Institute for Industrial Productivity

CASE STUDY

Energy management at St Marys Cement

ST MARYS

SECTOR	COUNTRY	THEME	TOPIC
Cement	Canada	Energy management	Energy management systems

This case study documents the development and implementation of the successful energy management system (EnMS) at St Marys Cement Bowmanville plant in Ontario, Canada. According to the company, an EnMS is "a formal commitment to the management of energy resources, supported by an approved energy plan with the objective to reduce energy consumption and emissions of greenhouse gases." The Bowmanville plant obtained certification of the ISO 50001 global EnMS standard in November 2011.

KEY LESSONS FROM ST MARYS ON THEIR ENERGY MANAGEMENT SYSTEM AT BOWMANVILLE

- An EnMS brings continuous energy and cost reductions, which in turn provide a competitive advantage in a global market (including cost reduction that does not necessarily require capital investment). Over five years, EnMS triggered an 8 percent absolute reduction in energy operating costs, amounting to savings of $C750,000–1,000,000 in total operating costs per year.
- Obtaining the EnMS standard ISO 50001 provides the company with an internationally-recognized response to sustainability and energy efficiency issues.
- The success of a corporate energy management program requires a team effort and should not be the responsibility of an individual. Ownership of energy management should be across all responsibility centers and plant personnel.
- An EnMS:
  - creates a management structure, which can sustain and maintain performance improvements
  - promotes the accelerated implementation of energy management projects
  - establishes the measurement and verification systems necessary to properly assess and track key performance indicators.
- Employee awareness of the costs of various operations and procedures and training programs brings important energy savings.
- Companies that have strong environmental management experience, particularly in lean manufacturing or other certification program can implement ISO 50001 with in-house staff.

CASE STUDY

Energy management at St Marys Cement

Profile of the Bowmanville plant

People: 118 people

Facility: Operates 24/7 with a rated capacity of over 1.8 million metric tons of product

Products: Portland cement[1]–gray clinker, Portland cement for general use, Portland cement for moderate heat hydration and high early strength, and Portland cement general use with limestone additional

Energy source(s): Electricity, fossil fuels (coal, petroleum coke, fluidcoke), diesel, propane.

Annual electricity consumption: At the Bowmanville plant it totals 200 gigawatt hours (GWh) per year

Energy management system: 360 Energy Certification in Energy Excellence (silver level) and ISO 50001 Standard certified

Energy intensity goal: 2 percent per annum

About St Marys

St Marys Cement Group is one of the oldest cement companies in North America and one of the major producers of cementitious-related materials in the Great Lakes Region. It operates two cement production facilities in Canada, one of which is the Bowmanville plant.

St Marys Cement Group is a subsidiary of Votorantim Cimentos, a Brazilian company based in Sao Paulo. Founded in 1936, Votorantim Cimentos is one of the world's top ten manufacturers of cement, concrete and aggregates. In North America, it operates as Votorantim Cement North America (VCNA). The VCNA group of companies manufacture, distribute and sell cement, slag, ready-mixed concrete, concrete block, construction aggregates, gunite and shotcrete products throughout North America.

For Votorantim Cimentos, sustainability means the continuation and growth of its businesses in the long term, anticipating the future requests of its customers and incorporating them into its objectives. More specifically, this means:

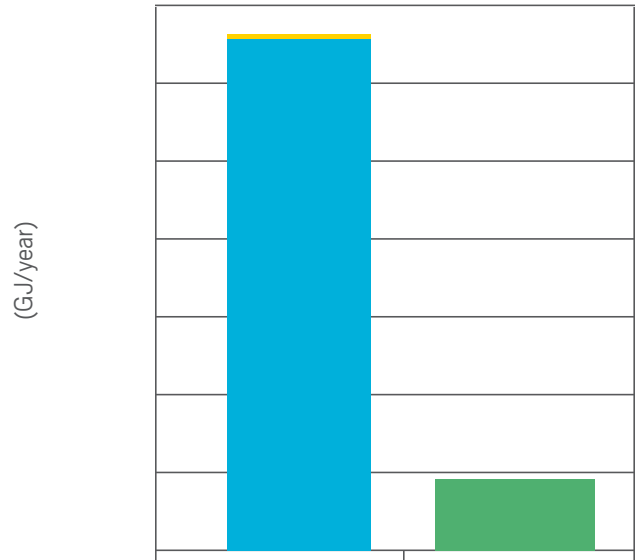
- being recognized by society as a socially and environmentally responsible company
- having sustainability as a strategy that guides corporate governance, management, education, decisions and investments, and creates value
- consistently improving economic, social and environmental results, pursuing efficiency and reliability in operations according to world-class standards
- being recognized as a company that attracts, develops and retains talented people to generate value and build a fair and inclusive society
- being committed to the well-being, health and safety of its employees, clients and partners
- contributing to the development of the communities in which the Group operates
- encouraging the cooperation and participation of all employees and interested parties in building partnerships and stimulating teamwork, in order to create mutual value.

