Get 'er Done! How to Implement Energy Efficiency Projects by Understanding Organizational Behavior and Decision Making

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ABSTRACT

Most energy efficiency programs are based on the assumption that inadequate technical information and poor financial returns are the primary barriers to implementing energy efficiency projects. If this is true, then why are so many energy audits sitting on shelves gathering dust? Why are utilities so challenged to meet their energy savings goals and often unable to give away all of their available incentive money? Why is it so hard to implement even no- or low-cost energy reduction opportunities in operational and behavioral changes? It appears that while technical assessments and capital incentives are important components of many energy programs, in their typical form these offerings are often not sufficient motivation for customers to implement many energy reduction projects.

This paper will review these questions and propose an answer: programs are ineffective when they fail to address clients' organizational and behavioral barriers to implementing change. These barriers exist even when the change will save money or increase quality. This paper will discuss successes Ecos has achieved in working with utilities to help businesses save energy. Our programs have worked in a variety of industries, both on behalf of utilities and directly to businesses, and we have had the opportunity to review many energy efficiency audits—some excellent and some poor. Ecos is able to address client decision making or information communication issues that slow or prevent implementation of energy projects. Our presentation will discuss this concept, provide examples of real world projects and provide the audience with useful tools to increase the effectiveness in selling energy savings within an organization.

Introduction

Scope of Paper

Utility energy efficiency programs are currently being challenged from a number of different directions. Utility program savings targets are continuing to increase, and new states are enacting efficiency and renewable requirements; however, experienced program implementation talent is limited. As updated building codes incorporate more technologies utilities currently incent (such as CFLs), these measures risk being excluded from contributing to utility savings goals. Last year's rapid and large increase in energy costs created market interest for energy efficiency among businesses and homeowners, but now those prices have fallen again—a repeat of the 1980s' efficiency boom and bust? During the last 15 to 20 years most business have viewed facility maintenance and engineering staff as a "cost center" to be minimized, resulting in today's minimum staffing levels and limited internal technical resources and talent. The general public belief that climate change is real and is being caused by human activity has greatly increased from just five years ago (five years ago few would have expected the United States President to propose a Carbon Cap and Trade system). Energy efficiency is the most cost effective approach to reduce carbon emissions (Enkvist, Naucler & Rosander, 2007). The current financial crisis has limited the availability of capital funding for renewable and efficient equipment upgrades while also increasing the business need for operating cost reductions. The massive Federal stimulus spending programs focusing on "green" job creation have everyone scrambling to understand what this means and how to get some of the stimulus money.

In this uncertain time, what changes need to be made for energy efficiency programs to adapt? How do we adjust our approaches to overcome all of these challenges when our resources are limited but the stakes are so high? This paper will attempt to answer these questions for one key aspect of efficiency programs: the industrial energy efficiency, or technical, audit.

Industrial energy efficiency audit: The audit is the stage of every energy efficiency program where the problems (opportunities) and solutions are identified. The purpose of a technical audit is to identify Energy Efficiency Measures (EEMs) that will result in cost effective energy savings if the recommendations are implemented. While technical audits are a key element of residential and commercial programs, this paper focuses on industrial audits. Industrial facilities are complex systems that are large consumers of energy. Typical sites include a mix of process equipment (industry-specific machines directly involved in product manufacturing or processing) and facility sub-systems (such as steam, hot water, chilled water, compressed air and hydraulic systems). In addition to this mix of equipment and interconnected physical systems, there are also complex human systems in terms of the organizational culture, relationships and decision making processes at a facility. An effective audit considers both physical equipment and organizational systems.

Ecos is an energy consulting company that manages programs on behalf of electric utilities and offers consulting services directly to businesses. In this capacity Ecos has had the opportunity to internally produce energy efficiency audit reports and to review nearly a hundred audit reports produced by others. Ecos often works with key client facility personnel to evaluate these reports to prioritize projects and eliminate recommendations that are incomplete or not applicable.

