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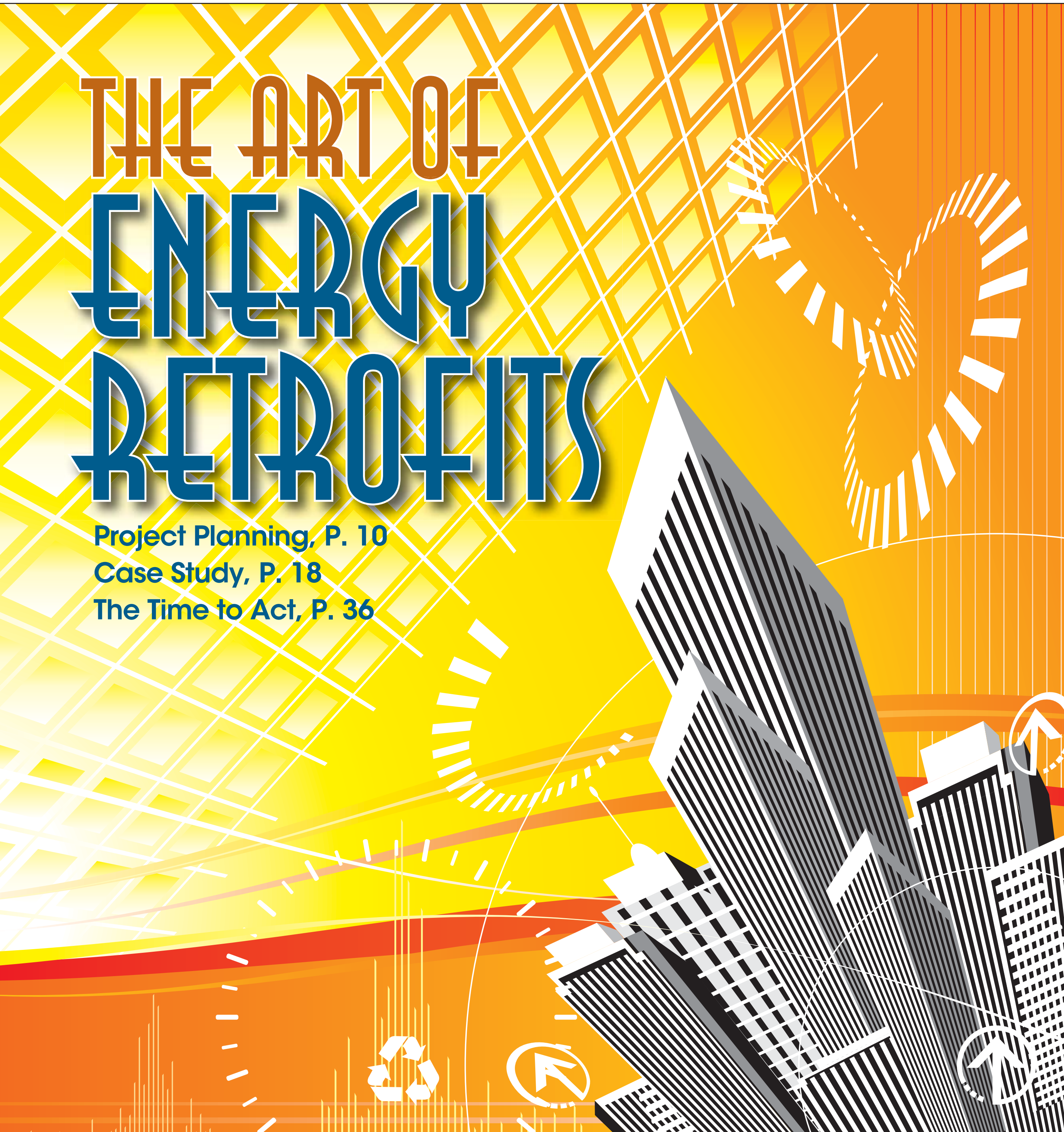
THE ART OF ENERGY RETROFITS



Existing buildings' operational inefficiencies can benefit from an energy or recommissioning program

Energy Retrofits: When Is the Time to Act?

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Many building owners think of solar fields, cogeneration, solar hot water, and absorption chillers when they hear the words "energy savings." Although these high-profile, trendy options can reduce energy costs, they typically require substantial investments that must be financed over several years to achieve a reasonable return. Savings projections usually assume that existing mechanical systems, in conjunction with the previously mentioned technologies, are operating efficiently. History tells us that is not always the case.

This article will explore whether an existing building is a candidate for energy savings through measures such as adjusting a building-automation program, addressing years of deferred maintenance, recommissioning existing mechanical systems, and training in-house maintenance staff. When appropriately applied, these measures have the potential to reduce current energy consumption, extend equipment life, and improve comfort levels. Additionally, they typically can be tied into local utility rebate programs.

It is important to understand how a building becomes operationally efficient as well as how its inefficient operation impacts a building's systems.

Deferred Maintenance

There are numerous reasons why scheduled mechanical-systems maintenance is not performed or is deferred. The most common explanations are a lack of funding, staffing, technical skills, or in-house staff production.

When confronted with budget cuts, companies usually trim the maintenance department first. As might be expected, the list of deferred items continues to grow in proportion to the irregularity of maintenance.

Deferred maintenance begins to impact system operation in subtle ways. A minor problem, such as a dirty filter, can be compounded by a dirty coil and worn pulley and result in decreased airflow delivery. The most common indicator of this type of failure is an occupant's complaint that a particular area of a conditioned zone is too hot or too cold. If the operational inefficiency is not addressed, energy costs are likely to increase. Because such an increase accounts for such a small percentage of a facility's total utility bill, it often goes unnoticed.

