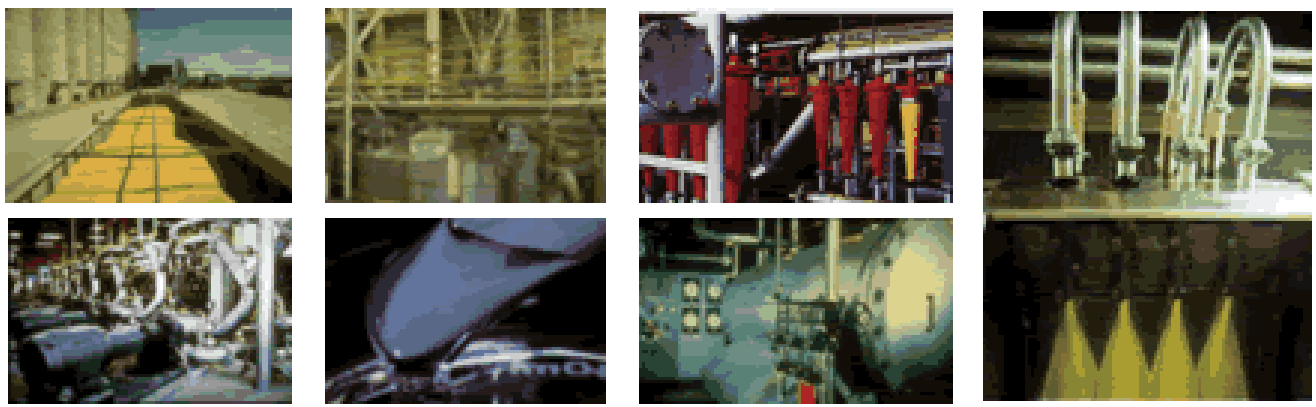
Introduction to Energy Savings in Process Heating for the Corn Refining Industry



Web-Cast Presentation By
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President E3M, Inc.
March 8, 2005

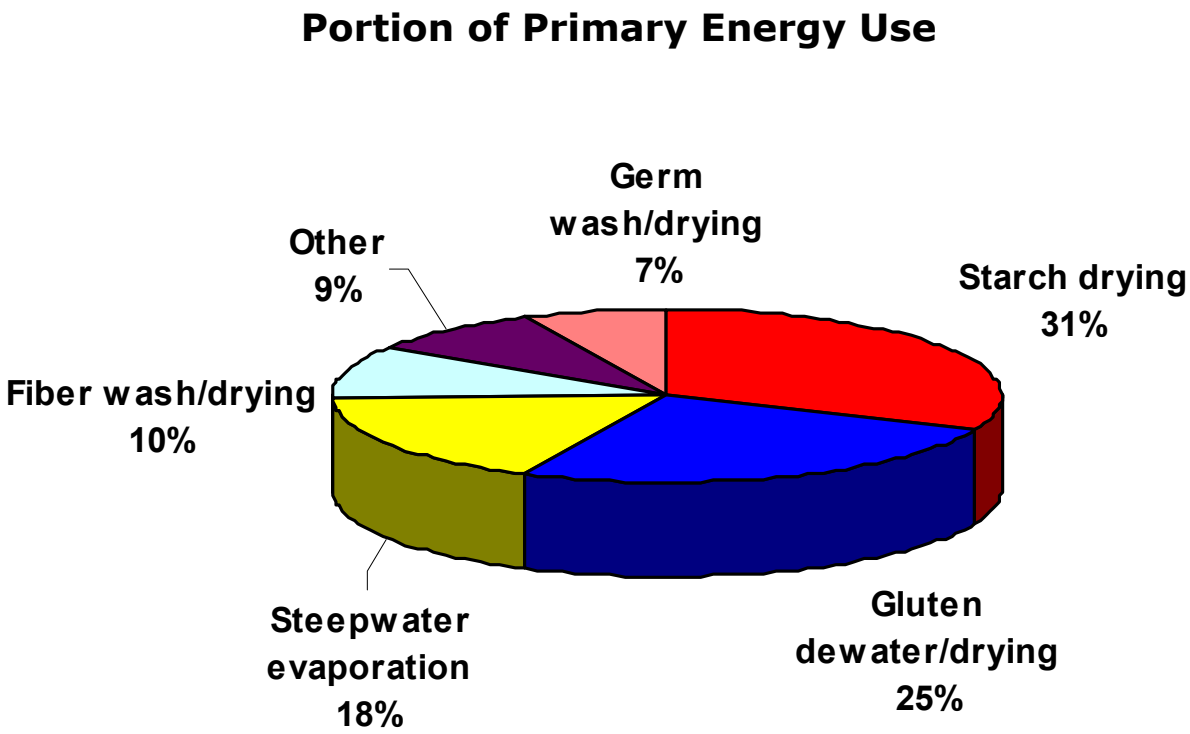
Energy Cost in Corn Refining Industries Operations

- Corn processing is very energy intensive
- Energy costs are the largest operating cost for the wet corn milling industry, next only to the cost of corn.
- Corn wet milling uses 15% of all energy used by the food and kindred products sector of U.S. manufacturing
- For a typical plant processing 100,000 bushels per day, energy cost is approximately 25 to 35 million dollars per year.
- This represents $0.75 to $1.50 cost per bushel of corn processed.
- Energy cost is projected to be the fastest rising cost element of the operating cost

Primary Energy Use in Corn Refining Industries

- **Process/Assembly (P/A)**
  - **Process heating - Drying**
    - Steam Generation
    - Fuel firing
  - Machine drive (Pumps, Fans, Blowers, Compressors, Vacuum pumps, Other Electric Motor Driven Systems)
  - Water and other utilities
- **Building (HVAC, Lighting etc.)**

Energy Use Distribution for Typical Corn Wet Milling Operation



•Source: Energy efficiency Improvement and cost Saving Opportunities for the Corn Wet Milling Industry, A report (LBNL 52307) prepared by LBNL for the EPA

What Is Process Heating ?



