



U.S. Department of Energy

**Energy Efficiency
and Renewable Energy**

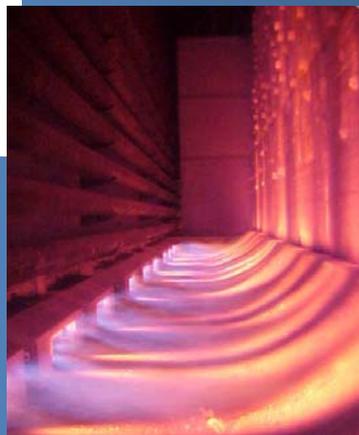
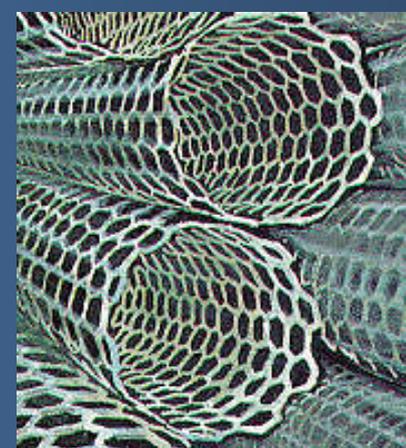
Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

Save ENERGY Now Webcast Series

ITP Software Decision Tools Awareness

Presented by Bill Orthwein

October 23, 2008



What Is the Industrial Technologies Program ?

The Industrial Technologies Program (ITP) is the lead federal agency responsible for improving energy efficiency in the largest energy-using sector of the country.

Together with our industry partners, we strive to:

- Accelerate adoption of the many energy-efficient technologies and practices available today
- Conduct vigorous technology innovation to radically improve future energy diversity, resource efficiency, and carbon mitigation
- Promote a corporate culture of energy efficiency and carbon management



Industrial Sector National Initiative

Goal:

Drive a 25% reduction in industrial energy intensity by 2017.

Save 
ENERGY
 **Now**



Technology Delivery Products and Services



Information

- Website
- Information Center
- Tip Sheets
- Case studies
- Webcasts
- Emerging Technologies



Tools

- Process Heating
- Steam Systems
- Plant Energy Profiler
- Motors & Pumps
- Fans



Standards

- Plant Certification



Training

- Basic
- Advanced
- Qualified Specialist



Assessments

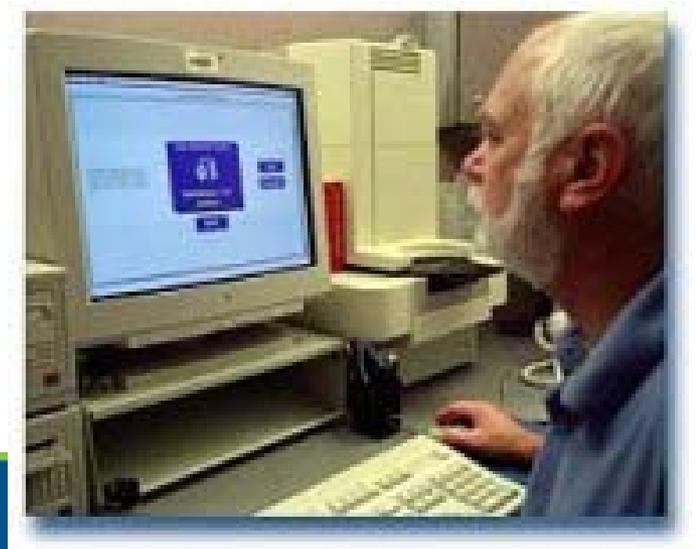
- Energy Savings Assessments
- Industrial Assessment Centers



DOE Power Based Software Decision Support Tools Available Online

- ❑ **Motor Master +** - Assists in energy-efficient motor selection and management. (International)
- ❑ **Pumping System Assessment Tool** - Assesses the efficiency of pumping system operations.
- ❑ **Fan System Assessment Tool** - Quantifies potential benefits of a more optimally configured fan system
- ❑ **Air Master+** - Provides comprehensive information on assessing compressed air systems.
- ❑ **Chilled Water System Assessment Tool** - Assesses the efficiency of a chilled water system.

<http://www1.eere.energy.gov/industry/bestpractices/software.html>



DOE Fuel Based Software Decision Support Tools Available Online

- ❑ **Steam System Scoping Tool** - Profiles and grades large steam system operations/management.
- ❑ **Steam System Assessment Tool** - Assesses potential benefits of specific steam-system improvements.
- ❑ **3EPlus Insulation Assessment Tool** - Calculates most economical thickness of insulation for a variety of operating conditions.
- ❑ **Process Heating Assessment and Survey Tool** - Assesses energy use in furnaces, ovens and kilns along with performance improvements
- ❑ **NOx and Energy Assessment Tool (NxEAT)** - Analyzes NOx emissions and energy efficiency improvements
- ❑ **Plant Energy Profiler** - Profiles plant energy supply along consumption streams and identifies energy savings opportunities

