WHITE PAPER

Energy Management in the Hospitality Industry

Introduction

The hospitality industry, like any other commercial enterprise, is largely driven by operating margins. While hotels can be largely categorized as a function of the services (and levels of services) they provide to their guests, the fact remains that the successful hotelier is focused on achieving the critical balance between guest comfort, offered services, operating margins, and brand awareness, and on maintaining this balance in the long-term.

In fact, according to the Environmental Protection Agency, the hotel industry spent over $5 billion on energy in 2004, and that number continues to increase – especially in the aftermath of Hurricane Katrina and the Iraq War's impact on oil prices.

Because of the intense focus on guest comfort, the steps that a hotelier can take in minimizing costs are often limited, if only by the guests' perception of the effect those cost-cutting measures have on the "image" of the property.

One area where significant advances can be made is in energy management – and over the past decade, evidence of this trend may be seen at just about every hotel. The most common sign is "re-lamping" – replacing traditional incandescent bulbs with low-energy fluorescents. Another common approach is identifying thermal leakage points, such as windows and doors, and sealing them appropriately.

The strategies above do, of course, represent worthwhile steps in reducing energy consumption. However, the potential for energy management savings goes much further than this. Advances in technology, and a well-planned approach to systems design, can yield a substantial decrease in energy consumption – and with that decrease comes significant additional savings in energy costs.

A note: it is essential to maintain a distinction between "reduced energy consumption" and "reduced energy costs." Energy costs fluctuate – consider the Enron scandal of 2000-2001, when energy costs (in kWh) rose approximately 700% in the span of an afternoon. During any arbitrary audit period in more placid times, it is probable that the cost of energy will fluctuate to some degree. Thus, it is not possible – or practical – to make predictions of "energy cost savings." More properly, the discipline should be viewed more as an effort to "reduce energy consumption."

With this framework in mind, this paper is intended to explore some of the aspects involved in mapping out an energy management strategy.

Property Types

Hospitality properties may be loosely-grouped into three distinctions: full-service, limited-service, and timeshare. In general:

- Full-service sites will tend to support not only guest rooms, but additional amenities, such as on-site entertainment/restaurant areas, conference rooms and suites, larger pool/patio areas, etc. Guest comfort is considered paramount.
- Limited-service properties will tend to support guest rooms primarily, with perhaps a smaller pool, and limited conference facilities. If a restaurant is located on-site, it will typically operate as a stand-alone or franchise unit, with its own power feed. Guest comfort, while still a critical factor, tends to be affected by the price point of the individual property.
- Timeshare properties typically include guest rooms, often-extensive amenities such as multiple restaurants, large pool/patio areas, and sometimes even larger recreational areas tied directly to the site. Some will also include conference center options.

Obviously, there can be a great amount of "overlap" between these categories when assessing a site – but in each case, the relative percentages of energy being used in these facilities will break down quite differently for each of these classifications.

In addition, the property type will have a direct bearing on several different dimensions of the guests' experience, and the appropriate means of targeting energy savings. These dimensions may be summarized as:

- Energy consumption breakdown by room or area
- Service level or comfort guarantee
- Room habituation patterns

Energy Consumption by Room / Area

Because the three different property-type classifications each support a different "guest demographic," it is evident that the distribution of energy consumption within each type will differ as well.

As an example, the relative energy use for a full-service property may appear as follows.

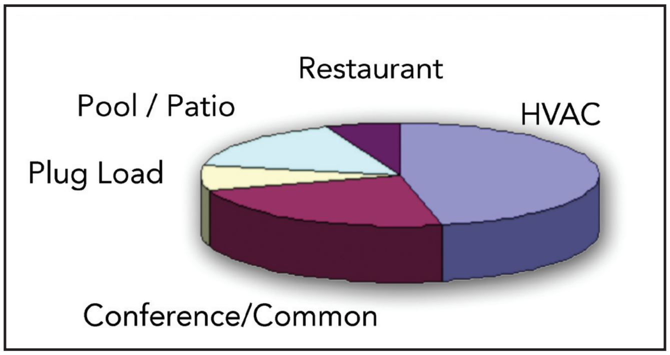

Figure 1. Relative Energy Use

In this example, it is apparent that heating, ventilation, and air conditioning (HVAC) accounts for the bulk (~46%) of the total energy consumption at the site. The precise component of HVAC usage will always vary somewhat, but industry trends show that these figures hover near the fifty-percent mark for most properties.

