Industrial Energy Project Identification

Jerry Zolkowski, PE, CEM

ABSTRACT

Industrial sites seeking energy improvements must have a means of identifying prospective projects. Upon starting a program of energy efficiency, a site typically progresses through methods that easily find prospects and takes on increasingly more difficult identification methods as the energy efficiency program matures. Four types of project identification are addressed in order of increasing difficulty.

INTRODUCTION

Often the topic of identifying energy savings projects arises. Everyone knows something about energy use and conservation, but after starting a process where a site actively seeks energy savings, those initial ideas will run out. Some projects are implemented, and others may not be suitable due to payback limitations, risk, or capital availability. So that means more prospects must be identified, to keep collecting energy savings.

Some perceive that it is possible to "do it all," and it no longer makes sense to seek performance gains. However, many Energy Star partner companies and others have shown that it is possible to get 2-3% savings or more annually for decades. Successful companies typically employ some sort of continuous improvement program to perpetuate the energy savings process, but all companies seeking to do more than just a few energy projects must have tools to identify where energy savings can be obtained.

Most companies that are committed over the long term step through a progression of methods. The reason for the sequence is people tend to do what is easiest first and then move on if the energy focus is still active. Easiest is not necessarily best, but it still gets results. The

reality is that companies, especially some large corporations, tend to take on new initiatives fairly often, and some of the initiatives just don't survive. It makes sense for most folks to delay the stuff that is a lot harder to accomplish. Going from easiest to hardest, the progression for methods to identify energy saving opportunities follows:

1. Common facility projects
2. Audits
3. Site staff engagement
4. System analysis

There can be some cross-over among these broad categories, but sites usually progress through this sequence as their systems seek to identify and implement more energy projects after some are completed and showing savings. There is no requirement to progress through these in sequence, nor would that necessarily be the most advantageous approach. This is just the most common path since it uses increasingly challenging methods to find savings.

FACILITY PROJECTS

The phrase "low hanging fruit" is often used to describe this category; however, that a misnomer. While it is fair to apply that phrase to some projects, this is really a category of projects that are broadly applied to many sites, the savings are well understood, and there is an excellent chance the savings will be realized. The payback periods and implementation effort can vary, but once implemented there will be savings if the project was executed correctly—including proper identification of where a project can save energy. Adding a variable frequency drive to a fan that is always required to operate at full speed would be an example of poor project identification.

Facility type projects can be identified through personal experience (e.g. turning off lights), vendors, or utility incentive programs. This includes most lighting and HVAC projects. The projects have been proven in many locations, they are low risk, may receive incentives, and may be recommended by existing service contractors who work at the facility. To identify these projects, use utility incentive catalogs [1] and ask contractors what they recommend. This is fairly easy, and

while not always low-cost, the projects tend to be low-risk.

Some examples of projects that fall into this category are:

- Lighting upgrades
- Higher efficiency space heating and cooling equipment
- Variable speed fans with feedback that allows speed reductions
- Demand controlled ventilation
- Programmable thermostats, energy management systems (EMS), or building management systems
- Boiler, chiller, and air conditioner tune-ups
- Steam trap repair or replacement

Some of these are maintenance activities. There is a lot of energy value in keeping equipment and systems operating as intended. Steam traps failed open, fouled heat exchanger surfaces, excess fan vibration, and incorrect EMS programming can quickly lead to poor performance and higher energy consumption.

Example

Consumers Energy in Michigan offers an Energy Optimization rebate program to promote efficiency. Program staff visits prospective commercial and industrial sites in an effort to educate them about the program. The program catalog and staff experience often identify common opportunities such as lighting upgrades, and the customer is advised on how to obtain rebates for the upgrade. The program also has "Trade Allies." These are contractors who will assist their customers in obtaining rebates. The program has discovered that listing rebate measures in the catalog has boosted the credibility of an efficiency measure when anyone recommends it to a site.

AUDITS

Auditing is another way to discover efficiency opportunities. Here, outside experts investigate a site or a particular system to identify ways to improve it. Using outside services for a particular system like compressed air or HVAC is fairly common, and these services are

often quite reasonable as the vendors want to sell the upgrades after the audit. When the auditor is also the equipment vendor, care should be taken when evaluating the recommendations. While their expertise may be strong, they clearly have an incentive to recommend items that will generate more revenue for their company.

Sources of audits may include utilities, the US Department of Energy funded Industrial Assessment Center [2], lighting or HVAC vendors, and consulting engineers. Aside from the expense, an audit requires little effort from the facility other than to host the auditors and answer their questions. The auditors are on site for a short time and deliver a comprehensive report sometime later. Audits are more demanding than reading through tip sheets and incentive catalogs, but still fairly easy since the demands on the facility staff are limited. There are different types and levels of audits, so an understanding of what the vendor will provide should be clear when acquiring the service.

