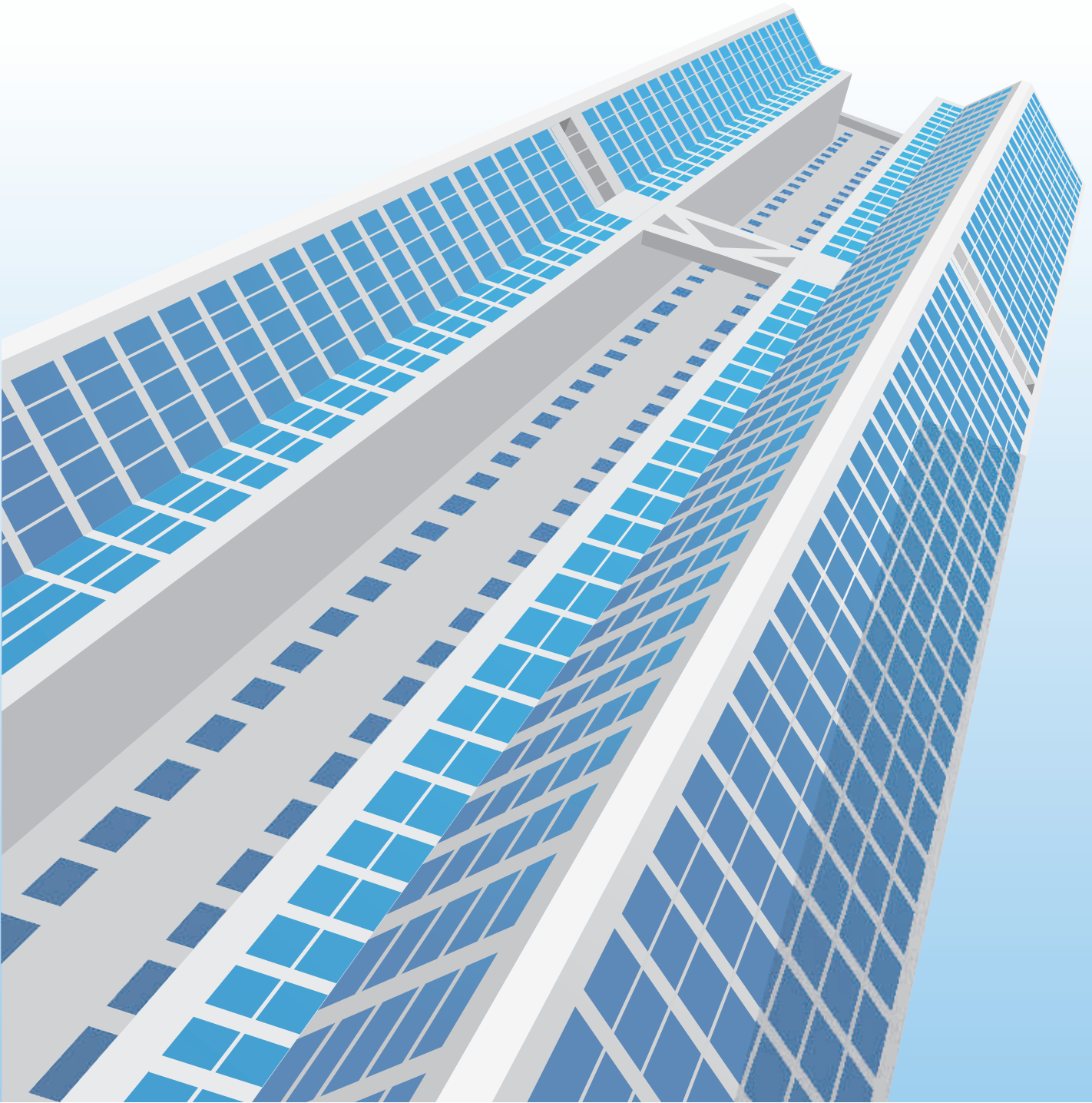


ENERGY MANAGEMENT IN YOUR HOTEL



Bureau of Energy Efficiency



British High Commission
New Delhi



ENERGY
MANAGEMENT
IN YOUR HOTEL

TABLE OF CONTENTS

Forward	3
Acknowledgements	4
Why Manage Energy Use	5
Initiating an Energy Management Program	6
Determining Efficiency Targets	7
Where is Energy Being Used	8
Conducting Energy Assessments	9
Performing a Walk-Through Assessment	9
Walk Through Assessment Checklist	11
Identifying Energy Savings Opportunities	15
Integrating Energy Management Into Hotel's Culture	15
Lighting	16
HVAC	20
Building Envelope	23
Hot Water	24
Food Preparation	25
Hotel Laundry	28
Front Office & Lobby	29
Implementing an Energy Management System	30
Calculating Costs and Payback	32
Glossary	34



ऊर्जा कार्यकुशलता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)

BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

अजय माथुर, पीएच.डी.
महानिदेशक

Ajay Mathur, Ph.D.
Director General

FOREWORD

The current electricity consumption in commercial buildings in India is about 8% of the total electricity supplied by utilities. The electricity demand in commercial buildings is growing annually by 11-12% which is more than the growth rate of electricity production in the country.

2. The hospitality sector accounts for a large proportion of energy use in commercial buildings. In any operational hotel building, electricity accounts for more than 50% of total energy utilization and is used for heating, ventilation and air conditioning (HVAC), lighting system etc. Studies have indicated that there is an enormous potential of saving of electricity by implementing energy efficiency in this sector.

3. Review of international experience and several energy audit studies conducted in India indicate that hotels can effectively reduce 20-30% of energy use without compromising the quality of hospitality services. In the process, the lesser energy use will entail cost savings for the hotels. This "Guidebook for Managing Energy Use in Your Hotel" developed with the help of funding support from Low Carbon Fund managed by the British High Commission is a useful documentation of best practices in hotel industry. It will serve not only as a guide for hotels intending to take up energy conservation activities but also as a demonstration for others who are uncertain of the benefits of the activities. This guidebook aims to highlight opportunities for energy management within a hotel, and provides detailed steps to identify energy opportunities, evaluate costs and paybacks, and develop and implement an energy management plan.

4. I am sure that the hotel owners and managers would find this document very useful, and that it would facilitate the process for achieving improved energy performances in hotel buildings.

(Ajay Mathur)

Director General

Bureau of Energy Efficiency, New Delhi

New Delhi, the 17th December, 2008

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation

चौथा तल, सेवा भवन, आर.के. पुरम, नई दिल्ली-110 066

4th Floor, Sewa Bhawan, R.K. Puram, New Delhi - 110066

टेली/Tel.: 26178316 (सीधा/Direct) 26179699 (5 Lines) फैक्स/Fax: 91 (11) 26178328

ई-मेल/E-Mail: dg-bee@nic.in वेबसाइट/Web-Site: www.bee-india.nic.in

ACKNOWLEDGEMENTS

The Guidebook for Managing Energy Use in Your Hotel has been prepared by ICF International with financial support from Strategic Programme Fund, Low Carbon High Growth Programme of British High Commission in India. ICF International would like to acknowledge the contributions of:

Dr. Ajay Mathur, Director General, Bureau of Energy Efficiency for providing his guidance in developing this guidebook.

Mr. Saurabh Kumar, Secretary, Bureau of Energy Efficiency for providing his guidance and encouraging us to develop a guidebook for hotels.

Mr. Sanjay Seth, Energy Economist, Bureau of Energy Efficiency for providing technical inputs to the guidebook.

Mr. Anurag Mishra, Senior Program Officer, British High Commission for his valuable support in developing this guidebook.

Mr. Saba Kalam, Program Officer, British High Commission for his valuable support in developing this guidebook.

Most importantly ICF International would like to express its sincere thanks to British High Commission, India for financial support, which made this guidebook possible.

WHY MANAGE ENERGY USE

Hotels are large consumers of energy and fossil fuels to provide high quality services to guests. India's current growth potential for hotel construction will continue to result in an increasing energy consumption trend. There is also a misconception that correlates increased energy use with improved quality of services.

Hotels can effectively reduce energy use without compromising the high quality of services for guests and in the process benefit from cost savings. Managing energy use in your hotel is the first step towards this. Energy management helps improve your bottom line and holds down operating costs. Controlling costs is a key to profitability in the hotel industry allowing your hotel to route resultant savings toward fulfilling other requirements including purchasing additional amenities, staff salary increases, etc.

There are numerous ways by which energy can be managed within your hotel. This guidebook aims to highlight several opportunities to create and implement an energy management plan within your hotel. Topics include what steps are required to develop and implement a management plan, how to identify energy opportunities and how to evaluate costs and paybacks.

MANAGING ENERGY USE IN YOUR HOTEL

- Initiate an Energy Management Program
- Determine Efficiency Targets
- Conduct an Energy Assessments
- Identify Energy Savings Opportunities
- Calculating Costs and Paybacks
- Implement Measures
- Monitor Performance

INITIATING AN ENERGY MANAGEMENT PROGRAM

Before any energy management program can be developed a dedicated staff team is required to ensure that accurate objectives are set and the right people will implement the plan.

Identify a core team. This is the first step in initiating an energy management team. Identifying key staff members who will be involved in energy management activities and those responsible for overseeing the program is imperative for success. An effective team should include members from owner or management, the hotel staff, facility operations, engineering and someone who understands finance. A key group to have represented among the hotel staff is housekeeping. Commitment from top-level management and their involvement is vital to providing focus to energy management operations. The General Manager's attitude toward energy savings sets the pace for increased efficiency. Also, designate a mid level or upper level employee as "Energy Manager" to monitor energy saving activities and projects daily.

Once the team is selected plan organize a introductory session to start laying the groundwork for the program.