The Bowmanville plant's energy use profile

Figure 1 profiles the energy use at the Bowmanville plant. It is categorized according to process and non-process energy use, based on the production output in the plant.

Process energy includes fuels used for limestone extraction (digging and hauling) raw meal and fuel preparation, the operation of the kiln, cement manufacturing, and generating process heat. Non-process energy use includes office building heating and mobile equipment fuel use.

FIGURE 1: Process and non-process energy use



	Total Heat	Total Electricity
Other GJ/year	49,400	
Process GJ/year	6,487,253	770,369

1 Portland cements are hydraulic cements, i.e. cements that set and harden by reacting chemically with water. The reaction process, called hydration, combines cement and water to form a stone-like mass. In Canada, the Canadian Standards Association (CSA) recognizes six types of Portland cement under Standard A3001.

Energy management at St Marys Cement

committee. The committee comprised representatives from the plant's operations, production, quality control, operations and maintenance, finance, procurement, and human resources teams. The initial focus of the committee was to establish an identity within the plant through a name and logo (they chose E=MC^2), raise awareness among staff of practical measures to reduce energy operating costs, and explain the role of the committee.

The Bowmanville plant developed business case metrics based on their own internal analysis of the opportunities. Return on investment was set as the key business case metric. The E=MC^2 committee also assessed certain non-energy benefits associated with the energy efficiency measures, including GHG emissions reduction and productivity improvements.

Aside from the implementation of the EnMS, the E=MC^2 committee has also:

- established an internal website to host the committee's efforts and actions
- organized a custom energy management training module for staff with support from Natural Resources Canada, which is the Canadian federal government agency responsible for energy management programs
- identified and acted upon over 100 separate energy efficiency initiatives.

As a result of the Bowmanville plant's energy management efforts, it received the Canadian Industry Program for Energy Conservation's Leadership Award and the Portland Cement Association's Energy and Environmental Award.

Involvement in government and utility programs

As part of its commitment to energy management, the Bowmanville plant has participated in a number of government and utility programs and incentives (see Table 1).

EnMS development and certification

The development and certification of the EnMS at the Bowmanville plant happened over seven years, starting in 2005. It is modeled on three separate EnMS standards:

- Energy Star for Industry – benchmarking and tracking (facility energy assessment matrix and plant energy performance indicators)[2]
- 360 Energy Inc Certification in Energy Excellence[3]
- The ISO 50001 Global Energy Standard.

The decision to develop an EnMS was motivated by two key factors. The E=MC^2 committee started monitoring and tracking energy use but, without an energy management framework, they quickly realized the limitations of this approach. Then, in 2007, the E=MC^2 committee became aware of another US plant that was developing a framework that would enable a more systematic approach to energy management. This plant implemented the Energy Star for Industry Facility Energy Assessment Matrix, which generates plant energy performance indicators and can be used for

2 www.energystar.gov/ia/business/industry/estar_and_manufacturers.pdf?deea-fb1f, www.energystar.gov/index.cfm?c=industry.bus_industry

3 www.360energy.net/our-success/certification-in-energy-excellence/st-marys-cement/

TABLE 1: Government and utility programs and incentives

Program	Details
Natural Resources Canada, Office of Energy Efficiency, Dollars to $ense Program	Developed a customized energy management training program for St. Marys Cement
Ontario Power Authority-Electricity Retrofit Incentive Program	Received C$15,000 in rebates for lighting retrofit
Ontario Power Authority Demand Reduction Program	Participated in the Ontario Power Authority Demand Reduction 1 and Reduction 3 program (DR3) and received incentives for reducing electricity demand from their operations at pivotal periods when Ontario's electricity system is under significant strain
Sustainable Development Technology Canada	Participated in a pilot project in conjunction with SDTC. The project included the installation of a system that monitors and controls combustion related to NOx, Sox and GHG emissions. The project reduced the heat consumption of the calciner through better process control and gave SDTC better understanding of the cement industry and the system's applications

Energy management at St Marys Cement

self-assessment of best practices and to compare performance against peer plants.

