Energy Efficiency Opportunities:
The Lodging Industry

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PREFACE

Most of us don’t associate the lodging industry with high energy usage. But when you consider the “24/7” nature of hotels, the variety of services they provide, and the transient and often wasteful energy-use habits of guests, energy efficiency opportunities abound. Any savings derived from a hotel property’s energy budget can be reinvested elsewhere.

In 2000, the Alliance to Save Energy reported that the lodging industry was the fourth most intensive user of energy in the U.S. commercial sector. In the United States and Mexico, energy costs in the lodging industry average nearly $2 per square foot. The hotel industry spends about $500 per room per year for fuel and electricity.

In this report, we’ll show you how to plan and implement energy efficiency improvements, and provide examples of hotel operators who have successfully executed similar programs. If you would like help pursuing such improvements, please email one of the authors.

The paper is published by the Center for Energy and Climate Solutions (CECS), a one-stop shop for helping companies and states design high-leverage strategies for cutting energy costs and reducing air pollution, including greenhouse gas emissions. The Center is a division of the Global Environment & Technology Foundation (GETF), a nonprofit dedicated to building the infrastructure for sustainable development. GETF facilitates the demonstration of new technologies and ways of doing business and helps make these ideas accessible and replicable throughout a number of sectors. We look for innovative technologies and partnerships that can significantly contribute to this goal.

Since its inception in 1998, the Center has developed best practices and high quality case studies on corporate greenhouse gas mitigation and energy efficiency. These were published in the 1999 book Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions. Since 1999, CECS has worked with the World Wildlife Fund to create the Climate Savers program, which encourages major companies to make GHG commitments. Climate Savers companies include IBM, Johnson & Johnson, Polaroid, The Collins Companies, Lafarge, and Nike.

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EXECUTIVE SUMMARY

There is no such thing as a typical hotel. The American Hotel & Lodging Association reported that in 2001, the U.S. hospitality industry is comprised of more than 53,000 properties with in excess of 4.1 million rooms, generating $108.5 billion in revenues.¹

Energy use and efficiency improvement opportunities for hotels and other hospitality facilities are closely related to the geographical location and the nature of the operations within the facility. Climate is a major factor, particularly in northern and southern locations that experience temperature (and humidity) extremes.

According to the Alliance to Save Energy, reducing energy costs while continuing to meet the diverse requirements of hotel customers can be challenging. Hotels consume enormous amounts of energy to provide a variety of customer services. In 2000 the Alliance to Save Energy reported that the lodging industry was the fourth most intensive user of energy in the U.S. commercial sector. The hotel industry spends about $500 per room per year for fuel and electricity.² That’s approximately $2 billion for the more than four million hotel rooms in the U.S.

With the strategies and technologies described in this paper, the hotel industry could cut energy costs 25% ($500 million) or more. We outline several examples of successful lighting, mechanical and energy management efforts already yielding results at properties around the world, including:

- Recent upgrades to the Hotel Queen Mary’s (Long Beach, Calif.) air conditioning system are helping to ensure that the ship's guests are kept comfortable while providing the hotel owners with award-winning energy savings that will top $100,000 per year.

- The Parkroyal Surfers Paradise hotel, on Australia’s Gold Coast, implemented lighting enhancements including compact fluorescent lights in guest areas, halogen lighting, metal halide external lighting and more efficient lighting for conference rooms. A capital investment of $130,000 achieved annual energy cost savings of $48,000, a payback of under three years.

- With temperatures frequently topping 90 degrees Fahrenheit, and humidity hovering in the 80 percent range, the Acapulco Princess Hotel has some significant energy challenges. By installing a new air conditioning system and upgrading its existing building automation system to integrate lighting control, comfort control for guest rooms, access control, and fire safety, the hotel achieved up to a 10 percent total savings on energy while realizing an 80 percent improvement in system cooling efficiency.

- Red Lion Hotel’s (Portland, Ore.) central laundry facility goes through an average of 70,000 gallons of fresh water per day and has the capacity to wash 25,000 pounds of laundry per day. An innovative recycling project is expected to reduce water use at the laundry facility by at least 40 percent. Most of the thermal energy from hot water discharges will be recovered, which will lead to an estimated gas bill savings of 40- to 50-percent. Overall, water and energy cost savings of $40,000 per year are projected.

Opportunities to save energy and improve the bottom line in the lodging industry are abundant. In this report, we’ll show you how to plan and implement energy efficiency improvements, and provide examples of hotels that have successfully executed such programs.
ENERGY EFFICIENCY OPPORTUNITIES: LODGING INDUSTRY

BACKGROUND
There is no such thing as a typical hotel. The American Hotel & Lodging Association reported that in 2001, the U.S. hospitality industry was comprised of more than 53,000 properties with in excess of 4 million rooms, generating $108.5 billion in revenues. They range from small Bed & Breakfast inns to mammoth, 2,500-plus room resort hotels. Ownership ranges from large multinational hotel chains to private individuals who own small motels, B&Bs and cabins. It is a broad and very diverse industry.

Most of us don’t associate the lodging industry with high energy usage. But when you consider the “24/7” nature of hotels, the variety of services they provide and the transient and often wasteful energy-use habits of guests, energy efficiency opportunities abound.