Identify and set specific objectives. Identifying the

program goals and objectives helps establish a standard of comparison for success and also lays the path toward achieving desired results. For example, if you want to save 25% over the next 1-3 years you should consider the following –

- Have you defined the 25% as reduced consumption of energy or as reduced cost?
- What is the base you will measure against?
- How and when will the measurement be made?

Receive input from your team and plan workable goals and objectives to establish a baseline for your efforts. Use this phase to also identify related budget factors to achieve goals.

Develop a plan. Create an action plan to define the implementation of the pre-determined energy management goals and objectives. This plan will outline steps toward achieving desired results, delegate responsibilities, identify budget limitations and set targets for energy saving opportunities.

Communicate plan. Once the plan is established the success of the energy management program depends on the effectiveness of communicating it to the involved staff members and other individuals including guests etc. Use the plan to delegate responsibilities to key

staff including housekeeping, front desk, and maintenance. Ensure that it is easy to understand and everyone shares the common goals and objectives of the program. Regular updates on program and visual tools to share progress are effective ways of building momentum within staff members.

Implement measures and monitor performance.

Implementing measures identified and monitoring of measures and associated results is imperative for the program. Without regular monitoring of program it will be difficult to evaluate any savings. Follow up is also required to ensure that measures have been implemented properly.

Motivate staff members. The key to keeping people onboard with your energy management plan is having a reward and celebrating successes. Don't wait until the end of a two year program to announce results. Have regular milestones and incentives to meet them. Make people feel part of the program's success and it will take on a life of its own. Create an environment where people work together to get things done and enjoy the rewards of achieving success on a regular basis. (Adapted from "Managing Energy in Your Hotel")

DETERMINING EFFICIENCY TARGETS

There are numerous variables that need to be considered while setting efficiency targets including occupancy rate, operating expenses, etc. The profitability of running a hotel must also be considered while identifying the

appropriate variables. Operating expenses is one of the significant “constant” variables to be considered while determining savings objectives. Others like occupancy rate, cost of materials and supplies will fluctuate based on external factors.

Operating expenses are largely influenced by actions you can take and on average, the cost of energy accounts for 3% to 5% of the total operating expense¹. Through this guide, your hotel can aim to reduce energy costs by up to 20%.

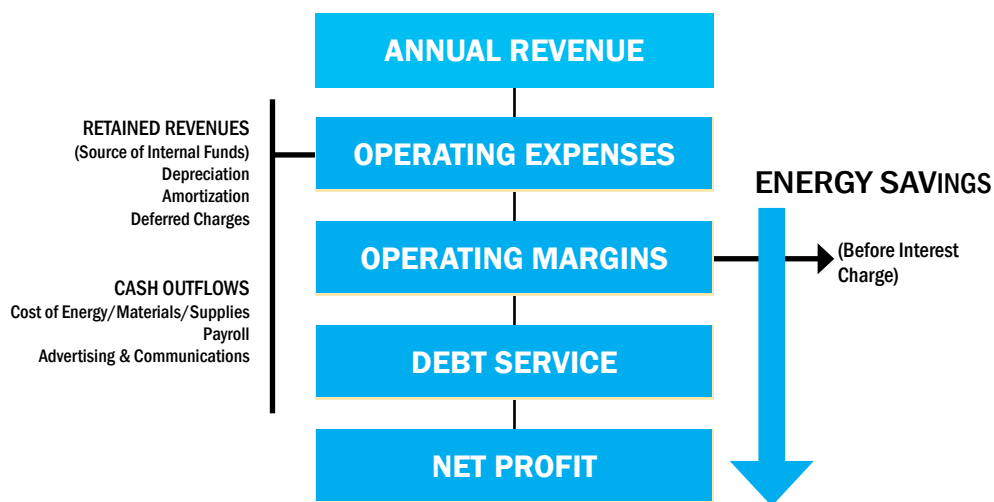


Figure 1 – Factors involved in establishing profitability for hotel
Source: “Managing Energy in Your Hotel”

WHERE IS ENERGY BEING USED

The first step in determining efficiency targets is to study where energy is being utilized within your hotel. Identifying areas of high and low energy use will help you target key areas for improvement and also areas that will provide maximum returns. Figure 2 below highlights a typical hotel energy end use graph.

¹ Managing Energy in Your Hotel

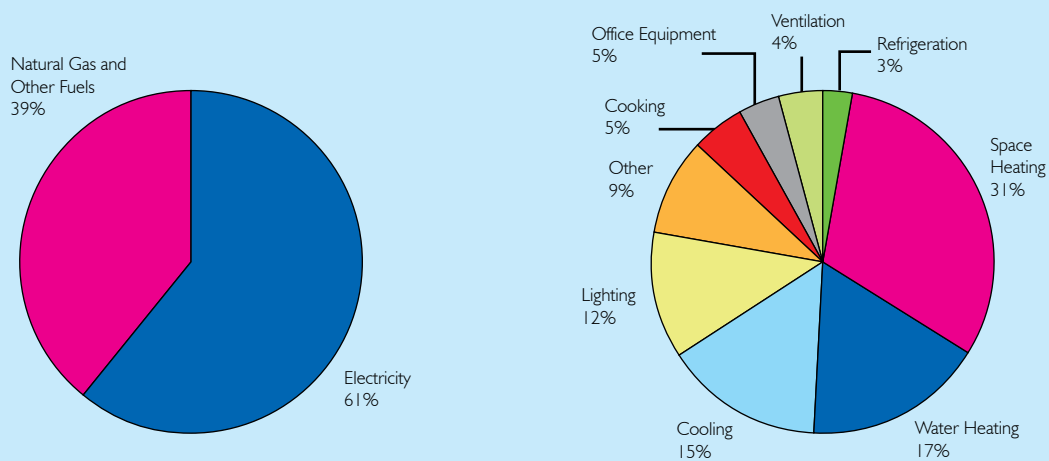


Figure 2 – Typical energy end use in a hotel

Source - http://epa.gov/cleanenergy/documents/sector-meeting/4bij_hotelenergy.pdf

ENERGY MANAGEMENT PAYS... ²

Facility Type	If Annual Energy Costs...	Estimated Annual Savings for reductions:		
		Lighting by 20%	HVAC by 20%	Water heating by 20%
50,000 sq. ft.	INR 3,525,000	INR 375,000	INR 164,500	INR 164,500
100,000 sq. ft.	INR 7,050,000	INR 750,000	INR 329,000	INR 329,000
150,000 sq. ft.	INR 10,575,000	INR 1,125,000	INR 488,800	INR 470,000

Assumes facility uses electricity and natural gas and each are about 50% of the total energy consumption, and hotel includes on-site food service, laundry, and pool.

² Managing Energy in Your Hotel

CONDUCTING ENERGY ASSESSMENTS

An energy assessment is an essential component of a successful energy management program. This will help you identify the present energy use situation within the hotel and flag energy costs. Energy saving opportunities can be identified based on the assessment report. The assessment will also help you develop a baseline for future comparisons of program success by comparing energy use before program implementation and after.

Hotels can conduct either a basic **walk-through energy assessment** or a more detailed **energy analysis audit**. Hotels also have the option of carrying out the assessment as a first step to identify existing energy saving opportunities and implement the results followed by a more detailed analysis audit to derive more detailed measures for savings including capital intensive energy saving opportunities.

This guide focuses on the **walk-through energy assessment process** as a means for hotels to delve immediately into saving energy and **improving their bottom line through less capital intensive measures**. Hotels are encouraged if they desire to follow the implementation of these measures with a more detailed audit to garner additional savings.

PERFORMING A WALK-THROUGH ASSESSMENT

Often 25% of a commercial building's energy consumption is wasted due to specific management practices³. Simple adjustments to management and operation practices can result in savings for your hotel. For example, adjusting the Building Automation Systems (BAS) to more effectively control your lighting can result in significant savings.

A walk-through assessment is the easiest and least expensive means of identifying and evaluating

energy use in your hotel. Since people have a major affect on how energy is used, this audit pays particular attention to identifying habits and procedures that can be adopted to use energy more efficiently. Basic information about the systems in your hotel is also collected. (Adapted from "Managing Energy in Your Hotel")

The first step in this assessment is to examine energy use and associated costs across systems within your hotel. Utilize your operations and maintenance staff

to assist in this process. Provided in the following pages are–

- 1) Energy Planning Ledger – assist you with highlighting required information to initiate the assessment
- 2) Walk-Through Assessment Checklist – assist you with identification of energy saving improvements that can be easily implemented.

Use both these sheets while walking through your hotel and recording information on energy use.

