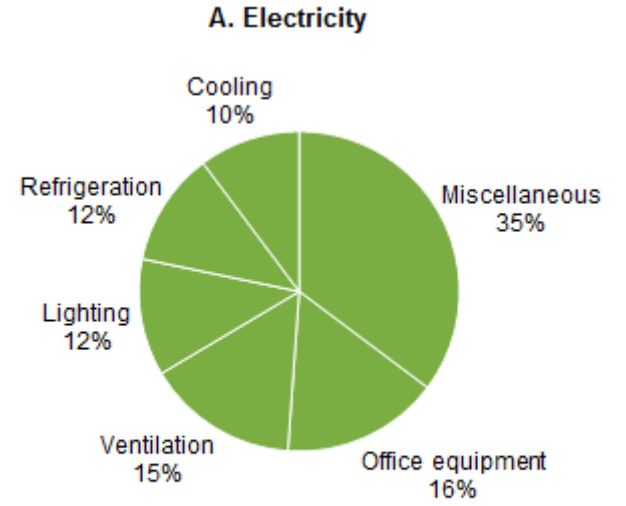
Managing Energy Costs in Hotels and Motels

Hotels and motels in the US use an average of 14 kilowatt-hours (kWh) of electricity and 49 cubic feet of natural gas per square foot (ft^2) annually, according to the 2012 Commercial Building Energy Consumption Survey (CBECS). Most of the electricity these facilities consume is used for space cooling and lighting (**Figure 1**); typically, space heating represents their largest use of natural gas. Hotel and motel energy use will vary depending on the types of amenities available.

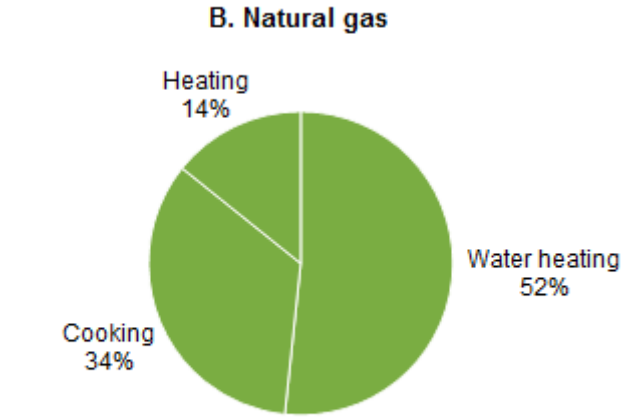
Average energy use data

Figure 1: Energy consumption by end use

In hotels and motels, office equipment, ventilation, and lighting are the primary consumers of electricity (A) and water heating requires the lion's share of natural gas (B).



Notes: Heating, computers, cooking, and water heating end uses each represent less than 5 percent of total consumption and are included in "Miscellaneous" uses.



Notes: Cooling and miscellaneous end uses represent a negligible fraction of total gas use.

Top technology uses

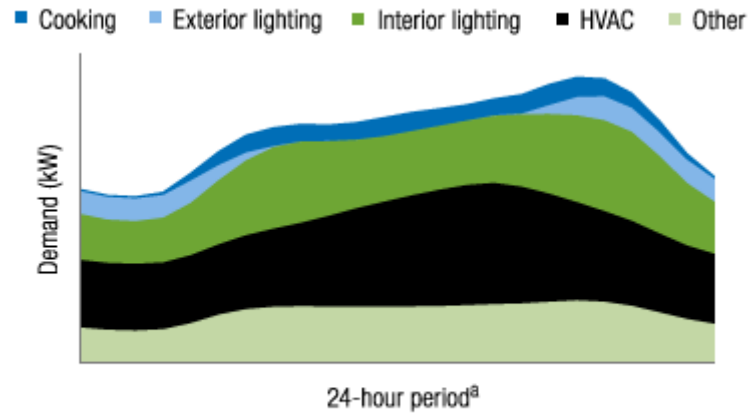
- Water Heating
- Office Equipment
- Ventilation & Air Handling