Service Level or Comfort Guarantee

This differentiator involves the level (and degree) of "comfort" that a particular property will provide to its guests. While this is a very subjective topic, the philosophy of a given property will have a large effect on the services rendered to the guests.

Room Habituation Pattern

Guests sleep in their rooms, but it is often surprising how little time they otherwise occupy their rooms. In many hospitality properties, guests will often leave in the morning (to attend to their daily meetings, work, or leisure activities), return in the evening, and then leave again for dinner and/or nightlife engagements. This is a critical area where an energy management system can reap huge rewards – controlling the run-time of the HVAC system when the room is unoccupied can tremendously reduce the consumption of energy.

The example below shows the simplified results of enabling a very basic energy management strategy: having the guest raise their thermometer settings when leaving the room during a summer stay. Here, the guest leaves the room at about 7:15 a.m., and returns at 5:00 p.m.

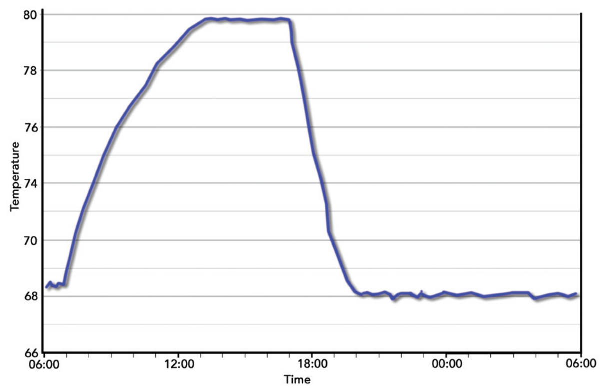

Figure 2. Simple TSTAT Modulation

In reality, this practice is simply not feasible: guests cannot be relied upon to modulate their thermostats! Very often, the guest will just leave the room, trusting their thermostat to retain their desired temperature throughout the day, such that the temperature is set when they return (hours later).

Taking this model to the next level, technology now allows the deployment of "intelligent thermostats" which – when tied into a room motion sensor – can detect whether or not the room is occupied, and maintain either an "occupied" temperature (the one which the guest has set) or an "unoccupied" temperature (an arbitrary temperature set by property management). Figure 3 shows the results of such a system, when the guest sets 70° and the unoccupied temperature is set at 76°.

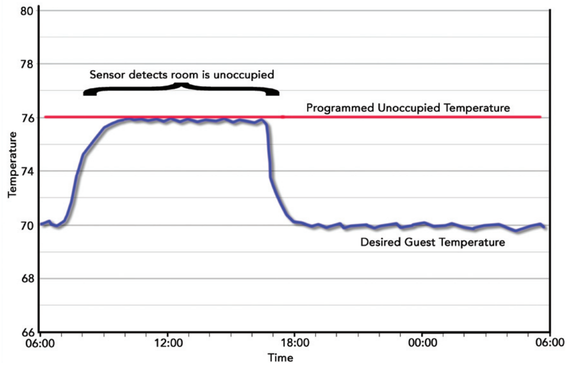

Figure 3. Smart TSTAT Modulation

The resulting reduction in energy consumption using such a system is not only immediate, but significant!

HVAC Recovery Time

When a guest enters their room, how long will it take the existing HVAC unit to bring their room to their desired temperature? A four-star hotel will obviously seek to keep this recovery time to a minimum. Thus, an optimal strategy will be to deploy a system capable of controlling not only the temperature within the room, but also controlling the amount of time that it takes the system to recover.

As an example, posit a luxury Southern property which allows summer guests to set their temperature to a minimum of 68°. As we saw above, invoking an "unoccupied" temperature maximum of 80° would allow a huge savings in energy consumption. However, the property owner has decided to add another element to the subjective "comfort" of her guests – she has mandated that when guests enter their rooms, the HVAC system will take no more than 8 minutes to recover to the guests' set point (70° in this example), regardless of the outside temperature.