Energy use and efficiency improvement opportunities for hotels and other hospitality facilities are closely related to the geographical location and the nature of the operations within the facility. Climate is a major factor, particularly in northern and southern locations that experience temperature (and humidity) extremes. Because of the temperate climate, a hotel in San Diego will experience much less energy consumption per guest than the equivalent hotel in Miami or Minneapolis. In Miami, hotels operate on 24-hour cooling and dehumidification, while a Minneapolis facility heats for much of the year. Hotels in mixed-climate areas have to do some of both.

Hotel guests, many of whom are paying top dollar for a home-away-from-home, won’t be denied the comforts and convenience they expect in their lodging. They want control over room temperatures, the ability to take limitless hot showers 24 hours a day, to leave the room set at the perfect temperature whether they are occupying it at the time or not, and to leave their rooms without worrying whether the lights are still on. They want round-the-clock room service and access to restaurants, business offices, conference rooms, stores, and spas. The primary focus of hotel owners and managers is to deliver those amenities.

Reducing energy costs while continuing to meet the diverse requirements of hotel customers can be challenging. But it is a challenge worth taking. Hotels consume enormous amounts of energy to provide a variety of customer services. In fact, in 2000 the Alliance to Save Energy reported that the lodging industry was the fourth most intensive user of energy in the U.S. commercial sector. In the United States and Mexico, energy costs in the lodging industry average nearly $2 per square foot. The hotel industry spends about $500 per room per year for fuel and electricity. That’s approximately $2 billion for the more than four million hotel rooms in the U.S.
A hotel’s services and activities also have a major influence on energy costs, a fact not always understood by hotel management. Many hotels have “energy sinks” that go unnoticed or get ignored because the energy is not accounted for on an individual operation basis. Most hotels don’t really know how much it costs to maintain a pool facility or in-house laundry services, so they don’t consider measures that could reduce energy costs in those operations. They believe it is an essential operation and must be maintained at any cost. This practice tends to overlook the potential savings from improving efficiency.

There is a wealth of information about energy efficiency opportunities in hospitality facilities and no shortage of case studies about hotel energy savings. Hotel operators need only determine what operations exist in their facilities and then match themselves to similar places where measures have been proven to reduce energy. Several hospitality trade associations have established energy efficiency programs for their members and the U.S. Department of Energy (DOE) and Environmental Protection Agency (EPA) have developed resources directed at such facilities.

**Benchmarking – What should I compare my property to?**
There are many factors that influence energy consumption in the hospitality industry. Therefore, it is very important to compare properties to facilities in similar climates and with similar features. The following features, in particular, can have a sizable impact on the energy consumption of hospitality properties.

- Laundry – In-house or outsourced?
- Swimming pool(s) – Indoor or out? Heated or not?
- Health Club – Hours of operations? Open to the general public?
- Meals – Full dining services? Serving non-guests? 24-hour room service?
- Meeting Facilities – Number and size? Ballroom? Exhibition space?
- Central HVAC or through the wall units?
- Single rooms or suites?
- Family vacation or business guests?
- Other activities – Casino, theater, retail, etc.?

The Hospitality Research Group (HRG), the research affiliate of PKF Consulting established a database that uses nine “amenity categories” with points of differentiation between budget-type (i.e., Motel 6) up to deluxe (i.e., Ritz-Carlton) and seven categories in between. The intent is to compare facilities to like facilities in the same category, but sometimes the dividing lines are not clear. There are simply too many variables that can affect energy use, and not all can be tracked and considered for every facility.

Lighting is not very dependent on geography, except perhaps in the far northern reaches such as Alaska. HVAC energy consumption varies widely by both geography and guest amenities and activities. Large hotel-casino complexes have extremely high-energy use because of their 24/7 operations and very high ventilation requirements. Most casinos permit smoking and over-ventilate to prevent complaints from non-smokers and to keep the air clear for video surveillance.

In order to simplify this report we have broken hotel energy use into two categories – lighting and mechanical/other. They are addressed separately in the following sections.

**LIGHTING**

Lighting is not always the biggest energy consumer in hospitality facilities but it is usually one of the best opportunities for reducing energy costs. And, as a bonus, most lighting upgrades also
result in improved lighting quality. New lighting technologies often produce energy reductions of 40- to 80-percent and paybacks less than three years. These lighting improvements generally fall into two categories – more efficient lighting fixtures and improved lighting controls.

**Efficient Lighting** – More efficient lighting is obtained by installing more efficient lamps and ballasts in more efficient fixtures. An easy change is to replace incandescent bulbs in the hallways with compact fluorescent lighting. In hospitality facilities, lighting retrofits must be done in a way that maintains or enhances aesthetics and caters to the guests. Backroom areas must maintain lighting that enhances high worker productivity. Each of the areas in hospitality facilities has its own concerns so the optimum lighting solution differs between areas.

**Back Room Areas** – “Back rooms,” the areas seldom seen by the guests, are often the best opportunities for lighting upgrades. They can represent a sizable portion of the total space in a hotel and in many facilities they are lit 24/7. Back room areas include administration, housekeeping, facilities operation and maintenance, laundry and food services. Most of these areas have very functional lighting, which can often be upgraded with fixture retrofits such as high efficiency lamps, ballasts and specular reflectors (where applicable).

