The Value of Comparing an Energy Management Program with Those in Other Industries

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ABSTRACT

Lafarge North America, a large producer of cement and construction materials with an annual capacity of over 20 million tons, operates 19 cement manufacturing plants in Canada and the U.S, as well as five grinding facilities. The company's production represents over 35 percent of Canadian and 12 percent of U.S. cement industry capacity. Cement is sold primarily for the manufacturing of ready-mix concrete manufacturing and other concrete products. Lafarge's significant construction material activities include manufacture and sale of ready-mix concrete, construction aggregates, other concrete products, and asphalt and road constructions. The company has operations at more than 450 locations and, aside from cement and ready-mix plants, includes quarry, sand and gravel sites, asphalt plants, and concrete plants.

Energy management is an important part of the operation of Lafarge's Cement Division. This article describes the current Lafarge energy management program by focusing on its successes, challenges, sustainability, organization, and people mobilization. It examines Lafarge's goals for energy management and the challenges in achieving them. Finally, an analysis of the similarities of criteria for success in energy management between Lafarge, 3M, and Corning is presented. The comparison demonstrates the value of cross-industry comparisons and their ability to improve energy management among diverse businesses.

BACKGROUND

Today, energy in all forms represents a significant percentage of the total production cost of cement, roughly equally divided between

"thermal" fuels and electricity. Since the mid-1990s, Lafarge has had a number of ongoing initiatives, including the current groups focused on contracting and purchasing energy (fuels and power), using alternate fuels (to replace fossil fuels), managing environmental issues (emissions—in large part related to the fuels used), training and mobilizing plant personnel on energy issues, optimizing the process, etc. Until four years ago, a group-wide three-year technical plan (TYTP) for power existed which addressed the technical aspects of power reduction, as well as organization. The reasons why this program was not sustainable will be described later in this article. Many of the Lafarge programs actively being implemented are broadly focused on reducing electricity use per ton of production, with the key priority being plant mastery. This priority, as well as where cost benefits are greater than 5-10 percent power reduction, is the main driver in Lafarge's focus on energy management. To date, there is limited integration of the various initiatives, and most of the energy performance targets are tracked individually. No formal organization has replaced the TYTP. Figure 1 illustrates Lafarge's past and current energy-related programs. The past program, TYTP, was theme-specific (power, quality, maintenance, etc.), and although very well structured and defined in its key performance indicators (KPI) and organization, it had less cross-functional interaction with other themes. The current program that includes ADVANCE, a performance-driven program, has removed some of the barriers between themes, with a strong focus on plant mastery and process optimization. Next steps

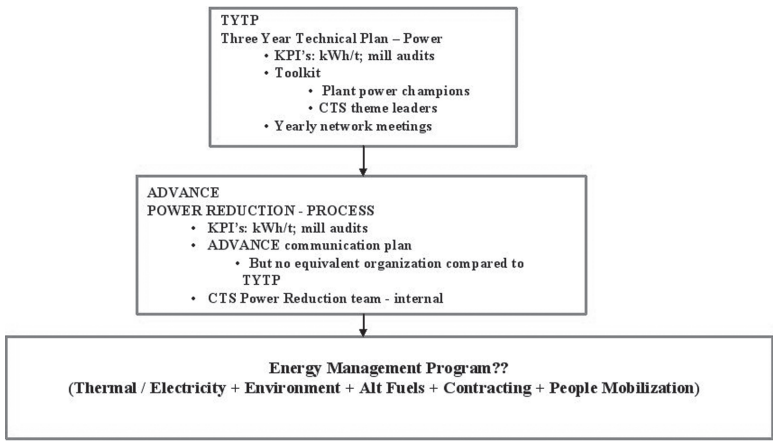

Figure 1. Lafarge energy-related programs.

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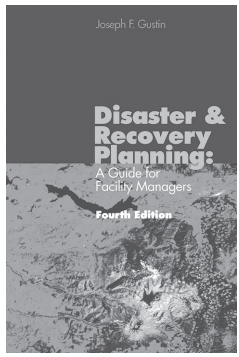

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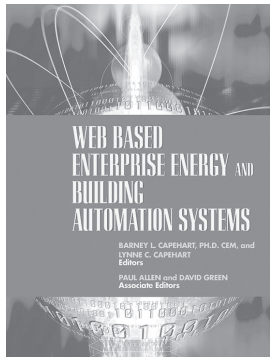

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include an assessment of how to leverage and integrate the best parts of these past and current programs, with the successful and sustainable programs achieved in other industries.

