

Energy Management in Commercial Bakeries



CSM
Worldwide



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The price of natural gas is SOARING!

And because of this, the price of electrical power is climbing as well.

Since utility costs in the bakery must be managed, our industry is looking toward real world implementation of ENERGY MANAGEMENT.

Frankly, it's the right thing to do.

As always, the baking industry is very practical and as such must look for practical ways to manage energy. The bakery is looking for straight forward, cost effective ways to conserve energy and to reclaim energy for further use.

Bakery engineers and management must find and implement efficiency improvements wherever either natural gas or electricity can be saved.

To this end, the bakery must implement conservation plans to minimized heat losses.

And, the bakery must implement *Waste Heat Recovery*, transferring the reclaimed heat to another part of the bakery where it can be put to good use.

Equally important, however, is the need to implement a real time *Facility Energy Monitoring System (FEMS)*. This provides a real time display profiling the bakery's energy status. Bakery engineers know that "to manage it, you must first measure it". *When FEMS is implemented, instrumentation is installed throughout the bakery to take key measurements of energy parameters.* For example, FEMS measures the temperature of all air flows entering and leaving the facility; it measures and records ambient conditions

Why is Energy Conservation and Waste Heat Recovery Important

- Natural Gas Prices are SOARING!
- Electrical Power Costs are on the INCREASE.
- Gas & Electric are Substantial Costs in Every Bakery
- Energy Conservation & Energy Recovery are More Important than Ever!

Conduct A Baking Facility Energy Audit

- Looking for Opportunities for:
 - Waste Heat Recovery & Heat Transfer
 - Efficiency Improvements to Save Natural Gas
 - Efficiency Improvements to Save Electricity
- Implement a Facility Energy Monitoring System

Waste Heat Recovery Heat Transfer

From:

- CatOx Exhaust
- Oven Exhaust
- Boiler Exhaust

To:

- Make Hot Water
- Heat Boiler Feed Water
- Generate Steam
- Heat Air
- Other Uses.

Today, it's possible, it's affordable, and it's being done.

It is best to begin, however, with simpler, easy to implement projects that get results fast. As stated earlier, the baking industry is very smart and very practical.

Begin by calling in the Energy Experts.

Contract for an energy audit.

Then make a list of recommended improvements and get going.

The next gas and electric bill is just around the corner.



within the bakery; it records natural gas usage by each oven, boiler or combustion device; and it notes these parameters on the same real time display. FEMS is also "smart". When a measured parameter strays from acceptable bounds, an alarm alerts the bakery to "check it out".

Examining Waste Heat Recovery, CSM recognizes that the *primary sources of recoverable heat in the bakery are exhausts from: ovens, boilers and Catalytic Oxidizers (CatOx).*

Recovered heat from these sources can be transferred to alternate locations in the bakery for any of the following uses: make hot water, pre-heat boiler feed water, generate steam, and heating air.

The particular economics for each of these projects differ, but as the price of natural gas has risen – the return on investment has improved significantly!

Listing only a few uses for recovered heat, consider:

- Making steam for use in the bakery including, perhaps, the proofer room.
- Using a glycol coil to transfer heat to the proofer room.
- Making hot air for comfort heat in the bakery shipping area or offices.
- Pre-heating the make-up air coming into the bakery.
- Making hot water for the wash room or for sanitary cleanup.
- Pre-heating the boiler feed water.

The objective is to evaluate each of the major energy using components in the bakery and deciding which practical improvements should be considered. With this in mind, look first at the baking ovens.

It is common knowledge in the bakery that some of the oven burner elements just don't light. These should be detected, repaired or shut down. No longer is it economical to bleed natural gas through unlit burners. Unburned methane going to atmosphere simply costs too much!

