

Managing Energy Costs in Multifamily Residences



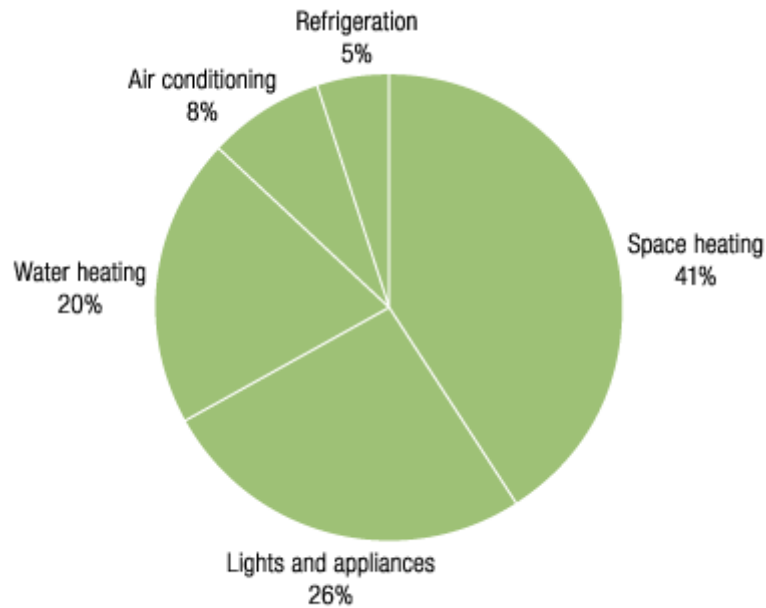
Reducing energy consumption is one way to improve both the profitability and value of any property. To illustrate the benefits of such improvements, the National Apartment Association (NAA) developed a scenario in which a property manager of a typical 20-unit apartment community with an annual operating income of \$98,000 retrofitted common-area lighting and upgraded the laundry room. Just these changes increased annual net operating income by \$3,000 and increased the property value by \$46,154 (assuming a 6.5 percent capitalization rate).

As attractive as such benefits may seem, energy management in multifamily residences does present its challenges. The most prominent is the complexity that arises due to the different—and sometimes conflicting—interests of property managers and their tenants. Nevertheless, there are still plenty of opportunities for property managers to reduce energy consumption and improve the bottom line for their properties and clients. The U.S. Energy Information Administration (EIA) estimates that, as of 2005, multifamily units accounted for 15 percent of U.S. energy consumption, and that owners and tenants pay over \$30 billion a year to purchase that energy. According to the U.S. Department of Energy (DOE), utilities typically are 25 to 35 percent of overall operating costs, making them the single largest controllable cost in multifamily housing (**Figure 1**).

Average energy use data

Figure 1: Energy consumption by end use

Space heating is the single biggest energy consumer in multifamily buildings.



© E Source; data from U.S. Energy Information Administration (2005)

Top technology uses

- Space Heating
- Water Heating
- Lighting

When it comes to reducing energy consumption in common areas, property managers typically face a relatively simple situation: They need only to gain the support of either the building owners or their investors. Reducing energy consumption in individual units is more complex and requires different strategies depending on whether energy costs are included in the rent—which, according to the National Bureau of Economic Research, is the case in more than a quarter of U.S. apartments.