In order to better manage your building's energy costs, it helps to understand how you are charged for energy. Most utilities charge commercial buildings for natural gas based on the amount of energy delivered. Electricity, on the other hand, can be charged based on two measures: consumption and demand (**Figure 2**). The consumption component of the bill is based on the amount of electricity (in kWh) that the building consumes during a month. The demand component is the peak demand (in kilowatts) occurring within the month or, for some utilities, during the previous 12 months. Demand charges can range from a few dollars per kilowatt-month to more than $20 per kilowatt-month. Because it can be a considerable

percentage of your bill, you should take care to reduce peak demand whenever possible. As you read the following energy cost-management recommendations, keep in mind how each one will affect both your consumption and your demand.

Figure 2: Diagram of a hypothetical daily load shape

Electricity bills for commercial facilities typically feature a consumption component and a demand component. The consumption component is based on the amount of electricity (in kWh) that the building consumes during a month. The demand component is the peak demand (in kW) occurring within the month or, for some utilities, during the previous 12 months.



Notes: kW = kilowatt.
a. 24-hour period = midnight to midnight.

QUICK FIXES

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Many hotels and motels can benefit from quick low-cost or no-cost solutions for saving energy in various parts of their operations.

Peripheral and back rooms. Make sure that HVAC settings in lobbies, offices, and other such peripheral rooms are at minimum settings during hours of low use.

Laundry. Set laundry hot water temperatures to 120° Fahrenheit. This is a good temperature for all hot water uses outside of the kitchen, where codes are specific about water temperature.

Pools and hot tubs. Make sure that all pools and hot tubs are covered after hours to diminish heat loss. Covering a heated pool can save 50 to 70 percent of the pool's energy

use, 30 to 50 percent of its makeup water, and 35 to 60 percent of its chemicals.

Housekeeping procedures. Encourage housekeepers to turn off all lights and set temperatures to minimum levels after cleaning each room. Closing drapes when a room is unoccupied will reduce heat gain in the summer and heat loss in the winter.

Kitchen and food prep. In the kitchen, food preparation equipment should not be turned on for preheating more than 15 minutes before it's needed; simply reducing the operating time of kitchen appliances can cut cooking-related energy consumption by up to 60 percent.

Bathrooms and fitness rooms. Use automatic faucet shutoff, single-temperature fittings, and low-flow showerheads with pause control to reduce hot water waste in bathrooms and fitness rooms.

Front desk. Teach registration staff that they can help save energy costs by booking rooms in clusters, so that only occupied building areas or wings need to be heated or cooled to guest comfort levels. Rooms on top floors, at building corners, and facing west (in summer) or north (in winter) can be the most energy-intensive to heat or cool; therefore, consider renting them last.

Computers and office equipment. For hotel office spaces, a computer monitor can use two-thirds of the total energy of a desktop system, so it's important to power down monitors whenever they're not in use. The US Environmental Protection Agency's Energy Star program offers a list of commercial power management software packages on its Activating Power Management page that can automatically place monitors and computers into a low-power sleep mode through a local area network. Whole-computer power management can save $15 to $45 annually per desktop computer; managing only monitors can save $10 to $30 per monitor annually.

Hallway lighting. Since hallway lights are on all day and night at most hotels and motels, there's great potential for savings in reducing the consumption of those lighting fixtures. If hallways have skylights or other natural light and your lighting has dimming capabilities, dim those lights by 30 percent during daytime hours.

Guest service options. Some lodging facilities offer guests the option of forgoing daily linen changes or other guest services to help conserve energy. Some guests may not perceive a need for daily sheet and towel replacement or for lights, radios, or televisions to be turned on when they're not in the room.

LONGER-TERM SOLUTIONS

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Longer-term energy-saving strategies should also be considered. Although the actions covered in this section require more extensive implementation—such as automating HVAC shutoffs (see our Hotel Room Automation topic for full details on this technology)—they can dramatically increase the efficiency of your facility without compromising the hospitality environment. Ask your local utility's representative for more information about initiating such projects.

