

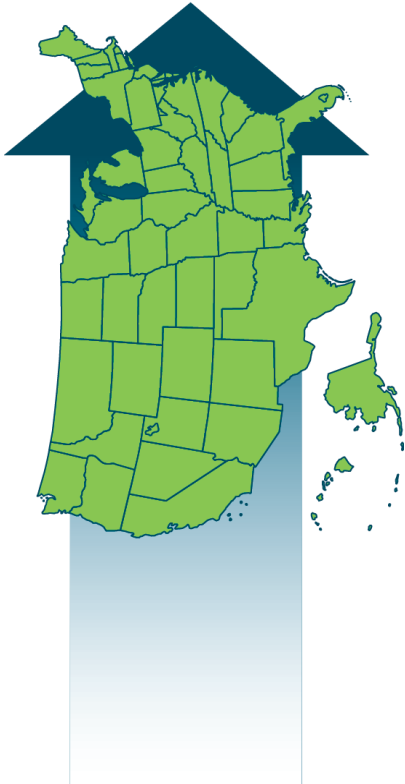
SEE Action

STATE & LOCAL ENERGY EFFICIENCY ACTION NETWORK

Sustained Energy Savings Achieved through Successful Industrial Customer Interaction with Ratepayer Programs: Case Studies


Industrial Energy Efficiency and Combined Heat and Power Working Group

October 2015



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Executive Summary

Many states have implemented ratepayer-funded programs to acquire energy efficiency as a predictable and reliable resource for meeting existing and future energy demand. These programs have become a fixture in many U.S. electricity and natural gas markets as they help postpone or eliminate the need for expensive generation and transmission investments. Industrial energy efficiency (IEE) is an energy efficiency resource that is not only a low cost option for many of these efficiency programs, but offers productivity and competitive benefits to manufacturers as it reduces their energy costs. However, some industrial customers are less enthusiastic about participating in these programs. IEE ratepayer programs suffer low participation by industries across many states today despite a continual increase in energy efficiency program spending across all types of customers, and significant energy efficiency funds can often go unused for industrial customers.

This paper provides four detailed case studies of companies that benefited from participation in their utility's energy efficiency program offerings and highlights the business value brought to them by participation in these programs. The paper is designed both for rate-payer efficiency program administrators interested in improving the attractiveness and effectiveness of industrial efficiency programs for their industrial customers and for industrial customers interested in maximizing the value of participating in efficiency programs.


The four industrial companies from around the country that are examined in this paper participate in different ratepayer-funded programs and manufacture a variety of goods:

- Terumo BCT (Terumo) – with a facility located in Lakewood, CO, Terumo participates in a ratepayer-funded program administered by Xcel Energy. Terumo manufactures technologies and devices in manual and automated whole blood processing, collection, and cell growth.
- Roquette America- with a facility located in Gurnee, IL, Roquette America participates in a ratepayer-funded program administered by North Shore Gas (NSG). It is one of two facilities producing a sweetener known as sorbitol used in sugar-free confectionery.
- Logan Aluminum– with a facility located near Russellville, KY, Logan Aluminum is a direct-serve customer of the Tennessee Valley Authority (TVA). Logan Aluminum is a manufacturer of flat rolled aluminum alloy sheets primarily used in the beverage can market.
- Husky Injection Molding Systems (Husky) – with a facility located in Milton, VT, Husky participates in a ratepayer-funded program administered by Efficiency Vermont. Husky manufactures 5,000 injection molding manifolds per year using 48 large metal-cutting machines.

Working with their respective program administrators, each of the four participating companies were able to achieve considerable energy and cost savings through a range of energy efficiency projects. In three of the four cases; Terumo, Roquette, and Husky, these energy efficiency investments and projects would not have been identified or implemented without technical support, personnel capacity, and planning support provided by the various programs. Even for Logan Aluminum, which had already developed an energy efficiency program of its own and had embarked on a range of gas-saving projects, TVA's offerings still provided good value, both increased confidence that energy savings performance would be robust, and incentives to reduce project costs to overcome payback hurdle rates.

Although the four case studies described in detail in the appendices of this paper are diverse, they show similarities both in terms of the value each customer has derived, and in certain elements of ratepayer-funded program design that enhanced the value of the offering. In each of the cases, the customers reported two primary value elements they received with program participation:

- One value element was customized technical assistance and support in project identification, packaging development, implementation, and evaluation. Technical assistance and project planning support provided critical expertise and the necessary time for additional professional personnel to identify and bring opportunities through to implementation. Industrial plant staff at several of the case study sites said that as the relationship evolved, the technical assistance provided became yet more valuable to them



than the financial incentives they obtained. Long-term, trusted relationships were also a significant factor in these results.

- The second element was the financial incentives to help reduce upfront investment costs. Financial incentives provided an initial entry point to interest facility and energy management staff and then they served as a tool for facility managers to obtain internal management support or approval for more energy efficiency capital projects than was possible before.

Success Factors


In all four cases, the program administrator and the customer worked in partnership to develop and implement measures that helped to overcome energy efficiency implementation barriers such as corporate upfront capital expenditure payback hurdle rates, insufficient plant staff time to devote to developing non-core business operating cost saving projects, and insufficient time and data to clarify cost-saving results. The key factors underlying the success of each of the four program-customer case studies in both generating value for the industrial customer and delivering low-cost program energy savings for the ratepayer programs included:

- Tailoring of specific industry energy efficiency program offerings and support by program administrators to the needs of industrial customers.
- Assignment of dedicated program staff and/or technical contractors to provide technical assistance, project identification and packaging, and/or technical economic performance assessment support.
- Program offerings that include both custom project incentives and prescriptive incentives, and flexibility to specifically structure offerings in ways to best accommodate the budgeting, processing and implementation needs of customers.

Recommendations for Program Administrators

Generating effective participation in industrial program offerings requires a hands-on, customized approach for these relatively large energy users with differing needs. In all four case studies, technical assistance and application of expertise at the plant were a key part of what was valuable to the customer, and complemented financial incentives geared to overcoming the project approval requirements in the industrial companies. None of the successful cases reviewed relied on financial incentive support alone - additional technical support was also necessary. To get the most value from the technical expertise, program personnel needed to demonstrate an understanding of the plant's processes and its specific energy needs and concerns. When the relationship worked well, program staff and experts were viewed as part of the energy team at the facility. Important program elements that contribute to greater success in the cases reviewed included:

- Development of multiple-year relationships between the utility/program administrator and industrial company personnel, involving a steadily evolving program of support and efforts to identify and implement multiple projects over time rather than a single project.
- Programs that can target energy efficiency gains in manufacturing processes in addition to energy used in support systems such as lighting, HVAC, compressed air. However, process improvement investments will almost never happen for the sole reason of increasing energy efficiency. Therefore, program flexibility and accommodating project scheduling and multi-year planning cycles is needed to allow industrial customers to participate as part of their regular business.
- Programs with strategic energy management (SEM) offerings that support internal company platforms for continual identification and implementation of energy savings measures, high-impact and low-cost behavioral changes, and operational and maintenance improvements.
- Promotion of smart manufacturing and enhanced metering practices such as: (1) installing sensors and embedding devices in software that communicate with one another and with other systems through networks; (2) automated control; and (3) improved measurement and management via cloud-based data analytics. Smart manufacturing brings about significantly enhanced and often more granular key data,



thus offering process or organization efficiencies and a reduction in the energy intensity of manufactured products.

Recommendations for Industrial Customers

Based on the four case studies, if industrial companies want to obtain maximum value from participating in the energy efficiency offerings of their local ratepayer-funded programs, they should consider:

- Requesting on-site meetings with program staff to discuss available incentives and technical assistance offered by the program that may be applicable to the plant. A discussion of the energy issues of greatest importance to the plant should follow.
- Requesting assignment of a single (and committed) program contact person who can explore incentives and provide assessment/technical assistance that would be of primary interest to the plant.
- Piloting several projects under the ratepayer-funded program including using available incentives. Relatively simple or small projects may be a good place to start, and program staff can assist in completing program applications and in understanding program procedures and requirements. Technical expertise from the program can often be leveraged to lessen the burden on plant staff, and once projects are completed, sound technical and economic performance assessments should be requested, to help the plant, as well as the program, evaluate results.
- If satisfactory results are obtained, plant staff could then work with program staff to identify customized technical assistance and project investment support for yet more meaningful energy efficiency solutions. Energy efficiency projects with program support can be integrated into the plant's capital budgeting cycle, under a multi-year cooperative effort. Key support also may be available for incorporating best-practice energy efficiency solutions in new equipment purchases or production line upgrades being contemplated by the facility.



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1. Introduction

This paper provides business value illustrations brought by ratepayer (customer)-funded energy efficiency programs to different industrial energy users in different parts of the country. The paper is designed for rate-payer efficiency program administrators interested in improving the attractiveness and effectiveness of efficiency programs for their industrial customers and for industrial customers interested in maximizing the value of participating in efficiency programs. The paper:

- Presents four detailed case studies of companies that benefited from participation in their utility's energy efficiency program offerings
- Identifies two key areas where customers derive – and programs can provide – value for industrial companies: technical assistance and financial incentives
- Analyzes common success factors¹ for design and implementation of technical assistance and financial incentives for both program administrator and customer
- Provides recommendations for program customers to maximize value from participation in programs and lower energy costs
- Provides recommendations for program administrators to design programs that deliver maximum value for customers and provide for significant cost-effective energy savings for the program.

1.1. Purpose


Industrial energy efficiency (IEE) is a low-cost energy efficiency resource that provides productivity and competitive benefits to manufacturers as it reduces their energy costs.² Where effective programs are offered, participating industrial customers can receive significant value and financial benefits, with new energy savings that provide far more financial value in most cases than what they pay in energy efficiency charges. Many states have implemented ratepayer-funded programs to acquire energy efficiency as a predictable and reliable resource for meeting existing and future energy demand. These programs have become a fixture in many U.S. electricity and natural gas markets as they help postpone or eliminate the need for expensive generation and transmission investments. The attractiveness of energy efficiency as a resource is that the unit costs are almost always far less expensive than the cost of new energy supply, while also providing major environmental benefits.

However, some customers, particularly industrial customers, who typically only see the negative impact of these programs on their energy rates, often are less enthusiastic about these programs and, if given the opportunity, are reticent to participate. Many industrials will argue that they will make these efficiency investments on their own; however, experience does not always bear this out as energy efficiency investments often face a number of barriers in the internal competition for capital. As a result, IEE ratepayer programs suffer low participation by industries across many states today despite a continual increase in energy efficiency program spending across all types of customers, and significant energy efficiency funds can often go unused for industrial customers.

Although the four case studies described in detail in the appendices are diverse, they show similarities both in terms of the value each customer has derived, and in certain elements of ratepayer-funded program design. In each case, the program administrator and the customer worked in partnership to develop and implement measures that helped to overcome energy efficiency implementation barriers such as corporate upfront capital expenditure payback hurdle rates, insufficient plant staff time to devote to developing non-core business operating cost saving projects, and insufficient time and data to clarify cost-saving results. The key factors

¹ Success factors are defined as approaches to program design or implementation that support the customer getting maximum value from the program, that help overcome barriers/hurdles to implementing efficiency measures, and that support successful energy and cost savings results.