![Typical “back room” lighting in a hotel](image)

Sometimes installing new fixtures is more cost effective, especially when the existing fixtures are old or damaged and the lenses, louvers or other fixture components cannot easily be replaced. At a minimum, back room lighting upgrades should result in T8 or T5 fluorescent lamps and electronic ballasts. All incandescent lighting should be replaced with fluorescent, either screw-in CFLs or new fluorescent fixtures. Retrofits of this type generally produce energy savings of about 40 to 80 percent.
**Meeting Rooms** – Meeting rooms can be an excellent opportunity because their lighting use is usually during the daytime peak hours when electricity is most expensive. Many meeting rooms still have incandescent lights because they are easy to dim during presentations and functions where low light levels are desired. Until recently, only incandescent lamps could be dimmed effectively but that has changed. Both linear and compact fluorescent lamps (CFL) can now be dimmed using special dimming ballasts.

The savings comes when the new fluorescent lights are at full brightness and they only consume about 25 percent as much energy as the incandescent lamps they replaced. Many of the new dimmable fluorescent fixtures are aesthetically pleasing so the upgrade does not have to sacrifice looks for efficiency. Although the run hours of most meeting rooms are not too high, the 75 percent energy savings more than makes up for it.

**Restaurants** – This is an area where energy engineers must tread lightly. Restaurants in many hospitality facilities are very concerned about aesthetics and any lighting upgrade must be inconspicuous, especially in upscale hotels. Fortunately, new energy efficient lighting fixtures have been developed that do just that. They are attractive and efficient at the same time. Most rely on dimmable compact fluorescent lamps while a few use indirect lighting from T8 or T5 lamps. Color is important and most of the new fixtures use lamps that come in several colors including the 2700 K that closely matches common incandescent lamps.

These incandescent fixtures could be easily retrofitted with new, dimmable CFL lamps of the same color.

**Kitchens** - Because of the numerous detailed tasks being performed in kitchens they deserve high quality, glare free light. Also, high CRI lamps make it easier to distinguish colors – i.e. a rare steak versus medium-well. Health requirements necessitate enclosed fixtures, which require regular cleaning and maintenance. Most commercial kitchens can obtain high quality, efficient light from either recessed troffers or enclosed wrap fixtures, which use T8 lamps, electronic ballasts and specular reflectors. The general lighting in kitchens may need to be supplemented by task lighting under hoods and in areas where very detailed tasks are performed.
**Guest Rooms** – For many years incandescent lights were considered the only acceptable choice for guestrooms and for good reason. Most fluorescent room lamps of the past had poor color, tended to flicker, and were not “instant-on.” The latter feature is important because guests expect instant light when they flip a switch.

![Typical resort guest room](image)

The past five years have seen the introduction of compact fluorescent lamps of all sizes and shapes; many of which are ideally suited to hotel rooms. Many of them can be installed in existing fixtures while others require a new fixture. Two fixture designs, in particular, are finding their way into hotel rooms.

The first, the fluorescent torchiere, provides high quality indirect light that is ideal for rooms with light colored ceilings at least eight feet high. The second, the Berkeley Lamp, is a combined direct-indirect lamp, which excels in hotel rooms. Both fixture types come with dimmable fluorescent lamps having excellent color.

![Fluorescent torchiere](image)

![Berkeley Lamp](image)

Initial data from a Lawrence Berkeley National Labs study (see section, Lighting Controls) indicates that compact fluorescent lamps (CFLs) and occupancy sensors offer significant energy savings potential in hotel guestrooms.

**Front Lobby** - Hotel front lobbies can be very small or, as is the case in large hotels, very large and opulent. For many properties the “main lobby” is a showpiece and it must make a statement. Often they are meeting places and cocktail lounges. Their lighting is often very innovative and cannot be modified or upgraded unless it maintains the desired effect. However, there are some lighting upgrade opportunities even in hotel lobbies. Because of the large windows, daylighting is often feasible in lobby areas. This can be enhanced and controlled with light shelves, which intercept direct daylight and redirect it upwards where it becomes softer indirect lighting.
Other lobby lighting upgrade measures include a) using T5 lamps for valance and indirect lighting, b) replacing small decorative incandescent lamps with LED lamps that last much longer, c) replace incandescent floodlights and spotlights with fluorescent fixtures having the same distribution (and dimmable if necessary). These incandescent to fluorescent conversions must only be done after evaluating several fixtures that can replicate the mood and ambiance desired in the lobby areas.

Light shelves at the Hyatt McCormick Place, Chicago

Office/Administration – The administrative areas of most hospitality properties are not unlike the office areas in most commercial buildings. Workers spend much of their time on computers and the phone. The optimum lighting for these areas is low level general lighting supplemented with task lighting. If ceiling heights permit, indirect T5 lighting fixtures are ideal for these areas.

Indirect lighting is ideal for offices with high computer use.

Indirect lighting in an executive office.
**Outdoor Lighting** – Outdoor lighting at most hospitality properties serves three purposes – security, aesthetics and information. Good outdoor lighting should also be energy efficient and low maintenance.

Presently HID lighting (metal halide, high pressure sodium and mercury vapor) dominates the outdoor lighting market but that is due to change. New high intensity fluorescent (HIF) lighting has been developed that provides better light using less energy. In most cases the improved color of the HIF lighting also enhances the property. Induction lighting (i.e. Philips QL or Osram Icetron) also fills the bill nicely in outdoor applications formerly dominated by HID light sources.