This paper will use specific examples from multiple facilities in different industries and locations to discuss effective and ineffective technical audit reports. In this context, "effectiveness" refers to the audit report's ability to result in persistent energy savings for the business. The goal is to examine current practices to improve future reports and to increase their effectiveness. Some identifying details may have been changed or omitted to make the examples anonymous. While some may disagree with specific observations on problem statements or recommendations, the overall objective is to aid the discussion on how the energy efficiency industry can improve going forward. If we fail in a project then we must "fail forward fast" (attributed to both Tom Peters and Cam Cameron) to allow us to learn fast enough to meet the tremendous challenges our planet faces.

The specific opportunities to improve the effectiveness of technical audits include:

- Improve the technical quality of the audit report recommendations.
- Improve the management recommendations in audits by including clear business proposals that can be understood by non-technical managers (financial decision makers—CFO's, CEO's, Plant Managers, etc.).
- Improve audit recommendations by including operations and maintenance recommendations in addition to the typical capital equipment measures to identify energy savings from no-cost/low-cost procedural or behavior changes.

- Improve the auditor's understanding of client organization and behavior to increase the quantity of recommended measures that are actually implemented by the client.

Background of Industrial Energy Efficiency Audits

Utility energy efficiency programs have long recognized that industrial customers present unique opportunities and challenges, resulting from the large quantities of energy used by industrial facilities. Often a single EEM at an industrial facility can save the same amount of energy as the combined impact of multiple measures installed in hundreds or even thousands of homes. Unfortunately, while the potential savings are large, the equipment that uses this energy is often deeply embedded into complex physical and organizational systems. The goal of industrial energy audits is to understand those complex systems to identify savings opportunities that are economically compelling enough to be implemented. Identified EEM opportunities that cannot or are not implemented are of no value to the utility or their business customer.

Industrial energy efficiency programs often identify two key barriers to the successful installation of EEMs: (1) lack of knowledge of savings opportunities and (2) high first cost of implementing EEMs. These barriers and typical solutions are outlined in Table 1 below. The technical audit reports are a common strategy intended to address the lack of knowledge of savings opportunities. Other barriers and strategies indicated in the table are included in this paper only as they affect the content of the audit reports.

Table 1: Traditional Barriers & Strategies for Industrial Efficiency Measures

Barrier	Strategy to overcome Barrier
Lack of Awareness & Knowledge	Program marketing, advertising Pay for engineering audits to generate reports of recommendations
High First Cost	Utility Incentives Tax Credits Measure pay-back calculations

Audits traditionally focus on equipment hardware replacements or upgrades. These recommendations are favored because they can be easily observed and documented:

- Does a pump or fan have a variable frequency drive (VFD) installed or not?
- Does a boiler have a stack/feed-water economizer installed or not?
- Are the facility lights the most efficient available?

These physical measures have the added appeal that estimates can be developed for the quantity of energy savings and for the expected life of the equipment. With this information, a savings "lifetime" benefit analysis can be made for both the business and the utility. For an initial first cost of **X**, the EEM will result in **Y** annual savings, which are typically used to estimate the time required for an EEM investment to be paid back—or net zero cost (see Figure 1). This approach tends to avoid "soft" opportunities for energy savings found in equipment operations and maintenance practices since these are much harder to observe, quantify and have indefinite persistence.

Figure 1: Financial Payback Calculation

$$Project\ Payback\ (years) = \frac{First\ Cost\ (X) - Incentive}{Annual\ Savings\ (Y)}$$

The traditional model for performing energy audits often relies on a very experienced senior engineer(s) to perform a detailed collection of data, perform the analysis and develop the resulting report. There is a limited supply of this type of experienced industrial energy auditor. The historical boom-bust cycle of many utility energy efficiency programs has deterred new engineers from choosing a career in energy efficiency (some regions of the country, such as California, have been more consistent long-term promoters of efficiency). A recent survey by the Association of Energy Engineers found that 72 percent of respondents indicated that there will be a shortage of energy professionals in the next five years, while 41 percent of those responders planned to retire in the next ten years (AEE survey at: http://www.energyvortex.com/pages/headlinedetails.cfm?id=4010). At the same time, utilities and businesses continue to be under cost pressure. This can result in many creative ways to deliver energy audits using less expensive and more available resources. The risk is that the quality and effectiveness of the resulting reports often suffers. If the audit reports become less effective or the estimated savings are not accurate, the perceived value of the report declines and the willingness for utilities and business to pay is reduced. This creates a vicious cycle where more and more reports are generated for lower and lower cost—each providing less value.

