

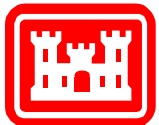
CERL PEPR Program

(Process Energy and Pollution Reduction)



Dr. Mike Lin, ERDC-CERL

Mr. Robert Lorand, SAIC



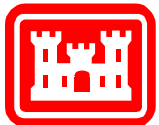
**US Army Corps
of Engineers**

Engineer Research and Development Center

Report Documentation Page				Form Approved OMB No. 0704-0188	
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				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
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15. SUBJECT TERMS					
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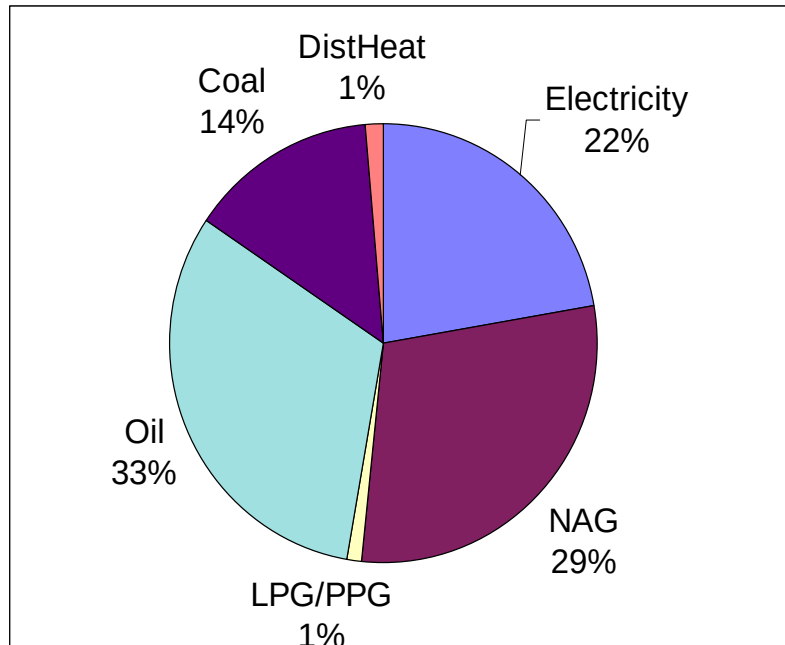
Background

- Industry accounts for 36% of US energy (\$100B/yr)
- DoD spends \$3B/yr, \$280M/yr at industrial facilities
- Process energy is reported on a voluntary basis
- AMC installations consume about 13 TBtu/yr for industrial processes, costing \$72M/yr
- Studies show that 20% reduction is possible
- However, it has not been very effective in DoD due to the lack of an incentive structure
- Most of the industrial facilities are GOCO

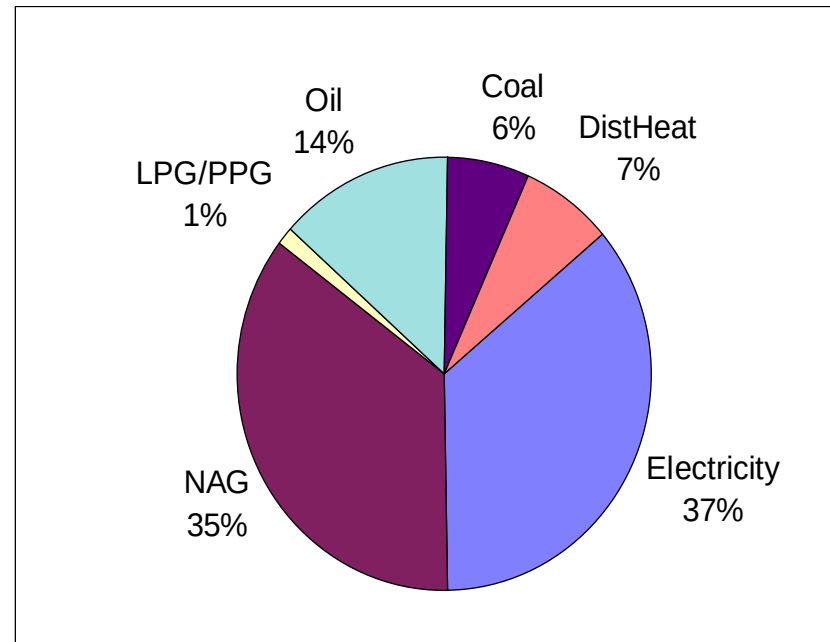


Army Reported Energy Usage

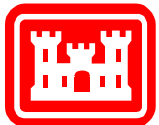
FY 85 – 132 TBtu



FY02 – 82 TBtu

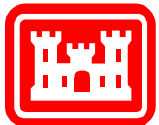


- **AMC installations consume about 13 TBtu/yr for industrial processes, costing \$72M/yr**



