

Don't Pay The Price

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Best practices for managing total cost of ownership

Managing total cost of energy (TCO) means managing energy.

One of the most common pieces of equipment at small commercial facilities is the rooftop HVAC unit (RTU). It is also one of the most likely to be managed under the run-to-fail or reactive replacement approach. So what is the total cost of ownership for this type of equipment?

The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) suggests the useful life is 15 years, although it is common for assets to remain in service past the end of their useful life. A TCO calculation reveals how costly it may be to extend the useful life. See Figure 1 for an illustration of how costs for a 10-ton electric cool gas heat RTU that cools for 1,800 hours a year stack up over a 20-year period. Heating costs are assumed to be 25 percent of cooling costs due to the relative efficiency of creating heat with natural gas. This illustration is based on industry sources and data collected from thousands of RTUs that are tracked by Powerhouse Dynamics. Other assumptions include an electricity rate of \$0.10/kWh, annual preventive maintenance cost of \$50, minor repairs of \$250 per incident, major repairs of \$1,500 per incident and emergency repairs of \$750 per incident. Energy costs and the frequency of repairs escalate over time. Initial installed cost of the unit was assumed to be \$1,200/ton of cooling capacity.

As predicted, compiling the total cost of ownership is revealing. For facility managers or finance staff who have always doubted the impact of equipment energy efficiency on costs, Figure 2 should be eye opening. For starters, over a 20-year period, energy comprises about 70 percent of the total cost of ownership. The amortized first cost of purchasing the unit represents roughly 15 percent, and the remaining 15 percent is repair and maintenance.

Managing Your Existing HVAC Fleet

So given the importance of operating costs to TCO, what are some best practices to manage your existing fleet of HVAC equipment?

- Invest in preventive maintenance. This idea is not new, but what is new is the type of data that is available to measure how valuable simple actions can be to the total cost of ownership. Consider this bellwether: The simple act of cleaning condenser coils can have a dramatic effect on performance and savings. Figure 3 shows energy usage of an RTU before cleaning coils and after, proving that clean coils reduce energy consumption by about 5kW, on average. If this unit runs 12 hours a day, that's 60 kWh per day saved. For this customer, the effective kWh rate from the July bill is \$0.10/ kWh. That's \$6 a day in savings, or \$1,000 over the 6 months of the cooling season (in the southern U.S., where this facility is located). Preventive maintenance savings opportunities like this exist across your facilities, and an asset and energy management tool allows you to put a dollar figure on each.
- Consider more than filters and coils. The California Energy Commission's Public Interest Research Group has done some excellent research to quantify performance degrading "faults" that are common for HVAC equipment. These faults translate into inefficient operations and higher operating costs. In addition, the group calculated the efficiency penalty for a combination of faults (more than one fault can occur at the same time). Specifically, they considered a combination of partial condenser coil blockage, partial airflow restrictions and low refrigerant charge. The total efficiency penalty for this combination was 21 percent, meaning the unit would be delivering 21 percent fewer BTU/kWh of cooling. In order to achieve the same climate control target, the unit would need to run longer to compensate.
- Prioritize avoiding emergency service. According to PRSM's 2012 HVAC Benchmarking Report, reactive service calls after equipment breaks are, on average, three times as expensive as proactive calls, costing around \$400 more per call on average. Moreover, system failures can have impacts on customers and staff that go well beyond the cost of the service call itself. Therefore, having the data needed to schedule service before a unit fails can drive down repair and maintenance costs while protecting your brand. An asset management system that tracks the current condition of all of your equipment assets and scores them based on their condition and operation can help you make smart decisions about what to replace first.

Building a Replacement Program

Developing an effective replacement program has always been a good idea, but the lens of TCO makes doing so a real imperative. Operating equipment beyond its useful life and having unplanned replacements both have a dramatic impact on the total cost of ownership. For many equipment types (heating/cooling, refrigeration), reactive replacement usually happens during the peak heating or cooling season. If the equipment has died, it often needs to be replaced as fast as possible, whatever the cost. These increased costs fall into two buckets:

1. Higher replacement costs. With planned replacement, equipment can be replaced during the shoulder seasons. This allows time to get multiple bids, both for the equipment itself and for the installation, which is often less expensive during non-peak months. Planned replacement may also allow for volume discounts. If we assume the added cost is 20 percent, another \$2,500 has been added to the TCO for the new equipment.

2. Higher operating costs. Selecting the best replacement equipment is impossible when the situation is perceived to be an emergency and there is pressure to minimize the length of the time before a replacement is installed. There is no time to analyze whether the system at each location has the correct capacity, or to assess nameplates to identify which units have been performing best at other local sites. More importantly, the best and usually most energy-efficient equipment is unlikely to be in stock. The optimal equipment for a given location may require many weeks of lead-time to manufacture and procure. And of course, desperation is not a good position from which to negotiate price. Said another way, if you need a new 10-ton RTU in 48 hours, you are unlikely to get the unit that is best suited to your needs. As a result, if we've reduced the energy efficiency of the replacement unit such that the energy used over the lifetime of that new equipment is 10 percent higher, we've added another \$5,000 to the TCO of the replacement equipment.

To avoid such pitfalls and to optimize the TCO of your HVAC equipment, we recommend the following best practices:

- Perform an inventory of the equipment at each of your locations. Cover the basics, such as make, model and age, and issues such as refrigerant type and system condition, including cabinet condition, coil condition, whether there is standing water and other observations. And remember that a photo is sometimes worth a thousand words. These factors should play a role in the repair versus replace decision. There are asset data capture apps that make it relatively easy for a technician to capture this information directly into a database.
- Track data to help you evaluate equipment performance. If possible, make sure you capture the cost of maintaining individual HVAC units, rather than lumping together HVAC as a single category or, as many companies do, just tracking maintenance in total. An inventory will make it possible to track maintenance costs at the RTU unit level. Also consider the benefits of tracking energy costs at the equipment level. Wireless sensors have made this quite affordable.
- Research utility rebate programs in your operating territories to see if there are rebates that cover HVAC equipment. A good source of information is the Database of State Incentives for Renewables and Efficiency database operated by North Carolina State University.
- Develop a methodology for prioritizing equipment replacement. Factors that should be taken into consideration include age, condition, frequency of required maintenance, growth in maintenance costs, energy cost and changes in energy cost. Some energy and asset management software packages have algorithms that integrate these types of data into equipment scoring metrics. The remaining lease term at each location must play a role as well.
- Develop an internal budgeting and planning process to determine how much can be spent annually on proactive replacement (recognizing that there will still be inevitable reactive replacement), when it should happen, and what the overall process should be in terms of timing, getting vendor bids, etc.

With a few technology-enabled tools like an asset management system, an energy management system and a good preventive maintenance program, you can keep TCO under control. Energy use is by far the biggest contributor to TCO, so monitoring and managing it closely will ensure that your equipment isn't eroding profits as quickly as your restaurants earn them. And of course, the cost of equipment failure, inevitably at the worst possible time, is painful to calculate: lost business, perhaps lost product and even lost reputation. Do yourself a favor and put these best practices action so you never have to do that math.

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