To meet these challenges and the growing demand for industrial energy savings, the energy efficiency industry needs to reexamine our current practices. We need to be open and honest about failures, learn from them, and improve so that our next work product is better than the last. We will all suffer if poor service delivery results in reduced expectations by our utility and business customers. This is all occurring at a time when the consequences for failure are bigger than ever. If you believe in global climate change, peak oil, the national security risk of dependence on foreign oil, declining US manufacturing competitiveness, or all of the above—they all have increased energy efficiency and productivity as a critical component of any solution. We live in an opportunity-rich environment.

Audit Reports: Examples of Four Problems that Represent Opportunities for Improvement

In geographic regions with a history of industrial energy efficiency programs, such as the West Coast, it is common to visit industrial facilities and discover existing energy audit reports. Often these reports can be found on a shelf in the office of the facility engineer or maintenance manger. In some cases, a few of the recommendations in the report have been implemented. Perhaps a few other recommendations are on a budget "wish list" waiting for funding approval. However, most recommended efficiency measures never make it beyond the audit report. Awareness of this situation is growing among utilities and businesses. In the Pacific Northwest, utilities are reluctant to pay for the cost of audits, instead they will agree to include the audit cost into the cost basis of any capital projects that are actually implemented—a skeptical "we'll believe it when we see it" approach. Following are four reasons why many audit reports end up collecting dust on the shelf.

Problem 1: Poor Technical Quality

Savvy business and utility clients are becoming aware of the wide variety of technical audit quality being produced. This has resulted in some clients desiring to obtain multiple audits from different sources. The lack of faith in the product quality and the perceived need to obtain multiple audits may result in a reduced willingness to pay for any particular audit. We need to be honest that some of the poor quality of audits is due to poor technical analysis of energy efficiency measures. This may be due to inexperienced field auditors, changes made during copywriting or editing by nontechnical support staff, limited understanding of complicated processes, or simply sloppy work. Regardless of the cause, the reputation of the entire industry suffers each time a technically invalid report is generated.

Example: wine barrel wash heat recovery. A relevant example is a technical audit performed at a large winery. The winery uses hot water to manually wash out all wine barrels twice per year—once immediately prior to filling and a second time after the barrel is emptied when the wine is bottled. Hot water is produced by a central propane water heater and supplied to manual hoses and spray wands at the barrel cleaning area. Supply water at 120-130°F is sprayed in the barrels, runs over a concrete floor into drain channels and then into a collection basin. A submerged pump then transfers the water and suspended debris to the facility waste water treatment basin. The energy audit recommended that the facility spend almost $300,000 to install a heat recovery system to capture residual heat from this waste water and use it to pre-heat the boilers. The report stated that 70ºF delta T would be available from the waste water (perhaps assuming a water supply temperature of 40-50ºF and that almost all thermal energy from the waste water could be recovered). The report suggested this measure would have a simple payback of 3.5 years based on reduced fuel consumption.

This recommendation did not take into account the heat losses from the wash water to the ambient air or to the concrete floor. It also ignores the operational challenges of using wash water with suspended particles in a heat exchanger. This one recommendation was so obviously unsound that the owner refused to follow any of the advice in the report—even when some other measures were technically valid. A better recommendation would have been to install reduced flow brushes at the end of the cleaning wands. For an initial investment of a few thousand dollars, this would greatly reduce both water and propane consumption.

While creative adaptations of the laws of physics do occur, it is much more common to see audit reports that incorrectly apply generic rules of thumb or in some cases appear to use cut and paste recommendations from other reports, as may be the case in the example below.