DoD Policy Requirements

- **ENERGY:** Executive Order 13123
 - Increase Industrial Efficiency 20% (1990 to 2005)
 - Increase Industrial Efficiency 25% (1990 to 2010)
 - Implement water conservation measures
- **COMPLIANCE:** Executive Order 12856
 - Promote Renewable Energy Technology
 - 50% Reduction in Toxic Pollutant Releases
- **POLLUTION PREVENTION:** Executive Order 12873
 - Incorporate Waste Prevention and Recycling
 - Use 'Environmental Preferable' Products/Services
 - Procurement Guides to Incorporate EPA Guidance

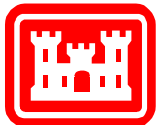


What Is CERL Doing for the Army in Process Energy Optimization?

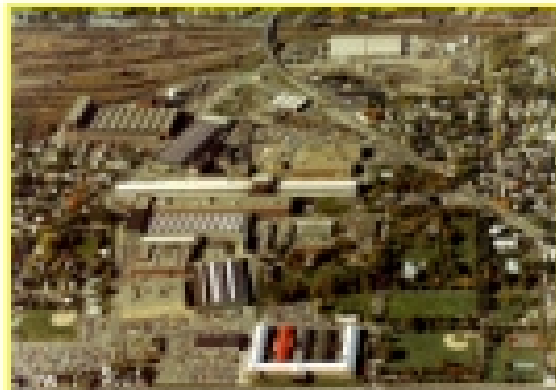
Identify and Demonstrate New opportunities for Army Process Energy and Pollution Reduction (PEPR) Through:

- New Technologies
- Improved Systems and Operational Modifications

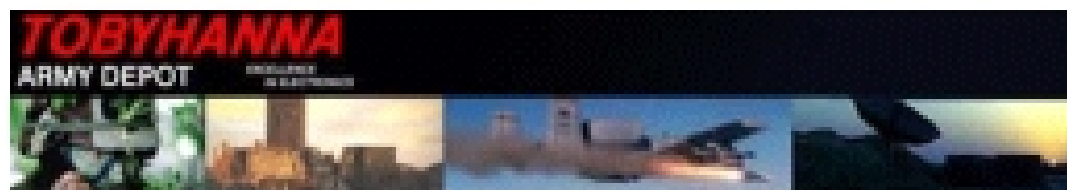
Emphasis is placed on implementing changes that can be applied to numerous military installations with significant industrial activities



Our Customers



Pine Bluff Arsenal



US Army Corps
of Engineers

Engineer Research & Development Center

Recent ERDC-CERL Energy/Environment Projects with AMC

- **Energy**

Process Optimization
Assessment

PBA, WVA, ANAD, TYAD

Heating System Evaluation

PICA, ARL

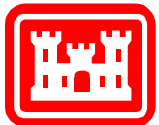
Low NOx Boiler

WVA

Compressed Air System Audit

**APG, CCAD, CEGA, LCAAP,
LSAAP, PBA, PICA, RIA, RSA,
SIAD, WVA**

PEPR Analysis Program &
Process Optimization Guide



US Army Corps
of Engineers

- **Environment**

Hazardous Air Pollutant
(HAP) Control

ANAD, WVA

Acid Mass Balance & Acidic
Wastewater Reduction

Radford AAP

Methylene Control

ANAD

Convert Oil-based to Water-
based Lubricant for
Forging Operation

Scranton AAP

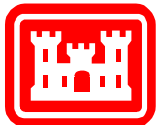
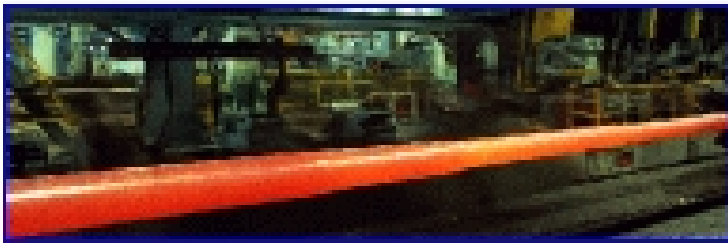
Pinkwater Treatment

