Managing Energy Costs in Office Buildings

On average, a U.S. office building spends nearly 29 percent of its operating expenses on utilities, and the majority of this expenditure goes toward electricity and natural gas. For the average office building, energy costs can exceed $30,000 per year. Therefore, measures for saving energy can significantly assist office buildings in improving their bottom line.

How Office Buildings Use Energy

Office buildings in the U.S. use an average of 17.3 kilowatt-hours (kWh) of electricity and 31.8 cubic feet of natural gas per square foot (ft^2) annually. (Data are calculated using a 2003 U.S. Energy Information Administration survey of commercial buildings.) Using average commercial energy prices of $0.10 per kWh and $0.98 per hundred cubic feet, the average cost of power per ft^2 for office buildings is approximately $1.73 for electricity and $0.31 for natural gas. For the average office building in the U.S. (approximately 15,000 ft^2), that translates into $30,600 spent on energy per year. For a customized benchmark rating of your facility, use the Energy Star National Energy Performance Rating system via Portfolio Manager software (**www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager**).

Overall, lighting, cooling, and ventilation are responsible for more than 60 percent of electricity use by office buildings, and heating dominates natural gas consumption (**Figure 1**). As a result, these are the best areas to target for energy savings.

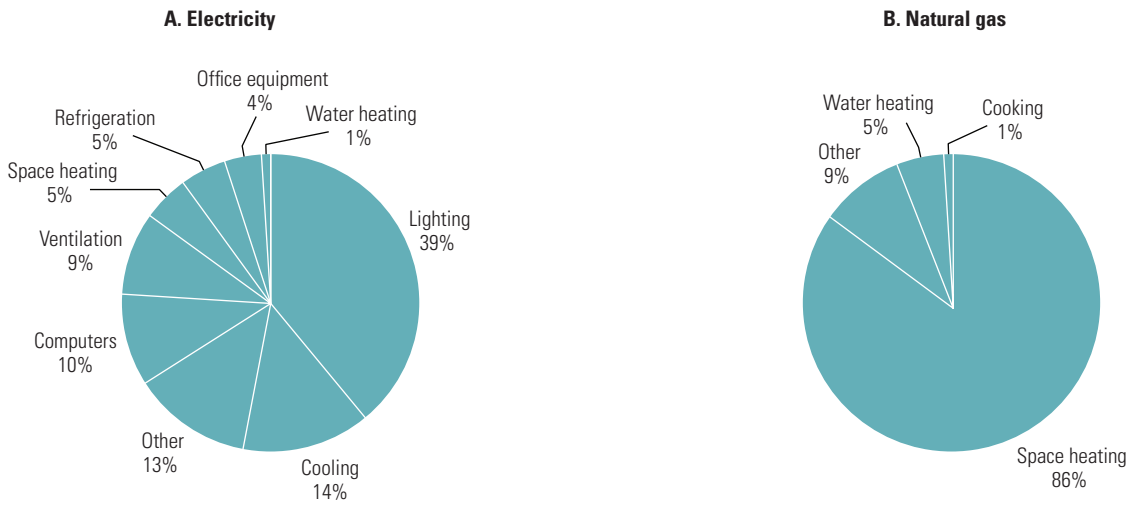
Quick Fixes

Many office buildings can benefit from quick low-cost or no-cost energy-saving solutions such as turning things off, turning things down, and following a cleaning and maintenance schedule that keeps equipment running efficiently.

Turning Things Off

It may seem trite, but the simple action of turning things off can yield considerable savings at no cost. Remember that for every 1,000 kWh that you save by turning equipment off,

FIGURE 1: Office buildings energy consumption by end use in the U.S.
Data from the U.S. Energy Information Administration show that cooling, lighting, and ventilation account for 62 percent of electricity use (A), and space heating dominates natural gas use at 86 percent (B).



Note: Insufficient data were available for electric consumption of Cooking equipment; sum may not total 100% due to rounding.

you save $100 on your utility bill, assuming average electricity costs of $0.10 per kWh.

Lights. Lights are the largest user of electricity in office buildings (39 percent), and managing lighting well can pay big dividends. The simplest way to save lighting energy is to turn off lights when they are not in use. Posters and stickers can provide effective reminders, especially when designed as part of a larger energy-awareness campaign. Occupancy sensors and timers can help, but a less expensive alternative is to encourage employees to turn off lights at the end of the day. Also, building automation systems can be programmed to turn selected lights off at certain hours.