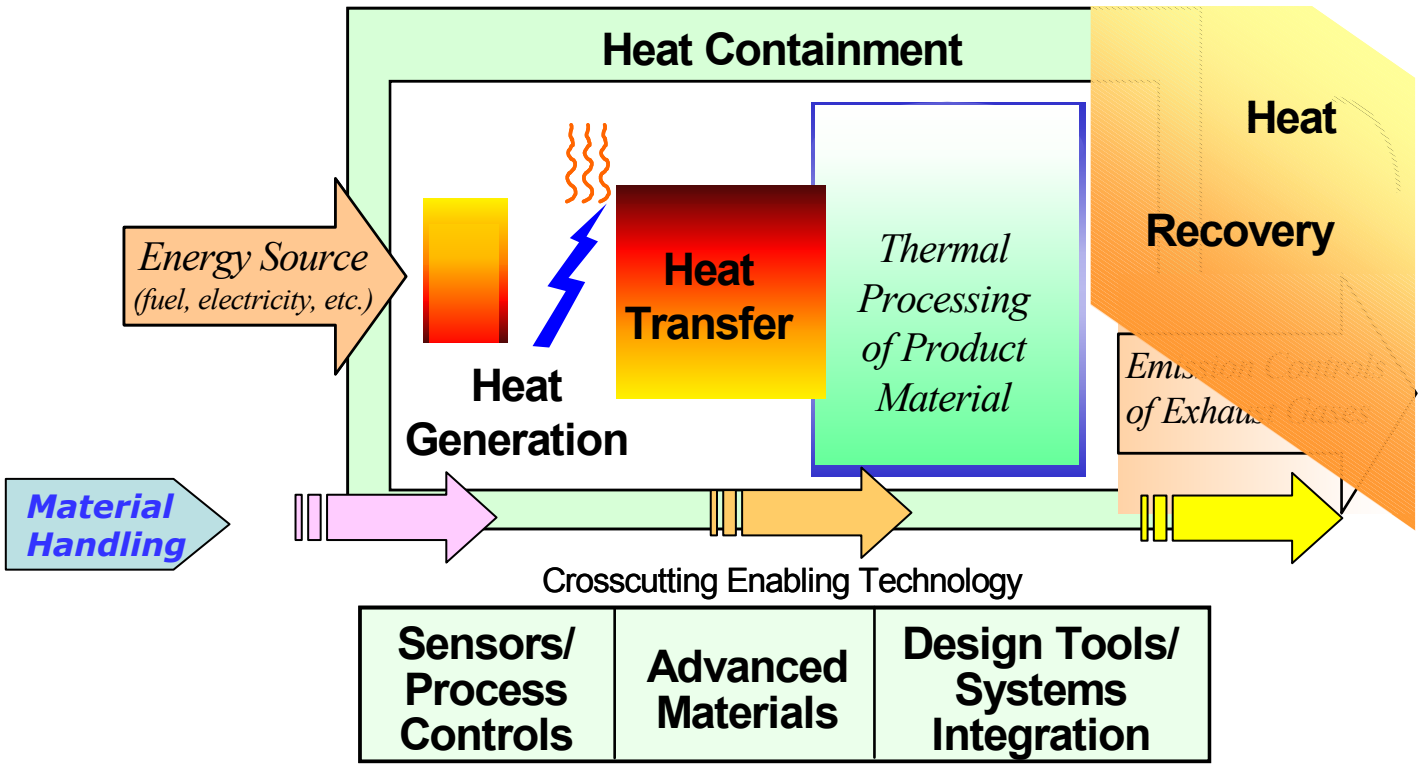

Supplying heat to materials using

- Dryers
- Boilers
- Furnaces
- Ovens
- Kilns

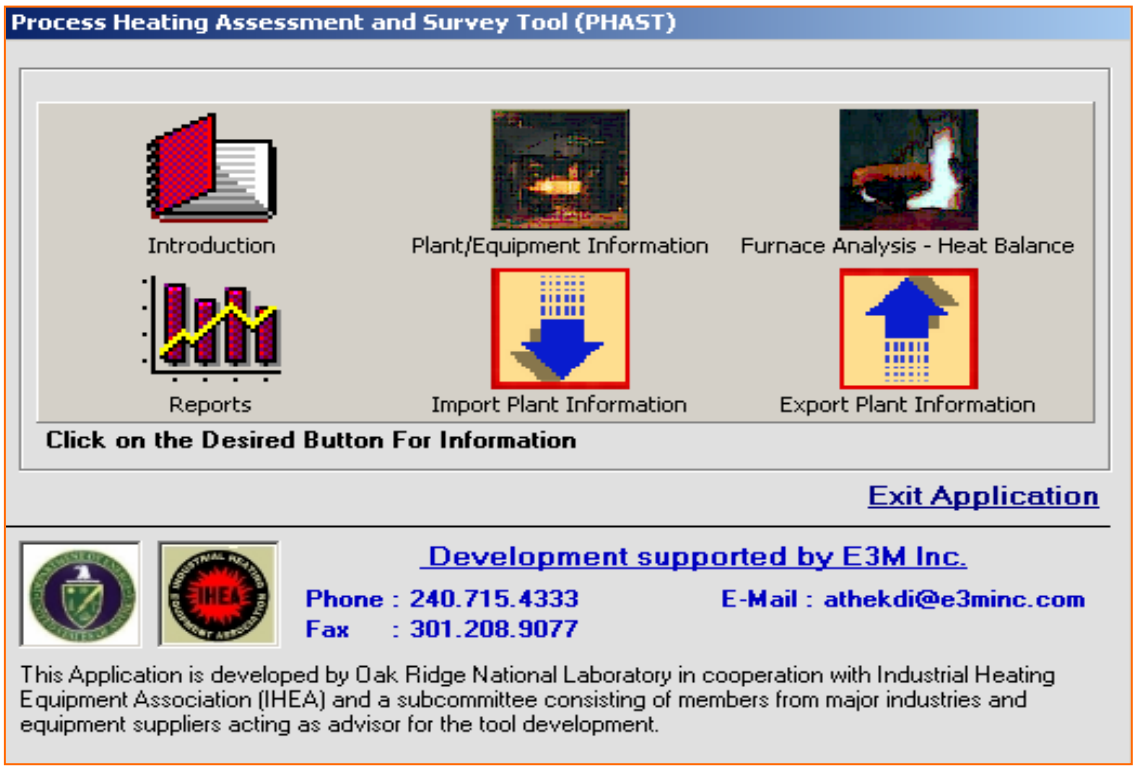
for further processing in manufacturing operations