Status

Since January 2005, the focus has been on implementation of reliable *power metering and tracking* as a pre-requisite to identifying areas for power reduction and process improvement. Priority for metering has been focused on the largest consumers (grinding), as well as incoming power (to insure accurate reconciliation with utility bills) and segregation by shop or process area.

Improved tracking of kWh/t follows, with optimization and fine-tuning by the plant historian. More accurate tracking has provided some plants the opportunity to apply an *equipment idle loads best practice,* which is essentially an optimization of process controls and plant standard operating procedures (SOPs).

Also, *compressed air optimization* opportunities have been or are currently being identified in several plants through compressed air audits and some implementation of recommendations has begun.

Fan optimization opportunities, based on fan audits conducted internally by Lafarge or by external specialized consultants, have also been identified in some plants.

Implementation and follow-up of *grinding best practices* are well integrated into plant operations. Equipment idle loads and compressed air optimization, along with lighting, are plant areas that represent approximately 10 percent of overall power consumption, with fan and grinding optimization representative of about 20 percent and 70 percent respectively.

SUCCESSES

Technical focus on energy management within individual programs is well established.

Where energy reduction has been established as a key plant priority to work on, results have been positive. One of the key drivers for prioritization is the cost of fuel and electricity in specific regions. Process optimization has been an added benefit to the reductions achieved in implementing some of the best practices described previously. Figure 2

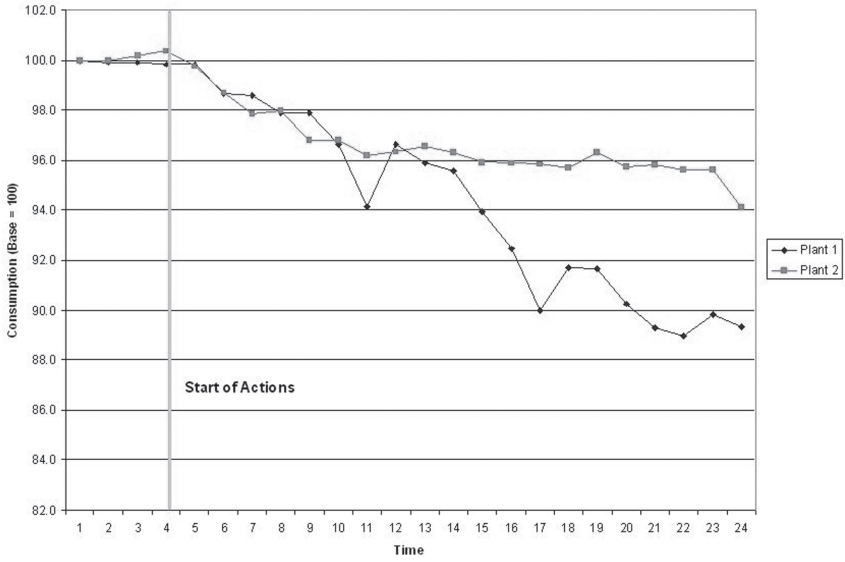


Figure 2. Power reduction focus plants.

illustrates a continued downward trend in energy reduction (primarily power—kWh/t) for two plants (Alberta, Canada, and New York, US) since the energy reduction focus was established.

There has been recognition and implementation of many of the Lafarge best practices such as power metering and tracking, idle load optimization, grinding, fan optimization, and compressed air optimization.

Several tools have been developed internally for assessing the power efficiencies of fans, grinding, and other process areas. These are applied by the plant process engineers.

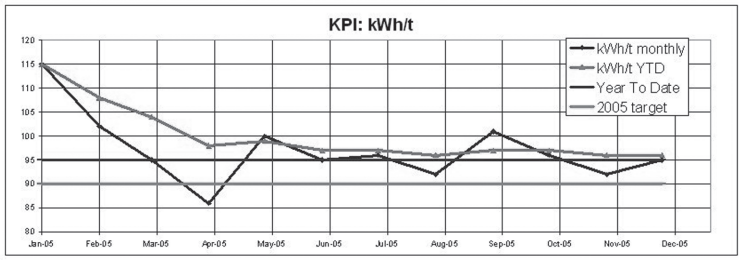
A common plant historian and plant information reporting system permits KPI tracking and analysis. Individual KPIs (such as for kWh/t) are based on a standardized method of calculation throughout the company. Figure 3 illustrates examples of daily, monthly, and yearly reports.