<http://www1.eere.energy.gov/industry/bestpractices/software.html>



Application of the Pumping System Assessment Tool



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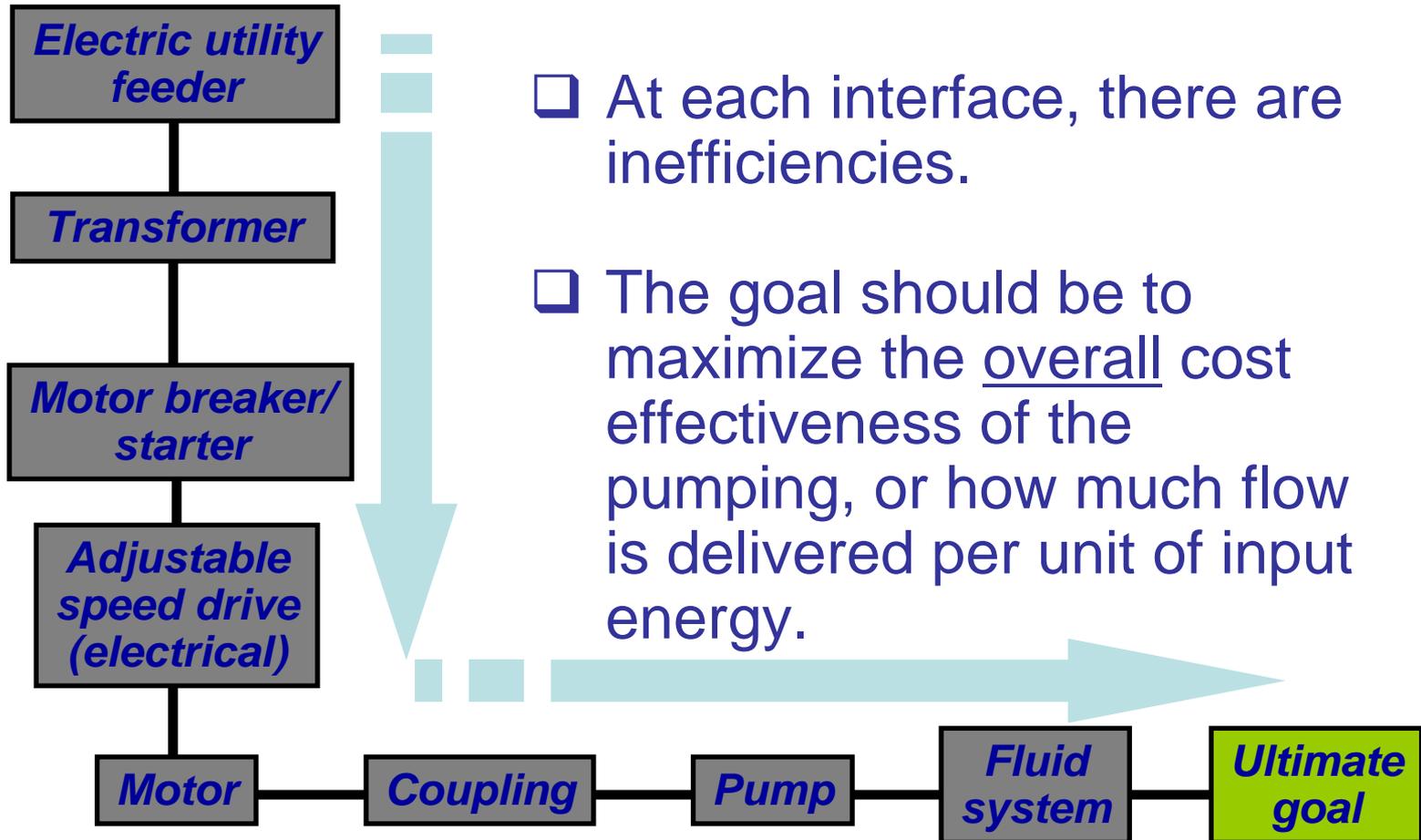
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Introduction to the Pumping System Assessment Tool (PSAT)

- ❑ Goal: To assist pump users in identifying pumping systems that are the most likely candidates for energy and cost savings
- ❑ Requires field measurements or estimates of flow rate, pressure, and motor power or current
- ❑ Uses pump and motor performance data from Hydraulic Institute standard ANSI/HI-1.3 and MotorMaster+ to estimate existing, achievable performance



Overview of Energy Flow for Pumping Systems



Applying the PSAT Tool to the Measured Conditions Shows Significant Potential Savings

Pump, motor, system information:

Pump style: API double suction
 Pump nameplate speed, rpm: 1785
 Fluid viscosity (cS): 1.0
 Specific gravity: 1.00
 Number of stages: 1
 Std nameplate hp: 350
 Motor nameplate speed, rpm: 1785
 Existing motor class: Standard efficiency
 Nominal motor voltage, volts: 2300

Operating parameters:

Operating fraction: 1.000
 Electricity cost, cents/kwhr: 5.40

Measured or required conditions:

Measured flow rate: 1200 gpm
 Measured head: 367.0 ft
 Load estimation method: Power
 Measured power: 154.0 kWe
 Measured bus voltage: 2370

Input basis:

Measured
 Required

STOP

	Existing pump, motor	Existing pump, EE motor	Optimal pump, EE motor
Pump efficiency, %	57.4	57.4	72.5
Motor rated hp	350	350	200
Shaft power, hp	193.6	193.6	138.6
Motor efficiency, %	93.8	95.3	95.6
Motor power factor, %	79.6	79.7	82.5
Motor current, amps	47.1	46.3	31.9
Electric power, kWe	154.0	151.5	108.2
Annual energy, MWhr	1349.0	1327.3	947.4
Annual cost, \$1,000	72.8	71.7	51.2
Annual savings, \$1,000	0.0	1.2	21.7

Size margin (%) for optimal pump motor: 25

Optimization rating

70.2

Click for background information

Existing summary files: CREATE NEW

Log current data | Retrieve Log data | Create new or append existing summary file -->

Facility: Y-12, Fusion | System: Demineralized water | Date: January 26, 1999
 Application: Low pressure pump J104 | Evaluator: Don Casada

Notes: Current and voltage monitored from secondary of CT's, PT's; head from suction, discharge test gauges. Flow curve. (Data acquired following J102 motor replacement with 6-pole motor)

