# 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.

# Technology Delivery Products and Services

Save ENERGY Now

## Information

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


## Tools

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

## Assessments

- Energy Savings Assessments
- Industrial Assessment Centers

## Standards

- Plant Certification

## Training

- Basic
- Advanced
- Qualified Specialist

# DOE Power Based Software Decision Support Tools Available via the Website

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

- **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.
- **ASDMaster** Determines economic feasibility of an ASD application.
- **Chilled Water System Assessment Tool** Assesses the efficiency of a chilled water system.

# DOE Fuel Based Software Decision Support Tools Available via the Website

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

- **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

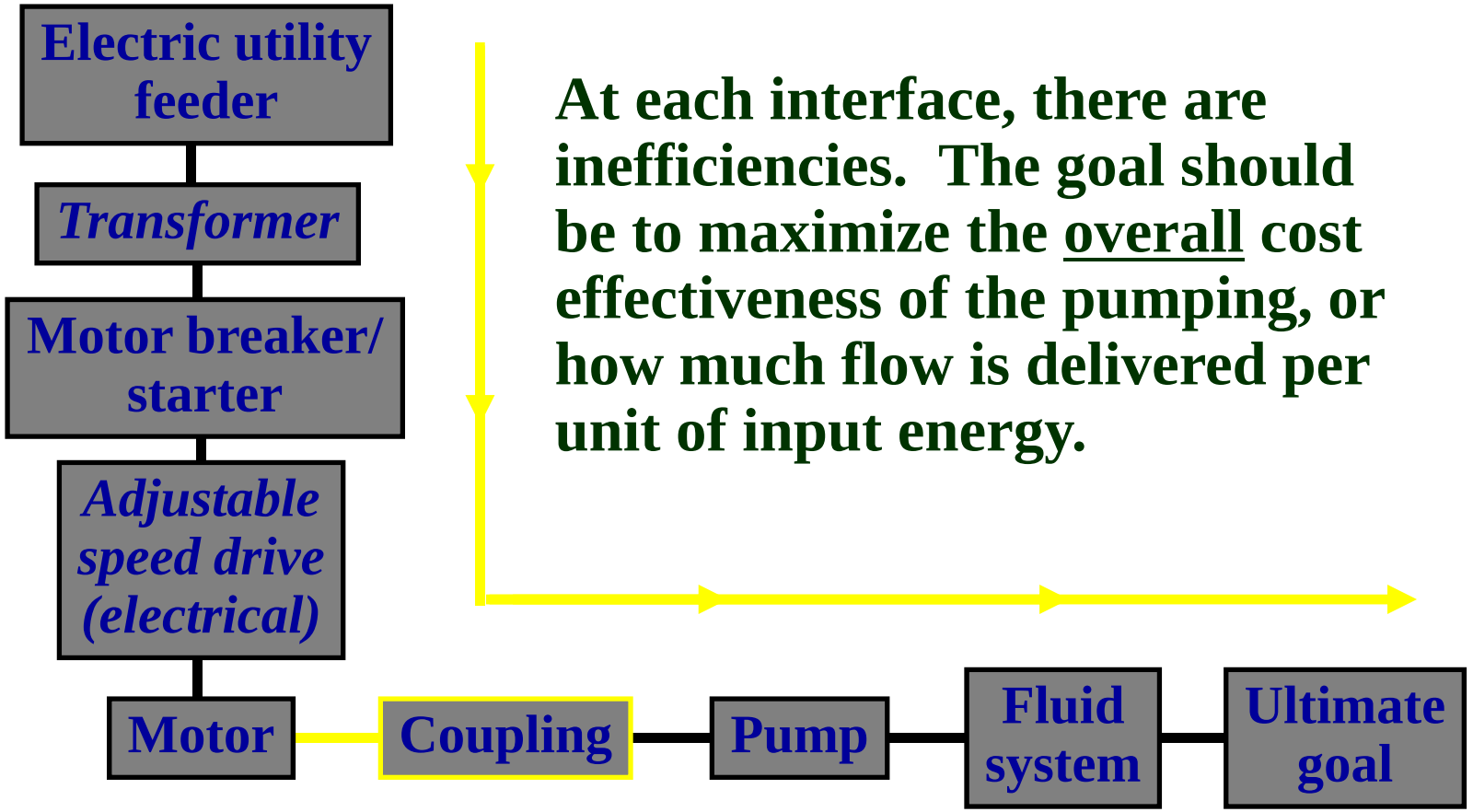