Computers and office equipment. Although the efficiency of some equipment is improving, the proliferation of auxiliary equipment in offices is increasing overall energy consumption. That makes turning office equipment off a critical energy-saving strategy. A typical desktop computer and monitor, for example, can draw about 140 watts of power when idle. If a single monitor that draws 70 watts is left on unnecessarily overnight and on weekends, it could add $50 or more to the annual energy bill. Multiply that figure by the total number of work stations in an office building, and wasted energy translates into a significant sum of wasted money. One way to start saving on computing costs is to use "smart" power strips with built-in occupancy sensors that shut off plugged-in devices like printers and monitors when no users are present. Additionally, most consumer electronics sold today can be set to go into a low-power sleep mode after a specified period of inactivity. Unfortunately, users rarely take advantage of these features. Making sure that these energy-saving modes are enabled can produce significant energy savings. Get more tips and tools for computer power management from Energy Star at **www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_enterprises**.

Turning Things Down

Some equipment cannot be turned off entirely, but turning these appliances and fixtures down to minimum levels where possible can save energy.

HVAC temperature setbacks. HVAC systems account for 28 percent of electricity and 86 percent of natural gas consumed by office buildings. Adjusting HVAC settings can be a source of significant savings. During closed hours and on weekends, turn temperature settings down in heating seasons and up in cooling seasons. Another strategy is to install simple controls to allow some equipment automation‘ this will permit you to schedule the HVAC unit to turn off or down when the building is unoccupied. You can also explore small temperature setbacks during working hours. A 0.5° Fahrenheit (F) to 1.0°F change upward or downward is not harmful to employee health or comfort and is frequently unnoticed.

Common-area lighting. If possible, dim hallway lighting by 30 percent during daytime hours to reduce demand charges and energy consumption. You may be able to identify fixtures that can be "delamped"—that is, extra lamps can be removed from overlit areas.

Water heating. While there is great variation in volume and use of water by office buildings, many facilities find that they can achieve energy savings by turning down the temperature a few degrees on their water heaters.

Cleaning and Maintenance

You can save energy and prevent costly heating and cooling bills by making sure that your HVAC system is regularly cleaned and serviced.

Check the economizer. Many air-conditioning (AC) systems use a dampered vent called an economizer that draws in cool outside air when it is available to reduce the need for mechanically cooled air. If not regularly checked, the linkage on the damper can seize up or break. An economizer stuck in the fully open position can add as much as 50 percent to a building's annual energy bill by allowing in hot air during the AC season and cold air during the heating season. Have a licensed technician check, clean, calibrate, and lubricate your economizer about once a year, and repair it if necessary.

Check the sensors on the economizer. Older economizer sensors by Honeywell (model number C7650) have a large

deadband of 10°F —they open at higher temperatures (letting in warm air) and remain open at lower outdoor temperatures than intended. The new Honeywell sensor (C7660) exhibits a deadband of only 2°F and can reduce annual cooling energy by 8 percent compared with the older model. The $70 for the sensor would be easily recovered from savings during a single summer cooling season.

Check AC temperatures. With a thermometer, check the temperature of the return air going to your AC, and then check the temperature of the air coming out of the register that is nearest the AC unit. If the temperature difference is less than 14°F or more than 22°F, have a licensed technician inspect your AC unit.

Change the filters. Filters should be changed on a monthly basis and more often if you are located next to a highway, construction site, or other site where the air is dirtier than usual.

Check the cabinet panels. On a quarterly basis, make sure the panels to your rooftop AC unit are fully attached, with all screws in place and all gaskets intact so that no air leaks out of the cabinet. Chilled air leaking out can cost $100 per rooftop unit per year in wasted energy.

Clean the condenser coils. Check the condenser coils quarterly for either artificial or natural debris that can collect in them. Thoroughly wash the coils twice annually for sound preventive maintenance.

Check the airflow. Hold your hand up to the registers to ensure that there is adequate airflow. If there is little airflow, or if you find dirt and dust in the register, have a technician inspect your unit and ductwork.

Longer-Term Solutions

Although the actions covered in this section require more time and investment, they can dramatically increase the efficiency of your facility without compromising the comfort and functionality of the working environment. Ask your local utility's representative for more information about initiating such projects and about options for technical and financial assistance.