Although not yet deployed, a roadmap for mobilizing and sustaining an energy management program at the plant, regional, and corporate levels has been developed.

Yearly

Year	2002A	2003A	2004A	2005 A	2006F	2007P	2008P
Total Power Consumption (kWh/t)	103.00	105.00	107.00	107.00	108.00	102.00	98.00
Total Fuel Consumption (MJ/t)	200.00	210.00	215.00	212.00	218.00	210.00	200.00

Monthly



Daily

Grinding

Parameter	Type	Avg.	Std. Dev.	Target	7 Day Avg.	7 Day Dev.	30 Day Avg.	30 Day Dev.
Bucket Elevator kW	I/II	11.55	0.56	12.2 +/- 1.1	12.05	0.76	12.02	0.85
Fuel (MJ/min)	Clinker	6912.9	467.0	8000.0 +/- 500.0	7120.3	720.6	7109.6	951.4

Figure 3. Daily, monthly, yearly reports.

GOALS AND CHALLENGES

Organizational focus has been diminished or lost in part because of the transition from one program to another. The challenge faced is to find ways to empower people, raise awareness, and get buy-in. This, along with the strong technical focus on individual initiatives that already exists, would insure improvement and sustainability in energy management.

Although there is senior management commitment to individual initiatives on energy management and optimization, there is at present little consolidation of the different programs under one unified energy management program.

Interfaces and communications between the different operational areas must continue to evolve and improve. Figure 4 illustrates Lafarge's current organization for initiatives related to energy management. Communication at present is limited to some informal interaction among the different groups. This, in part, contributes to a non-unified approach to energy management where individual objectives may not be aligned with a common strategy.

Challenges

- Acknowledge that power consumption can be managed and

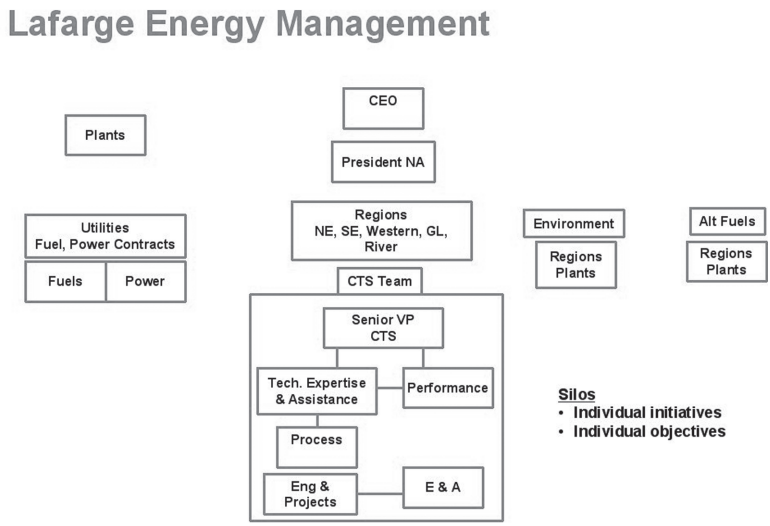


Figure 4. Lafarge current organization.

reduced—it's not just another project, but rather an integrated function of plant operations (process, production, maintenance, and quality).

- Acknowledge that the benefits of power consumption reduction are not only limited to cost reduction, but that better energy management also enables greater output.
- Recognize that optimization and energy reduction must be managed at the plant level with clear responsibilities and deadlines under the leadership of the plant management team.
- Encourage a culture of cross-functional participation (process, quality, production, maintenance, and engineering), creating a group that works together in the search for energy savings.
- Launch focus groups on quick-win actions (many incremental actions rather than a "one-shot" fix).
- Sell to senior management the viability of energy-related projects in relation to available capital investment.

Goals

- Leverage energy management within other programs or daily operations that include safety and process/production. This would insure that energy management is not perceived as another stand-

alone initiative or orphan. Further, the Lafarge safety program is well established in its organization, people mobilization, plant ownership, safety awareness. The same approach could be applied to good energy management.