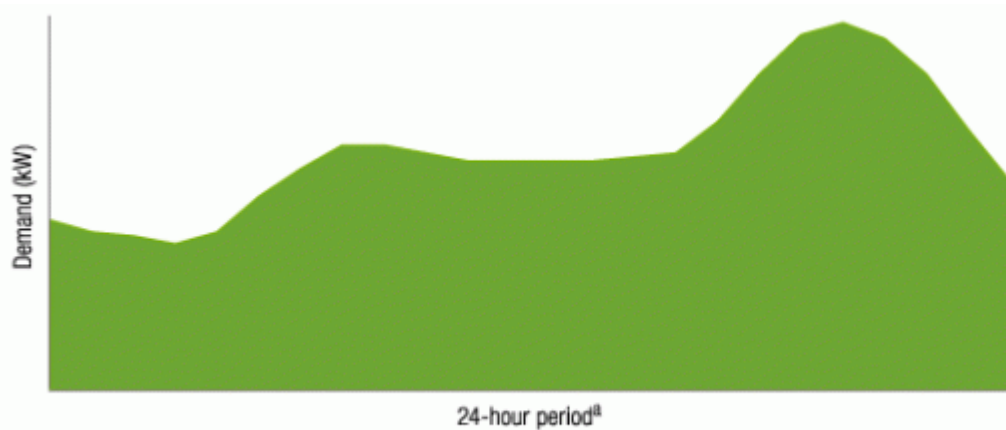
Property managers for buildings where rent includes utility costs have a clear interest in investing in efficient building shell components, heating and cooling equipment, and appliances. Energy use in these units represents an uncontrolled expense for managers because there are typically few limits on the energy such tenants may consume. Retrofitting submetering equipment into such units is one way to encourage those tenants to take control of their own energy expenditures. In buildings where tenants pay their own energy costs, offering “green leases” is a way to enable tenants to share in the costs of those energy-efficiency upgrades that they benefit from (see the “Get Tenants Involved” section).

A good place to start with any energy-reduction program is to observe the patterns by which your building systems and tenants use energy (**Figure 2**). Armed with such knowledge, a

manager can improve how the common areas, lighting, HVAC, parking areas, vacant units, pools, and hot tubs are operated. For example, schedule common area services to be fully functional during peak demand and reduce their availability during low-demand periods.

Figure 2: Multifamily load patterns exhibit early and late peaks

The electrical load profile of a typical multifamily residence exhibits two distinct peaks. The first, smaller one occurs in the early morning and tops out around 9:00 a.m. The second, larger one is much higher, lasting until about 8:00 p.m.



Notes: kW = kilowatt.

a. 24-hour period = midnight to midnight.

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QUICK FIXES

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To ramp up your energy management program, first take advantage of small opportunities that require little up-front capital investment. For example, turning off equipment that is providing little or no amenity to residents is as simple and inexpensive as energy management gets. Once you've built momentum and experience, you can move on to more expensive and complex actions.

Start with the Basics

Educate your residents. Let your residents know that there are a number of no-cost and low-cost improvements they can do to help save money on their energy bills, including:

- *Turn off the lights.* Turn off lights when leaving a room. According to the US Environmental Protection Agency's Energy Star program, turning off just one 60-watt

incandescent bulb that would otherwise burn eight hours a day can save about \$15 per year.

- *Replace incandescent bulbs with CFLs or light-emitting diodes (LEDs).* An Energy Star-certified light bulb—whether CFL or LED—uses 70 percent to 90 percent less energy than a traditional incandescent bulb, can last 10 to 25 times longer, and saves \$30 to \$80 in electricity costs over its lifetime, according to Energy Star. Residents can contact the local utility for details on lighting product rebates and giveaway programs.
- *Prevent waste in water use and water heating.* Ask the property manager to fix leaky faucets, showerheads, pipes, and toilets. Lower the thermostat on the water heater to 120° Fahrenheit (F) and minimize hot shower time. Scrape food off dishes instead of rinsing them, and wash only full loads of dishes and clothes. Install faucet aerators and low-flow showerheads to reduce hot water use, and use cold water for laundering.
- *Avoid overdrying clothes.* Clean out the dryer's lint trap before drying clothes, and dry only full loads.
- *Control plug loads.* Unplug small appliances like smart phone and tablet chargers when not in use. Other “plug-load” devices such as microwaves, televisions, laptops, and video game consoles can draw power through the electric cord even when the appliance is turned off. A no-cost solution is to simply unplug these appliances when not in use. Other options include plugging appliances into a switched power strip that can be turned off when the appliances aren't in use, or using “smart” power strips that automatically turn off plug loads when not in use.
- *Clean refrigerator coils and check the gaskets.* Vacuum dust from the vent beneath the door and from the coils behind the fridge every two months or so—more often if the household has pets that shed. Check for leaks around the refrigerator door; if gaps exist, ask the property manager to repair the gasket or install a new one.
- *Seal gaps.* Use caulk and weather-stripping to seal gaps around windows, doors, chimneys, and other structural elements.
- *Make use of the sun.* During cold months, open drapes or shades on windows that receive direct sun—let the sun's heat help warm the home during the day, but close the shades for extra insulation when the sun goes down. In warmer months, close drapes or shades to prevent heat gain from the sun and lighten the load on any air-conditioning units.
- *Use fans in hot weather instead of air conditioning.* Ceiling fans and portable fans use