Fluorescent security lights can be controlled with occupancy sensors.

A few properties still use incandescent lighting for landscape and accent lighting. Any such incandescent lights should be replaced with more efficient and longer lasting fluorescent fixtures. Both standard and induction types of fluorescent lamps should be considered for these applications.

Fluorescent lighting is ideal for outdoor signs

Energy efficient CFL accent lighting
Parking lots and garages – Parking areas are another place where fluorescent lighting is now superior to HID lighting. The new HIF fixtures are more energy efficient, have much better color and are instant on/instant re-strike. Fixture selection is important because at low temperatures fluorescent lamps must be in enclosed fixtures. Also, as with most outdoor lighting the use of sharp cutoff fixtures is essential to avoiding “light trespass” complaints from neighbors.

An energy efficient fluorescent parking lot light fixture.

High quality, energy efficient HIF lighting in a parking garage.

Recreational Lighting – Many large hotels have outdoor swimming pools, tennis courts and other recreational areas for use by guests and sometimes the paying public. Here again, high intensity fluorescent is replacing HID as the lighting of choice. It is more energy efficient and has better color. Also, its instant on capability makes it ideal for occupancy sensor controls.

These fluorescent tennis court lights can be controlled with occupancy sensors.

Indoor pools, tennis courts and exercise rooms are also excellent candidates for HIF lighting with occupancy controls. Many hotels leave the lights on 24/7 in such areas even though they are vacant for many hours each day.
LIGHTING CONTROLS

Having efficient lighting fixtures achieves only a portion of the results in hospitality facilities. The remainder of the savings comes from optimizing the lighting controls -- having lights on only when they are needed, where they are needed. Lighting controls can be as simple as manual switching and as sophisticated as being computer controlled.

Occupancy sensors – These devices have improved significantly and now provide reliable control of lights according to an area’s occupancy. In hotels they find use in back rooms, exercise rooms, meeting rooms and guest rooms. Sometimes the occupancy sensor can also control the HVAC system for the area.

In 1998 Lawrence Berkeley National Labs (LBNL), in conjunction with the DOE, conducted a study to better understand the lighting usage and energy consumption patterns in typical hotel guestrooms. Emphasis was placed on determining where guests were using lighting energy and identifying the savings potentials that energy efficient technologies could present.6

Ten guestrooms on the same wing and floor of the Redondo Beach (Calif.) Crowne Plaza hotel were used for the study. The rooms were both single and double occupancy and had the following lighting fixtures: an entryway downlight, a bathroom light, one or two bed-end table lamps (depending on room type), a table lamp on the desk, and a floor lamp. (See Figures 1 and 2).
For three months in the summer and fall of 1998, lighting use profile data from the ten guestrooms was collected. The chart shows the average use data (or “on-time”) for each type of guestroom fixture. This data is based on the average of the ten guestrooms during every occupied day during the study (except for the data from bathroom lights that used the occupancy controllers). This data indicates quite clearly that bathroom lights experience particularly heavy usage at nearly eight hours of operation a day. Since some hotel bathrooms use incandescent vanity fixtures, this can lead to significant energy loads. At this level of daily usage, a bathroom vanity fixture with four 60W bulbs (the fixtures currently used by the Redondo Beach Crowne Plaza) consumes over 600 kilowatt-hours a year, or almost $60 per year in each guestroom for bathroom lighting alone. The next most used fixtures were the table lamps on the bed end tables that were on for an average of almost 5 hours per day. With 100W bulbs, this represents nearly 180 kilowatt-hours per year, or over $12 per table lamp per year to operate.

In general, during the early morning hours (midnight to 5:00 a.m.) only a small fraction (less that 15 percent) of the lights are turned on. Alternatively, all fixture types experience peak usages in the morning (6:00 – 10:00 a.m.) and in the evenings (after 5 p.m.). It is interesting to note that some of these fixtures, most notably the high use bathroom and bed fixtures, do not experience a significant “dip” during typically unoccupied daytime periods between 11:00 a.m. and 5:00 p.m.. These lights are on 20- to 25-percent of the time during this period. Significant energy savings could be achieved if hotel policy encouraged housekeepers to turn all room lights off when they leave.

A significant finding in this study is the relatively high usage and energy impact of the bathroom lighting. While many bathroom fixtures are already fluorescent, significant energy savings could be achieved through the integration of occupancy sensors in bathrooms due to the substantial burn hours of these fixtures. Because of their high wattage, incandescent bathroom fixtures offer extraordinary energy savings for occupancy sensors at nearly $40 per fixture per year. But even fluorescent bathroom fixtures could save nearly $10 a year with the addition of an occupancy sensor. Integration of a bathroom lighting controller/occupancy sensor can present energy savings that rival those achieved by retrofitting all table and floor lamps with CFLs, with a much lower initial investment.

In most cases a simple payback of less than two years can be achieved by replacing incandescent lamps with CFLs in table and floor lamps. Many hotels have recognized the energy saving potential of CFLs and mandated their use in all their facilities. But as many as half of the hotel rooms in the U.S. still use incandescent lamps in the table and floor lamps.