³ eeBuildings' Low-Cost and No-Cost Improvements Yield High Returns

Energy Planning Ledger⁴

Hotel Building Statistics

Cooled Sq. Ft.	Heated Sq. Ft.	Number of Floors:	Building Age:

Energy Use and Cost

	Last Year's		Current Prices
	Use	Cost	
Electricity - Consumption	kWh	INR	INR per kWh
Demand	kW	INR	INR per kW/month
Natural Gas	units*	INR	INR per unit
Heating Oil	gallons	INR	INR per gallon
Other	units	INR	INR per unit
TOTAL		INR	

*units may be "therms" (100,000 Btu/therm) or "ccf" (hundred cubic feet) or "mcf" (thousand cubic feet)

Energy Source

Electricity: _____ % of total cost

Gas: _____ % of total cost

Hot Water Uses:

Predominant Type of Lighting:

Occupancy Data:

Time Period: _____

Max Number of People: _____

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

⁴Adapted from "Managing Energy in Your Hotels"

WALK THROUGH ASSESSMENT CHECKLIST

Adapted from "Managing Energy in Your Hotels"

CHECK LIST	ACTION LIST	OBSERVATIONS
HVAC		
Check temperature and humidity levels in various areas: - Guest rooms - Meeting rooms - Dining rooms - Corridors - Lobby	OPERATION - Monitor outside air use - Avoid heating and cooling at the same time - Use modular, localized heating/cooling units where possible - Control system by time-of-use when possible for public areas - Use ceiling fans to increase comfort - Shut off chiller during winter if possible.	
Check ductwork and airflow Check condition of windows and doors Check refrigerant levels.	MAINTENANCE - Seal ductwork leaks- Clean filters and allow free air-flow to grills - Seal unused building openings - Install vinyl curtains in loading areas - Weather-strip doors and windows, caulk cracks - Insulate: doors, pipes, ductwork - Cover and lock thermostats and ventilation controls in public areas to prevent unauthorized adjustments - Clean boilers, chillers and condenser coils regularly, straighten fans.	
Check thermostat readings Check availability of passive solar	PROCEDURES - Do not heat/cool in low traffic areas, hallways or unoccupied rooms/floors - Adjust building temperature by season: lower in winter / higher in summer - Advise employees to dress appropriately for seasonally maintained building temperature - Utilize available passive solar heat during cooler months by opening blinds and drapes - Close doors to outside and unheated or un-cooled areas - Use ventilation only when required	

	- Establish routine maintenance procedures - Plan occupancy so guests are assigned in same area of hotel - Have housekeeping close draperies and adjust thermostat to acceptable level in unoccupied area or rooms.	
LIGHTING		
Check when lights are being used. Check lighting levels.	OPERATION - Use automated lighting Controls - o Photocells • All-night outdoor lighting - o Timers • Parking lots • Restricted-access areas - o Motion sensors • Low-traffic areas - o Dimmers • Auditoriums • Meeting rooms - De-energize fixtures/ballasts not in use - Reduce lighting to minimum acceptable level for safety/security - o Parking areas - o Storage areas - o Corridors	
Check cleanliness and condition of lamps and fixtures Check accessibility of switches	MAINTENANCE - Clean lamps for maximum illumination - Repair broken fixtures - Replace non-working lamps/bulbs - Install lowest acceptable wattage bulb - Install energy-efficient ballasts - Add reflectors to existing lighting - Label panels and switches so lighting can be monitored and controls can be accessed	
Check how lights are being used	PROCEDURES - Turn off lights not being used - Use task lighting in place of area lighting where possible	

SERVICES / AMENITIES

Check equipment operating times Check temperature settings.	OPERATION - Use timers on bathroom heat lamps - Connect bathroom exhaust fans to light switches - Automate pool/spa heaters - Close outdoor pool/spa during cooler months - Set swimming pool heater to 72°F - Limit operation of food warmers/equipment - Preheat ovens, grills, broilers only when needed - Reduce temp on fryer/grill during slow hours - Direct cooling fans towards workers - Stagger turn-on times for equipment - Reduce domestic hot water temperature - Set water thermostat to minimum acceptable sanitation level	
Check equipment condition and cleanliness	MAINTENANCE - Clean and polish heat reflectors - Clean burners and check regularly - Recalibrate broiler thermostats - Insulate water heaters and pipes - Install flow restrictors - Clean pool skimmer, strainer, basket, filter - Keep pool area clean; trim back foliage	
Check how equipment is being used	PROCEDURES - Instruct housekeeping to turn-off TVs/radios and close drapes in unoccupied rooms - Wash and dry laundry during off peak hours - Close door to keep conditioned air out of laundry - Cook during off-peak periods when possible - Cook food in large volumes, close together - Minimize use of range tops, griddles and broilers by using ovens, steamers, fryers and microwave - Load and unload ovens quickly to avoid heat loss - Use properly-sized flat-bottom pots with tight lids - Shut off exhaust hoods when leaving - Launder full loads; use cold water when possible - Run dishwasher with full loads: use chemical rinse instead of hot water for sanitation	

MISCELLANEOUS

Check equipment operating times, and location
Check equipment settings.
Check motor operation for efficiency and use patterns.

OPERATION

- Locate refrigerator away from cooking equipment
- Use booster heater in dishwashers to achieve hot rinse temperature required for sanitation
- Avoid refrigerator temperature settings lower than necessary
- Locate refrigerator condenser coils in cooler place
- Use timers or other devices for elevator motor start/stop
- Use automatic temporary elevator shut-off for low-use periods

Check equipment condition and cleanliness.

MAINTENANCE

- Clean refrigerator coils, replace worn seals, defrost regularly
- Maintain proper refrigerant charge in refrigerator systems and ice machines

Check how equipment is being used.

PROCEDURES

- Refrigerate items only when necessary: do not overload units
- Label items so they are easy to find in refrigerator or cooler
- Cool hot items on counter before refrigerating
- Thaw frozen items in refrigerator.

IDENTIFYING ENERGY SAVING OPPORTUNITIES

This chapter has been taken from the “Managing Energy Use in Your Hotel” guide as it highlights all the salient points that go into identifying opportunities for energy savings within your hotel.

INTEGRATING ENERGY MANAGEMENT INTO HOTEL'S CULTURE

New employee energy management training:

At all departments in the hotel, employees receive thorough training in department norms and expectations, safety procedures, and office etiquette. Developing an energy management training and integrating it into new employee orientation will help instill energy management as a department-wide value and teach employees how to use energy more efficiently in their work areas. Reinforcing this orientation training with regular energy management seminars, brochures, or other visibility will ensure that the initial training stays with employees throughout their tenure at the hotel.

Tracking and reporting energy consumption to all employees:

While most department heads receive some energy and water use data on a weekly/monthly basis, very little of this information is shared with the rest of the employees. Energy consumption at each department can serve as a tool for reinforcing the importance of energy management, since consumption spikes in energy and water use can be more quickly

identified and resolved when employees are tracking weekly/monthly use. The engineering department at the hotel is already tracking the energy-use data for all departments but still there is a need to identifying best and worse performers so that best-practices can be recognized and shared.

Creating a culture of continuous improvement:

Make energy efficiency an integral part of employee culture. Encouraging leadership and visibility, tracking energy use and offering incentives will help. These aspects are described in more detail below.

a. Tracking – All efficiency efforts at the employee level should be recorded, tracked over time, and evaluated. This process will help department heads evaluate their energy performance training, incentive programs, and visibility level of the program. A transparent data-driven program will allow the employees to see their individual and collective impact on energy performance and encourage them to actively participate in charting the impact of their activities.

b. Visibility – A simple method

like using a dedicated whiteboard to track daily energy data could be useful. A whiteboard that is centrally located can be used to record energy data and any factors that may influence energy use, as well as strategies to reduce energy consumption. Engineering staff and department heads can conduct daily briefings to discuss the data and energy management strategies.

c. Incentives – The recognition of employee commitment to energy efficiency can have a strong impact on participation. The recognition can be formal or informal, ranging from something as simple as offering employees free CFL lights as a reward for reducing energy consumption by a certain percentage, to rewarding cash bonuses for identifying major energy savings and process improvements.

d. Recognition – Employees who take leadership positions in energy management initiatives should be recognized for their efforts—from turning off the lights at work each night to developing ways to make sure that equipments are switched off when not in use.

LIGHTING

The lighting system is the most visible energy user in the building. And while it's usually a hotel's largest energy consumer, lighting may well be the first place to look for energy savings. Some hotels report finding 20 to 50 percent savings in their lighting systems. These savings are some of the most rewarding to achieve because most are easy to make and cost little or nothing.

Identifying savings opportunities within your lighting systems

Begin your lighting improvement project by determining how much light is really needed in the various areas of the hotel and its surroundings. Areas where people are walking as opposed to seated or working require very different

lighting levels, but all too often are lit to the same high levels.

Do a walk-through of the facility looking at the existing lighting in each area and the area's lighting needs. It's a good idea to use a light meter (lighting suppliers often lend them). You can then compare your present lighting levels to recommended levels for the tasks being performed.

RECOMMENDED LIGHTING LEVELS FOR HOTELS

Hotel Area	Average Foot candles	Hotel Area	Average Foot candles
Hallways	10.0	Guest Rooms	20.0
Lobby	15.0	Front Desk	75.0
Dining/Function Rooms	15.0	Kitchen	75.0

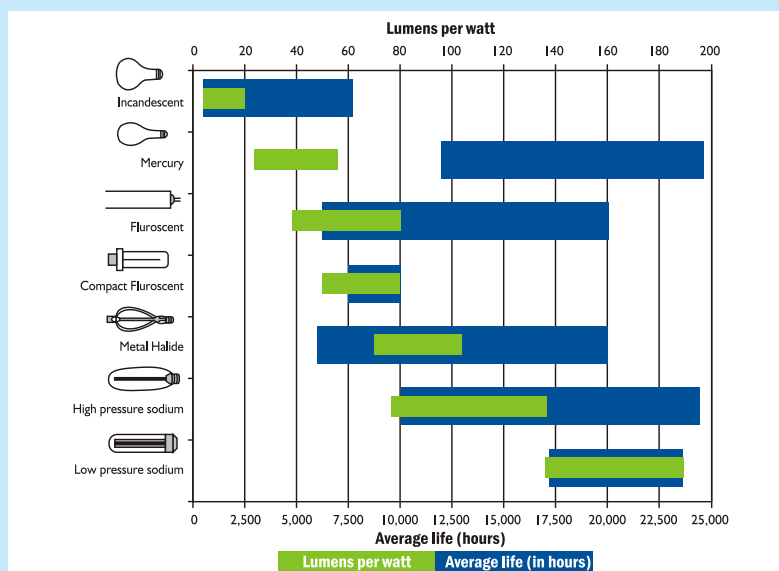
As you walk through the hotel, also note the type of lighting present. One of the keys to improved lighting efficiency is using the most efficient light source to produce light. Incandescent bulbs are least efficient and have the shortest lives, but have the advantage of low first cost, good color rendition and easy installation. Fluorescents are popular in general because they are 4 to 5 times more efficient and have 10 times the life expectancy of incandescent.