much less energy than air conditioners. If it's too hot to use a fan only, combine the use of a ceiling fan with the use of an air conditioner—the combination will enable the setpoint of the air conditioner to be turned up 4° to 5°F without a decrease in comfort. Consider an Energy Star–qualified room air conditioner—according to Energy Star, they use at least 10 percent less energy than standard models. In arid or semiarid climates where nights are cool, open windows at night, and then close them during the day to retain the cool air.

- *Tune up the furnace and replace the filter.* Get the furnace tuned up at the beginning of winter and change the filter twice each heating season.
- *Avoid blocking air vents.* Check air vents in the unit to make sure they aren't covered or blocked by furniture, curtains, or other objects, so air can circulate without restraint. Shut off registers in unused rooms.
- *Install a programmable thermostat.* Install programmable thermostats to automatically alter the unit's temperature settings when residents are sleeping or away. Energy Star notes that when used properly, a programmable thermostat can save up to \$150 a year in energy costs.

Educate your team. According to the DOE, educating employees to be diligent about energy use is one of the most effective means to reduce energy bills. Instruct building staff to turn off unnecessary lights, minimize the use of heating and cooling when possible, turn off computer equipment and appliances that are not in use, make sure model and vacant units are operated efficiently, and take notice of malfunctioning controls such as broken or maladjusted photosensors. Educate your vendors and any contractors working on the property of the steps being taken to save energy.

Remove excess lamps. Reduce lighting in public and common spaces by removing lamps in areas where natural lighting is available or dimming lights in proportion to the availability of sunlight. Consider [daylighting controls](#) to automate dimming. Measure lighting levels and compare them to the recommendations of local building codes or national standards (a list of recommended lighting levels is available in the lighting chapter of the U.S. Environmental Protection Agency's [Building Upgrade Manual](#)). Where lighting levels exceed recommendations, remove lamps and measure again.

Turn Equipment Down or Off

Manage vacant units. Turn off breakers where freezing and security are not a concern, turn heating and cooling off or down to minimal temperature settings, adjust refrigerators and freezers to their warmest settings, and turn off water heaters. Regularly review vacant units' energy bills to identify unnecessary energy use and walk through them to ensure that lights and thermostats are off and that windows and blinds are closed.

Set accurate garage temperatures and ventilation rates. Lower the thermostat setting in heated garages (and other low-use areas, such as service or mechanical areas) and accurately set the ventilation rate. Calculating the appropriate ventilation rate requires data collection, including the average rate of car emissions, the number of moving cars, the average travel time within the garage, and the average speed of cars in the garage. Hire an engineer to collect such data and do the necessary calculations.

Lower the settings on water heaters. Turning down water heater settings by 10° Fahrenheit (F) can decrease heating energy costs by 3 to 5 percent, according to the DOE. Take care, though, that you do not expose your tenants to excessive risks regarding Legionnaire's disease. Legionella bacteria are widely present in potable water systems. To minimize the risk of contagion, ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) recommends that water heaters be set at 140°F in high-risk situations (for example, nursing homes, but presumably anywhere that residents with compromised immune systems are present) and 120°F in all other situations.