**Dimming and Daylight Harvesting** – Lighting should be dimmable in areas receiving daylight from windows, skylights or atriums. Photocell controls combined with dimmable ballasts will automatically reduce the output from fluorescent lighting fixtures whenever there is adequate daylight.
Lighting management system – Even with the use of occupancy sensors there may be places where lights remain on when the area is unoccupied. These tend to be large open areas such as meeting rooms and conference/exhibit spaces. An automatic lighting management system can be programmed to turn off the lights after the event has ended. Some of these systems are combined with an energy management system to permit both lights and HVAC to be scheduled for various events.

The application of energy efficient lighting products and controls can reduce lighting energy costs by more than 50 percent in many hospitality facilities. More important however is the improvement in lighting quality and reduced maintenance costs that result from these upgrades. Paybacks for these measures range from one to five years depending on local electric rates and the availability of utility rebates.

Case Study: Parkroyal Surfers Paradise, Australia

The Parkroyal Surfers Paradise, located on Australia’s Gold Coast, is a 379-room, 528,766 sq ft (49,124 m²) hotel with two towers and a total of 48 floors (22 in the North Tower and 26 in the South Tower). An investment of $130,000 in efficient technologies achieved annual energy cost savings of $48,000, a payback of under three years.

Among the many lighting enhancements are compact fluorescent lights in guest areas, halogen lighting, metal halide external lighting and more efficient lighting for conference rooms. The Parkroyal replaced 50-Watt lamps in 348 of its guest bathrooms with 20-Watt lamps, and also replaced eighty 150-Watt lamps in conference rooms with more efficient 75-Watt lamps.
LODGING – MECHANICAL OPPORTUNITIES

Although not present in every facility, the following mechanical energy efficiency opportunities exist at many hospitality facilities:

Central Plant

Install higher efficiency chillers (or other AC systems) – New chillers are 25 to 50 percent more efficient than chillers 10 or more years old. Since many facilities with central chillers must replace them to comply with the CFC phase-out it pays to invest in a new, high-efficiency unit. The new chillers also have vastly improved controls that make it easier to optimize chiller efficiency.

Case Study: Sheraton New York Hotel

The Sheraton New York Hotel, located on Manhattan’s Seventh Avenue between 51st and 52nd Streets and adjoining retail and business centers, is a 1.2 million sq ft facility encompassing 1,750 guestrooms and a wide variety of dining, entertainment and business meeting options.

The hotel was built in 1962 and was operating on its original chiller plant. That plant included two 1,100-ton steam turbine-driven centrifugal chillers, and one 400-ton electric centrifugal machine. Steam for the two large machines was supplied by New York's district steam system.

Analysis by consulting engineers revealed that electric centrifugal machines could save significantly in building operating costs for this 24 hour per day operation. During off-peak (evening and weekend) hours the hotel is able to take advantage of low rates to operate at a cost of less than three cents per ton-hour, versus nearly ten cents for steam. The Sheraton accepted bids for high efficiency chiller alternatives in addition to the .62 kW/ton base bid. A .528 kW/ton bid was accepted, promising a payback of less than 3 ½ years.
Recent updates to the Hotel Queen Mary's air conditioning system are helping to ensure that the ship's guests are kept comfortable while providing the hotel owners with award-winning efficiency savings that will top $100,000 per year.

Launched in 1936, the RMS Queen Mary was...for many years the grand lady of the Atlantic Ocean. She pampered her passengers in art deco luxury while setting the Atlantic speed record on two occasions. Although permanently docked at Long Beach, California, since 1967, the Hotel Queen Mary continues to pamper guests in original staterooms. Cooled and/or heated air is distributed to state rooms via the original overhead duct outlets.

Today, the Queen Mary is served by land-based electric and water utilities. To maintain the comfort that Queen Mary guests expect, the ship’s owners have updated the HVAC system to improve reliability and efficiency. Chilled and hot water for HVAC is piped to the Queen Mary from the energy plant located three-fourths of a mile away. The ship was originally designed without mechanical air conditioning systems and relied on the distribution of cool North Atlantic air, heated as necessary, for ventilation and comfortable temperatures throughout the ship. However, permanent berthing in warm Southern California made mechanical cooling a necessity. Large chilled water coils were installed in the ship’s air intakes such that cool, dehumidified air is distributed using the original ductwork.

An analysis conducted by Henry Lau, PhD and senior engineer at Southern California Edison, indicates the estimated annual savings to the Queen Mary for the high-efficiency variable speed chiller is 896,000 kWh or $107,000 per year.
Case Study: Horseshoe Casino and Tower, Bossier City, La.

The Horseshoe Casino and Tower encompasses a 25-floor super-deluxe hotel with 606 rooms connected to an enormous floating casino boat and a temporary theater with seating for 1,350. Add to that a growing attached luxury retail area and four restaurants plus an employee cafeteria. The facility is located in Bossier City, La., near Shreveport, with an annual average of 2,538 cooling degree-days and chronically high summer heat and humidity.

A focus on “high quality” by the hotel’s owner is the reason most of the hotel cooling is performed by a chilled water system with individual fan-coil units in guest rooms and variable air volume (VAV) equipment in public areas, including hallways, restaurants and retail areas. These are supplemented with blower coil air handlers.

All of the public areas are spacious and well ventilated. This is a requirement because of the large number of visitors to the facility. Horseshoe’s records show that the recreational site has had 21 million visitors in the past five years. For this reason, equipment needs to be kept on line around the clock and comfort levels must be constant.