- Improve communications across all operational and functional areas. Promote ownership of energy management at the local plant level.
- Further investigate the possibility of implementing an energy performance indicator or equivalent to include thermal as well as electric energy.

ANALYSIS OF SIMILARITIES OF CRITERIA FOR SUCCESS IN ENERGY MANAGEMENT BETWEEN LAFARGE, 3M, AND CORNING

Based on the challenges and goals described previously, Lafarge has begun a process of investigating other industries which have achieved success and sustainability in energy management. This analysis will include a comparison of the criteria for success in energy management between Lafarge, 3M, and Corning. Further, because Lafarge previously had a technical plan for power which encompassed many of the current requirements for a successful energy management program, this article includes some discussion on the reasons for its lack of success.

Buy-In

Both 3M and Corning have commitment from their senior management. The message from the top corporate leadership to the plant floor on policy, programs, organization, KPIs, and accountability for set objectives is consistent.

The primary focus for Lafarge is plant mastery (good plant reliability and performance). This is well supported by all levels of management. Where this has been achieved, in whole or in part, there has also been increased focus on better energy management. Lafarge has senior management commitment to individual initiatives in energy management and optimization, and the objectives within the individual initiatives are well-defined. However, objectives and priorities of the individual energy initiatives may conflict with each other. The challenge in getting senior management buy-in to a more integrated approach to

energy management will be in demonstrating that aligning the objectives and priorities of the individual initiatives under one common goal or policy is beneficial in terms of improved performance and cost reduction (as has been demonstrated by 3M and Corning).

Energy Management Programs

3M's energy management program is worldwide, and has been established and consistently applied for several years. 3M leveraged an existing environmental program to include energy management. As part of an in-house program, energy mini-chapters have been established whereby technical experts provide energy savings input to energy teams on engineering projects and on specific equipment optimization.

Corning's program is established primarily in the U.S. and Canada. Its energy management program is defined on the similarities and parallels drawn from its safety program. Its in-house program targets three areas for energy reduction: low cost/no cost efficiency, capital projects—energy supply and use, and improved procurement. Return on investment criteria for energy-related projects differ from those required for other capital projects. A small capital pool is provided to the energy manager to launch projects.

Energy tracking, costs, consumption, and purchasing are all part of the 3M and Corning energy management programs. Both 3M and Corning have awards programs, based on points systems and/or objectives tied to bonuses.

Lafarge has a limited integrated approach to energy management; environment, fuel/electrical contracting, alternate fuels, engineering, and purchasing are still managed for the most part, as silos. In terms of capital available for energy investments, there is no real differentiation; the same criteria apply for all projects with the exception of capital allocated to improve power metering in the plants. No awards program is in place.

Energy Team

Both 3M and Corning have established corporate energy teams led respectively by engineering (profile: engineering and environment) and procurement (profile: procurement and business services). These teams have incorporated most or all functional areas of operations, purchasing, engineering, and maintenance.

3M has established energy champions worldwide (at each location

for larger installations) who report to their respective engineering, maintenance, and plant managers. Metrics for energy team effectiveness were established (self-assessments and validation by the corporate team) as well.

In Lafarge, other than an internal cross-functional corporate team, no formal energy team organization is in place, either at the corporate or the local level. Where it exists, plant energy management is incorporated into specific projects or focus contracts (production, process, power reduction contracts, etc.). The challenge will be to leverage these individual successes in order to build a foundation for a more effective energy management program.

Tools, Dashboards

Good data and ease of access is KEY.

3M and Corning use many tools and applications that already exist throughout their organization and that are familiar to all.

Energy dashboards and reports for 3M include energy trends and team metrics (world class rating).

Lafarge corporate-wide plant historian (at each location) has facilitated ease of access to energy-related KPIs. Some common dashboards are in use or under development. With the implementation of better metering, users are gaining confidence that the data they review and analyze are good. There is worldwide yearly integration of data.

Key Performance Indicators (KPI) for Energy Management and Energy Costs

As a corporate objective, Corning and 3M have defined a percentage per year improvement as follows:

- 3M: Btu/lb. of production
- Corning: cost of energy/unit of production.

3M also measures energy management team effectiveness.

Energy commodity is managed in-house for 3M and outsourced for Corning (bill payments, reporting use and cost).

Objectives for Lafarge KPIs on energy management are defined and managed in a more segregated manner:

- Power: kWh/t
- Thermal: MJ/t
- Tracking of cost/energy

- Energy commodity management is in-house.

