Usage	No data
TRI Chemical Release	No data

EPR Exhibit 2 Report for KNOX970009

Law/Reg Area	PRVN	Compliance Status:	ESDL
ECAT:	POLP	Regulatory Driver:	No data
Class:	3	Project Assessment:	H
Activity/Process:	Other	Must Fund:	N
Total Identical Units:	No data	Years Economic Life:	No data
Major Pollutant:	No data		
Base Quantity Stream:	No data	Source:	
Annual Unit Poll Reduction:	No data	Source:	
Unit Investment Cost:	No data	Source:	
Annual Unit Recurring Cost:	No data	Source:	
Annual Unit Energy Savings:	No data	Source:	
Total Unit Savings:	No data	Source:	
Waste Unit Savings:	No data	Source:	
Energy Unit Savings:	No data	Source:	
Labor Unit Savings:	No data	Source:	
O&M Unit Savings:	No data	Source:	
Mtl Procure Unit Savings:	No data	Source:	
Other Unit Savings:	No data	Source:	
Latest FY Start:	No data	Earliest FY Start:	

Project Narrative:

Solvent used in parts washers was routinely replaced, generating used solvent that was disposed of as hazardous waste. This project funded the installation of filters on the parts washers that would extend the life of the solvent in the parts washers and double the service interval for each parts washer. By using the filters, the quantity of new solvent required would be reduced and the quantity of used solvent disposed of as hazardous waste would be reduced.

Lessons Learned:

The filter system was intended to extend the life of the solvent, however the filter system never worked properly, suffered from poor design and installation.

Assumptions/Calculations:

No data.

Risk/Compliance Reductions:

- Reduce the quantity of used solvent disposed of as hazardous waste.

Data Sources:

EPR Exhibit 2 Report

Vendor Information:

No data.

Fort Knox Ultraviolet Disinfection System at the Wastewater Treatment Plant

INSTALLATION: Fort Knox, Kentucky

POC: Joe Yates, Environmental Protection Specialist, Directorate of Base Operations Support, Environmental Management Division

Project Name: Ultraviolet (UV) Disinfection of Secondary Effluent at the Wastewater Treatment Plant (WWTP)
Implementation Date: This project is not operational.
Funding Source(s): OPA
Project Goals: • Reduce the use and storage of large quantities of chlorine at the WWTP. • Reduce EPCRA TRI reporting. • Improve safety at the WWTP.
Description of Project: This project funded the design phase for a replacement of the present chlorine disinfection system at the wastewater treatment plant with an ultraviolet disinfection system. The replacement of chlorine will eliminate an extremely hazardous substance from the EPCRA TRI reporting.

Trojan Technologies Inc. UV Disinfection System

Breakdown of Unit Investment Costs (Capital Costs)*

Project Number(s)	Item(s)	FY98	Totals
KNOX970001	Design Costs for UV Disinfection System	$71,291	$71,291
N/A	Estimated costs for equipment purchase and installation		$698,375
	Total Unit Investment Cost:		**$769,666**

*This project funded only the design costs for the UV system.

Breakdown of Recurring Annual Costs (Annual Operating Costs)*

Project Number(s)	Item(s)	FY
N/A	Estimated operation and maintenance costs	$12,000
	Total Recurring Annual Cost:	**$12,000**

*This project is not operational. Annual operating costs are estimated.

Annual Savings*
Base Quantity Stream: No data

Savings in:	FY	
	Quantity (units)	Savings ($)
Materials purchase (chlorine)	No data	$25,000
Waste disposal	No data	
Maintenance and operations	No data	$70,000
Transportation for disposal	No data	
Testing	No data	
Pollution controls maintenance	No data	
Pollution controls supplies	No data	
Protective equipment	No data	$50,000
Training labor	No data	$95,000
Recordkeeping labor	No data	$65,000
Process labor	No data	
Other	No data	
Total Reductions/ Savings:		$305,000

*This project is not operational. Annual savings are estimated.

