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Case study:

Maple Leaf Foods Inc. reaps long-term benefits from process integration

Since Maple Leaf conducted its PI study and took action, the company has realized at least $2.2 million in savings.

Rothsay is a member of the Maple Leaf Foods family that provides essential services for the efficient and environmentally responsible management of collecting, processing and recycling edible and inedible animal by-products. In 2005, the company conducted a five-month process integration (PI) study with support from Natural Resources Canada (NRCan) that produces results to this day.

NRCan wanted to demonstrate that the PI approach could identify energy savings opportunities in food and beverage plants. The Maple Leaf Rothsay rendering meat plant in Dundas, Ontario, was already using 35 percent less gas per tonne processed compared to its other plants. Because of the complexity of its process equipment and energy systems, NRCan felt that this facility would be a good place to demonstrate PI benefits.

In the seven years since the study, the plant has saved more than $2.2 million cumulatively in energy costs and reduced natural gas consumption from 43.0 to 39.7 cubic metres (m^3) per raw tonne processed.

Past energy audits at the plant focused on specific systems or equipment but the PI study was much more comprehensive and went much further, looking at all the opportunities between and within systems.

"We had been looking at things such as boiler blow-down heat recovery, insulation, capacitors, compressor efficiencies and variable frequency drives but those were in isolation," recalls Ron Vincent, Maple Leaf's Six Sigma Senior Black Belt. "It had not yet occurred to us to go across all the systems and see the balance."

Conducting the study

Maple Leaf had been involved with Six Sigma – a set of tools and strategies used for process improvements – since 1999, so Rothsay used the DMAIC (define, measure, analyze, improve, control) methodology[1] to conduct the PI study.

The DMAIC phase took five months. NRCan staff spent 150 hours conducting the thermal energy balances and analyses and reporting potential energy-saving projects; Rothsay staff spent 250 hours collecting data and developing process maps.

One of their advantages was having a small cross functional team consisting of the operations manager, power and plant engineers, and Vincent himself. With such a small team, if they could not find answers, they brought in subject matter experts as needed.

[1] The DMAIC methodology is not exclusive to Six Sigma and can be used as the framework for other improvement applications.

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Process maps that included energy inputs and losses were developed for all processes within the facility, and several years' worth of historical energy consumption data was reviewed. A pinch analysis determined the minimum utility consumption required for the various processes to function and identify where heat exchanges were using excessive energy.

The largest opportunities for improvement rested with the plant's use of thermal energy. Due to the nature of the process, rendering plants expel large amounts of heat but Vincent was surprised by the large amount of waste heat that was generated.

"We thought we had made significant improvements to our boiler efficiencies by improving steam production but the savings did not show up at the tail end," says Vincent. "That was because things like leaking valves further down the line were never connected to boiler efficiency."

The "hot" moment, as Vincent puts it, came when the PI study revealed how waste heat from boilers and evaporator condensers could be reused to heat water or heat certain systems.

Projects at the top of the list

The PI study identified an initial $1.1 million in annual savings from simple, quick projects, such as replacing degraded insulation on tanks and pipes and fixing air leaks. In many cases, inefficiencies could receive immediate action.

One early project was recovering waste heat from the compressor and inducting it into other areas of the plant where heat was needed. The PI study also showed that heat released from the evaporator surface condenser could be used to heat process hot water, boiler combustion air, boiler make-up water and other buildings within the facility. Maple Leaf extrapolated the data and applied similar ideas to five other plants.

An additional $1.5 million in savings was identified to install boiler economizers and retrofit the plant evaporator. These measures were long term and involved major equipment redesign, with consequently longer payback periods.

"It took a few years to get economizers installed (this work was completed in 2008 and 2010), and we are now looking to add an evaporator section to another facility. All of these projects are assessed on their merits compared to other capital projects that need to be done."

PI studies are used primarily to identify thermal energy efficiencies, therefore electrical improvements were not studied in-depth in the 2005 study. Because natural gas costs are steady or declining and electricity rates are rising, Vincent says that they are now investigating the use of high-efficiency motors, LED lighting and other electricity-saving initiatives.

Results

Since Maple Leaf conducted its PI study and took action, the company has realized at least $2.2 million in savings. Vincent notes that, although all projects are tracked, not all results have been captured, which means that savings may be higher.

Production efficiencies have also improved. In 2005, the Rothsay plant was using 43 m^3 of natural gas per raw tonne processed; in 2012, that figure had improved to 39.7 m^3. This is very significant because the plant is also processing a lower yielding raw material in 2012 than they were in 2005. "It is a more efficient process, and we are removing more water, so we are better off processing that low-grade material here."

Additional changes have included regular energy consumption reviews with operations personnel and monthly reviews of energy projects.

Rothsay set a target of reducing energy consumption by 3 percent annually for the last five years for each of its facilities, a reduction that is tied to employee operating bonuses. "More often than not, we have met that target," says Vincent.

Rothsay has also been able to set an example for other Maple Leaf facilities and share information. Even before the PI study, Maple Leaf had an "Energy Share" staff group that helped promote energy awareness and implement energy efficiency projects. Although the group has since disbanded, Rothsay has maintained many of the group's practices.

