Energy Efficiency in Automotive and Steel Plants

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Synopsis

This paper reports results of energy efficiency projects at three major automotive companies and two large steel plants, including a statement of industrial needs in energy conservation.

Abstract

A large urban utility cooperated jointly with three major automotive companies and two steel plants to carry out industrial energy efficiency projects. This paper describes the context of collaboration, and reports the needs of large industrial concerns that make their energy efficiency projects different from projects in other sectors, and essential technical results.

1. Introduction

The Large Manufacturing Customer Pilot Program (LMCP), implemented in 1994, required the active and close cooperation of a large urban utility and its five largest industrial customers. Measurement of results of LMCP was the responsibility of an Evaluation Collaborative. The program was an intermediate step between traditional utility programs and the Special Manufacturing Contracts (SMC). The LMCP included unique features regarding the project types and program administration:

(1) Appropriate projects exceeded the operative corporate payback limits (hurdle rates). Projects that would not otherwise be implemented by the corporations on their own were "bought down" to the customer hurdle rate with utility DSM fund contributions. This basic design was successfully implemented. Also, flexibility was added to incorporate some long range studies with no immediate payback, so long as the overall set of projects for an industry was projected to be cost effective (project carries project within each industrial corporation).

(2) The program attempted to overcome the limitations of previous rebate programs. Previous programs were oriented toward simple equipment efficiency improvements. The new program was designed to provide flexibility to industry engineers to develop projects that made sense within an industrial perspective. Some of these projects were simple equipment change outs, but there were also some studies with no immediate payback aimed at developing knowledge regarding possible long-range strategic savings, and a number of projects that were much more complex than would have been possible under a simple rebate approach. The idea is that industrial customers will find larger potential savings through pursuing "best practices" in energy projects. The key is freedom to apply industry knowledge and an overall efficiency perspective (of which energy efficiency is one important aspect) in relation to industry needs and priorities. These savings developed and the value of the knowledge produced do, in fact, greatly exceed those found in programs oriented toward simple equipment efficiency improvements.

The LMCP Program had the following specific program requirements:

(1) Projects chosen for participation must involve hardware installation.
(2) The non-hardware portion of the project must be equal to or less than 10% of the project cost.
(3) Project applications, including calculation sheets, must be reviewed and signed off by DSM, Partnership energy engineer, account executive, and facility/plant engineer.
(4) The utility’s DSM fund shall not exceed $100.000 USD for a project.
(5) The DSM fund will be limited to facility locations in the utility's service areas.
(6) Project type can be lighting, air conditioning/chiller motors, pumps, or any approved hardware project.
(7) The ratio of electric energy savings to project savings will be greater than 50%.
(8) The ratio of DSM fund to project cost will be around 20%.
(10) No "free rider" projects will be funded.
(11) Committed funds for a project will be released after the following:
    (b) Project installation is completed, tested and evaluated. A certificate of completion is required.
    (b) Project goals are met and the reported savings can be substantiated.

1.1 Background

The program made an effort to understand and take advantage of the complex issues that arise when large manufacturing corporations undertake energy cost reduction projects. Past industrial DSM programs have, at times, been complicated by the differences in the way electric utilities and manufacturing corporations operate. Large manufacturing corporations are forced by competitive cost pressures to require energy projects to meet normal company hurdle rates for all projects. Energy projects must be weighed against projects that may increase production capabilities or influence product quality. These requirements mean company personnel charged with energy responsibility must find projects that appear very attractive against projects that impact production and quality. *However, the premise of the LMCP program was that such projects do exist.* Furthermore, when the economics are attractive for the company, large industrial customers do implement energy savings measures as a part of simply doing good business. Because of the large scale of their businesses, engineering staff and review processes are in place to carry out energy savings projects once they are identified. Consequently, outside groups less familiar with their operations may not be as effective as they might be in smaller companies. (Strategies implemented since the LMCP have found large benefits, however, when utility personnel who are very familiar with the operations can be dedicated on-site to work on energy projects).