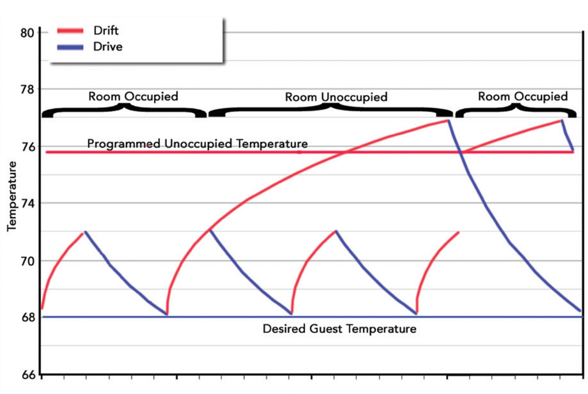

Figure 4. Floating Setpoint

In this example, the air conditioner can be seen allowing the temperature to drift upward until it reaches the trigger threshold, at which point the A/C turns on and "drives" the temperature back down to the Set Point. When the guest leaves the room, the motion sensor no longer senses the room as occupied – and allows the temperature to drift upward toward the Unoccupied Set Point (known as the Set-Back temperature).

If the room remains unoccupied, the system will then maintain the Set-Back temperature via the same drift/drive cycles – the only difference is that the temperature is higher than in the occupied state. However, because the system has been programmed to guarantee a return to the guests' set point within 8 minutes, the temperature in the room may never reach the Set-Back. The intelligent thermostat "knows" how long it will take to re-establish the set temperature at any given time, and will thus not allow any temperature excursions which would compromise that time.

When the guest re-enters the room, the sensor detects the movement, and the thermostat then begins driving the temperature back to the desired Set Point.

This technology may seem somewhat complex at first glance, but it carries with it another vector for energy savings: because the intelligent thermostat is "state aware" of the dynamics of the room, it can continuously and autonomously adjust to the weather conditions. On a cooler day, an unoccupied room would reach the Set-Back Point, resulting in fewer drive/drift cycles – and thus, less energy consumption.

Humidity and Air Quality

Humidity control can play a huge part in the longevity of a property's room furnishings and ambiance. Especially in humid geographic areas, adding humidity-control can eliminate the potential for mold, and enhance comfort. The relationship between HVAC run time and humidity is not always readily apparent.

The ability of an air conditioner to de-humidify the air within a room is the result of moving the air across the condenser coils. As the air passes over the coils, moisture in the air is condensed into water droplets, and channeled away via a drip line. This is a very effective means of controlling humidity – within limits. The difficulty is that many equate "cold" with "low humidity," because when the A/C first initiates its drive cycle, a long run lowers the humidity as planned – but as time passes and the A/C enters its short-term drift/drive cycle, the temperature may remain low, but the humidity will gradually increase.

Consider the graph below, taken from actual test data. In this example, the guest has set their thermostat to 68°.

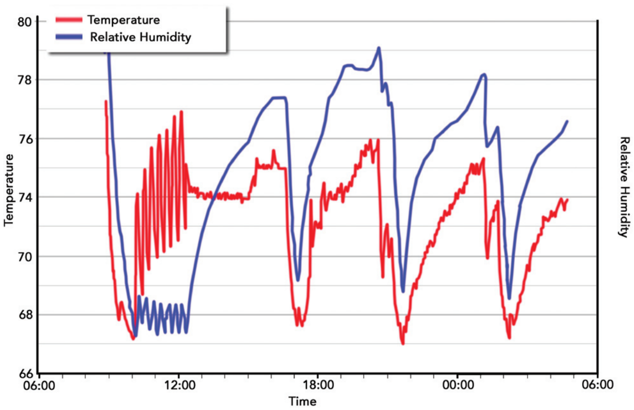

Figure 5. Temperature vs. Relative Humidity

In this test (initiated at 9:00 a.m.), the initial drive cycle lowers both the temperature and (as a side-effect) the relative humidity. By approximately 9:30, the temperature has stabilized at 68°. The initial drive cycle, from 9:00 to 9:30, moved a significant portion of the room's atmosphere across the condensing coils of the air conditioner. As a result, the relative humidity dropped as one might expect.

Note, however, the disparity between the temperature and RH after 9:30. In this case, after the initial cooling period, the fact that the A/C was now simply "maintaining" the set point resulted in very short drive durations. These short drive durations were too short to drive sufficient air across the condensing coils to achieve the desired humidity reduction. As a result, from noon until about 5:00 p.m. (18:00), the RH continued to climb, despite the fact that the desired temperature was maintained.

Guest Control

It should go without saying that in higher-service hospitality settings, the guest should have (apparent) ultimate control over their surroundings. This will naturally include control over the climate within their rooms. This is a fundamental fact of the hospitality industry. However, with the appropriate admixture of technology, the property owner now has the power to exert some control over the guests' energy expenditures, in a manner that is completely transparent.

The Physical Aspect of Energy Management

Within the demographic of the properties we are considering here (full-service, limited-service, and timeshare), the physical structure of the HVAC system tends to fall into three basic categories.