Example

Consumers Energy Business Solutions is piloting an Industrial Continuous Improvement Program (ICIP) as part of the larger energy optimization (rebate) program. ICIP requires participating companies to appoint an energy champion, form an energy team, establish key performance indicators, and commit to ISO 50001 or take the Energy Star Challenge for Industry. As an incentive ICIP staff provides energy training, and a facility audit, and rebates are boosted by 25%. For two site audits conducted in late 2013, the recommended savings exceeded 20% of the sites' utility expenditures. One audit provided nine detailed recommendations with a combined simple payback of 0.8 years (after incentives), and the other provided ten individual recommendations with a combined payback of 1.7 years (after incentives). Both of these sites had recently started efforts to obtain energy savings, and the recommendations in the reports provided them some excellent projects to choose from. Both sites reported starting on some recommendations immediately.

SITE STAFF ENGAGEMENT

There is the simple "suggestion box" that relates to personal experiences which is an easy step, but really engaging the staff by execut-

ing an Energy Kaizen [3] or Treasure Hunt [4] requires some staff time and commitment. For sites already engaged with Lean Manufacturing, the same Kaizen techniques applied to eliminating waste, material movements, and processing can be applied to energy waste as well. For the Energy Kaizen the Value Stream Map uses energy inputs into the process. These sites already have trained facilitators and have staff familiar with Kaizens, so executing an Energy Kaizen for a significant energy consuming process is a natural progression.

The Treasure Hunt is similar to the Energy Kaizen in that it engages employees to find efficiency opportunities with an organized process. General Electric and Toyota have been very open about their Treasure Hunt process and the success they have found with it. These events require an employee group to closely investigate a process, identify saving opportunities, and evaluate and prioritize them over the course of several days. The group is comprised of staff from the site representing different areas of expertise such as production, maintenance, and engineering, plus a coordinator to guide the process.

One helpful measure during an employee engagement process is to have an energy professional participate, to provide some guidance and rapidly evaluate the proposals before prioritizing. There may be dozens of prospects identified, and having expert guidance can help the group understand the impacts.

Advantages to using these methods to engage site staff are:

1. Low out-of-pocket costs.
2. A tendency to find at least a few low/no-cost opportunities (there may be many identified).
3. Opportunities tend to be related to each individual's work experience. This can lead to findings auditors would never identify, because they can be specific to each process.
4. Some opportunities may be implemented through procedural changes or operator settings which can be executed quickly with little expense.

While the advantages listed can be very attractive, there are some other aspects that need to be considered as well:

1. While many findings may be low-cost, many will also be low-impact.

2. The demand on staff time is significant. Beyond using several people for days at a time during the event, there is also preparation and follow-up. Some of those people are normally involved with making the products that bring the company revenue.

3. The view of staff is limited to their experience. For example, operators may be able to change operating procedures, but the concept of changing the equipment (e.g. adding a VFD and controls to an exhaust fan on a dryer instead of fixed speed) may not be something they would consider.

Engaging site staff to identify opportunities has particular strengths, and it is a practice that should be utilized when the site is ready to devote some effort to engage employees to find unique opportunities.

Example

A large multi-plant flooring producer began an energy efficiency program by expecting Six Sigma savings from all portions of the manufacturing operation. Facility/plant engineers saw energy as their savings opportunity, and thus embarked upon identifying opportunities through audit type activities. The resulting projects demonstrated savings, and the success drove a quest to identify more opportunities. After three years the audit ideas were essentially used up. The company already had an established lean manufacturing program, so they executed Energy Kaizens at some plants. Each Kaizen identified over 100 prospects which covered a wide range—some were low-cost, some were unattractive, and others required further investigation, planning, and/or funding. One of the best aspects of the Kaizen activity was staff participation from a sister plant with the same processes. The knowledge sharing of even minor items about "this is how we handle that issue" proved to be invaluable and hard to replicate.

SYSTEM ANALYSIS

"System analysis" is intended to mean a detailed investigation into machine performance and performing a root cause analysis when variances occur. This is by far the hardest to perform. To execute this,

significant energy users must record energy consumption which is then normalized to some productive output from the individual process. This concept matches well with production equipment, but it also can apply to energy systems. Production equipment may measure energy per unit of production (e.g. kWh/lb), and systems such as compressed air or steam can also measure output per unit of energy input (e.g. kWh per 1000 standard cubic feet of air or Btu per lb of steam). The intent is to track and monitor significant energy users.

Collecting the energy data usually means meters or submeters connected to a data collection system, but that can be expensive. Temporary data loggers like those available from Dent or Onset can be used with much lower cost for limited time periods. Data loggers are also used to measure the impact of a change to the system.

Data are collected to compare how a single machine performs over time. If machine operators can change settings that impact energy use, there may be opportunities to get all operators to adopt the practices of the most efficient operators. Using the meters and correlating them to production volumes will provide a picture of when production was most efficient, and those machine settings or operator practices can be identified and standardized. Analysis between shifts or analysis of how a machine performs over time is possible. Any performance differences can be identified and connected to setups, production rates, or different products. With the metering and performance data, it even becomes possible to have accounting variances that can lead to the identification of good or poor practices. The same logic extends to facility systems (lights, compressed air, space heat, etc.).