# Application of the

# Pumping System Assessment Tool

# An introduction to the Pumping System Assessment Tool (PSAT)

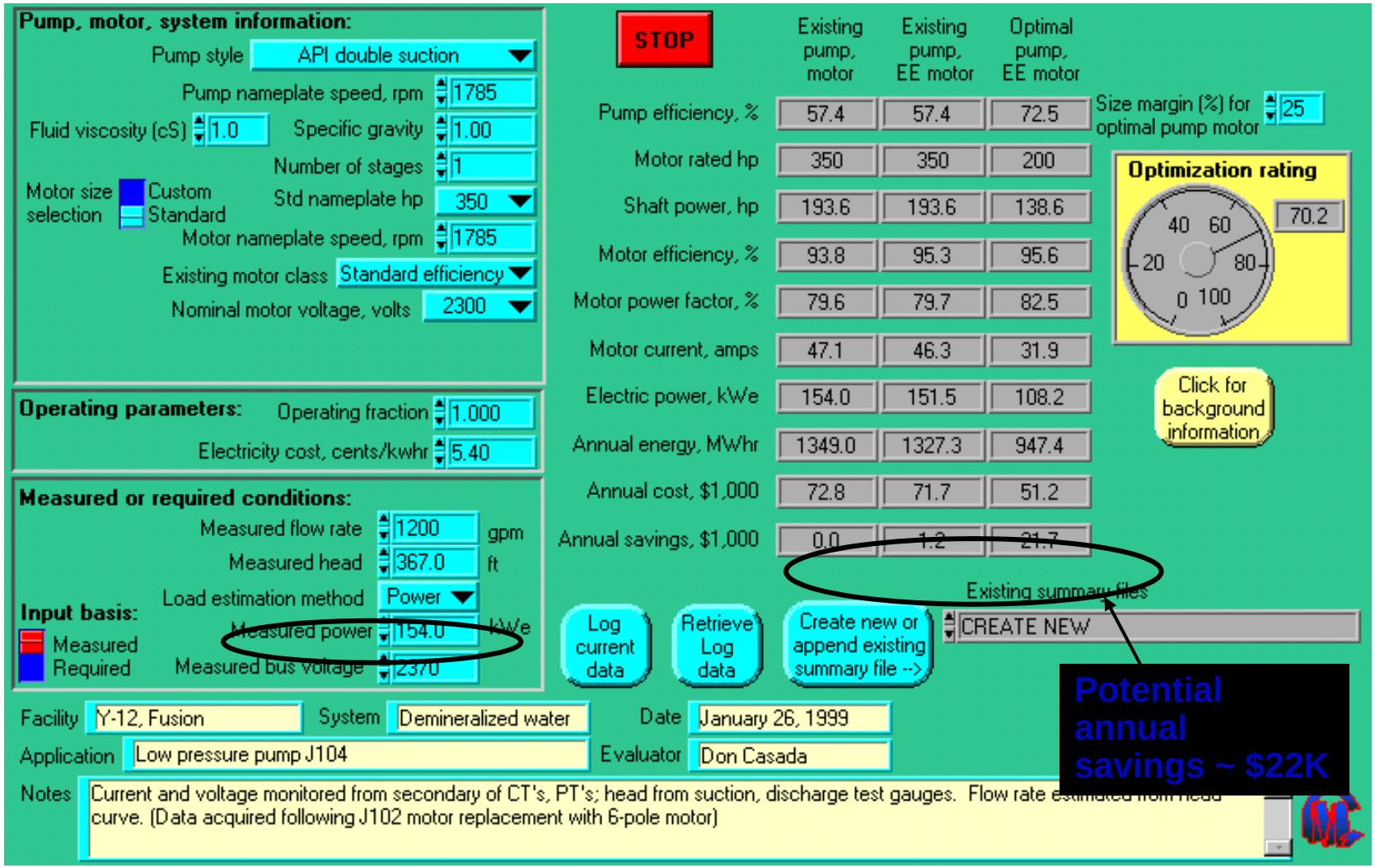
- Goal: to assist pump users in identifying pumping systems that are the most likely candidates for energy and cost savings
- Requires field measurements or estimates of flow rate, pressure, and motor power or current
- Uses pump and motor performance data from Hydraulic Institute standard ANSI/HI-1.3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

## Big picture perspective of energy flow for pumping systems

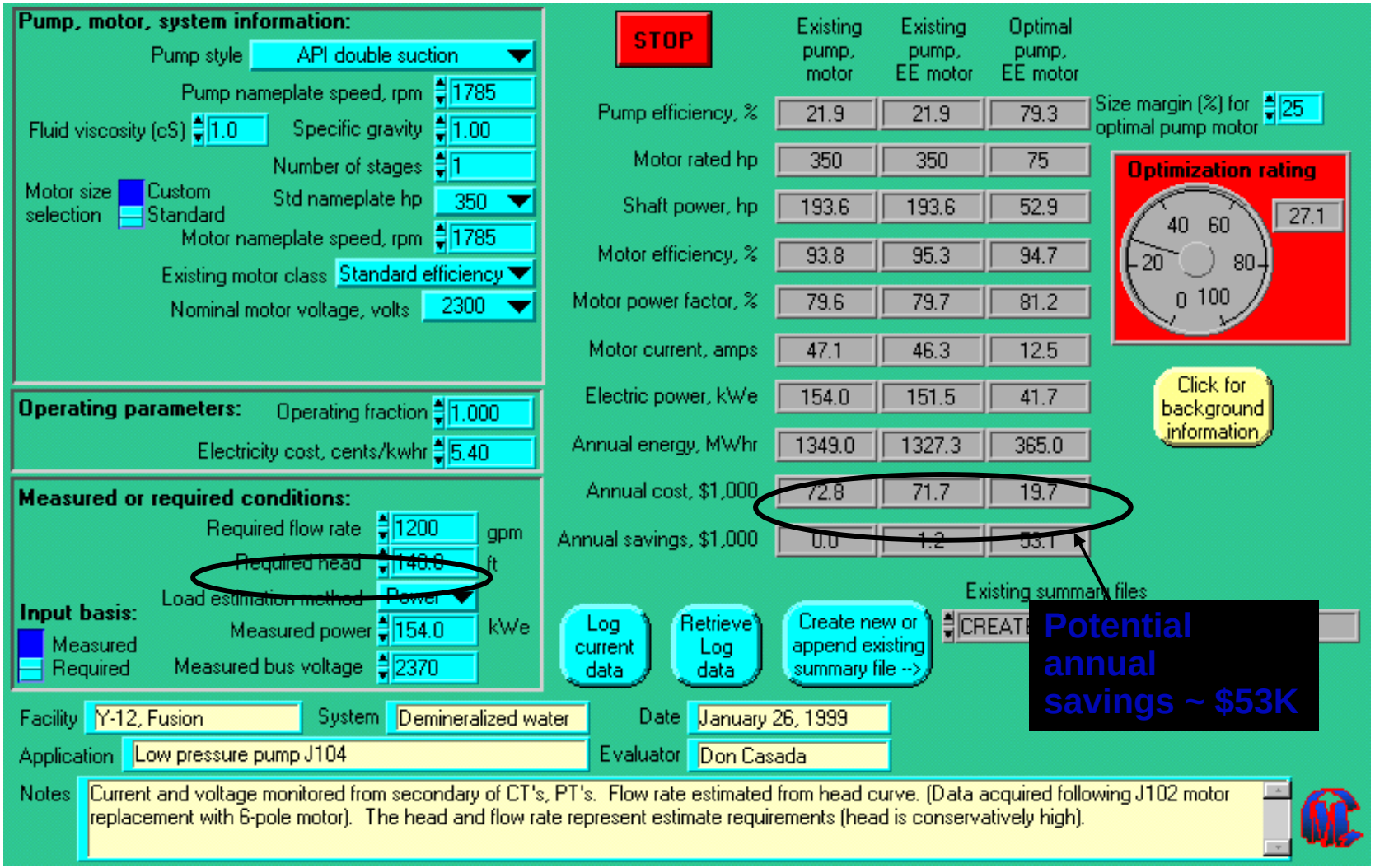



**At each interface, there are inefficiencies. The goal should be to maximize the overall cost effectiveness of the pumping, or how much flow is delivered per unit of input energy.**

# Applying the PSAT tool to the measured conditions shows significant potential savings



Using the required head estimate instead of the actual operating head could yield much greater savings