The actual casino is aboard a boat on the Red River. High levels of outdoor make-up air are mixed into the air stream in the casino area through air handlers and a variable air volume (VAV) distribution system. Even though smoking is allowed in the casino, high ventilation levels make it almost unnoticeable. And because of these high ventilation levels, deep coils and low chilled water temperatures are essential for adequate dehumidification.

High levels of outdoor make-up air are mixed into the air stream in the casino area through air handlers and a variable air volume (VAV) distribution system.
Consider installing a larger cooling tower to improve efficiency and reduce tower return temperature - Cooling towers are rarely sized to handle “worst case” conditions. As a result the entire cooling system is very inefficient on the warmest days. An oversized cooling tower results in lower return water temperatures and higher chiller efficiency.

An energy efficient cooling tower with a variable speed fan.

**Install variable speed drive(s) on the cooling tower fan(s)** – A variable speed fan will allow the cooling tower to operate efficiently using less fan energy and will reduce fan maintenance by eliminating on-off fan cycling.

**Install high efficiency condensing boilers for heating hot water** – All gas and propane-fired boilers should be modulating condensing boilers with efficiencies higher than 90 percent. This is about 30 percent more efficient than most older boilers. Also, condensing boilers operate very efficiently at low loads. Most new installations utilize two or more smaller, modular boilers rather than a large boiler.

**Install a high efficiency hot water heater** – New high efficiency hot water heaters use much less energy to heat water for kitchen, pool and guestrooms.

**In warm months, reduce outside air outside intake, especially when enthalpy is high** – Many facilities bring in too much outside air during warm and humid periods.

**Repair (and upgrade where necessary) insulation on steam, hot water and chilled water piping. Consider “wicking” insulation on chilled water piping** – Much of the installation on existing steam, hot water and chilled water piping was installed when energy was cheaper. Additional insulation will further reduce piping losses.

**Install variable speed drive(s) on the hot water pumping system(s)** – All continuously operating hot water pumps should have variable speed drives that reduce pumping energy during periods of low hot water use.
Obtain “free” hot water from the chiller(s) or other air conditioning units. Consider adding a new “heat recovery” chiller to produce hot water – Facilities which require cooling most of the year can obtain “free” hot water from their refrigeration equipment. This can be accomplished by double bundled heat exchangers in the chillers or using a plate heat exchanger in the condenser-cooling loop going to the cooling tower.

**Case Study: Hotel Intercontinental, Miami**

At the four-star Hotel Intercontinental, efficiency reigns. Catering to a business clientele, the 640-room facility has one million square feet of air conditioned space, including four restaurants and a full complement of meeting space. A new centrifugal chiller provides 700 tons of cooling for a mere 337 kW, using an auxiliary condenser to preheat make-up water for the boiler.

Feed water enters the auxiliary condenser at 70 °F and leaves at 82 °F, benefiting the system efficiency in two ways. One, it helps reduce the head at which the machine must operate; improving the chiller efficiency to .481 kW/ton at ARI-rated conditions. Second, the auxiliary condenser preheats the make-up water to the boiler; substantially reducing the energy consumption of the hot water system. To add to the performance of physical plant, the hotel specified variable frequency drives on the chilled water pumps. Equipment efficiency earned Hotel Intercontinental an 11 percent rebate from Florida Power and Light for the total installed price.

For hotels, an auxiliary condenser option typically pays back in less than a year.

**Install variable speed drives on all constant speed fans that are throttled back in response to variable loads** – Fans that are controlled with dampers should be retrofitted with variable speed drives. A speed reduction of only 20 percent will reduce fan energy by nearly 50 percent.

**Install premium efficiency motors on pumps and fans that have long run hours** – Motors on all pumps and fans with long run hours should be replaced with premium efficiency motors. Also, oversized motors should be replaced with smaller motors, which operate more efficiently than the oversized motor they replace.
Consider geothermal heating and cooling –
Using the ground (or a nearby body of water) for a heat source or heat sink can result in high heating and cooling efficiency, especially during peak conditions.

Install ozone cooling tower water treatment –
An ozone water treatment system will keep chiller heat exchanger surfaces clean and efficient while reducing cooling system chemicals.

Install/upgrade HVAC controls to include intelligent new EMS technologies – The latest generation of energy management systems are much easier to use and deliver more consistent savings than earlier energy management control systems. They can deliver a substantial savings while also improving comfort.

**Case Study: Acapulco Princess Hotel**

The Acapulco Princess Hotel is a luxury hotel comprising three main buildings residing on 250 acres, surrounded by the Pacific Ocean and the Sierra Madre Mountains. Hotel amenities include 1,019 rooms and suites, seven restaurants, a shopping arcade, ballroom, conference rooms and offices totaling 118,000 sq ft.

With temperatures frequently topping 90 degrees Fahrenheit, and humidity hovering in the 80 percent range, the Acapulco Princess has some significant energy challenges. By installing a new air conditioning system and upgrading its existing building automation system to integrate lighting control, comfort control for guest rooms access control and fire safety, the hotel achieved up to a 10 percent total savings on energy while realizing an 80 percent improvement in system cooling efficiency. The new system operates at 0.5 kW/ton instead of 0.9 kW/ton. Operator response time and productivity also were increased, thanks to the advent of centralized control.