² For a discussion on the importance and benefits of industrial energy efficiency and in-depth background on industrial energy efficiency programs, see SEE Action (March 2014).



underlying the success of each of the four program-customer case studies in both generating value for the industrial customer and delivering low-cost program energy savings for the ratepayer programs included:

- Tailoring of specific industry energy efficiency program offerings and support by program administrators to the needs of industrial customers.
- Assignment of dedicated program staff and/or technical contractors to provide technical assistance, project identification and packaging, and/or technical economic performance assessment support.
- Program offerings that include both custom project incentives and prescriptive incentives, and flexibility to specifically structure offerings in ways to best accommodate the budgeting, processing and implementation needs of customers.

By exploring these success factors, this paper provides insights for utilities and third parties looking to maximize IEE potential in their service territories, encourage greater industrial customer program participation, and develop compelling engagement pathways for their industrial customers. The paper also highlights how industrial customers can derive maximum benefit from IEE programs and identifies specific program elements they can promote /ask for from their utility or program administrator.

1.2. Four Industrial Company Case Studies

The four industrial companies from around the country that are examined in this paper participate in different ratepayer-funded programs and manufacture a variety of goods. Their geographic distribution is shown in Figure 1. The industrial companies are:

1. Terumo BCT (Terumo) – with a facility located in Lakewood, CO, Terumo participates in a ratepayer-funded program administered by Xcel Energy. Terumo manufactures technologies and devices in manual and automated whole blood processing, collection, and cell growth.
2. Roquette America- with a facility located in Gurnee, IL, Roquette America participates in a ratepayer-funded program administered by North Shore Gas (NSG). It is one of two facilities producing a sweetener known as sorbitol used in sugar-free confectionery.
3. Logan Aluminum– with a facility located near Russelville, KY, Logan Aluminum is a direct-serve customer of theTennessee Valley Authority (TVA). Logan Aluminum is a manufacturer of flat rolled aluminum alloy sheets primarily used in the beverage can market.
4. Husky Injection Molding Systems (Husky) – with a facility located in Milton, VT, Husky participates in a ratepayer-funded program administered by Efficiency Vermont. Husky manufactures 5,000 injection molding manifolds per year using 48 large metal-cutting machines.

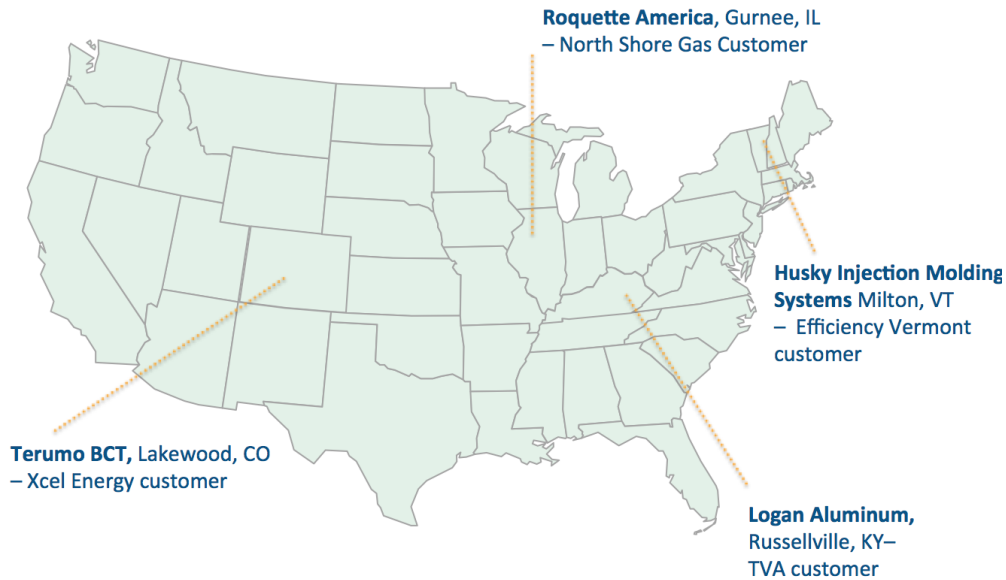



Figure 1. Four industrial customers and four IEE ratepayer programs are shown on the map
 Source: The authors (2015).

As shown in Table 1, these four facilities comprise four distinct industries, ranging from biotechnology, organic chemicals, industrial capital goods, and bulk aluminum. Terumo, Roquette and Husky facilities are all core facilities of international companies, while Logan Aluminum is a joint venture of two aluminum manufacturing companies. All of the facilities are medium to large in size (greater than 100 employees) and spend more than \$1 million a year on energy, yet their energy use patterns vary widely. While energy costs are large in absolute terms at Terumo, Roquette and Husky, they are relatively small compared to overall production costs. As an example, Husky spends \$1-2 million per year on energy, but the plant's energy costs are equivalent to only about 1 percent of the facility's business volume. On the other hand, Logan has both a higher magnitude of absolute energy expenditures and energy costs are a relatively high percentage their operating costs.

Table 1. Industrial Case Study Facilities

	Terumo	Roquette	Husky	Logan
Facility location	Colorado	Illinois	Vermont	Kentucky
Manufacturing category	Biotechnology	Organic chemicals	Machinery components	Aluminum
Rate-payer program	Xcel	North Shore Gas/Franklin Energy	Efficiency Vermont	Tennessee Valley Authority
Annual energy costs over \$1 million?	Yes	Yes	Yes	Yes
Share of energy costs in total operating costs	low	low-medium	low	medium-high



For Terumo, Roquette, and Husky, with energy use playing a relatively minor role in operating costs, there is little economic justification for intensive allocation of staff resources for energy efficiency. Therefore, efforts to reign in energy costs were not pursued before participation in ratepayer programs. Logan, on the other hand, is an enterprise where energy is of more obvious cost concern and the plant had already set energy efficiency goals, developed an energy efficiency strategy, identified and implemented its own projects, and partnered with DOE in the Better Plants program. However, all four facilities found value in ratepayer program participation.

Case Study Participant Program Summaries

Xcel Energy, NSG, TVA, and Efficiency Vermont administer the four ratepayer programs that the companies participate in. All four program administrators provide incentives to encourage adoption of efficient technologies and best practices; and free or cost-shared technical assistance for engineering or feasibility studies, energy management support, and/or project implementation support. Each of the programs, to some degree, depends on contractors to support various aspects of program implementation.

Xcel Energy provides prescriptive incentives including for: compressed air, cooling, heating, lighting, and motor equipment and systems. It also offers a custom project incentive for equipment and process improvements that do not fall within predetermined rebates under prescriptive products. Its main industrial program, the Process Efficiency (PE) program, integrates its technical assistance, energy management support, and incentive programs. The PE program offerings are available to industrial customers with energy conservation potential of at least two gigawatt hours (GWh). The program helps industrial customers evaluate business practices and technical projects as well as supports companies to practice energy management as a tool to strengthen existing and ongoing EE activities. For the PE program, Xcel Energy account managers rely on a third party energy engineering and data firm, Graphet Data Mining (Graphet), to provide technical support and services for their customers. For custom offerings as well the PE program, the account manager will also work closely with Xcel's in-house group of efficiency engineers who each have expertise in different areas. When necessary the engineering group serves as a resource to meet and discuss more complex projects with customers.³


In Illinois, NSG has a range of energy saving programs for commercial and industrial (C&I) customers providing prescriptive and custom rebates; free installation for EE products; staffing grants; continuous project management support; and a Gas Optimization Study Program which provides engineering services to identify opportunities that have significant natural gas savings with low implementation costs. Acting as NSG's turnkey program implementer, Franklin Energy manages EE activities exclusively and equipment vendor (trade ally) relationships as needed.⁴

Efficiency Vermont's programs for industrial customers involve technical assistance for energy audits, project development, energy management, and employee energy efficiency awareness. It also offers financial incentives for both customized energy efficiency projects and prescriptive, common-technology applications. In addition, Efficiency Vermont conducted a two-year Energy Leadership Challenge for commercial and industrial customers in 2011 and it selected a cohort of industrial customers for ongoing strategic energy management (SEM) assistance through its Continuous Energy Improvement program in 2012. Efficiency Vermont's program is managed by a team of large-customer account managers centered on assistance with finance and business expertise to support customers' decision-making. The Account Manager teams with experienced energy consultants to bring technical expertise to address complex situations and challenges.

TVA's "EnergyRight Solutions for Industry" program provides financial incentives, technical assistance and information to help industrial customers make the transition to a more energy efficiency facility. Two types of incentives are offered under the program: standard (prescriptive) incentives for measures that involve a simple upgrade or replacement of existing equipment with more efficiency equipment, and custom incentives for projects engineered for a specific application. Both incentives are designed to help offset the cost of implementing more

³ It also has data center efficiency, new construction, and re-commissioning incentives as well as a self-direct program.

⁴ It also has a Small Business program providing free on-site energy assessments and energy-saving products, and rebates for installing energy-efficient equipment; and Retro-Commissioning for C&I buildings provided in partnership with ComEd, one Illinois' electric utilities in the service area.



efficient technology, reduce the project payback period, and help customers realize energy efficiency savings sooner. The incentives are not designed to subsidize facilities that have the ability to overcome internal financial barriers through the energy savings alone. As part of the custom program, TVA offers tailored solutions for large, complex projects, cutting edge technologies, or projects with a potential incentive exceeding a \$500,000 cost. Lockheed Martin provides operational support to TVA's energy programs including engineering analysis, incentives processing, incentive payment administration, and call center operations.

2. Customer Participation in Programs and Results

Working with their respective program administrator/account manager, each of the four participating companies were able to achieve considerable energy and cost savings through a range of energy efficiency projects (see Table 2). These energy efficiency investments and projects would not have been identified or implemented without technical support, personnel capacity, and planning support provided by the program. In the case of Terumo, Roquette, and Husky, IEE program staff and contractors provided by the program administrator worked in essence as an extension of each company's energy team to provide facility maintenance staff with project identification, packaging, implementation, and evaluation assistance. Even for Logan, which had already developed an energy efficiency program of its own and had embarked on a range of gas-saving projects, TVA's offerings still provided good value, both increased confidence that energy savings performance would be robust, and incentives to reduce project costs to overcome payback hurdle rates. Note that the four companies did not utilize every program offering available through their respective utility programs. Each, with the assistance of technical support, identified program elements and specific offerings that provided solutions to specific operational issues or priorities.

Table 2. Energy Saving Results to Date

Customer	Program	Annual energy cost savings (estimates)	Total annual energy savings through program engagement	Number of projects implemented to date	Engagement period (yrs)
Terumo BCT	Xcel Energy	\$52,000 + \$177,000 from planned projects	789,000 kWh + 2,112,057 kWh from planned projects	13	4
Roquette	North Shore Gas	\$430,000	664,000 therms	7	3
Husky Injection Molding Systems	Efficiency Vermont	\$600,000	5,900,000 kWh	46	12
Logan Aluminum	Tennessee Valley Authority	\$300,000	4,206,000 kWh	7	4

Source: The authors (2015).

Across each of the case studies, engagement periods ranged from three to twelve years. Simple or prescriptive projects in the early stages were able to achieve quick gains in efficiency. Longer-term engagements resulted in more complex projects, process efficiency projects, and low-cost process optimization and SEM improvements. For example, Figure 2 below shows how Husky's savings accumulated over time with steady participation.