McAlester AAP

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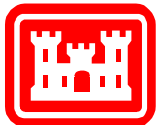
Typical DoD Processes

- Metal working: cutting, welding, machining, heat treating
- Spray painting & de-painting
- Electroplating
- Load, assemble & pack (LAP)
- Explosives/propellants production
- Steam systems
- Compressed air systems
- Motor/engine testing & repair



Major Cost Issues

- Capacity Utilization: Bottlenecks
- Material Utilization: Off-Spec, Scrap, Rework
- Labor: Productivity, Planning/Scheduling
- Energy: Steam, Electricity, Compressed Air
- Waste: Air, Water, Solid, Hazardous
- Equipment: Outdated or State-of-the-Art



Process Optimization

- Extends conventional energy & environmental auditing to production/maintenance processes
- Uses a 12-step methodology and includes all major cost issues
- Financially audits the industrial process
- Links process changes to the “Bottom-line”

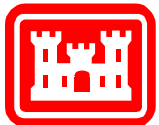
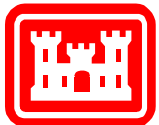
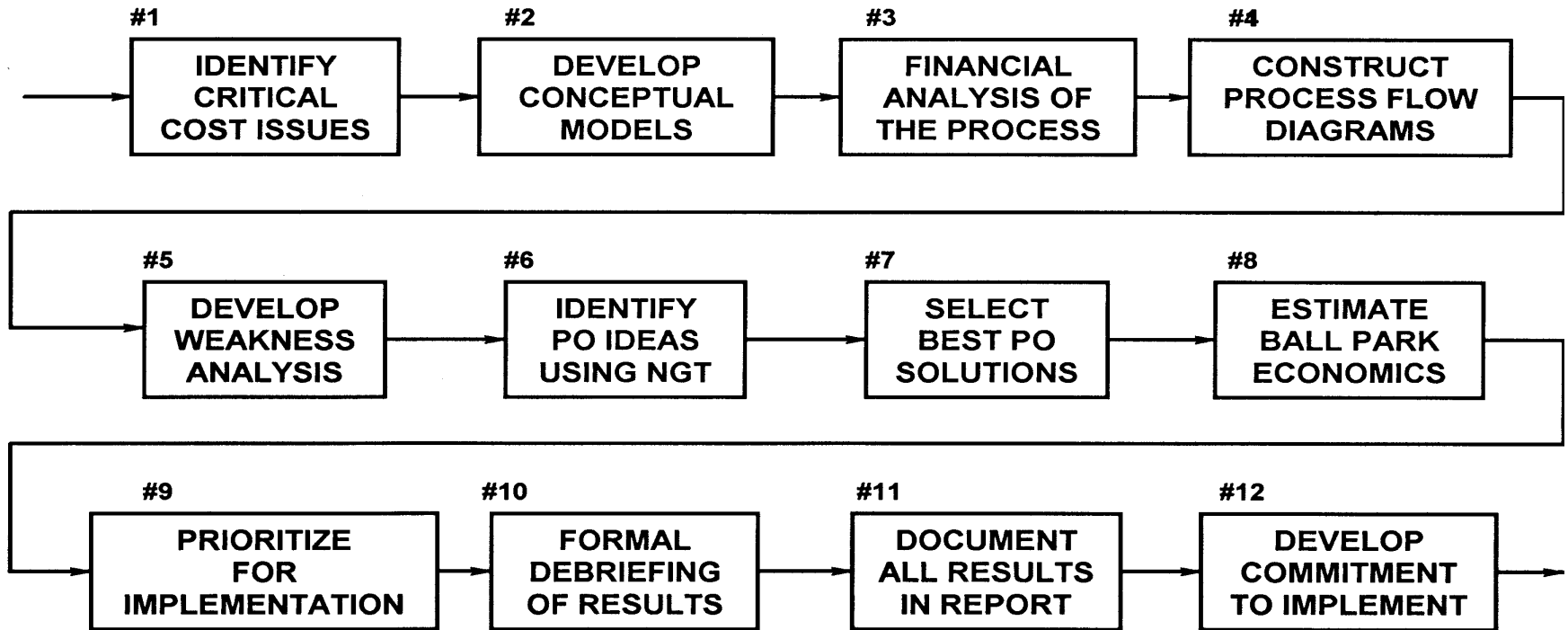


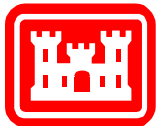
FIGURE 1: TWELVE STEPS OF THE PO METHODOLOGY



