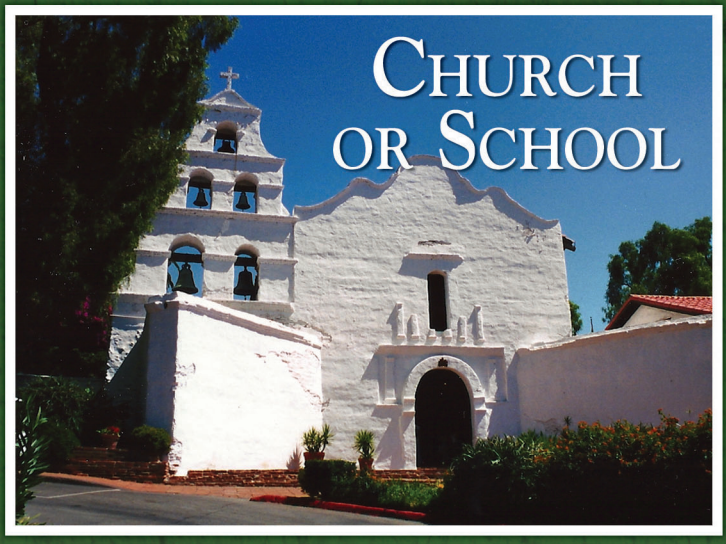
Quick and Easy Green Books

77 Ways To Save MONEY and ENERGY

At Your



By David A. Troesh
LEED AP

In cooperation with
Aztec Energy Partners

DAVID A. TROESH
77 WAYS TO SAVE MONEY AND ENERGY AT YOUR CHURCH OR SCHOOL

INFINITY

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1094 New DeHaven Street, Suite 100
West Conshohocken, PA 19428-2713
Toll-free (877) BUY BOOK
Local Phone (610) 941-9999
Fax (610) 941-9959
Info@buybooksontheweb.com
www.buybooksontheweb.com

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CTAC – Southern California Edison's Consumer Technology Applications Center. Offers dozens of free in-depth classes and seminars on all aspects of energy efficiency and energy management. Much of what is presented here, I learned or refined at CTAC. The staff at CTAC is extraordinarily knowledgeable and extremely helpful. Everyone even remotely connected to the Southern California energy industry, even as just a customer, should avail themselves of this SCE resource.

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TABLE OF CONTENTS

PREFACE

Whether you are a pastor, a principal or both, you are BUSY! Too busy doing your real job to wade through a quagmire of engineering data in the hope of reducing your electric bill. We intentionally have kept this book short and non-technical to save you time. We show you the most productive ways to start saving up to 50% on your energy bill. No matter the size or age of your facility, this book can save you money.

Everyone talks about doing their best for the environment, but deep down, on a personal level, four questions pop up. 1.) I know we should do something but I barely have time to do my real job as pastor or principal, how can I find the time to help save the environment? 2.) There are so many higher priority things that need immediate funding around here, what do we have to "give up" in order to save enough money to do the "right thing" for the environment? 3.) I'm just one person, what good can I do? 4.) Even if I had the time, resources and inclination to help, this whole "saving the environment" problem is so huge, where would I start?

The four short answers that we'll expand on later are: 1.) Share the problem with the youth you serve by starting a "Green Team." 2.) Long-term environmental sustainability will simply be the result of better choices now, not by "giving up" something important to us. 3.) Nearly all the most important good works in the world started with an idea shared by one person. 4.) Start with our Chapter One list of fifty easy-to-do 'Free or Nearly Free' upgrades that are applicable to either a church or school.

It makes no difference whether you manage a 1000 square-foot church or a 1,000,000 square-foot campus. Your energy problems are essentially the same. To save you the

research time, the suggestions here were gathered from scores of up-to-date sources and apply to virtually any church or school with lights, air conditioning and refrigeration. That's just about all of us!

Tip: Depending on the size of your facility, some of the listed upgrades don't apply. Adapt the checklists to your specific needs to save the most money and energy.

WHY BOTHER?

Overall, there are four big reasons to invest in energy efficiency at your church or school:

1) Reduce operating and maintenance costs. What would your church or school do with an extra $10,000 or $20,000? Would you help an under-funded ministry, buy new sports equipment or classroom computers? Ignoring energy consumption is throwing money away.