While the program was developed and implemented collaboratively by the utility and its five largest customers, the evaluation was developed and implemented under a collaborative framework. The Evaluation Collaborative, established by order of the state utility regulatory commission, included in addition to the utility and industry engineers, state regulatory agencies, consumer representatives, conservation advocates, and other informed customer and government representatives.

1.2 Scope

This paper reports on what was learned regarding the needs of large industrial corporations in the energy efficiency project area, and on the technical results of the evaluation.

2. Methodology

One of the important differences between worldwide industrial corporations and other businesses is that the giant industrial corporations have their own energy departments. These departments operate ongoing worldwide energy efficiency programs within their corporations. Some are excellently organized with annual cycles of project proposal (worldwide) and selection by the central energy department. Within the corporations, energy efficiency is conceptualized within the framework of overall efficiency, including process efficiency. Given the economic value of efficiency to each corporation, it is not surprising that each has excellent staff capability to select, implement, and assess energy efficiency projects independently of utility or governmental DSM efforts. The three automotive companies, in particular, could easily match or out-match the best university or national laboratory staff for energy efficiency knowledge, which they combine with seasoned industry knowledge and experience.

Since the necessary procedures, knowledge, and skills were already available within the industries, the program relied on this knowledge for project development and evaluation. Plant managers and energy departments within each of the five industrial corporations developed the projects according to their own internal processes. Selection took place jointly between each corporation and the utility. At some of the corporations utility engineers also assisted in the project development. Industry energy departments, working jointly with the utility performed project evaluation, in the first instance. Evaluation used whatever methods were determined to be appropriate and applicable under the energy efficiency documentation procedures operative at each corporation. Because the utility DSM portion of total program funding (23%) was by order of the state utility regulatory commission, a separate and independent program evaluation was conducted under the auspices of the Evaluation Collaborative. This evaluation consisted of interviews with industry energy department managers who oversaw the projects and utility engineers. In addition, it included an independent review of proposals, engineering assumptions, and calculations, and documentation of results.

3. Results

The results of the study are of two kinds: (1) a confirmation of the industry technical perspective on energy efficiency and evaluation of energy efficiency projects, and (2) the technical results of the specific projects.

3.1 Industry Needs: Problems of Typical Utility Programs

Large corporations find typical utility programs both difficult and frustrating. In this section we report learning regarding both what not to do ("cookie cutter" programs) and what to do ("best practice" and flexible programs which allow freedom to industry engineers to best do their job). Utility programs in the US are perceived by energy and environment staffs of global industrial corporations to embody at least four major types of problems.

3.1.1 Failure to Respect the Decision Structure

First, for a worldwide corporation, the decision cycle for non-major projects from proposal to project start is about three years in length. Typically, utilities in whose service areas these companies have plants have launched rebate programs, often on a yearly cycle, with year to year changes in availability and specifications. Thus, large industries often cannot take advantage of what industry engineers refer to as "cookie cutter" utility programs. Utilities announce, open, and close programs before a corporation can acquire the appropriate levels of internal approval through normal procedures.

A second aspect of this problem, which will be familiar to anyone who has worked in a large-scale organization of any sort, concerns protocol. When an industry engineer takes the risk of engaging an industrial corporation's participation in a utility rebate program, it may require diverting funds from approved projects. Disruption of protocol, even though logical from the perspective of a particular department, is not functional within the operating pattern of an organization as a whole. A large organization must operate according to a higher logic in order to balance the diverse operating rationalities of its many departments.

3.1.2 Short-term Perspective

A second timing problem occurs when utilities implement programs that require installation of energy efficiency equipment with a one or two year timeframe. For the auto industry, for example, there are only two brief times during the year when lines are shut down. Then, however, any available engineering and technical staff is intensely busy. A multitude of projects, not only the energy efficiency projects that are the focus of the utility must be accomplished within these intensely busy windows of opportunity.