High Intensity Discharge (HID) lamps, which were once used almost exclusively outdoors because of their poor color rendition, are more and more being brought indoors in color-corrected versions due to their extremely high efficiency and long life.

First, Do Things That are Free

Remove unnecessary lamps. Because a number of hotels were designed and built in an era when energy efficiency was not a high

priority, lighting levels often are higher than necessary. But be careful. If you remove lamps near windows, make sure there will still be enough light on overcast days or at night.



Make sure lights are turned off when an area is unoccupied. For the most part in hotels, that means getting employees on-board with the program.

Use switch plate covers reminding people to turn lights off when leaving an area. In public places, guests and employees are hesitant to turn lights off without “permission,” so signage is important. Wind-up timers, time clocks and occupancy sensors can help get lights off when they are not needed.

Keep the fixtures clean to be sure you are getting all the light for which you are paying. Cleaning fixtures and reflectors can compensate for reduced light levels from de-lamping.

Consider group re-lamping, which means changing all the

lamps at once rather than as they burn out. Light output from lamps decreases as they age, so replacing them in a group assures you get full light output, and the practice can reduce the maintenance costs associated with lamp replacement by half.

Low -Cost and Low - Investment Projects

After doing the no-cost projects, consider modifying the lighting system. Many projects require only a small investment. Before investing, calculate the payback period and, for large expense projects, consider life cycle costs to see if the project will be a good investment. And, try an improvement in a small area before committing to major changes.

A. Retrofitting exit signs

is one of the quickest payback projects in many hotels. The idea of replacing conventional exit signs with energy-efficient compact fluorescent ones has been widely promoted over the past ten years. Instead of two incandescent light bulbs that last a few months, compact fluorescent exit signs require only about 12 watts and generally last two years in continuous use.

Converting to LED exit signs has become more popular. The light emitting diode, or LED meets electrical code requirements in most applications, uses minimal amounts of electricity and lasts up to 50 years. LED's are winners for cost savings and avoiding the inconvenience of replacing lamps.

S. N.	Cost Description	LED Lights	Incandescent Bulbs
1.	Lifespan	60,000 Hr.	800 Hr.
2.	Number of bulbs used in 60,000 hours	1	75
3.	Cost	INR 1000.0	INR 10.0
4.	Power dissipation	4 Watt	20 Watt
5.	Power savings per year*	140.0 kWh	-
6.	Lifetime power savings	960.0 kWh	-
7.	Cost saving per year	INR 490.0	-
8.	Lifetime cost saving	INR 3360.0	-
9.	Payback period	2-years	-

* With one bulb in use for 24 hours and 365 days in a year. The power cost is INR 3.50/kWh.

B. Retrofitting Corridor Fixtures

are also a quick payback project in hotels. Attractive fixtures that house compact fluorescent lamps with color rendition similar to that of an incandescent are available. In most cases, no one will notice the difference.

C. Installation of more Efficient Lamps

is one of the most effective ways to make lighting more energy efficient is to use the most efficient lamp possible. Here are some of the best examples:

Replace Incandescent with Compact Fluorescents

The standard incandescent light bulb may seem inexpensive, but it is not a bargain. Not only is it extremely inefficient, less than 10%, it also has a very short life, which means it must be replaced frequently. One of the great advances in lighting technology is the compact fluorescent lamp. Developed as a replacement for the common incandescent light bulb, the super energy efficient compact fluorescent is a spiral or miniature U-shaped fluorescent tube and ballast. Screw-in or pin holder compact fluorescents fit many of the fixtures where you previously used incandescent light bulbs.

This makes it possible to replace an incandescent (15 lumens/watt, 800 hours life) with a more efficient and long lasting fluorescent lamp (70 lumens/watt, 6000 hours life).

Consider that you can replace a 60-watt incandescent with a 15

watt compact fluorescent that will last 10 times as long and will deliver about the same amount of light for one quarter the energy. Compact fluorescents are more expensive than incandescent, but they will more than pay for themselves with savings in electricity, lamp replacement and labor costs. Payback is quickest when they are installed in fixtures that are used for many hours each day.

Compact fluorescents are available in a wide variety of styles to suit most lighting needs, with reflectors and extenders that can make them fit and work well in many fixture types.

They come either as one-piece screwing units that include the ballast or as modular units where the tube can be separated from the ballast when the lamp burns out. The compact fluorescent tubes have lifetimes of 10,000 hours, while the ballasts last 4 or 5 times that long.

Compact fluorescents can be used outdoors when they are protected by an enclosure. However, they have some cold limitations. For instance, they are dimmer for a short time when they start, until they get up to their operating temperature and may not start at all when it is very cold. Using an enclosed light fixture helps. Ask your supplier which would be the best option for your outside needs.

Fluorescent Ceiling Lights

Since some lighting systems in hotels are fluorescent, let's look at what can be done to improve

their efficiency. There are four primary options –

1. Install lower wattage or more efficient lamps

- When selecting new, more efficient fluorescent lamps, make sure they are compatible with the existing ballasts, although it may be cost-effective to replace the ballast as well. While some of the replacement lamps may yield slightly less light, this may be acceptable since in many areas you may have more light than you need. Furthermore, when clean new lamps are installed, and the diffuser and reflecting surfaces of the fixture are cleaned, there may be an increase in light output even with lower wattage.

2. Replace the ballasts -

Replacing existing magnetic ballasts is often one of the most cost effective energy improvements. For instance, installing electronic ballast can reduce the energy consumption of a fixture with two 34-watt lamps from about 74 watts to about 59 watts, a 20% drop, with no reduction in light output.

3. Replace the fixtures -

Fixture retrofits can involve changing out the ballast, replacing yellowed or hazy lenses, diffusers, and globes with new ones that will remain brighter and transmit more light, and installing reflectors that "bounce" more light out of the fixtures. New lenses and reflectors may

enable you to use fewer or lower wattage lamps and still achieve acceptable lighting levels.

4. Rewiring or installing

more efficient controls can be an effective investment, with a fast return.

D. Train Cleaning and Security Staff

Twenty four hours of operation and varied occupancy schedules can result in lights and office equipments being left on in areas (offices, restaurants, kitchens, etc) where occupants are no longer in the building. Invariably, there will also be lights, computers, and other electronic equipment left on by employees who forget to shut down their workspace. Both security and cleaning staff can play an integral role in energy management by assisting in overall savings.

In most hotels, the house keeping staff provides two services to the guest rooms and they are responsible for getting the room cleaned and checked between the check out and check in. Most hotels have key cards for rooms, which is good to minimize wastages when guest is not in the room.

It is recommended that to reduce the wastages, the house keeping staff should be trained to switch off all the lights and leave the curtains open after the morning service and close them at the time of providing evening service. Only one bed side light and one bathroom light should be left on after they finish the evening

service. This will minimize the wastages on lights during the day. Most guests do not bother to open the curtains and switch off the lights.

E. Some Other Tips

Control Outdoor Lighting. Most hotels have lights that are left on all the time for code compliance or to meet safety and security needs. While meeting code requirements, use only lighting necessary to do the job. It is recommended that the outside lighting should also be fitted with timers. Different timing should be set for summer and winter months. The alternative lights can be switched off after 11.30 pm. It is also recommended to create zones of every third lamp, and have each zone turn on 30 minutes apart, and turn off 30 minutes apart, instead of all at once.

Rewiring. If your present switches don't give you enough control to turn off unneeded lights, you should consider rewiring and installing additional switches or dimmers.

Occupancy sensors. In public areas where employees forget to turn lights off, an occupancy sensor may be the answer. These easy-to-install motion detecting devices turn lights on and off automatically in a space such as a restroom, storage area or stockroom. A sensor can be mounted on the wall where a light switch would normally go or can be installed in the ceiling or high on a wall. Occupancy sensors are activated when they detect motion, heat or both. Energy

savings from sensors is greater the more hours the lights are off and the more watts controlled by the sensor. Savings from 20% to 40% are possible and even greater savings are possible when spaces are infrequently used. Consider installing occupancy sensors in the following: senior executive offices, conference rooms, employee locker rooms, restrooms, stockrooms, and storage areas. While providing the sensors in toilets it is important to note that WC areas should be kept out of the circuit to avoid inconvenience to the guests.

Use Task Lighting. Install desk lamps for close work at office desks and reception desks. This type of task lighting puts light where it is needed, when it is needed, and may permit ceiling lighting levels to be lowered.

Use Day lighting. Day lighting is the practice of using free light from the sun during the day to supplement or even eliminate purchased light. Taking advantage of day lighting may require installation of blinds or shades to control heat gain and glare. Combining this with rewiring and installation of switches will enable you to save money by turning off lights when they are not needed.

HVAC

The hotel's heating, ventilating, and cooling systems are what create comfortable conditions inside the hotel. HVAC systems are large consumers of a hotel's energy. That means HVAC is an area likely to produce good returns on energy efficiency improvements. Finding savings of 20% or higher are quite often possible through more efficient operation and maintenance of the HVAC system. Much of the savings will come from simple things you can do yourself like keeping the system off when it is not needed, or operating it less by changing temperature settings. The remainder of the potential savings comes from making the system more efficient.

Use the HVAC checklists provided in this guidebook during your walk-through of the facility. In addition, here are some ideas to consider.

A. Keep System Off During Unoccupied Times.

The best time to save money in an area of the hotel is when no one is there. All too often energy is being wasted heating or cooling the air when nobody is there. Making matters more complicated, your occupancy hours are different for the various parts of the hotel building, like when there is a banquet in the ballroom or a convention in only one wing. Temperature can only be controlled for individual areas when there are separate heating or cooling units, zones, or thermostats.

