A Framework for Converting Hotel Guestroom Energy Management into ROI

by Francois Carle

Executive summary

Hotel guests and staff are not directly accountable for a hotel's overall utility bill. As a result, room occupants have little incentive to adopt energy-efficient habits. Yet, guest room energy consumption accounts for between 40 and 80% of energy use within the hospitality industry. In addition, industry data shows that guests remain outside of their rooms for several hours a day, on average. This paper analyzes room energy management approaches that accommodate both guest comfort and efficiency.

998-2095-04-24-14AR0_A4

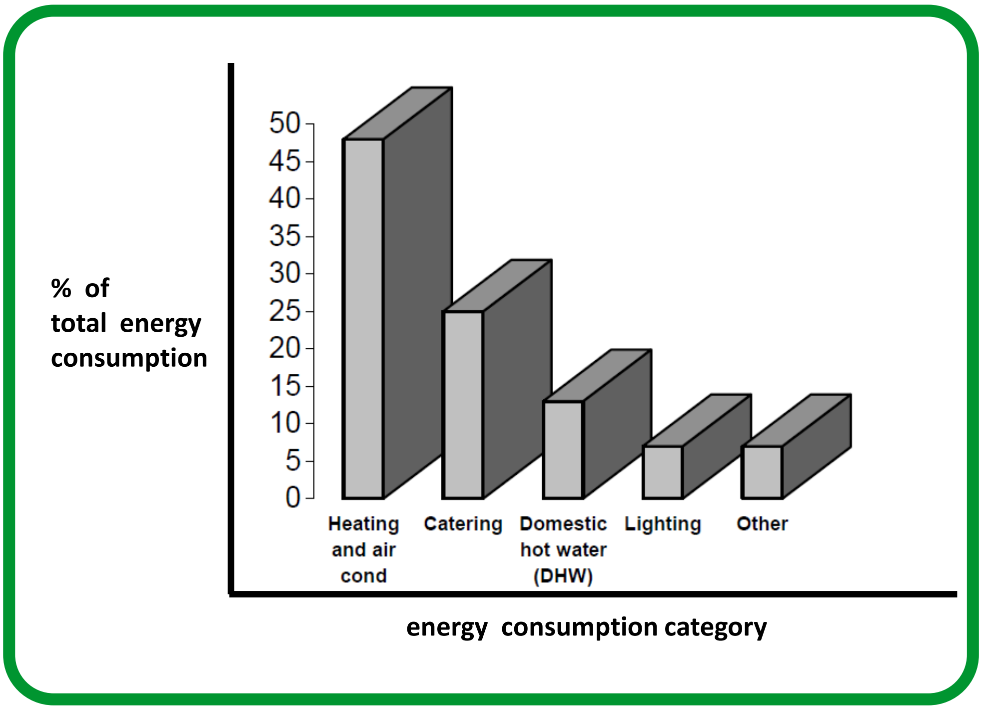
Introduction

According to industry data, the typical high-end guestroom uses 50 to 70kW of energy per day, and a luxury room often more than 80kW of energy per day.[1] This number varies depending on the type of hotel, location, and other factors. **Figure 1** illustrates a typical breakdown of how this energy is used within the hotel environment (again with variability based on specific environments and locations).[2] This data illustrates that hotel operators spend a significant portion of their budget on guestroom energy.

Reducing these numbers has a major impact on improving hotel asset Return on Investment (ROI). A 10% reduction in energy consumption would have the same financial effect as increasing the average daily room rate (ADR) by $0.62 in limited-service hotels and by $1.35 in full-service hotels.[3] An assessment of potential energy conservation in southern European hotels reveals that there is a potential for 25-30% in energy savings, especially in hotels with high annual energy consumption.[4] However, until now, it has been difficult to cash in on this potential entitlement.