An occupant's complaint results in a service request to the maintenance department. Because of the numerous duties of a typical maintenance department, the response is handled one of two ways:

• *By an in-house maintenance professional.* With time constraints and skill-level issues, some type of temperature adjustment or controls override typically is used, forcing the system into full cooling or heating. The cooling or heating system then must run longer because of the shortage of airflow to the space. Meanwhile, energy costs increase.

Overriding the system or lowering the thermostat setting eventually causes an occupant to stop complaining about the cold and start complaining about the heat. The original service request then is repeated with similar consequences. Energy, as well as a maintenance staff's time, are wasted, increasing an owner's costs.

• *By an outside contractor.* An outside contractor typi-

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Deferred maintenance begins to impact system operation in subtle ways. For example, a worn pulley can cause rubber buildup on a coil.

cally addresses the most obvious symptom, rather than the root cause of a problem. This approach usually focuses on the component, rather than system, level. For example, a contractor may simply adjust the thermostat or controller, while the real problem could be system failure caused by multiple minor system deficiencies and/or deferred maintenance (e.g., a dirty filter, dirty coils, worn pulleys). This situation inevitably leads to a second service call to the outside contractor because the root issue remains unresolved. Once again, energy, as well as the contractor's and maintenance staff's time, is wasted, increasing an owner's costs.

Something as small as an improper repair made to a supply-duct connection can create big problems. Fixing "small" issues often can make a difference on utility bills.

In this scenario, the system eventually will experience total failure, which is far more costly than if the initial issue had been addressed and routine maintenance performed.

Poorly Integrated Building Automation

The push to reduce energy usage is creating many challenges for owners of buildings constructed within the last 30 years. Most of these facilities' building-automation systems (BAS) are complicated and carry high maintenance costs. Because maintenance crews are not always trained properly, simple system overrides often are standard operating procedure. Building automation, however, has evolved significantly, requiring systems to be maintained carefully and reprogrammed and updated periodically to take advantage of the latest technology.

When properly installed, programmed, and maintained, BAS operate mechanical systems in an energy-efficient manner. When a BAS is not maintained or reprogrammed properly or is installed on poorly maintained mechanical equipment, excess energy is consumed. Meanwhile, the owner has a false sense of security that energy costs are being controlled.

Obsolete Mechanical Equipment

Although retrocommissioning programs can save energy in new buildings, the greatest return on investment occurs in buildings ranging from 5 to 25 years old.

Some older buildings utilize dual-duct mixing as the primary cooling and heating method. Many still are using pneumatic primary and secondary controls. Buildings older than 10 years typically use electric-to-pneumatic devices for zone control, as well as pneumatic valves or actuators for basic zone actuation. These types of buildings offer substantial opportunities to reduce energy.

Many older buildings were designed around specific usage conditions that have changed over the years. Comparing existing tenant conditions with original intent can provide insight on energy-reduction opportunities.

Contrary to what many believe, the installation of solar panels, cogeneration systems, and other major energy systems will not reduce the amount of energy wasted by the problems described above. Energy savings should start with a thorough investigation of a facility's operation-and-maintenance schedule.

Getting Started

After examining the situation and pinpointing areas for potential energy savings, the first step is to select a team to develop an energy approach.

An ongoing equipment-specific maintenance program can help prevent issues, such as a loose belt that has slipped off of a worn drive pulley, from becoming dilemmas.

Members of this team should include experienced personnel who can identify the root cause of energy waste and provide multiple solutions. Team members must be committed to the project and have constant and open communication regarding solutions and objectives.

After the team is developed and the commitment is made, the team must see how the building operates. The investigation should include:

- Scope definition.
- Data gathering and interviews.
- Site investigation.
- Availability of utility incentives.
- Survey-result review.
- Root-cause analysis.
- Recommendation development.
- Financial-impact review.
- Fund commitment.

After the current stage of the building and the building's intended operation are understood, a detailed analysis can be developed. The analysis should identify and prioritize deficiencies and outline the appropriate steps needed to correct them. The analysis should identify potential energy savings, such as maintaining equipment and restoring existing systems.

After the team's review of the recommended energy approach, funds must be committed to implement the chosen energy-savings plan, which can include:

- Implementing approved recommendations.
- Implementing proactive maintenance, including building-information-modeling integration.
- Continuous evaluation.
- Applying for utility rebates.

For continued performance to be ensured, specific operating-and-maintenance tasks, including ongoing equipment-specific maintenance tasks and monitoring, are required. Tasks need to be building-specific to match each facility's unique demands. Ongoing support also should be provided to the maintenance staff using industry standards (including LEED) on the proper operation of new technology.

Conclusion

In summary, three conditions—deferred maintenance, poorly integrated building automation, and obsolete mechanical equipment—are the primary culprits of energy waste and poor mechanical-systems performance.

If a building suffers from these conditions, it should be evaluated carefully, and appropriate retrocommissioning should be performed.

Big-ticket energy-retrofit projects gain plenty of attention, but the simplest solution often is the most effective. By examining maintenance schedules and monitoring proactively for potentially costly repairs, building owners stand to see a return on their investment much sooner than with an expensive and complicated alternative-energy plan.

It is important to have management and financial approval early on in the process. Changing the way a company handles its operations will require a cultural shift and financial commitment. It takes years for a building to degrade, putting big demands on maintenance productivity and a constant drain on financial budgets. This will not change until an energy or retrocommissioning program is conducted. Once completed, maintenance costs will decrease as the building becomes more efficient. The trick is to manage the newly retrofitted building and avoid letting it fall back into being an unmanageable budget drain.

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