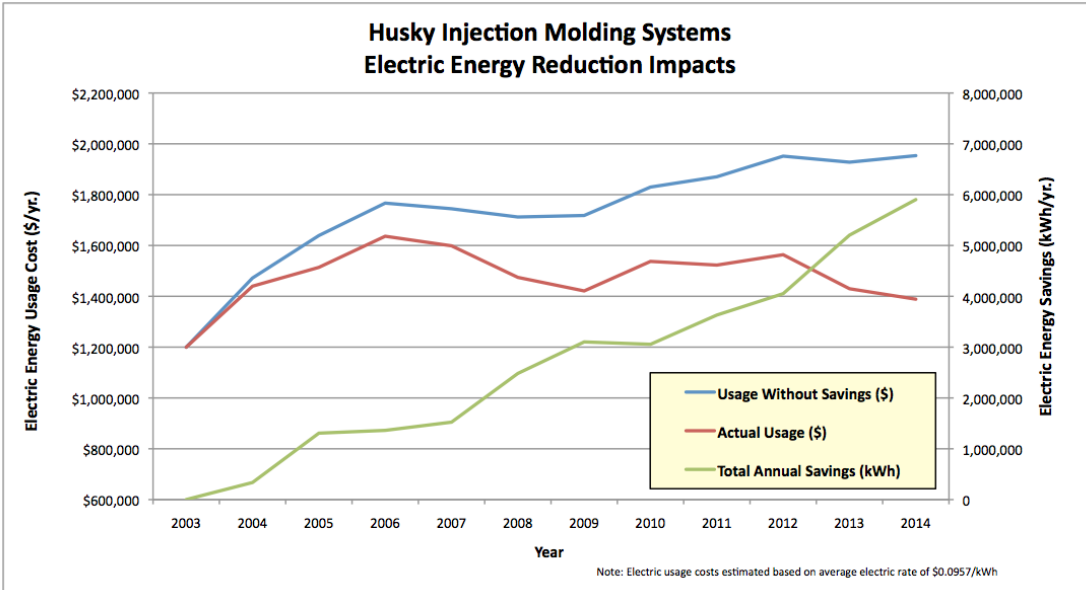


Figure 2. Cumulative Energy Savings and Energy Cost Savings at Husky’s Milton plant, 2003-2014
Source: Efficiency Vermont (2015)



3. IEE Program Value to Industrial Customers

The case studies demonstrate the significant energy and cost savings available to industrial customers when they participate in ratepayer programs. In each of the cases, the customers reported two primary value elements they received with program participation:

1. One value element was customized technical assistance and support in project identification, packaging development, implementation, and evaluation. Technical assistance and project planning support provided critical expertise and the necessary time for additional professional personnel to identify and bring opportunities through to implementation. Industrial plant staff at several of the case study sites said that as the relationship evolved, the technical assistance provided became yet more valuable to them than the financial incentives they obtained. Long-term, trusted relationships were also a significant factor in these results.
2. The second element was the financial incentives to help reduce upfront investment costs. Financial incentives provided an initial entry point to interest facility and energy management staff and then they served as a tool for facility managers to obtain internal management support or approval for more energy efficiency capital projects than was possible before.

These two value elements are further explored below with examples.


3.1. Technical Assistance

Few industrial facilities have internal staff with sufficient time to pursue the details of energy efficiency project identification, design and implementation given their many competing duties. Provision of reliable and trusted technical assistance is therefore highly valued. Technical assistance provided to the four customers took various forms. These included:

- Identification and packaging of project opportunities
- Both broad and very specific engineering and optimization studies
- Third-party technical review and advice on already identified projects
- Performance verification of EE projects
- Assistance in introducing and establishing SEM systems in the facilities
- Review of manufacturing processes for efficiency gains through further optimization.

For each of the customers, engagement by their program administrator typically began with introducing prescriptive incentives for simple cross-cutting technologies. However, as relationships evolved, growing trust enabled more complex custom, continuous improvement projects and process optimizations to be undertaken that generates larger savings. For example, as the relationship and project portfolio between Husky and Efficiency Vermont began to mature, Efficiency Vermont paid increasing attention to possible projects and efficiency gains in the plant's core manufacturing processes, in addition to auxiliaries, lighting, and motors. The systematic approach actually brought about better project economics than the earlier prescriptive projects (see Appendix 3). This also appears to be the case for Terumo in its forthcoming 2015 (and onwards) PE engagement. Similarly, a large process project at Roquette's facility, the desiccant wheel modification, established a relationship of trust between Franklin and Roquette leading to further collaboration on the even larger air handler upgrade and subsequent projects. The engagement has also boosted overall satisfaction with the utility relationship.

At Terumo, Husky, and Roquette, staff responsible for energy efficiency work are able to attend to energy matters as only one of many tasks they must deliver. As the relationship with their relevant ratepayer energy efficiency program developed, program account managers and key technical contractors helped to fill out the facility's energy team as well as provided increasingly valued and steady technical expertise to facility managers and others



at the plants. The program staff and contractors also helped undertake some of the time-consuming tasks having to do with energy use diagnostics, economic assessment of possible projects, packaging of projects for management approval and contracting, and post-implementation performance assessment.

Terumo

Terumo has been making full use of Xcel Energy's in-house and contracted experts since their relationship with the utility's energy efficiency account manager began in 2011. The Xcel Energy account manager's initial attendance at one of Terumo's external contractor meetings made all the difference since Terumo staff were previously not aware of Xcel Energy's program offerings. The continued follow-through and technical support enabled Terumo to undertake some projects immediately, incorporate others into its three-year scheduling and budgeting processes, and embark on a longer-term, ongoing continuous improvement engagement under the PE Program.

As a manager, I have limited resources. For some of the opportunities I would like to chase, I just don't have the resources to be able to tackle them. When I start a project or ask for money for that project, I may not have as much background as I would like to have. Having added resources provided by Xcel Energy, with the data tagged to it, has helped me present and explain a project. When you are chasing money, you have to tell the story. Having those added resources helped me tell the story. This is why we're going to do it, and this is how we are going to do it. The program gave us a focus and additional resources that we didn't have on site. That was a huge benefit to our business. We thought we were doing the right things, now we know we are doing the right things. – Chris Sirbin, Building Operations Manager, Terumo BCT

Terumo has leveraged Xcel Energy's engineering and feasibility studies as a basis to develop procurement plans and incorporate long-range scheduling and capital investment cycles. When projects were found not to be eligible for rebates because they had a payback of less than one year, the studies still brought awareness and they allowed Terumo to go ahead with these highly profitable EE projects. Terumo would have not otherwise pursued such projects. The data analytics and real-time tracking of energy use provided by Graphet has also been key to enable the Building Operations Manager make operations and maintenance changes.

The value for us was two-fold: first, getting to work with knowledgeable program representatives who helped us understand the benefits available to us, someone to walk us through the process. Second, obtaining the incremental funding which made the projects feasible. Probably would never have been done without the rebates. - Steve Calewarts, the Plant Manager, Roquette America's Gurnee facility

Roquette

In Roquette's case, EE and energy management strategies were not fully realized at the Gurnee facility prior to participation in the North Shore Gas programs. The facility's energy management team consisted of a maintenance and project coordinator devoting 10 percent of his time to energy management activities with support from utility account management staff. With top-level management buy-in for strategic energy saving efforts company-wide, yet severe in-house staffing constraints at the facility, the maintenance and project coordinator enlisted the NSG Natural Gas Savings Program team, contracted to Franklin Energy, to serve as an extension of their energy team.

The work we have accomplished with Efficiency Vermont is the result of a relationship that has been built over 10 years of collaboration. The consultation services they provide allow us to methodically evaluate potential projects and focus our efforts on the ones that are the most impactful. They have a clear understanding of our business from both an operational and financial standpoint and this allows them to adapt their focus to help us meet our goals. – DeWayne Howell, Husky Injection Molding Systems

Husky

Husky and Efficiency Vermont began their work together in 2001

with simple projects such as electric motor modifications. Dealing with energy use is only one of many responsibilities for the plant’s operations staff, and certainly not the most important one. Financial incentives were an important part of the rationale for launching projects. As the plant’s maintenance manager put it, “Why not accept the incentives?” Increasingly, however, Efficiency Vermont’s account manager assigned to Husky became part of Husky’s internal team for developing new projects. Over time, the assistance from Efficiency Vermont in identifying cost-saving projects and helping to package them in ways matching the plant’s priorities and budgeting practices became, in the words of the maintenance manager, “even more important than the financial incentives.”

Logan

In 2008, Logan established an overarching goal to reduce its energy intensity⁵, develop a five-year energy-saving plan, and enlist in DOE’s Better Plants program. Several assessments of EE opportunities, including DOE-sponsored assessments, indicated that the largest savings were from natural gas saving projects from its furnaces, so Logan started there. While the bulk of its savings initially came from its natural gas-fired furnaces and steam boilers, Logan’s partnership with TVA on electricity projects have become increasingly important. In 2011, TVA reviewed Logan’s energy-saving plan, which allowed TVA to demonstrate value by providing performance monitoring and verification services on one of Logan’s existing projects. After this, TVA provided Logan with energy assessments that enabled performance verification estimates on Logan’s proposed projects as well as control strategies for variable-speed motor drives. When this project was installed, metered, and verified to meet the TVA estimated savings, Logan continued to see increased program value. Technical opportunities and upfront savings analyses identified in TVA assessments along with the use of expert third-party services (Lockheed Martin), continues to increase Logan’s comfort with energy efficiency projects; and helps offset perceptions of project risk. Logan’s improvement team use TVA assessments as trusted information for requesting capital dollars from Logan management. This has allowed the Logan management team to more confidently support energy-themed capital spending proposals.

3.2. Financial Incentives

Financial incentives, as the second key value element identified by industrial customers interviewed for this paper in addition to technical assistance, have also played an important role in the success achieved by the four companies in their partnership with their local energy efficiency programs. The incentives offered and paid by the programs in the four cases substantially helped offset the cost of implementing efficiency projects, reducing the project payback period to below internal hurdle rates (see Table 3), and helping the facilities realize energy efficiency savings sooner.

Table 3. Program Incentive Effects on Project Investment Payback Periods

Customer	Number of projects	Total incentive value since engagement (\$)	Payback period without incentive (average)	Payback period with incentive (average)
Terumo BCT*	18	\$206,917	6.2	4.5
Roquette	7	\$868,000	3.6	1.4
Husky Injection Molding Systems	46	\$350,000	2	1.4
Logan Aluminum	7	\$395,000	2.3	1

*Includes planned projects in 2015 and 2016
Source: The authors (2015)

⁵ Logan’s goal is to reduce energy intensity 13.5% overall from the 2007 baseline of 270 Btu per pound to 233.6 Btu per pound in 2017.



Terumo

Terumo's Building Operations Manager is thrilled with the ongoing rebates available to his facility. The project incentives, reducing payback periods by 1.7 years on average, were significant in getting more EE projects implemented. The rebates have also been an internal communication tool to obtain corporate buy-in. The facility has monthly departmental update meetings whereby the Building Operations Manager and his staff report on progress toward their individual cost savings goals. The rebates are an important part of these updates and occasionally "giant rebate checks" from Xcel Energy have been presented. Written updates also go to the Vice President.