The rise in energy costs and the increased percentage of energy costs to manufacturing costs has been a key incentive to increased focus on better energy management for Lafarge, 3M and Corning.

Communications

3M and Corning utilize many different methods to communicate energy awareness, objectives, and successes. These include regional and global meetings, net meetings, conference calls, and webcasts. 3M also produces a quarterly energy newsletter.

Communication on energy awareness in Lafarge is limited to those plants that have a specific energy reduction priority. Other communication on energy management in the form of network meetings on other topics such as process is informal.

Comparison of Lafarge Three Year Technical Plan (TYTP) for Power and Current Energy Management Initiatives

The analysis done with 3M and Corning led to the question of why Lafarge's previous three-year technical plan for power did not do as well as desired. This plan had addressed the technical aspects of power reduction as well as organization. The program, along with other TYTP manufacturing programs was implemented in the late 1980s and remained active until about four years ago.

The organization of teams, champions, and sponsors was similar in structure and in definition of roles and responsibilities to those defined by Energy Star and set up by 3M and Corning. Refer to Figure 5, which illustrates the former TYTP matrix of responsibilities.

Targets based on a group-wide reference baseline were defined. Plants were expected to meet these objectives. They specified how these objectives would be achieved through the development and implementation of action plans specific to the plan theme. Power-specific action plans no longer exist today; specific actions—targets related to individual energy reduction initiatives—have been integrated into overall plant improvement plans.

In terms of communication plans, annual international steering committee (primarily representation from each technical center and little plant representation) and LNA network meetings were held. International meetings were used to communicate the progress and status of

		Plant Champion	Plant Coordinator	Plant Reporting	Plant Manager	Program Manager	VP Manufacturing	Theme Leader (CTS)	VP Performance/ Director Process	SR VP CTS	TYTP Sponsor
1	OU TYTP Management Process					C	C	C	R	A	V
2	Develop Indices, Tools & Techniques	C				C		R	A	C	C
3	Region TYTP Management Process				C	R	A	C	V	V	
4	Plant TYTP Management Process		R		V	M	A	C	V		
5	Achieve Theme Leader Commitment								A/R	C	
6	Achieve Plant Manager Commitment					C	A/R	C	C	C	
7	Achieve Plant Commitment	R	M		A	C	C	C	C	C	
8	Select Plant Champions		C		R	A		C			
9	Intra-Plant Coordination	C	R		A	M	M				
10	Develop Action Plans	R	C		A	C/V	V	V			
11	Develop Budgets	R	C		A		V	C			
12	Identify Resource Requirements	R	V		A	C	V	C	C		
13	Identify Global Training Needs					C	C	R	A	V	
14	Identify Local Training Needs	C	C		R	A	V				
15	Set Plant Priorities	C	C		A	C	V		C		
16	Execute Plans	R	M		A	M		M			
17	Plant Action Plan Progress Reporting	R	M			A		V			
18	Statistical Reporting	R	M	V		A		V			
19	Submit Reporting			R							
20	Performance Analysis	C	C		C	C		A	V		
21	Inter-Plant Coordination					C	C	R	A	M	
22	International Coordination					C		R	A	M	V
23	Maintain Lotus Notes Database					M		R			

Assure	A	: to make sure it happens.
Contribute	C	: to be involved.
Monitor	M	: to monitor and report.
Responsible	R	: accountable, responsible for completion of action.
Validation	V	: to certify action/results.

Figure 5. TYTP organization.

each business unit. Many of the power best practices were developed at this level. In contrast, the LNA meetings were organized by corporate theme leaders and attendance came mostly from the local level. At these meetings, overall results and progress were reviewed, and plants reported their progress on action plans and validated best practices. Ideas for new best practices were solicited and case studies on plant-specific power reduction projects or actions were also presented. This part of the TYTP organization no longer exists.

Progress was measured on a monthly and yearly basis, comparing targets to actual results achieved. This is still the case today, with an emphasis on obtaining reliable data.