3.1.3 The "Hurdle Rate" Barrier

Within an industrial corporation, an energy efficiency project must compete against other possible use of corporate funds. Within an auto company, for example, the appropriate department periodically computes a corporate hurdle rate. This rate will be then be operative within the worldwide operation.

A US government lighting program did not meet corporate hurdle rate for one company, so it could not participate. The utility will have one hurdle rate, and the industrial corporation another. Programs have not typically been designed to mitigate the hurdle rate problem. Also, hurdle rates change due to the cyclical nature of business conditions. A stable, long-term utility-industrial partnership should be able to accommodate at the least the normal range of such changes.

3.1.4 The Technical Immaturity of Utility Programs

A fourth issue is the equipment replacement focus of utility rebate programs. Often, the utility approaches an industry with a specific list of equipment for which rebates will be available. While this approach may be suited to small, medium-sized, and even some large corporations (which do not have strong energy staff capability), they are a very bad fit for worldwide corporations with active energy departments. The projects which could save the most energy require more complex thinking, and are largely outside the knowledge of the typical "cookie cutter" utility program. For a worldwide corporation with an internal department of energy & environment, real savings come from multi-year projects which engage overall industrial efficiency. Utility efforts need to provide maximum design flexibility and funding to their energy departments with minimum external guidelines.

3.2 A Positive Approach: High Autonomy & Flexibility for Industry Engineers

The concept of "best practice" was a unique aspect of the program. Basically, the term meant conducting the program in such a way that the large manufacturing corporations could install the best overall projects as well as conform to the program requirements. Many felt the way business decisions are made in companies of this size can prevent the installation of the best type of projects when they are constrained by the requirements of typical DSM rebate programs.

3.2.1 Freedom to Develop 'Locally Appropriate' Solutions

Lighting programs often simply rebate a fixed monetary amount per piece for a particular lamp type. Participation in such programs has often been on a "first come, first served" basis. This approach prevents an industrial customer from considering beneficial process impacts or from looking at options that might be of greater benefit. In the LMCP, for example, one installation involved special dual-output level fixtures and occupancy sensors. In the large storage area where the project was installed, there are frequent occasions when activity is very limited. During these periods, the lighting level is reduced to low levels. When the occupancy sensors detect personnel present, higher light levels are restored. This type of installation results in much higher savings than would have occurred with a traditional installation of energy efficient lamps. In a typical rebate program, this solution would not have been permitted.

3.2.2 Freedom to Go For 'High Risk/High Reward' Projects

The LMCP also allowed customers to look at new technologies and new ways to carry out operations. Many industrial customers believe that large energy efficiency improvements (and large savings) are possible in the process areas. However, since changing any operational aspect could have impacts upon the profitability of production that far outweigh any savings in energy costs, industrials must consider such changes with great care. They can be a "high risk, high reward" opportunity. Customers could look at projects from a larger scale perspective, choosing the best opportunities for their business that would result in the highest overall energy savings.

3.2.3 Real Engineering Support

Automotive customers were particularly supportive of the SMC arrangement of having utility engineers on site. They felt it was extremely important that these people stay intimately familiar with the manufacturing operations and procedures for project installation. Most saw the LMCP as a "transitional" program. It was a major step forward from the traditional DSM rebate programs that set the stage for the much more flexible program in place today. Customers commented that even after studies had been completed in the past, it was sometimes difficult for energy projects to get funding priority. Programs such as the LMCP raise the level of visibility. Here again, the SMC process with on-site engineers increased the attention in this area.

3.2.4 Committed Funding

Another strength discussed was the targeted fixed amounts of funds available for each company. All commented that the time requirements for internal project approval had prevented their companies from participating in many past rebate programs. Internal project approval is a major consideration because in all projects, the majority of the project funding is from the industrial customer. For all of the LMCP projects the customer contribution averaged 77% of the project cost.

