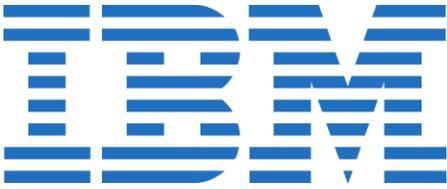


Global Energy Management System Implementation: Case Study

Canada, CAN/CSA-ISO 50001



Bromont manufacturing plant cuts energy consumption by 9.2 percent and saves CAD\$550,000 in 2013



The Bromont plant replaced a vacuum system that used air compressors with a central vacuum system.

Photo: IBM

Energy Management System Overview

The employees, plant managers and IBM's corporate leaders all deserve credit for the success of the energy management system (EnMS) implemented at IBM Bromont in Quebec. Since it issued its corporate policy on environmental affairs in 1972, IBM has launched significant energy conservation and efficiency initiatives. At the plant level, management has recognized that engaging employees and providing support for energy efficiency initiatives can be a key differentiator in the competitive world of semiconductor manufacturing.

The IBM Bromont EnMS bears all the hallmarks of a successful system. It includes a strategic plan for energy efficiency that requires measurement, management and continuous improvement. The EnMS is championed by a cross-divisional team that includes a range of employees and managers. The EnMS also has clear policies and procedures.

Case Study Snapshot

Industry: Semiconductor manufacturing

Energy Management System (EnMS) guidance/standard: CAN/CSA-ISO 50001, the first IBM facility worldwide to be certified

Key driver for EnMS: Cost and CO₂ emissions reduction

Improvement focus: Energy efficiency for production and building operation processes

Location: Bromont, Quebec, Canada

Product(s): Semiconductors

Annual energy cost savings: CAD\$550,000 in 2013

Payback period: Typically less than two years

Energy sources: Electricity primarily and natural gas

Energy reduction goal: Through continuous improvement, 4 percent energy conservation year after year

Natural Resources Canada (NRCan)

Natural Resources Canada's ecoENERGY Efficiency for Industry program offers cost-shared assistance to industrial companies to implement energy management projects, including the CAN/CSA-ISO 50001 Energy Management Systems standard, and accelerates energy-saving investments. The program's partnership with industry, Canadian Industry Program for Energy Conservation (CIPEC), supports ISO 50001 implementation and the exchange of best-practices information within Canada's industrial sector.

IBM sites across the globe are expected to follow corporate best practices. IBM assesses each site's energy management practices and ranks the top 100. "Our plant ranks seventh in energy use across IBM," says Nathalie Christen, an engineer at the Bromont plant who serves as IBM Canada's Environmental Affairs and Energy Manager.

Business Benefits Achieved

By implementing its EnMS, IBM Bromont achieved 9.2 percent energy conservation and saved CAD \$550,000 in 2013. The plant averaged an annual reduction in total energy use of more than 8 percent between 2004 and 2013 – almost double the corporate goal of a 4 percent reduction in annual energy consumption of electricity and natural gas. "Four percent is our corporate energy conservation target, but at Bromont we aim to conserve 5 percent per year," Christen says.

These energy savings have reduced the plant's energy bill by \$5,925,000 since 2004. Ongoing conservation efforts have delivered electrical energy savings of more than 25 percent as compared with electricity consumption in 2008.

The plant's focus on reducing energy use has enabled a 59 percent reduction in greenhouse gas emissions in relation to the 1990 reference year and a 24 percent reduction in relation to 2005. These and other sustainability success stories are communicated publicly to help enhance IBM's image as a company that takes corporate social responsibility seriously.

"Since 1998, Bromont has always beaten our corporate energy conservation target of 4 percent. We've ranged from 4.1 percent to 13.5 percent annual conservation," says Yves Veilleux, Director of Energy and Environmental Affairs for IBM Canada.

Company Profile

The Bromont plant, located 80 kilometres east of Montréal, is IBM's largest semiconductor assembly and testing facility and its only manufacturing plant in Canada.