2) Improve productivity. Various studies by The Heschong Mahone Group, Carnegie Mellon University, Turner Construction and others show that improved daylighting, especially skylights, can improve student test scores by up to 17%. Cleaner, healthier circulating air can reduce classroom colds and flu by over 50% and reduce teacher turnover by 5%. Going green not only saves money, it creates a happier, healthier, more learning-conducive school environment.

3) Improve building appearance and comfort. As our population becomes more ecologically aware, comfort has been redefined to include upgraded lighting elements and clean healthy air. Green buildings epitomize both.

4) Enhance your public image. Nobody wants his kids trying to learn in an old, poorly lit, inadequately ventilated, unhealthy or unsafe school. Parents,

students and teachers (and congregations) will all notice and appreciate your facility improvements.

STARTING YOUR GREEN TEAM

With a little help, going green is easy. Start with just a tiny, personal priority shift toward conservation. When your church or school sees a new standard of sustainability coming from the top, the savings are almost guaranteed.

Don't underestimate the enthusiasm or the potential for excellence of the youth you serve. Give them the Energy Survey in Appendix F to find out the most fervent among them. Task them to work on the fifty Chapter One "Free or Nearly Free" upgrades then loosely monitor their progress. Even though most of the upgrades seem minimal, the cumulative savings are huge. An inspired, motivated Green Team can save you a fortune. Share and celebrate the changes in your electric bill as their work comes to fruition. For many churches and schools, sustainability is the most successful fund-raiser they've ever sponsored.

Topics for your "Green Team" to address include: maintenance, warranties, operational schedules, set points, equipment start-up/shutdown, emergency procedures, air quality, ambient temperatures, adopt-a-door, recycling, lighting and new student energy-consciousness training. See the www.awarenessideas.com website to learn more ways to keep your team involved and enthused.

TIPS FROM TEACHERS

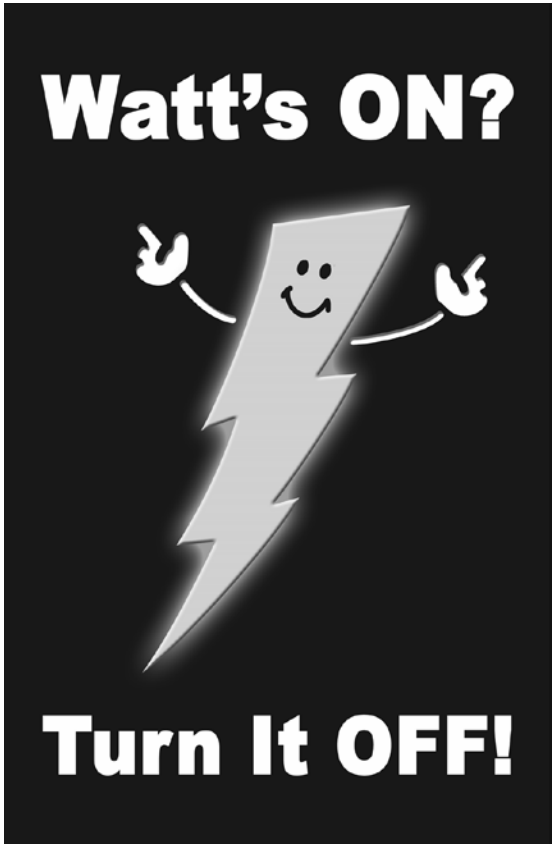
We queried both front-line teachers and administrators to find out how to best approach building a green team to lead the push toward sustainability in your church or school. Here are a few of their thoughts about what had worked well in the past at their schools.

1. **Create a visible goal.** A recycling or energy awareness program led by student leadership will only be effective if the students have a visible goal (i.e. ten new computers, a field trip or special assembly).
2. **Complete support from the top.** Whether teachers or students lead your program, the administration needs to be 100% supportive.
3. **Get the PTA involved.** If you let the PTA pick the special group or person for the assembly, they are more likely to better support your program.
4. **Reward the school.** The school, not the school district should be awarded most of the saved money.
5. **Remember the children.** Teachers work hard to find or create the best teaching tools possible for their students. Teachers want to see that the program rewards go directly toward helping their students.
6. **Collecting cans and bottles.** Don't do this more than two to five days a month. It works best when a parent, not a teacher, volunteers to transport the cans and bottles to the recycler.
7. **E-cycling.** Look into e-cycling electronics, cell phones, computers, TVs etc. Since the concept is so new, many people don't understand it. It requires more publicity to be successful but it pays better.