The metering and data collection system is costly, and then someone has to look at the data and correlate it to production during those periods which can be time consuming. However the potential gains can be significant, and the gains associated with a behavior change can yield large savings with little additional capital investment. The poor performing "operator settings" get identified and optimized just by changing a work practice.

Example

Chemical manufacturing tends to require high capital investment in plant and equipment. A large chemical company had in place extensive meters, monitoring, and data collection to track each process during manufacturing. This typically included pressure and tempera-

ture sensors within processes, flow meters for process chemicals, flow meters for energy inputs such as steam, power monitors, and so on, so that every aspect of production was tracked. These data could be used to establish key energy performance indicators for each process and tracked over time so that variations could be found and analyzed. A software system to perform that analysis more easily for the users was installed at two sites and is expected to extend to several more in the coming years.

IDEAL APPROACH

The sequence of easy to hard is most common, but it is not necessarily the best. The optimal business approach is one that maximizes returns and minimizes risk. In industrial operations most of the energy is consumed in the manufacturing process, so the ideal approach focuses on the production process first. Process project identification can only succeed when those close to the process provide their input, so employee participation and buy-in is critical. These employees are the operators from all shifts, maintenance staff, and support staff such as engineering.

True employee buy-in comes when management demonstrates commitment to the employees and the energy improvement process. When management chooses to allocate staff time and capital spending to improving energy performance, employees see that and gain confidence that their efforts to contribute are worthwhile.

With management commitment and employee buy-in, the ideal path to identifying energy opportunities emphasizes the manufacturing process and how it can be improved. Some of the opportunities identified will be low or no-cost which can be implemented first since that provides the highest return. Note that implementing staff originated measures also demonstrates management commitment to the employees' ideas. Having personal recommendations implemented is a tremendous morale booster.

Therefore the ideal path begins with employee involvement. This can be in the form of a Kaizen or Treasure Hunt or less intensive methods if enough ideas are generated. The easily identified projects in the "Facility Projects" section that come from personal experience or generally available information will still be identified, and spending some

money to execute those low risk projects demonstrates management commitment.

The next step on an ideal path would be to move to "System Analysis." Again employee participation is crucial to connecting the data to events or settings that cause energy variations. This fits well with site staff engagement since some items could be identified there first, but system analysis is more data driven. Here variances are found, and then the root cause and corrective action are applied—so the opportunities arise from measurements. In the initial phase opportunities arise from personal observations and are later supported with measurements. Again some of the findings will be low and no-cost which places this high on the ideal approach list.

The ideal path first follows employee engagement and then system analysis to find the highest impact and lowest cost projects. Along the way it is likely facility projects will be identified, and the ideal path would conclude with identifying any facility projects that might have been missed and arranging for target audits of systems where outside expertise is likely to find opportunities site staff did not already identify.

CONCLUSION

While project identification from any of these methods is worthwhile, it only has value within a functioning system where energy saving projects are implemented. ISO 50001 and Energy Star Challenge for Industry promote a process for continuous improvement. The steps to improvement include identifying prospective projects, planning, implementing projects that promote company goals, and verifying that the projects are performing.

The progression of identifying project prospects by seeking mature technologies to upgrade facility systems, audits, engaging site staff, and performing detailed system analyses contributes to one piece of the total energy management system. Project identification is a critical step, and it is truly useful when the entire energy management system is effective.

References

1. http://www.consumersenergy.com/eeprograms/business.aspx?id=4070&linkidentifier=id&itemid=4070
2. http://energy.gov/eere/amo/industrial-assessment-centers-iacs

3. http://www.epa.gov/lean/environment/toolkits/energy/resources/lean-energy-climate-toolkit.pdf
4. http://www.energystar.gov/buildings/tools-and-resources/energy-star-treasure-hunt-guide-simple-steps-finding-energy-savings

---

ABOUT THE AUTHOR

Jerry Zolkowski, PE, CEM, has been a senior engineer at DNV GL since 2013. He works on the Consumers Energy Business Solutions incentive program in Michigan with a focus on making industrial plants more efficient. He can be contacted at: Gerard.Zolkowski@dnvgl.com

Prior experience includes 2.5 years with Dow Corning, the world leader in silicones, supporting global manufacturing energy efficiency efforts; and 6 years finding and evaluating energy conservation opportunities for Shaw Industries' manufacturing operations. Shaw has over 50 manufacturing plants and is the country's largest carpet producer. Also 10 years at the state's industrial extension service at Georgia Tech. That work included energy conservation, environmental compliance, and plant & design engineering.

Jerry has a BS in mechanical engineering from the University of Rochester and an MBA from Columbus State College.