Tuning the burners for optimum combustion is now a very "smart thing to do", and pre-heating the air inlet to the



Possible Uses for Recovered Waste Heat

- Heat Steam for the Proofer Room.
- Heat for the Bakery (Plant, Shipping, Offices, etc.)
- Pre-Heat Inlet Air to the Bakery Oven
- Hot Water for Use in the Wash Room or for Sanitary Cleanup
- Pre-Heat Boiler Feed Water
- Generate Steam for Use in the Plant.

Bakery Ovens

- Oven Burner Optimization
 - Minimize Wasted Natural Gas.
 - Try to Make All Burners Light
 - Shutdown Burners that Don't Light
 - Pre-Heat Inlet Air to the Oven
 - Tune Burners for Optimum Combustion.
- Oven Controls
 - Calibrate Thermocouples & Instrumentation.
 - Install Gas Meter to Monitor Usage.
 - Install Waste Heat Recovery on Exhaust.

oven by reclaiming heat from the oven exhaust should be considered.

One of the simplest and smartest things to do is to calibrate the ovens' thermocouples and instrumentation.

Distributed Generation COGEN Systems

- Natural Gas Fired Stationary Engines to Generate Electric Power (500 kW to 3 MW). Generate Steam and Make Hot Water.
- Adsorption Chillers may be used on the Engine Exhaust for Air Conditioning.

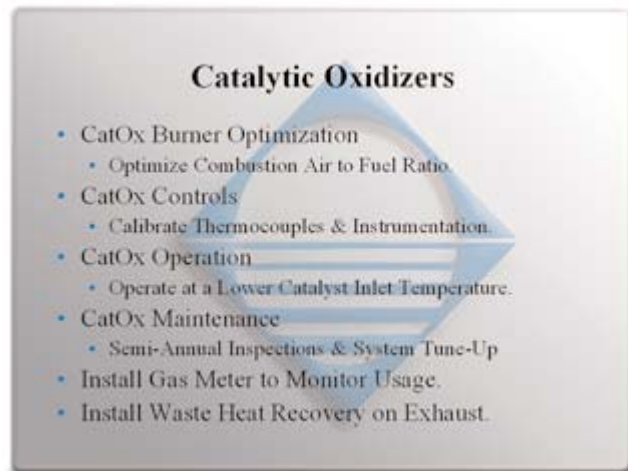
Also, it is important to install a gas flow meter on each oven and record gas usage. Remember, let's manage it!

Most bakery ovens today have a Catalytic Oxidizer or CatOx installed to destroy ethanol emissions. The CatOx already uses an air-to-air heat exchange to recover heat for reuse in the CatOx. But, there is more that can be done.

CatOx burner optimization is required. Again, unburned methane to atmosphere is not affordable. The combustion air to fuel ratio of the CatOx burner can be modified and optimized.

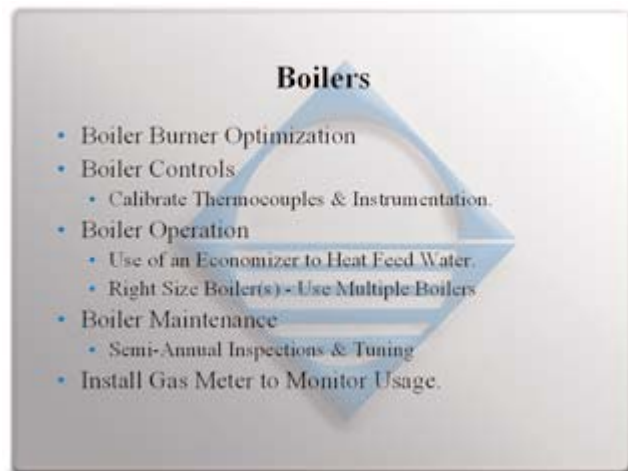
CatOx thermocouples and instrumentation should be calibrated on a scheduled basis.

Semi-annual overall maintenance, conducted by the CatOx manufacturer, is an imperative. The expert system tune-up has a payback!



