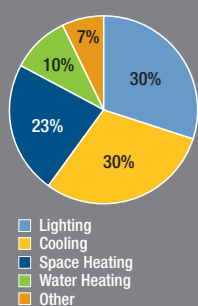


EnergySmart Schools

EnergySmart Schools Tips: Retrofitting, Operating, and Maintaining Existing Buildings

Quick wins and long-term facility management strategies that pay for themselves and result in energy savings

Typical School Energy Use Distribution
(varies by climate zone)



Combining preventative operations and maintenance (O&M) with strategic retrofitting of building systems improves a school's energy performance. For schools with limited resources and experience, "quick wins" in O&M and retrofitting provide a valuable starting point to energy management. As a next step, strategically prioritizing long- and short-term measures produces overall returns on investment. Please refer to the *Guide to Operating and Maintaining EnergySmart Schools* for more information.

Lighting Quick Wins

In a typical school, lighting consumes 30 percent of total energy. Lighting is considered the "low-hanging fruit" of energy efficiency plans because improvements are usually easy to implement and cost-effective. A complementary activity is to educate students and teachers about lighting techniques, control systems, and energy conservation.

- Swap incandescent bulbs with compact fluorescent bulbs (CFLs) wherever possible. CFLs use about 25 to 30 percent of the energy of incandescent lamps and last up to 10 times longer. Energy savings depend on the electricity rate, but they can be higher than anticipated because CFLs produce less heat than incandescent bulbs, therefore decreasing the cooling load.
- Upgrade fluorescent bulbs from T-12 to T-8. This investment saves up to 30 percent of lighting energy and decreases the electric bill by as much as 6 percent. Use an electronic ballast, rather than a

magnetic ballast, to realize the fixtures' full energy savings. The payback period, depending on electricity rates and incentives, is typically less than three years.

- Replace conventional incandescent exit signs with LED (light-emitting diode) exit signs. LEDs use at least 75 percent less energy than incandescent bulbs. The payback period for LEDs decreases further because the lamps last longer and require fewer replacements than incandescent lamps.

HVAC Quick Wins

Heating and cooling account for more than half the energy consumed in school buildings. The HVAC system is a primary target for energy savings, much of which can be achieved at little cost.

- Maintain HVAC units regularly. Clean burners and air conditioner coils, clean or replace air filters, and check ducts and pipe insulation for leaks and wear.
- Upgrade to programmable thermostats to control room temperatures more efficiently. The devices range from \$50 to \$200 but will save money in the long run because they prevent the conditioning of unused spaces. If building occupants have access to controls, they should be trained to avoid changing downtime temperatures.
- Perform annual maintenance and tune-ups on boilers. This can lower energy consumption by 10 to 20 percent and increase occupant comfort.

For help in selecting energy-efficient equipment and building features, visit:

- *Guide to Operating and Maintaining EnergySmart Schools* and *ASHRAE Advanced Energy Design Guide for K-12 School Building*, www.energysmartschools.gov
- *USGBC LEED for Existing Buildings: O&M*, www.usgbc.org
- *The Collaborative for High Performance Schools Best Practices Guide*, www.chps.net
- *National Clearinghouse for Educational Facilities*, www.edfacilities.com

- Inspect ducts, pipe insulation, and steam traps for damage and replace as needed. These smaller components of the heating system can be overlooked, but they are a significant source of wasted energy.
- Consider establishing boiler shut-down policies at temperatures recommended by the equipment manufacturer. For example, during unoccupied periods, boilers can be turned off when there is no danger of freezing. Be mindful of the recovery time needed to get the building back to the desired temperature.
- Install an economizer, a set of automatically controlled dampers, to save energy. Economizers draw outside air for free cooling and close vents when the outdoor temperature is too high or low. If an economizer is already installed, check it for proper operation.

Teacher support is vital to achieving energy savings, stresses Jyoti Sharma, Wake County (North Carolina) Public School System's (WCPSS) senior director of facility design and construction. For example, daylighting is one strategy for conserving lighting energy, but it can only be effective if teachers are trained to turn lights off. WCPSS incorporates energy conservation into education, encouraging students and teachers to take responsibility for improving their school's environmental footprint.

Water Heating Quick Wins

On average, water heating is responsible for 10 percent of a school's energy demand. Retrofitting and preventative maintenance of piping, insulation, and fixtures can increase water heating efficiency.

- Limit water storage temperatures to 130°–140°F. Install booster water heaters where higher temperatures are needed, such as kitchens.
- Fit hot water heaters and pipes with insulation to increase their efficiency.
- Investigate the use of heat exchangers to recycle heat from hot wastewater.