Process Heating System Components

All heating systems include nine basic processes/components



Process Heating Assessment and Survey Tool (PHAST)



Process Heating Assessment and Survey Tool (PHAST)

What is PHAST?

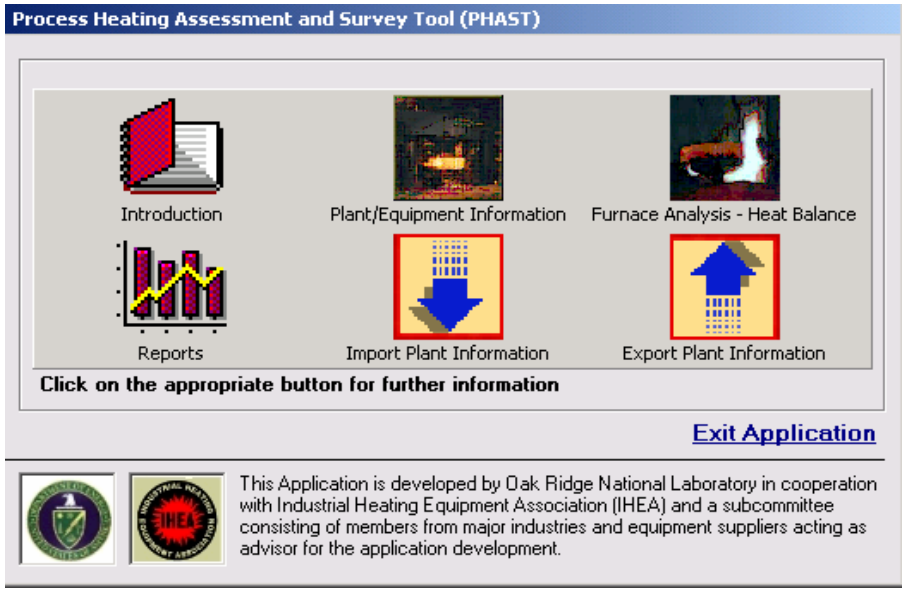
A tool that can be used to:

- 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

Process Heating Assessment and Survey Tool (PHAST)

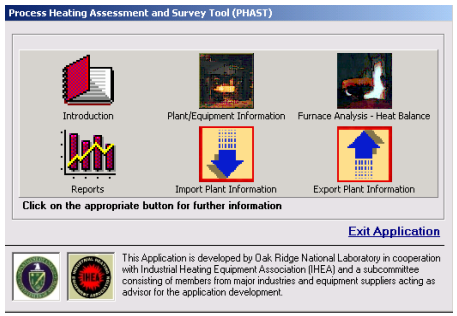
- The Process Heating Assessment and Survey Tool (PHAST) was developed by Oak Ridge National Laboratory in cooperation with the Industrial Heating Equipment Association (IHEA).
- A subcommittee consisting of members from major industries (i.e., petroleum refining, chemical) and equipment suppliers acted as an advisor during the tool's development.
- Development efforts were supported by The Office of Industrial Technologies (OIT) of the US Department of Energy (DOE).

Process Heating Assessment and Survey Tool (PHAST)



Overview of features and use

Main Screen



The main screen is used to select the required section of PHAST.

There are six options

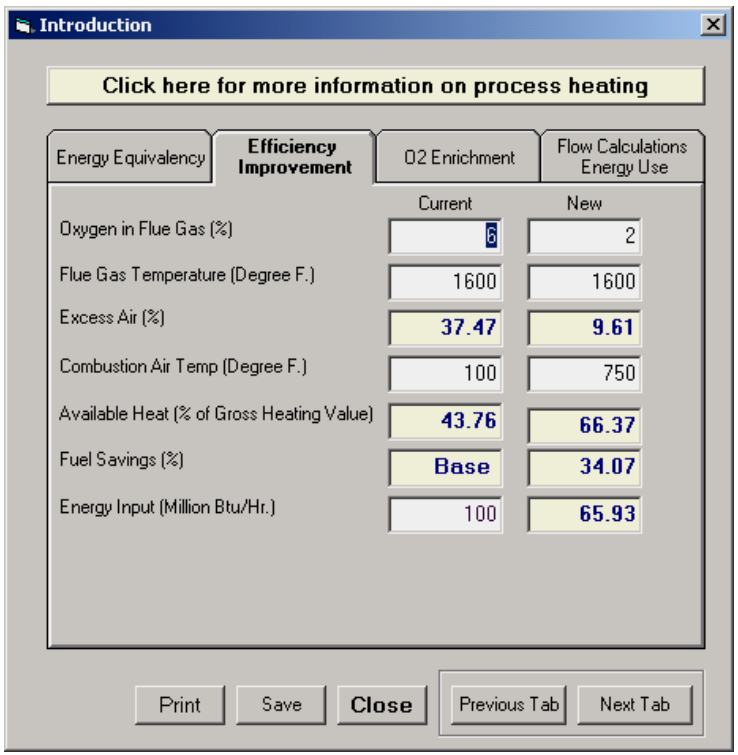
1. Introduction
2. Plant Energy Analysis
3. Furnace Heat Balance
4. Reports
5. Export Plant Information
6. Import Plant Information