# AirMaster+: A Compressed Air Systems Assessment Tool

**AirMaster Plus** 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

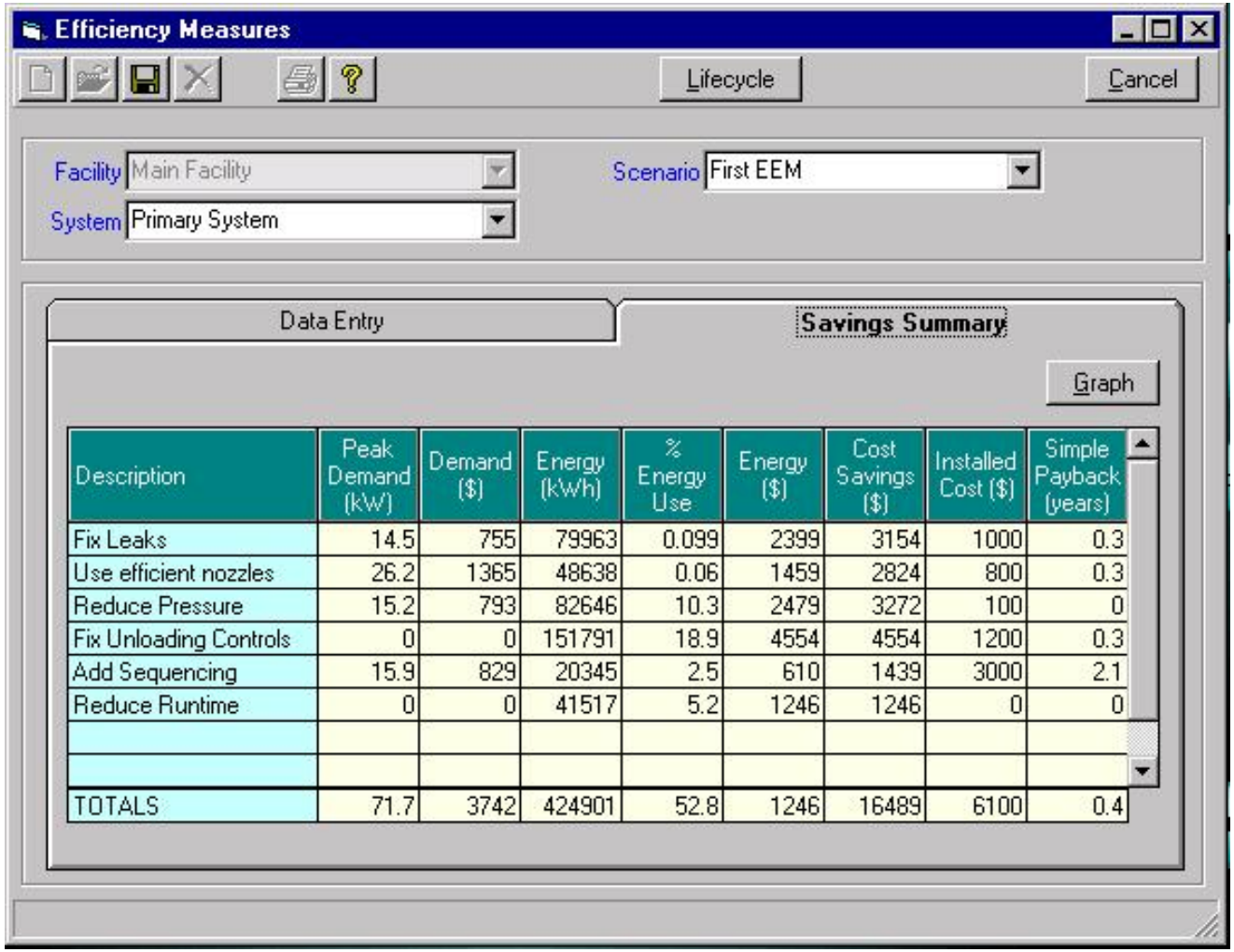
-Reduce System Pressure

-Sequence Compressors

-Reduce Run Time

-Add Primary Storage

# Savings Summary Report




| Description | Peak Demand (kW) | Demand ($) | Energy (kWh) | % Energy Use | Energy ($) | Cost Savings ($) | Installed Cost ($) | Simple Payback (years) |
|---|---|---|---|---|---|---|---|---|
| Fix Leaks | 14.5 | 755 | 79963 | 0.099 | 2399 | 3154 | 1000 | 0.3 |
| Use efficient nozzles | 26.2 | 1365 | 48638 | 0.06 | 1459 | 2824 | 800 | 0.3 |
| Reduce Pressure | 15.2 | 793 | 82646 | 10.3 | 2479 | 3272 | 100 | 0 |
| Fix Unloading Controls | 0 | 0 | 151791 | 18.9 | 4554 | 4554 | 1200 | 0.3 |
| Add Sequencing | 15.9 | 829 | 20345 | 2.5 | 610 | 1439 | 3000 | 2.1 |
| Reduce Runtime | 0 | 0 | 41517 | 5.2 | 1246 | 1246 | 0 | 0 |
| | | | | | | | | |
| | | | | | | | | |
| TOTALS | 71.7 | 3742 | 424901 | 52.8 | 1246 | 16489 | 6100 | 0.4 |