Install a timer on hot water circulation pumps. Shut off hot water recirculation during times of low use (for example, 11:00 p.m. to 7:00 a.m.). When determining low use times, consider tenant habits—some might need a shower after returning late from a night out or a night shift.

Adjust pool and hot tub temperature. The American Red Cross recommends 78°F as the optimal pool temperature. In warmer months, turn the heater off altogether. Set hot tubs to 96°F during warmer months and no higher than 102°F during cooler months.

Cleaning and Maintenance

Clean and maintain HVAC equipment. According to the DOE's Energy Star program, a clean heat transfer surface can provide energy savings of up to 10 percent. Energy Star also recommends conducting regular preventive maintenance on heating and cooling equipment including checking and replacing filters regularly; cleaning dampers, blower

units, housing units, and motors; inspecting fans, bearings, and belts; and making sure that terminal fan coil units and baseboards are not blocked. Maintaining and cleaning heating and cooling systems can yield energy savings of upwards of 15 percent, according to Energy Star.

Keep lights clean and calibrate sensors. According to the DOE, cleaning light fixtures can boost light output by 10 percent indoors and up to 60 percent outdoors. Replacing discolored lenses will increase output by up to 20 percent. See [Boosting Lighting Efficiency with Reflectors and Maintenance](#) for additional cleaning tips. Calibrating occupancy sensors and photocells to restore correct operation can reduce energy use by up to 50 percent. The DOE's Federal Energy Management Program has created a [fact sheet](#) (PDF) that will help you save energy and money by maintaining lighting and controls.

LONGER-TERM SOLUTIONS

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Once your energy management program has demonstrated success with the items above, you're ready for measures that require financial investment and detailed planning.

Tune Up Building Systems and O&M Programs

Track your energy use. Use the Energy Star Program's [Portfolio Manager](#) to track your buildings' energy consumption (if you need help, Energy Star has created a [site](#) specifically for multifamily housing). Once you've entered basic data such as building floor area and utility bill data, this tool calculates an index of energy consumption per square foot that will enable you to compare individual buildings, either across your portfolio or against their past performance. Armed with such comparisons, you can identify and prioritize the buildings with the biggest energy consumption problems, or track your progress for those buildings in which you've implemented energy-efficiency measures.

Upgrade your operations and maintenance (O&M) program. One simple way to improve the energy efficiency of buildings with little or no capital investment is to ensure that the building shell—and the expensive systems within it—are properly operated and maintained. Implementing a rigorous O&M program requires the buy-in of senior management and O&M staff alike. Ensuring that O&M activities are thoroughly documented and that staff are well-trained and -equipped also helps. The U.S. Department of Housing and Urban Development (HUD) published a [workbook](#) (PDF) that contains

O&M checklists as well as suggestions for numerous other O&M measures.

Commission your building. According to the Building Commissioning Association, commissioning is a systematic process for investigating, analyzing, and optimizing the performance of building systems by improving O&M procedures to ensure continued performance over time. Even for smaller buildings, according to a Lawrence Berkeley National Laboratory (LBNL) study, simple payback periods were usually less than 5 years, and frequently less than 10 years. LBNL found that most commissioning activities yielded simple payback periods of less than 3 years. [Retrocommissioning](#) can guide you through the process and help you decide whether commissioning is right for your building.

Take Control of Lighting and Temperature

Replace incandescent bulbs with compact fluorescents. Lighting typically offers some of the most rapid simple payback periods of any energy-efficiency upgrade—often less than three years. [Compact fluorescent lamps](#) (CFLs) consume about one-third to one-quarter of the energy consumed by incandescent bulbs, put out less waste heat to be removed by the air-conditioning system, and require less maintenance because they typically last 10 times longer than incandescent bulbs.

Install lighting controls. Install timers in areas where occupancy is predictable and occupancy sensors where it's not. See [Lighting Controls](#) for additional efficiency ideas. Install two-level lighting—which lowers light levels during low-usage times, when less light is sufficient—for corridors, stairways, or other areas that need to have the lights on 24/7. Check with building codes to determine what areas require 24-hour lighting.