Roquette

For Roquette, the air-handling desiccant wheel regeneration modification had previously been denied by Roquette's management because without incentives it had a payback of more than three years, and it had stalled for three years as a result. The rebate lowered the payback to an acceptable level from five to two years and now the facility is saving over \$53,000 annually in avoided energy costs with annual energy savings of 125,414 therms and 1,700,000 kWh from just that project.

Husky

Financial incentives were also helpful to Husky management in reaching decisions about moving forward with energy efficiency projects and certainly helped to reduce payback hurdles.

Logan

For Logan, TVA incentives were a catalyst for aligning investment interests. Savings estimates can vary due to shifts in the volume, pace, mix of production output, or changes in energy commodity prices. However, incentives helped to reduce Logan's investment risk to tolerable levels.

Logan's participation in TVA's EnergyRight Solutions for Industry program has been a very good partnership. The program has provided assistance in evaluating project savings that reduce the risk associated with completing these projects. The dollar incentive associated with those projects favorably reduces SPB [standard payback], which makes the difference in whether or not several of the projects obtain funding. - Russ Hendrick, Logan Aluminum


4. Conclusions and Recommendations

4.1. Success factors

With the detailed customer case studies described in the appendices, this paper highlights specific success stories of industrial facilities that are deriving considerable value from their participation in ratepayer industrial energy efficiency programs. Four industrial customer case studies from different regions of the United States explored how specific elements of ratepayer programs created ultimate success for both program administrators and the participating customers in generating substantial energy and energy cost savings.

The customer case studies show the featured companies are saving hundreds of thousands of dollars on their energy bills each year.⁶ In three of the four cases where the facilities are not particularly energy-intensive operations and energy is not a central operating cost, these significant financial savings would in all likelihood not have been obtained without the support of the local ratepayer-financed programs. The programs provided facility maintenance staff with needed additional expertise to identify, package, and successfully implement the energy efficiency projects. The programs also provided incentives to buy down upfront costs to levels where payback periods met acceptable levels to the companies. In the fourth case study where the facility had already developed

⁶ While they have not been monetized in all cases, productivity improvements, water savings, and non-energy benefits would likely further increase total financial values.



an energy-savings plan and begun its implementation, the local program still provided substantial value to the facility with technical assistance to assess project performance and develop new projects with important project implementation financial incentives.

In all four case studies, strong interpersonal relationships between efficiency program administrators, contractors, and facility staff proved central to the depth and success of engagement by providing the glue that enabled benefits to their customers. As relationships grew stronger and benefits accrued over time, customers became more comfortable with the development and implementation of an EE project portfolio and the program participation process overall. Although the financial and technical support from the program remained important, especially as projects tended to move towards more system-specific and complex areas, facility staff also became increasingly willing to put in additional internal time and resources towards continued project identification and implementation to achieve continuing energy savings.

With a core focus on steady, customer-specific human engagement between program and customer staff and experts, three key factors underlying the success of each of the four program-customer case studies in both generating value for the industrial customer and delivering low-cost program energy savings for the ratepayer programs included:

- Tailoring of specific industry energy efficiency program offerings and support by program administrators to the needs of industrial customers. To generate meaningful, multi-year savings, programs need to accommodate: (a) the varying technical needs of different industrial facilities with program staff competent in industrial operations or with easily engaged technical experts; (b) the multi-year production facility upgrading cycles of factories and the specific investment budgeting systems and requirements of the company with program flexibility and multi-year planning; (c) the need for understanding of specific factory circumstances and the ability to flexibly develop project solutions accordingly; and (d) the importance of gaining trust among facility staff, especially where process or production systems are involved. SEE Action (2014).
- Assignment of dedicated program staff and/or technical contractors to provide technical assistance, project identification and packaging, and/or technical economic performance assessment support. Few small to medium-sized industrial facilities have internal staff with sufficient time to pursue the details of energy efficiency project identification, design and implementation given their many competing duties. Provision of reliable and trusted technical support is therefore highly valued. In each of the four cases a specific and competent account manager or technical contractor point person was assigned to the industrial program participant. The account manager or contractor could arrange for all relevant program elements and expertise to be brought to bear for the facility in ways customized to the company's needs. Continuity of this dedicated support personnel was key for the development of the steady, multi-year relationships needed for success.
- Program offerings that include both custom project incentives and prescriptive incentives. Custom project incentives were typically part of a broader project development and packaging support effort for the customer. Incentives levels were often specifically designed to help meet the internal investment hurdle rates of customers. Often, project pipelines were specifically structured in ways to best accommodate the budgeting, processing and implementation needs of customers. However, prescriptive incentives remain important as a means for supporting simple projects, for getting new customers involved, and for developing the program/customer relationships needed for long-term success.

All four utility programs evolved over time in response to the changing needs of customers and their increased levels of program participation. Both program and facility staff developed a more sophisticated understanding of energy use patterns and opportunities for efficiency gains. Two out of the four programs included SEM and/or continuous energy improvement offerings, and in both of the programs, the relevant facility has begun participation in these offerings.



4.2. Recommendations for Program Administrators

In many states the industrial sector accounts for a large part of the cost-effective potential for energy efficiency gains, which deserves commensurate attention from ratepayer-funded energy efficiency programs. Because the industrial sector historically saves more energy per program dollar than other customer classes, and a single EE investment at an industrial facility can often generate more energy savings than thousands of residential retrofits, engagement with industrial customers is a critical component of EE program efforts (SEE Action 2014, Aden 2014). Industrial customers are usually large enough to attract special attention from the program administrator.

However, generating effective participation in industrial program offerings requires a hands-on, more customized approach for these relatively large energy users with differing needs. In all four case studies, technical assistance and application of expertise at the plant were a key part of what was valuable to the industries and complemented financial incentives geared to overcoming the project approval requirements in the industrial companies. None of the successful cases reviewed relied on financial incentive support alone - additional technical support was also necessary. To get the most value from the technical expertise, program experts needed to demonstrate an understanding of the plant's processes and its specific energy needs and concerns. When the relationship worked well, program staff and experts were viewed as part of the energy team at the facility.

In addition to the success factors listed above, important program value elements that contribute to greater success in the cases reviewed included:


- Development of multiple-year relationships between the utility/program administrator and industrial company personnel, involving a steadily evolving program of support and efforts to identify and implement multiple projects over time rather than a single project. Continuity in assigned program staff was also important.
- Programs that can target energy efficiency gains in manufacturing processes in addition to energy used in support systems such as lighting, HVAC, compressed air. However, process improvement investments will almost never happen for the sole reason of increasing energy efficiency. Therefore, program flexibility and accommodating project scheduling and multi-year planning cycles is needed to allow industrial customers to participate as part of their regular business.
- Programs with SEM offerings that support internal company platforms for continual identification and implementation of energy savings measures, high-impact and low-cost behavioral changes, and operational and maintenance improvements.
- Promotion of smart manufacturing⁷ and enhanced metering practices such as: (1) installing sensors and embedding devices in software that communicate with one another and with other systems through networks; (2) automated control; and (3) improved measurement and management via cloud-based data analytics. Smart manufacturing brings about significantly enhanced and often more granular key data, thus offering process or organization efficiencies and a reduction in the energy intensity of manufactured products.

4.3. Recommendations for Industrial Customers

The four case studies provided examples of how the above success factors helped industrial customers obtain good value from local ratepayer funded programs. Based on those experiences, if facility maintenance or other staff at industrial companies are considering participating in the energy efficiency offerings of their local ratepayer-funded programs, they might obtain maximum value by considering the following:

- Requesting an on-site presentation by program staff to discuss the incentives and technical assistance offered by the program that may be applicable to the plant. A discussion of the energy issues of greatest importance to the plant should follow.

⁷ For a detailed discussion of smart manufacturing, see Rogers (2014).

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- Requesting assignment of a stable program contact person who can explore incentives and provide assessment/technical assistance that would be of primary interest to the plant. Project payback periods before and after incentives should be calculated.
 - Piloting several projects in cooperation with the ratepayer-funded program including using available incentives.
 - Selection of relatively simple or small projects may be a good place to start.
 - Assistance in completing program applications and in understanding program procedures may be requested.
 - Technical expertise from the program may be leveraged to lessen the burden on plant staff.
 - Once projects are completed, sound technical and economic performance assessments should be requested, to help the plant, as well as the program, evaluate results.
 - If satisfactory results are obtained, plant staff could then determine whether or not to proceed in:
 - Requesting programs to provide customized technical assistance and project investment support for yet more meaningful energy efficiency solutions. Energy efficiency projects with program support can be integrated into the plant's capital budgeting cycle, under a multi-year cooperative effort. Key support also may be available for incorporating best-practice energy efficiency solutions in new equipment purchases or production line upgrades being contemplated by the facility.
 - Considering participation in SEM or continuous energy improvement programs, if offered, as a continuing mechanism to identify and implement ongoing low-cost projects.



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Appendix A. Xcel Energy Customer: Terumo BCT, Lakewood CO

Introduction of Terumo BCT and its Lakewood Facility

Terumo BCT is a blood component and cellular technologies company serving customers in more than 120 countries and employing nearly 5,000 associates in more than 95 countries and territories. The Company delivers a comprehensive product range for blood centers. It is a medical device manufacturer; delivers technologies in manual and automated whole blood processing, collection and cell growth; and provides therapeutic solutions for blood disorders. The Lakewood facility has more than 2,000 employees and it as the largest independent employer in Lakewood with a commitment to manufacturing in Lakewood for 35 years.

Engagement with Xcel Energy

Xcel Energy Program Offerings


Terumo is in Xcel Energy Colorado's service territory. Xcel Energy provides simple incentive applications for a full suite of programs including: prescriptive, self-direct, and custom process EE incentives to provide flexibility for their customers. Its prescriptive rebates are available for compressed air, cooling, heating, lighting, and motors equipment and systems. Its custom efficiency offering provides incentives for a wide variety of equipment and process improvements that do not fall within predetermined rebates under prescriptive products. It also has data center efficiency, new construction, and re-commissioning incentives.

Xcel Energy's Process Efficiency (PE) program integrates its technical assistance, energy management support, and incentive programs. The PE program is available to industrial customers with energy conservation potential of at least 2 GWh, which usually translates to total annual electricity consumption of at least 20 GWh. The PE program helps industrial customers evaluate both business practices and technical projects, and it supports companies that practice energy management as a tool to strengthen existing and ongoing EE activities. The program operates in three phases:

- Phase 1—Identify Opportunities - Xcel Energy offers a no-cost, one-day energy management session based on the EnVinta One-2-Five® energy management model to:
 - evaluate energy-intensive processes and benchmark energy management practices;
 - identify energy-saving technical opportunities during a high-level, walk-through audit; and
 - review a follow-up assessment report that outlines industrial customers' energy management practices and high- priority action items.
- Phase 2—Scope EE Potential - Facilities then develop an energy action plan based on the assessment report. Xcel Energy prepares a customized proposal to help support additional project scoping and provide engineering and technical studies to develop energy-saving opportunities. Xcel Energy funds 75% of the cost of the study. Facility contributions are limited to 25% with a cap of \$7,500. If the study costs more than \$30,000, Xcel Energy will cover the balance.
- Phase 3—Implement EE Improvements and Qualify for Rebates - After the detailed assessment is completed, Xcel Energy and the customer sign an agreement that outlines improvements to implement, sets a timeline for installation, and details customized rebates, bonuses, and support. Xcel Energy encourages the customer to agree to complete projects within a year, but they allow longer timeframes if needed.