# Steam System Assessment Tool (SSAT)

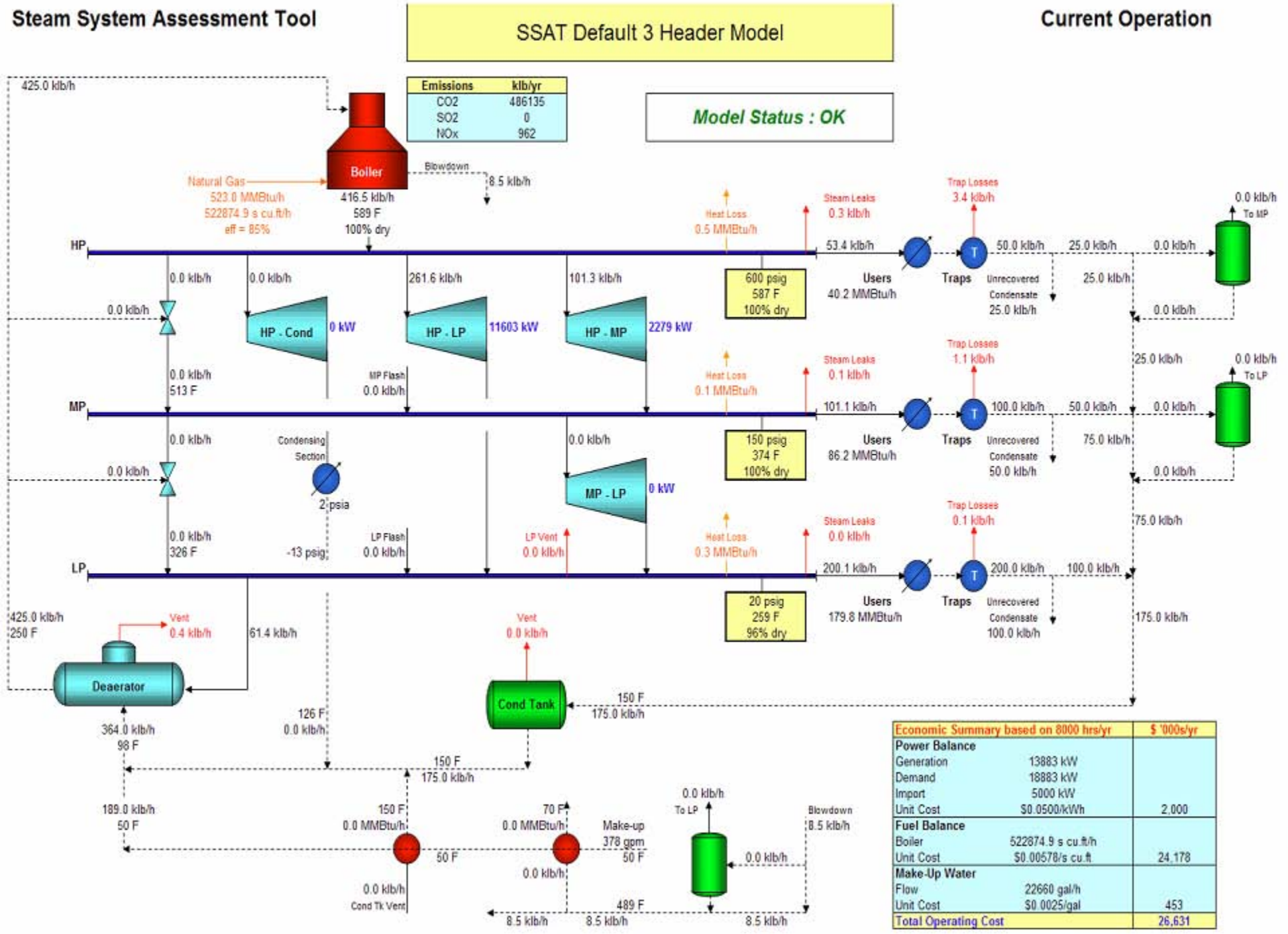
- PURPOSE:
  - Demonstrate the magnitude of energy, cost, and emission savings related to specific steam system improvement opportunities

- AUDIENCE:
  - Engineers involved with operation and/or improvement of steam systems