Energy costs are not easy to control. As guests and staff are not directly accountable for a facility's overall utility bill, they often have little incentive to adopt energy-efficient habits. In addition, guest comfort is a top priority for hotel operators, especially if they expect hotel guests to return for repeat visits. On the other hand, industry data shows that guests remain outside of their rooms for long durations. In Europe, for example, rented rooms are unoccupied 60 to 65 percent of the time during the day.[5] In situations where guest comfort parameters are not adjusted during these periods of significant "away" time, considerable amounts of energy are wasted. **This paper examines how both standalone and integrated energy management systems can enable hotel operators to reduce room energy use without sacrificing the guest comfort.**

Figure 1
Example of a typical hotel facility energy consumption profile



[1] www.energystar.gov/ia/business/challenge/learn_more/hotel.pdf

[2] Paulina Bohdanowicz, Angela Chourie-Kallhauge, Ivo Martinac, "Energy Efficiency and Conservation in Hotels – Towards Sustainable Tourism", Royal Institute of Technology, Stockholm, Sweden, 2001

[3] www.energystar.gov/ia/business/challenge/learn_more/hotel.pdf

[4] Hotel Energy Solutions, "Analysis on Energy Use by European Hotels: Online Survey and Desk Research", Hotel Energy Solutions project publications, 2011

[5] Ibid.

Hotel guestroom consumption accounts for 40 to 80% of energy use within the hospitality industry (depending on the hotel size, location, type, heating, ventilation and air conditioning equipment, occupancy, and other characteristics).[6]

According to EnergyStar, hotels in the United States spend, on average, 6% of their operating budget on guestroom energy. In dollars, that comes to $2,196 per available room every year.[7] The figures vary depending on hemisphere, continent, and region, as well as each hotel's rating and services. It's been estimated that hotels spend as much as 30% of unneeded costs per room each year on guestroom energy for rented but unoccupied rooms.

Energy management simplification

Imagine a hotel where staff has quick and easy access to screens that enable them to control and monitor energy consumption in rooms that are either occupied, rented but not occupied, or not rented. From an energy and comfort perspective, all of these categories of rooms need to be managed differently, Sensors within the rooms gather an abundance of comfort, safety, and energy consumption data and building analytics software converts that data into actionable intelligence that improves the energy efficiency performance of the hotel and boosts the satisfaction of the guests.

The artificial intelligence built into the system identifies problem conditions in the various rooms and then offers suggested proposals and actions to address the situation. This type of automated fault detection and diagnostics is sent to cloud-based data storage. The data in the cloud is analyzed by qualified experts. The reports generated from this data, in addition to identifying equipment and system faults, identify a prioritized sequence of operational improvements, and energy usage trends. In addition, avoidable costs, total energy savings during pre-defined periods, and analyst commentary are provided (see **Figure 2**).

To get to this point of integration hotel operators will need to familiarize themselves with the various approaches available and ascertain which scenario makes the most sense in order to address both immediate and long-term hotel energy management needs.

