

No Cost Energy Efficiency Measures – Operations and Maintenance

Based on the successful practices of ENERGY STAR partners and BOMA members, EPA has identified key components for a successful energy management program.

Step 1: Benchmark the building to get a baseline Energy Star Energy Performance Rating between 1 and 100.

Step 2: Make an Action Plan to improve the Energy Performance Rating by identifying areas for improvements, setting realistic and achievable performance goals, and focusing on operational strategy and low and no cost improvements first.

Energy Reduction Tips:

- Regularly inspect all equipment and controls to ensure they are operating as designed. Estimated savings: 2.9 – 11.5%
- Calibrate thermostats by periodically walking through the building and comparing the thermostat setting with a hand held digital thermostat (preferably with 2 decimal places). Ensure thermostat setting equals actual space temperature. Estimated savings: 0.6 – 2.9%
- Adjust dampers to bring in the least amount of outside air necessary to maintain proper air quality (within code requirements). This will minimize the need to condition outside air. Estimated savings: 2.9 – 5.7 %
- Utilize janitorial best practices. Janitorial staff is often ignored when developing energy saving strategies, yet they typically account for almost 25% of the weekly lighting use, which is equivalent to approximately 7% of total building energy use. Estimated savings: 0.6 - 8%
 - Team Cleaning—janitors go through the building as a team floor by floor and the lighting is turned on/off as they progress through the building.
 - Coordinate—have the janitors coordinate with the security crew to walk through the building and turn off equipment that was inadvertently left on by the tenants.
 - Day Cleaning—janitors clean during the day while the lights are already on.

If all of these tips are implemented, energy savings of anywhere from 7 – 28 percent can be achieved. Therefore, it would be reasonable to expect a typical building to reduce energy by 17 percent and save approximately \$37,000. These savings can be used to finance more capital intense improvements such as equipment upgrades.

Quantifiable Results for Changes to O&M

Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Function as Designed	2.9	\$6,285	11.5	\$23,839
Calibrate Thermostats	.6	1,300	2.9	6,285
Adjust Dampers	2.9	6,285	5.7	12,353
Employ Janitorial Practices	.6	1,322	8.0	17,338
CUMULATIVE EFFECT	7.0	\$15,192	28.1	\$59,815

No Cost Energy Efficiency Measures – Occupant Behavior

Occupants play a critical role in how energy is used in facilities, and in some instances, have more control over consumption than building owners, managers, and engineers. Occupants directly impact the three major energy consumption variables in office buildings: plug load, lighting, and heating, ventilation and air conditioning (HVAC). For example, building occupants may open windows, cover vents, leave lights and equipment on when they leave their offices, adjust thermostats, use more equipment than is intended for the space, or use equipment with a high energy intensity (i.e., X-ray machines).

Energy Reduction Tips:

- Turn off equipment. Motion sensors are the most effective, cheapest way to ensure that lighting is turned off. You can also install Watt Stoppers to turn off task lights, and ENERGY STAR equipment automatically powers down when not in use. Estimated savings: 0.6 - 5%
- Institute an Energy Awareness Program. Instituting an Energy Awareness Program is extremely low cost and includes little more than printing costs. Include Energy Awareness Program materials in orientation and regular tenant communications; display posters throughout the facility to remind occupants of their role in conserving energy; and remind tenants how energy efficient behavior impacts the profitability of their organization. Estimated savings: 0.4 – 1.7%
- Use ENERGY STAR Equipment. A considerable amount of ENERGY STAR equipment is already in use in commercial real estate. If we could get an additional 75% of NON ENERGY STAR equipment to become ENERGY STAR equipment, the savings would be almost 2%. Qualified products include computers, copiers,

external power adapters, fax machines, laptops, monitors, multifunction devices, printers, scanners, and water coolers. Estimated savings: 0.6 – 1.9%

- Install Monitor and Computer Power Management Software. New chip technologies make power management features more reliable, dependable, and user-friendly than even just a few years ago. In U.S. companies alone, more than \$1 billion a year is wasted on electricity for computer monitors that are left on when they shouldn't be. Companies using Power Management Software include Cisco, Pitney Bowes, Goodwill, Citigroup, Proctor & Gamble, Harvard University, Ford Motor Company, General Electric, Wal-Mart and BP. Estimated savings: 1.1 – 3%
- Harvest Daylight - use natural daylight in place of artificial light whenever possible. To best accomplish this, locate work stations requiring high illumination adjacent to windows, switch off lights when daylight is sufficient, and clean windows and skylights. Estimated savings: 0.3 – 1.9%
- Use Work Station Task Lighting. Work station task lighting directs lighting where it is needed and reduces the need for unnecessary lighting. Direct light at areas where tasks are being performed and use lower wattage for overhead ambient lighting. Estimated savings: 0.5 – 1.4%

The cumulative effect to changes in occupants' behaviors may result in energy savings of 3.5 – 15.2 percent.