Catalytic Oxidizers

- CatOx Burner Optimization
 - Optimize Combustion Air to Fuel Ratio.
- CatOx Controls
 - Calibrate Thermocouples & Instrumentation.
- CatOx Operation
 - Operate at a Lower Catalyst Inlet Temperature.
- CatOx Maintenance
 - Semi-Annual Inspections & System Tune-Up
- Install Gas Meter to Monitor Usage.
- Install Waste Heat Recovery on Exhaust.



Boilers

- Boiler Burner Optimization
- Boiler Controls
 - Calibrate Thermocouples & Instrumentation.
- Boiler Operation
 - Use of an Economizer to Heat Feed Water.
 - Right Size Boiler(s) - Use Multiple Boilers
- Boiler Maintenance
 - Semi-Annual Inspections & Tuning
- Install Gas Meter to Monitor Usage.



Energy Conservation

- Check/Improve Insulation on Duct & Stacks Leading to Heat Recovery Equipment & CatOx.
- Check/Improve Insulation on Hot Water & Steam Piping.
- Eliminate "Dead Legs" of Such Piping.
- Check & Maintain Condensate Traps.

Can the CatOx be operated at a lower catalyst temperature? Sometimes it can and the manufacturer should be charged with finding out!

Again, a gas meter belongs on the CatOx – measure and manage!

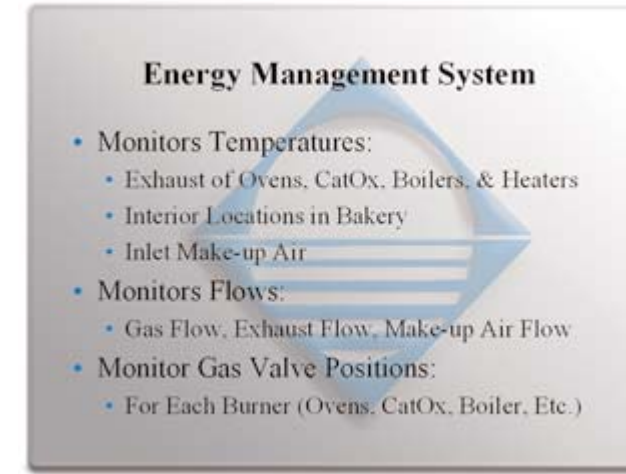
Additional Waste Heat Recovery can be applied to the clean, hot air exhaust of the CatOx. The CatOx exhaust, even after primary heat recovery, still has heat to give back to the bakery!

Boiler optimization is so practical and so necessary. Again, semi-annual maintenance by a qualified technician is required. The burner control system with associated thermocouples and instrumentation must be calibrated and checked.

Boiler exhaust can give up heat via use of an economizer to pre-heat the boiler feed water, and gas meters are needed here as well.

Should the boiler be upgraded to a more efficient and modern system? What are the ramifications of such including emission requirements? Can the bakery do better by installing small boilers and perhaps more of them?

Bakery wide conservation should include checking and improving, where appropriate and economical, insulation of ducts, stacks and steam/hot water piping. And, especially in older facilities with decades of modifications, eliminating the "dead legs" in such piping. While at it, remember to check and maintain condensate traps.



Energy Management System

- Monitors Temperatures:
 - Exhaust of Ovens, CatOx, Boilers, & Heaters
 - Interior Locations in Bakery
 - Inlet Make-up Air
- Monitors Flows:
 - Gas Flow, Exhaust Flow, Make-up Air Flow
- Monitor Gas Valve Positions:
 - For Each Burner (Ovens, CatOx, Boiler, Etc.)

Electric power must be conserved as well.

Look for opportunities to economically upgrade to premium efficiency motors and to install VFD's. Inspect and clean blower air intake filters.

Install timers where applicable.

Look upward and examine the lighting. Can high efficiency fluorescent lighting be used?

Find every heater used in the bakery! Must it run all the time? Is it the right size?