A theme-specific awards program for best and most-improved plant was also part of the TYTP. If a plant achieved its objectives on all

ENERGY STAR® Energy Management Assessment Matrix

	LFG TYTP POWER	LFG ADVANCE - Current	Comments
Make Commitment to Continuous Improvement			
Energy Director			TYTP: International sponsor - senior VP Technical Center
Energy Team			TYTP: Roles, responsibilities defined from local to Corporate; Current team is internal corporate only
Energy Policy			TYTP: based on specific KPI (kwh/t, mill audits); Current: some aspects included in environmental policy
Assess Performance and Opportunities			
Gather and Track Data			TYTP: reporting but data not always accurate; Current: metering improvements implemented, better tracking
Normalize			
Establish baselines			TYTP: Groupwide reference value
Benchmark			Yearly report compares internally
Analyze			
Technical assessments and audits			
Set Performance Goals			
Determine scope			No common / unified energy objectives
Estimate potential for improvement			
Establish goals			Targets for specific KPI set and tracked
Create Action Plan			
Define technical steps and targets			TYTP - specific action plans on Power; now integrated into overall plant improvement plans
Determine roles and resources			
Implement Action Plan			
Create a communication plan			
Raise awareness			TYTP: international and LNA yearly network meetings
Build capacity			
Motivate			Contact in both programs limited to yearly network meetings
Track and monitor			Monthly TYTP reports, yearly consolidation
Evaluate Progress			
Measure results			
Review action plan			
Recognize Achievements			
Provide internal recognition			TYTP: Awards program for best plant and most improved
Get external recognition			

Figure 6. Comparison of past and current Lafarge programs.

TYTP themes, an overall award was given. This program is no longer active.

Refer to Figure 6, which uses the Energy Star Assessment Matrix to illustrate the similarities and rankings between the previous and current Lafarge programs.

Though Lafarge had developed and implemented a well-defined organization, and specific targets, objectives, and awards in the past, we should have been more successful in maintaining and sustaining this program. Some of the reasons why this program may not have been sustainable are described below.

- In spite of well-defined roles and responsibilities at all levels, the plan was perceived as a corporate initiative.
- Plant champions assigned to a specific theme were often from the more junior plant management ranks, and so may not have been empowered to implement change or successfully drive the actions

defined in the plan.

- The commitment or buy-in from the local level was a function of what priority the specific theme had in relation to other plant priorities.
- There was little accountability for objectives not met. The plan was perceived more as a reporting initiative than a performance improvement initiative.
- The fact that there were several themes under the TYTP may have contributed to mixed messages at the corporate and local levels on what priorities the plants needed to focus on.
- Energy reduction awareness was not and still is not part of plant culture. As long as the plant champion took care of the objectives, no one else needed to.

CONCLUSIONS AND SUMMARY

From the analyses and comparisons done with 3M and Corning as well as the internal assessment between the two Lafarge programs, certain preliminary conclusions can be drawn and factors for successful energy management identified.

Energy Management: Combine strengths of existing programs with similar criteria to create and sustain a successful energy management program. Use the same criteria and commitment that was used to establish a safety or environmental culture.

Energy Team: Integrate energy management and functions into existing plant organization. Empowerment of plant champions to implement change, and accountability, are key.

Tools and Dashboards: Keep it simple. Rationalize the number of applications required to access data and encourage the use of existing applications and tools.

KPI: Setting an objective for overall cost/energy and energy/ton provides a more complete overview of total energy consumption and costs. Tracking individual KPIs may minimize the overall impact of opportunities provided by energy reduction. Common indicators would allow employees to focus on common goals.

Communications: Through more formal, consistent, and regular communication, energy management becomes part of an energy awareness culture that is well integrated into daily operations.

Power consumption reduction is not only a technical issue to be resolved through investments or short-term focus; it should be part of a broader energy management strategy that includes plant mastery, an integrated organization, and clear, common objectives. These criteria set the stage for a consistent, sustainable approach to energy management.

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Helen Beecroft has more than 25 years of experience in the development, design, and implementation of electrical and process controls for application in the cement industry and a range of other industries. As electrical and automation director for the Lafarge Corporate Technical Services, she is responsible for developing, managing, and directing major aspects of Lafarge's North American electrical and automation initiatives. She has been involved in several corporate (international and North American) initiatives related to power reduction for the past nine years. A graduate of Concordia University in Montreal, she earned her Bachelor of Science degree in physics. She is also an active ISA (Instrumentation, Systems, Automation Society) member and past president of the ISA Montreal Section and a contributing author to the ISA Practical Guides for Measurement and Control, Fundamentals of Industrial Control.

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