- Packaged Terminal Air Conditioners (PTACs) – Through-the-wall units often seen in hotels, usually positioned beneath a window. These units are – as the name implies – "packaged," in that the entire assembly is contained within a unitized case. Here, the actual A/C unit and the thermostat are all resident within the same package.

- Unitized Systems – These systems are typically characterized by a wall-mounted thermostat, accompanied by a separate HVAC unit. Because the HVAC body of the system can take several forms (not necessarily constrained to under-window placement), unitized systems find favor in full-service hotels. Their form factor allows placement in-between a suite of rooms, for example, and provides a generally-better distribution of airflow across a given room layout.

- Centralized Systems – Known as "Central Air Conditioning" (CAC), these systems operate at a building-wide level. Instead of using independent air conditioning units (as in the previous two variants), CAC systems rely on one or more cooling towers, which are typically mounted on the roof of the property. To control the temperature within specific zones or rooms, devices known as variable air valves (VAV's) control the distribution of cooled or heated air. The key distinction between CAC and the previous two variants is that the heating/cooling capacity of the entire system does not change – only the movement of the conditioned air into a specific area.

The type of HVAC unit(s) deployed at a property is a function of the specific property type. As an example, a limited-service property will almost-always have PTAC units.

This typography is a natural outgrowth of the economics of the specific property. Limited-service, and even many full-service properties, are often built by developers. During the design stage of the property, the developer will establish specific cost metrics associated with the construction of the property. In an effort to keep costs at a minimum (and thus maintain an attractive sale price to the eventual property owner), the developer will often deploy PTAC units. This accomplishes the dual purpose of providing essential air conditioning services at the property, and keeping the sale price of the property within specified limits. It is always less expensive (from the developer's point of view) to leave a hole in the wall, and insert a $300 PTAC unit per room, than to engineer and construct a unified building energy managed HVAC system.

A sad point of truth is that many buildings are doomed to energy inefficiencies from their initial blueprint stage! If one were to tally the independent costs of the multiple PTAC units necessary to provide complete conditioning of the property's airspace , the energy costs can easily approach an order of magnitude above that of a single unified system. In addition, from a property owner's perspective, the capacity for overall control of the system has been lost, because each guest has control over their own PTAC, and thus over the energy consumption per room.

A subtle point of distinction arises from the property's room layout. For example, a limited-service hotel will consist of a main area and bathroom, whereas a full-service hotel's suite might comprise several rooms. Expanding on this scale, a timeshare property's suite might be comprised of several bedrooms, a kitchen/common area, living and dining rooms.

It becomes immediately obvious that there is no one single answer to the requirements of a unified energy management strategy.

Energy Market Variables

Thus far, we have focused on the property itself, and how the dynamics of the property might lend themselves to energy savings strategies. Let us now turn our attention to the energy market, circa 2007.

The National Electrical Grid

In 2003, the nation was appraised of an unpleasant fact – the National Electrical Grid, through years of underfunding and relative neglect, had been marginalized to a degree which severely impacted the "self healing" nature of the structure. A simple demand overload in one substation trigged a sequential shutdown of hundreds of other substations, and rendered a unique portrait of a system on the edge of collapse.

Figure 6. 2003 Blackout in the Northeast United States

Since 2003, the electrical utilities have focused on methods of controlling (and containing) demand across the continental United States (CONUS). Great attention has been exerted at making the population aware of the need to control and contain energy demand.

This represents a significant bellwether in the evolution of the public utilities across the nation – up until now, they had been content to rake in the profits from an incessant increase in energy demands. The 2003 Blackout demonstrated the grave liabilities in the national infrastructure.

Predating – but more importantly, since that time, the public utilities have worked to develop strategies which would allow them some measure of control over the energy demands on their section of the grid at any given time. Perhaps the most well-known of these strategies is that of "demand response."

The principle of demand response is simple – during high-demand periods, the utilities issue "shed-load" requests to their customers. The customers, who have contracted themselves as a part of this strategy, receive subsidies/discounts in return for reducing their load during these periods (or face stiff penalties for a failure to comply). An example of this model is seen in Figure 7.