For example, in 2009, Rothsay developed the "Biggest Energy Loser" contest in which plants competed to reduce their energy consumption over 12 months. "We used to have prizes – the Montréal plant won an employee green space for its facility one year – but now it is just for bragging rights," says Vincent. Nevertheless, the contest helps maintain the energy awareness of all employees, not just the engineering team. The Dundas plant, with an overall 5 percent energy use reduction, led the 2013 contest.

Additional benefits

Maple Leaf has benefited from other, less obvious changes, such as factoring energy use into new equipment purchases. Designers and purchasers compare vendors, looking at energy consumption, capacity, and maintenance and utility costs.

Vincent says that the PI study made them more likely to consider the energy impact of any change, not just engineering or mechanical ones. Employees now routinely ask about the yield of a product, how much water has to be removed, what it will cost and whether rendering different meats produces better efficiencies. "People are really looking at the energy use between systems."

Although Maple Leaf has no formal training program, it does make energy awareness training available to its staff, and the company has taken advantage of provincial and utility training programs to increase staff awareness.

Challenges

A major challenges any industry faces is obtaining the capital needed to implement energy efficiency initiatives. Vincent says that Maple Leaf prefers capital projects that have a two-year or shorter payback period but notes that this depends on when the capital is available and what other projects are planned. Eighty Maple Leaf plants compete for capital funds, so if the choice is between improving natural gas efficiency by 1 percent or adding a new hot dog line to improve customer satisfaction, the money will go toward the latter.

A related challenge is keeping the focus on energy management. "There have been lots of changes at Maple Leaf over the years, and that has taken the focus away from energy as a portfolio. The core principles have never gone away but sometimes attention gets sidetracked," says Vincent. However, he notes that Maple Leaf is standardizing operations across its facilities – having each plant on a common business platform with one reporting structure – which will include minimum requirements for energy management.

Advice and lessons learned

Vincent admits that an immediate follow-up with top management to execute the projects after the PI study would have sped up the process. "We should have done a better communication job up front," he says. "But we learned from that and have since done a much better job of communicating the benefits."

Vincent also offers insights that other industries might find useful if they are considering a PI study:

- Get the support of top management first. Before spending months putting together a proposal, find out if the president is even going to support it. Energy projects must become part of the normal capital planning and budgeting cycle, and be prioritized along with other capital requests.
- Identify a champion whose mandate is focused on energy. Relying on resources that are already stretched is a gamble. If it is not about through-put and productivity, they do not have time for it. A dedicated person is the way to go, even if it is a term position.
- Take a long-term view. Some opportunities requiring major redesigns will only become viable when equipment must be replaced.
- Hire experts or additional staff, if necessary. Vincent suggests hiring an engineer for six months or having one on a retainer so that you can consult him or her on various projects. Rothsay also hired a summer student in 2011 to conduct an electricity use analysis. The student made detailed process maps of thermal and electric energy. The plant engineers can now use those maps to see what impact changing one motor or one system has on the bottom line.
- Prepare yourself with engineering resources to look into the feasibility of projects. Adequate resources are needed to act on the PI study findings and that must come from the top down.
- Pursue simple, less complicated projects. Executing projects or maintaining energy awareness does not have to be expensive. Maple Leaf executed several small, inexpensive upgrades that added up to more than $1 million in energy savings

Next steps

Rothsay is reviewing the entire rendering process to see how systems could be optimized. "We have reduced the amount of oil recycling within the Dundas system, and a side benefit of that is that it reduces the hydraulic load and increases the capacity of the facility," says Vincent.

Although the PI study was conducted eight years ago, the benefits continue to accrue and Vincent says that Maple Leaf will continue to use the study findings and apply the lessons to Rothsay as well as other Maple Leaf plants.

Process integration

PI is a powerful approach to energy management in complex industrial facilities that consume significant amounts of thermal energy and operate numerous heat exchangers to heat and cool process streams. Unlike an energy audit, which tends to be equipment-based, a PI study is more comprehensive, taking into account all energy systems and process operations, including their interactions. PI has the potential to cost-effectively reduce your company's energy bill. Thermal energy savings range from 10 to 30 percent and have typical payback periods of a few months and three years.

More than 600 industrial facilities in Canada are suitable candidates for a PI study, including large industries such as oil and gas, pulp and paper, petrochemicals, steel mills and metallurgical plants, and medium-sized industries with complex energy systems such as dairies, food processing plants, breweries, textile dye houses and small chemical plants.

For more information about process integration, visit canmetenergy.nrcan.gc.ca/industrial-processes/industrial-systems-optimization/process-integration/approach/743.

PI cost-shared assistance

Funding from NRCan can cover up to 50 percent of the cost of a PI study, to a maximum of $25,000 (the cost of a PI study ranges between $40,000 and $150,000). This financial assistance can help industrial companies bear the costs of hiring a specialized firm to conduct a PI study and, ultimately, reduce the plant's energy consumption through the implementation of energy recovery projects. The energy analysis must be site-wide and cover all heating and cooling process requirements as well as utility production systems in the same study.

For more information, visit oee.nrcan.gc.ca/industrial/financial-assistance/17996.

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