B. Use Ceiling Fans. Ceiling fans can save you energy costs by making guests feel comfortable at higher temperatures in the summer. The fans create an evaporative cooling effect as they pull air over the skin. In winter, ceiling fans redistribute the warm air that collects near the ceiling to the lower part of the space for people's comfort. This can mean that heating thermostats need not be set as high.

C. Put Locking Covers on Thermostats.

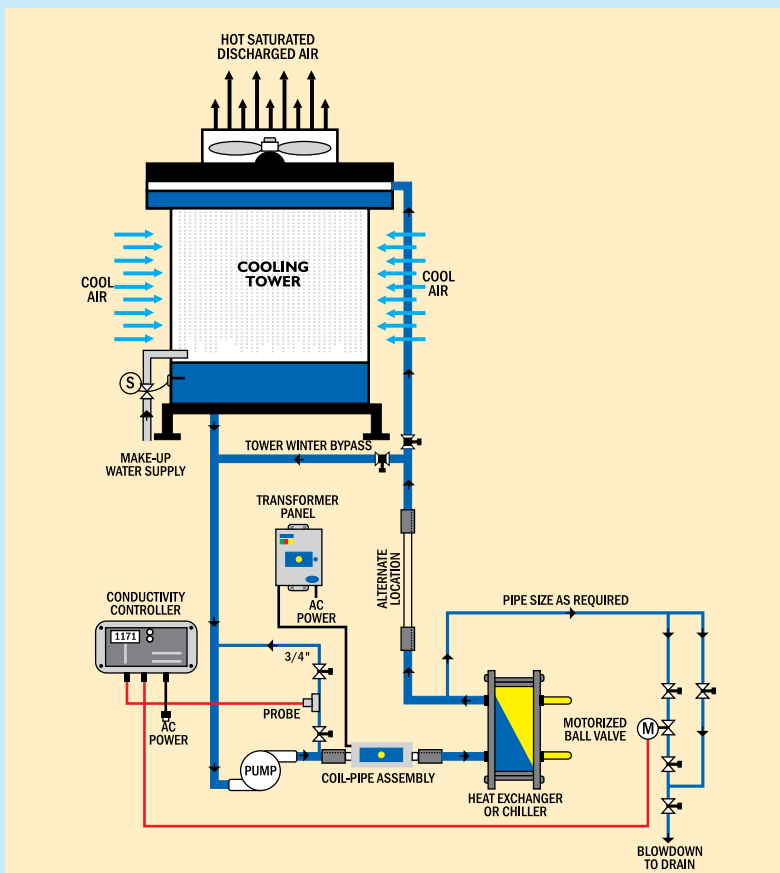
Employees should not be given free reign on spending your energy money. Determine a reasonable



setting and cover programmed thermostats in public areas with tamper-proof covers or look into replacing them altogether with ones that hold a fixed setting. Make sure to also check the accuracy of thermostats. At a time when your heating or cooling system has the hotel at a stable temperature, walk through with an accurate thermometer and see if the thermostats are accurately recording the temperature. If the thermostat says it is 70°F and the actual temperature in the space is 74°F, the heating system may be running more than necessary.

D. Inspect and Repair Duct Leaks.

In air distribution systems,



take a look at the duct system as part of your energy check-up. Over the years, these systems deteriorate and can even get stepped on and damaged by contractors and technicians working in the area. Fix broken joints and other leaks, and be sure they are insulated if they run through unconditioned space.

E. Replace/Clean Filters & Coils. It's one of the simplest of the conservation measures, and it's often overlooked. Take time to check that there are filters in place and see that coils and filters are cleaned and changed regularly. Filters and coils are the two most critical elements in HVAC system.



They are where the mechanical system interacts most directly with the environment it is trying to impact. It does not take much dirt and dust to degrade thermal transfer across the coils, and as filters get dirtier, air delivery to spaces and fan energy required to deliver air will suffer. Very aggressive cleaning schedules for coils and filters are always a part of the maintenance regime for

buildings. It is very common to observe dirty filters and coils even when maintenance staff reports an aggressive approach. Often, teams will rely on pressure drop alarms in the BAS system to signal the need for filter cleaning. Our experience in the field indicates that this is not a proactive approach associated with capturing available low-cost savings.

The hotels do have regular maintenance schedules for their HVAC systems and for cleaning of coils and filters. But still it is recommended that the coils and filters be cleaned very aggressively and on schedule (preferably every month). Close inspection of coils and filters on a periodic basis will be the best initial indication as more aggressive schedules are set. The amount of dirt on the coils and filters can easily be determined by wiping the surface with a finger or clean cloth. As this measure is less popular with maintenance staff, motivation and oversight are required, which might result in a checklist that appoints a responsible staff person to ensure on time completion. Replaceable filters can be cleaned in batches to reduce labor associated with this measure, and pre-filters can be considered depending on local condition. Where coils and filters are difficult to access, it is important to document the process, appoint specific staff who can learn to do the job efficiently, and evolve cleaning techniques that are appropriate to the challenge. For example, if coils and filters are in terminal units above high end conference space, frequent cleaning with a liquid chemical solution may

not be feasible compared to brushing, vacuuming, and forcing compressed air through the coils. The goal is to look at current conditions and practices and come up with a reasonable definition of an aggressive, sustainable approach.

The estimated savings for this measure are difficult to calculate but with past experience it has been observed that this practice can save between 10-20 % of electricity use every year as very clean coils and filters are a fundamental part of excellent HVAC performance and should not be treated as an option to be weighed against others.

F. Chiller Coil Temperature Reset. In hotels, chiller coils are operated at the temperature established during the design process to ensure adequate cooling during peak cooling conditions. They are designed to produce supply air temperature to meet set point temperatures under the most extreme loads anticipated the local climate and weather. This design coil temperature is lower than that required to meet building cooling loads under more typical, less extreme conditions. It is possible to slightly increase the cooling coil temperatures when cooling loads are not at peak, saving chiller energy. The EMS should be used to increase or decrease the coil temperatures in response to outdoor air temperatures. Even without using EMS, it is also possible to vary coil temperatures manually, and this can be done daily, weekly, monthly, or seasonally, depending on how motivated the building

engineering team is. More frequent adjustments produce greater savings.

The load decreases by increasing the chiller coil temperature by even 1°C. This decreases the electricity consumption of the chillers by 10%.

G. Condenser Water Temperature Reset. This initiative increases the efficiency of the chiller by reducing the condenser water temperature supplied from the cooling towers. Instead of a standard fixed condenser water supply temperature, water as cool as possible is supplied to the condenser side of the chiller based on manufacturer's recommendations and the continued ability to meet interior temperature set points. It is assumed that the cooling towers can produce a minimum condenser supply water temperature equal to 88°F above the outside air wet bulb temperature. This can be applied to the condenser water loop with temperature set points as low as 75°F.

It is recommended that the hotel should determine how much decrease in condenser water temperature is possible, while still meeting manufacturer's recommendations and interior set point temperatures. Vary condenser water temperatures depending on the outdoor conditions either by programming the EMS to automatically adjust temperature or by training staff to adjust the temperature manually based on outdoor air conditions. More frequent adjustments result in more energy savings. The

estimated savings from decreasing the condenser temperature can exceed 10% of annual chiller energy and the payback is immediate if controls or manual approaches can be implemented without outside assistance.

H. Adjust Temperature Set Points. Different sections of the hotel have different expectations for interior temperatures associated with seasonal climatic temperature conditions. About 1°C reduction in interior temperature settings during the winter months (October to February) can save as much as 5% in energy costs during these months. By carefully selecting seasonal set points that meet but do not exceed comfort expectations, considerable energy can be saved and guest satisfaction can be maximized.

I. Plan Ahead. People rarely plan for an equipment failure, and when one occurs you will be under pressure to get it up and running right away. This makes it difficult to shop and plan for energy efficient replacements. So, prepare in advance for likely units that may fail, particularly in guestrooms, and check on the price and availability of efficient units. HVAC systems last a long time, so your hotel will live with the replacement for many years to come.

J. Buy Energy Efficient Equipment. There are laws in place that require manufacturers of HVAC equipment and appliances to meet minimum efficiency levels and to label each product with its efficiency rating.

Check with your local utility or HVAC Service Company for what is recommended for your area.

K. Heat Exchangers. Consider installing heat exchangers to move fresh air in and stale air out of your hotel while exchanging 50% to 70% of the energy between the two air streams. In humid climates, heat exchangers with desiccant capability can control the humidity in the hotel. This is a good application where ventilation requirements are high, such as lounges, fitness rooms, smoking areas and cafeterias or where waste heat is being exhausted, for instance, by a kitchen hood. In some cases, chiller condenser waste heat can be used. Look into Cool Storage. When chilled water is used as the cooling medium, installing a cool storage system allows you to save on your electric bills by paying lower, night time, off-peak electricity rates to create and store the cooling you will need for the next day. A cool storage system can save a lot of money, but you will need professional advice to evaluate your situation.

L. Consider Heat Pumps. Heat pumps are electrical devices that move heat from one place to another. A heat pump can provide both heating and cooling. Most heat pumps are air-to-air systems. In the cooling mode, the heat pump operates like a window air conditioner, removing heat from inside air and moving it to the outside air. In the heating mode, it operates like an air conditioner in reverse that moves heat from the outside air and pumps it into the building. Water source heat

pumps take heat from or reject it to a water pipe or connecting loop. Heat is rejected from the loop to a cooling tower or is provided to the loop by a boiler if the loop temperature falls.