Commissioning

Commissioning is a process during which engineers observe a building and perform a "tune-up" to ensure that its systems are operating efficiently and as intended. Commissioning typically takes place when a facility is first built; however, if a building has never been commissioned, it's ripe for retrocommissioning, which entails a similar tune-up on an existing building. All buildings also stand to benefit from regular recommissioning, which can then take place periodically throughout a building's life.

Studies have shown that commissioning can save a typical 100,000-ft2 hotel 10 to 15 percent of its energy costs, or roughly $20,000 per year. Savings typically result from resetting existing controls to reduce HVAC waste while maintaining or even increasing comfort levels for occupants. A hotel should be recommissioned every three to five years to maintain optimal performance. The precise timing will vary depending on the timing of changes in the facility's use, the quality and schedule of preventive maintenance activities, and the frequency of operational problems. Commissioning should also be performed after major remodels or additions.

Lighting

A variety of light sources can be used to provide efficient lighting throughout hotel or motel operations. LEDs have become a potential solution that can be applied throughout a hotel or motel facility. Though not yet cost-effective in all cases, LED technology is worthy of consideration for any lighting application.

Daylighting. Natural daylight has been shown to improve a hotel's indoor environment while reducing energy use and peak demand. Whenever possible, any lighting renovation should

start by using daylighting as much as possible and reducing electric lighting accordingly. Good daylighting design will not introduce excessive heat gain, heat loss, glare, or uneven illumination. Window films that diffuse natural light, such as 3M's Daylight Redirecting Film, increase the effect of daylighting in the room and minimize glare. Daylighting controls in lobbies can improve lighting quality while reducing energy costs. Hotels have also used clerestories and tubular skylights to provide daylighting in hallways, lobbies, and guest rooms.

Back-room applications. In back-room areas such as kitchens and office spaces, lighting fixtures that use T12 (12/8-inch diameter tubes) and commodity-grade T8 (1-inch diameter tubes) fluorescent lamps and ballasts can be replaced with high-performance T8 lamps and electronic ballasts , a combination that can reduce lighting energy consumption by 35 percent. Adding specular reflectors, new lenses, and occupancy sensors or timers to a T8 fluorescent lighting system can double the savings. Payback periods of one to three years are common. Many LED fixtures can also be a cost-effective option for back-room lighting. The Occupational Safety and Health Administration's (OSHA's) Nationally Recognized Testing Laboratory (NRTL) program has approved retrofit kits that enable users to safely replace fluorescent bulbs with LED lamps without replacing the fixture.

Guest room lighting. In guest rooms, CFLs have become the standard for table, floor, and reading lamps, and in recessed and vanity lighting in the bathroom. CFLs reduce energy use by two-thirds and yield savings of up to $20 per lamp per year. Many hotel public areas, including corridors and hallways, can use CFLs in wall sconces and in recessed downlights. During renovations or when buying new table or floor lamps, consider fixtures designed to accept only CFLs so that maintenance staff cannot accidentally relamp them with incandescents. As with back-room lighting, LEDs can be a cost-effective alternative option for guest room lighting in all of the applications currently using CFLs, and as low-power nightlights.

Restaurants and lounges. Historically, halogen lamps have been widely used in restaurants and lounges for their color quality and dimming capabilities. LED technology, which used to be undesirable for this application due to its poor color quality and unreliable dimming features, has improved enough to be considered a potential solution. Now, LEDs are frequently used to create specialized lighting effects, and they can also provide an accent to exterior arch elements and facades.

Exit signs and hallway lighting. The Energy Policy Act of 2005 requires that all exit signs manufactured after January 1, 2006, draw no more than 5 watts (W) per illuminated face.

This specification eliminates not only incandescent but also fluorescent light sources from contention, making LEDs an obvious choice. Using LED exit signs is a proven energy- and labor-saving measure that can pay for itself in less than two years, according to the North Carolina Energy Office's Exit Sign fact sheet (PDF).