In 2008-09, the E=MC^2 committee decided to pursue the 360 Energy Inc. Certification in Energy Excellence, along with the development and implementation of a sustainable energy plan (explained below). The certification program focused on four distinct areas of best practice:

- commitment from management: a mandate from senior management that outlines the organization's energy management practices for the next three years
- energy procurement practices
- investment in energy efficiency: successful implementation of processes, programs and projects
- demonstrated energy performance improvements: verifiable energy improvements that show the organization's leadership in their industry and community.

The E=MC^2 committee convinced senior management about the value of the certification program because it had already established its credibility. By way of example, the committee had earlier identified various no-cost and low-cost energy management measures that could offer rapid paybacks ("low-hanging fruit"). In addition, the committee had secured large financial incentives from the Ontario Power Authority through participation in its Demand Reduction program.

360 Energy Certification in Energy Excellence

The Bowmanville plant gained a silver level 360 Energy Certification in Energy Excellence in 2009. Achievement required:

- the assembly and analysis of various energy use key performance indicators, which led to the introduction of a better system of data collection, analysis and reporting
- an in-depth, 12-month, third-party energy assessment
- the development of a sustainable energy plan, which comprised an energy policy for the plant, a commitment to reduce energy intensity and costs, and a program to implement the plan within three years. The action plan identified 68 energy management measures.

The E=MC^2 committee developed a performance scorecard to assess the plant's energy performance in five key areas:

1. Energy data management
2. Energy supply management
3. Energy use in facilities
4. Equipment efficiency
5. Organizational integration

ISO 50001 Standard

After achieving the 360 Certification in Energy Excellence, the E=MC^2 committee identified adoption of the ISO 50001 EnMS standard as a priority, even before the standard was formally completed by ISO and adopted by the Canadian Standards Association. The E=MC^2 committee saw this as an important platform to better communicate to customers, regulators and suppliers about the plant's improved energy efficiency and its lower GHG emissions.

On November 15, 2011, the Bowmanville plant received the first ISO 50001 certification in North America. The transition from the initial EnMS – which was developed under the auspices of the 360 Certification in Energy Excellence – did not require additional senior decision-making approvals. The initiative was led by an E=MC^2 committee member and supported by the rest of the committee under the authority of the Bowmanville plant manager.

According to Martin Vroegh, Corporate Environment Manager for St. Marys Cement Inc. (Canada), "ISO 50001 is the first ISO standard for St. Marys Cement that directly benefits our bottom-line with reduced energy costs and consumption."[4]

The E=MC^2 committee was able to meet most of the ISO 50001 requirements by building on the EnMS established to attain the Certification in Energy Excellence. The main requirements were:

- Energy planning (energy review, energy baseline, energy performance indicators and objectives, targets and action plans): These steps are required for the certification in energy excellence and involve updating the baseline to establish new targets and action plans.
- Implementation and operations (competence, training and awareness, communication, documentation, operational control): These procedures were already in place and just needed to be updated.
- Checking (monitoring, measurement and analysis, legal and other requirements, internal audit of the EnMS, control of records): Adjustments were made to the existing EnMS to accommodate the checking requirements.

4 Natural Resources Canada, Office of Energy Efficiency. Heads Up CIPEC Newsletter. June 15, 2012. Vol. XVI, No. 12.

Energy management at St Marys Cement

The Bowmanville plant was able to use existing hardware and software to meet the requirements. This had two benefits: the plant implementation cost was largely in-kind labor; and the time to fully implement the ISO 50001 was reduced – full implementation was carried out over around five months. The implementation of the EnMS was done in-house, without the aid of utility or government incentives. Certification cost was C$30,000.

The results

As a result of the energy management program, the Bowmanville plant has seen the following incremental improvements during the 2008-2011 period (relative to a 2006 baseline):

- energy intensity improvements of 2 percent per annum
- GHG emission reductions of slightly less than 1 percent per annum
- about an 8 percent absolute reduction in energy operating costs, amounting to savings of $C750,000-1,000,000 in total operating costs per year.