In addition to being highly efficient, heat pumps often have lower

first cost, lower maintenance, and space savings compared to two separate heating and cooling systems. However, air-to-air heat pumps are not designed for severe cold. If the temperature drops too low, its heating effort may need to be supplemented

by other sources of heat, either electric resistance or fuel-fired system. Most heat pumps have electric resistance heating elements for backup, but there are also dual fuel heat pumps that use gas for heating below a certain temperature.

BUILDING ENVELOPE

While it consumes no energy itself, the hotel building envelope has a large influence on a major energy consumer, the HVAC system. The envelope consists of the buildings outside walls, its roof, windows, doors, and floors. It is the barrier or filter between the inside conditioned space and the outdoors.

When it operates effectively, your buildings will require less energy. From an energy perspective, its purpose is to minimize heat loss

and gains. While there are some easy improvements, like fixing broken windows or leaky doors, many building envelope projects require large investments and become difficult to justify on a return on investment basis.

The roof and walls, windows and doors are the most obvious places to look for energy losses. The five critical areas for building envelope energy improvements are:

Infiltration is air leaking through openings or cracks around

building components. It is one of the easiest losses to locate and fix.

Poor insulation lets heat leak into or out of the building, primarily through the walls and roof.

Single pane windows have extremely low resistance to heat loss or gain.

Lack of shading increases solar loads in the summer and increases air conditioning costs.

The HVAC equipment allows losses through piping, ductwork, stacks, dampers and rooftop units.

Here are the most important things you can do to improve the building envelope:

A. Infiltration. Find and seal leaks. This is most easily done on a day when there is a large difference between inside and outside temperature. This can also be done by using fans/HVAC to create a pressure differential between the indoor and outdoor areas. You should be able to walk around the facility and look for cracks and feel for drafts. Ask employees where they feel drafts. The worst culprits are around

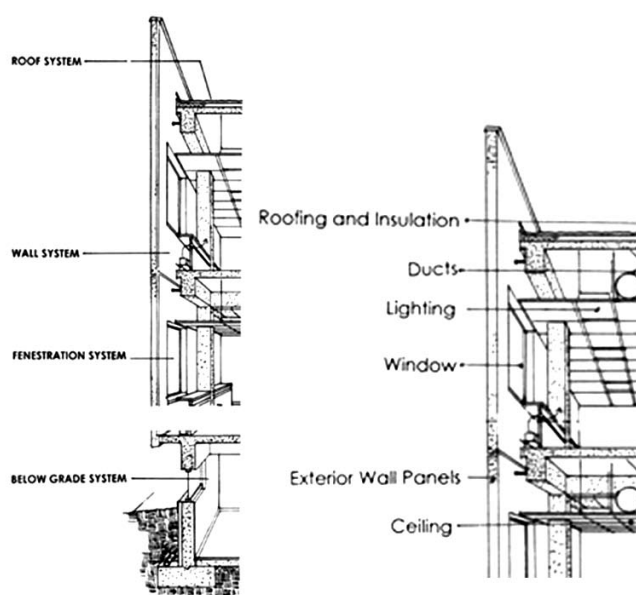


Figure 1: The building envelope systems: Left, the 4 systems; Right, a portion of the envelope showing some of the other systems that integrates with the envelope⁵

⁵ Building envelopes Design Guide, National Institute of Building Sciences, USA

windows and door frames, and any area where dissimilar building materials meet, like where a metal door frame meets mortar around brick. Start fixing the largest and easiest to fix leaks. Use high quality caulk to fill small gaps, and use materials like glass fiber insulation to fill larger openings.

Tighten window and door frames and install weather-stripping to reduce air leaks. Replace broken windows, and adjust any automatic door openers/closers to ensure they close quickly and completely. If your facility has window air conditioners, cover them in the off-season and make sure they are sealed tightly in the window frames.

In some instances, a vestibule, where two sets of doors create an air lock, can dramatically reduce air flows related to people entering and leaving the hotel. They are especially beneficial when there are lots of door openings, particularly in windy locations. Adding a vestibule

can be cost prohibitive, but you may be able to create a low-cost version by adding another set of doors inside the external doors.

B. Poor insulation. Add insulation to reduce heat flow through the building components. The place to begin is assessing what is there now. If there is none, the most cost-effective place to begin is probably the roof, then the walls and floors. Because these measures often require a large investment, you may want to consult with an energy specialist to run a building simulation and estimate savings.

C. Single glazing. While they are beautiful to look at, windows are virtually thermal holes in the building envelope. Consider that a wall might have a resistance to heat flow, or R-value, of 19. A single pane window has an R-value of less than 1, almost 20 times less resistance to heat flow!

Double panes (R-2) and triple panes (R-3) do improve the situation, they double or triple

the window's R-value, but by comparison to even a wall, this is not much of a heat flow barrier. Often the best you can do with windows is covering them with shades or curtains that increase their resistance to heat flow.

D. Shading. Reducing heat gain through windows can reduce cooling costs, but can also increase occupant comfort. Particularly in warm climates, protecting windows from the sun can have a big impact. The first principle of shading is begin as far from the building as practical and move in. That means planting deciduous shade trees or building trellises for vines to create summer shade. Deciduous vegetation is best because it drops its leaves in winter when the extra solar gain is appreciated. Awnings are also an option.

E. HVAC equipment losses. In unconditioned space look for uninsulated pipes carrying hot or cold water or air ducts and consider getting them insulated.

HOT WATER

Water heating in hotels is needed for guestrooms, laundry, public restrooms, janitorial work, kitchens, locker room showers, and occasionally swimming pools. Water heating can be a relatively large energy user in hotels, particularly when laundry is done on-site. There are some inexpensive and easy measures that can reduce your water heating costs.

A. Lower Water Temperature Settings. All too often water heater settings are much higher than they need to be, and turning them down is one of the easiest ways to reduce energy waste. Before you do this, make sure the tank and piping have adequate insulation, and then measure the temperature of the water at some points of use. The recommended water temperature for hand



washing and showering is 105°F. With gas units, simply turn the dial to adjust the temperature. You might want to mark its current position so you have a reference point as you start making adjustments. On electric units, there are often two thermostats, each located under metal plates, which must be removed to change the setting. Be sure to turn off electricity to the unit first, or leave the job to an electrician.

B. Reduce Hot Water Use.

Install flow restrictors and aerators in sink faucets. Don't install them in areas like janitor's closets where they are used for filling buckets where filling speed is important. Install low-flow showerheads to reduce hot water usage. Some showerheads, particularly older ones, have flow rates of more than 5 gallons per minute, while low-flow models are half that amount. Check the flow rates in the showers by turning on the

shower to a normal flow rate and timing how long it takes to fill a gallon bucket. Install self-closing faucets in public restrooms.

C. Reduce Heat Loss. If the tank is warm to the touch, it is losing valuable heat to the surroundings 24 hours a day and needs a tank wrap or blanket. Blankets are inexpensive and easy to install, and are readily available at hardware stores. Also insulate the exposed hot water piping, and repair or replace any existing insulation.

D. Label Faucets. Remind people of your conservation effort by posting labels asking them to "Please turn off the water." If continuously running water is a problem, install self-closing faucets where you push down on a lever for 10 to 15 seconds of water flow. Also, occupancy sensing controls typically consisting of a photo cell and solenoids can be

installed above sinks to control water flow.

E. Reduce the Amount of Time the System Operates.

It may pay to turn the water heaters off during times the facility is closed, or during peak electric demand hours. Time clocks are available for this purpose. Circulating pumps can be turned off in unoccupied wings of the hotel when hot water is not necessary instantaneously.

F. Maintain the System. Fix hot water leaks. Check and adjust the fuel-fired systems to be sure they are burning properly. Have a service technician check it out and clean it once a year. Drain any sediment from the bottom of tank water heaters by letting a little water out until it runs clear. When left to accumulate, the sediment forms a layer of insulation at the bottom of the tank, where with fuel-fired systems; heat transfer is trying to take place.

KITCHEN & FOOD PREPARATION

Food preparation in hotel restaurants is a factor in the energy budget, with cooking using about 6% and refrigeration (not including guest icemakers) using about 2% of the total energy consumed in the hotel. In seeking energy savings, consider these opportunities:

Cooking

- Turn individual pieces of cooking equipment off or down to an idling temperature during slack production times or when not needed.



- Operate at the proper temperature, (e.g., fryers at 325°F to 350°F). Excessive temperature wastes energy and often results in improperly cooked food. Don't increase temperature during rush hours to increase production. Excessive temperature could destroy the quality of the product and energy consumption will increase.
- On gas units, make sure each gas flame burns blue and adjust the gas to-air ratio when necessary. Keep burner parts clean. Poorly adjusted flames waste gas and may also deposit soot and carbon on the food.
- Do not load the units beyond the manufacturer's recommended capacity. Overloading results in poor food quality.
- Keep all units clean and properly maintained.
- Establish and implement a regular schedule of preventive maintenance tasks.

Specific measures for energy intensive equipment include –

A. Fryers. Drain and strain the oil and check fat levels frequently. This saves oil and preserves food quality. Low fat levels can cause premature oil breakdown.

B. Griddles. Pre-heat only until the griddle surface has achieved the correct cooking temperature required to cook the food, and heat only the sections necessary. Clean the griddle frequently and always re-season. Scrape

the cooking surface between production intervals. Cleaning some types of griddle surfaces requires special tools - use them. Inspect each griddle section periodically for hot or cold spots.

C. Broilers. Preheating a broiler for an extended period of time or at an excessively high temperature wastes energy and could alter the food quality and taste. Load the broiler to maximum capacity to gain maximum efficiency. Clean grates frequently - carbonized grease hinders heat transfer, lowers cooking efficiency, and mars food quality. Adjust broiler section power; for example, use one section to full heat for rare meats, and lower another section for well-done meats, to save energy while also improving cooking consistency. Consider infrared broilers whenever possible as they may be turned off when not in use and then quickly reheated when needed.