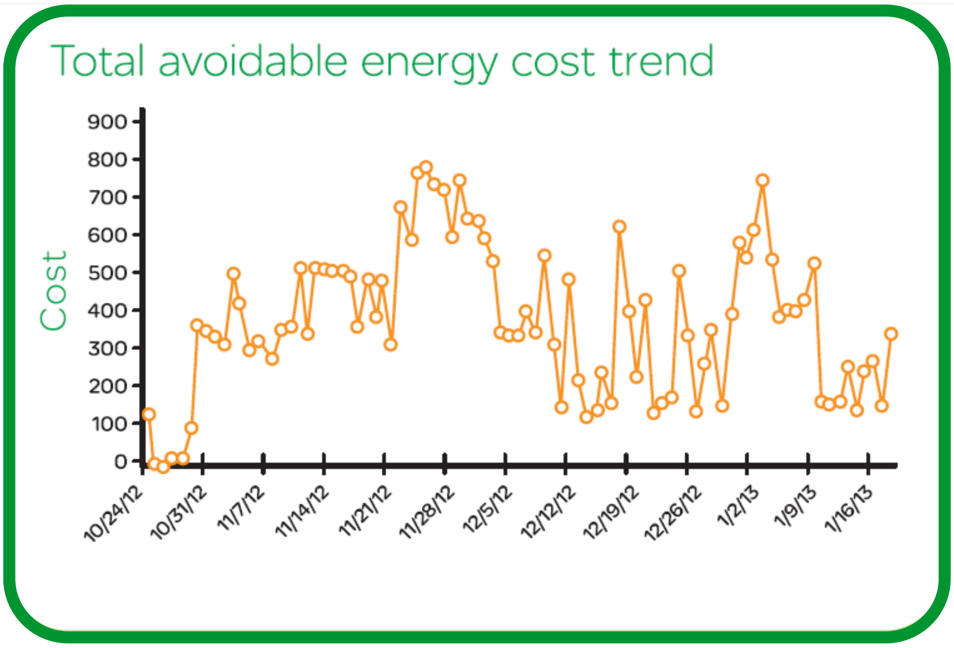


Figure 2
Sample building analytics chart derived from weekly reports

6 J. Blanchard, "Guest Room HVAC Occupancy-Based Control Technology Demonstration", Sept 2012

7 www.energystar.gov/ia/business/challenge/learn_more/hotel.pdf

Guestroom energy management systems utilize sensors and controls to adjust heat, ventilation and air conditioning (HVAC), lighting, and other environmental factors in rooms, based on whether or not the room is occupied. These systems are deployed in different ways.

Key card holder system: The key card holders approach has been widely accepted over the last 10 years especially in Europe and Asia. Utilizing this system, when a guest enters their room, they place their card in a special holder that activates the room HVAC and lighting settings (see **Figure 3**). This system has a weakness, however because it can affect the guest comfort. As soon as the card is removed, the light and the HVAC are switched off. Under such circumstances, when the guest comes back after a period of time, the room is often not at the desired temperature. As a result, guests who have experienced this once or twice, often bypass this “obstacle” by keeping a second card inserted in the slot while they are away. This behavior is sometimes even proposed by the hotel staff members, who want to ensure a comfortable stay for their guests. Such a practice results in significant energy waste and higher cost for the hotel operator.

Figure 3
Example of a card holder slot that is mounted on a wall near the door inside the hotel room.

In order to avoid this problem, smarter key card holders can be installed that both identify the key card and also manage a set-back position for the temperature

Enhanced guest presence detection: More hotel operators are now moving towards a guest presence detection system based on a combination of movement detection and door status. This approach has several benefits: it is seamless to the guest, it cannot be bypassed, and it is compatible with new access control devices such as mobile phones. Instead of a key card, a mobile phone can be used to enter the room, making key card holder unnecessary.

These systems rely on advanced logic to identify guest presence in the room (see **Figure 4**). While a single motion sensor can be an acceptable solution for managing the light in the bathroom, it is not an option for the living room or bedroom portion of the guestroom. This system evaluates several parameters simultaneously. The system factors in the status of the door in combination with the detection of presence. Depending on the size and shape of the room, additional sensors may be required.

When the guestroom is empty, the system adjusts HVAC and lighting to predetermined setbacks. When guests return, settings are restored, the room quickly adjusts, and guests have full manual control again. The increasing availability of wireless solutions has made this advanced system practical for both new hotels and renovated hotels at reasonable cost.

