The Energy Manager's Role in the Design-build-operation Process

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ABSTRACT

Problem

The energy management input during the design and construction process of a facility is hit or miss at best, which results in reactionary energy management sometime during the lifetime of the facility. It is the intent of this article to recommend ways that the energy manager can assist in all phases of the building process to achieve an energy efficient design that will withstand the future challenges of a changing energy economy.

INTRODUCTION

The term "energy management" generally refers to the control of the use of energy within an existing facility. Typically, it is reactionary in nature and sometimes it is too little too late for certain types of projects. This can be seen in Figure 1, where the certified energy manager (CEM) normally operates in the building process. There are many other ways that energy engineers can manage the use of energy throughout a facility's lifetime, and it is imperative to think about the entire project span for implementing energy efficiency and management. As understood today, reactionary energy management, i.e. auditing to identify retrofits, might fade away due to better sustainable design practices.

Examples of reactionary energy management are:

- A system has become inefficient in an industrial process and is starting to cost down time and lack of productivity for a plant. A

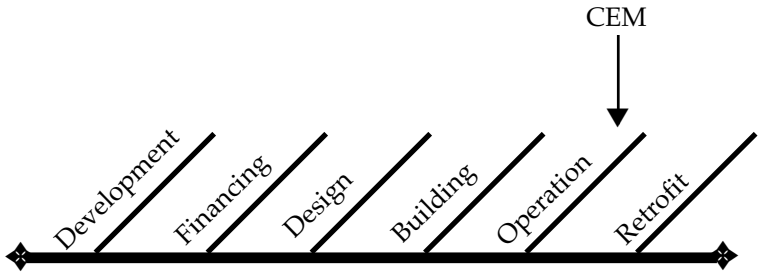

Figure 1. Reactionary Energy Management

consulting engineer enters the picture and makes not only process upgrade recommendations, but also offers more energy efficient ways of accomplishing the same productivity at a lesser unit cost.

- An energy services contracting organization (ESCO) offers to retrofit the systems in an existing facility to upgrade the equipment to more efficient standards.

- Delay of occupancy permits for non-compliant clients caught during inspection who call the nearest energy code consultant to help.

- Retrofit installation of new generating equipment to prevent down times due to power shortages that have proven costly in terms of money and other intangible losses.

If CEMs continue to concentrate on the later stages of a building's lifetime, they will be missing opportunities that may have greater overall impact. As buildings become more energy efficient, the need for "later stage" or reactionary energy management will virtually disappear. Energy conservation codes are required nearly everywhere, and products in the marketplace are swiftly moving up the scale of efficiency. Real-time metering capability is beginning to change the way owners look at building management. Due to the increasing popularity of sustainable design practices, it is quite realistic that in a short amount of time, it will be very difficult to design an inefficient building. As a result of all this good sustainable and energy management progress, CEMs will not have the backlog of facilities to audit and reform that they do now.

It is time to become proactive in our involvement with the facility life span (See Figure 1) that actually begins during development. In our society, energy will soon become a prime driver in all aspects of design, construction, and operation of facilities as the resources become increasingly scarce. It will no longer be acceptable for engineers to quantify energy management as a process by which a building is controlled or retrofitted. The entire process of design-build-operate will have to include specific sustainable practices which should occur right from the outset of development.

SUSTAINABLE DESIGN

The sustainable design process helps achieve this from a global approach. One definition of sustainability might be: "To design, build, and consume materials in a manner that minimizes the depletion of the natural resources and optimizes the efficiency of consumption." Therefore, sustainability encompasses not only design intent and construction practices, but also the use of the earth's resources before, during, and after construction. This includes a very broad spectrum of resources, starting with obvious ones such as water, coal, oil, and natural gas, all the way to oxygen, vegetation, and more esoterically, natural aesthetics.

Sustainability does not primarily mean energy conservation as exemplified by a "certified sustainable" building in Seattle, WA. This project involved a heightened awareness of indoor air quality and a "once-through" philosophy for air movement in areas that a particular teacher would be occupying. To make a very long story short, the facility was not very efficient in the energy conservation realm due to once-through ventilation in the classrooms, but had a superior rating for the indoor air quality. Additional points were obtained by using innovative construction techniques such as the use of collecting and naturally filtering the site water run-off. Thus for those people who instantly think that sustainable means minimizing energy usage above all else, this example shows that just the opposite can still render a building certifiably sustainable. Indeed, energy efficiency is only one of the five categories in which compliance must be shown to obtain a certification.

The LEED certification process for sustainable design is a self-assessing, self-documenting point system that rates a building's sustainability per guidelines defined by the US Green Building Council.