Install programmable thermostats. Lower the temperature settings in common areas during times of little or no use. Setting temperatures back by 10° to 15°F for eight hours per night may reduce heating costs by 10 percent, according to Energy Star. HUD estimates that renters with dedicated heating and cooling systems can save about \$180 a year by properly setting and maintaining [programmable thermostats](#) .

Install New Equipment or Replace Old Equipment

Reduce pool losses. Install a pump timer so that the pool pump does not run during times of low usage. Purchase a pool cover to help maintain pool temperature and achieve energy savings of 50 to 70 percent, according to the DOE. For indoor pools, reduce energy costs by installing a humidistat to control the pool exhaust fan so that it does not run

continuously.

Upgrade HVAC equipment upon replacement. Prepare for replacement of failed HVAC equipment now. Contact suppliers and ask them to recommend high-efficiency replacements for aging equipment so that when the time comes you can quickly specify the equipment you want. New cooling equipment sometimes may be sized smaller than the original equipment if efficiency measures have reduced energy consumption and heat loads. Retain an engineer to do sizing calculations. Document the specifications for replacement equipment so that they can be readily accessed and updated every few years.

Upgrade water heaters upon replacement. Plan for water heater replacements as you would the replacement of HVAC equipment. For multiunit systems with gas heating, upgrade to condensing water heaters, which can reduce water heating bills by about 30 percent, according to the DOE. For single-unit installations, a [tankless water heater](#) might be a good way to go. Where electric water heating is used, under some circumstances, a [heat pump water heater](#) can cut energy consumption in half. Energy Star maintains a [list of high-efficiency products](#), including a variety of water heater types; it also provides estimates of how much you can save with Energy Star–qualified products.

Replace old appliances with Energy Star appliances. An Energy Star refrigerator uses at least 20 percent less energy than required by current federal standards and 40 percent less than a conventional 2001 model. An Energy Star clothes washer can reduce energy costs by more than a third and water costs by more than half. An Energy Star–rated dishwasher uses at least 41 percent less energy than conventional dishwashers. Energy Star has created [calculators](#) to help you estimate how much an Energy Star product can save you.

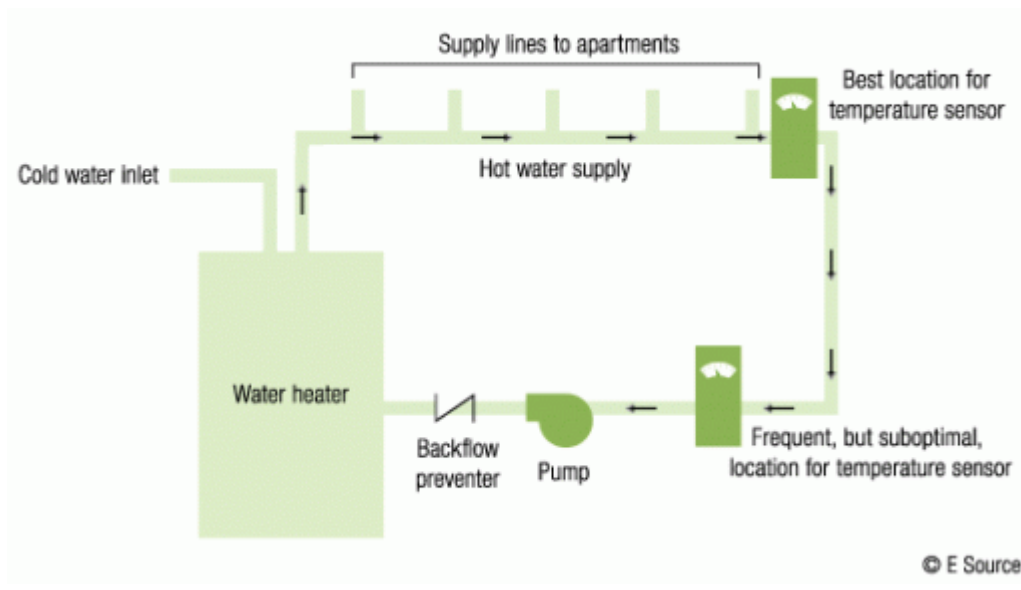
Reduce hot water demand. Low-flow showerheads and aerator faucets can be placed both in common areas and in individual units to reduce the flow of hot water and, thereby, the demand on water heaters. According to the DOE, low-flow showerheads can be purchased for \$10 to \$20 apiece and can achieve water savings of 25 to 60 percent.