Every system produced worldwide by IBM uses at least one Bromont-manufactured component. And the two most popular game consoles in the world — Microsoft® Xbox 360® and Nintendo® Wii™ — both contain processors from Bromont.

The plant occupies 13 935 square metres. It assembles 200 types of products using 800 manufacturing processes. A new production batch enters the assembly line every three minutes in this state-of-the-art facility, and a new part number is assigned every two hours.

Business Case for Energy Management

IBM subscribes to a corporate credo that says sustainability is no longer an option – it is an imperative. IBM builds energy efficiency into its products and uses energy efficiency as a competitive advantage. Energy-

About CAN/CSA ISO 50001 Energy Management Systems standard certification

ISO 50001 provides organizations with a structured framework to manage energy in a way that it can increase energy efficiency, reduce costs and improve energy performance. This standard is based on the common elements found in all the ISO management systems standards, assuring a high level of compatibility with ISO 9001 (quality management) and ISO 14001 (environmental management). Based on the Plan-Do-Check-Act cycle, this standard integrates both technical and managerial activities.

"Our plant ranks seventh in energy use across IBM"

Nathalie Christen,
Environmental Affairs
and Energy Manager,
IBM Canada

- Total energy savings have exceeded \$5 million since 2004.
- The energy management team is staffed by full-time professionals.

and climate-related issues are at the top of the company’s strategic agenda. Indeed, IBM embeds effective sustainability within and among enterprises to provide corporate benefits, including competitive differentiation and positive brand image; cost efficiencies in energy, water and waste management; and the potential for gaining market share in new and growing segments.

Energy Efficiency Enhances Competitiveness

The semiconductor industry is marked by constant changes in manufacturing processes. IBM Bromont must also compete against suppliers from around the globe. Consequently, manufacturers such as IBM Bromont must seek out every competitive advantage they can to remain viable. The plant’s energy efficiency program provides a vehicle to continually improve plant operations and reduce costs, in turn improving competitiveness. The energy savings contributed to reductions in operating costs and facilitated the installation of advanced equipment to manufacture new semiconductor technologies.

Implementation

For IBM Bromont, ISO 50001 certification was the next logical step in an ongoing improvement process that underlines IBM’s commitment to sustainability. IBM started on the path that ultimately led to ISO 50001 certification in the early 1970s. In August 2012, the Bromont team volunteered to be a pilot IBM plant to prepare for ISO 50001 certification. The plant was audited in February 2013 and certified afterwards by Bureau Veritas Certification’s registrar. The plant’s long-standing focus on continuous improvement, which mirrors a similar focus of the ISO 50001 standard, helped earn the certification in a short period of time.

To attain ISO 50001 certification, IBM Bromont developed performance indicators linked to energy efficiency for production and maintenance processes. The program implementation had several components, including

- Establishing objectives
- Training employees
- Identifying opportunities
- Implementing specific projects
- Monitoring these projects
- Communicating project results

Between 2008 and 2013, the plant established an EnMS and launched 181 projects related to energy efficiency. These projects included recommissioning building systems, automating boiler controls, installing variable frequency drives on pumps and fans, and replacing some compressed air systems with a central vacuum system. Projects typically have to have a payback period of less than two years.

| IBM Bromont – Energy Conservation Results (2004–2013) | | | |
|--|-------------------------|----------------------|--------------------------|
| Year | Conservation (%) | Savings (MWh) | Savings (\$ '000) |
| 2013 | 9.2 | 15 012 | 550 |
| 2012 | 9.5 | 14 559 | 605 |
| 2011 | 6.8 | 10 723 | 467 |
| 2010 | 5.8 | 9 778 | 410 |
| 2009 | 10.6 | 17 179 | 781 |
| 2008 | 13.5 | 23 770 | 1,030 |
| 2007 | 7.1 | 13 887 | 577 |
| 2006 | 8.2 | 15 039 | 626 |
| 2005 | 6.4 | 11 580 | 467 |
| 2004 | 6.3 | 10 511 | 412 |
| Total | 8.3 (average) | 142 038 | 5,925 |

Key plan components

- Annual objectives
- Energy checklists for all mechanical systems and infrastructure
- Regular monitoring of all conservation projects
- Energy team visits to manufacturing sectors
- Information sharing with partners

The plan is based on the principle of continuous improvement. The annual plan, approved by the plant’s senior management, helps to share ideas between sectors or buildings and standardize operations to maximize energy efficiency.