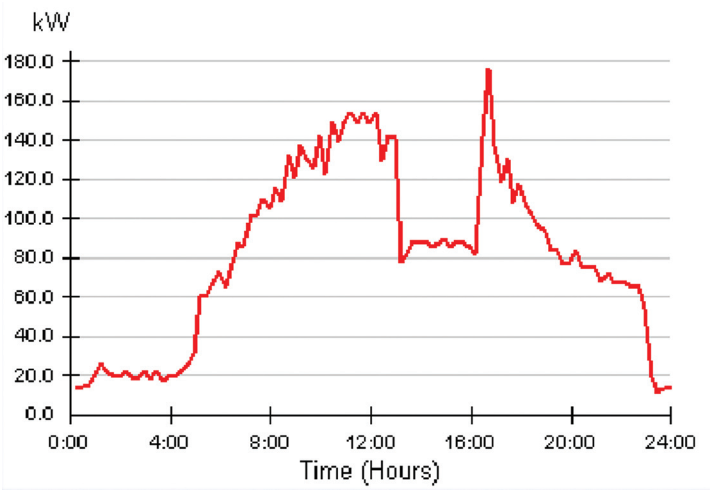

Figure 7. Shed Load

In this example, a commercial business plots its usage (in kilowatts) against time of day. We see a gradual increase in energy consumption from about 5:00 a.m. (when the first employees arrive) through lunch hour. At about 1:00 p.m., the property receives a "shed-load" request from the utility. Managers at the property then enforce the request, which is evidenced by the precipitous drop in energy consumption through about 6:30 p.m. After that, an upward spike (most-likely as a result of air-conditioning recovery atop the employee's plug load) is followed by a gradual decline as the employees leave the site.

It is imperative to realize that in the example above, the shed-load process was essentially a "manual" one – until recently, no technology existed to automate this process. The shed-load was accomplished by individuals walking through the site, turning off equipment (or cajoling others to do so)!

This procedure of demand-response has huge benefits to the electrical utilities, in two key areas.

1. By shedding load, the strain on the infrastructure (substations, transformers, HV lines, etc.) is rendered more "controllable."

2. If peak demand is reduced, the utilities will not have to light "peaker plants." Peaker plants are typically jet-powered electrical generators which sacrifice operating costs for the ability to rapidly bring them online .

Utility Constraints in the Hospitality Model

We must point out the differences between the example above and that of the hotelier – specifically, because since the hotelier is charged with providing maximum guest comfort, it would be disadvantageous to mandate an arbitrary curtailment of HVAC services during peak times! At the same time, the hotelier must remain attuned to the state of the market, and constantly seek a means of controlling costs without impacting guest comfort.

Energy Management Strategies

Given the sum of the factors discussed above, the property manager at a site may find themselves at a crossroads of confidence: to whom does one turn for assistance in mapping out an energy management strategy?

Telkonet, with significant experience in this field, stands ready to help. We recommend the following mission plan.

1. Collect twelve-plus months of contiguous energy bills. By assessing the energy costs and utilization across a baseline of one year or more, very distinctive trends and patterns emerge which will set the stage for determining the potential for immediate and long-term savings.

2. Verify that the energy expenditures for your property approach or exceed $100K per year. Our experience has shown that properties spending this yearly figure on energy (electricity, gas) can be shown demonstrative models of ROI which typically fall into the 18-26 month range.

3. Having shared the following information, invite Telkonet to conduct a site survey of your property. Our engineers are trained to pinpoint specific areas where our solutions can yield immediate – and long term – benefits.

No two properties are the same, and deployment strategies may vary – but the most common immediate gains are found in replacing the controls surrounding the HVAC system: smart thermostats and PTAC controllers.

Subsequent gains are achieved by networking thermostats to obtain a site-wide window of vision into the energy usage at a site, and by transmitting that data to an Energy Control Center (ECC). The ECC then parses data, performing trend analysis, and perhaps identifying methods by which the property could contract with the local utilities to obtain discounts – such as rebates for specific infrastructure upgrades, etc.

In the future, methods will exist to allow the utilities to manage shed-load requests in a remote, transparent model – which in turn would entail significant discounts. Such shed-load requests might be issued by a utility, through the ECC, and sent to the property itself.

Still, it is important to emphasize that each of these steps – and its impact (if any) upon the hotel's guests – is configurable: based upon the preferences of the hotelier, a staggering number of possibilities exist.

Summary

Energy management is not rocket science – rather, it is a sober and considered application of modern technology to very common-sense principles.

At the same time, there are a number of variables involved, each of which warrants attention and focus. While a strict common-sense approach might reap rewards, we submit that a broader approach – one which leverages the collective experience of a company which has focused on the hospitality industry for years – will be best suited to assist you in navigating these variables.

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