Process Energy & Pollution Reduction

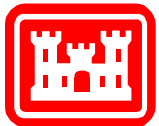
(PEPR) an Analysis Model

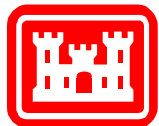
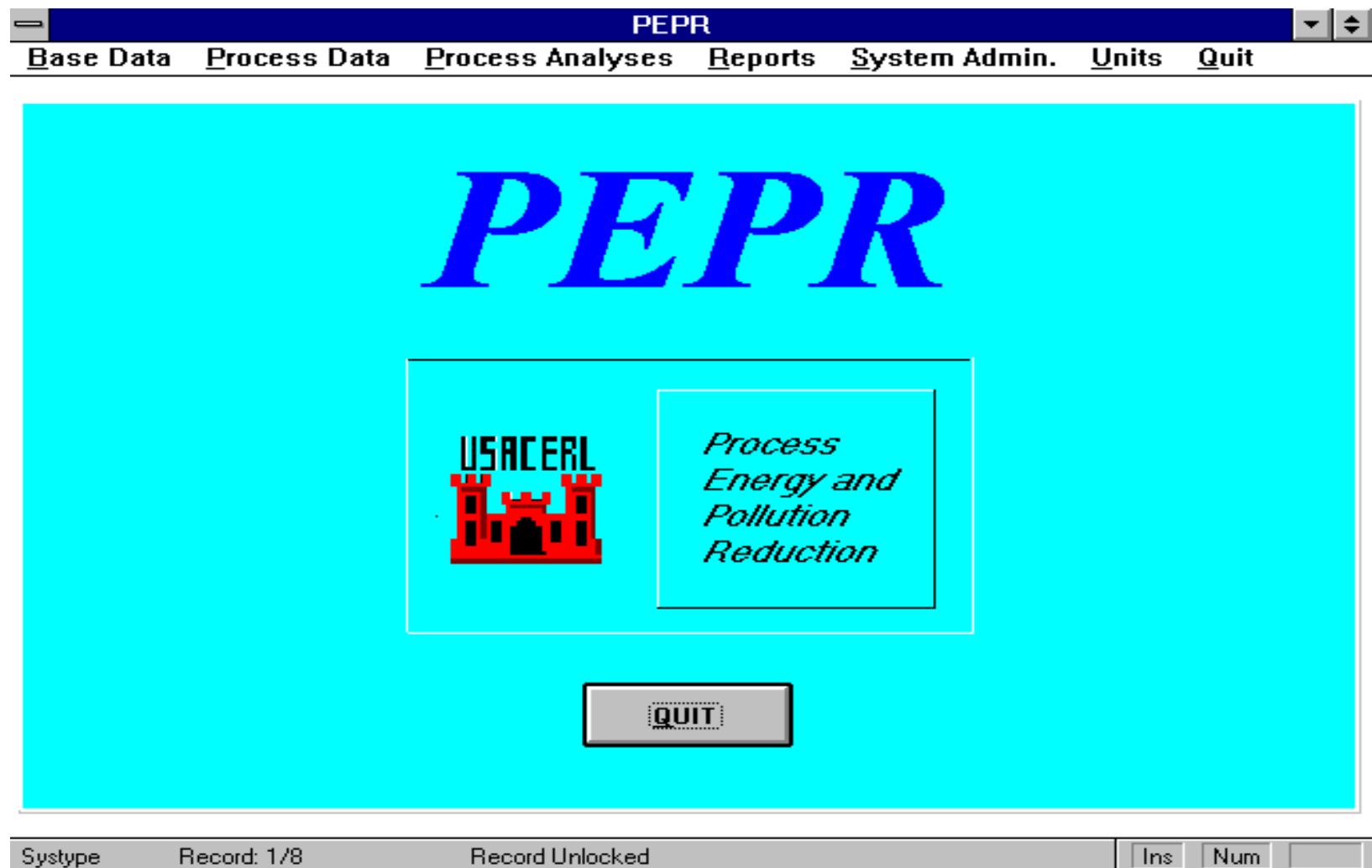
- Builds process database
- Constructs process flow diagram
- Estimates process energy & emissions
- Suggests innovation techniques
- Calculates SIR and PB period
- Provides technical reference & unit conversion
- Screens DoD industrial operations
- Supports technology transfer



Case Examples Contained in PEPR

- Heat Treating
- Spray Painting
- Electroplating
- A Load, Assemble and Pack Line (LAP)
- Explosives Production
- Steam/Hot Water Distribution System
- Compressed Air Distribution System