Introduction

This section includes

- A number of calculators to assess effect of key furnace operating parameters on the furnace performance.
- Resources that provide additional-updated information.
    A. Link to DOE-OIT and IHEA web sites
    B. Glossary of terms used in process heating
    C. Reference material related to process heating

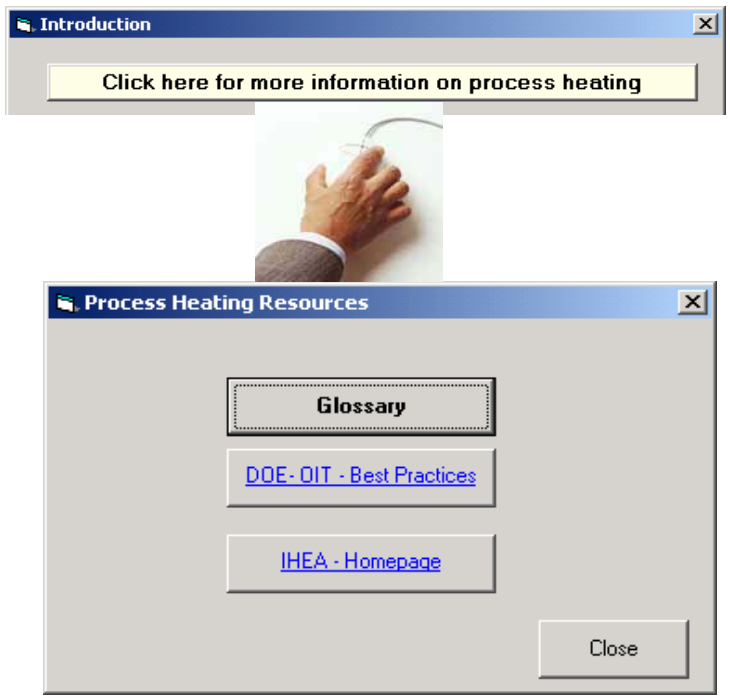
Process Heating Calculators



The calculators can be used to

1. Compare gas (fuel) vs. electrical energy for heating applications
2. Estimate energy efficiency improvements with proper air-fuel ration control and use of air preheating
3. Calculate effect of O2 enrichment of combustion air for energy savings
4. Calculate air or gas flow with use of orifice flow meters in gas or air lines.

Information on Process Heating and web-page links



Clicking on the top bar leads to three links.

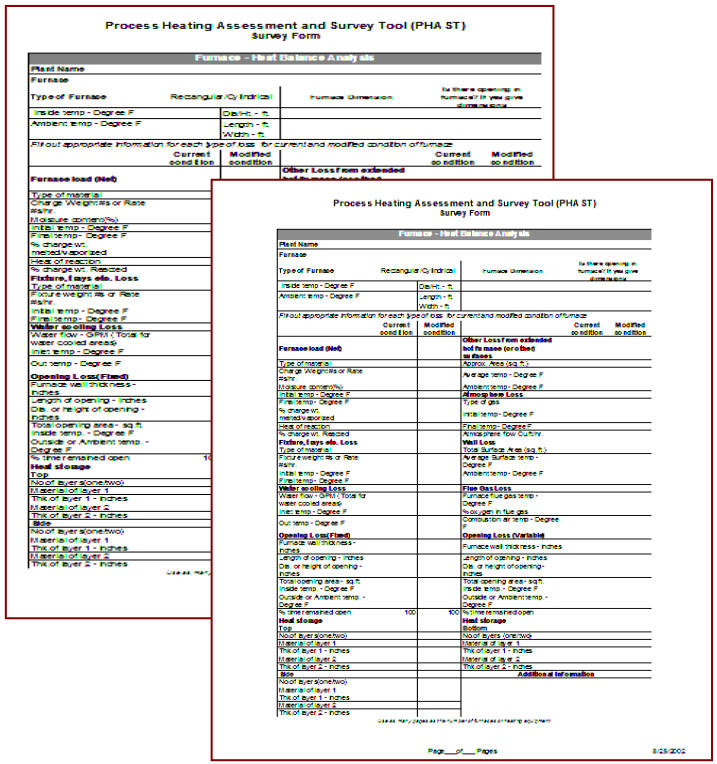
- Glossary section gives a list and brief description of commonly used terms in the process heating industry
- Link to DOE OIT Best Practices web page. The web page includes wealth of information on energy efficiency improvement
- Link to IHEA web page. This links include information on process heating equipment suppliers and links to web page of some of them.


Plant/Equipment Information

Plant Equipment Information

The **"Plant Information"** section of PHAST is used to survey the process heating (PH) equipment used in a plant, estimate their energy use and cost and compare relative energy cost for all PH equipment.