Summary Data*

A	**Total Unit Investment Cost:**	$769,666
B	**Total Annual Savings:**	$305,000
C	**Total Annual Recurring Costs:**	$12,000
D	**Return on Investment (Line B – Line C):**	$293,000

E	**Payback Years (Line A ÷ Line D)**	2.6

*This project is not operational. Return on investment is estimated.

Pollutant Reductions/Environmental Benefit*

Estimated Annual Reductions	Quantity (Units)
Hazardous Materials Usage (chlorine)	No data
Hazardous Waste Disposal	No data
Solid Waste Disposal	No data
Air Emissions	No data
Wastewater Generation	No data
TRI Chemical Usage (chlorine)	No data
TRI Chemical Release (chlorine)	No data

*This project is not operational. Pollutant reductions are estimated.

EPR Exhibit 2 Report for KNOX970001

Law/Reg Area	PRVN	Compliance Status:	PSDF
ECAT:	POLP	Regulatory Driver:	EPCRA-Toxic Release Inventory
Class:	2	Project Assessment:	H
Activity/Process:	Hazardous Material Management	Must Fund:	Y
Total Identical Units:	0	Years Economic Life:	15
Major Pollutant:	Chlorine		
Base Quantity Stream:	0 lb/yr	Source:	
Annual Unit Poll Reduction:	0 lb/yr	Source:	
Unit Investment Cost:	$800,000	Source:	Estimation
Annual Unit Recurring Cost:	$45	Source:	Estimation
Annual Unit Energy Savings:	0 kWh/yr	Source:	
Total Unit Savings:	$50,000	Source:	Estimation
Waste Unit Savings:	$0	Source:	
Energy Unit Savings:	$0	Source:	
Labor Unit Savings:	$0	Source:	
O&M Unit Savings:	$0	Source:	
Mtl Procure Unit Savings:	$0	Source:	
Other Unit Savings:	$0	Source:	
Latest FY Start:	2001	Earliest FY Start:	2000

Project Narrative:

Due to the large quantities of chlorine gas used for wastewater treatment, Fort Knox must report chlorine, an extremely hazardous substance, on its EPCRA TRI report. E.O. 13148 requires federal facilities to reduce releases of toxic chemicals by an additional 40 percent prior to December 2006. To meet this goal, Fort Knox has begun a project to replace the present chlorine disinfection system at the wastewater treatment plant with an ultraviolet disinfection system. Installation of this system will reduce the use and storage of large quantities of chlorine at the WWTP.

This project funded the evaluation of the UV disinfection system by Jones Technologies and the development of specifications and design for the system by QEI Engineers, Inc. Several types of systems were evaluated and a system equivalent to the Trojan Technologies Inc. UV3000 system was recommended. Estimated project costs for providing and installing the equipment are $698,375. The annual operation and maintenance costs are estimated at $12,000, which includes maintenance and bulb replacement.

Advantages of the UV disinfection system are that it is environmentally positive (no chemicals needed), provides greater safety for operators (eliminates hazardous chlorine gas), provides greater effectiveness on wide range of pathogens, and has fast treatment times (typically less than 10 seconds). In addition, UV disinfection has the lowest operating cost of any disinfection process. It reduces capital costs, there is no requirement for dechlorination, and there are minimal system maintenance requirements.

Assumptions/Calculations:

This project is not operational. Except for design costs, all costs and savings are estimated.

Lessons Learned:

This project is not operational, however the design phase for the project has been completed.

Anticipated Risk/Compliance Reductions:

- Eliminate chlorine from EPCRA TRI reporting.
- Reduce safety risk to personnel from chlorine gas.

Data Sources:

EPR Exhibit 2 Report
Fort Knox Pollution Prevention Project Description and Project Analysis Worksheet
Fort Knox Engineering Evaluation of Options, July 21, 1999
Fort Knox UV3000Plus Budget Quote, Trojan Technologies Inc., July 8, 1999

Vendor Information:

Trojan Technologies Inc.
2050 Peabody Road, Suite 200
Vacaville, California 95687
(707) 469-2680
www.trojanuv.com

PWTB 200-1-20
7 February 2003