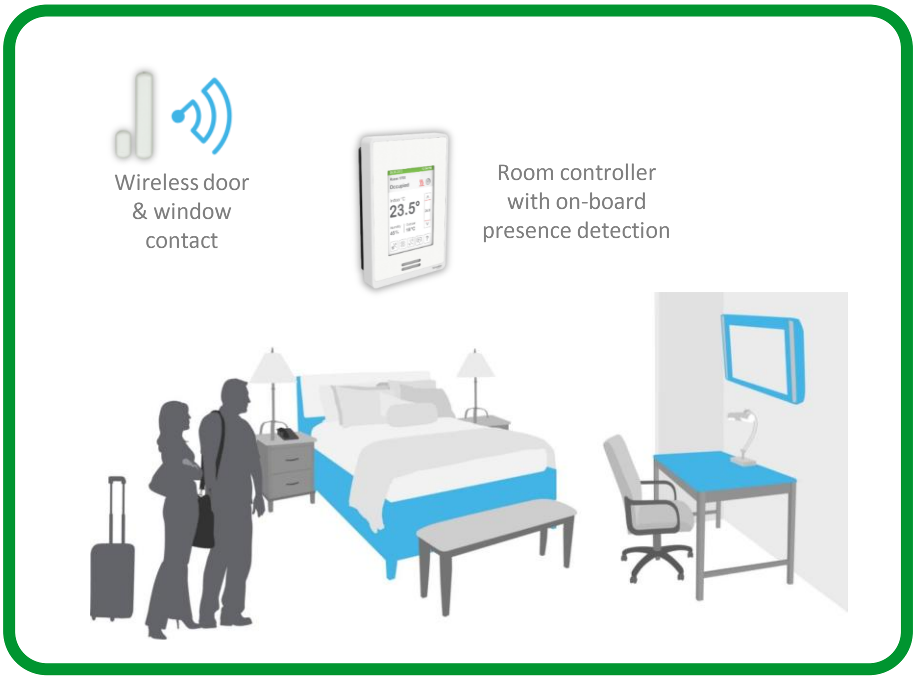


Figure 4
Instrumentation that allows for the development of a "smart" guestroom

As these systems continue to evolve, use of advanced presence detection approaches are now merging with the concept of "target" temperature settings to manage activation of heating and cooling systems in guestrooms. These settings allow the room temperature to fluctuate up or down a pre-determined temperature range. Hotel operator-selected variances, setback, and deep setback settings help to keep the room at desired temperature ranges thoughout various room status scenarios.

"New sensor technology is unobtrusive, and can even be built into thermostats to avoid being seen by the guest as a potential camera."

The purpose of these variable fluctuations is to ensure that the target temperature is maintained for guest comfort, while eliminating unnecessary "vacant energy expense" while guests are out of the room. When a guest re-enters, temperatures return to the guest's preferred settings, with the ability to make manual adjustments.

When the energy management system determines a room is unoccupied, it sends a signal to each light switch and turns off any light that is left on. Similar to the heating and cooling settings, a time delay can be programmed to system operator preference. As soon as the door opens again, guests can be greeted by warm courtesy lighting. Rules can also be set to not activate courtesy lighting during daylight hours when natural light is sufficient, thus maximizing the energy savings potential.

Systems can also include sensors for open windows to ensure that the heating or cooling is stopped while the window is open so that less energy is wasted.

The standalone system

Room controls can be managed as a standalone system, using presence detection sensors and door/window contact sensors. Temperature is relegated to a set-back position when the room is unoccupied and deep set-back after a pre-defined unoccupied period. Electrical circuits are turned off when the system detects that the room is empty (except for some outlets that can remain active so guests can recharge laptops and devices at any time they wish), and turned back on when guests return. In a standalone system, devices exchange information inside the room but are not connected to other systems outside the room.

Schneider Electric Case Study

This example (see **Table 1**) is taken from a study conducted by Schneider Electric in a 5-star hotel in the Middle East. Cost savings are based on actual energy use and costs for one room using a standalone energy management system and comparing it to a room which is metered but with no guestroom control.

Table 1
Impact of stand-alone guestroom controls on energy cost

EMS Savings Estimator Property Information		CEM HVAC System	
Number of Rooms	327	**Average Installed Cost per room (€)**	250
Electricity Reduction (kWh)	280,143	**Project Cost (k€)**	82
Carbon Footprint Reduction (Tons CO2)	180	**Yearly Energy Savings (k€) (Dubai Energy Price)**	24
Energy Savings	35%	**ROI Timeframe (years)**	3.5

US Department of Energy Case study

The US Department of Energy, in conjunction with the General Service Administration’s (GSA) Green Proving Ground program, evaluated the energy savings potential of HVAC occupancy-based control (OBC) systems. These systems were deployed in six different hotels in three metropolitan areas: Washington DC, Dallas TX, and Los Angeles CA.

Data was collected during four 1-month periods with each period representing a season or seasonal-shift (winter, spring, spring-to-summer, and summer).

Within each hotel, eight guestrooms were monitored in four pairs. Each guestroom pair had one room with the OBC HVAC system (i.e., controlled room) and one room with a standard thermostat-controlled HVAC system (i.e., baseline room). The four pairs were selected for their relative orientation to include the four cardinal directions.

The study found savings percentages commensurate with manufacturer estimates of between 10% and 30%. While savings varied significantly room-to-room and over any given period, the aggregated savings by hotel varied between a low of 10.8% and a high of 26.5%.[8] The annual energy savings per guestroom included heating, cooling, and fan energy use.

The integrated system

This system performance and associated savings can improve when the guestroom systems are integrated to the hotel’s building management system (BMS) and property management system (PMS). Such integration allows for deeper temperature set-backs of unrented guestrooms which results in additional savings. The use of open standards, allows both BMS and room controls to be integrated with a facility's front desk and PMS. This allows hotels centralized control of room comfort and promotes a building-wide approach to managing energy and guestroom comfort.