Moreover, the system enables precise control of temperature and humidity. Each zone is equipped with temperature and humidity sensors, which allow the control system to automatically modulate chilled water and/or steam valves in air handling units to maintain set points. Chilled water feeds a total of 96 constant volume air handling units, serving the common areas of the buildings. Of these, 43 air handlers serve guest areas and have electronic humidity control. The rest serve public areas such as laundry rooms, elevators and mechanical rooms, where humidity control is not as critical.

Consider installing a desiccant HVAC system – Desiccant technology (which dehumidifies air) has become a valuable tool in the industry’s arsenal of space-conditioning options. In certain cooling applications, desiccant cooling units provide advantages over the more common vapor-compression and absorption units. For example, desiccant units don’t require ozone-depleting
refrigerants, and they can use natural gas, solar thermal energy, or waste heat, thus lowering peak electric demand. They are particularly effective at treating the large humidity loads resulting from ventilation air in much of the country.12

In the lobby of Park Hyatt Hotel in Washington, D.C., two rooftop desiccant units handle the make-up air requirements for the lobby and hallways, eliminating a 100-ton rooftop chlorofluorocarbon (CFC) chiller. Such desiccant cooling and dehumidification systems could replace many of today's chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) vapor compression systems, thus saving energy, improving indoor air quality, and reducing the threat to the Earth’s ozone layer.

A secondary benefit of desiccant systems: The American Hotel and Motel Association has reported that repair of mold and mildew damage to wallpaper, paint, carpet, and other materials caused by high humidity levels could cost hotels and motels $68 million annually.13 Desiccant systems can lower the humidity levels in these spaces, saving millions of dollars in unnecessary repairs. Desiccant systems also improve indoor air quality, improve ventilation rates, and remove air pollutants and odors.

LAUNDRY

Install ozone laundering - Ozone laundering is a new technology that benefits hospitality facilities by cleaning guest linens using less chemicals and colder water. Users report improved cleaning and extended fabric life.

Install heat recovery in the laundry hot water system – A properly located heat exchanger can recover heat from laundry wastewater and transfer it to incoming laundry water.

Install more efficient, intelligent gas dryers in the laundry – New gas dryers are available with intelligent controls that dry fabric better using less energy.
Case Study: Red Lion Hotels

Red Lion Hotels won the 1996 BEST Innovation Award for waste water recovery and recycling improvements in its central laundry in southeast Portland, Ore. The demonstration project, a micro-filtration system that recovers heat and recycles water, is the first project of the Hospitality Industry Forum on Energy Conservation (HIFEC).

The hotel consortium was formed by the Department of Energy to speed the introduction of energy-efficient technologies into the hotel/motel industry. Consortium members include Red Lion Hotels, Holiday Inn, Promus Corporation, Sheraton, and La Quinta. The consortium represents about 30 percent of all hotel/motel square footage in the United States.

Red Lion’s central laundry facility, located in Portland’s Central East Side Industrial Area, goes through an average of 70,000 gallons of fresh water per day and has the capacity to wash 25,000 pounds of laundry per day. At the time of the award, the facility consumed about 26 million gallons of water per year.

The micro-filtration system – expected to be a model for the rest of the hospitality industry – became operational in December, 1995. The system uses a series of filters and a membrane to filter out suspended solids and oils from laundry waste water normally discharged to the sewer and recycles the water for reuse and heat recovery.

The old system continually heated 52 °F city water to 150 °F and dumped it after a single use. Now, a microprocessor directs the new system to recycle 110 °F water through a mechanical shaker screen, pressurized stainless steel strainer, and into the sub-micron membrane filter.

Together, they remove particulates to 0.5 microns. The filtered water is then heated by the existing gas steam boiler to 150 °F and run back through the washers.

The innovative recycling project is expected to yield a number of benefits, both environmental and economic. The system is expected to reduce water use at the Portland laundry facility by at least 40 percent. Most of the thermal energy from hot water discharges will be recovered, which will lead to an estimated gas bill savings of 40 to 50 percent. Overall, water and energy cost savings of $40,000 per year are projected. It was thought that the filtration system might even allow for the recovery of some cleaning detergents. Water that goes back to the city water system is restored to its pH balance before discharge. Capital costs for the filtration system came to $180,000, with a payback of about 3 ½ years.
RECREATION

Install cover on heated swimming pool (for night hours) – A pool cover reduces heat loss as well as conserving pool chemicals. Even cooling for only 8 hours at night saves considerable energy. Automatic pool covers make covering easy and quick. Install variable speed drives on swimming pool pumps. Pool pumps do not need to run at full speed except during startup conditions. A variable speed drive on the pump motor can reduce pump costs by more than 50 percent.

Install high efficiency pool heater - Pools should be heated with a 95-plus percent efficiency condensing boiler. Most inexpensive pool heaters are less than 75 percent efficient.

Consider installing solar swimming pool heater – Installing solar water heating panels can save significant pool heating energy in sunny climates.

Use a heat pump for both dehumidification and pool heating – Indoor pools must often dehumidify the pool area. A heat pump will accomplish this while simultaneously heating pool water.
FOOD SERVICE

Install intelligent fan controls (i.e., Melink) with cooking sensors on kitchen hoods – The Melink intelligent fan controls slow down kitchen hood fans when little or no cooking is going on.

Consider installing heat pump water heaters in kitchen and other warm areas to produce “free” hot water – A heat pump water heater located in the kitchen area can provide free cooling while producing hot water for kitchen use.