Quantifiable Results for Changes to Occupants' Behaviors

Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Turn off Equipment	0.6	\$1,322	5.3	\$11,486
Energy Awareness Program	0.4	759	1.7	3,684
ENERGY STAR Equipment	0.6	1,300	1.9	4,118
Power Management Software	1.1	2,384	3.0	6,502
Harvest Daylight	0.3	650	1.9	4,009
Work Station Task Lighting	0.5	997	1.4	3,034
CUMULATIVE EFFECT	3.5	\$7,412	15.2	\$32,833

Identify and Sequence Low Cost Improvements: Lighting

Lighting is another area where building operators can achieve dramatic financial returns with low capital investment and use off the shelf, proven technologies. Lighting accounts for approximately 29 percent of energy used in offices and the latest technology often has a less than one year simple payback.

Energy Reduction Tips:

- Change Incandescent bulbs to compact fluorescent (CFL) and high intensity discharge (HID) bulbs. In many buildings you may find areas where incandescent and halogen lighting is still being used, particularly in vanity areas, such as lobbies and areas with artwork. Also, check the lighting in restrooms, closets, server rooms, and some common areas. Estimated savings: 0.6 – 1.2%
- Convert T12 fluorescent lamps to T8 and T5 lamps, and install electronic ballasts in place of magnetic ballasts. Even if you just relamped your buildings three years ago, take a lighting survey again. Lighting continuously gets more efficient – and in less than ten years we have gone from 40 watt, to 32 watt to now 28 and 25 watt fluorescent lighting options. Converting to more efficient lamps and ballasts saves total building energy. Estimated savings: 3.5% - 9.7%
- Reduce lighting levels, delamp, and disconnect unused ballasts. Many office spaces are over lit, using four bulb fixtures when three or two bulbs would more that adequately light work surfaces. Take a look around at your common areas and tenant spaces. See if delamping opportunities exist. If they do, you may be able to go from four lamps in perimeter spaces down to two, and from four lamps to three in interior spaces. Be sure that you also disconnect the unused ballasts, as ballasts still use a significant amount of energy even though tubes have been removed. Estimated savings: 3.3 – 5%
- Program and periodically verify that the energy management system (EMS) is performing as intended, including full floor lighting sweeps and turning off all appropriate equipment. During construction, some building lights may be hard wired to the “on” position, meaning that EMS-programmed lighting sweeps will not turn off the lights. If this is the case, make the adjustment so it is not hard wired on in a permanent position. Also, some building managers recommend staying at work late one night a month after hours to ensure that the programmed lighting sweep is actually taking place and to make sure equipment is all turned off as intended. Estimated savings: 0.5 – 1.4%
- Install occupancy sensors to automatically turn off lights when physical movement stops. Estimated savings: 0.3 – 3.2%

- Replace inefficient Emergency Exit signs with high efficiency LED Exit signs. LED exit sign lamps last up to 6-7 years and use less than 2 watts whereas the older exit sign lamps last less than a year and use 40 watts. This saves energy in that these Exit Signs are on 24 hours a day, 365 days a year and will also reduce maintenance costs due to extended life. Estimated savings: 0.2 – 0.3%
- Install timer controls or photocells for exterior lighting to control lights in response to daylight. Reexamine how the exterior lighting is actually being used, and make sure that if there are timer controls on it someone is looking at the timer controls to make sure they are functioning properly. Look at the lighting outside the building to see if you can use some kind of sequencing as to when the lighting in certain areas comes on and off with tenant safety and security upper most in your mind. Estimated savings: 0.7 – 2.9%

Cumulative energy reduction from lighting could range from 9.4 – 25 percent.

Quantifiable Results for Changes to the Lighting Systems

Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Function as Designed	2.9	\$6,285	11.5	\$23,839
Calibrate Thermostats	.6	1,300	2.9	6,285
Adjust Dampers	2.9	6,285	5.7	12,353
Employ Janitorial Practices	.6	1,322	8.0	17,338
CUMULATIVE EFFECT	7.0	\$15,192	28.1	\$59,815

Identify and Sequence Low Cost Improvements: Controls

Control devices can be calibrated and monitored to more effectively reduce energy consumption.

Energy reduction tips:

- Adjust temperature. Physically walk through the building and talk with tenants to determine if the actual temperature is comfortable. The key point is to make sure that the temperature you have in the building is what tenants need (we are not advocating sacrificing tenant comfort or violating the terms of the lease). Have the lowest amount of dehumidification when the building is unoccupied and raise the indoor thermostat setting during the cooling season. Summer clothing is typically lighter, thereby requiring less air conditioning to keep the tenants comfortable. Conversely, winter clothing is heavier, thereby requiring less heat to keep the tenants comfortable. In addition, you should be able to reduce thermostats by a minimum of 10 degrees F at night, or weekends and holidays during the heating season. Estimated savings: 1.1 – 2.9%
- Examine after hours usage/operating hours. Re-examine original assumptions regarding occupancy patterns and building usage. Talk to the tenants to see if they are actually using their space during the lease required operating hours. Do they really need the air until 9:00 p.m.? Or on weekends? If not, adjust building operating hours to reflect actual tenant usage. Estimated savings: 0.7 – 1.5%
- Adjust ventilation in low density or vacant space. Reduce exhaust and outdoor-air ventilation rates without sacrificing tenant comfort and within code requirements. Estimated savings: 2.9 – 5.7%