PHAST Survey Forms

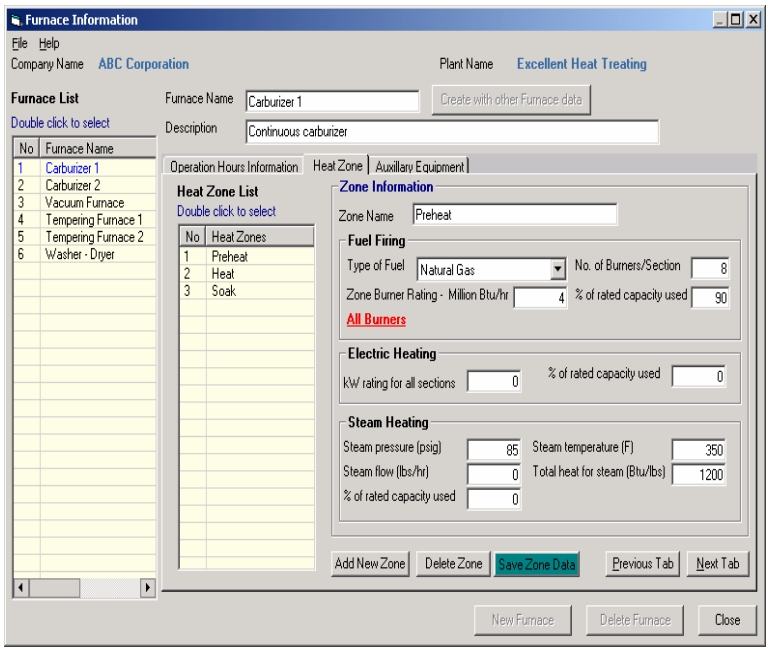


Survey forms are used to collect energy use data for the furnaces, heaters etc.

1. The forms are used to collect information on process heating (PH) equipment energy supply and operating data that needs to be entered in various sections of PHAST
2. The survey forms are given as MS Excel spreadsheets.


Plant/Equipment Information

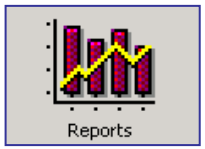
Heating Equipment Inventory and Energy Use



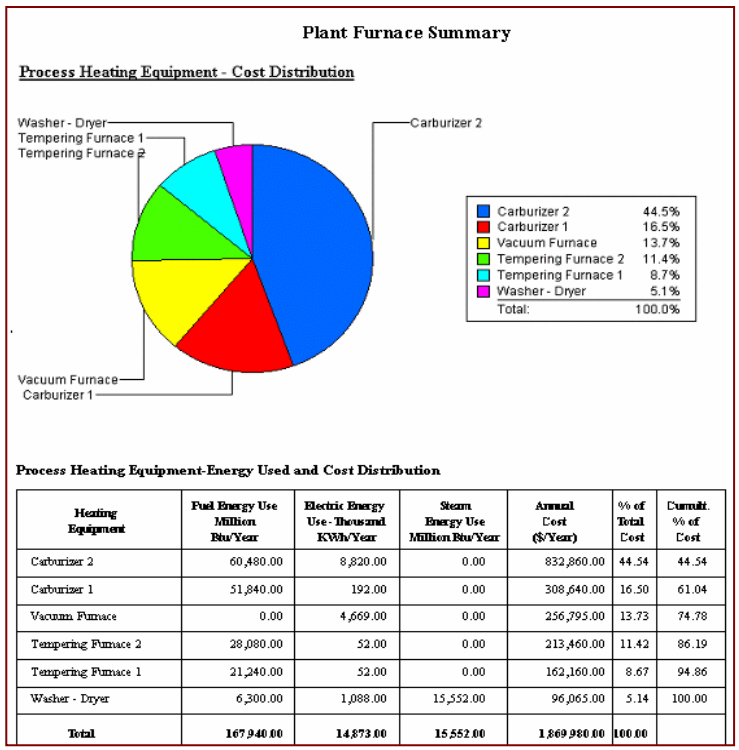
Forms in this section are used to enter equipment inventory information

- Type of fuel – energy used and unit cost
- Number of heating equipment (boiler, dryer, heater, oven etc.) and their operating information
- Information on auxiliary equipment such as motors, pumps, fans etc. associated with each heating equipment
- General information for the company, plants and general description of the plant information

Use one form for each plant.



Energy Use and Cost Distribution Report



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.

Use this report to identify high energy user equipment and to select one or more furnaces for further analysis

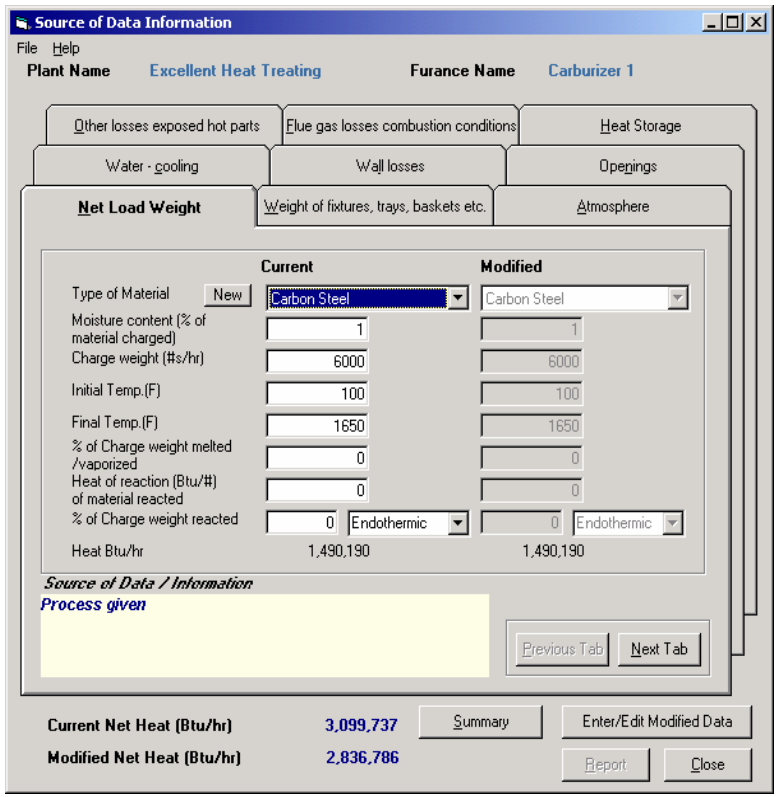
What Next?