A WORD OF CAUTION

This copy of *77 Ways to Save Money and Energy* has been made available as a planning resource through special arrangements between David A. Troesh and the Archdiocese of Los Angeles. The Archdiocese is not responsible for the contents of the book or views of the author.

The author has asked that readers are advised that some of the more advanced ideas in this book require specialized skills and/or training for implementation. Please make sure that all uninsured volunteers are properly trained and supervised. In some cases, it may be necessary to contract with qualified licensed professionals and contractors.



12"x18" colored poster from

CHAPTER ONE

FIFTY FREE OR NEARLY FREE UPGRADES

As you will see, nearly all of this chapter's upgrades necessitate only a slight shift in your Green Team's environmental philosophy and/or a little more attention to detail. None are difficult and, cumulatively, they all have an immediate and measurable bottom line payback.

Some of the tasks listed below are obvious. Hopefully, many of them are already part of an established sustainability program. You probably thought about some of the others but never realized how much money you can save every month.

First, check off on the following list what tasks and upgrades you have already accomplished. Next, see the short explanations, simple suggestions and tips about how to best attack the yet to be completed part of your Chapter One list.

Interior and exterior lighting account for 49% of your electrical usage. All the lighting tasks below fall into the following four easy-to-remember categories: 1.) Reduce illumination levels. 2.) Increase light source efficiency. 3.) Increase fixture efficiency. 4.) Reduce operating time. You can save the most money in your facility by addressing the following lighting issues first.

The next best place to create electrical savings is in your HVAC system that uses 30% of your electricity. See the pie chart at the beginning of Chapter Three for an idea on where you can most cost-effectively direct your efforts.

Easy Savings Checklist

LIGHTING

- Replace incandescent lamps with CFLs (compact fluorescent lamps).
- Turn off unneeded classroom, auditorium, sanctuary, accent and specialty lighting.
- Reduce lighting by removing selected ceiling fixture lamps.
- Do not over light.
- Remove excess lighting in stockrooms, closets and storage spaces.

- Take advantage of existing natural daylight to lower interior lighting.
- Minimize exterior illuminated sign usage.
- Turn parking lot lights off during the day and down very late at night.
- Adjust timers to accommodate the seasons, daylight savings and summer break.
- Pursue rebates and tax incentives on all unplanned capital purchases and/or repairs.
- Take advantage of your utility company's "Time Related Demand Metering" rules.
- Dissect your electric bill.
- Reduce plug load.
- Install occupancy sensors in all closed rooms and classrooms.
- Install LED (Light Emitting Diode) lights in all EXIT signs.
- Buy only Energy Star® rated lamps.

HVAC (Heating, Ventilation, Air Conditioning)

- Set your cold thermostat at 78° F and hot at 68° F degrees.
- Seal off unused offices and rarely used areas and passageways.
- Close exterior doors.
- Schedule sanctuary or auditorium events with heat retention in mind.
- Turn off exhaust fans when not in use.
- Turn heater pilot lights and timers off in summer.

- Keep air grills and registers clean and unblocked.
- Lower water heater temperature to legal minimum.
- Direct cooling fans toward employees.
- Use portable space heaters or fans in enclosed rooms.
- Install Energy Star® approved programmable thermostats.
- Install timers to shut down non-essential systems during off hours.
- Set economizers properly.
- Create and carefully follow an HVAC vendor preventative maintenance schedule.
- Replace worn or cracked weather stripping and seal up all holes.
- Install door sweeps on exterior doors.

REFRIGERATION

- Use correct temperatures. Colder isn't always better.
- Create accountability for case temperatures.
- Keep refrigerators and water coolers four inches from the wall.
- Clean self-contained refrigerator coils annually.
- Perform a dollar bill test on all freezer and cooler doors. (It shouldn't slip out.)
- Adjust defrost controls.

OFFICE EQUIPMENT AND FACILITY OPERATIONS

- Use power strips dedicated to specific equipment.