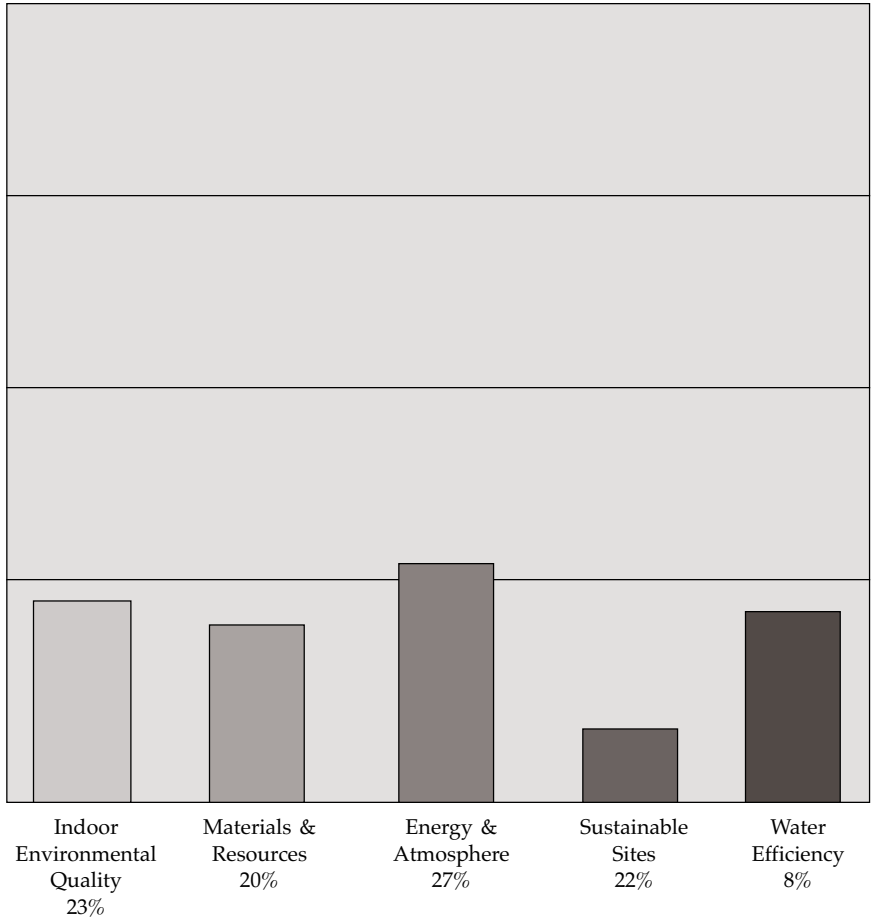

Figure 2. LEED™ Point Distribution

A building must accumulate about 35 percent of the points available to qualify as certified sustainable. The good news is that nearly half of the points available are tied to energy engineering or a similar field, as shown in Figure 2 in the bar sections labeled indoor environmental quality and energy and atmosphere. Sustainable doesn't always mean that energy conservation is happening. But with good energy management planning in the beginning stages of a project, the building can become LEED™ certified without much additional effort.

Other areas for the energy manager to pursue are design and development related, and don't necessarily have to be tracking a point-

based rating system. The energy professional can begin to incorporate energy management into the design and future operational planning of the facility from the beginning of a project all the way through operation and beyond. The primary ways to accomplish this are:

1. *Passively*: Assure that the project meets the applicable energy codes and standards. As energy managers, it is essential to be familiar with the codes that govern a particular design and to be able to see the effect that these codes can have on design and operation of a facility. The better the newer systems become at conserving energy, the lesser the need for audits and retrofits in the future (i.e. the dinosaur principle for reactionary energy management). In eight years of plans examining, the author has yet to see a set of plans that meets the state energy code 100 percent.

2. *Actively*: Creatively assist the design team in integrating all aspects of sustainability into the design to achieve a target building efficiency. Too often the architects and engineers don't communicate until the project is committed to a certain design approach. Then the mechanical and electrical design teams have to just make it work the best that they can. Working as facilitators in this process, energy managers can guide the process toward a totally integrated building that dovetails all of the sustainable features into one system. Site selection based on types of energy available and the potential for distributed generation and hydrogen infrastructure are just a couple of examples that can be considered in the site selection area of sustainable design.

3. *Comprehensively*: Project the potential costs of operation of the facility, comparing different system concepts for the acquisition of energy to demonstrate how much the actual cost of traditional systems vs. energy-managed systems will be for the owner. Another comprehensive effort would be to sell the idea of real-time energy monitoring in manufacturing and industrial facilities to the owner, then model the results of such a system to show life-cycle potential. This, of course, would be done in conjunction with design and would need to be priced accordingly. State-of-the-art technology allows for this to be done nicely from a remote location via the internet.

4. *Another Comprehensive Approach*: In construction, there is presently a great deal of talk about commissioning and its necessity. Several systems are actively commissioned, such as fire alarm and notification and commercial kitchen equipment—usually because it is connected to the fire alarm system. The energy systems are commissioned only as far as a test and balance at turn-over is required. It is unfortunate that when the test and balance is needed again—preferably when the season changes significantly—the contractor is gone and the idea has been lost. Recommissioning and/or continuous commissioning is one way of taking a great idea to its logical conclusion. By rigorously testing all energy systems in a building during all seasons, and then recommissioning at defined intervals, the system can be tuned up in a preventive maintenance fashion. If the owner is prudent enough to install metering equipment to alert maintenance when systems are not performing well or going bad, then the continuous commissioning philosophy is helpful to prevent surprises during recommissioning or the headaches of retrofitting after an audit.