- Review energy use and energy cost for the furnaces surveyed
- Select a furnace to analyze energy use distribution
- Collect necessary data using the survey form
- Perform detail heat balance for the furnace using section of PHAST
- Review energy use pattern and identify energy saving opportunities
- Perform "what-if" analysis to study effect of the energy saving opportunities

Heat Balance Analysis

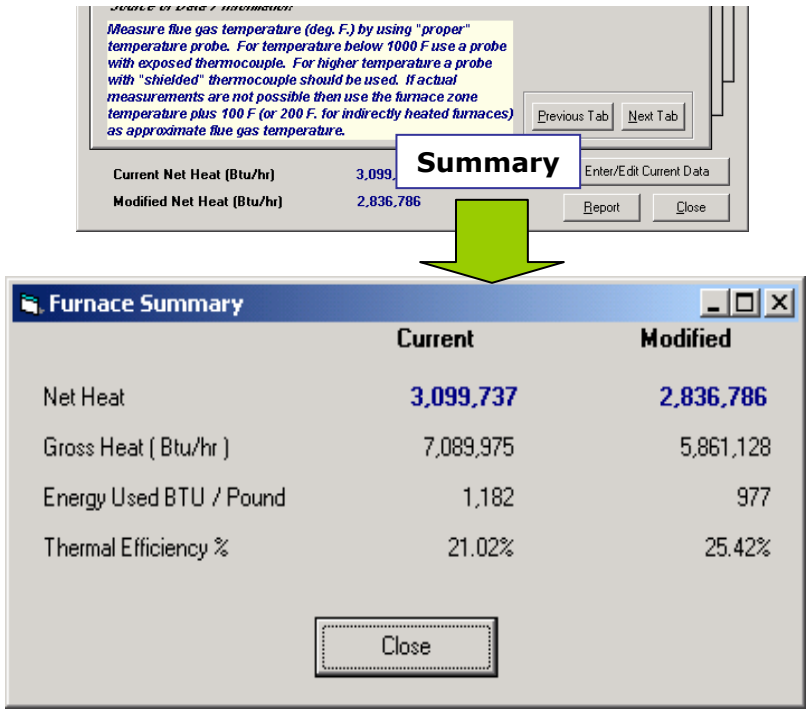
- Analyze the energy used in various parts of a furnace under a given operating condition. The areas for energy use include charge or load, fixtures, trays etc., wall losses, water cooling losses, losses through openings and exposed hot parts, flue products (or exhaust gases) and heat storage.
- This section allows the user to identify major areas of energy use and the magnitude of losses to study the effect of changes in operating conditions and their effect on the energy used in the furnace.

Heat Balance Section



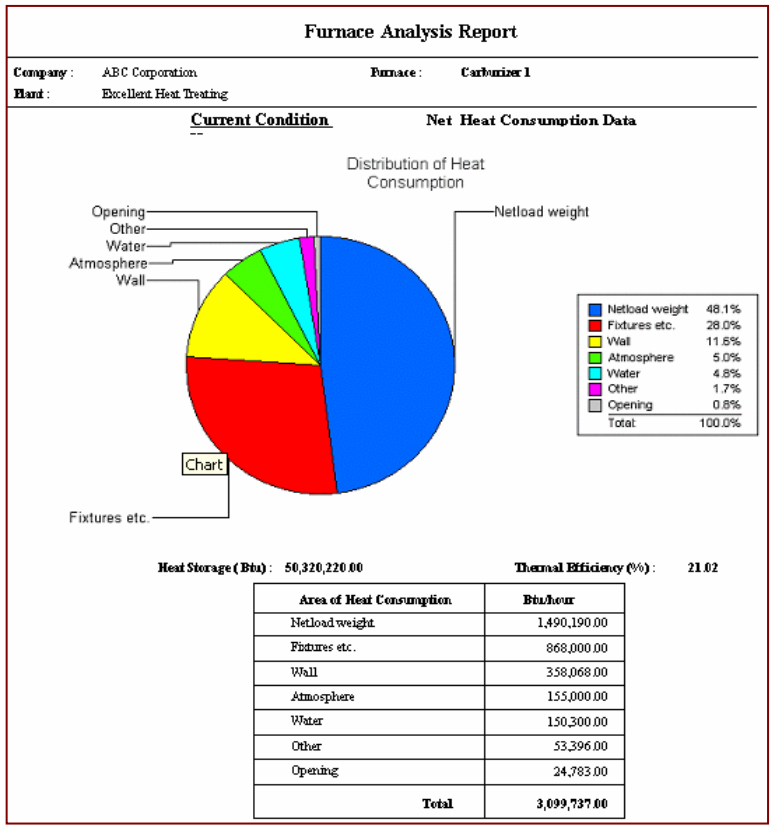
- A number of forms are used to enter data for various areas where heat is used in a heating equipment
- The areas include
  - Load
  - Fixtures, trays, baskets etc.
  - Wall losses
  - Opening losses
  - Radiation loses
  - Flue gas losses
  - Heat storage
- A data base includes thermal properties of commonly processed – heated used materials.
- Total heat requirement (Btu/hr) is calculated and displayed at the bottom of the data table.