- Activate power management software on your computer.
- Print on both sides of all memos. Go paperless when possible.
- Use recycled paper.
- Recycle more than just paper.
- Look at the recycled content.
- Support your Green Team.
- Create a Green Team Preventative Maintenance Schedule.
- Use ‘Green’ cleaners and insecticides.
- Buy only Energy Star® rated office equipment.
- Install timers on your copy machine and vending machines.

COOKING

- Shut off exhaust hoods when not in use.
- Use flat-bottom pans with lids.
- Microwave ovens are energy savers. Use them first.
- Put timers on coffee makers. Use Carafe-style coffee makers.
- Polish heat reflectors and clean burners regularly.

12”x18” colored poster from awarenessideas.com

Checklist Suggestions and Tips

LIGHTING

Replace incandescent lamps with CFLs (compact fluorescent lamps). Immediately replace the ten incandescent light bulbs that are illuminated most often and

have the longest burn times with CFLs. There are CFLs (compact fluorescent lamps) for nearly any application but be careful to limit the number of different types and sizes to avoid stocking requirements and confusion. (Tip: Lamp is the industry term for what the rest of us call light bulbs.) CFLs can cost a little more but according to EPA studies, last at least ten times longer. Different types are available to fit almost any application and many come with rebates.

Make sure you get the proper lamp to take full advantage of the reflective capacity of your existing light fixture (i.e. screw-in CFL flood lamps instead of the pigtail variety where needed). Changing out the lamps with the longest daily burn time will net you the fastest payback. Based on a $.15 /kWh rate, selectively replacing only twenty 100-watt spotlights with 32 watt CFL lamps will save you about $600 over the life of the lamp. You will net even more savings when you factor in the maintenance labor cost to replace them, especially in hard-to-reach places. Tip: Don't buy the cheap CFLs. They don't last. Energy Star® rated lamps are definitely worth the extra money. They will live up to your long life expectations.

The downside of CFL lamps is the tiny amount of mercury inside. Since mercury is now classified as a hazardous material, the disposal is more difficult. Tip: Some CFL manufacturers claim their 25-watt lamp is an adequate replacement for a 100-watt incandescent. (4:1 ratio) A better solution, because of lumen degradation and the effect of temperature, is to replace a 75-watt incandescent with a 25-watt CFL. (3:1 ratio) A final CFL comment: CFLs are today's short-term answer to replacing your high-energy-consuming incandescent lamps. A better long-term efficiency solution is LED lighting which we describe later in this chapter and in Chapter Three. New LED lighting applications and technologies are being developed worldwide. LED lamps last even longer than CFLs and contain no hazardous mercury.

INCANDESCENT vs. CFL SAVINGS

INCANDESCENT		CFLs		
Watts	Average Anticipated Life	Watts	Average Anticipated Life	Potential Annual Savings
40	1500 hours	7	10,000 hours	$47.17
60	1000	13	10,000	63.45
75	750	18	10,000	79.08
100	750	26	10,000	102.67

The savings shown above are based on the differences in lamp life at $.15 / kWh.

Turn off unneeded classroom, auditorium, sanctuary, accent and specialty lighting. The most energy-efficient use of lighting is OFF! The dozens of methods to control lighting are solely for our convenience. The most convenient lights are on all the time. Use your Green Team to find the middle ground. A productive starting point is monitoring the lighting in the less-frequented areas of your facility. Experiment with ways to limit the number of kilowatt hours burned in storage rooms, hallways and by your facility's office or classroom task lighting. Tip: Unless you are doing a major retrofit, in the short term, you might save money by leaving the least-used lights in your facility alone. For example, replacing a T-12 fluorescent tube with a new T-8 will always save energy. But if the lamp only burns a couple hours each month, you will be a long time getting a reasonable return on your investment. See the easy-to-use energy calculators at energystar.com to figure out your ROI.

Reduce lighting by removing selected ceiling fixture lamps. A number of facilities have accomplished measurably successful energy reduction by simply removing one or more lamps from dual or multi-lamp fixtures (i.e. half the lamps from a dual or four-lamp trough ceiling fixture). Actually, you save two ways when you reduce your ceiling lamp count. First, and most obvious, using only half of your lamps burns only about half as much electricity. (There is still a small amount of electricity running through your unused ballast.) Second, your A/C only needs to compensate for half as much lamp-generated heat as before. Note: It is not surprising that over 40% of school electrical usage cost is for lighting when you consider that removing just one typical T-8, 32- watt fluorescent lamp can save you over $30/year.