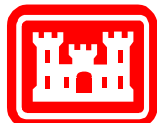




US Army Corps
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PEPR													
Base Data		Process Data		Process Analyses		Reports		System Admin.		Units		Quit	
Military Base													
Base Type				Base Abbreviation		RFAAP				Page 1			
Military Service		ARMY		Base Name		RADFORD AAP							
Major Command		AMC											
Water Service Quantity		4,499,974		Water Service Total Cost		\$571,621							
Water Service Unit Cost		0.13		Water Distribution		826							
Sewage Service Quantity		1,718,332		Sewage Service Total Cost		\$1,874,714							
Sewage Service Unit Cost		1.09		Electric Service Quantity		162,741							
Electric Service Total Cost		\$3,427,581		Electric Service Unit Cost		21.06							
Gas, Oil, & Coal Total Cost		\$6,079,853		Baseline (1985) Energy Consumption		5,055,483							
				Capacity		Consumed							
Gas Fired Heating Plant < .75 MBtu/Hr				1		0							
Gas Fired Heating Plant .75 to 3.5 MBtu/Hr				0		0							
Gas Fired Heating Plant >3.5 MBtu/Hr				0		0							
Coal Fired Heating Plant < .75 MBtu/Hr				0		0							
Coal Fired Heating Plant .75 to 3.5 MBtu/Hr				0		0							
Coal Fired Heating Plant >3.5 MBtu/Hr				1,374		2,326,874							
Oil Fired Heating Plant < .75 MBtu/Hr				0		23							
Oil Fired Heating Plant .75 to 3.5 MBtu/Hr				0		0							
Oil Fired Heating Plant >3.5 MBtu/Hr				0		0							
First		Prev		Next		Last		Locate		Add		Edit	
Delete		Print		Page 2		Close							
Go to first record.										Ins		Num	



PEPR

Base Data Process Data Process Analyses Reports System Admin. Units Quit

Process

Service Base Abbreviation

Process Name Production Line

System Type Process ECO

Process Category Use this process version for aggregations

Unit Product Name or Material Processed

Annual Production, units/yr ONE UNIT measures:

Production Capacity, unit/hr Scale Factor

Technical Description

Data Source

Batch or Continuous Number of Shifts/week

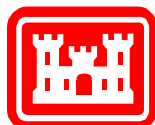
Operating Hours per Year Number of Production Lines Designation

Operational Hazard

Product Quality Variables #1 #4

#2 #5

#3



[illegible]

PEPR

Base Data Process Data Process Analyses Reports System Admin. Units Quit

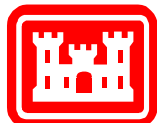
Please Select Both a Baseline and a Comparison Process

Service	Base	Process Category	Process Name	Process ECO	Production Line
ARMY	ANAD	PAINTBOOTH	VEHICLE DRIVE-THRU, WATER	EXISTING	B433
ARMY	ANAD	PAINTBOOTH	VEHICLE DRIVE-THRU, WATER	INSTALL DRY FILTER	B433
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELL	EXISTING	LL3
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELLS	HEAT TIMER-CONTROLLER	LL3
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELLS	INSULATE HEATING PIPING	LL3
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELLS	INSULATE PROCESS EQUIP.	LL3
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELLS	INSULATE PROCESS PIPING	LL3
ARMY	IWAAP	LAPPROCESS	LAP M106 SHELLS	USE NAT.GAS IN P-C OVENS	LL3
ARMY	RFAAP	EXPLOSIVES	NITROCELLULOSE	CONVERT DRYER TO N.G.	A
ARMY	RFAAP	EXPLOSIVES	NITROCELLULOSE	EXISTING	A
ARMY	RFAAP	EXPLOSIVES	NITROCELLULOSE	HT. EXCHANGE FOR PREHEAT	A
ARMY	RFAAP	EXPLOSIVES	NITROCELLULOSE	INS. BOILING, PORCHER TUBS	A
ARMY	RFAAP	EXPLOSIVES	NITROCELLULOSE	USE INFRA-RED DRYER	A
ARMY	RIARS	PAINTBOOTH	VEHICLE DRIVE-THRU, WATER	AUTO. DAMPERS CLOSE FLUE	B208
ARMY	RIARS	PAINTBOOTH	VEHICLE DRIVE-THRU, WATER	CENTRICLEAN SYSTEM	B208

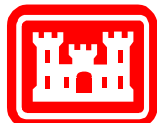
 "Baseline" process RFAAP NITROCELLULOSE EXISTING A