Take control of hot water recirculation loops. Install controls on recirculation pumps so that they don't run continuously—heating water and electricity for running the pump all the time can waste copious amounts of energy. Temperature-controlled systems are better, although systems that measure the water temperature at the return to the water heater can be improved by moving the sensor to the last riser (**Figure 3**). After all, there's nothing to be gained by keeping the return pipe after the last riser warm. Insulate the recirculation

loop to minimize losses and keep the pump off longer. And even more energy waste can be eliminated by installing demand controls, which ensure that the recirculation pump only runs when hot water is needed. Signal demand at major hot water system end-points with buttons, motion sensors, or flow switches, and mount a temperature sensor at the last riser to turn off the pump.

Figure 3: Controlling recirculation pumps

Where recirculation loops are controlled by temperature, the sensor is frequently located right near the pump and backflow preventer, where water is returned to the water heater. A better way to control such loops is to locate the temperature sensor right near the apartment supply line that is farthest from the water heater. Such a location will enable the pump to turn off when heated water reaches the sensor location, and allow the portion of the recirculating loop that doesn't serve any supply lines to remain relatively cool. Insulate the heated portion of the recirculation loop so that it stays warm longer after the pump has shut off.



Replace exit signs. According to current U.S. federal standards, all [exit signs](#) manufactured after January 1, 2006, must draw no more than 5 watts per illuminated face of the sign. To see what your building could save by replacing aging exit signs with contemporary models, use the [Energy Star exit signs savings calculator](#) .

Get Tenants Involved

Make green leases. Green leases provide a vehicle by which building owners can invest in

efficiency improvements in tenant space and recoup the costs by raising the rent in the middle of the term. For example, assume a building owner invested in an efficiency upgrade that reduced a tenant's utility bill by \$20 per month. The manager could then increase the rent by \$18 per month, recovering \$216 a year to pay for the investment. The tenant would enjoy both a small reduction in overall costs as well as any additional amenities provided by the upgraded property. So far, green leases are used more frequently in commercial properties than residential properties due to their complexity.

Meter individual units. According to the New York State Energy Research and Development Authority's (NYSERDA's) "Residential Electrical Submetering Manual," submetering saves energy and the savings persist over time. Furthermore, the manual makes the case that submetering benefits 60 to 70 percent of residents and is "eminently fair and ultimately benefits building owners." Installation costs for typical submeters (such as the one shown in **Figure 4**) can range from \$150 to \$700 per unit, depending on the meter selected and how and where it is installed. According to NYSERDA, electricity consumption usually drops by about 10 to about 20 percent when master-metered buildings are converted to individual submeters. Electronic meters combined with wireless communication make it feasible to retrofit such meters into a wide variety of buildings.

Figure 4: Submeters empower tenants to manage their energy costs

This submeter, manufactured by E-Mon D-Mon, is typical of many such products suitable for installation in multifamily buildings. Such submeters can be retrofitted into existing buildings using a wireless mesh communication network.



Source: E-Mon D-Mon (www.electricsubmeter.com).

Some tenants have resisted submetering, especially when their units were retroactively converted. One way to minimize such resistance would be to employ green leases that would enable managers and tenants alike to improve both building shell and energy consuming equipment in conjunction with the submetering implementation.

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