Potential Annual Savings: \$22K



Using the Required Head Estimate Instead of the Actual Operating Head Can Yield Much Greater Savings

Pump, motor, system information:

Pump style: API double suction
 Pump nameplate speed, rpm: 1785
 Fluid viscosity (cS): 1.0
 Specific gravity: 1.00
 Number of stages: 1
 Motor size selection: Custom
 Std nameplate hp: 350
 Motor nameplate speed, rpm: 1785
 Existing motor class: Standard efficiency
 Nominal motor voltage, volts: 2300

Operating parameters:

Operating fraction: 1.000
 Electricity cost, cents/kwhr: 5.40

Measured or required conditions:

Required flow rate: 1200 gpm
 Required head: 140.0 ft
 Load estimation method: Power
 Measured power: 154.0 kWe
 Measured bus voltage: 2370

Input basis:

Measured
 Required

STOP

	Existing pump, motor	Existing pump, EE motor	Optimal pump, EE motor
Pump efficiency, %	21.9	21.9	79.3
Motor rated hp	350	350	75
Shaft power, hp	193.6	193.6	52.9
Motor efficiency, %	93.8	95.3	94.7
Motor power factor, %	79.6	79.7	81.2
Motor current, amps	47.1	46.3	12.5
Electric power, kWe	154.0	151.5	41.7
Annual energy, MWhr	1349.0	1327.3	365.0
Annual cost, \$1,000	72.8	71.7	19.7
Annual savings, \$1,000	0.0	1.2	53.1

Size margin (%) for optimal pump motor: 25

Optimization rating

27.1

Click for background information

Existing summary files
 CREATE NEW

Log current data
 Retrieve Log data
 Create new or append existing summary file -->

Facility: Y-12, Fusion
 System: Demineralized water
 Date: January 26, 1999
 Application: Low pressure pump J104
 Evaluator: Don Casada

Notes: Current and voltage monitored from secondary of CT's, PT's. Flow rate estimated from head curve. (Data replacement with 6-pole motor). The head and flow rate represent estimate requirements (head is conservative)

Potential Annual Savings: \$53K



Application of AirMaster+: A Compressed Air Systems Assessment Tool



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AirMaster+ Can Be Used to Baseline a Compressed Air System and Then Evaluate the Energy Savings from Seven EEM's

Reduce Plant Air Leaks

Adjust Manual Staging

Use Unloading Controls

Reduce System Pressure

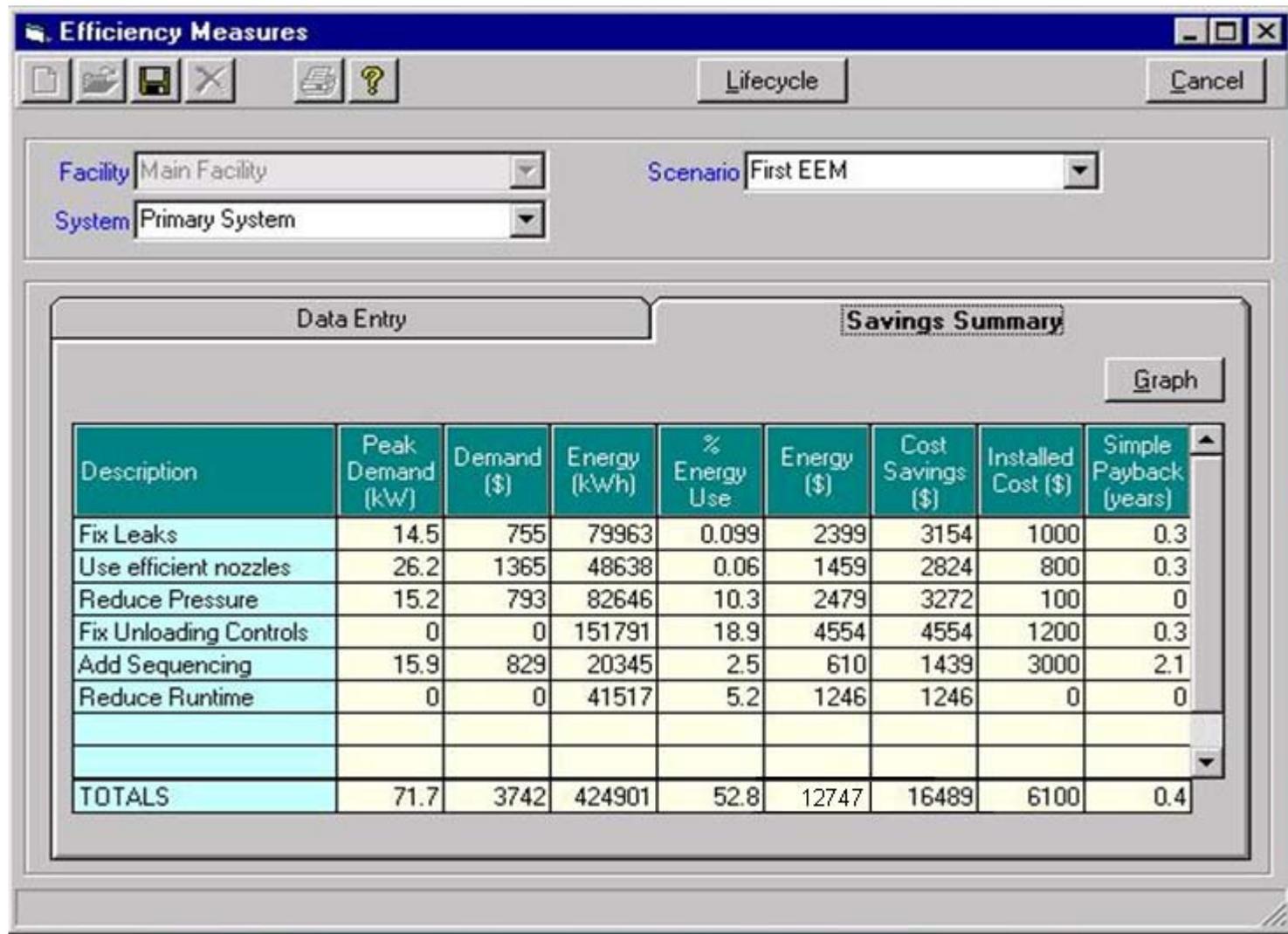
Sequence Compressors

Reduce Run Time

Add Primary Storage



Savings Summary Report



Application of the Steam System Assessment Tool (SSAT)