Team at the Heart of the System

The successful implementation of the EnMS is due in large part to the energy management team at IBM Bromont, which developed an annual energy management plan. This plan is based on the principle of continuous improvement. The annual plan helps to share ideas between sectors or buildings and standardize operations to maximize energy efficiency.

The energy team is staffed by full-time engineers and other professionals led by Christen, who is based in Bromont but works for IBM across Canada. The team also includes senior energy coordinators and energy efficiency specialists. In the manufacturing plant, the team is further supported by an energy committee made up of ISO 50001 representatives who cover all sectors.

Employees, Suppliers, and Customers Help Build a Corporate Energy Culture

The idea of integration extends beyond the energy management plan to IBM staff themselves. New employees receive environmental and energy efficiency awareness training as part of their orientation. Twice a year, the plant manager meets all employees and discusses energy efficiency targets and results.

Monthly monitoring and documentation of achievements in energy efficiency ensures employee efforts are acknowledged.

Accountability for energy efficiency also extends to IBM Bromont suppliers. Their services are judged in part on their energy efficiency rating. All subcontractors are also made aware of environmental targets and procedures before working in the plant. Even IBM Bromont customers are encouraged to learn about plant energy efficiency initiatives and visit the plant.

Tools to do the Job

The energy team also involves employees closely in energy management decisions by giving them greater control over equipment. Dashboards that show energy use data in real time were implemented to help manage operations according to key energy performance indicators.

These dashboards, developed by an in-house technical team, enable operators to view operating conditions in real time and to take immediate action to maintain the optimal energy performance of plant systems at all times. In practical terms, dashboards enable staff to do such things as adjust the fresh air supply to a portion of the building.

The Bromont site also introduced IBM's ITEO Smarter Buildings Solutions. This intelligent system compares information from measuring instruments and optimal operating rules, and generates automatic alerts and work orders to respond to the alerts. The system allows building systems to be managed against dynamic performance rules and helps improve overall operational performance while reducing energy use. "We saved \$40,000 in building-related energy costs in 2013 with ITEO Smarter Buildings," Christen says.

The projects to get the job done

Highlights from the 181 improvement projects launched since 2008:

Optimizing the boiler power plant

- Improved the operational sequences
- Automated the adjustment of the steam pressure set point from 110 to 50 pounds per square inch (psi) based on outside air temperature and minimized energy consumption
- Checked the water inlet pressure by using a variable frequency drive set to 50 psig
- Installed micro-modulation controls on two steam boilers for optimum combustion
- Calibrated the sensors and revised the calibration process.

Optimizing for heating, ventilating, and air conditioning (HVAC) systems

- Improved the operational sequences
- Installed new instrumentation
- Installed variable speed drives and motors on fans.

Optimizing the chilled water system

- Comprehensively reviewed the operational sequences to improve the operation of chillers, cooling towers and distribution systems
- Installed variable speed drives on chillers, evaporators and condenser pumps to reduce power usage
- Reduced chilled water supply from 80 psig to 60 psig
- Adjusted chilled water temperature and implemented a differential pressure control according to HVAC demands
- Improved the operation of the variable speed chiller to ensure maximum efficiency

Corporate Monitoring and Reporting to Support Best Practices

An IBM corporate tool stores all energy data for IBM buildings throughout the world. It allows IBM Bromont to access and update global corporate energy information. Its Enterprise Energy Monitoring application provides ongoing access to electricity meters for several IBM sites. And the Business Intelligence @ IBM portal application allows IBM senior management access to key energy consumption and conservation indicators worldwide.