Heating Performance summary



- Click on "Summary" button would open a form that shows summary of the furnace performance.
- The table shows: net heat requirement of the furnace; gross heat and energy used per unit (Lb.) of the products or material being processed.
- It also shows Thermal Efficiency of the furnace based on heat delivered to the load compared to gross heat input for the furnace.
- Thermal efficiency is NOT the same as available heat for the 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

Opening
Other
Water
Atmosphere
Wall
Netload weight
Fixtures etc.
Chart

Netload weight	48.1%
Fixtures etc.	28.0%
Wall	11.6%
Atmosphere	5.0%
Water	4.8%
Other	1.7%
Opening	0.8%
Total	100.0%

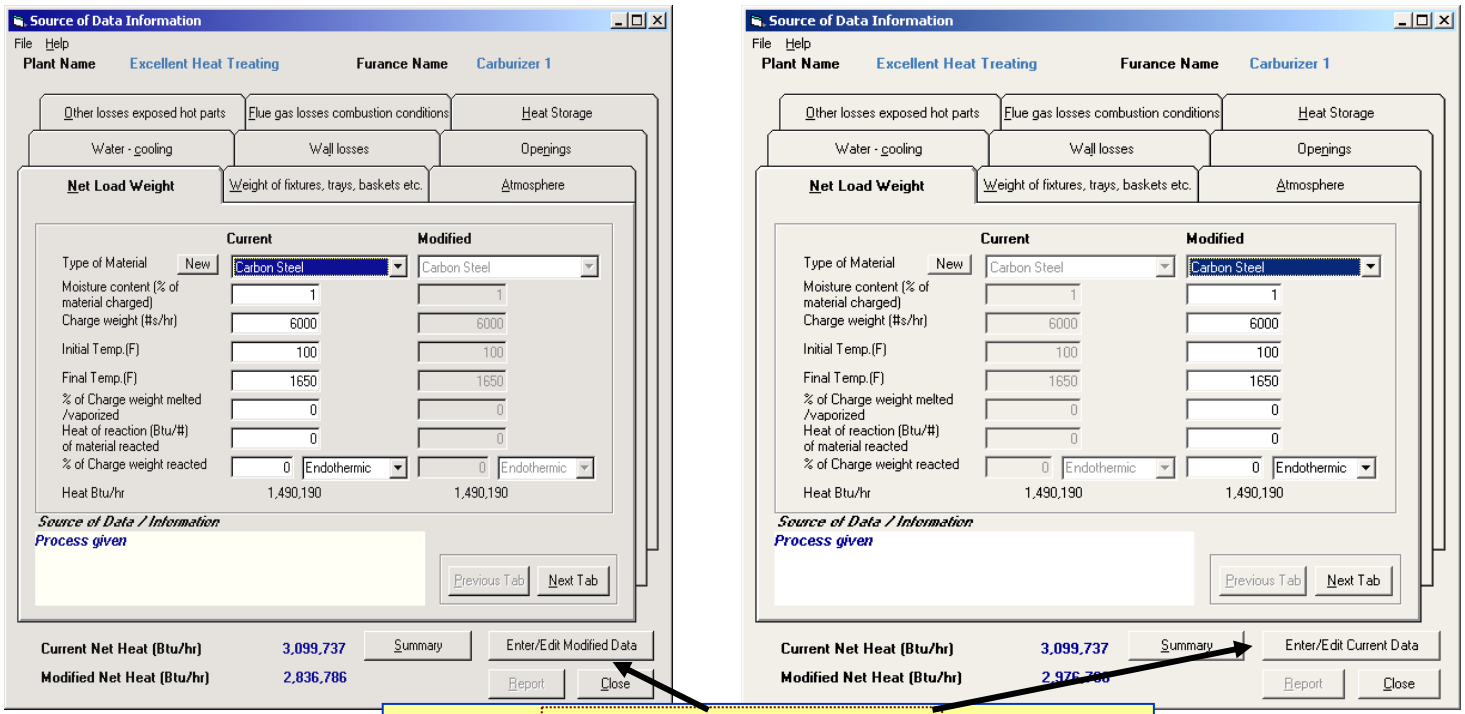
Heat Storage (Btu) : 50,320,220.00 **Thermal Efficiency (%) :** 21.02

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**

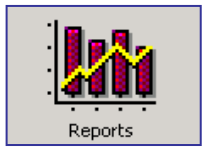
The report shows

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

Modified Conditions Data for Performance Improvement



Use Enter/Edit Modified Data Button to switch from "Current Condition" Data to "Modified Conditions" Data

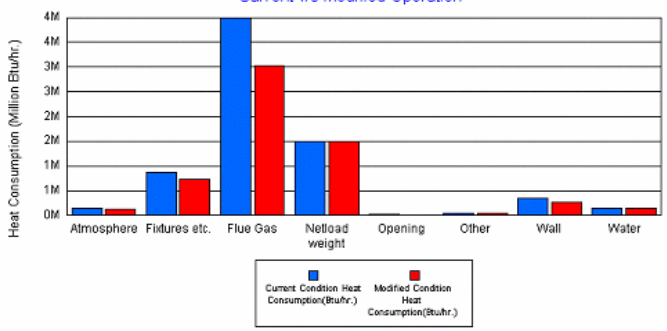


Heat Balance: Energy Use - Current vs. Modified Conditions

Company: ABC Corporation Furnace: Carburizer1
Plant: Excellent Heat Imating

Comparision : Consumption of Heat

Current v/s Modified Operation



	Current Condition Heat Consumption(Btu/hr.)	Modified Condition Heat Consumption(Btu/hr.)
Atmosphere	155,000.00	130,000.00
Fixtures etc.	868,000.00	728,000.00
Flue Gas	3,990,238.00	3,024,342.00
Netload weight	1,490,190.00	1,490,190.00
Opening	24,783.00	10,468.00
Other	53,396.00	53,396.00
Wall	358,048.00	274,432.00
Water	150,300.00	150,300.00
Total	7,089,975.00	5,861,128.00

The report shows

- Comparison of energy use for current operations and with possible changes (what-if analysis) in operating conditions for the furnace.