**Steam System Assessment Tool**

# SSAT Default 3 Header Model

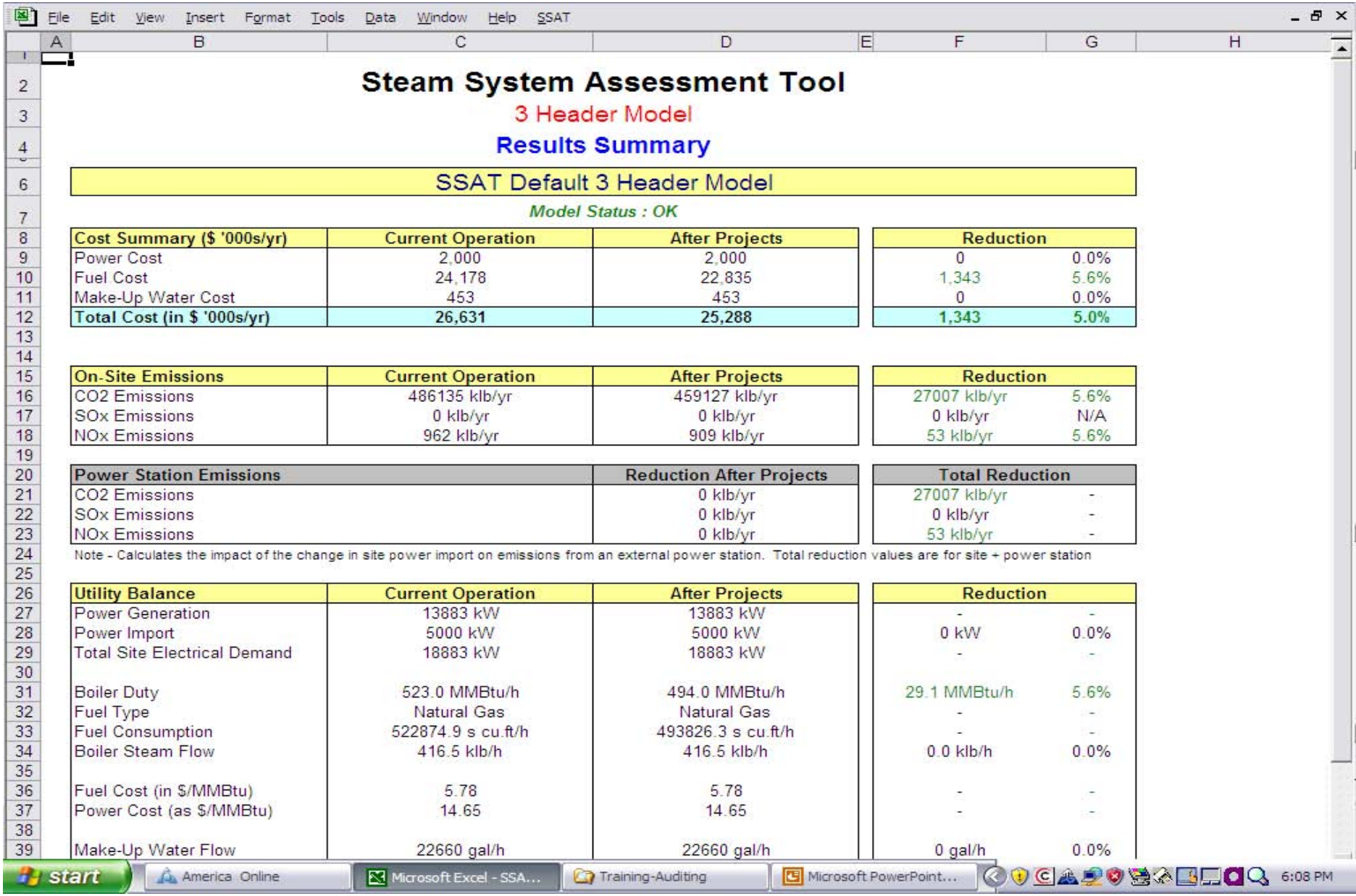
**Current Operation**




| 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


File Edit View Insert Format Tools Data Window Help SSAT
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 $/MMBtu) | 14.65 | 14.65 | - | -
Make-Up Water Flow | 22660 gal/h | 22660 gal/h | 0 gal/h | 0.0%
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Training-Auditing
Microsoft PowerPoint...
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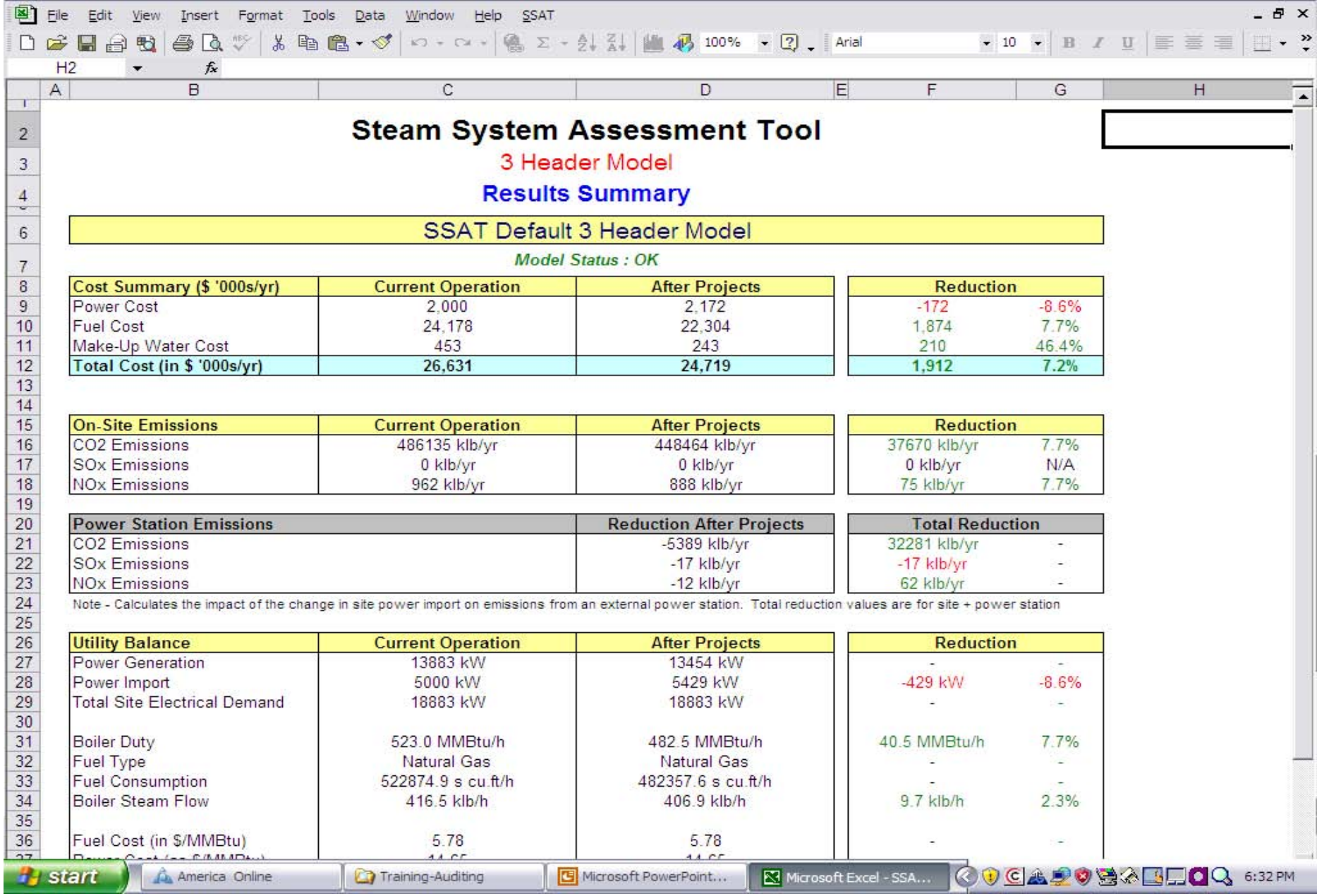
File Edit View Insert Format Tools Data Window Help SSAT
H2
Steam System Assessment Tool
3 Header Model
Results Summary
SSAT Default 3 Header Model
Model Status : OK
Cost Summary ($ '000s/yr) | Current Operation | After Projects | Reduction
Power Cost | 2,000 | 2,172 | -172 | -8.6%
Fuel Cost | 24,178 | 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 | -
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Training-Auditing
Microsoft PowerPoint...
Microsoft Excel - SSA...
6:32 PM