Outdoor lighting. For parking lots and outdoor applications, any incandescent or mercury vapor lighting should be replaced with something more efficient. High-pressure sodium and metal halide are the most common choices, but fluorescent or LED lighting can be more-efficient options. In parking garages, which often use inefficient high-intensity discharge fixtures, high-efficacy fluorescent fixtures can provide more-even illumination with fewer fixtures. Fluorescent lamps should be enclosed when used outdoors in cold climates. LEDs, on the other hand, perform well in cool temperatures and can cut energy use by 40 percent or more in certain outdoor applications, making them another contender for outdoor lighting. It used to be that LEDs were too expensive to be cost-effective in most applications, but those costs are coming down. Induction lamps are another possibility—they boast a very long life and are a good choice in hard-to-access areas.

It's also important to avoid over-lighting outdoor areas. Most parking lots are designed with far more lighting than the Illuminating Engineering Society's *Lighting Handbook* (2000) recommends—that is, an average of 1 foot-candle or less for most applications. Using lower-wattage bulbs can actually increase the safety of your lot: An over-lit lot can be dangerous to drivers if their eyes cannot adjust quickly enough in the transition from highly lit to dark areas. If more light is needed, consider a bilevel lighting system for parking garages—these systems use motion sensors to detect when a portion of the garage is occupied and requires more intense lighting than the minimum setting. This measure can reduce energy consumption by about 40 percent, and in some cases, the savings may be as high as 90 percent.

Lighting controls. Lighting controls such as occupancy sensors and scheduling systems can also reduce lighting energy use. Occupancy sensors save energy and help reduce maintenance costs by lengthening the relamping interval: Turning fluorescent lights off for 12 hours each day can extend their expected calendar life by 75 percent, to nearly seven years. In large restrooms, ceiling-mounted ultrasonic occupancy sensors detect occupants around partitions and corners. For hallways, a recommended strategy is to use a combination of scheduled lighting and dimming plus occupancy-sensor controls after hours. Guests may not like a totally darkened hallway, but dimming lights in unoccupied hallways and stairwells and then turning them up to full brightness when someone enters is

a sensible approach. Occupancy sensors are also appropriate for meeting rooms and back rooms.

Water heating

Water heating is a major load for hotels and motels, accounting for a third or more of a facility's energy consumption. Commercial heat pump water heaters (HPWHs) are two to four times more efficient than conventional water heaters, while also providing space-cooling capacity. In fact, they can cut water heating costs up to 50 percent. However, before deciding to use an HPWH, it's important to do a careful economic analysis—they're more expensive than conventional water heaters, and their performance varies with climate. Direct-vent, sealed-combustion condensing water heaters and boilers with efficiencies higher than 90 percent are the next-most-efficient option. Unlike traditional water heaters, condensing boilers operate very efficiently during periods of low water demand, and they can also provide space heating. In general, installing multiple smaller water heaters provides better reliability, effectiveness, and efficiency compared to using one large water heater.

Hotels and motels can also use HVAC, shower, laundry room, or kitchen heat-recovery systems to cut hot water expenditures. Hotels can obtain "free" hot water from their cooling and refrigeration equipment by using double-bundled heat exchangers in the chillers or a plate heat exchanger in the condenser-cooling loop. Drain water heat-recovery equipment—explained by the US Department of Energy (DOE) on its Drain Water Heat Recovery page—when used with showers, can save 50 to 60 percent of water-heating energy with a payback period ranging from 2.5 to 7 years. It can also double or triple the first-hour capacity of water heaters. In addition, installing a variable-speed drive (VSD) and controls on the hot water pumping systems will reduce pumping energy during periods of low hot water use.

In the hotel kitchen, low-flow pre-rinse spray valves are one of the easiest and most cost-effective energy-saving measures available. These devices use a spray of water to remove food waste from dishes prior to cleaning in a dishwasher. They reduce water consumption, water heating energy, and sewer charges. Look for models with a flow rate of 1.6 gallons per minute or less.