Looking ahead

The Bowmanville plant intends to remain certified to both ISO 50001 and the 360 Energy Certification in Energy Excellence (CEE) standards. Jason Schultz, the plant's Quality Manager, notes that the CEE and ISO 50001 certifications go hand in hand: "ISO 50001 provides the framework for a strong energy management system, while CEE ensures that the energy gains are validated (and implemented)."[5]

Fabio Garcia, Plant Manager says that recertification to the Certification in Energy Excellence "requires a demonstration of continuous improvement over three years. We're always re-evaluating what we do and how we do it, and we look forward to seeing what sort of improvements we can make in the next couple of years."[6]

The Certification in Energy Excellence expires in 2012, meaning the plant will need to update the sustainable energy plan and set new targets and commitments. The ISO 50001 certification runs until 2014.

The E=MC^2 committee continues to meet weekly to advance energy efficiency at the plant. These meetings typically focus on reviewing actions and performance, and any new ideas, which are documented.

EnMS success factors

The key factors influencing the success of the Bowmanville plant energy management program overall and the implementation of the EnMS included:

- developing a strong business case for energy management and continually updating and advancing it, based on verified performance. The foundation that was built as part of the certification process for the 360 Energy Certification in Energy Excellence set the stage for management's support of ISO 50001
- an energy management plan and initiatives that were part of the plant's operational DNA. Practically, this meant integrating energy management activities and key performance indicators into day-to-day management and operational systems at the plant. Factors that helped the Bowmanville plant to make this transition were a strong foundation in adopting lean manufacturing, and previous certification under 9001 (quality management) and ISO 14001 (environmental management). The plant's quality management procedures and processes served as an important foundation for the EnMS (e.g. the manual the plant developed on how it adheres to ISO compliance requirements).

5 Natural Resources Canada, Office of Energy Efficiency. Heads Up CIPEC Newsletter. June 15, 2012. Vol. XVI, No. 12.

6 360 Energy Inc case study. ST MARYS CEMENT 360-Degree Focus on Energy Management.

7 Most of the information in the table was taken from the 360 Energy Inc case study, ST MARYS CEMENT 360-Degree Focus on Energy Management.

8 Bowmanville plant has received over C$1 million in revenue from participation in DR3. https://saveonenergy.ca/Business/Program-Overviews/Demand-Response/Demand-Response-3.aspx

Energy management at St Marys Cement

TABLE 2: Summary of the plant's energy management measures[7]

Energy management measure	Details
Demand reduction	• Bowmanville plant is a participant in Ontario Power Authority's Demand Reduction 3 (DR3) program. DR3 is contract-based and offers financial incentives to participants to shed electricity demand from their operations when Ontario's electricity system is under significant strain.[8] This payment is based on the amount of energy curtailed during peak hours. Previously, the plant had participated in the inaugural DR1 program.
Load shifting	• Rescheduled some of the operations to off-peak hours – including milling, grinding, material handling, fuel unloading, and conveying
Operational improvements	• Performance scorecard to assess the plant's energy performance in five key areas: energy data management, energy supply management, energy use in facilities, equipment efficiency and organizational integration • Constantly monitoring the wholesale price of electricity to plan operations • Introduced trigger points and alarms, which are set to go off if the plant approaches pre-determined demand thresholds • Improved run-time (total production time that the machine has been running and producing parts) • Monitoring and control software • Installation of energy pricing-based equipment and system operational controls
Awareness and education	• Real-time energy data displays accessible throughout the plant to inform employees about energy use • Publication of newsletter articles about conservation issues • Energy conservation week held every year. In 2012 it included seminars on fuel efficiency, hydrogen/ power generation from waste heat; addressing fuel efficiency challenges; and an awards ceremony to celebrate the past seven years of conservation efforts that led to the ISO 50001 certification
Process improvements	• Automated processes to shut down equipment when inactive • Consolidated two process lines into one process • Variable speed drives on various motors • Elimination of one of two 1,500 hp fans powering the bypass system, saving the company C$96,000 in a yearly basis (perpetuity savings).
Fuels	• Fuel optimization • New fuel dosing system (CAPEX investment of Can$ 1.9 Million)
Non process	• Retrofitting light fixtures in the office and production areas, and installation of occupancy sensors in the office space • Raising the thermostat set point for baghouse fans used in dust control • Programmable thermostats • Ceiling fans in the quarry garage

Energy management at St Marys Cement

Case study prepared by ICF Marbek

2200 Pennsylvania Avenue, N.W., 4th Floor, East Tower, Washington, D.C. 20037 U.S.A.
iipnetwork.org | info@iipnetwork.org | Twitter.com/iipnetwork