# 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%** |

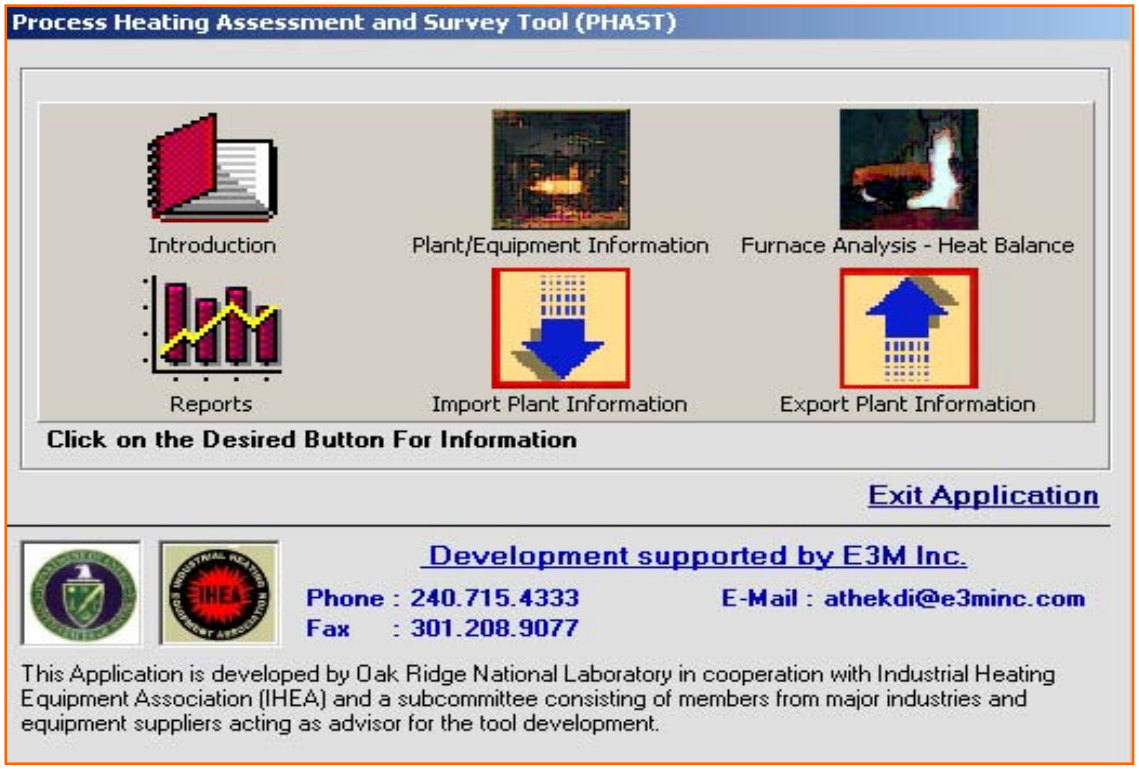
| On-Site Emissions | Current Operation | After Projects | Reduction | |
|---|---|---|---|---|
| CO2 Emissions | 486135 klb/yr | 443383 klb/yr | 42752 klb/yr | 8.8% |
| SOx Emissions | 0 klb/yr | 0 klb/yr | 0 klb/yr | N/A |
| NOx Emissions | 962 klb/yr | 878 klb/yr | 85 klb/yr | 8.8% |

| 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 | - | - |

# Process Heating Assessment and Survey Tool (PHAST)

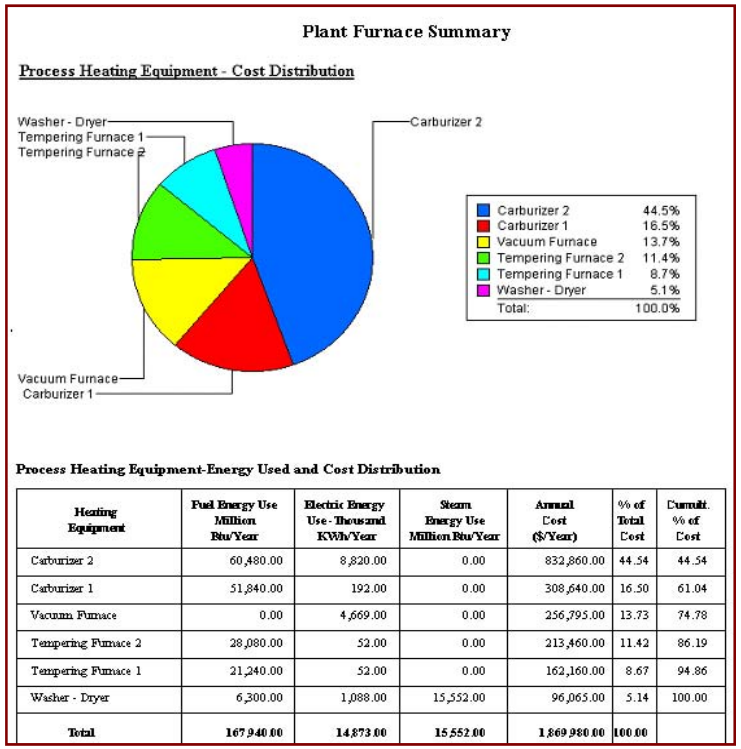


# Process Heating Assessment and Survey Tool (PHAST)

## *What is PHAST?*

- A tool that can be 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*

**Plant Furnace Summary**

Process Heating Equipment - Cost Distribution



**Process Heating Equipment-Energy Used and Cost Distribution**

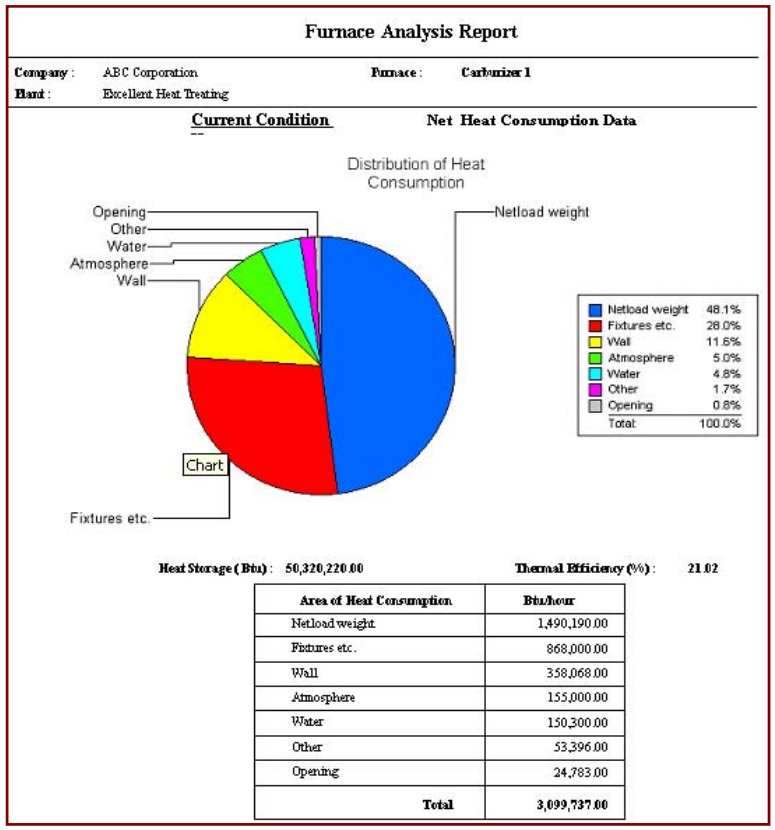
| Heating Equipment | Fuel Energy Use Million Btu/Year | Electric Energy Use - Thousand KWh/Year | Steam Energy Use Million Btu/Year | Annual Cost ($/Year) | % of Total Cost | Cumult. % of Cost |
|---|---|---|---|---|---|---|
| Carburizer 2 | 60,480.00 | 8,820.00 | 0.00 | 832,860.00 | 44.54 | 44.54 |
| Carburizer 1 | 51,840.00 | 192.00 | 0.00 | 308,640.00 | 16.50 | 61.04 |
| Vacuum Furnace | 0.00 | 4,669.00 | 0.00 | 256,795.00 | 13.73 | 74.78 |
| Tempering Furnace 2 | 28,080.00 | 52.00 | 0.00 | 213,460.00 | 11.42 | 86.19 |
| Tempering Furnace 1 | 21,240.00 | 52.00 | 0.00 | 162,160.00 | 8.67 | 94.86 |
| Washer - Dryer | 6,300.00 | 1,088.00 | 15,552.00 | 96,065.00 | 5.14 | 100.00 |
| Total | 167,940.00 | 14,873.00 | 15,552.00 | 1,869,980.00 | 100.00 | |