D. Ovens. Energy efficiency of ovens depends upon how well they are constructed and used. Insulation levels and quality are

two of the most significant factors in oven design. Some inexpensive ovens have little-to no insulation in the oven door. In addition, ovens consume considerable amounts of energy when they are left on, even when no food is being cooked. If your kitchen production requirement does not call for a full-sized oven, consider a half-size oven; it will operate at much better economies.

E. Steamers. Steamer ovens are well insulated to reduce heat loss to the kitchen. They are quick to preheat because of the high heat transfer characteristics of steam. Therefore, they require less energy to stay up to temperature during slow times. Keep the unit fully loaded when possible as a steamer operates at peak efficiency and productivity at full capacity. Control the water quality to the steamer. If the water in your area is hard or contains chemicals at any significant levels, these can coat and corrode the steaming components. This scale and possible chemical carryover can deteriorate steamer performance,



food quality, and almost always results in premature steamer component failures. Check with a professional water treatment company about proper water softening.

Energy Conservation in Kitchen Refrigeration

Refrigeration is a vital tool for almost every food service operator but refrigeration systems have two strikes against them – they are “On” all the time and they consume electricity. The hotel has a number of deep freezers and cold storage rooms. This means that even small amounts of energy wasted by poorly maintained refrigeration will add up to substantial costs over time.

Here are some practical recommendations to keep refrigeration systems running efficiently:

- Use strip curtains or plastic swing doors on cold stores. These “infiltration barriers” block warm moist air from getting into the boxes while the door is open. Strip curtains used in busy kitchens can reduce compressor runtime significantly and that saves lot of energy. Remember, strip curtains have to cover the entire door opening.
- Make sure that the doors of the cold stores are shut all the time. Repair or replace broken auto-closers on the doors, lubricate door hinges, and realign sagging doors. Also, don't allow employees to prop open walk-in doors.
- Check all the door gaskets every fortnightly on all refrigerators and replace any gaskets that are torn, cracked, worn out, or just plain missing. (Always use the manufacturer's specified replacement). A refrigerator door must seal completely to be effective. Remember, that the proper sealing of doors is not for keeping the cold air in – it is to keep hot and humid kitchen air out.
- Airflow is an important part of refrigeration. When the coils are clogged and dirty, the compressor works harder and will fail sooner. Thus it is recommended to clean the evaporator coil (the cold one inside the refrigerator) and condenser coil (the hot one outside the refrigerator or on the roof) at least quarterly. If the aluminum fins are frozen or bent/damaged then call a qualified service person for the cleaning. Remember – never use a caustic cleaner on these coils.
- Find the time clocks that control the freezer defrost and set them properly. Time clocks might be located on top of or underneath the freezers, on the wall, or on the roof. There is a clock for each freezer. With the help of these clocks, the number of daily defrost cycles can be reduced from four to three and sometimes even two. Each cycle should be about 15 minutes long. Also, make sure that the evaporator drain line is heated and insulated so that the defrost condensate has some place to go. Improper defrosting can waste a lot of electricity and compromise safe freezer temperatures.
- Use only Compact fluorescent lamps (CFL) in cold storages. A regular CFL will work fine in the cold storage but for freezer a low temperature rated CFL or LED light is required. LED's would be the ideal solutions for both applications.

Energy Conservation in Kitchen Ventilation

An unbalanced or poorly designed kitchen exhaust system can spell trouble both for restaurant's air quality and for utility bills.

- **Catch all that is possible**
 - Cut down on spillage by adding inexpensive side panels to hoods that are failing to capture, and push each appliance as far back against the wall as possible to maximize hood overhang and close the air gap between the appliance and the wall.
- **Rebalance the act** – If an air balance has not been performed recently, it's time to do so. Time, maintenance, broken belts, and poor commissioning all lead to kitchen exhaust systems that are out of balance, potentially moving too much or too little air, spilling and costing money. This also applies to dining room heating, ventilation, and air conditioning (HVAC) system; outside doors that

are hard to open because of suction or that blow open by themselves are a sure sign that it's time to order an air balance.

- **Use variable-speed exhaust** – Typically, kitchen exhaust hoods have two settings: “off” and “on”. Naturally, “off” is ideal for when the kitchen is empty, and “on” may be great for the frenzied lunch and dinner

rush—but neither is quite right for the afternoon lull, the post-dinner wind down, or any other situation when the kitchen isn't operating at full capacity. Variable-speed, demand-based exhaust controls get around this problem by using sensors to monitor the cooking and varying the exhaust fan speed to match the ventilation needs. Demand ventilation

controls typically reduce the cost to operate an exhaust system by anywhere from 30 to 50 % and can be installed on either new installations or retrofitted to existing hoods.

- **Maximize hood size** – A 4-foot deep hood is somewhat typical for restaurant exhaust, but more smoke and heat can be captured if a 5 or 6 foot deep hood is used.

HOTEL LAUNDRY

One of the large consumers of water and heat in the hotel, laundry is an outlet that can significantly reduce energy consumption with no effect on guest comfort or satisfaction. Some of the important points to achieve desired results are listed below:



- Shift the lights - different switches operating for different corners of the laundry. This will help in switching off the lights when not required.
- Clean lamps and lights fixtures every month to maintain the lighting levels.
- Clean and wash walls, floors and ceiling to allow better reflection of lights.
- Check and record the water consumption. Compare water consumption daily to find wastages, if any.
- Consider using cold water detergents. It will greatly

reduce energy consumption.

- Reduce hot water temperature to 48°C.
- Repair or replace all hot water piping insulation.
- All steam line valves should be checked for leaks. That is, you should be able to shut off steam to any machine not in use keeping steam supply main open.
- If possible use final rinse water for 1st wash while washing uniforms and hotel cloths.
- Reduce time between loads to prevent tumblers from cooling down.

- Air line should be checked for leaks.
- Periodically clean exhaust duct and blower of lint and dust.
- Keep steam pressure at lowest possible level.
- Shut off steam valve whenever machine is not being utilized.
- Keep radiator coils and fins free from dirt all the times.
- Ensure all steam traps in perfect working order.
- Keep an eye on the preventive maintenance schedule of all laundry equipments by Engineering Department to ensure timely compliance.

- Ensure that drying tumblers and washing machines are kept clean and free from scale at all times.
- Switch off laundry exhaust fans when laundry is closed.
- Ensure that extractors are working properly. Incomplete extraction increases load on dryer and consumes more energy for drying.
- Inform boiler room when hot water is not required so that boilers can be shut down to save fuel.

FRONT OFFICE & LOBBY

Front office can play an important role in energy conservation. When occupancy is not high, front office should rent the rooms by virtue of their location. In summer, rooms on the east or north sides of the building will be cooler. Also, corner rooms with two outside exposures will be warmer. Rooms close to heat source should also be avoided if possible. This would certainly help reduce air conditioning load and result in energy savings.

- During low occupancy period try to block a complete floor. If this is not practical, attempt should be made to block as far as possible total wings of individual floors.
- Front office should make sure that air-conditioning is switched off in the rooms which are not to be rented out during lean periods. If any one of these is to be rented out, the air conditioning can be started 30 minutes before the guest moves in.
- Lower all lighting levels during late night and day light hours.



Turn off all lights in offices when these are closed.

- If possible, instruct shopkeepers to reduce the amount of shop and display lighting. Although, in most cases, shopkeepers do pay for their electric consumption, the lighting load still affects hotels cooling systems.
- Lobby, managers should ensure that Lobby Main Entrance doors are not unduly kept opened. A door opening will result in ingress of heat from outside and adversely effect air conditioning.
- Lobby Managers, in course of their duty, do take rounds of the property. On their rounds they should ensure that no unnecessary lights or water taps are left ON by careless staff.
- During day light hours reduce electric lighting load in Lobby etc. to minimum to make full use of natural light.

IMPLEMENTING AN ENERGY MANAGEMENT SYSTEM

An energy management system (EMS) can save 10% to 40% on electric bills⁶. An EMS in your hotel can enhance your existing operations by allowing you to control various aspects of your energy use including lighting, and HVAC from a central point, reducing error intensity caused by manual operation of these services. It has been noted the EMS' have been proven to deliver 2 to 5 year paybacks.

EMS' are categorized primarily into 3 levels (adapted from "Managing Energy in Your Hotel") –

Level – I EMC Systems:

These systems are essentially electronic time clocks that perform a single function and are usually located on or in close proximity to the equipment being controlled. The control functions include:

- On and off time,
- Automatic temperature set-back/set-up,
- Dry bulb economizer,
- Enthalpy controllers,
- Single and multi-zone systems,
- Chiller energy management controllers.

SOME IMPORTANT TIPS TO CONSIDER BEFORE SELECTING AN EMS

- Do not select an over complicated EMS. There are many types available in the market so first understand your system needs before selecting the EMS model
- You might already have an EMS in place. If so, appraise the effectiveness of the current system and analyze how well the existing energy systems will integrate into a new EMS.
- Will your employees be able to operate the system effectively?

Level – II EMC Systems:

These systems generally provide remote control and perform more than one function typified by duty-cycling and optimized start-stop. Some of the better applications include:

- Demand controllers (to reduce peak electrical demand),
- Multi-load system programmers (to schedule multiple chillers on and off line),
- Multifunction programmable controllers.

Level III EMC Systems:

These are the central building control systems with the fancy control screen graphics. The central console monitors and

analyzes remote data logging equipment. These systems are usually appropriate only when the hotel comprises many buildings or floors in a high-rise with a central plant and several remote mechanical equipment rooms. Typical optimizing functions include, but are not limited to:

- Economizer cycle,
- Hot/cold deck temperature reset,
- Discharge air temperature reset,
- Chilled water reset,
- Outside air schedule reset,
- Start/stop optimization,
- Air distribution optimization,
- Chiller plant optimization and demand control,
- Boiler plant optimization.