3.2.5 "Best Practice" Approach

Industrial customers said that few energy projects are "sold" within their companies on energy savings alone. The benefits to quality, environment, and labor issues are often more important than the energy savings. The "best practice" approach of the LMCP tended to heighten the awareness of these additional issues.

One company said the LMCP had led to a change in motor practice polices for the company. This change is still in effect even though the LMCP has ended and there is no DSM rebate program currently in place. Current corporate purchasing policy is to examine the cost effectiveness of energy efficient motors on every motor purchase. For most replacement and new motors in their operation, energy efficient motors are specified. The same company also said most of their manufacturing projects are multi
million dollar projects scheduled two to three years in advance. An example is a blast furnace project. They have a useful life of about ten years. Project design and scheduling begins two years before the end of furnace service life. When programs like the LMCP are available, the planning process can include energy efficient measures up front that may not have been otherwise considered. However, it is also true that the projects are too large for some of the changes to be solely influenced by DSM rebates. A several hundred horsepower variable speed drive may go in because of the reduced losses or improved control versus the old system. In this case, the DSM funding simply helps improve the economics (With these projects it is also difficult to prove or disprove the particular project as a free rider. Without the DSM contribution, these large drives often have paybacks longer than two to three years based on energy savings alone. Process control savings can improve the payback, but these savings are difficult to estimate until after the fact).

3.2.6 A Basis for Evolution

The greatest strength voiced by the automotive company participants was that LMCP was an evolutionary program. All felt that it was a good beginning. It facilitated an expanded outlook toward the way an electric supplier and large industrial customers do business. They all preferred the increased flexibility that their newer (10-year) Special Manufacturing Contracts (SMC) have, but felt the 1994 program was a step in that direction. They all have a strong drive to reduce operating expenses and energy costs are one of those expenses. Programs such as LMCP and SMC bring resources that do not exist without them. One customer commented that the level of direct attention for energy cost reduction was increasing in the corporation. The company raised the authority position for energy management issues in 1995. However, without the LMCP program it would have been difficult to get money approved for the type of projects that took place. Another customer said there was no question the projects completed with the program would not otherwise have been completed.

3.2.7 The Positive Role of Process Projects

Industrial energy projects involving the manufacturing process have often yielded the highest energy savings. They also always involve the highest risk. It is easier to install a lighting or motors project that uses a proven technology. Changes to the manufacturing process, however, can affect so many issues including the quality of the product, cost of labor, or the overall cost of manufacturing. Consequently, industrial energy managers have often been forced to avoid these areas. However, when energy saving process projects are implemented, they can result in very large savings. The driving issue can be convincing management that the reward of higher savings is worth the risk of affecting the manufacturing process. Eight of the LMCP projects involved process areas. The average Cost of Conserved Energy (CCE) for the eight projects based on total costs including administration was a very cost effective 3.28¢ per KWh. One of the major process projects has not proved practical to date. Another project was a study in a very large area of the company's manufacturing operations. It identified major savings opportunities in this area that the company is now pursuing. However, the LMCP data included no savings from either of these projects. The overall process project category was still very cost effective because the projects that worked tended to be very profitable. Such results support the "high risk, high reward" nature of process area projects. It also shows that process area projects are a very worthwhile area for energy savings. The specific process area projects in the LMCP program accounted for about 12% of the savings. However, the actual savings eventually realized from projects in this area will be much higher. Encouraging these kinds of installations is a significant feat in the industrial arena.

A single project whose results were among the highest savings realized (annual savings of over $220,000) and undoubtedly had the shortest final payback (3.4 months-total project payback) would not have occurred without the program, according to the customer. It was very difficult to estimate the savings prior to the project. As approved and based on estimated savings, the project would have a two-year payback. However, the industrial customer said they could not have convinced plant management to approve the project without the program because of the difficulty in estimating the end result savings.