Do not over light. Too much light is worse on your eyes than too little. According to the IESNA (Illuminating Engineering Society of North America) over-lighting and glare can create discomfort, loss of visual performance and impaired visibility. When you consider the increased light-producing efficiency of today's higher output lamps, just because an older light fixture can accommodate more lamps is no reason to install them. Based on a $.15/kWh rate, reducing your lighting by just 1000 watts for twenty hours every week will reduce your electric bill by nearly $150.

Remove excess lighting in stockrooms, closets and storage spaces. Remove any extra lamps in seldom-used rooms. (Some particularly easy-savings targets include: janitor closets, utility rooms, food or sports equipment storage areas, and security lock-ups.) There is a smaller potential for savings here, but even reducing consumption by 1000 kWh can net you a $150 annual savings. Tip: Don't create an unsafe condition or remove any emergency lighting.

Take advantage of existing natural daylight to lower interior lighting. Adjust your lighting during that short time everyday when the sun is shining most brilliantly through your windows. If your school is blessed with skylights, make sure that your photo sensors are operating properly. In a classroom with east-facing windows, taking advantage of the morning sun by turning off a couple rows of lights can also net you a big return.

Minimize exterior illuminated sign usage. Unless you have a marquee-type sign advertising the date, time and temperature, make sure your exterior signage doesn't stay on all night, or even worse, burn all day when no one can tell the difference. Also check on the wall-wash spot lights and any special accent lighting. Many churches illuminate exterior architectural elements as part of their outreach to the community. Revisit your exterior lighting to see if it can be reduced or modified. Investigate LED lighting as a replacement. It will likely create the same light intensity at a substantially lower cost.

Turn parking lot lights off during the day and down very late at night. Reduce parking lot lighting to a bare, but safe minimum after the last person exits the lot. Make this circuit easily accessible and simple to temporarily override to keep your students, teachers and congregation safe if they stay longer than usual.

Adjust timers to accommodate the seasons, daylight savings and summer break. Thousands of dollars are wasted each year with the faulty justification that "just an hour doesn't make any difference." Check and adjust both interior and exterior timers monthly to match the changing sunrise and sunset times. Don't forget to adjust for spring and Christmas breaks, too.

Pursue rebates and tax incentives on all unplanned capital purchases and/or repairs. In California, where this book was written, there are a number of creative programs designed to recoup your energy investment dollars. Call your local utility company or check its website to see if any of your upcoming capital expenses or emergency repairs can be covered by rebates. Oddly enough, many utilities will actually reward you with cash for buying less of their product. You will be surprised how readily available this money can be. It is worth a quick call to find out how you can qualify. Also discuss your purchase plans with your tax professional. They can best advise you on how to maximize the temporary tax incentives available from all levels of government.

Take advantage of your utility company's "Time-Related Demand Metering" rules. Many electric utility companies impose a "Demand Time" billing charge on their high-usage customers. Your monthly demand charge can be based on your highest electrical usage during any single fifteen minute incremental time period. For example, if you come in early and quickly turn on all your lights, office equipment and the air conditioning, the electricity you used to power up everything at once sets your demand rate for the month. You can easily lower your demand time rate by staggering your lighting turn-on times over an hour or so and never illuminating 100% of your lights until just before class or services start. Many utilities will help you find ways to lower your bill by smoothing out your demand peaks.

Dissect your electric bill. There are several rate programs that can save you money. You might very well be stuck on the most costly rate plan simply because somebody checked the wrong box on your original utility start-up form. Unlike regular retailers, your energy provider is glad to help you reduce the amount of money you pay them every month. They even have teams of well-trained customer service

specialists to help you find ways to lower your energy-related operating costs. Depending on the age and sophistication of your Green Team, dissecting your electric bill should be among its very first assignments. (Tip: Even fifth and sixth graders can be excellent at this task.)

Reduce plug load. Plug load is simply the amount of power needed to run anything that is plugged into a wall socket. Your Green Team can use an inexpensive watt meter (i.e. Kill A Watt®) to measure the wattage draw of each appliance and piece of electrical equipment in your facility. Power strips and timers are typical ways to reduce your plug load.