Example: demand response audit of medical device manufacturer. In this audit the system overview section indicated that the facility had two air compressors: a 60 hp primary unit with a VFD and a 75 hp non-VFD back-up unit. During the site walk, demand for compressed air was observed to be low, with the 60 hp machine cycling completely off for extended periods of time. The report calculations, however, identified peak demand reduction opportunity based on a 175 hp compressor that operated 8,400 hours per year—enough to forecast it would operate during peak demand hours. The report estimated a system leak rate of 30 to 40 percent and used the 175 hp and 8,400 annual operating hours to estimate an annual energy cost of compressed air leaks (despite the observations from the site visit that the compressor was often off completely—indicating low leak rates). Finally the report recommended installing a heat recovery system for the air compressors. The report included calculations of the potential thermal energy that would be recovered (again using 175 hp compressor operating almost constantly) but did not indicate how this heat could be used by the facility (the report did not indicate if the existing compressor was cooled by air or water). This report was of poor quality due to the conflicting facts and assumptions that reflected, at a minimum, poor editing and potentially a failure of the auditor to understand the system that was being reviewed.

Recommendation: audit industry needs to improve technical quality. The entire energy efficiency industry needs to make a concerted effort to ensure the quality of the technical reports we produce. This needs to be done in a professional manner. This is a challenge in the competitive environment in which we all operate. It is never pleasant to give or receive negative feedback—particularly from a client, but we must be open to receive it. We should be grateful to the customer who expresses doubt or raises questions, and is willing to work with us, instead of simply ignoring our report and leaving with a negative impression of our firm. As professionals, energy efficiency auditors need to learn from our mistakes, challenge each other, and establish rigorous internal process reviews to increase the quality of the product we deliver to our customers. If we are unable to police ourselves, we should be prepared for someone else to eventually step in to police our work.

The EPA's Energy Star program has addressed this concern by requiring all requests for official facility Energy Star certification to be stamped by a licensed Professional Engineer (P.E.). Anyone can use the Energy Star evaluation tools to perform a self-audit, but only those completed by a Professional Engineer will be recognized by the EPA. In most states, a P.E. license is required by any company or individual offering engineering services to the public. This requirement is often avoided by providing "technical" services rather than using the term "engineering." A potential solution for increasing the technical quality of energy audit reports is to require that a P.E. sign each report to certify the quality of the report's analysis and recommendations.

Problem 2: Lengthy Engineering Reports with Little Value to Senior Business Managers

Many technical audits appear to be written by engineers to be read by other engineers. Sometimes the recipient engineer is a facility engineer at the client. Other times the target audience is a quality control engineer or funding agent at the sponsoring utility. Rarely are energy audit reports written with the nontechnical business manager in mind. This is unfortunate since it is often a nontechnical senior manager or budget owner who must approve the funding for the recommended EEMs. With this audience in mind, technical audits should include a section that provides the "business case" for why an EEM deserves investment. Following is an example of where an audit fell short, and how the process could be improved.

Example: compressed air audit. A food processor facility received a compressed air system report. The report was 70 pages in length, the first 54 pages of which constituted a generic overview of compressed air systems and their components—interesting information, but it provided no indication of the equipment or system configuration at the audited facility. Finally, near the end of the report, some facility-specific observations and recommendations were offered. The project summary table found on page 61 of the report is reproduced in Table 2.

Table 2: Project Recommendations from EXAMPLE Compressed Air Audit

Project	Payback
Identify and fix all leaks.	As was indicated in our presentation, if your leak load is 20% of your total flow, which is the industry norm, you should be able to find and repair a minimum of 50% of those leaks. This equates to a minimum $12,710.49 savings annually.
Repair or replace all broken regulators, gauges and lubricators and start a program of regular lubricator servicing.	Properly lubricated components last longer and take less energy to operate.
Lower mainline system pressure and compressor room pressure.	The reduction of even 15 PSI is excessive pressure can have a significant payback. Minimum energy dollars save $7,827.00
Remote Monitoring Upgrade	Remote monitoring is a low cost high value product that can illuminate deficiencies in your compressed air system. This will allow you to truly manage the utility of compressed air.
Install pressure regulators in back-flush lines to use only the amount of air needed for the job.	The same as patching a large leak.