 "Comparison" process RFAAP NITROCELLULOSE HT.EXCHANGE FOR PREHEAT A

Process Record: 23/52 Record Unlocked



PEPR					
Base Data		Process Data		Process Analyses	
Reports		System Admin.		Units	
Quit					
Differences between Baseline and Comparison Processes - Page 1					
Unit Product	Baseline	NITROCELLULOSE@30% MOIST		Annual Production	28,000,000
	Comparison	NITROCELLULOSE@30% MOIST		(units/yr)	28,000,000
<i>Economic Analysis</i>					
Region (PADD)	3				
General Discount Factor	14.74	Demand Discounted Savings	\$0.00 \$		
Electricity Discount Factor	15.61	Electricity Discounted Savings	\$0.00 \$		
Gas Discount Factor	20.96	Gas Discounted Savings	\$0.00 \$		
Oil Discount Factor	17.56	Oil Discounted Savings	\$0.00 \$		
Coal Discount Factor	17.58	Coal Discounted Savings	\$6,172,591.15 \$		
Water Cost Savings	\$0.00 \$/yr				
Water Treatment Cost Savings	\$0.00 \$/yr				
Annual O & M Savings	\$0.00 \$/yr	<i>Discounted Savings</i>			
Annual Non-Energy Cost Savings	\$0.00 \$/yr	Non-Energy	\$0.00 \$		
Annual Energy Cost Savings	\$351,114.40 \$/yr	Energy	\$6,172,591.15 \$		
Total Annual Savings	\$351,114.40 \$/yr	Total	\$6,172,591.15 \$		
Total Investment	\$130,700.00 \$	Savings-to-Investment Ratio	47.22717		
Adjusted Economic Life	20.00 years	Adj. Internal Rate of Return	26.11 %		
Simple Payback	0.37 years	Payback Test Flag	1		
Page 2 Page 3 Page 4 Close					
Compare		Record: 1/1		Exclusive	
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Process Energy and Pollution Reduction - [Report: Process_List]

File Window Help

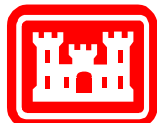
1/15/96 16:30 Summary of Processes in Process Database Page 2

Process Category	Service	Base Abbreviation	Process Name	Process Description (Existing or ECO Name)	Production Line
LAPPROCESS	ARMY	IWAAP	LAP M10 SHELLS	HEAT TIMER-CONTROLLER	LL3
LAPPROCESS	ARMY	IWAAP	LAP M10 SHELLS	INSULATE HEATING PIPING	LL3
LAPPROCESS	ARMY	IWAAP	LAP M10 SHELLS	INSULATE PROCESSEQUIP.	LL3
LAPPROCESS	ARMY	IWAAP	LAP M10 SHELLS	INSULATE PROCESSPIPING	LL3
LAPPROCESS	ARMY	IWAAP	LAP M10 SHELLS	USE NAT.GASIN PC OVENS	LL3
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERSCLOSE FLUE	B403
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	EXISTING	B403
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	INSTALL DRY FILTER	B403
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERSCLOSE FLUE	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	CENTRICLEAN SYSTEM	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	DECREASE AIR CIRCULATION	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	EXISTING	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	W/LP SPRAY GUN	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	INSTALL DRY FILTER	B208
PAINTBOOTH	NAVY	NRFLK	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERSCLOSE FLUE	B1499
PAINTBOOTH	NAVY	NRFLK	VEHICLE DRIVE-THRU,WATER	EXISTING	B1499
PLATING	AIR FORCE	REAFB	PLATING SHOP	ELECTRIC AGITATION	B142
PLATING	AIR FORCE	REAFB	PLATING SHOP	EXISTING	B142
PLATING	AIR FORCE	REAFB	PLATING SHOP	FLOATING BALLSINTANKS	B142
PLATING	AIR FORCE	REAFB	PLATING SHOP	NAT.GASFORHEAT.TANKS	B142
PLATING	AIR FORCE	REAFB	PLATING SHOP	REDUCE OVERPLATING	B142

Page: 2

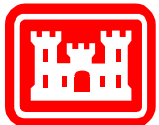
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Energy Savings and Investments for All DoD Process-Oriented Bases