ENERGY-SAVING POTENTIAL USING OCCUPANCY SENSORS

APPLICATION	ENERGY SAVINGS
Private Offices	13 TO 50%
Open Space Offices	20 TO 25%
Restrooms	30 TO 75%
Hallways/Corridors	30 TO 40%
Storage Areas	45 TO 65%
Meeting Rooms	45 TO 65%
Conference Rooms	45 TO 65%

Note: These figures represent maximum savings under optimum saving conditions. Source: California Energy Commission/Us Department of Energy – Electrical Power Resource Institute.

Install occupancy sensors in all closed rooms and classrooms. Timers on interior rooms work well for most applications, but occupancy sensors work better. They can be adjusted to go dark as soon as motion stops or a number of minutes later. Occupancy sensors are most effective in classrooms, offices, closets, supply rooms, rest rooms and conference rooms. They are particularly useful in classrooms where they illuminate only partial lighting when activated. The remaining lighting should be switch-activated but also turned off when the room is completely empty. A combination motion/infrared sensor works well for restrooms since it reacts to both movement and to heat. Since there are so many lamps involved in a sanctuary or auditorium, occupancy sensors are a good upgrade there, too. See the chart above for other potential savings.

Install LED (Light Emitting Diode) lights in all EXIT signs. Typical incandescent EXIT sign lamps consume 20 to 50 watts with an anticipated life of only 2000 to 5000 hours. A single sign could cost as much as $60/year. An LED lamp burns only 1.5 to 2.0 watts with an up to 40-year estimated useful life. Most people generally ignore emergency exit signs except for that once-in-a-lifetime situation when we need them the most or during a fire inspection. It's cheap insurance to install new LED lamps once and know that they will most likely remain operative for the rest of your career. Tip: Many utilities are offering significant rebates on LED exit lights. We included this upgrade in Chapter One because even without a rebate the payback is typically less than one year.

Buy only Energy Star® rated lamps. Energy Star® lamps are meticulously tested by third party agencies for quality and to verify advertised service life. Note: The advertised rated lamp service life (typically just called lamp life) is the amount of time it takes for 50% of a large test sample to burn out under standard conditions.

HVAC

Set your cold thermostat at 78° F and hot at 68° F degrees. Before you set your thermostat, make sure they are accurate. Then lock them to help keep them accurate. Even without interference, most temperature settings will drift several degrees every year. Calibrating and adjusting your thermostats has an instant payback. That accomplished, next adjust your A/C timers or EMS to take advantage of slow times. Except in extreme weather, don't preheat (or pre-cool) your facility before opening. At end of day, if you don't have EMS controls, shut down your A/C as early as the outside temperature allows. Tip: When cooling, raising the set temperature 1° saves 2% of your A/C costs. When heating, lowering your temperature set point will save you up to 3%. A final note: Small area temperatures (i.e. an office area) should be adjusted by altering the airflow through that specific air register, not by adjusting the entire system. Tip: Saving energy and money is important, but it is always secondary to the comfort of your students and/or congregation.

Seal off unused offices and rarely used areas and passageways. If an area is only occasionally visited, it does not require ongoing conditioning. Close vents and all doors to untrafficked areas. The most obvious are secure storage areas, janitor closets, back hallways and private offices. Tip: Pay particular attention to supplies and equipment that are temperature sensitive and might be damaged by temperature extremes. Be sure to store them properly.

Close exterior doors. Don't heat or cool the great outdoors. Close exterior doors whenever the A/C is running. In a classroom, students should be directed to use only one door when they have more than one option. In a church, the doors should be wide open to welcome the congregation but closed during the service and as quickly as is reasonable after the

congregations exits the building. Tip: Appoint classroom door monitors to help keep your doors properly closed.

Schedule sanctuary or auditorium events with heat retention in mind. Since it is so costly to heat (or cool) a large sanctuary or auditorium space, take advantage of residual heat after the service or other event is over. When possible, schedule weekly events that require conditioned air (like choir practice, cleaning, large gatherings or classes) before the building settles back to its base ambient temperature.

Turn off exhaust fans when not in use. Hoods are designed to suck out smoke, steam, cooking smells and the occasional gusts of hot air from your stove and other kitchen appliances. While your hood is fulfilling its primary function, it is also sucking out your expensively conditioned air. Shut down all hoods and exhaust fans when not in use. Hoods should only run when you are actually cooking, not while on stand-by or preheating. Tip: You can save over $100 per year for every extra hour per day that an 8' hood is shut off.