Anonymous Compressed Air Audit report, September 2005

While many of the recommendations mentioned in Table 2 are sound advice, how is a business manager to evaluate their cost effectiveness? This is an extreme example, but many audit reports make it very difficult for a business manger to understand the value proposition of proposed projects. Financial managers are not typically familiar with energy terms such as therms and kWh. Some technical audits can have 15 to 20 (or more) individual EEM recommendations with a range of financial returns. Project returns are often expressed in years to "pay back" the cost of investment, but could also be stated as expected annual return on investment (ROI) or Net Present Value (NPV). Audit reports often include anticipated utility incentives (particularly if the utility is paying for the report), but rarely are potential federal and state incentives and tax credits included in the analysis. At best, these items are mentioned in a footnote with the details left to the client to investigate further. If our goal is to achieve savings by actually implementing measures, why do we make it so hard for our clients to turn recommendations into projects?

Recommendation: create audits with clear business proposals. As engineers, we need to seek out and understand the business needs and perspectives of our clients. Our energy efficiency recommendations should be presented as a prioritized business proposal with all cost and benefits identified along with potential business risks and strategic value. Audit reports will still need to include valid engineering data and analysis for the facility or utility engineer, but a key target audience of the report should be the financial decision maker who has authority to approve funding for the proposed projects. This seems to be common sense, but it rarely happens. Most technical audit teams spend little time to understand their customer's business issues or identify key decision makers.

A good audit contains a concise executive summary with a table of financial analysis supporting one to three high-impact measures. The audit should identify only the high-priority measures in the summary to avoid the loss of focus created by a long list; the full list of evaluated measures should be included in the body of the report. Recommendations should be prioritized based on best return on investment, lowest up-front investment (after incentives) and biggest cost reduction impact. The body of the report should be limited to 10-15 pages, including graphs, tables and diagrams. The detailed engineering calculations required to justify the utility incentives and other supporting material should be included in appendices. The goal is to make the report action-focused and effective—resulting in the actual implementation of recommended measures. The auditor should not try to impress the client with a large number of pages of standard material. Clear, concise reports should replace the long, rambling and jargon-filled audits that lack the necessary information for business evaluation of the costs and benefits of the recommendations.

Problem 3: Energy Audits Often Ignore Equipment Operations & Maintenance

Typical utility programs are only able to offer incentives for equipment or hardware upgrades or replacements. Operations and Maintenance (O&M) "low-cost/no-cost" behavior or procedure changes are rarely eligible for incentive payment because verifying savings can be a difficult task. For this reason, most technical energy audits focus on equipment projects and largely ignore O&M opportunities. It is often the sponsoring utility that drives this—since it is paying for the audit, the utility wants the auditor to spend time only on measures the utility can claim towards its conservation goals. Unfortunately, this results in overlooking many cost-effective (sometimes free!) energy savings opportunities or productivity improvements. In some cases, fewer equipment projects result due to poor understanding of equipment operation. This problem is sometimes made worse when the system expert or energy auditor is also the new equipment vendor.

Example: recommending additional efficient compressed air capacity without evaluating system demand requirements. We have encountered a number of examples of this occurring in compressed air systems. In one case, at a high-technology facility, an audit recommended replacing an aging desiccant dryer with a new model but ruled out using a refrigerant dryer due to the low air dew point requirements (very low moisture content in the supplied air). On further investigation, it was discovered that the existing compressed air system had been inherited from the previous building tenant, and the current compressed air dew point setting was much lower than what was required by the present occupant's air-using equipment. Changing the system dew point set point allowed the use of a smaller and more efficient dryer, and greatly increased the energy savings potential of the project.

In another example, at a food processing facility with compressed air pressure and capacity problems, an auditor recommended a larger receiver tank and a new VFD compressor to meet the facility's demand peaks. On further investigation of the demand side, a number of "open blowing" situations were found where air was being used constantly (even when the line was down). Eliminating the open blowing resulted in lower compressed air capacity demand. The reduced demand resulted in lower air flow rate and velocity through the piping distribution system—thus reducing pressure drop, and allowing a reduction in the compressor discharge pressure. It was also found that the existing dryer was a non-heated regenerative model that had a constant blow down of 14 percent of its rated capacity (regardless of what the actual system demand required). The resulting project installed a new air receiver and dryer but was able to avoid purchasing any new compressor capacity because the existing system could now keep up with the process demand. In this case, a solid audit was able to solve the client's operational issues (pressure and capacity problems), avoid a costly new compressor, and save energy by reducing waste from open blowing and excessive dryer blow down.