If a firm has no CEMs and the areas of work in this report touch on the nature of particular business, that firm should consider supporting a person to become certified, or hiring an individual with a CEM certification. The training that a CEM receives for certification and the background that person has qualifies them to assist at all levels of energy management during a building's lifetime.

DIFFICULTIES

Currently, early involvement by a CEM is not the first thought in developers' minds. It is the rare client that will seek out the energy conservation specialist in the initial idea phase of a project. One marketing strategy that could entice a developer to use an energy conservation specialist might be to highlight the condition of the owner's existing facility with respect to energy efficiency and then show where proper energy management consideration could alleviate pressing energy issues.

Education on what energy management can be, instead of what it presently, is will be crucial to establishing a strong presence in the entire design-build-operate spectrum. Most professionals in the design-build profession would have difficulty describing what a certified energy

manager does. The key to success is "getting the word out" to other industries and tying the various threads together to illustrate how they can benefit each other.

SOLUTIONS

Marketing CEMs for the expertise that they have is key to becoming a central figure in the early design-build process. In the classes that prospective CEMs take to become certified, a broad range of information is covered that could be applied to the early stages of a project. These areas are:

- Traditional design, including emphasis in non-traditional energy systems such as thermal storage. There are numerous ideas that are not considered because traditional designers are used to doing it the same way every time. Trying to establish a strong presence in the tried-and-true areas of building design could help traditional projects make use of technology that is out there but little known.

- Economic analysis: Modeling the different sources of energy available similar to the way HVAC equipment is modeled in a life cycle cost analysis would be a valuable tool for projects faced with difficult site selection decisions. If the present energy supply is projected to increase in cost and decrease in amount in the next 20-30 years, the facility might suffer a significant impact if it limits its source availability due to site location. This would be a large concern if there were no alternative energy sources available at the site. This of course is largely grid dependent, except for cogeneration plants. However, these should be closely looked at since the cheap and plentiful supply of natural gas is not as cheap and plentiful as previously thought.

- Cogeneration and distributed generation (DG) analysis. Selection of distributed generation equipment is not relegated to the socially militant hermit who burns wood in the winter, blocks off the windows with insulation and uses homemade candles for reading at night. Cogeneration and DG are becoming choices for large industries and for businesses that cannot afford to lose power unexpectedly. This choice should be discussed for certain customers up front, and the pros and cons weighed carefully. This is best done

with an energy professional on board well before site selection is complete. The uncertainties stemming from the deregulation environment is another reason to consider the steady and controllable power output of cogeneration or DG.

- Building envelope material analysis for architects. The options for values in code compliance documents are limited. By applying U-value knowledge and energy management training, a more informed choice can be made by architects and contractors in choosing the skin of a building. Architects rarely know how to perform this calculation, and it is probably never performed before the selection of materials is made as a quantitative determining factor in material selection.

- Metering specifications. Since the use and location of meters is crucial to controlling the demand of a facility, a metering study for large facilities could be instrumental in working with the utility to obtain the optimum metering of a facility.

Popular management consulting solutions can be tailored to the energy management realm and performed by CEMs with just a bit more training:

- Energy use-availability risk assessment. What is the potential result of black-outs or of a supply change? How likely is this to happen? Risk assessment has been routinely used to predict catastrophic events that might ruin a company or cause a setback severe enough that preventive measures are desirable. If a company's energy supply were analyzed in a traditional risk assessment mode in the development stage, decisions on design and product selection could be made with a more complete understanding of the consequences.

- Root cause analysis of power waste or blackout occurrences. Previously reserved for accidents or unwanted incidents, this technique could be used for analyzing processes to pinpoint exactly where energy waste is occurring. This technique could also be used to decide what the priority should be in a retrofit for energy conservation if money and/or time is limited.

CONCLUSION

As energy cost, reliability, and availability becomes more significant in the profit calculations of industry and business, energy management will be a driving force in the development and design of large facilities. The two design disciplines of engineering and architecture can provide the global community with the best in "sustainable design" by incorporating energy management into all critical steps of the building design process. There are other activities that the energy professional can market to that could help to broaden the scope of energy management. These activities include:

- Introducing creative design solutions early in a project's lifetime to secure financial and emotional support from the owner.
- Providing detailed financial analysis so design decisions can be made with a better understanding of the consequences.
- Site selection consulting for energy sources and supply for the present and future.
- Assisting architects in building envelope analysis and simulation.

The energy manager's role can thus be expanded from a reactionary one into a comprehensive, proactive one in the building industry.

ABOUT THE AUTHOR

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