Turn heater pilot lights and timers off in summer. If you are uncomfortable with the technology, the gas company will help you deactivate your heater pilot lights. Newer models have electronically activated pilot lights that don't need your attention. The heating system should be deactivated except when definitely needed to combat the cold.

Keep air grills and registers clean and unblocked. Remove the clutter around all grills, registers and diffusers. Increasing the potential airflow reduces the run time on your A/C motors and extends their life. Many facilities compromise their A/C efficiency by accidentally blocking air intakes with bookcases, storage boxes and miscellaneous furniture.

Lower water heater temperature to legal minimum. Your hot water heater should be set to generate hot water only as hot as the health department mandates (usually 120° to 140°). Setting the temperature higher is both wasteful and dangerous.

Direct cooling fans toward employees. The use of directional fans is an inexpensive way to help cool a food prep area rather than waiting for the A/C to catch up. Studies show that, even though the change isn't real, people perceive a 5° temperature drop as soon as the moving air hits them. Make sure the refreshing air is blowing toward your kitchen workers, not the food.

Use portable space heaters or fans in enclosed rooms. In closed rooms, especially offices, it is far more economical to use a space heater or fan to help condition the air rather than adjusting the building A/C unit. Comfort is a function of temperature, humidity and air movement but "comfortable" is an ambiguous perception that is defined differently and debated by everyone. Simple fans can negate a temperature increase of 5° F. Remember that a 1° change in temperature can lower your A/C cost by up to 2%. Also note that in a typical school, nearly 30% of your total annual electric bill is directly related to your A/C. Caution: Even with all the mandated safety features operating properly, children and space heaters are a dangerous combination. Don't allow them to mix in your facility.

Install Energy Star® approved programmable thermostats. If you can't afford a complete EMS system, one of the easiest, least expensive and most effective upgrades is to install programmable thermostats. With this simple schedule-driven, solid-state device, you can set temperature parameters and on/off times. However, it can be overridden for special events as needed. Your facility

temperature needs to be both congregation friendly and energy-conserving. Make sure that your new thermostats are not installed near a heat or cold source or in direct sunlight and that they are properly calibrated as you install them. Tip: Raising your thermostat setting a single degree can save you 2% of your A/C cost per year. Lowering the heat setting 1° F can save 3% of your heating cost. Tip: Specify an Energy Star® qualified programmable thermostat to be sure of quality.

Install timers to shut down non-essential systems during off hours. Install timers or setback programmable thermostats to shut down unneeded A/C systems during non-essential, night, weekend and holiday hours. (Typical night setting temperatures are: cool to 90° F and heat to 55° F.) With an inexpensive Energy Star® programmable thermostat, you can adjust the A/C schedule to deactivate itself when not needed.

Set economizers properly. An efficient economizer requires reliable sensors, actuators and damper mechanisms. Economizers are one of the most energy-saving parts of your air conditioning system. They are also the part that is most often disabled or compromised. A recent survey showed that only 10% of the test sample economizers were working properly eighteen months after installation. Make sure that your HVAC service includes inspection, lubrication and repair of the A/C economizers to maximize the benefit of "free cooling." When your outside air temperature and humidity are lower than the inside air (i.e. at night) your A/C unit shuts down and the economizer takes over. Since it is only a fan unit and doesn't actually cool the air, it can lower your A/C bill by about 30%.

Create and carefully follow an HVAC vendor preventative maintenance schedule. To avoid bacteria and mold growth and dirt accumulation, have all your filters changed every three months. Belts and bearings should be inspected and serviced as needed at the same time. Pay particular attention to cleaning your condenser coils and fan blades and calibrating your humidity sensors. Your contractor should also check refrigerant levels, verify current drawn (amps.), check for duct leaks and make sure that all the dampers and valves are operating as designed. See Appendix E for a more comprehensive sample PM (Preventative Maintenance) check list.

Replace worn or cracked weather stripping and seal up all holes. Cracked or broken weather stripping is an ongoing conditioned air leak blowing from your building. Like from a window that never closes, either your cool air or your high cost heat is escaping to the outside. If your windows or doors rattle, your weather stripping is probably deteriorating. Besides the leaks to the outside, any conditioned air being blown into an unconditioned space is costing you money, too. Search out and seal any drywall holes into your supply rooms, closets, storage areas, janitor's closet and attic space. (Tip: Foam board and spray foam work for most repair applications.)