Consider converting walk-in coolers and freezers from air cooled to water cooled – Many walk-in coolers and freezers have condensers in places that restrict good heat transfer. This results in high compressor head pressure and low efficiency. Water cooled condensers are much more energy efficient and can provide some “free” hot water.

A heat pump water heater provides free cooling while heating water.

GENERAL

Replace motor-generators in high-rise elevators with solid state power supplies and intelligent elevator controls. Specify AC motors with VFD in new elevators – Elevator energy efficiency upgrades are not usually cost effective unless included as part of a more complete elevator upgrade.

Install power factor controllers on escalator motors – Most escalators operate for much of the time with little or no load. Installing a motor power factor controller will reduce energy consumed during such low load periods.

Install waterless urinals in men’s rooms that get frequent use – These devices actually do work and are relatively odorless. Considerable water can be saved, especially in locations that get high use.

Install occupancy based HVAC controls in guestrooms – Devices such as the SensorStat save energy by idling or turning off HVAC equipment in unoccupied guestrooms. The device reduces energy consumption by 30 to 50 percent, all while maintaining guest comfort.

Install demand controlled ventilation controls in meeting rooms and other areas that have variable occupancy – Outdoor air to meeting rooms can be reduced during periods of low occupancy with the help of IAQ monitors.

The SensorStat turns off HVAC in unoccupied guest rooms.
Install more efficient ice making machines – Consider installing water-cooled icemakers in areas with high usage. For help in selecting efficient ice making equipment visit: http://www.eren.doe.gov/femp/procurement/pdfs/icemkr.pdf

Do not install air-cooled refrigeration equipment in areas with poor air movement – Ice making and beverage vending machines are often placed in rooms with little or no air for cooling. This reduces the efficiency and increases the cooling cost of the units.

Case Study: Starwood Hotels & Resorts Worldwide, Inc. 15

Excellence in energy management is a philosophy that starts at the top and runs through the 740-property, 225,000 room Starwood Hotels organization. In fact, sound energy management is so important to Starwood that its corporate headquarters has dedicated three full-time employees to oversee the company’s energy performance. These employees are not responsible for other facility/engineering issues, and are dedicated solely to improving the energy efficiency of Starwood’s hotels. This group also provides training to hotel general managers and engineers, develops and implements energy projects and investigates new energy efficient technologies and tracking programs.

Starwood’s measurable energy performance goals include basing a portion of the Energy Department’s bonuses on energy consumption reduction, and to have a portion of each hotel’s executive management incentive based on obtaining the ENERGY STAR label for hotels or by improving ENERGY STAR Benchmarking tool score.

Energy efficiency is a priority when purchasing equipment. The Energy Star label was a line-item in the assessment of televisions to be purchased for guest rooms, at multiple properties. Starwood will purchase 12,000 to 15,000 TVs with the ENERGY STAR label. Starwood’s Strategic Sourcing department is currently in the process of specifying ENERGY STAR labeled products, where available, in corporate purchasing policies, with a goal of finalizing new policies by the second quarter, 2002.

Starwood has committed to spending at least $45 million over the next four years on energy efficient projects at all of its owned hotels. Starwood’s 2001 energy achievements include:

- Dedicated $8.5 million to energy efficiency projects
- 10 year contract signed November 2000, to provide commodity and energy efficient projects.
- 38 Ozone Laundries installed, which use ozone to clean laundry. These systems use fewer chemicals, less water, and little to no hot water. Substantial gas, electric, and water consumption savings obtained.
- Instituted a “Green Program,” giving hotel guests the option of not changing room linens each day.
- Signed letters of intent to install four fuel cells at New Jersey and Connecticut hotels by the fall of 2002.
- 23 VFD’s installed at several hotels, on various motors, and two chiller VFD and efficiency projects complete.
- CO2 sensors installed to prevent overventilation during periods of low occupancy.
- Seven hotels retrofitted with high efficiency lighting.
- Two hotels retrofitted with Inncom guestroom controls and full EMS to reduce temperature while the room is unoccupied.
• Two hotels retrofitted with Vending Misers to reduce energy consumption on vending machines during low use times

The financial value of Starwood’s energy efficiency accomplishments include:

• Results equivalent to increasing corporate profit margins $3.4 million.
• Energy cost savings equivalent to the salary of approximately 25-50 additional personnel, with benefits
• Results equivalent to renting 9,370 rooms after backing out operating costs.
• A payback of approximately 2 ½ years.

CONCLUSION

Opportunities to save energy and improve the bottom line in the lodging industry are as numerous as hotel rooms. The hotel management team that recognizes and plans for upgrades and improvements makes its property more desirable, thus generating higher occupancy rates and revenues, while reducing operating costs. It’s a win-win situation that demands attention. And there’s a hidden benefit: hotels that successfully implement energy-saving strategies and communicate these upgrades to their guests often spark a change in behavior in those guests, too.

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2 Ibid.
3 Ibid.
5 Ibid.
7 Case study on Parkroyal Surfers Paradise from the Australia Department of Industry, Tourism and Resources, www.industry.gov.au
8 Commercial case study, www.trane.com
9 Ibid.
10 Ibid.
13 Ibid.
15 From Starwood Hotels 2002 ENERGY STAR Award Application, provided by John Lembo, Starwood Corporation, White Plains, NY.