Automated blood collection system. *Image courtesy of Terumo BCT*



For the PE program, Xcel Energy account managers rely on a third party energy engineering and data firm, Graphet, to provide technical support and services for their customers. For custom offerings as well the PE program, the account manager will also work closely with Xcel Energy's in-house group of efficiency engineers who each have expertise in different areas. When necessary, the engineering group serves as a resource to meet and discuss more complex projects with customers.

Terumo Participation in Xcel Energy Programs

Terumo BCT has been participating in Xcel Energy EE programs since 2011. Prior to this time, Terumo staff had not made any concerted or strategic efforts to undertake EE projects. They had not set reduction goals for energy or carbon reduction and they were not effectively tracking energy use. When they replaced equipment, they were not considering how much energy the new equipment would save and they were not leveraging any EE incentives because they were not aware of the Xcel Energy offerings available to them.

They were, however, a good candidate for the programs since their operations require running day and night and they need to be sophisticated and knowledgeable about their energy use. As a company running unique equipment made specifically for highly specialized operations, Terumo has high power quality and voltage conditioning needs and runs their equipment 24 hours per day on week days. As a result, they had installed an intense power-monitoring network ten years ago with more than 150 connected meters and software (known as "Powerlogic") throughout the various buildings and manufacturing facilities at Lakewood.

With a highly sophisticated operation to manage, the Building Operations Manager relies on a number of third party contractors to provide mechanical engineering services and building automation software. Responsible for both production and maintenance, the Facility Director holds quarterly meetings with all contractors and vendors to discuss upcoming projects. Xcel Energy's account manager for Terumo accompanied by a sales engineer, attended one of these meetings in early 2011.

Xcel Energy staff immediately realized Terumo would be a prime candidate for their programs particularly the PE program because the Lakewood facility has a number of different buildings, both commercial facilities and manufacturing operations. Xcel Energy followed up with an introduction letter with a summary of its rebate programs and EE offerings. The Building Operations Manager expressed a keen interest as soon as he received it since he was already thinking about saving energy but was not sure where to start; and was not aware of Xcel Energy's offerings. In addition, the Building Operations Manager was aware that Terumo's corporate strategy from its headquarters in Japan included clear sustainability and environmental goals, therefore, major obstacles to obtaining EE project approvals would not be likely.

In 2011 and 2012, Terumo worked with Xcel Energy's account manager and energy engineers to participate in a number of prescriptive and custom rebates since a number of upgrade projects had been identified and they wanted to get started implementing them immediately. Beginning in early 2013, Xcel Energy engaged their PE program support contractor Graphet to work with Terumo in undertaking a continuous improvement engagement. Together, Graphet and Terumo:

- assembled a cross-departmental team and participated in a self-diagnostic exercise in energy management practices and maturity using the Envinta One-2-Five® energy management model;
- gathered energy and production data, identified key variables, determined an energy baseline and performed a regression analysis using the Company's existing metering equipment (2013); and
- completed a full report and energy action plan with energy allocations and a comprehensive list of prioritized opportunities with cost-benefit and payback information (2014).

This energy action plan is currently being incorporated into Terumo's planning process with specific projects beginning implementation in 2015.



Smart Manufacturing at Terumo

Terumo's operations employ various smart manufacturing practices. One of the operations uses automated paper vehicles in an automated vehicles line to transport raw materials, manufactured blood bag kits, transfusion machines, and other blood equipment systems within and between its various buildings. The primary enterprise software is the Trane Tracer ES which gives Terumo an enterprise management view into its building control and automation systems. Having multiple buildings on its campus, the front-end system lets operators of multiple facilities manage all buildings as a single enterprise. The facility relies on Trane mechanical engineers as one of its major contractors for software support.

Terumo also uses a power monitoring network of over 150 connected meters that runs through the Schneider Electric Square D PowerLogic software and engineering services. The software runs from an application server that provides the visualization of the electrical system for up-to-the-minute energy usage and quality readings as well as long-term trending. The monitoring system has allowed managers to set energy usage benchmarks within each facility, make system or process adjustments, and track possible savings against the original levels.

Terumo is now integrating its enterprise building automation and power monitoring systems via an integrated dashboard to overlay these systems including tying in manufacturing and machine energy into both these systems. Coupled with Graphet's energy data and regression analysis to identify all variables that affect energy use, the continuous meter readings and the overlay dashboard now allows Terumo to monitor equipment energy use and occupancy; measure all its energy use in real time in intervals of a few minutes; identify and reduce significant energy users; visualize its peak demand use curves; identify why those peaks are occurring; and help to smooth those peaks out. With Graphet's expertise and prioritized EE project portfolio within the PE program, Terumo is able to track the impact of energy management practices and project, with increased reliability, and claim substantial energy cost savings.

The Terumo-Xcel Energy Project Portfolio

The Lakewood facility mostly uses electricity. The electric consumption is broken down as follows: 25% in lighting; 16% in the sterilization process; 18% in the manufacturing production (plastic extrusion, welding, and assembly); 17% in HVAC fans; 9% chilled water for process cooling; and 6% in compressed air.

Project Information

Between 2011 and 2014 Terumo completed 13 prescriptive and custom EE projects with a saving of 789,000 kWh annually and reducing demand by 147 kW per year by the end of the time period. Terumo received over \$85,000 in rebates across those projects.⁸ The overall project incentives helped to reduce payback periods by two years on average. A summary of EE projects implemented by Terumo through the Xcel Energy program support is provided in Table A-1 below.

⁸ In 2010, it also implemented two solar programs, saving 255,000 kWh in energy costs annually, and enjoying a rebate of \$260,000.

Table A-1. Xcel Energy Projects Implemented at Terumo to Date

Project	Completion Date	Annual energy savings (kWh)	Demand reduction (kW)	Annual cost savings (estimate)	Project cost (\$)	Electric Rebate \$	Pay-back before rebate (yrs.)	Pay-back after rebate (yrs.)
Motors Efficiency 1	June 2011	8,944	2.64	\$716	\$2,769	\$1,250	3.9	2.1
Lighting 1	June 2011	7,139	1.63	\$257	\$3,023	\$652	11.8	9.2
Recommissioning*	Dec. 2011	86,906	15.19	\$6,952	N/A	\$18,250	0	0
Motors Efficiency 2	Sept. 2012	13,359	3.241	\$1,069	\$17,162	\$2,710	16.1	13.5
Motors Efficiency 3	Aug. 2012	77,650	15.883	\$6,212	\$17,480	\$6,000	2.8	1.8
Compressed Air **	April 2013	298,285	37.267	\$19,634	\$72,018	\$22,360	3.7	2.5
Motors Efficiency 4	Aug. 2013	21,627	5.082	\$1,730	\$9,699	\$3,530	5.6	3.6
Motors Efficiency 5	Feb. 2014	22,253	4.363	\$1,780	\$11,333	\$3,000	6.4	4.7
Motors Efficiency 6	Feb. 2014	75,894	17.584	\$6,072	\$35,625	\$12,000	5.9	3.9
Lighting 2 **	Oct. 2014	162,108	37.011	\$6,398	\$93,304	\$14,804	14.6	12.3
Lighting 3	Nov. 2014	11,404	5.796	\$912	\$3,041	\$1,230	3.3	2.0
Lighting 4	Dec. 2014	1,559	0.715	\$125	\$1,776	\$780	14.2	8.0
Totals		789,011	146.838	\$51,857	\$267,231	\$86,566	7.3	5.3

*This was a study rebate. Xcel Energy claimed the kWh savings, but none of the Energy Conservation Opportunities resulted in a rebate to the customer.

**Annual cost savings estimated through the Terumo custom efficiency program.

Note: Cost savings are estimates only based on assumed cost per kWh of \$0.08.

Source: Xcel Energy (2015).

In November 2014 the Building Operations Manager also started pursuing operations and maintenance (O&M) practices according to Total Productive Maintenance, Kaizen, and 5S principles. For example, the company commissioned design engineering studies to optimize equipment, performed thermal imaging, and improved differential pressure for all motor filters. Starting in 2015, Terumo will choose to implement opportunities identified through the PE program with the potential for an additional 2,112,057 kWh and \$ 177,000 in annual energy savings (see Table A-2).

Table A-2. Projects Planned for Implementation

Project	Planned Completion Date	Energy Savings (kWh)	Demand Reduction (kW)	Annual Cost Savings	Project Cost (\$)	Electric Rebate \$	Payback Before Rebate (yrs.)	Payback After Rebate (yrs.)
Lighting	2016	461,933	53	38,712	117,000	46,797	3.0	1.8
Cleanroom HVAC	2016	534,838	61	44,822	400,000	24,422	8.9	8.4
HVAC Scheduling	2015/2016	414,279	47	34,719	30,000	18,917	0.9	0.3
HVAC Airflow/ Pressurization	2015/2016	492,353	56	41,261	56,000	22,482	1.4	0.8
Drives	2015/2016	208,654	28	17,486	50,000	7,733	2.9	2.4
Totals		2,112,057	245	177,000	653,000	120,351	3.7	3.0

Source: Xcel Energy (2015)

Project Decision-Making and Approval Process

Within the company EE projects are left to the Building Operations Manager to identify and manage. The Building Operations Manager has an operating budget of \$2 million per year with discretion to conduct any number of O&M improvements.

For EE and non-EE capital projects, capital is drawn up three years in advance and built into the facility’s pre-approved, long-range plan. The facility has a master schedule where departments list various projects planned for implementation. The Building Operations Manager then includes approved capital projects in the annual budget of \$3.5 million. Based on the updated energy plan in addition to the standard rebates, Terumo works with Xcel Energy’s PE program to determine which projects will proceed. The PE program funds technical and engineering studies with a maximum customer contribution of \$7,500, and it provides for bonus incentives to meet and exceed the EE project savings goals. This allows for an increased uptake in EE projects and a higher success rate for on-time completion. The facility’s projects department then estimates the capital cost and writes up capital expense request to justify the investment. Internally, the projects are then packaged up ensuring that they demonstrate a solid business case and an attractive return on investment for corporate approval. Xcel Energy engineers determine the cost-effectiveness of any submitted custom projects. Comments from the Building Operations Manager are:

As an owner, I have limited resources. For some of the opportunities I would like to chase, I just don’t have the resources to be able to tackle them. When I start a project or ask for money for that project, I may not have as much background as I would like to have. Having added resources provided by Xcel Energy, with the data tagged to it, has helped me present and explain a project. When you are chasing money, you have to tell the story. Having those added resources helped me tell the story. This is why we’re going to do it, and this is how we are going to do it. The program gave us a focus and additional resources that we didn’t have on site. That was a huge benefit to our business. We thought we were doing the right things, now we know we are doing the right things. – Chris Sirbin, Building Operations Manager.

The project evaluations by Xcel Energy do tend to show variable return on investment (ROI) metrics. Because Xcel Energy rebates only qualify for projects with a payback over one year, Terumo will often pursue the projects under the threshold without Xcel Energy support. All projects have an energy aspect. Project teams have a checkbox for EE when analyzing new projects.

Appendix B. North Shore Gas Customer: Roquette America, Gurnee, IL

Introduction to Roquette America and its Gurnee Facility

Roquette is an international biorefiner and manufacturer of industrial organic chemicals, starch, polyols, and maltodextrins. The Company's 700+ products are derived from four basic vegetables: corn, wheat, potatoes, and peas. Roquette's products are intermediate inputs for the production of foodstuffs (sweeteners), paper and cardboard, pharmaceuticals, and cosmetics. Headquartered in France, Roquette has been in operation for 75 years.