3.3 Technical Results

This section begins with a numerical summary results, proceeds to a conceptual perspective on industrial evaluation, and then deals with the five technology areas involved in the program. The program’s 35 projects can be grouped into five categories: Compressed Air (five projects), HVAC (six projects), Lighting (10 projects), Motors (six projects), and Process (eight projects).

3.3.1 Numerical Summary

The program targets included 2,9 MW of demand reduction, 11.137 MWh of energy savings, and a budget goal of $1.425.000 in 1994. The actual demand reduction of 5,1 MW exceeded the target by 76%. The actual energy reduction was 37.000 MWh and the total (utility) DSM project contribution was $1.226.000 or 23% of total project cost. The average industrial customer cost contribution for the installed projects was 77% of the total project cost. The DSM costs were allocated by a method that assigned half of the DSM contribution to demand and half to energy. Using that method, the maximum project targets were $214 USD per KW and $0,0557 USD per KWh. The actual costs based on implementations averaged $121 USD per KW and $0,017 USD per KWh.

These results include two of the process projects that have no savings yet included in the program. Both involve areas that account for major manufacturing costs to the customers involved. One will require further equipment changes to be practical. The other demonstrated the potential for very large savings in the process examined. The customer has subsequently initiated a large savings project to take advantage of the identified potential.

3.3.2 Realities of Industrial Evaluation

Savings estimates in the industrial sector are always challenging for energy engineers. The industrial environment is a very dynamic one and the total cost of energy as a percentage of manufacturing cost is usually small -- less than 10%, often less than 5%. This means monitoring energy use for individual processes is often not cost effective. This situation is in contrast to energy issues in the residential and commercial sectors. In those sectors, direct monitoring costs can be defrayed using the logic of sample studies of statistical aggregates. In addition, determining the energy use of the equipment involved is more straightforward. Project energy savings in the industrial area are *always* estimates, even when the determination occurs after the projects have been in operation. This is because assumptions are always required to determine savings.

An energy efficient chiller installation is a good example. Energy efficient chillers are available with a Coefficient of Performance (COP) in the area of 6,4 versus new standard chillers a COP of about 5,0. However, the COP is accurate only at full load and only for specified inlet and exit conditions. The actual use for an energy efficient chiller can have a COP as low as 3,5 at low load. The performance of the cooling tower varies significantly with changing outdoor temperature, and this can have substantial impacts on chiller efficiency. Another major factor in estimating annual energy costs is the time the chiller is operated. Consequently when an engineer calculates the savings for installing an energy efficient chiller, one is confronted with many assumptions. This is the case even if the exact cost of operating the old unit in the prior year is known. The engineer builds a case for the new chiller by estimating the varying load on the unit across the year and estimating the efficiency impact on the two units at varying loads. Corrections must also be made for the cooling tower effects as outdoor temperature changes. Since manufacturing schedules tend to change year to year, there are also changes in building internal load to be accounted for, as well as operating hours.

The major point here is that even if one knows the exact original operating cost the savings for a new unit is always an estimate. Most methods call for establishing a baseline to estimate savings with assumed load variations, outdoor temperatures, and operating hours. Hence the comparison is always hypothetical. Measuring the improvements with metering equipment in industrial situations is normally useless because of these issues.

Industrial lighting is one of the simplest areas for estimating savings. Even here, operating schedules change and the lighting impacts on the cooling load are subject to the issues discussed in the chiller case.

The purpose of the prior discussion is to give some insight into the task of estimating savings in the industrial sector. Savings calculations always involve judgment. Different assumptions can lead to very different calculations, and both can be correct. The challenge of this technical evaluation is to compare the assumptions and calculations on the projects installed under the LMCP with methods that one normally encounters in industrial energy projects. Another challenge in industrial work is that many of the results are proprietary and confidential. One of the requirements for the project was that the exact projects and results from one customer could not be shared with other customers. A challenge is presenting enough information to assure readers of the depth of the analysis without making proprietary project information available to competing companies.