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Steam System Assessment Tool (SSAT)

□ **PURPOSE:**

Demonstrate the magnitude of energy, cost, and emission savings related to specific steam system improvement opportunities

□ **AUDIENCE:**

Engineers involved with operation and/or improvement of steam systems



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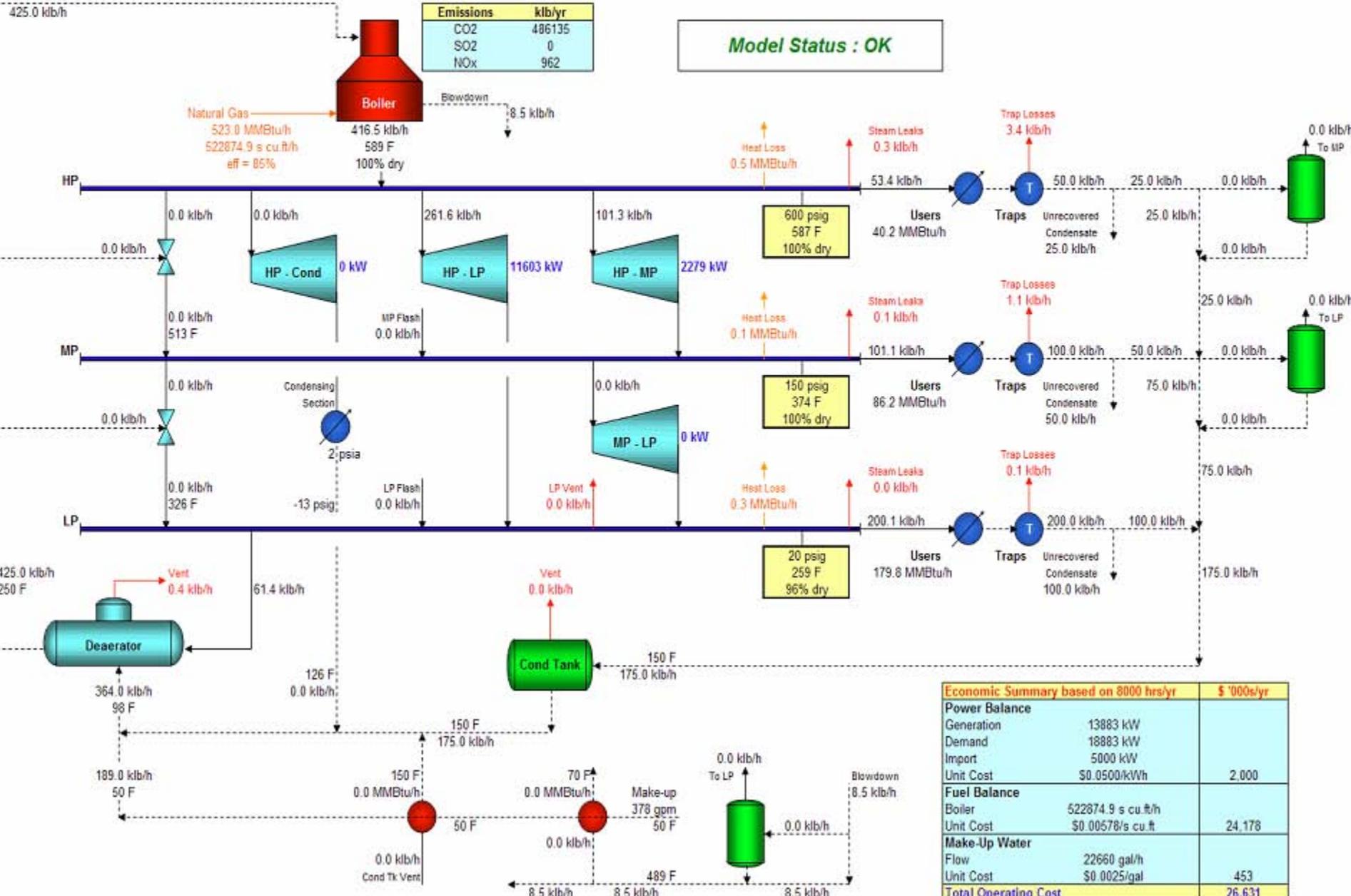
Steam System Assessment Tool

SSAT Default 3 Header Model

Current Operation

Emissions	klb/yr
CO2	486135
SO2	0
NOx	962

Model Status : OK



Economic Summary based on 8000 hrs/yr		\$ '000s/yr
Power Balance		
Generation	13883 kW	
Demand	18883 kW	
Import	5000 kW	
Unit Cost	\$0.0500/kWh	2.000
Fuel Balance		
Boiler	522874.9 s cu.ft/h	
Unit Cost	\$0.00578/s cu.ft	24.178
Make-Up Water		
Flow	22660 gal/h	
Unit Cost	\$0.0025/gal	453
Total Operating Cost		26,631