For information on central chillers and cooling towers, visit:

U.S. Department of Energy, *Federal Energy Management Program Operations and Maintenance Best Practices Guide*, www1.eere.energy.gov/femp/operations_maintenance/om_bpguide.html

Building Envelope Quick Wins

Low-cost opportunities to address the building envelope include:

- Re-caulk and weather-strip leaky windows and doors to maintain the integrity of the building envelope.
- Close or tilt window blinds in warmer months to reduce heating by the sun and open them in the winter for the opposite effect. This strategy reduces heating and cooling bills, but beware of tradeoffs. For example, closing blinds in warm temperatures may reduce the cost of cooling the space, but it decreases the savings gained from daylighting.

For more tips on building envelope energy efficiency, visit:

- National Fenestration Rating Council, www.nfrc.org
- Roof Coatings Manufacturers Association, www.roofcoatings.org

Plug Load Quick Wins

Office, instructional, vocational, and cleaning equipment, as well as personal appliances brought in from home, are considered plug loads in schools and can account for up to 25 percent of electricity consumed annually. Most of this equipment is left on all day, and only minor adjustments are required to reduce energy consumption.

- Shut down equipment at night. During the day, adjust built-in activity features to hibernate after 30 minutes or less of inactivity. Frequently, hibernation features are not correctly set up to maximize energy savings.
- Computers, for example, use about twice as much energy as monitors and their sleep settings are rarely activated. The ENERGY STAR® Low Carbon IT campaign provides free software that sets computers across a network to automatically enter a low-power sleep mode, saving up to \$50 a computer (www.energystar.gov/lowcarbonit).
- Individual printers should be turned off when not in use. Printers that must be online all the time can save as much as \$15 a year by implementing an ENERGY STAR power-down feature.
- Upgrade to ENERGY STAR-qualified vending machines to save about 45 percent of energy costs and 1,700 kWh per year. In addition, vending machine lights can be either deactivated or upgraded from T-12 to T-8 to save approximately 1,000 kWh per year.
- Upgrading to ENERGY STAR-qualified copiers can provide energy savings of around 30 percent over a standard copier.

Long-Term Investments (all building systems)

- Install lighting controls to decrease wasted lighting energy, making sure to commission them for proper installation and settings:
 - Timers that switch off lights at specified times are a good solution for areas with predictable lighting needs, such as outdoor areas.

For more on planning and measuring the returns on energy efficiency measures, visit:

- U.S. Department of Energy's *Guide to Financing EnergySmart Schools*, www.energysmartschools.gov
 - ENERGY STAR *Building Upgrade Manual*, www.energystar.gov/index.cfm?c=business.bus_upgrade_manual
- Occupancy sensors automatically turn off lights in unoccupied spaces by sensing motion and are best suited for classrooms, restrooms, offices, and libraries.
 - Photosensors can be strategically installed to function with daylighting outdoors and indoors. These sensors dim or turn off lights when daylight reaches bright levels. When using sensors to control fluorescent lighting, dimmable ballasts are required. Photosensors are best for large, well-lit common areas, such as the cafeteria, library, or other gathering spaces. Proper design and placement are important for a successful daylighting project.
 - Replace oversized fans and their motors. Equipment that is too large for its load wastes energy. A 20 percent reduction in an oversized motor can reduce energy use by 50 percent.
 - Replace storage water heaters with tankless water heaters. Tankless heaters use energy for on-demand heating, instead of keeping a large amount of water heated at all times. Tankless heaters suit most applications and should be located as close as possible to their point of use.
 - Install double-paned or low-emissivity (low-e) coating windows to reduce cooling and heating costs.
 - Upgrade the roof by increasing roofing reflectivity, installing vegetative roofs, and upgrading roof insulation.
 - Purchase ENERGY STAR equipment over conventional equipment. These computers, copiers, printers, and other equipment have built-in low-power modes for periods of inactivity.