## 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



**Furnace Analysis Report**

**Company :** ABC Corporation **Furnace :** Carburizer 1
**Plant :** Excellent Heat Treating

**Current Condition** **Net Heat Consumption Data**

Distribution of Heat Consumption

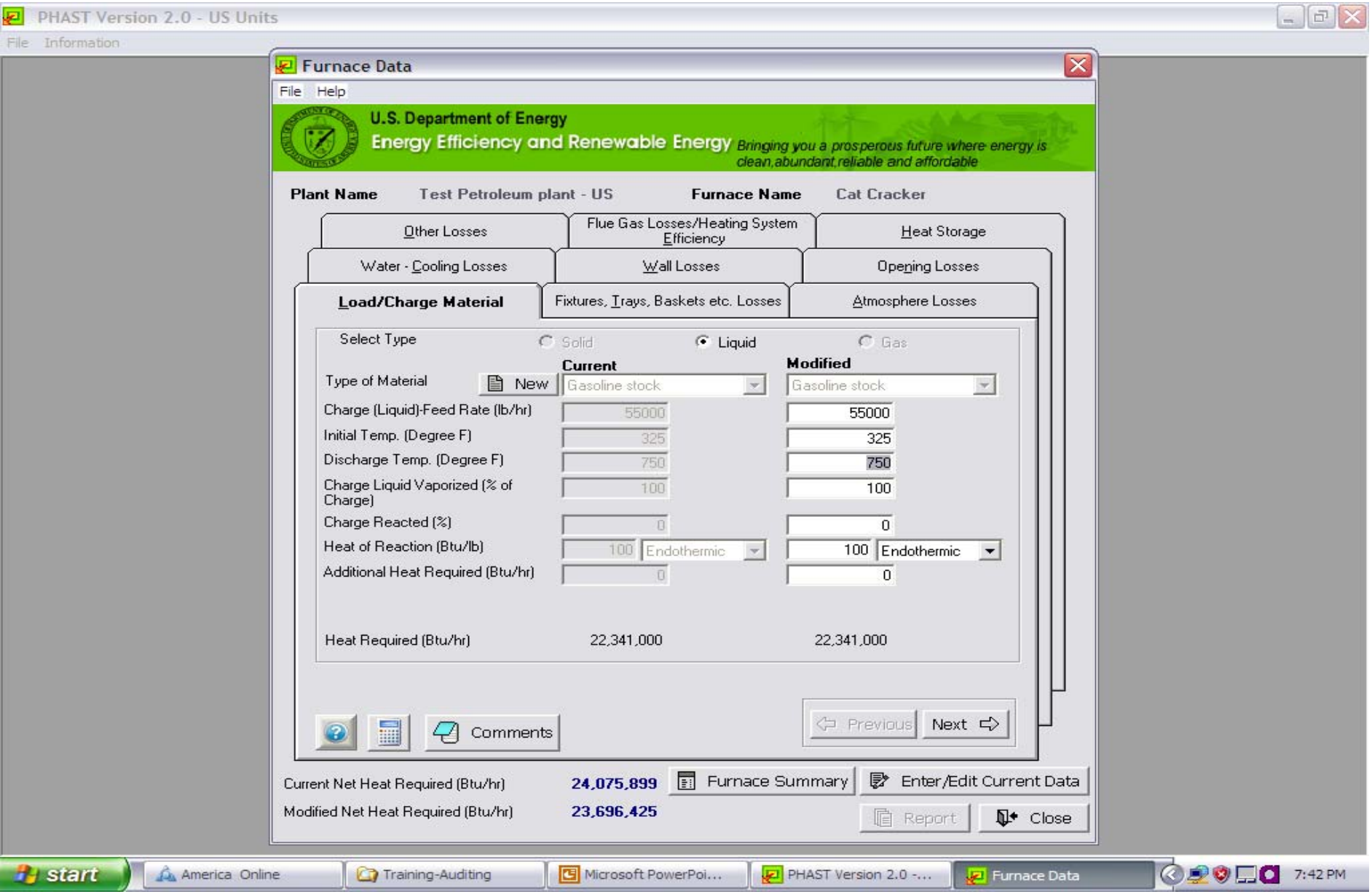


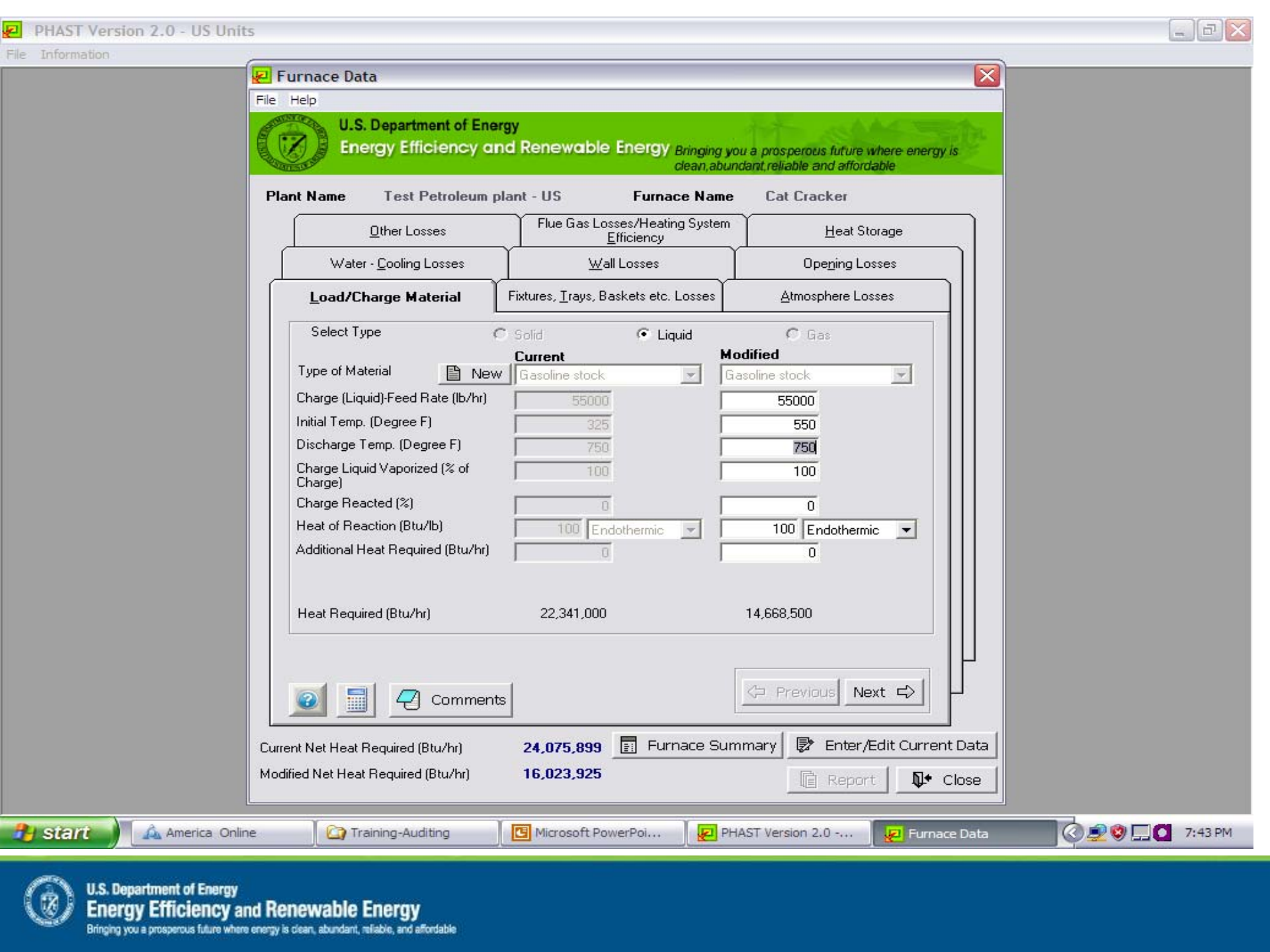
**Heat Storage ( Btu ) :** 50,320,220.00 **Thermal Efficiency (%) :** 21.02

| Area of Heat Consumption | Btu/hour |
|---|---|
| Netload weight | 1,490,190.00 |
| Fixtures etc. | 868,000.00 |
| Wall | 358,068.00 |
| Atmosphere | 155,000.00 |
| Water | 150,300.00 |
| Other | 53,396.00 |
| Opening | 24,783.00 |
| **Total** | **3,099,737.00** |

**The report shows**

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


PHAST Version 2.0 - US Units
File Information
Furnace Data
File Help
U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable and affordable
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
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 PM


PHAST Version 2.0 - US Units
File Information
Furnace Data
File Help
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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
New
Gasoline stock
Gasoline stock
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
Comments
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
start
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Training-Auditing
Microsoft PowerPoi...
PHAST Version 2.0 -...