Examples of how such an integrated system can be leveraged include the following:

Programming degrees of drift, deep setback, and room shut down - If a room is rented but unoccupied, the system can be programmed to allow "drift" from the last set point attained before the occupant left the room. By utilizing this drift capability, the hotel

[8] J. Blanchard, “Guest Room HVAC Occupancy-Based Control Technology Demonstration”, Sept 2012

eliminates the energy wasted to heat or cool a vacant room. If a room is unrented and unoccupied, the deep-set back mode can also be utilized or, in some cases, the room may temporarily shut down to eliminate unnecessary expense. The ability to fine-tune these settings can significantly impact ROI during the initial payback period.

Troubleshooting, training, and monitoring - Continuous monitoring and convenient electronic alerts result in higher guest satisfaction and improved maintenance response time if problems arise. Staff can access system controls by room or floor to help resolve problems and manage in-room energy usage for peak performance. Additional data captured by the system, such as number of manual setback overrides, can also provide management with visibility into their employees' "green performance."

Tracking unauthorized room entry - When the guestroom energy system is linked to the PMS, useful data can be collected relating to the rented or unrented status of a room. With occupancy and vacancy detection, the system is able to alert personnel if a room is occupied during unrented periods. This safeguards company property inside a room, and assures management that only authorized personnel are permitted to enter when the room is vacant.

ROI elements to consider

The ROI of a hotel energy management system is affected by a number of key drivers (see **Figure 5**). Understanding these drivers can help to maximize energy efficiency benefits derived from improvements and help to assure rapid payback periods.

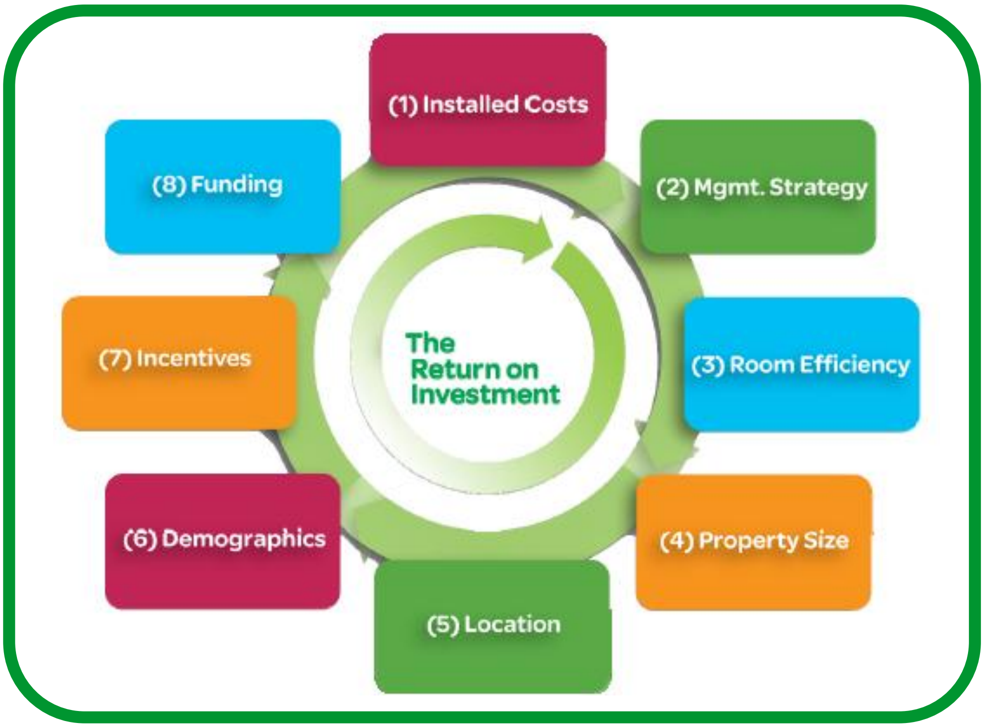


Figure 5
Multiple ROI drivers help to maximize energy efficiency benefits

1. **Installation costs -** These costs can be minimized by choosing a wireless system, that makes physical installation as simple as replacing a thermostat or installing a new light switch. This simple retrofit technology does not restrict a building's daily operation or require the shutdown of individual floors or occupied rooms for installation. This kind of system can be phased in by floor, building, or campus to accommodate the hotel operator's budgetary schedule.