And, what about refrigeration? Is it time to upgrade? Are the units set to the right temperature and are they performing well?

Returning to a baking Facility Energy Monitoring System or FEMS. It's likely to be ethernet based using thermocouples and instrumentation throughout the bakery to provide data for real time display.

FEMS displays the temperature on each exhaust and all make-up air. The temperature of each critical location throughout the bakery is also displayed.

Observe the position of each gas valve at each combustion point in the bakery. Each gas flow meter reports to the FEMS. Being creative and thorough, a bevy of other useful calculated energy parameters should be displayed as well.

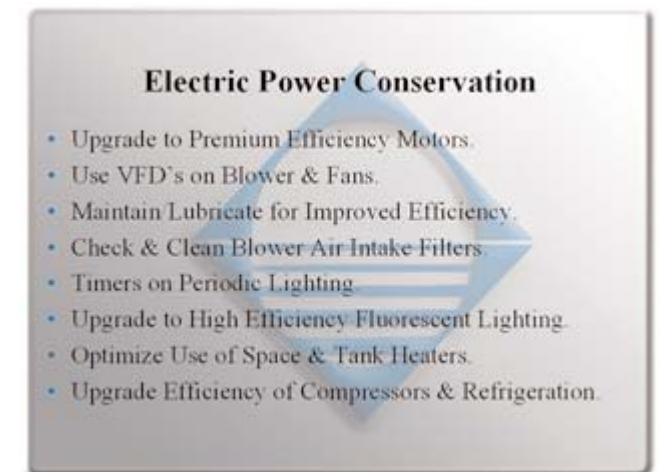
FEMS is smart! Alarms will display wherever and whenever a critical parameter strays "out of bounds"; the range of acceptable values are set by the bakery maintenance personnel or perhaps the Plant Manager. Each excursion is documented and quantified.

More importantly, the bakery investigates, finds the problem and corrects it.

Can more be done? Absolutely.

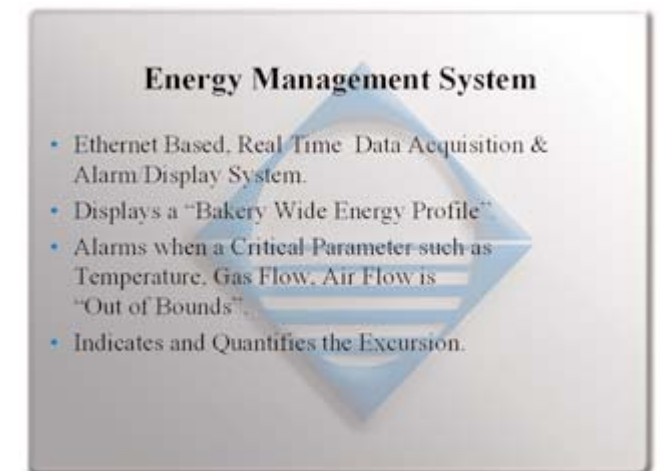
Some of the additional energy management options are much more complex and still others may not yet be affordable.

How about installing a highly efficient, natural gas fired COGEN System using one or more reciprocating engines or a microturbine, the exhaust of which feeds a steam boiler. Hot water can be made at the same time!



Electric Power Conservation

- Upgrade to Premium Efficiency Motors.
- Use VFD's on Blower & Fans.
- Maintain Lubricate for Improved Efficiency.
- Check & Clean Blower Air Intake Filters
- Timers on Periodic Lighting
- Upgrade to High Efficiency Fluorescent Lighting
- Optimize Use of Space & Tank Heaters.
- Upgrade Efficiency of Compressors & Refrigeration.



Energy Management System

- Ethernet Based, Real Time Data Acquisition & Alarm Display System.
- Displays a "Bakery Wide Energy Profile"
- Alarms when a Critical Parameter such as Temperature, Gas Flow, Air Flow is "Out of Bounds".
- Indicates and Quantifies the Excursion.