You Can Use SSAT to Evaluate These Key Steam Improvement Initiatives

- Real Cost Of Steam
- Steam Quality
- Boiler Efficiency***
- Alternative Fuels
- Cogeneration Opportunities
- Steam Turbines vs PRVs
- Boiler Blowdown
- Condensate Recovery***
- Steam Trap Operating Efficiency***
- Heat Recovery
- Vent Steam
- Steam Leaks
- Insulation Efficiency
- Emissions Calculations



Steam System Assessment Tool

3 Header Model

Results Summary

SSAT Default 3 Header Model

Model Status : OK

Cost Summary (\$ '000s/yr)	Current Operation	After Projects	Reduction	
Power Cost	2,000	2,000	0	0.0%
Fuel Cost	24,178	22,835	1,343	5.6%
Make-Up Water Cost	453	453	0	0.0%
Total Cost (in \$ '000s/yr)	26,631	25,288	1,343	5.0%

On-Site Emissions	Current Operation	After Projects	Reduction	
CO2 Emissions	486135 klb/yr	459127 klb/yr	27007 klb/yr	5.6%
SOx Emissions	0 klb/yr	0 klb/yr	0 klb/yr	N/A
NOx Emissions	962 klb/yr	909 klb/yr	53 klb/yr	5.6%

Power Station Emissions	Reduction After Projects		Total Reduction	
CO2 Emissions	0 klb/yr		27007 klb/yr	-
SOx Emissions	0 klb/yr		0 klb/yr	-
NOx Emissions	0 klb/yr		53 klb/yr	-

Note - Calculates the impact of the change in site power import on emissions from an external power station. Total reduction values are for site + power station

Utility Balance	Current Operation	After Projects	Reduction	
Power Generation	13883 kW	13883 kW	-	-
Power Import	5000 kW	5000 kW	0 kW	0.0%
Total Site Electrical Demand	18883 kW	18883 kW	-	-
Boiler Duty	523.0 MMBtu/h	494.0 MMBtu/h	29.1 MMBtu/h	5.6%
Fuel Type	Natural Gas	Natural Gas	-	-
Fuel Consumption	522874.9 s cu.ft/h	493826.3 s cu.ft/h	-	-
Boiler Steam Flow	416.5 klb/h	416.5 klb/h	0.0 klb/h	0.0%
Fuel Cost (in \$/MMBtu)	5.78	5.78	-	-
Power Cost (as \$/MMBtu)	14.65	14.65	-	-
Make-Up Water Flow	22660 gal/h	22660 gal/h	0 gal/h	0.0%

Steam System Assessment Tool

3 Header Model

Results Summary

SSAT Default 3 Header Model

Model Status : OK

Cost Summary (\$ '000s/yr)	Current Operation	After Projects	Reduction	
Power Cost	2,000	2,172	-172	-8.6%
Fuel Cost	24,178	22,304	1,874	7.7%
Make-Up Water Cost	453	243	210	46.4%
Total Cost (in \$ '000s/yr)	26,631	24,719	1,912	7.2%

On-Site Emissions	Current Operation	After Projects	Reduction	
CO2 Emissions	486135 klb/yr	448464 klb/yr	37670 klb/yr	7.7%
SOx Emissions	0 klb/yr	0 klb/yr	0 klb/yr	N/A
NOx Emissions	962 klb/yr	888 klb/yr	75 klb/yr	7.7%

Power Station Emissions	Reduction After Projects		Total Reduction	
CO2 Emissions		-5389 klb/yr	32281 klb/yr	-
SOx Emissions		-17 klb/yr	-17 klb/yr	-
NOx Emissions		-12 klb/yr	62 klb/yr	-

Note - Calculates the impact of the change in site power import on emissions from an external power station. Total reduction values are for site + power station

Utility Balance	Current Operation	After Projects	Reduction	
Power Generation	13883 kW	13454 kW	-	-
Power Import	5000 kW	5429 kW	-429 kW	-8.6%
Total Site Electrical Demand	18883 kW	18883 kW	-	-
Boiler Duty	523.0 MMBtu/h	482.5 MMBtu/h	40.5 MMBtu/h	7.7%
Fuel Type	Natural Gas	Natural Gas	-	-
Fuel Consumption	522874.9 s cu.ft/h	482357.6 s cu.ft/h	-	-
Boiler Steam Flow	416.5 klb/h	406.9 klb/h	9.7 klb/h	2.3%
Fuel Cost (in \$/MMBtu)	5.78	5.78	-	-



Steam System Assessment Tool

3 Header Model

Results Summary

SSAT Default 3 Header Model

Model Status : OK

Cost Summary (\$ '000s/yr)	Current Operation	After Projects	Reduction	
Power Cost	2,000	2,197	-197	-9.9%
Fuel Cost	24,178	22,051	2,126	8.8%
Make-Up Water Cost	453	234	220	48.4%
Total Cost (in \$ '000s/yr)	26,631	24,483	2,148	8.1%

On-Site Emissions	Current Operation	After Projects	Reduction	
CO2 Emissions	486135 klb/yr	443383 klb/yr	42752 klb/yr	8.8%
SOx Emissions	0 klb/yr	0 klb/yr	0 klb/yr	N/A
NOx Emissions	962 klb/yr	878 klb/yr	85 klb/yr	8.8%

Power Station Emissions	Reduction After Projects		Total Reduction	
CO2 Emissions	-6201 klb/yr		36551 klb/yr	-
SOx Emissions	-19 klb/yr		-19 klb/yr	-
NOx Emissions	-14 klb/yr		71 klb/yr	-