Example: refrigeration at a food processor. A common operational issue occurs when one part of a system is optimized but the overall system performance actually declines. This often occurs in systems with inadequate instrumentation or controls. People tend to monitor and change the equipment they can influence. An example of this was identified during a holistic refrigeration system audit that looked at both equipment and how that equipment was operated. The plant's condensing tower circulation pumps and fans were being controlled off the compressor discharge head pressure. The compressors each had independent PLC load control, which continued to increase discharge head pressure as the system demand increased. On the condensing tower, the fans and pumps were staged on as the compressor discharge pressure increased. At some stages, towers would run with just fans and no circulation water—greatly reducing the effectiveness and capacity of the tower. All condensing fans and pumps were not activated until the compressor discharge pressure exceeded 150psi; a good ammonia system should be able to operate at 90psi or less. The total horsepower of the condensing tower fans and pumps was 200 hp. The total compressor capacity of the system was almost 3,000 hp. By not operating all of the cooling tower fans and pumps, the cooling tower was less effective at rejecting heat from the ammonia fluid. This resulted in shifting work to the compressors, which had to work harder to produce higher ammonia discharge pressures and temperatures, which used more electricity. So the plant's attempt to save some power in the condensing tower—with 200 installed horsepower—resulted in increased energy use by the system compressors with 3,000 of installed horsepower! The net effect was an increase of electricity use. A better approach would have been to operate the condensing tower at full capacity (all pumps and fans operating) in order to keep the discharge pressure as low as possible—reducing the load on the compressors. This opportunity was identified because the audit looked at system operations rather than just the physical configuration of the equipment.

Recommendation: provide incentives based on measured results. Both of these projects benefited from being part of a performance based program (i.e., a program that provides incentives based on measured and verified savings on the system rather than engineering estimates). In the first example, this allowed the auditor to look at the entire system and make the operational changes (eliminate open blowing) that allowed the customer to avoid the cost of the new compressor. The client received an incentive payment based on the measured energy reduction between his baseline (prior) and post-measure installation condition (under the same general production and operating conditions).

In the compressed air example, the utility also avoided the added electrical load that would have resulted if the new efficient VFD compressor had been installed. Ironically, a typical deemed savings program would have only provided an incentive if the VFD compressor had been installed—effectively providing an incentive for *increased* electrical use. While the O&M changes to reduce total compressed air demand and lower pressure would have received no incentives. This is because typical efficiency programs are equipment-focused and are often not able to reward procedural changes since they are seen as less persistent than new hardware.

Recommendation: pay attention to facility operation. As professionals, we owe it to our clients to perform due diligence and understand how equipment works in the context of the entire process. If we notice operations and/or maintenance opportunities for "low-cost"/"no-cost" savings, we should include them in our audit reports—even if they are not eligible for incentives. These are the best way to quickly achieve savings that will reduce the client's cost and have the best return. This practice establishes trust and makes the client more willing to invest the capital needed to implement the equipment based EEMs—the ones the utility can take credit for. Professionals performing technical audits should work hard to provide the best solution for the end customer, not just the best solution for the utility. This will build plant trust in the utility program and, in the long run, result in greater energy savings and an improved relationship between the utility and their customer.

Problem 4: Lack of Understanding of Client Organizations and Relationships

Many auditors feel their job is to inspect the equipment, collect the data, perform the analysis, and write a report with recommendations—and believe that what happens after the client has the report is out of their control. Sure, they hope the client follows the recommendations and achieves some savings, but the auditors feel they can't make that happen. We believe that while this view is typical, it is unfortunate and incorrect. Auditors should take ownership and should do all that they can to make it as easy as possible to implement EEM recommendations. When we generate audit reports, we should ask ourselves: "How many of these recommendations will be installed in the next year?" And: "What can I do get more of them completed?" Based on our experience, the following are our recommendations for developing technical audits that account for the organizational and behavioral realities of the end customer. These recommendations are geared toward encouraging implementation of more EEMs—and ultimately garnering more savings.