Furnace Data
7:43 PM
U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

# 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** | 124 | 2.6 | $16,171,563 | 0.7 | $4,093,971 | 40,990 |
| **Fans** | 32 | 4.2 | $26,362,030 | 0.01 | $147,500 | 756 |
| **Multi-System-Paper** | 8 | 5.3 | $40,016,500 | | | |
| **Process Heating** | 204 | 40.8 | $293,228,814 | 4.4 | $36,469,247 | 236,110 |
| **Pumps** | 68 | 2.8 | $14,849,267 | 0.2 | $795,009 | 9,401 |
| **Steam** | 281 | 60.8 | $546,433,081 | 18.0 | $93,670,615 | 1,411,578 |
| ***Total*** | ***717*** | ***117*** | ***$937,061,256*** | ***23.3*** | ***$135,176,342*** | ***1,698,835*** |

# Plant Energy Profiler (PEP) & Integrated Tool Suite

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

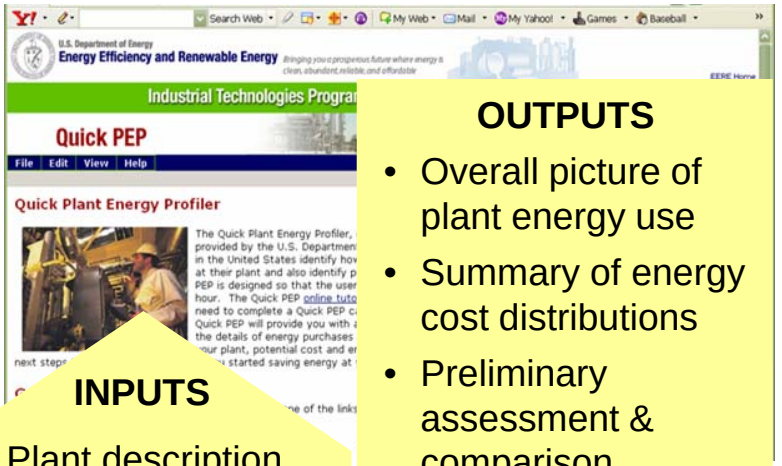
- Where is my energy is going?
- What is my potential for improvement?
- What resources are available to help me?

**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

# Subscribe to *Energy Matters*!

Look for in-depth article on the ITP software tools in the Spring 2009 issue of ***Energy Matters***, the U.S. Department of Energy's Industrial Technologies Program quarterly online newsletter. This issue will be available at the end of April 2009—subscribe today!

http://apps1.eere.energy.gov/industry/bestpractices/energymatters/

http://www.eere.energy.gov/industry/bestpractices/software.html


Save
ENERGY
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