Note - Calculates the impact of the change in site power import on emissions from an external power station. Total reduction values are for site + power station

Utility Balance	Current Operation	After Projects	Reduction	
Power Generation	13883 kW	13389 kW	-	-
Power Import	5000 kW	5494 kW	-494 kW	-9.9%
Total Site Electrical Demand	18883 kW	18883 kW	-	-
Boiler Duty	523.0 MMBtu/h	477.0 MMBtu/h	46.0 MMBtu/h	8.8%
Fuel Type	Natural Gas	Natural Gas	-	-
Fuel Consumption	522874.9 s cu.ft/h	476891.9 s cu.ft/h	-	-
Boiler Steam Flow	416.5 klb/h	402.3 klb/h	14.3 klb/h	3.4%
Fuel Cost (in \$/MMBtu)	5.78	5.78	-	-



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Application of the Process Heating Assessment and Survey Tool (PHAST)



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Process Heating Assessment and Survey Tool (PHAST)

Process Heating Assessment and Survey Tool (PHAST)

 Introduction	 Plant/Equipment Information	 Furnace Analysis - Heat Balance
 Reports	 Import Plant Information	 Export Plant Information

Click on the Desired Button For Information

[Exit Application](#)

  [Development supported by E3M Inc.](#)

Phone : 240.715.4333 E-Mail : athekdi@e3minc.com
Fax : 301.208.9077

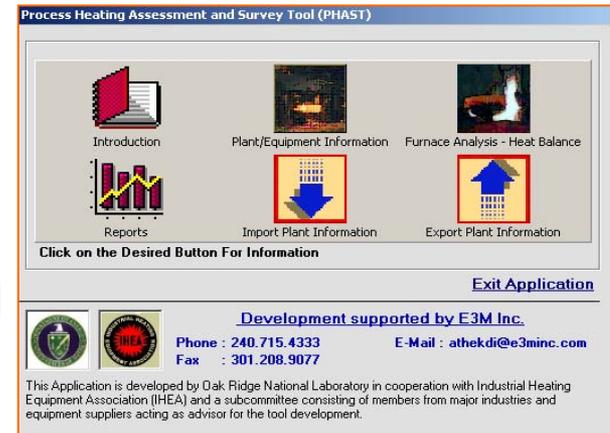
This Application is developed by Oak Ridge National Laboratory in cooperation with Industrial Heating Equipment Association (IHEA) and a subcommittee consisting of members from major industries and equipment suppliers acting as advisor for the tool development.



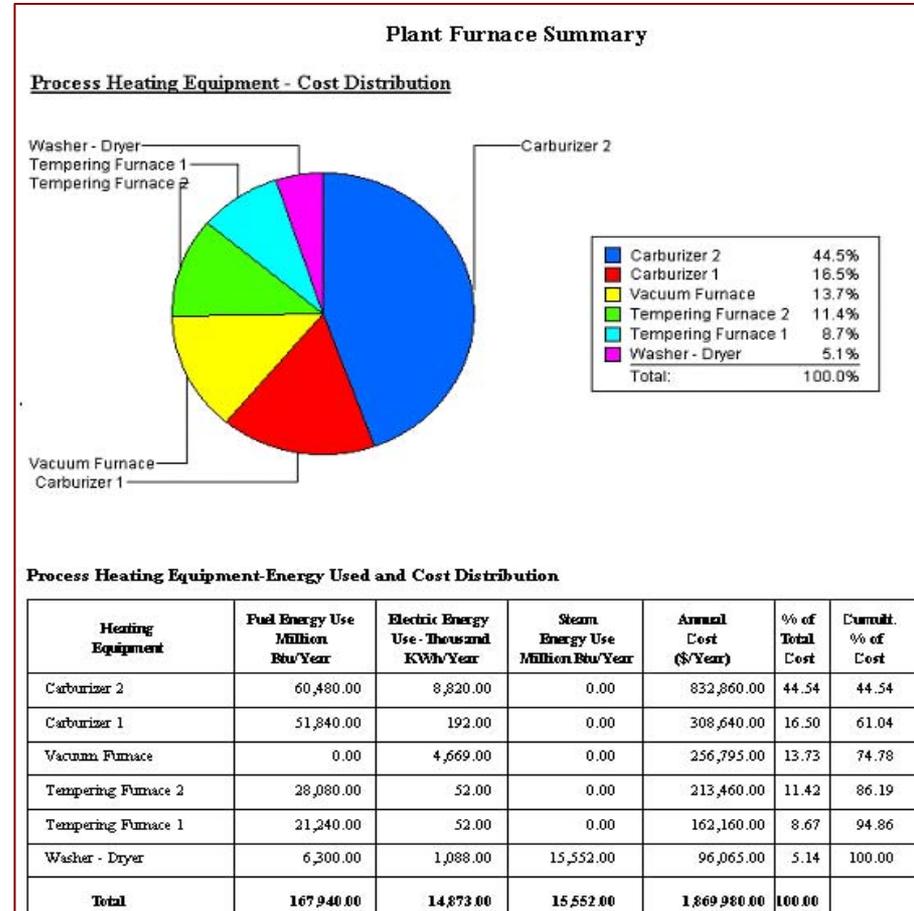
Process Heating Assessment and Survey Tool (PHAST)

**PHAST
is
used
to:**

- ❑ Estimate annual energy use and energy cost for furnaces and boilers in a plant
- ❑ Perform detail heat balance and energy use analysis that identifies areas of energy use, efficiency and energy losses for a furnace
- ❑ Perform “what-if” analysis for possible energy reduction and efficiency improvements through changes in operation, maintenance and retrofits of components/systems
- ❑ Obtain information on energy saving methods and identify additional resources



Plant Energy Use and Cost Distribution Report*



The Report Shows:

- ❑ Estimated annual energy use and estimate annual cost of energy for heating equipment (furnaces, ovens etc.)
- ❑ List of heating equipment and % of total energy cost used for each equipment in order of annual cost of energy used.