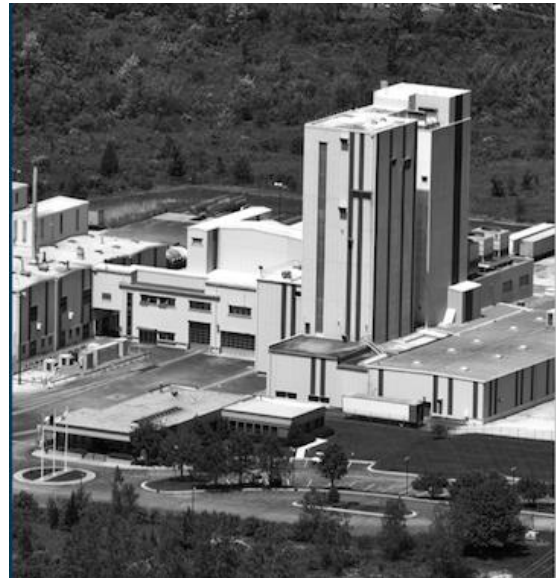
Roquette America – The Gurnee facility is a local industrial plant part of the Roquette Group. It is one of two facilities producing a naturally derived substance known as sorbitol. The sorbitol produced at Roquette is used as a sweetener and compression agent in sugar-free confectionery products such as chewing gum, pan coating, and tablets.

Engagement with North Shore Gas

North Shore Gas Program

NSG has a range of energy saving programs for C&I customers including:

- C&I prescriptive and custom rebates
- The Jumpstart Program that provides free installation for EE products
- The Gas Optimization Study Program, that provides engineering services to identify opportunities that provide significant natural gas savings with low implementation costs
- Staffing Grants for funding of internal staff time and engineering support to oversee and manage installation of large projects.
- Continuous project management support services provided by energy advisors.
- The Small Business program that provides free, on-site energy assessments, free energy-saving products, and rebates for installing energy-efficient equipment
- Retro-commissioning for C&I buildings is provided in partnership with ComEd, one of Illinois' electric utilities in the service area.



Roquette Gurnee facility. *Image courtesy of Roquette.*

Acting as NSG's turnkey program implementer, Franklin Energy represents EE activities exclusively, while NSG retains responsibility for billing, commodity delivery, and other utility matters that are "upstream" of the gas meter.

The standard NSG EE investment incentive provides \$1.00 per therm saved. However, customers may use Franklin Energy's Request for Proposal (RFP) service to apply for variances that effectively increase the incentive. Application for the variance is both time- and information-intensive. Franklin's RFP service provides this on the customer's behalf. Franklin also manages equipment vendor (trade ally) relationships as needed. Every effort is made to enlist trade allies that the customer chooses. Under the Gas Optimization Study Program, recipients of NSG's energy assessments are required to pay up to \$10,000 for the implementation of any assessment recommendations that demonstrate a one-year payback or less.



Roquette Participation in North Shore Gas Programs

Roquette used both prescriptive and custom services as well as a range of technical services provided by NSG programs. Prior to participation in NSG programs, EE and energy management strategies along with planning, were not fully realized at the Gurnee facility. The Gurnee facility's energy management team and activities consist of a maintenance and project coordinator devoting 10 percent of the project coordinator's time to energy management activities with support from the utility account management staff. Therefore, the Gurnee facility certainly welcomed the incentives and services offered by NSG and other utilities. If these utility programs were not offered, Roquette at Gurnee would not have pursued the volume of energy savings opportunities that it has to date.

Roquette America's corporate arm has increasingly encouraged strategic energy saving efforts. In recent years, it has requested all regional in-house staff to form and manage energy teams to become a more sustainable company (NSG 2014). With top-level management buy-in, yet severe in-house staffing constraints, the maintenance and project coordinator enlisted the NSG Natural Gas Savings Program team to serve as an extension of their energy team.

The main program features that identify and manage major capital improvements include:

- A detailed Gas Optimization Study providing a three-day, on-site evaluation of energy systems and operation. This study generated piping & instrumentation (P&ID) drawings for customer review
- A rebate designed in Roquette's case to bring a ROI cost of capital, depreciation, tax rate and associated cash flow to be within the corporate investment threshold of a one-year payback
- A Staffing Grant in collaboration with ComEd (Roquette's electric utility), offered to fund internal staff time and engineering support specifically to administer a large air handling retrofit project
- Continuous project management support services provided by Franklin's Major Account Energy Advisor. Much of the ongoing effort involves program reporting as well as day-to-day vendor activity and bid management; time-consuming tasks that would otherwise burden the facility's managers.

The Roquette-North Shore Gas Project Portfolio

The facility's products are hygroscopic. The hygroscopic product requires the facility maintain an atmosphere of no more than five grains of moisture per pound of dry air, 365 days per year. Dehumidification is achieved via chilled water and a desiccant wheel. Other thermal applications include various drying, evaporation, and distillation tasks including steaming of raw inputs unloaded from rail cars in cold weather. Virtually all gas use is for steam and heat that conditions the production atmosphere and material inputs.

NSG's Gas Optimization study provided a floor-by-floor inventory of steam traps, bare steam and condensate pipes, valves, and tanks. Analysis with 3E-Plus mechanical insulation diagnostic software calculated volumes of energy loss and potential savings. These results were compared with vendor bids to calculate payback on investment. As a result of this analysis, tanks, valves, and hundreds of feet of pipe were insulated. Also, steam traps were inspected and replaced as needed.

A key process improvement project was the air-handling desiccant wheel regeneration modification. This involved recovering heat once transferred into the process stream where it was unwanted instead of using it to preheat the desiccant regeneration section where heat is beneficial. Prior to the incentives, this project had previously been denied by Roquette's management because the project had a payback of more than three years. The Franklin team managed this project through the C&I Competitive Bid Program, giving Roquette the opportunity to propose a rebate amount that reduced their payback from five years to two years. With customer guidance, the Franklin team successfully took the lead on preparing applications, verifying energy savings, and submitting the project for rebate approval. The project cost \$425,000 and it resulted in annual energy savings of 125,414 therms and 1,700,000 kWh.

The desiccant wheel upgrade was tied into the facility's process control system; a dashboard for documenting current operating conditions at key points in the process. This control system relies on staff to monitor readings for variances that may indicate a need for remediation.

The desiccant wheel modification project established a relationship of trust between Franklin and Roquette. This relationship led to further collaboration on an even larger project with higher energy savings. The air handler energy upgrade project consisted of reworking the design of large portions of multiple air handlers. It solved an issue that Roquette's maintenance and project coordinator had thought was wasteful for a long time, but they never had the resources to address.⁹ The ultimate project cost was just over \$800,000. The incentive was \$500,000 from North Shore Gas. The project generated \$250,000 of annual natural gas savings, which made it very attractive. It helped Roquette avoid unnecessarily heating hundreds of tons of air per hour and it provided ongoing, substantial energy savings that allowed Roquette to have a competitive advantage.

Table B-1 below lists a summary of EE projects implemented by Roquette through NSG program support.

Table B-1. Projects Implemented at Roquette Gurnee Facility

Project Name	Year of Installation	Annual therm savings	Annual cost savings*	Project cost	Gas rebate (\$)	Payback before rebate (yrs)	Payback after rebate (yrs)
Steam Trap Replacement	2012	852	\$554	\$2,130	\$360	3.85	3.2
Steam Trap Replacement	2013	13,498	\$8,774	\$3,080	\$2,800	0.35	0.03
Pipe & Fitting Insulation	2013	39,051	\$25,383	\$66,410	\$66,410	2.62	0
Desiccant Wheel Upgrade	2013	125,414	\$81,519	\$423,787	\$216,910	7.96	3.89
Air Handler Energy Upgrade	2014	395,959	\$257,373	\$803,100	\$500,000	3.12	1.18
Pipe & Fitting Insulation	2014	70,102	\$45,566	\$135,208	\$79,620	2.97	1.22
Steam Trap Replacement	2014	19,087	\$12,407	\$2,606	\$2,606	0.21	0
Project totals	2012-2014	663,963	\$431,576	\$1,436,321	\$868,706	3.56	1.41

*Estimates only. Assumes an average gas cost of \$0.65 per therm.

Note-For the highly several profitable projects (e.g. steam trap replacements), prescriptive incentives were leveraged.

Source: Franklin Energy Services (2015).

As outlined in Table B-1, the incentives provided for the various projects were important to reduce paybacks to align with Roquette's project investment criteria. In most cases, NSG offerings reduced project paybacks from over three years to fewer than two years.

The value for us was two-fold: first, getting to work with knowledgeable program representatives who helped us understand the benefits available to us, someone to walk us through the process. Second, obtaining the incremental funding which made the projects feasible. Probably would never have been done without the rebates. - Steve Calewarts, the Plant Manager, Roquette America's Gurnee facility.

⁹ Rather than use high-pressure steam to provide freeze protection for chilled water coils, an automatic drain-down system was installed to empty the chilled water coils during freezing temperatures. The steam coils were replaced with a glycol system that is only activated on severely cold days.

Appendix C. Efficiency Vermont Customer: Husky Injection Molding Systems, VT

Introduction to Husky Injection Molding Systems and its Milton Facility

Husky manufactures injection molding hot runners in multiple facilities on three continents. Manifolds are fabricated from steel plate stock involving multiple drilling, cutting, and grinding operations. The manifolds are used by custom injection molders in conjunction with multi-cavity injection molds to enable accurate, repeatable cavity filling. Husky's facility in Milton, Vermont manufactures 5,000 manifolds per year and operates 360 days per year. Forty-eight large metal-cutting machines operate in 200,000 square feet of manufacturing floor space.

Engagement with Efficiency Vermont

Efficiency Vermont Industrial Program Offerings

Efficiency Vermont is a statewide energy efficiency utility, working with customers to deliver energy savings across the state, except for the City of Burlington. Efficiency Vermont is operated by the Vermont Energy Investment Corporation, and it is funded primarily by a systems benefit charge on electricity consumption collected by the state's 17 electric distribution utilities.

Efficiency Vermont has continuously targeted and proactively engaged commercial and industrial customers for deep energy savings since its first three-year contract cycle beginning in 2000. The energy efficiency utility's longstanding programs for industrial customers involve technical assistance for energy audits, project development, energy management, and employee energy efficiency awareness. Efficiency Vermont also offers financial incentives for both customized energy efficiency projects and prescriptive, common-technology applications. Customized projects are by far the dominant source of the deep energy savings, accounting for approximately 90 percent of the savings achieved in energy efficiency projects in Efficiency Vermont's industry market sector in recent years. Efficiency Vermont also conducted a two-year Energy Leadership Challenge for commercial and industrial customers in 2011 and then they selected a cohort of industrial customers for ongoing Continuous Energy Improvement assistance in 2012.


Efficiency Vermont's program for industrial project development and implementation support is managed by a team of large-customer account managers and energy consultants. Ten account managers currently cover the state's largest business customers, creating ongoing relationships centered on assistance with finance and business expertise to support customers' decision-making. These account managers team with experienced energy consultants to bring technical expertise to these customers to address complex situations and challenges. Account managers recommend financial incentive and investment cost-sharing levels for their customized projects following Efficiency Vermont's overall paperlines.