- Limit access to thermostats. Tenants typically feel that they should have access to the thermostats since they are paying for the energy. It is not uncommon for people to adjust thermostats too wildly--if they feel cold they will move the thermostat from 72 to 85 or conversely—if they feel hot, they will move the thermostat from 72 to 50. Prevent unauthorized adjustment by using EMS controls, tamper-proof locking covers on thermostats, or locking screws to prevent tampering. Estimated savings: 0.3 – 1.3%
- Optimize start up time and equipment sequencing. Start up, staging, and sequencing deal with *when* in the day your equipment is turning on and *how many pieces* of equipment are turning on at the same time. If every piece of equipment in the building is firing up at 8:00 a.m., your peak demand will be much higher than if you begin at 7:45 and bring your equipment online in a sequential manner over the next half-hour or so. Experiment with start-up times to determine the latest possible start up time while maintaining satisfactory comfort levels for occupants. You should also sequence the loads so as not to have too many pieces of equipment turning on at the same time. For example, for high rise buildings with multiple elevators there is some very simple solenoid (micro processors) equipment that is available that ensures that you never have two elevators starting and stopping at the same time. This is especially important when the utility company is measuring your peak demand. Estimated savings: 0.6 – 2.9%
- Schedule seasonal changes to thermostats. Temperatures in the cooling season need to be different from temperatures in the heating season. If you set the thermostats at 70 in the winter, you won't want to set the thermostat at 70 in the summer. Once again, this does not mean sacrificing tenant comfort, but identifying opportunities to reduce the building's heating/cooling needs. Combine this with building walk-throughs and speaking to tenants to assess their needs. Estimated savings: 1.1 – 5.7%
- Coast last hour of operations. Experiment to determine the earliest possible time the systems can be powered down while maintaining comfort. Outside air temperature changes toward the end of the workday. For example, during cooling degree days, the outside air may be a few degrees cooler than it was at noon. So, coasting the last hour of operations may not cause a noticeable difference in comfort level to the tenants. Estimated savings: 0.6 – 2.9%

In summary, energy savings for control measures may range from 7.3 – 22.9 percent.

Quantifiable Results for Changes to Controls

Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Adjust Temperature	1.1	\$2,384	2.9	6,285
After Hours Usage	0.7	1,517	1.5	3,251
Adjust Ventilation	2.9	6,285	5.7	12,353
Limit Access to Thermostats	0.3	563	1.3	2,817
Optimize Start-up Times	0.6	1,300	2.9	6,285
Seasonal Changes to Thermostats	1.1	2,384	5.7	12,353
Coast Last Hour of Operation	0.6	1,300	2.9	6,285
CUMULATIVE EFFECT	7.3	\$15,821	22.9	\$49,846

Identify and Sequence Low Cost Improvements: Equipment

Building owners and managers should also examine potential equipment changes that can reduce energy consumption.

Energy reduction tips:

- Install variable frequency drives (VFD) & variable air volume (VAV) systems. Motors and fans may not need to run at full speed at all times, due to varying levels of demand placed on the system at different points throughout the day. VFD (motors) and VAV (fans) pay for themselves rather quickly. Estimated savings: 1.5 - 9.3% (There are some buildings that have no VFDs or VAVs whatsoever and others that are using VFD and VAV in many systems, which accounts the large variation in potential savings.)
- Install heat recovery equipment. Optimize the conditioning of ventilated air by recovering heat that is being produced by other heat producing equipment in the building. If you have the opportunity to install heat recovery equipment in the building, you can save anywhere from 1.7 to 5.2%.
- Relocate thermostats to optimal locations. Thermostats are best located in a place that will give you the readings that you want to send to your HVAC system. Often thermostats were originally located in optimal locations, but over time through tenant improvements such as moving walls, duct work being blocked, and a variety of other

changes to the building, the thermostats are no longer in optimal locations. Estimated savings: 0.3 – 1.4%

The whole building energy savings potential for equipment changes ranges from 3.5 – 15.9 percent.

Quantifiable Results for Changes to Equipment

Note: 100,000 sf Blended rate = \$.09/kWh Initial Energy Performance Rating = 50	Low Estimate		High Estimate	
	Energy savings %	Cost savings \$	Energy savings %	Cost savings \$
Install VFD or VAV	1.5	\$3,251	9.3	\$20,155
Install Heat Recovery Equipment	1.7	3,684	5.2	11,269
Relocate Thermostats	0.3	650	1.4	3,034
CUMULATIVE EFFECT	3.5	\$7,585	15.9	\$34,675

Conclusion

In conclusion, there are many no and low cost energy reduction measures that operators of public and private sector buildings can take that improve the performance of the building, reduce energy consumption, and save money – without sacrificing tenant comfort. BOMA believes that building owners and managers should continuously assess their energy usage and strive to be responsible environmental stewards.

We thank the Subcommittee for holding this important hearing, and look forward to working with Congress, the General Services Administration, Department of Defense, and other public and private sector partners to achieve our mutual goal of improving energy efficiency in the built environment.