Commissioning

Commissioning is a process in which engineers check and tune up building systems to ensure that they are operating appropriately and efficiently. A 2009 study by Lawrence Berkeley National Laboratory indicates that commissioning existing buildings yields average energy reductions of 16 percent. Savings typically come from resetting existing controls to reduce HVAC waste while maintaining or even increasing comfort levels for occupants. Assuming 16 percent savings, a typical 15,000-ft^2 office building could save up to $4,896 annually. If your building was previously commissioned, consider investing in recommissioning every three to five years.

Lighting Measures

Fluorescent lamps. Lighting is a popular retrofit area because the costs can be recovered within three years. If your facility uses T8 fluorescent lamps, relamping with high-performance T8 lamps (also known as super T8s) and electronic ballasts can reduce your lighting-energy consumption by 30 percent. If your facility is still using old T12 lamps and ballasts, your savings from a retrofit would be even greater—70 to 80 percent! When used with rapid-start or programmed rapid-start ballasts, high-performance T8 lamps last 20 to 80 percent longer than standard T8s. Adding specular reflectors, new lenses, and occupancy sensors or timers can double the savings.

Smart lighting design in parking lots. Most parking lots are designed with far more lighting than is necessary—or even safe. Using lower-wattage bulbs can provide adequate illumination and actually increase the safety of your lot. An overlit lot can be dangerous to drivers if their eyes cannot adjust quickly enough in the transition to dark areas. When designing lighting for a new parking lot, instead of high-pressure sodium lamps, consider using low-wattage metal halide lamps in fixtures that direct the light downward. Metal halide is less efficient than high-pressure sodium in conventional terms, but it puts out more light in the blue part of the spectrum, which

makes it easier for our eyes to see under low-light conditions. Thus, you can use lower-wattage bulbs. Light-emitting diodes (LEDs) are also becoming a viable alternative for parking-lot lighting. They offer long life and high efficiency, and the ability to direct the light precisely minimizes light pollution. However, products must be selected carefully because manufacturers often exaggerate LED product performance.

Daylighting. Light shelves installed high on the inside of south-facing windows shade and prevent glare in the bottom six feet of a floor, which is where most occupants work. The shelves also reflect the daylight up onto the ceiling, which indirectly illuminates a room. Light pipes—cylinders lined with highly reflective materials—help direct light from the roof or walls into buildings and can be installed as an efficient and low-cost retrofit. However, without lighting controls, daylighting may not save any energy. Automatic photosensor controls that sense ambient daylight are the best approach because they ensure that electric lighting will be reduced when enough daylight is available.

High-Efficiency HVAC Units

A highly efficient packaged AC and heating unit can reduce cooling energy consumption by 10 percent or more over a standard-efficiency, commercial packaged unit. Because the units do not run at full capacity most of the time, it's best to select equipment that has multiple levels of capacity (compressor stages) with good part-load efficiency.

Reflective Roof Coating

If a roof needs recoating or repainting, consider white or some other highly reflective color to minimize the amount of heat the building absorbs. This change can often reduce peak cooling demand by 15 to 20 percent, in addition to reducing your overall cooling load. The reduced cooling load can make it possible to downsize the cooling system, offsetting some of the new roof's costs. To get an idea of how much you can save, see the Energy Star Roofing Calculator: www.roofcalc.com/RoofCalcBuildingInput.aspx. For a list of suitable reflective roof coating products, check out the U.S. Environmental Protection Agency's web site at www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products.

The Bottom Line

When considering how to make budgets go further, especially in these tough economic times, cutting energy costs is a change everyone can get behind. Depending on the measures you choose, your paybacks can be quick, and your building will continue to accrue those savings over time. Most of the measures discussed in this pamphlet will save money while simultaneously enhancing the aesthetics of your office as well as staff productivity.

To get started, perform an energy audit to identify opportunities for energy savings. Your utility may provide audits and also financial incentives, such as rebates or low-cost financing, to help you implement energy-saving measures. And federal tax credits are available for making efficiency improvements in commercial buildings; to learn more, visit the Tax Incentives Assistance Project Business Tax Incentives page at http://energytaxincentives.org/business/commercial_buildings.php.

Resources

Energy Star, "Activating Power Management Features in Enterprises," www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_enterprises

Lawrence Berkeley National Laboratory, "Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions," http://cx.lbl.gov/cost-benefit.html (July 2009)