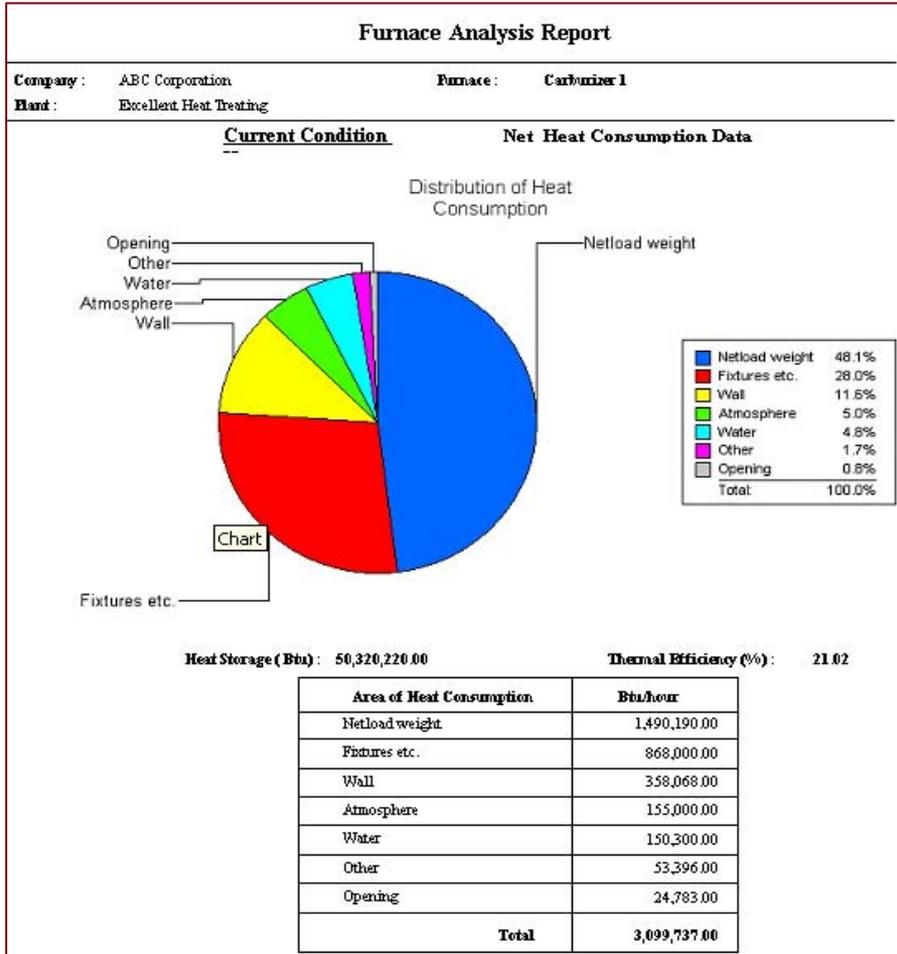
* for the Surveyed Process Heating Equipment



Furnace Heat Balance Energy Use – Losses Distribution

The Report Shows:

- Analysis of energy used in various parts of a furnace under a given operating condition.



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Plant Name Test Petroleum plant - US **Furnace Name** Cat Cracker

Other Losses	Flue Gas Losses/Heating System Efficiency	Heat Storage
Water - Cooling Losses	Wall Losses	Opening Losses
Load/Charge Material	Fixtures, Trays, Baskets etc. Losses	Atmosphere Losses

Select Type Solid Liquid Gas

	Current	Modified
Type of Material	<input type="button" value="New"/> Gasoline stock	Gasoline stock
Charge (Liquid)-Feed Rate (lb/hr)	55000	55000
Initial Temp. (Degree F)	325	325
Discharge Temp. (Degree F)	750	750
Charge Liquid Vaporized (% of Charge)	100	100
Charge Reacted (%)	0	0
Heat of Reaction (Btu/lb)	100 Endothermic	100 Endothermic
Additional Heat Required (Btu/hr)	0	0
Heat Required (Btu/hr)	22,341,000	22,341,000

Comments

← Previous

Next →

Current Net Heat Required (Btu/hr) **24,075,899**

Modified Net Heat Required (Btu/hr) **23,696,425**

Furnace Summary

Enter/Edit Current Data

Report

Close

start America Online Training-Auditing Microsoft PowerPoi... PHAST Version 2.0 - ... Furnace Data 7:42

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Plant Name Test Petroleum plant - US **Furnace Name** Cat Cracker

Other Losses
Flue Gas Losses/Heating System Efficiency
Heat Storage

Water - Cooling Losses
Wall Losses
Opening Losses

Load/Charge Material

Select Type Solid Liquid Gas

Type of Material	Current	Modified
Charge (Liquid)-Feed Rate (lb/hr)	55000	55000
Initial Temp. (Degree F)	325	550
Discharge Temp. (Degree F)	750	750
Charge Liquid Vaporized (% of Charge)	100	100
Charge Reacted (%)	0	0
Heat of Reaction (Btu/lb)	100 Endothermic	100 Endothermic
Additional Heat Required (Btu/hr)	0	0
Heat Required (Btu/hr)	22,341,000	14,668,500