3.3.3 Compressed Air

Compressed air is a very expensive utility in the industrial plant. Most of the customers involved in the LMCP use very large amounts of compressed air. Centrifugal compressors, the most common type in the large size range encountered here, consume about 37 KW per 100 standard L/s of compressed air at 689 kPa. Because of the large quantities of air used in these industrial plants (automotive plants may have compressed air requirements of 14.000 L/s), it is not surprising that compressed air accounted for the largest area of savings in the program. Centrifugal compressors have historically been prime areas for savings because, while they are cost effective when operated at high loads, efficiency drops off rapidly at load levels below 70%. As individual unit demand drops below 50%, these units must discharge air to the atmosphere in order to prevent damage to the machine.

Consequently, systems and procedures to maintain centrifugal units as fully loaded as possible are usually cost effective. Several projects under the LMCP were of this type.

The estimates for air loss reductions and pressure reductions were generally typical of those in industries with large compressed air systems. One of the project types used a system to effectively reduce plant air pressure. The savings estimates for the project were about 5% to 6% of the compressed air electrical demand. Given that a pressure reduction of 14 kPa on a centrifugal air compressor results in a savings of about 1% in electrical demand, this would correspond to an effective reduction of 70 to 84 kPa, since a typical pressure for an industrial plant system is 689 kPa. Such reductions seem reasonable; knowing a large portion of the actual savings came from scheduling the centrifugal units to prevent blowoff.

Leak reduction was another important compressed air implementation area. With so much compressed air in use, it is not unusual for leak reduction programs to save substantial amounts. At 620 kPa, a leak through a 6,4 mm orifice costs about $6.400 USD per year. One must accept the reports concerning the magnitude of the leaks identified. Not surprisingly, this was an area where the savings actually identified after the fact exceeded the original estimates when the LMCP contribution was made. Even so, the results were similar to those found in other industries operating large compressed air systems.

3.3.4 HVAC

The six HVAC projects in the program generally involved either energy efficient chillers or variable speed drives. Variable speed drive projects often concern fans. They take advantage of the fact that a 15% reduction in fan speed (as an example) can reduce the energy to drive the fan by 39%. Savings calculations based on these systems appeared reasonable. The other area in HVAC projects involved installing energy efficient chillers to replace standard machines. Taking into account the issues described for estimating chiller savings in the previous discussion, the approach was to compare the efficiency improvements for the project machines with standards generally accepted in the industry.

Energy efficient chillers use larger heat exchange areas and more efficient compressors to achieve more efficient overall operation. Actual rated efficiency is very machine specific. However, in the range of machines involved here, generally 500 to 1.000 tons, energy efficient chillers manufactured today can achieve COP's of 6,4. Standard machines, particularly those installed more than 10 years ago, can operate at a COP of 4,1 or lower.

The projects frequently used the "Equivalent Full Load Operating Hours" method for calculating savings. This is a widely used method where the actual hours at varying load levels are converted to a reduced number of hours at full load operation in order to compare scenarios with different equipment.

3.3.5 Lighting

Ten of the 35 projects were lighting projects. The projects tended to involve new fixtures that were either high-pressure sodium types or T-8 fluorescent lamps and electronic ballasts. Both of these technologies are widely documented and such replacements are common in the industrial arena. This type of savings is among the easiest to estimate. All projects appeared reasonable given the type and number of fixtures. Several lighting projects involved distributors with well-established programs for calculating savings for lighting retrofits.

3.3.6 Motors

There were six projects in the group that involved motor change outs. Some of them combined the use of energy efficient motors with variable speed drives. Savings calculations for variable speed drives tend to be site specific. The common use of energy efficient motors in industry involves replacing standard efficiency motors with those of energy efficient design. Energy efficient motors achieve higher efficiency through improved design, better materials, and tighter tolerances. Improvements vary with motor size, but for motors less than 75 KW improvements average about four percentage points for energy efficient motors. The savings is not generally high enough to change out working motors. However, for new motor purchases, the additional cost for an energy efficient motor can be a worthwhile investment. The energy efficient motor projects in the LMCP were generally this type of incremental purchase consideration.