The corporate energy management dashboard displays current energy metrics and key performance indicators at the enterprise level. It consolidates and arranges numbers, metrics and performance scorecards on a single screen. Corporate energy checklists, from a group of IBM experts worldwide, allow staff to identify opportunities to improve building systems and maintain them at an optimum level of efficiency.

Support Network to Maximize Energy Saving Potential

IBM Bromont enlists the support of government agencies and utilities to take advantage of funding and expertise. Natural Resources Canada (NRCan) supports IBM Bromont through the Office of Energy Efficiency and the Canadian Industry Program for Energy Conservation (CIPEC). By joining CIPEC, IBM Bromont gained access to energy conservation tools and services and became a CIPEC Leader.

Plant staff participated in a variety of CIPEC webinars and workshops. Subjects included ISO 50001, energy management information systems, employee awareness, energy metering, and motor management. Spot the Energy Savings Opportunities, part of the CIPEC Dollars to Sense Energy Management workshops series, has also proved popular with plant staff.

In 2011, the Bromont plant received the CIPEC Leadership Award for integrated energy efficiency strategy. NRCan also produced a video that tells the story of the plant's journey to ISO 50001 certification (view the video at www.newscanada.com/video-leader-of-the-pack).

Utilities Hydro-Québec and Gaz Métro also play key roles in maximizing energy savings. Hydro-Québec named IBM Bromont to its Energy Savers Distinction level for reducing annual electricity consumption by 25 percent between 2005 and 2013.

Barriers

The IBM Bromont team, already experienced at delivering on the promise of energy efficiency, did not encounter significant challenges in ensuring their EnMS met the ISO 50001 standard.

“Because we already had an environmental

- Adjusted chiller temperature to maintain 85 percent chiller load
- Automated free cooling with cooling towers start-stop to expand usable period.

Improved manufacturing processes

- Reduced the need for ventilation
- Reduced deionized water consumption
- Eliminated compressed air leaks
- Improved the operating procedures to switch equipment off or to standby mode.



Four steam gas boilers (natural gas, oil backup): 73 000 lbs/hr, 2200 hp, 50 to 125 psi. Enough energy to heat about 1000 average homes for one year. Used for heating, humidification and the production process.

Photo: IBM

management system and there was a lot of common ground between our previous ISO 14001 certification and the ISO 50001 certification requirements, the steps to ISO 50001 certification were pretty straightforward,” Christen says.

Moving forward, Christen did acknowledge that the plant’s success is also a two-edged sword. “There is no more low-hanging fruit. Maintaining our commitment to continuous improvement requires new ideas and a focus on innovation.”

Lessons Learned

Christen and her team have learned several lessons that other energy management teams can benefit from:

- Identify and concentrate on significant energy users first to score big wins.
- Invest in training the staff that use the tools and the associated energy.
- Engage all staff and foster a corporate culture that rewards energy efficiency ideas.
- Establish energy performance criteria with procurement staff.

Results

In 2013, the \$550,000 in energy savings came from 36 projects. Approximately 27 percent of the savings were generated on the manufacturing side through tool modification. For example, by changing equipment in the chip-encapsulating process, the plant was able to replace four tools with one and deliver energy savings.

The other 73 percent of savings were generated by upgrading the facilities. HVAC and exhaust reduction projects were the main focus in 2013. Installing variable frequency drives was one project highlight.

Next Steps

IBM Bromont will continue to foster a culture of continuous improvement. A variety of projects will be considered and executed; some related to manufacturing processes and tools and others related to building operations. The IBM Bromont team will also be helping their colleagues in the IBM Canada head office in Toronto to earn their ISO 50001 certification.

Keys to Success

- The Corporate Energy Management dashboard displays the energy metrics and key performance indicators at the enterprise level.
- It consolidates and arranges numbers, metrics, and performance scorecards on a single screen.
- Corporate energy checklists, from a group of IBM experts worldwide, help staff to identify opportunities to improve building systems and maintain them at an optimum level of efficiency.

The Global Superior Energy Performance (GSEP) initiative was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC). Through GSEP’s Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. For more information, please visit <http://www.cleanenergyministerial.org/energymanagement>