⁶ http://www.treeo.ufl.edu/greenlodging/content/_nrg.htm

After determining the type of EMS required for your hotel, consider the following recommendations **for purchasing the system:**

- Request bids from several vendors.
- Obtain a detailed list of the services and hardware provided.
- Determine what training your employees will need.
- Insure that service and operational support will be readily available.
- Talk with someone from another facility similar to yours who has installed the system.

Energy Management using EMS

Energy bills can form the basis for monthly reminders to department heads and other staff of the importance of energy management. Achievements can be tracked and unexplained changes can be surfaced for early investigation and intervention. More advanced tracking of performance may include 24 hour plots of hourly energy use.

These “day plots”, developed with the help of EMS, show the pattern associated with system start up, parasitic power (when the building is less occupied), and peaks associated with heating and cooling loads. This view of how dynamic energy use is over the course of a day allows engineers to understand the events that drive energy use and when the peaks and valleys occur. If done seasonally—that is, summer, winter, and swing seasons—these day plots can reveal important differences caused by climate and weather.

It is recommended that day plots be developed using the EMS, or, if necessary, using sub-metering equipment or manual readings off the utility meter. If this approach can be automated within the EMS, daily viewing will reveal shifts in patterns that inform operations. If effort is required to generate day plots, weekly, monthly, or seasonal plots are recommended. The more frequently these day plots are reviewed to assess change over time, the more value they have as a diagnostic and strategic tool for continuous performance improvement.

CALCULATING COSTS AND PAYBACK

Evaluation and calculating costs and payback period form the lifeline for an energy management program. Cost savings are a driving factor behind the longevity and success of the program. Associated savings can be used to improve the program or re-invested within the hotel for enhancing other services. For example, cost savings are invested in additional bonus money for hotel staff. Understanding the payback period also helps hotel management assess the viability of the measures to be implemented. Please note that the payback option is primarily used as a basic calculation for each measure implemented. Determining cost effectiveness of large investments over time would require a life

cycle cost or monthly flow calculations.

There are many ways associated with calculating costs and payback period. This guidebook focuses on the “**simple payback**” method, which is one of the least complicated ways to evaluate the value.

Simple Payback Method

The following calculation method and calculator has been adapted from the energy management guide “Managing Energy in Your Hotel”. The calculator can be modified to include variables specific to your hotel.

The simple payback method involves calculating the simple

payback by dividing the cost of the improvement by the annual energy savings. The result is the number of years to payback the investment from the energy savings.

This method comprises of a basic calculation and is utilized primarily for low investment measures. It doesn't take into account the time value of money, energy cost changes, tax effects if any, nor the expected life of the equipment. Please note that to make the ratio as accurate as possible, remember to subtract any rebates from the initial cost of the measure and deduct any required operating costs from the annual energy savings.

$$\text{Simple Payback} = \frac{\text{Cost of Measure (minus any rebates)}}{\text{Annual Energy Savings (minus any operating expenses)}}$$

Example: If installing a time clock costs INR 2,000 and saves INR 4,000 annually on energy costs, it has a 0.5 years or 6 months payback.

$$\text{Payback} = \frac{\text{INR 2,000}}{\text{INR 4,000/year}} = \frac{1}{2} \text{ years}$$

ELECTRIC ENERGY IMPROVEMENT PAYBACK CALCULATOR

Cost For Implementing Measures

Cost of Materials INR _____ ,
 Cost of Labor INR _____ ,
 Cost of Training INR _____ ,
 Total Cost of energy Saving Measures INR _____ (A)

Electric Usage Savings

Complete the following calculations for each measure determine your total Rupee savings and compute your payback.

Details	Old	New
(B) Watts		
(C) Hours/day		
(D) Watt-Hours/day (Multiply B & C)		
(E) Days/year		
(F) Watt-Hours/year (Multiply D & E)		
(G) Total Kilo-watt-hour (kWh)/year (F/1000)		
(H) Annual kWh Savings [(G – Old) – (G – New)]		

Annual Electricity Cost Savings

Annual kWh Savings INR _____ (H)
 Times Electricity Cost/kWh x INR _____
 Total Energy Savings INR _____ (I)
 Less any incremental O & M Costs INR _____ (J)
 Total Savings INR _____ (K)

Simple Payback In Years

Simple Payback = $\frac{\text{Total Cost of Energy Saving Measure}}{\text{Total Savings}}$

GLOSSARY*

Air Handling Unit (Ahu):

Equipment that distributes conditioned air.

Ambient Temperature:

Outside air temperature.

Ballast:

A device used with fluorescent and other types of gaseous discharge lamps to aid starting and limit current flow and to provide voltage control at proper design levels. Can be magnetic or electronic.

British Thermal Unit (Btu):

Equal to the amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit. One Btu is about equal to the amount of heat given off by a wooden match.

Building Envelope:

The elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior.

Caulking:

A flexible material used to seal up cracks or spaces in a structure.

Coefficient Of Utilization:

The ratio of lumens on a work plane to lumens emitted by lamps.

Comfort Zone:

Average: The range of effective temperatures over which the majority (50 percent or more) of adults feel comfortable. Extreme: The range of effective temperatures over which one or more adults feel comfortable.

Conversion Factors:

1 Watt = 3.413 Btu/hr

1 kW = 3,413 Btu/hr

746 Watts = 1 HP (Motor)

1 Gal. Oil = 140,000 Btu

1 Lb. Coal = 12,500 Btu

1 Therm of Natural Gas = 100,000 Btu

1 Cu. ft. of Natural Gas = 1,000 Btu

1 Cu. ft. of Propane Gas = 2,500 Btu

1 Lb. of Propane Gas = 21,500 Btu

1 Ton refrigeration = 12,000 Btu/l hr

Degree Day:

The degree day value for any given day is the difference between 65°F and the mean daily temperature. Example: for a mean daily temperature of 50°F, the degree days are 65 minus 50 or 15 degree days.

Energy Audit:

Any survey of a building, business or complex that reviews energy-using equipment or behavior.

Energy Conservation Measure (Ecm):

A permanent change made to a conditioned building after completion of operation and maintenance measures which will result in energy savings.

Energy Efficiency Ratio (Eer):

The ratio of net cooling capacity in Btu/hr to total rate of electric input in watts under designated operating conditions.

Foot Candles (Fc):

Energy of light at a distance of 1 ft. from a standard (sperm oil) candle.

Glazing:

Another term for glass in windows.

Horsepower (Hp):

British unit of power, 1 HP = 746 W or 42,408 Btu per minute.

Insulation:

A material used to minimize heat losses from a given space.

Kilowatt Hour (Kwh):

A unit of energy equal to that expended by one kilowatt in one hour = 3,414 site Btus and 11,600 source Btus.

Infiltration:

The process by which outdoor air leaks into a building by natural forces through cracks around doors and windows, etc. (usually undesirable). Usually caused by the pressure effects of wind and/or the effect of differences in the indoor and outdoor air density.

Lumen:

Unit of light energy or output (luminous flux).

Makeup Air:

Outdoor air that is brought into a building to compensate for air removed by exhaust fans or other methods.

Multizone System:

An HVAC system that heats and cools several zones each with different load requirements from a single, central unit. A thermostat in each zone controls dampers at the unit that mix the hot and cold air to meet the varying load requirements of the zone involved.

Photo Cell:

A device sensitive to light which is now commonly used to turn on and off the lights at dusk and dawn.

Pneumatic:

Operated by air pressure.

Power:

Power is the time rate of doing work. In connection with the

transmission of energy of all types, power refers to the rate at which

energy is transmitted. In customary units it is measured in watts (W),

British Thermal Units per hour (Btu/hr), or Horsepower (HP).

Refrigeration, Ton Of:

Equivalent to the removal of heat at a rate of 200 Btu per minute, 12,000 Btu/hour, or 288,000 Btu/day.

Resistance (R-Value):

Term used to measure insulation material resistance to the flow of heat in units of square feet per hour.

Retrofit:

The improvement of existing buildings to make them more energy efficient.

Setback:

Reducing the level of heat required from the conditioning system to the lowest practical point especially during periods where the room activities or occupation allows.

Simple Payback (Spb):

Time required for an investment to pay for itself. The cost of the retrofit measure divided by the

annual energy cost savings in Rs/year.

Single Zone System:

An HVAC system that supplies one level of heating or cooling to a zone or area controlled by one thermostat. The system may be installed within or remote from the space it serves, either with or without air distribution ductwork.

Thermal Barrier:

A strip of nonconducting material, such as wood, vinyl, or foam rubber, separating the inside and outside surfaces to stop conduction of heat or cold to the outside.

Ventilation:

The process of supplying or removing air, by natural or mechanical means to or from any place. Such air may or may not have been conditioned.

Weatherstripping:

Metal, plastic or felt strips designed to seal between windows and door frames to prevent air infiltration.

Zone:

A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

* Note – Glossary adapted from "Managing Energy in Your Hotel"

ENERGY MANAGEMENT IN YOUR HOTEL



Brazil: Rio de Janeiro **Canada:** Toronto **India:** New Delhi **Russian Federation:** Moscow **United Kingdom:** London
United States: Albany, NY • Arlington, VA • Baton Rouge, LA • Charleston, SC • Dallas, TX • Dayton, OH • Fairfax, VA
• Houston, TX • Lexington, MA • Los Angeles, CA • Middle Town, PA • Ogden, UT • Oklahoma City, OK • Orange County, CA
• Research Triangle Park, NC • Rockville, MD • San Francisco, CA • Seattle, WA • Washington, DC

www.icfi.com