	Annual Use MBtu	Identified Savings		Identified In vestments	
		% Annual Use	MBtu/yr	\$/Annual MBtu	\$M
Thermal Energy					
A M C Bases (29)	13,328,980	22.8	3,039,007	5.22	15.86
A EDC + A L C s (5)	6,163,819	14.2	875,262	3.82	3.34
N a v a l Bases	10,892,704	8.7	947,664	11.43	10.84
Electricity					
A M C Bases (29)	4,997,411	8.4	419,783	20.33	8.53
A EDC + A L C s (5)	7,384,623	2.1	155,077	33.35	5.17
N a v a l Bases	6,150,884	3.7	227,582	16.52	3.76
Total Energy					
A M C Bases (29)	18,326,391	19	3,458,790	7.05	24.39
A EDC + A L C s (5)	13,548,442	8	1,030,339	8.26	8.51
N a v a l Bases	17,043,588	7	1,175,246	12.42	14.60
Totals	48,918,421	12	5,664,375	8.39	47.50



**Pollution Abatement Associated with
Energy Savings and Investments for All DoD Process-Oriented Bases**

	SO_x Abated, tons/yr	NO_x Abated, tons/yr	CO Abated, tons/yr	CO₂ Abated, tons/yr
Thermal Energy				
A M C Bases (29)	2,528.42	584.53	193.95	254,443
A E D C + A L C Bases (5)	3.09	60.22	14.88	50,555
Naval Bases	492.26	133.96	39.36	73,929
Electricity				
A M C Bases (29)	1,198.95	244.65	86.45	87,604
A E D C + A L C Bases (5)	426.53	90.36	31.64	33,817
Naval Bases	276.60	62.08	19.94	28,121
Total Energy				
A M C Bases (29)	3,727.37	829.18	280.40	342,047
A E D C + A L C Bases (5)	428.62	150.58	46.52	84,372
Naval Bases	768.86	196.04	59.30	102,050
Totals	4,924.85	1,175.80	386.22	528,470



**US Army Corps
of Engineers**

Engineer Research and Development Center

ERDC-CERL Support to Industrial Energy

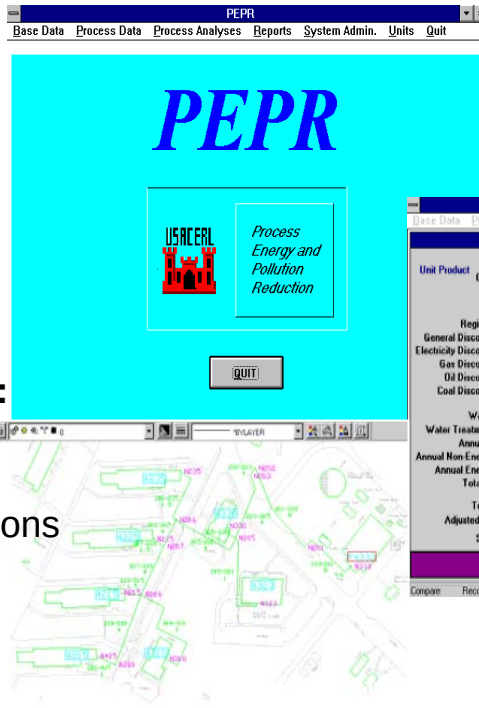
**Research for
decision
support tools**

HEATER/Heatmap:

- PICA
- ARL-Adelphi
- and troop installations

*Estimate life cycle cost of
repair, replacement, and
upgrade options.*

*Minimizes greenhouse
pollutants*



PEPR audits:

- PBA
- WVA
- ANAD
- TYAD

*Average 20% + increase in
process energy efficiency &
reduced O&M costs*

**Technology
demonstration
projects**

Differences between Baseline and Comparison Processes - Page 1			
Unit Product	Baseline: NITROCELLULOSE @ 30% MOIS 1	Comparison: NITROCELLULOSE @ 30% MOIS 1	Annual Production (units/yr): 20,000,000
Economic Analysis			
Region (PAD0)	3		
General Discount Factor	14.74	Demand Discounted Savings	\$0.00 \$
Electricity Discount Factor	15.61	Electricity Discounted Savings	\$0.00 \$
Gas Discount Factor	20.96	Gas Discounted Savings	\$0.00 \$
Oil Discount Factor	17.56	Oil Discounted Savings	\$0.00 \$
Coal Discount Factor	17.50	Coal Discounted Savings	\$6,172,591.15 \$
Discounted Savings			
Water Cost Savings	\$0.00 \$/yr	Non Energy	\$0.00 \$
Water Treatment Cost Savings	\$0.00 \$/yr	Energy	\$6,172,591.15 \$
Annual O & M Savings	\$0.00 \$/yr	Total	\$6,172,591.15 \$
Annual Non-Energy Cost Savings	\$251,114.40 \$/yr		
Annual Energy Cost Savings	\$251,114.40 \$/yr		
Total Annual Savings	\$502,228.80 \$/yr		
Total Investment	\$130,700.00 \$	Savings-to-Investment Ratio	47.22717
Adjusted Economic Life	20.00 years	Adj. Internal Rate of Return	26.11 %
Simple Payback	0.37 years	Payback Test Flag	1