2. **Management strategy -** A guestroom energy management system empowers hotel operators to develop effective management strategies based on real data.

Such a system can track millions of key data points that directly impact a facility's profitability and operating performance.

3. **Individual room efficiency -** Every property will experience rooms or apartments that run more efficiently than others. This is often due to factors such as aging HVAC equipment, a room's orientation to the sun, or poor insulation and thermal leakage. By collecting a facility's energy usage statistics over time, a hotel can identify the more efficient rooms, as well as those that are less efficient. This can provide valuable information for off-peak seasons, where management can choose to rent the most efficient rooms first to improve profitability.

4. **Property size -** There is usually a fixed-one-time expense associated with a server and software installation required for guestroom control energy management system. Since this fixed expense is spread over the number of available rooms in a multi-unit dwelling, larger properties with a high number of units will experience a faster Return on Investment. Additionally, by addressing periodic low fill rates in large properties, hotels will experience a greater impact on payback when they choose to set back or turn off large blocks of rooms during slow periods.

   In the United States, the federal government provides incentives for energy efficient investments based on property size. The Energy Policy Act (EPAct) of 2005 provides a federal tax incentive that allows accelerated depreciation during a property's first year based on a property's square footage. EPAct offers a tax deduction up to $0.60 cents per square foot for lighting and $0.60 cents for HVAC improvements. For example, a property operating under a 40% tax bracket with 80,000 sq. ft. (7,432 sq. m) under roof would net $38,400 in one year (80K X $1.2 X 40%).

5. **Location -** Local climate dramatically impacts energy usage and the ROI of an energy management system. Local variations in energy costs will also affect ROI. Energy cost is referred to in terms Average Cost per Kilowatt Hour, and can vary widely by city or region. In 2008 in the United States, for example, 18 states faced double-digit increases in energy costs while 32 states experienced increases of 5% or more.

"By collecting a facility's energy usage statistics over time, a hotel can identify the more efficient rooms, as well as those that are less efficient."

6. **Demographics -** Guest demographics can be an indication of guest occupancy habits. This can provide basic guidance toward achieving the optimum system settings. For example, vacationers are likely to spend more time in their rooms during the morning and afternoon hours to take advantage of the guest amenities or the opportunity to catch up on sleep. By contrast, business travelers are known to have regular working hours spent away from their room, departing early for meetings, followed by dinners and evening entertainment. By assessing such demographic patterns, hotels can gain a better understanding of the energy savings they can expect. Examples of demographic categories to consider include business travelers, vacationing families, retired couples, one night stays, and multiple night stays.

7. **Incentives and funding -** To encourage property owners to reduce their carbon footprint and dependence on fossil fuels, many local, state, and federal governments are offering incentive programs and funding packages for the installation of renewable and energy-efficient technologies such as energy management systems. Additionally, a multitude of incentive plans are available from local utility companies for sustainable installations. This often comes in the form of product rebates on a per-unit basis or preferential low-interest loans. Further information on state, local, utility and federal incentives and policies in the United States can be found at www.DsireUSA.org.

Conclusion

The goal in guestroom energy management is to provide a high level of guest comfort with a room controller that is simple to operate and non-intrusive.

As guestroom energy accounts for the majority of energy use within the hospitality industry – representing an average of 6% of the total operating budget – the efficiency provided by guestroom energy management systems is an additional driver to widely deploy these solutions.

Savings of hundreds of Euros per room per year have been verified, providing a rapid return on investment. The benefits are increased when the guestroom system is linked with the property management system, providing an unprecedented level of visibility and control of energy use.

By understanding the key factors that drive ROI, hoteliers can ensure that they will have a guestroom energy management system that meets their needs, works within budget, and pays for itself by optimizing energy efficiency and improving the bottom line.

About the author

Francois Carle is the Director, Global Hotel Solutions within the Buildings Business of Schneider Electric. Driving global business development, Mr. Carle leads the creation, expansion and implementation of the Hotels offer as it relates to global energy efficiency measures. Mr. Carle has more than 20 years of experience in the building energy management domain with expertise in both engineering and business administration.