Fixtures, Trays, Baskets etc. Losses

Atmosphere Losses

← Previous Next →

Current Net Heat Required (Btu/hr) **24,075,899**

Modified Net Heat Required (Btu/hr) **16,023,925**

📄 Furnace Summary 📝 Enter/Edit Current Data

📄 Report 🔒 Close

Tool Metrics

2006, 2007 and 2008 Annual Saving Opportunities

System Area	Identified Annual Savings			Implemented Annual Savings		
	# of completed ESA's	Identified Source Energy Savings Upgrades (TBtu)	Identified Cost Savings (\$)	Implemented Source Energy Savings (TBtu)	Implemented Cost Savings (\$)	Implemented CO2 Savings (metric tons)
Compressed Air	103	1.91	\$12,068,313	0.62	\$3,727,440	36,401
Fans	26	1.99	\$12,872,830	0.01	\$152,092	788
Process Heating	184	38.18	\$274,147,878	3.51	\$27,468,255	187,711
Pumps	55	1.54	\$7,932,398	0.08	\$482,769	4,864
Steam	256	56.06	\$520,096,501	16.89	\$88,867,811	1,235,444
Total	624	99.68	\$827,117,920	21.11	\$120,698,367	1,465,208



Plant Energy Profiler (PEP) Tool

Provides a mill or plant a quick method for answering these questions:

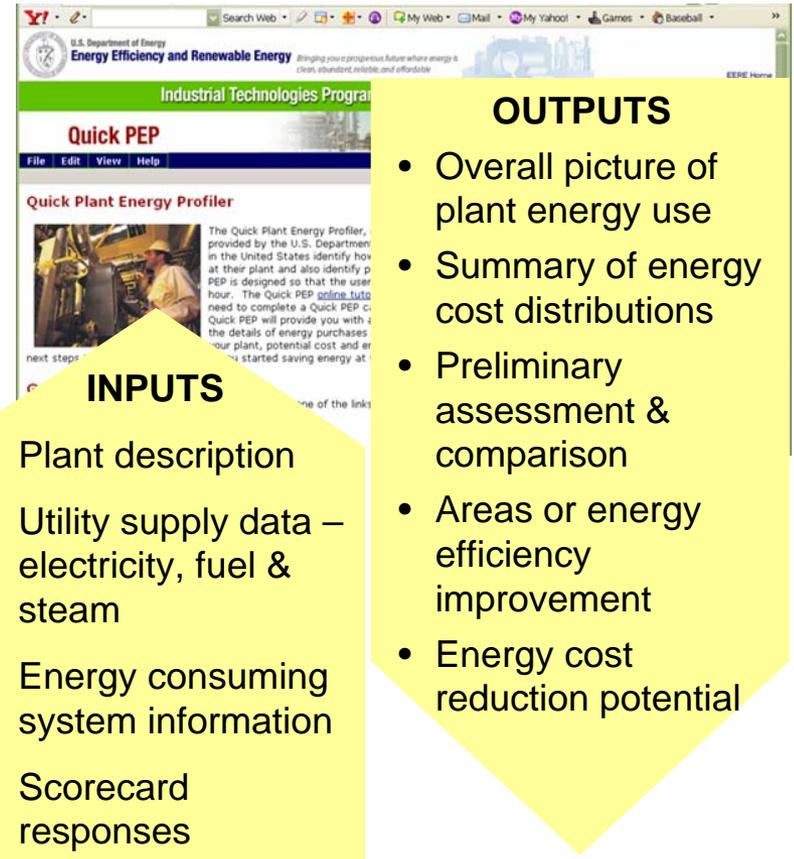
- Where is my energy going?
- What is my potential for improvement?
- What resources are available to help me?

Within a few hours you will have :

- An overall picture of plant energy use
- A summary of energy cost distribution
- Estimated energy cost savings potential

At minimum, you will need :

- A monthly bill for each purchased energy stream (electricity, fuel & steam)
- Plant production data for the same month (optional)



INPUTS

- Plant description
- Utility supply data – electricity, fuel & steam
- Energy consuming system information
- Scorecard responses

OUTPUTS

- Overall picture of plant energy use
- Summary of energy cost distributions
- Preliminary assessment & comparison
- Areas or energy efficiency improvement
- Energy cost reduction potential



Base Lining and Carbon Foot Printing

ITP's online QuickPEP tool provides base lining, and profiles plant energy purchases along with major systems that consume energy so as to help industrial plant personnel understand how their energy is being utilized and how they can save energy and money.

QuickPEP 2.0 Has Enhanced Base Lining Capability

- Multiple units of production within one or more plants
- Applicable to both 25 in 10 pledge and non-pledge end users

QuickPEP 2.0 Also Has a Carbon Footprint Calculator

- Based on up to 24 energy sources
- Tracks absolute changes of annual energy use
- Tracks absolute changes in annual CO2 emissions

http://www1.eere.energy.gov/industry/quickpep_ml/



Links and Resources

Register for future ITP webcasts by clicking the links below:

October 30, 2008: [Quick PEP Tool Demonstration and Results](#)

November 6, 2008: [Energy Assessments: What are the Benefits to Small and Medium Facilities?](#)

November 13, 2008: [Assessing Data Center Energy Use](#)

November 20, 2008: [Super Boiler Technology](#)

Learn More

To learn more about the Save Energy Now program, including information about no-cost energy assessments, software tools, and additional resources, training, tip-sheets, and sourcebooks, please visit ITP's Save Energy Now Web site: <http://www1.eere.energy.gov/industry/saveenergynow/>.

Stay Informed

Sign up to receive ITP's free monthly e-newsletter, *E-Bulletin*, BestPractices quarterly journal e-magazine, *Energy Matters*, and partner with ITP to Save Energy Now:

<http://apps1.eere.energy.gov/industry/saveenergynow/partners/>



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