Several options are available for hotel laundry operations. Efficient tunnel washers can reduce costs through labor and utility savings. A few manufacturers are utilizing new alternative technologies to save energy. For example, ozone and polymer bead laundering

systems offer big savings by using cooler water and much less of it; they also use less energy and detergent. And CO2 laundry technology is completely waterless and eliminates the need for drying, yielding significant savings. At this time, CO2 laundering is only offered as a third-party service, and only on a cost-per-pound-of-laundry basis, but it should be considered by facilities that contract out their laundry service.

For hotel swimming pools, indoor pool covers typically yield paybacks of one year; covers for heated outdoor pools and hot tubs may yield even better savings. Indoor pools require simultaneous heating and dehumidification, and HPWHs can efficiently serve both of these needs: They heat water while producing cool, dehumidified air for the room housing the pool. Using an HPWH can reduce heating costs for gas- and electricity-heated pools as much as 40 and 80 percent, respectively. Low-temperature unglazed solar water heaters are an inexpensive approach that is well-suited to swimming pools and spas in warmer climates. Glazed flat-plate collectors can provide higher-temperature water. Also, although we haven't yet seen any robust research confirming energy savings, it's likely that variable-speed pumps and controls can save energy in certain swimming pool applications. For example, if the local requirements around flow rates are lower than those currently being used by the pool in question, variable-speed pumps could offer significant opportunities for energy savings.

Building envelope

Outside the hotel, awnings, overhangs, and windows with a low solar heat gain coefficient (SHGC) help reduce the amount of solar heat that comes in while still allowing daylight through. Strategically planted shade trees can also reduce solar heat gain in buildings. Cool roofs , which often include light-colored roofing materials, not only reduce cooling energy consumption by 25 to 65 percent during the summer, they also extend roof life. Green roofs—planted with grass and other vegetation—provide excellent insulating properties, prolong roof life, reduce storm-water runoff, and offer an aesthetic appeal that could be valuable to a hotel or motel property. However, green roofs are expensive and have not been proven to be cost-effective.

Retrofitting with new, high-performance windows can be prohibitively expensive, but installing reflective film inside existing windows can be a more cost-effective option for reducing solar heat gain while still admitting useful visible light, resulting in payback periods of less than three years. Other window coverings such as shutters, shades, and draperies provide insulation benefits. This is especially true in summer months, when they

reduce the amount of sunlight and heat entering rooms.

For lobby areas, revolving doors are the best choice for keeping wind and weather out. The National Renewable Energy Laboratory (NREL) explains on its Commercial Building Envelope Checklist (PDF) that revolving doors can reduce the amount of unconditioned air entering the building by a factor of eight compared to standard doors. Check these doors periodically to ensure that there are no leaks along their edges or bottoms.

HVAC

Dehumidification. Mold and mildew damage to wallpaper, carpet, and other materials caused by high humidity levels are big problems in the lodging industry. Causes include leaks in the building envelope in humid areas, oversized HVAC systems, poorly balanced air-handling systems, and insufficient moisture-removal capacity of vapor-compression HVAC systems. Desiccant HVAC and dehumidification systems lower humidity levels, improve indoor air quality, and increase building occupant comfort. Desiccant systems have low maintenance costs, can use a variety of fuels (waste heat, natural gas, or solar thermal energy) to lower peak electric demand, and have the potential to reduce energy consumption in humid climates. However, they may still be more expensive to operate than traditional HVAC systems, depending on local utility rates.

Ventilation controls. Hotels can use outdoor-air economizers with air-handling units so that outdoor air can be used for free cooling during spring and fall or for building precooling on summer nights when the humidity level is not too high. As described in the American Council for Energy Efficient Economy report, Premium Economizer: An Idea Whose Time Has Come (PDF), economizer controls can further reduce energy consumption and improve the device's reliability by ensuring that the economizer is operating at its best settings. Dry climates can benefit from indirect evaporative cooling, as seen in the Coolorado product. Indirect evaporative cooling systems precool the intake air with evaporative cooling without adding humidity to the supply air, thus reducing the air-conditioning load and ultimately reducing energy consumption.