3.4 Organizational Considerations & Project Approvals

Overall results may mean it is easier for industrial energy managers to gain approval for higher amounts of company resources in lighting projects because of their lower risk nature. After lighting projects, process projects accounted for the next highest amount of total energy project expenditures. Process project expenditures were about 21% of the total. Considering the higher risk in process projects, the LMCP program showed real progress for customer energy managers and utility personnel convincing customer company management of the potential in these areas. It is interesting that the customer contribution portion was also relatively high in this category as well. The fact that the customer contribution for the compressed air was the lowest percentage, about 55%, shows the challenges industrial energy managers face in this area. The compressed air projects accounted for more savings than any other area. Yet, the industrial participant in the compressed air project that yielded much higher than predicted savings said management would not have given approval to proceed with the project in the absence of the LMCP funding. Compressed air continues to be a very expensive commodity whose savings potential is often not fully realized. The CCE was lowest for the compressed air projects. These projects generally resulted in large KWh savings and one large project yielded much higher savings than anticipated. The large number of low cost KWh had a substantial impact on lowering the overall average CCE. The HVAC cost of conserved energy was the highest at $0,0432 USD per KWh. The CCE is based on KWh saved (without regard to demand or $ savings) and the HVAC projects often operated at lower annual load factors than the others. This had the effect of increasing the CCE when compared to the other projects. However, when total electricity cost savings were considered, as is the case when calculating internal rates of return, customers found the projects met their hurdle rate requirements. Additionally, the HVAC projects tended to have substantial benefits other than energy savings, such as reduced maintenance.

3.5 Emissions Impacts

The projects selected for implementation and the measures installed in the program were essentially all baseload projects and measures. As such, they effect reductions in emissions during all hours of operation. Using average yearly emission factors based on the steam output of a typical, large pulverized coal plant in the US, and a steam conversion efficiency of 85% to convert the steam delivered to equivalent raw fuel supplied, and assuming a heat rate of 10.530 kJ/KWh, plus a 5% transmission loss, the yearly reductions due to the program are as follows: CO_2 (32.547.000 kg); CO (7.940 kg); SOX (180.000 kg); NOX (90.000 kg); VOC (600 kg); Particulate matter (15.000 kg).

4. Conclusions

The program was successful in meeting the real needs and constraints of the worldwide corporate industrial sector and, as such, the program can be viewed as a transition to better program designs. However, it takes an unusual and long-term commitment on the part of a utility to dedicate certain expert engineering staff to support large industrial customers. The type of service required is nothing like that offered in a traditional utility model. In the next step, SMC, the utility dedicated some of its best engineers to a 10-year on-site assignment to the customer corporations. In addition, in the next step the independent external collaborative evaluation will be foregone, as each company selects, implements, and evaluates projects according to internal policy, with the assistance of the utility engineers.

The value of the Evaluation Collaborative, composed (in addition to the utility and five largest customers) of representatives of the state regulatory authority, consumer advocates, conservation advocates, and various other parties enabled learning by other sectors and an external independent test of the industrial perspective. The Evaluation Collaborative, created by order of the state regulatory authority, accepted the results of the independent evaluation. The industrial parties proved their point: large, worldwide, industrial corporations are different -- they have the full capability and incentive to implement ongoing energy efficiency without ‘cookie cutter’ utility programs and without programmatic state regulatory intervention. At the same time, the project showed the advantage to the corporations of some collaboration with utilities. Such collaboration enables good projects, which would not otherwise be approved internally, brings additional (and dedicated) funding, and provides (dedicated) engineering support for the corporate energy departments.

The achieved cost of conserved energy also demonstrates the environmental and social value of these industrial programs.

References

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