**Low NOx Boiler
Demo's:**

- WVA
- and 3 troop
installations

*Average total energy
savings per plant =
~44%*

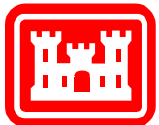


NGEDAC Demo's:

- PICA
- WVA
- SIAD

Industrial Energy Optimization

<u>Action</u>	<u>Where</u>	<u>When</u>
PO Workshop & Audits	Pine Bluff Arsenal, AR	June 94 & Aug 96
PO Audit	Anniston Army Depot, AL	July 1995
PEPR Software	CERL	May 1996
PO Workshop & Audits	Watervliet Arsenal, NY	Feb 1999
PO Guide	CERL	May 1999
PEPR Enhancement	CERL	June 2000
PO Workshop & Audit	Tobyhanna Army Depot, PA	June 2002
PO Audit	Ft. Leonard Wood, MO	April 2003
PO Audit	Ft. Carson, CO	May 2003



Process Optimization Assessment at Ft. Leonard Wood and Ft. Carson

The 5-Day Audit Covered the Following Industrial Processes:

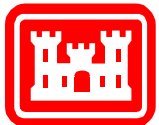
- (1) Central heating plants
- (2) Laundry
- (3) Painting and Media blasting
- (4) Engine overhaul and Vehicle repair

We Identified Opportunities, for each Process, to:

- (1) Improve Performance
- (2) Increase Efficiency and to Reduce Energy and Emissions including
Air, Water and Solid Waste.

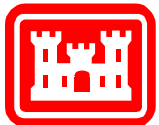
We Developed, for each Process:

- (1) Preliminary Capital Investments
- (2) Potential Cost Savings from Process Optimization and Improvement

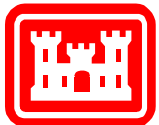


Process Optimization Assessment Results

Army Base	Fort Leonard Wood	Fort Carson
# of Post Wide ECM	5	10
# of Heating Plant ECM	11	9
# of Laundry ECM	4	N/A
# of Maintenance Complex ECM	6	10
Total # of ECMs	26	29
Savings	\$1,963,275	\$2,117,250
Investment	\$1,929,300	\$1,250,300
Simple Payback	1 yr.	0.6 yr



NGEDAC Demonstrations



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ERDC/CERL Technical Reports

“Energy Conservation and Air Toxic Compliance Plan for DoD Industrial Facilities”

“Level I Process Energy Review and PEPR Workshop at Pine Bluff Arsenal”

“Level II Audit of White Phosphorus Dry-Fill Process at Pine Bluff Arsenal”

“Level II Audit of Smoke Grenade Manufacturing Process at Pine Bluff Arsenal”

“Development of Process Energy and Pollution Reduction Analysis Tool”

“Identification of PEPR Opportunities at DoD Industrial Facilities”

“Process Optimization Guide for Military Manufacturing and Maintenance Facilities”

“PEPR Level I Review at the Watervliet Arsenal”

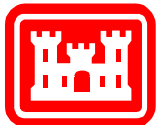
“Applications Guide for Compressed Air Systems”

“Compressed Air System Survey at Army Industrial Facilities”

“Demonstration of Natural Gas Engine Driven Air Compressor at Army Industrial Facilities”

“Process Energy Optimization Level I Review, Tobyhanna Army Depot, PA”

“Process Optimization Assessment, Fort Leonard Wood, MO and Fort Carson, CO”



US Army Corps
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Engineer Research and Development Center

Summary and Conclusions

- **Energy Can Be Used to Improve Process Performance, Directly Contributing to the Business Bottom Line.**
- **Energy is an Important Solution Tool. However, Rethinking and Optimizing All Inputs to the Process Systems are the Total Answer.**
- **The 2-5 Day POA Provides the Change, Focus and Speed to Achieve Significantly Faster and Far Greater Profitability than Other Traditional Energy Audit Approaches.**
- **The PEPR Program Facilitate Data Collection, Analysis and Technology Transfer**

*Thank
You !*

