Canadian Manufacturers & Exporters

Case Study

Bakery Heat Recovery and Overhead Loads

Key Opportunity

The heat from oven flue gases can be used to preheat combustion air and warm make-up air during the winter.

Savings potential: 7,400 MMBtu/yr

Expected cost: $100,000

Expected payback: 3.4 years

Applicability: This opportunity is applicable for all bakeries that contain gas-fired appliances with high make-up air flows.

Introduction

Commercial bakeries mix large batches of dough that are then portioned into individual loafs and placed into baking pans. The pans are first conveyed through a proofing oven that warms and humidifies the dough as it rises, before being conveyed into a high temperature oven that cooks the dough. After leaving the oven, the pans proceed through a spiral conveyor to allow the product to cool before the final product is wrapped for shipping.

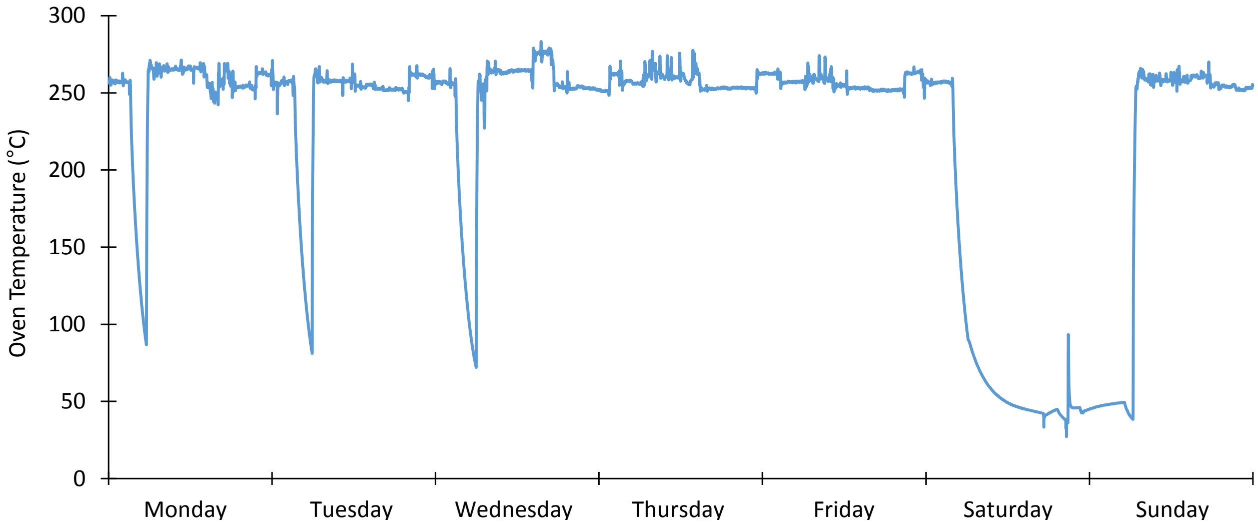
The Energy Pathfinder Research Initiative used sub-meters at a commercial bakery to monitor the energy consumption of the following systems:

- Gas-fired oven (1 sub-meter)
- Air compressor (1 sub-meter)
- Gas-fired boiler (1 sub-meter)
- Dough mixer (1 sub-meter)

Energy Analysis

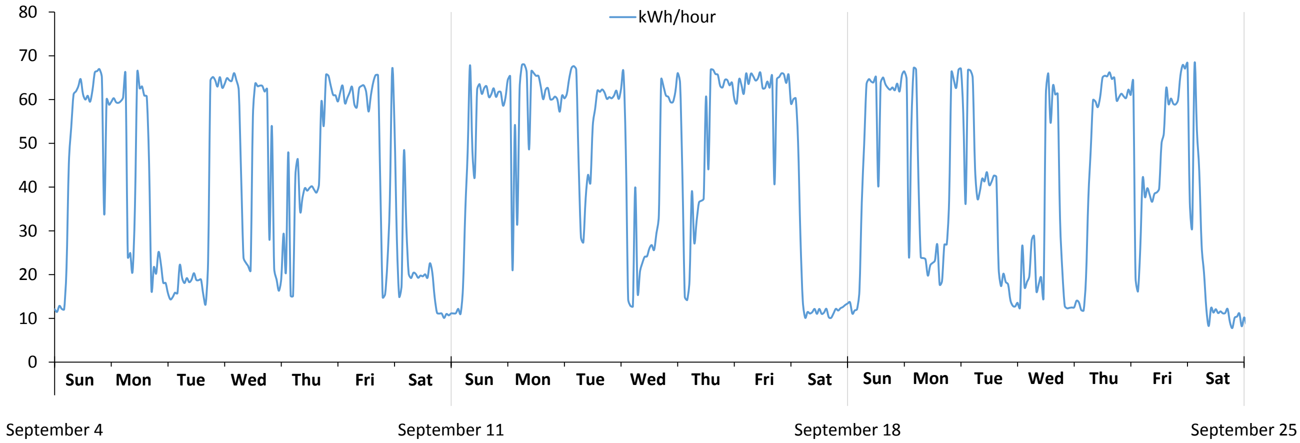
As the bakery's primary piece of production equipment, this case study focused on energy saving opportunities related to the gas-fired oven. The large continuous production oven draws its combustion air from within the building thus using building ventilation air. For this reason, the bakery uses a closed air system within the building to control air cleanliness. To avoid product contamination, outside air is filtered and tempered before entering the process area. During the winter, the outside air is currently being tempered with gas air heaters. As shown in Exhibit 1, the oven typically operates at temperatures exceeding 250°C. Because of this high operating temperature, the oven exhausts a significant amount of useful energy to the atmosphere.