Manifolds manufactured from steel plates.
Image courtesy of Husky Injection Molding Systems.

Husky's Participation in Efficiency Vermont's Programs

Husky and Efficiency Vermont began their work together in 2001 with simple projects such as electric motor modifications. Financial incentives were an important part of the rationale for launching projects. As the plant's Maintenance Manager put it, "Why not accept the incentives?". Increasingly, however, Efficiency Vermont's



Account Manager assigned to Husky became part of Husky's internal team for developing new projects. The Account Manager helped to incorporate them into operating or capital project budgets.

Although substantial in absolute terms, the plant's energy costs are equivalent to only about 1 percent of the Company's business volume. Dealing with energy use is only one of many responsibilities of the plant's operations staff, and certainly not the most important one. Over time, however, the assistance of Efficiency Vermont in identifying cost-saving projects and helping to package them in ways matching the plant's priorities and budgeting practices became, in the words of the Maintenance Manager, "even more important than the financial incentives." Although the financial incentives were helpful for management to reach decisions about moving forward with energy efficiency projects, the technical assistance from Efficiency Vermont helped to identify and develop the projects in the first place.

As the relationship and project portfolio between Husky and Efficiency Vermont began to mature, Efficiency Vermont paid increasing attention to possible projects and efficiency gains in the plant's core manufacturing processes in addition to auxiliaries, lighting, and motors.

Efficiency Vermont's Husky Project Portfolio

Husky and Efficiency Vermont together completed 46 energy efficiency projects from 2003 through 2014. Project investment costs totaled about \$1.2 million, yielding 5.9 GWh of annual savings. Efficiency Vermont provided financial incentives of about \$350,000 for the portfolio, while Husky covered the remaining investment costs. In addition, technical assistance provided by Efficiency Vermont staff and consultants was substantial with costs estimated conservatively between \$130,000 - \$160,000 over the time period.

The early projects were relatively simple involving improvements in lighting, electric motor, and compressed air systems. However, even in the early days, Efficiency Vermont also worked with Husky to identify energy efficiency gains from more energy-efficient design features or equipment procurement in Husky's plant expansion and equipment renewal investments. Efficiency Vermont offered financial incentive support to make investments in the more energy-efficient alternatives increasingly attractive. The efficiency utility was active in the plant's 2004 new addition and for a 2008 major cooling system upgrade, contributing to the booking of big energy savings in those years.

As shown in Table C-1, the simple payback from energy cost-saving benefits alone varied significantly for the various energy efficiency projects. During the first nine years of the period (2003-2011), the weighted-average total investment in terms of simple payback was 3.3 years. Efficiency Vermont's financial incentives brought the weighted-average investment project payback to 2.2 years, counting only electricity cost savings.

Table C-1. Efficiency Vermont's Husky Project Portfolio, 2003-2014

Year	Number of Projects	Investment Costs (\$ '000)	MWh Saved Every Year	Project Simple Payback (yrs)	Payback after Incentives (yrs)
2003	1	0.2	1	1.8	0.2
2004	3	190.9	1,305	2.6	2.1
2005	1	0.5	3	1.5	0.5
2006	3	51.8	211	2.9	2.0
2007	6	11.1	25	6.2	4.5
2008	3	439.2	1,564	4.1	2.9
2009	7	57.9	124	3.4	1.1
2010	5	172.8	711	3.0	2.5
2011	6	35.8	129	2.3	0.9
2012	4	46.9	445	1.0	0.6
2013	3	44.0	2,045	0.3	0.2
2014	4	132.3	810	1.6	1.0
Totals:	46	\$1,184	7,371*	2.0	1.4

*Gross savings during 2003-2014. Subtracting retired savings from earlier projects total net cumulative savings were 5903 MWh.

Source: Efficiency Vermont (2015).

Smart Manufacturing and Process Improvements at Husky

Beginning in 2012, the project portfolio began to change with increased attention to the manufacturing process itself. Husky and Efficiency Vermont began to review energy efficiency options in the core metal-cutting operations of the plant by installing meters on individual machines and analyzing electricity consumption through the operations schedule.

Husky and Efficiency Vermont devised a two-week metering and measurement plan to monitor and compare pump-by-pump electricity use for the Henry machine cutting-fluid pumping system under varying fluid pressure conditions. Through the test results, the team discovered ways to optimize the operation of the plant's pumping system, and to modify machine shut-off protocols yielding large energy efficiency gains.¹⁰ Husky has since moved to installing permanent meters on its machines.

The costs of these smart manufacturing projects were particularly low, consisting primarily of costs for collection of new information through new metering and data logging, analysis of results, and operational re-design. With investment costs of only about \$31,000 for the two efforts, and annual savings of approximately 2 GWh of electricity, the strict payback on the dollars invested in the two projects was only about two months.¹¹ However, the project required substantial technical assistance from Efficiency Vermont, which conducted the initial metering and data analysis work, and they worked closely with plant staff on the operational re-designing.

¹⁰ The test results showed that there was significant demand on the Henry system and, accordingly, on its electricity consumption—in excess of what the machines actually needed. Further investigation found a key cause to be the fluid diverter valves, located where the Henry system piping enters each machine. The valves enable pressure to be lowered for each machine from the high-pressure system by allowing fluid to exit to the collecting trough. The valves were set with conservative, long-time assumptions and rarely adjusted. Fluid at pressure was being fed into the collecting trough at all times, whether machines were in use or not. Following the test results, Husky's maintenance division decided to plug the diverter valves; allow full line pressure to the machines; and adjust line pressures. In addition, Efficiency Vermont installed variable frequency drives (VFDs) on the pump motors. Subsequently, it also was based on metering results. Husky and Efficiency Vermont also discovered that electricity consumption could be significantly reduced by using emergency-stop controls to shut off machines not in use rather than simply putting machines in idling mode.

¹¹ This calculation excludes investments in a pressure accumulator later made by the plant to complete the Henry system operational re-design.

Another 2014 high-payback project of interest was the completion of a compressed air system audit by a specialized third party, which was conducted as part of a new Efficiency Vermont program for several of its industrial customers. The cost was approximately \$32,000; the audit and low-cost follow-up measures are now yielding electricity cost savings of approximately \$42,000 every year.

Primarily due to the smart manufacturing projects and compressed air system audit effort, the weighted-average total investment simple project payback for Efficiency Vermont’s Husky portfolio from 2012 through 2014 was just 0.7 years. Efficiency Vermont’s financial incentives brought the average payback for Husky down to 0.4 years. With the contribution of these economical projects, the weighted average total investment simple project payback for the entire 46-project portfolio was 2.0 years with a project payback for Husky of 1.4 years (see Table C-1).

With increasing information at the system and machine levels, further production optimization measures are possible and likely in the future. For example, it might be possible to further optimize the deployment of specific cutting machines for specific tasks thus reducing the machine operating times and increasing productivity. Energy consumption for similar machines performing similar tasks can also be compared to help identify best operational practices.

Cumulative Results

The completed Husky-Efficiency Vermont projects continue to generate energy and savings year after year. Figure C-1 shows the compounding kWh savings and energy cost savings across the 12-year period. Some projects, such as the Henry system optimization project, have lifetimes of at least 20 years. However, lifetimes of others are shorter. If one subtracts project savings as projects reach the end of their lifetimes, the compounded kWh savings of all the projects reached almost 5.9 GWh per year by 2014. The Husky plant was able to reduce its annual electricity use by almost 30 percent, compared to what it would have had to consume without the projects supported by Efficiency Vermont. Whereas Husky’s electric power bill would have normally increased over these years following increases in plant output, the plant’s electric power bill has actually fallen since 2006 despite increased production. In fact, as the savings from completed projects began to sharply accumulate, the total dollar savings from energy efficiency gains from 2008 through 2014, were twice as large as the Company’s total 2013 electricity bill.

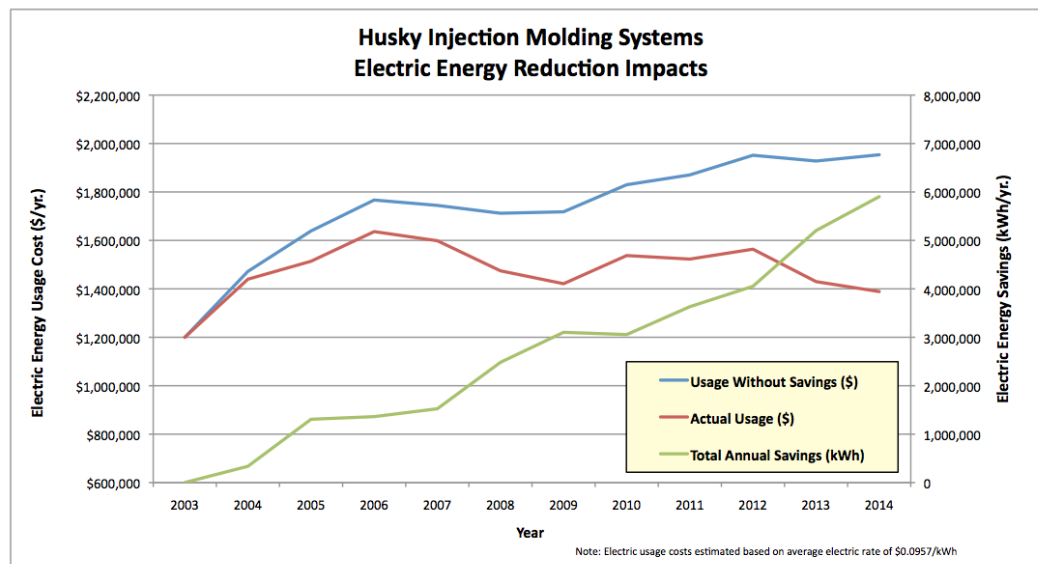


Figure C-1. Cumulative Energy Savings and Energy Cost Savings at Husky’s Milton Plant, 2003-2014
Source: Efficiency Vermont (2015)

Husky's Participation in Efficiency Vermont's Continuous Energy Improvement Program

In July 2011 Efficiency Vermont issued an Energy Leadership Challenge for businesses statewide challenging participants to work with Efficiency Vermont to reduce energy use by 7.5 percent. Sixty-nine large businesses participated including Husky's Milton plant. As of early 2015, 31 of the participants had already met the 7.5 percent goal.

With the commitment of plant management, the success of the Henry project, and the increasing focus on energy efficiency work, Husky's plant has moved further to participate in Efficiency Vermont's relatively new Continuous Energy Improvement Program for businesses. Husky is in the first cohort of businesses participating in the program. The program aims to systematically strengthen internal energy management using new tools and widely engaging staff to continuously improve energy efficiency. Working with Efficiency Vermont, the plant is beginning to use a new energy management information system that can help identify opportunities, especially those involving further system optimization. The plant has also benefited from an application of Efficiency Vermont's new Industrial Peak Initiative Tool, which helps identify electricity costs savings through improved management of the timing of its electricity loads. The plant's Maintenance Manager feels that broader staff engagement is a key part of the initiative, which helps machine operators and others become more aware of how they can help reduce energy costs.



Efficiency Vermont's Account Manager reviews the performance of Husky's pumping system optimization project. Image courtesy of Husky Injection Molding Systems.