In meeting rooms and other areas with variable occupancy, demand-controlled ventilation (DCV) systems can be used to reduce the amount of outdoor air that needs to be conditioned, minimizing energy consumption during periods of low occupancy. DCV is most cost-effective for facilities located in a moderate to extreme heating or cooling climate and where existing HVAC systems do not use 100 percent outdoor air (such as those with evaporative cooling systems).

Large facilities with high ventilation demands, such as casinos where smoking is allowed, can use heat-recovery ventilators (HRVs) or energy-recovery ventilators (ERVs) to reduce energy consumption. HRVs and ERVs have balanced exhaust and supply fans and can meet all ventilation needs without creating drafts and air-pressure imbalances. HRVs can feature efficiencies as high as 85 to 95 percent and can pay for themselves in roughly 3.5 years. ERVs, which have the additional feature of dehumidifying air, can be cost-effective as well. Although fan energy consumption tends to remain unchanged or even rise in certain cases, the cooling and heating savings generally far outweigh any increase in fan energy consumption. Consider either of these units whenever air is continuously exhausted and makeup or ventilation air is required, especially in extreme climates.

A number of hotel HVAC systems can use VSDs, including variable air-volume systems, where a VSD can adjust fan speeds according to operating requirements at different times of the day. VSDs should be installed on cooling-tower fans, continuously operating circulation pumps, and any constant-speed fans that only meet partial loads (for example, fans controlled with dampers). In kitchens, for example, fans can be linked to burners to reduce energy consumption during off-peak cooking periods. Be careful, however, not to cut exhaust to the point that kitchen odors permeate other areas of the facility.

Energy management systems. Hotel studies have shown that sold rooms are unoccupied for 12 or more hours per day. Hotel operators can link their energy management system (EMS), reservation system, and automated check-out system together to keep an unsold room ventilated but with minimal heating or cooling. A sold room can then be heated or cooled to a comfortable temperature an hour before a guest's scheduled arrival. Once the guests arrive in the room, they can then adjust the temperature as they like until they check out, when the HVAC system returns to the unsold mode. An EMS can enhance guest comfort while reducing energy costs by 25 to 45 percent, for a return on investment of 50 to 75 percent. Keycards that shut off all, or most, power-consuming devices when a guest leaves a room can also help reduce guest-room energy consumption.

Vending and food storage

Vending machines. Because vending machines operate continuously, one refrigerated vending machine can consume 2,500 to 4,400 kWh annually—which, at $0.10/kWh, can cost up to $440 per machine per year. The VendingMiser is a control device that turns off vending-machine refrigeration and lighting when nobody is near and when temperature levels are low enough that refrigeration is not needed. VendingMiser has resulted in vending-machine energy savings ranging from 24 to 76 percent, with paybacks of less than three years.

Ice machines. Since ice production is typically coincident with utility peak periods, there's great demand-saving potential in scheduling production during off-peak hours. Energy Star–qualified ice makers with oversized storage bins can produce and store enough ice during off-peak hours to meet the daily demand, leading to a reduction in both demand and energy consumption.

Smart refrigerators. Guest-room refrigerators waste energy if they're on while the room is unoccupied. To help reduce energy consumption, manufacturers such as MiniBar Systems are designing "smart" fridges that will switch to an energy-saving mode after 48 hours of non-use and will return to standard settings automatically when the door is opened. According to manufacturers, upgrading to a smart fridge could save as much as 50 percent of energy consumption compared to a conventional mini-fridge.

Buy energy-efficient equipment

A simple way to ensure that equipment is energy efficient is for hotel purchasing departments or franchisees to specify products that are certified by Energy Star. Energy Star–qualified products relevant to hotel and motels include things like commercial refrigerators and freezers, televisions, DVD players, audio equipment, computers, monitors, printers, commercial fryers, commercial steam cookers, fax machines, mailing machines, scanners, copiers, and vending machines. In addition, the DOE?s recommendations for Energy-Efficient Product Procurement (PDF) from its Federal Energy Management Program may be appropriate for items not covered under the Energy Star program.