Exhibit 1 Baking Oven Temperature (March 21, 2016 to March 27, 2016)



While the process controls effectively aligned consumption with production requirements, this facility showcased several electrical overhead auxiliary load opportunities. The bakery had already taken a proactive role in seeking opportunities, and one of the key findings was the identification of waste energy related to the bakery's compressed air systems. First, the bakery was able to reduce its peak demand by approximately 70 kW by shifting loads and removing its rarely needed second air compressor. The bakery also reduced the energy consumption of its remaining air compressor by reducing its operating pressure, installing a variable frequency drive, and replacing compressed air nozzles with a 3 HP blower for pan cleaning. Finally, the bakery discovered that it could still meet its production requirements while turning off the air compressor for one day each weekend. This simple protocol is currently being implemented successfully, as shown evidenced in Exhibit 1.

Exhibit 2 Air Compressor Energy Consumption (kWh/hour)



Opportunity for Energy Cost Reduction

Heat Recovery for Air Heating

Because the oven's exhaust piping is in close proximity to both the fresh air intake ducting and the gas burner inlet air piping, there are two opportunities to recover heat from the oven's flue gas. The first opportunity could save 5,600 MMBtu annually through the installation of a new heat exchanger that transfers heat from the exhaust gas to the incoming fresh air. The second opportunity could save an additional 1,800 MMBtu annually by recovering energy from the exhaust to preheat the combustion air for the gas burner. This strategy of recovering heat from process exhaust can be used at any similar food processing site that requires the filtering and tempering of cold make-up air.

Reducing Overhead Loads

As mentioned above, the bakery was a successful showcase for some previously implemented overhead load reductions. Removing the rarely needed second air compressor lowered peak demand by approximately 70 kW. While turning off the air compressor for one day each weekend is expected to save the bakery approximately 75,000 kWh annually. Additionally, controls were installed to turn off the oven's exhaust fan when the oven is not in use. This simple measure has a payback of less than one year and will save the bakery approximately 50,000 kWh annually.

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Exhibit 3 Summary of Energy Saving Opportunities

Opportunity	Capital Costs	Annual Energy Savings	Annual Energy Cost Reduction	Payback (years)
Heat recovery from oven flue gases	$100,000	7,400 MMBtu	$29,600	3.4
Turn exhaust fans off when oven is off	$5,000	50,000 kWh	$5,500	0.9
Turn air compressor off for one day each weekend	-	75,000 kWh	$8,250	-
Turn off second air compressor	-	70 kW	$5,675	-

How many energy efficiency best practices has your facility adopted?
Find out by downloading and completing the CME Pathfinder benchmarking survey (by clicking here). This Excel-based survey covers important best practices associated with process heating, process cooling, machine drives, HVAC systems, lighting, and compressed air. Completing the survey will provide your facility with insights into where it can focus its future efforts to improve energy efficiency.

CME Energy Pathfinder Research Initiative

The Energy Pathfinder Research Initiative is designed to explore, define, and quantify low cost opportunities to improve, control, or optimize specific end uses and energy intensive processes for selected industries within the Ontario industrial and manufacturing sector. The project is unique in that it ***focused on the identification of operational opportunities rather than upgrading inefficient assets*** and aims to identify new best practises for waste energy reduction, realigning energy consumption to correct drivers, and identifying opportunities for load shifting or shedding for lowering peak demand and demand response.

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