The work we have accomplished with Efficiency Vermont is the result of a relationship that has been built over 10 years of collaboration. The consultation services they provide allow us to methodically evaluate potential projects and focus our efforts on the ones that are the most impactful. They have a clear understanding of our business from both an operational and financial standpoint, which allows them to adapt their focus to help us meet our goals. – DeWayne Howell, Husky Injection Molding Systems

Appendix D. Tennessee Valley Authority Customer: Logan Aluminum, KY

Introduction to Logan Aluminum Russellville, KY facility

Logan Aluminum is a joint venture between Novelis Corporation and the Tri-Arrows Aluminum

Corporation. Located near Russellville, Kentucky, Logan Aluminum is a leading manufacturer of flat rolled aluminum alloy sheets, primarily for use in the beverage can market. Logan's main products are beverage can tops, tabs, and bodies. The facility makes extensive use of recycled aluminum as a product input. Logan Aluminum uses the latest technology in tandem with a unique team-based work system to drive its competitive position in the industry.

Engagement with TVA

TVA Industrial Program offerings

TVA's industrial energy program was launched in 2009 as "EnergyRight Solutions for Industry." Industrial program service is distinct from the business program, which serves commercial and institutional customers. TVA's Senior Program Manager, Brent Powell, is a proactive energy advisor who informs and motivates customers, such as Logan Aluminum, to pursue improvements that may otherwise not be realized.

Depending on customer needs, service offerings include: (1) standard (prescriptive) incentives; (2) custom incentives for projects engineered for a specific application, and (3) tailored solutions for large, complex projects, cutting edge technologies, or projects with a potential incentive exceeding \$500,000 in cost. TVA's prescriptive incentives can be paid within 2-3 weeks if all necessary paperwork is completed. Tailored incentive pay-outs are structured in phases to coincide with periodic post-implementation performance evaluations.

All non-residential EE program offerings are presented through one point of application. TVA then directs customers to the appropriate program channel. Lockheed Martin provides operational support to TVA's energy programs including engineering analysis, incentives processing, incentive payment administration, and call center operations. Consumers served by TVA's utility network do not see an itemized charge for energy efficiency program activity. Rather, program costs are blended into a comprehensive rate per kWh delivered.

Participation in the TVA Program

Logan Aluminum's program participation began in 2011. The facility obtained TVA-sponsored custom incentives for many of its electricity efficiency improvement projects. Standard (prescriptive) incentives were issued for lighting upgrades. TVA-sponsored expert advice for key projects including performance monitoring and verification.

Since 2000, Logan has had an Energy Reduction Task Force monthly meeting. It identifies and prioritizes an ongoing list of potential energy-saving improvement projects. In 2007, energy reduction became a greater priority.



The Logan Aluminum rolling mill is located on a 1,000-acre site just north of Russellville, KY. Power is supplied by the Tennessee Valley Authority. *Photo courtesy of Logan Aluminum.*

The facility's two corporate owners each have their own energy and sustainability policies, but as an autonomous entity, Logan implements its own energy management agenda to support owner policies. Energy market turbulence in 2007 inspired Logan's to establish an energy policy to support the owner's goals which is " We strive to reduce specific energy consumption, minimizing our carbon footprint by utilizing a structured system to make energy conservation a part of our everyday business."

Logan established an energy consumption baseline, which provided the basis for Logan's EE goals and performance metrics. By using in-house resources, the improvement team determined an energy intensity of 270 Btu per pound based on 2005-07 data. In 2008, Logan established an overarching goal to reduce energy intensity 13.5% from the 2007 baseline of 270 Btu per pound to 233.6 Btu per pound in 2017. This represents an average of 2% savings per year through 2012 and 1% per year thereafter through 2017. To meet its goals, Logan's tactics are to: (1) foster a culture that promotes consumption and cost reductions; (2) attain continual improvement in energy management/efficiency; (3) continue success of operations; and (4) utilize alternate energy resources as appropriate.

TVA's relationship with Logan began with an initial overview presentation of TVA programs. TVA reviewed Logan's existing five-year energy-saving plan while both parties collectively brainstormed potential project initiatives. An automated dryer controls project already developed by Logan allowed the TVA to demonstrate value by providing performance monitoring and verification services. After this, the TVA provided Logan with energy assessments that provided performance verification estimates on Logan's proposed projects as well as control strategies for variable-speed motor drives. When this project was installed, metered, and verified to meet the TVA estimated savings, Logan continued to see increased program value. Technical opportunities identified in TVA assessments as well as performance verification provided by TVA is used by the improvement team as trusted information for requesting capital dollars from the Logan management. This has allowed the Logan management team to more confidently support energy-themed capital spending proposals.

TVA and Logan Aluminum have enjoyed a relationship for mutual benefit. Logan gains access to energy efficiency resources, while TVA reduces stress on existing power generation, transmission, and supply capacity. Logan Aluminum's testimonial bodes well for the effectiveness of the TVA's industrial energy support:

Logan's participation in TVA's EnergyRight Solutions for Industry program has been a very good partnership. The program has provided assistance in evaluating project savings that reduce the risk associated with completing these projects. The dollar incentive associated with those projects favorably reduces SPB [standard payback], which makes the difference in whether or not several of the projects obtain funding. - Russ Hendrick, Logan Aluminum

TVA and Logan continue to work to align program and energy reduction activities with their fiscal year to manage the pipeline of projects to "get things done."



Russ Hendrick, senior engineer, has worked at the Logan facility since its opening in 1984. His experience with all business units across the site makes him a natural leader for energy management efforts. *Photo courtesy of Logan Aluminum.*

The TVA-Logan Project Portfolio


Logan’s energy consumption features natural gas-fired furnaces for melting, pre-heating, waste incineration, and other applications. The Logan facility also operates steam boilers for process fluid heating, air-drying and pre-heating, and space heat applications. Gas consumption peaks at about 560 thousand cubic feet per hour. The Logan facility’s electricity use features a variety of motor drives, contributing to a peak load of 90 thousand HP. Beginning in 2007 and through FY 2015, Logan Aluminum implemented energy reduction projects that reduced its energy intensity (Btu per pound) by 13.9%.

Gas and electric energy reduction opportunities have been identified by internal and external resources. Logan initiated an “Energy Reduction Task Force” which has undertaken several energy audits and studies since 2004. In 2007, The Logan facility participated in DOE’s *Save Energy Now* program (now Better Plants program) and it gained access to experts in air assessment and process heating assessments. These assessments identified additional opportunities that were added to its opportunities list which prioritizes opportunities according to the energy reduction potential and estimated resources required to implement them. A long-range, energy work plan is updated annually and it is included in Logan’s long-range, capital budgeting process. This budgeting process allows Logan to include annual energy reduction projects in its capital improvement process.

Several DOE assessments indicated that the largest savings were from natural gas saving projects from its furnaces, as a result, Logan started there. Twelve natural gas projects in total provided the majority of savings realized to date (12.4% of 13.9% total), which were undertaken independently of the TVA incentives. Major upgrades from recuperative to regenerative furnace technologies created a 25% reduction in these natural gas consumption processes. To go further, the remainder of the savings was achieved by 22 electric projects with many of these the result of the partnership between Logan and TVA (energy projects that were supported by TVA incentives are provided in Table D-1). All gas and electric improvements required approximately \$16 million in capital expenditure.

Table D-1. Electricity Projects Undertaken at Logan Aluminum with TVA Support

Project	Date installed	kWh/yr saving	TVA incentive	Annual cost savings @ \$0.07/kwh	Simple payback before Incentive (yrs)	Simple payback after incentive (yrs)	Non-energy benefit	Process impacts
Automated dryer controls – Compressor #1	Apr 2012	48,478	\$4,848	\$3,393	9.0	7.5	None	Heat based on moisture
Highbay and parking lot lighting	Aug 2012	107,740	\$10,774	\$7,542	3.2	1.8	None	Improved light levels
Variable frequency drives (VFD) applied to cast water system	Jun 2013	1,174,188	\$106,384	\$82,193	1.8	0.6	Pump life	Flow to demand
Retrofit plant lighting from T12 to T8 fluorescents	Apr 2013	344,797	\$32,481	\$24,136	3.1	1.7	None	Improved light levels
VFDs applied to fluid supply pumps	Apr 2014	534,581	\$53,458	\$37,421	2.1	0.7	Pump life	Flow to demand
Highbay lighting upgrade, J-M Bay, Est. in progress	Mar 2015	368,385	\$34,892	\$24,424	4.2	2.8	None	Improved light levels
HM FM Coolant filter pump VFD, Est. in progress	In progress	1,628,000	\$150,500	\$113,960	1.9	0.5	Pump life	Flow to demand
TOTALS:		4,206,169	\$393,337	\$293,069	2.3	1.0		



NOTE: Total capital cost for all electricity-saving projects: \$680,000
Source: TVA (2015)

Leveraging the TVA offerings, the electricity projects undertaken since 2012, have generated over 4.2 GWh in electricity savings and cost savings of almost \$300,000 per year. Incentives reached almost \$395,000 and they helped to reduce the average payback period across all projects from over two years to just one year. Upfront savings analyses help to fortify investment proposals for these improvements. Logan and the TVA have several energy efficiency opportunities in the pipeline, which are planned for implementation in 2015. These energy efficiency opportunities include upgrades to the remaining highbay light fixtures, plus a coolant pump upgrade that will provide an estimated 2.6 GWh \$160,000 of annual energy and cost savings. TVA anticipates providing a \$260,000 incentive for this project.

Several projects provided additional, non-energy benefits and process improvements. Pump system upgrades including through use of variable frequency drive (VFD) saved energy while also extending the pumps' economic lives. The upgrades for the natural gas furnace accelerated process times. The gains in output volume created value in addition to the energy savings.

Smart Manufacturing at Logan

The Logan facility had electric and gas process sub-metering technologies installed during its construction. While there is no "energy dashboard" per se, there are monitoring devices distributed throughout the Logan facility connected to energy-intensive production assets, such as melting furnaces. These monitoring devices provide consumption readings at regular time intervals and also record consumption for each product batch. A daily Btu per pound Energy Report trends and tracks variances from energy consumption norms, which in turn may indicate the need for adjustments to process operating parameters.

Project Decision-Making and Approval Process

Logan's capital investment decisions seek the biggest return on the dollar. EE projects compete accordingly with other priorities. Logan's energy champion, Russ Hendrick, advances energy-saving opportunities through the Logan facility's five-year capital planning process. This requires collaboration with the site's autonomous business units, each of which has its own capital planning agenda.



Appendix E. Acronyms

Btu - British Thermal Unit

C&I - commercial and industrial

CEI - Continuous Energy Improvement

EE – Energy efficiency

GWh – gigawatt hour

Husky - Husky Injection Molding Systems

IEE – Industrial Energy Efficiency

kWh – kilowatt hour

M&V- Measurement & Verification

NSG - North Shore Gas

O&M - operations and maintenance

PE - Process Efficiency

ROI – Return on investment

SEE Action - State and Local Energy Efficiency Action Network

SEM - strategic energy management

TVA - Tennessee Valley Authority

VFDs - variable frequency drives

This document was developed as a product of the State and Local Energy Efficiency Action Network (SEE Action), facilitated by the U.S. Department of Energy/U.S. Environmental Protection Agency. Content does not imply an endorsement by the individuals or organizations that are part of SEE Action working groups, or reflect the views, policies, or otherwise of the federal government.