Ten Steps to Reduce Energy Use in Heating Systems for the Corn Refining Industry

1. Air-fuel ratio (exhaust gas oxygen) control in boilers and fired dryers through proper operation - maintenance
2. Waste heat recovery from flue (exhaust gases) - Combustion air preheating, feed water or material preheating etc.
3. Heat cascading – use of high temperature steams (gases, liquids) for lower temperature processes
4. Heat recovery from thermal oxidizer gases (use of regenerative systems)
5. Use of thermal oxidizer gases for dryer (directly or indirectly)
6. Use of dryer gases with low concentration volatile materials as combustion air for boilers or other fired systems
7. Replace indirect heating (steam or fuel fired) by direct heating using new generation burners or waste heat from other processes
8. Use of direct fired – indirect fired fuel fired systems to replace steam heating where the boiler fuel costs justify it
9. Use of combined heat and power for steam generation or thermal oxidizers
10. Reduce heat losses
    Insulate hot surfaces, plug openings, use pressure control, reduce steam or hot gas losses (fix leaks), maintain stem traps, return condensate etc.

Process Heating Assessment and Survey Tool (PHAST)

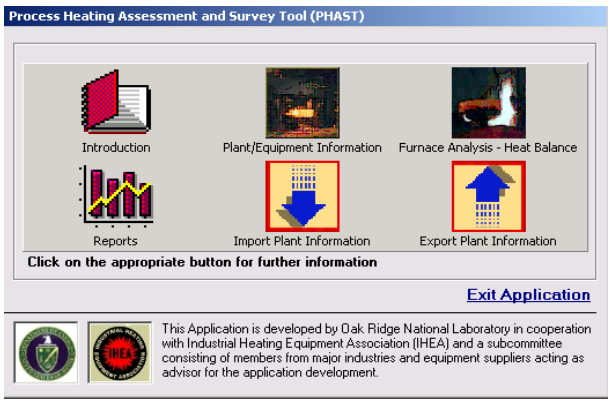
Download PHAST tool
from the DOE web site

http://www.eere.energy.gov/industry/

Use following steps:

- **Program Areas**
- **Best Practices**
- **Tools and Publications**
- **Software**
- **Process Heating Assessment and Survey Tool (PHAST)**

Process Heating Assessment and Survey Tool (PHAST)



The downloadable version of PHAST includes following files.

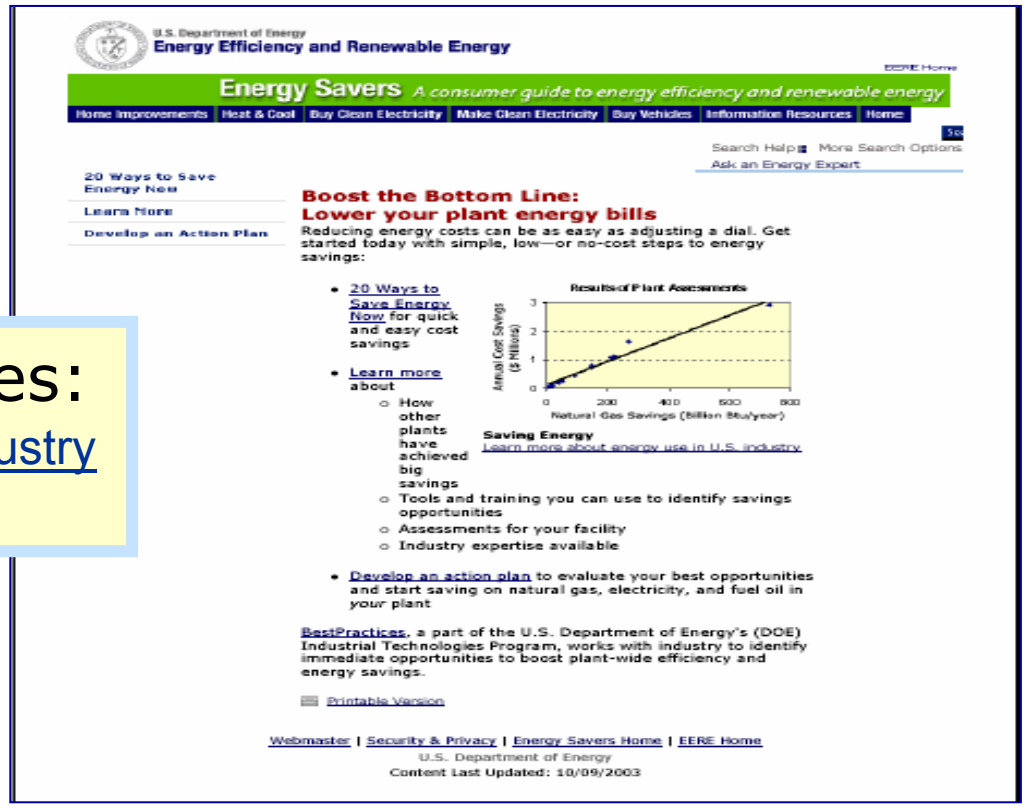
1. **Read me file – This should be read first**
2. **User manual – This should be reviewed and printed for future reference**
3. **Software for PHAST – This is the main program for the tool**
4. **Survey forms – These are to be used for collection of data that would be used for use of PHAST**

Next steps

- Attend one-day end-user PHAST training to learn capabilities of PHAST and its use
- Attend qualified specialist training to become a qualified trainer to teach others how to use PHAST. This is a 2 to 2 ½ days course offered at selected locations throughout the country
- Refer to DOE-EERE-ITP web page (www.eere.energy.gov/industry) for schedule and location in your area
- Sign-up for the end user training at the end of this meeting

Energy Savers Tips for Industries

Visit the Web Sites:
www.eere.energy.gov/industry



Resources & Information

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