Recommendation: encourage client to take "ownership" of EEM recommendations. In many cases, the plant manager or engineer responsible for implementing the measures in an audit report may feel that they "should have known" that these opportunities existed prior to the audit. In these cases, this individual may feel threatened by the report—even more so if there are large savings opportunities or short pay-back projects. These concerns are real and common—particularly in work cultures that are not open to continuous improvement and learning from mistakes. To overcome this, it is often effective to jointly develop or share ownership of ideas—this allows the individual at the facility to claim credit for the positive actions that will result from the audit. Unfortunately, if this effort is successful and the client does take ownership of the idea, the follow-up utility evaluator may determine the measure was a "free rider" since the client feels they would have implemented the project without the help of the audit.

Recommendation: assist in developing recommendations into business proposals. Often the plant engineer who receives the audit report is very busy and has many urgent operational problems that demand his or her time. If fire fighting prevents him from taking immediate action on a report, the report becomes stale and drops further down the list of pressing priorities. Sometimes the auditor can assist the client in taking recommendations to the next step—perhaps by developing a budget estimate for a feasibility study for proposed recommendations. In some cases, the recipient of the audit report may not understand the financial issues that need to be addressed to obtain funding approval. As we mentioned in Problem 2 above, if the audit is written as a business proposal ready for management review it will require less time for the engineer to turn the audit recommendations into actionable projects.

Recommendation: in a non-threatening way, make sure the report recipient understands the EEMs. This may appear obvious—but how many auditors take the time to do this? This does not mean making a presentation to a full room of client and utility staff. This is a personal conversation where recommendations are reviewed point by point. The objective is not for auditors to prove how smart they are—the objective is to implement projects to get energy savings. Taking a little time to ensure that the client fully understands and agrees with the assumptions, analysis, and recommendations empowers them to speak with confidence when advocating for implementation. Utility programs can encourage this by adding a follow-up step to their typical audit processes calling for the auditor to walk though the report in detail with the primary contact individual at the client facility.

Conclusion

The technical audit is a key component of any program intended to achieve industrial energy efficiency savings. Unfortunately, poor quality control, lack of a clear business message, and an overemphasis on equipment hardware solutions leave many audit reports lacking. It is important to keep in mind that we all share the common goal of increasing energy savings by the successful implementation of high-quality audit recommendations. For these reasons, we need to be willing to examine the effectiveness of the audits we commission, prepare and review. We need to look hard at what changes are required to allow more EEM recommendations to be implemented into projects. We need to work hard to ensure that none of our reports end up "sitting on the shelf gathering dust." This paper touched on a few recommendations for improving the audit process and making our reports more effective:

- Improve the technical quality of the audit report recommendations
- Improve the management recommendations in audits by including clear business proposals that can be understood by nontechnical managers (financial decision makers—CFOs, CEOs, plant managers, etc.)
- Improve audit recommendations by including Operations & Maintenance recommendations in addition to the typical capital equipment measures to identify energy savings from no-cost/low-cost procedural or behavior changes
- Improve the auditor's understanding of client organization and behavior to increase the quantity of recommended measures that are actually implemented by the client

Many auditors are implementing these improvements and others to increase the results of their work. But all of us can do better. We must do better. We welcome other recommendations and ideas for improvement so that we can add them to our own reports—and so that we can share those improvements with those we work with. Please send your ideas to mbailey@ecosconsulting.com and we will try to share them with everyone who contacts us.

The challenge of an uncertain economy, accompanied by the increasing awareness of energy issues (peak oil, climate change, dependence of foreign oil, etc.), creates a golden opportunity for the energy efficiency industry to greatly expand the scope of our work and our impact on the world. For many reasons, we must find a way to do this. Failing to act and continuing with business as usual is not an option. Even if we do not see the full impact of our actions in our lifetimes, we must keep in mind the legacy we leave for our children and their children. For these reasons, we must constantly strive to improve the effectiveness of our work to increase the savings we are able to achieve.

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