An Energy Management Plan

For schools and districts with greater resources and experience, an energy management plan is a more advanced facilities strategy. This plan establishes goals, methodologies, responsibilities, and accountability. The energy management plan should align with a school or district's core strategies and should stress coordinating O&M, retrofits, renovations, commissioning, training, curricula, and building occupant programming over time to optimize efficiency. When developing a school or district energy plan, consider the following:

- Collaborate with and include input from all interested parties and stakeholders, including teachers, students, business managers, senior administrators, facility managers, and custodial and maintenance staff members.
- Use quality assurance strategies, such as commissioning, to realize the true performance benefits of upgrades and retrofits. In some cases, energy-efficient retrofits fail to pay for themselves because they are not correctly installed or operated.
- Stress the importance of data collection and analysis, such as auditing and benchmarking, to identify quick-win retrofit opportunities. Incorrect benchmarking can misrepresent a baseline, making energy savings smaller than anticipated. Schools and districts can provide internal training to accomplish this goal or hire externally, based on available resources.
- Include input from external partners, such as utilities or consultants, in energy planning. For example, a utility may be able to provide customized energy bill data, reducing the need to internally compile data.
- Require an annual energy summary to document progress and renew goals and strategies. This document establishes accountability and shares successes with the community.

Renewable Energy Options

Increasingly, schools are considering generating their own energy by tapping into wind, solar, geothermal, landfill gas, and other renewable sources. The amount of energy available from these sources and the overall costs depend on a school's geographic location, project size, and availability of financial incentives. Additionally, external expertise is vital to the successful planning, installation, and operations and maintenance of unconventional energy sources.

- Install solar water heaters to cut water costs. This equipment uses the sun for heating water and replaces heat from purchased gas and electricity. Energy savings and the payback period for solar water heaters depend on the number and intensity

of sunny days and the price of the electricity or natural gas being replaced.

- Purchase solar photovoltaic (PV) cells to displace purchased electricity. PV will provide electricity when schools use it the most: during the day, when the sun is out. However, PV is limited to regions with the most abundant solar resources because of its high up-front costs.
- Use small-scale wind turbines to generate from 10 to 100 kW of electricity—enough to power a school or at least offset some purchased electricity. The availability of wind resources varies by location and may provide more electricity during the evening than the day. Siting is a major consideration for the installation of small-scale wind, so third-party consultation is recommended.
- Install a geothermal heat pump for heating and cooling. Installed in the upper 10 feet of the earth's surface, this system uses the ground as a heat source, or sink. It can be very efficient but requires a well field, pond, lake, or other source.
- If located near a closed landfill, a school can pump landfill gas to a generator or use it to displace natural gas. Building a small pipeline is the most common method for transporting landfill gas from its source.
- Purchase electricity from a renewable energy generator through a Power Purchase Agreement (PPA) instead of directly owning the renewable energy equipment. This contracting vehicle may be a better option for schools that cannot afford to invest the human and financial capital into owning, operating, and maintaining complicated technology. PPAs typically last five to 25 years.
- The Renewable Energy section of the EnergySmart Schools Web site (www.energysmartschools.gov) contains more information about alternative energy opportunities.

Schools can consider four approaches to energy management, depending on their resources and capabilities.

Quick Fix and Low Cost—These projects require little or no systematic energy consumption tracking or educational focus.

Energy Awareness—These projects focus on communications and education to garner support from teachers, students, and staff members for voluntary conservation.

Performance Contracting—This strategy involves a contract with an Energy Service Company (ESCO) for specific energy services in exchange for “sharing” a portion of the resulting energy savings.

Energy Tracking and Accounting—This advanced strategy involves computerized collecting, recording, and tracking of monthly energy costs at all facilities, enabling facilities managers to control temperatures and HVAC use. Although this method has higher implementation and training costs, it can be used to optimize building design and renovation plans.

**Northbrook School District 27,
Northbrook, Illinois**

Enrollment: 1,200

Number of Schools: 4

Total Building Sq. Ft.: 274,000

Preventative maintenance reduces the energy consumption of Northbrook School District 27 and extends the useful life of its equipment. Building chiefs at each school record space heating boiler readings daily to quickly identify and correct problems. These readings also provide a valuable historical record of boiler operation. In addition to monthly meetings with all the building chiefs, the director of facilities conducts training sessions three times a year. The district works with a specialized water service company to conduct annual inspections of its potable water heaters. An integral part of this maintenance is to remove hard-scale buildup and sediment by flushing the water heaters with a manufacturer-approved, foodgrade de-liming solution, replace anode rods and service the gas train. Scale buildup reduces the water heating system's ability to transfer heat efficiently and produces unnecessary wear. Preventative maintenance reduces Northbrook's energy use, safely extends the life of equipment, and decreases risks of mechanical failure.

*Source: Douglas Heurich, CFM, Director of Facilities
Northbrook School District 27*



U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

For more information, contact:

EERE Information Center

1-877-EERE-INF (1-877-337-3463)

www.eere.energy.gov

Endorsed
by



National School
Boards Association



Printed with soy ink on recycled paper