Your acoustic ceiling is a temperature barrier between your air conditioned space and the sun-baked roof deck. Replacing a few missing or damaged ceiling tiles is more than an aesthetic issue, it saves you money. Tip: The weather stripping on continually-used exterior classroom doors generally wears out very quickly due to the heavy traffic. Unless you live in an extreme weather area, the A/C energy saved is not worth the cost of continually replacing it. Tip: Weather stripping is for moveable structures like doors and windows. Caulking is for non-moveable areas like cracks, holes and electrical openings.

Install door sweeps on exterior doors. If you can see light under an exterior door, you are cooling (or heating) the great outdoors. Door sweeps are an easy fix. Also many health departments require door sweeps to keep out rodents. A mouse can crawl under a door with only a pencil width of clearance. Door sweeps can easily help solve two problems at once.

REFRIGERATION

Use correct temperatures. Colder isn't always better. Properly controlling food temperatures can literally save a life. Closely follow these food industry temperature standard ranges for each type of refrigerated case. The recommended standards are:

Dairy/meat/deli	32° to 36° F
Frozen Food	0° to -5° F
Ice Cream	-8° to -12° F

Create accountability for case temperatures. Make sure everyone on your Green Team knows how to recognize a real refrigerated case problem and checks the temperature on each case at least once a day. Post defrost times on each case to save expensive wasted calls to your refrigeration contractor.

Keep refrigerators and water coolers four inches from the wall. Refrigerator coils need moving air flowing around them to operate properly. Don't set your self-contained water coolers, refrigerators or freezers tight against the wall where they can't breathe.

Clean self-contained refrigerator coils annually. Keep your self-contained refrigerator coils clean, including all the hidden personal refrigerators in the classrooms or offices. An occasional vacuuming will significantly extend the

machine's life by decreasing the motor run time. Plus: keeping coils clean can reduce energy consumption by 25%.

Perform a dollar bill test on all freezer and cooler doors. (It shouldn't slip out!) If a dollar bill slips easily between your door seals, you need to replace them. Some municipalities and/or utilities will rebate a portion of this cost. Check for cracked, smashed or bent door gaskets around each freezer and cooler door. Typically, the seals at the bottom of the door wear out first because of people kneeling or standing on them.

Adjust defrost controls. Based on the recommendations of your refrigeration contractor, have your defrost cycles reset to a minimum on your self-contained coolers and freezers. Myth: Frost on frozen food indicates that another defrost cycle should be added. Truth: Frost usually indicates that the defrost is running too long or there are clogged drains, air leaks or other issues. Adding another defrost cycle will simply exacerbate the problem and increase your energy consumption.

OFFICE EQUIPMENT AND FACILITY OPERATIONS

Use power strips dedicated to specific equipment. Many types of office equipment, especially printers and monitors suck phantom electricity even when not in use. When possible, centralize these to run off a power strip to simplify turning them all off at once. A combined computer and CRT burn close to 150 watts of power. Turning the two of them off for only eight hours every night will save $65.00 per year. If you have to leave the computer on as part of a network system, at least power down the monitor and printer overnight. Tip: Utilizing a screensaver doesn't save energy. When your screensaver is on, your computer is still drawing full power.

Activate power management software on your computer. If your computer doesn't have a power management system, you can download free software from Energy Star®. (www.energystar.gov/benchmark - ENERGY STAR'S® power management software). Properly used, a good power management system can reduce your computer system power usage by up to 90%. The problem with all power management software is that, unless reminded, people stop using it. Make monitoring computer shut-offs one of your Green Team's top priorities.

Print on both sides of all memos. Go paperless when possible. Draw a quick yellow highlighter stripe across unneeded (and unwrinkled) memos, then feed them back into your printer's paper tray. It is a very small thing that makes a very strong statement to your Green Team and everyone else in you facility about your true commitment to the environment. Never send actual old-fashioned paper memos when an email would suffice. Every tree saved from the paper mill reduces carbon dioxide emissions, air pollution and is an eco-victory your Team can brag about. Tip: Print in gray scale when possible. Use colored ink only when absolutely necessary.

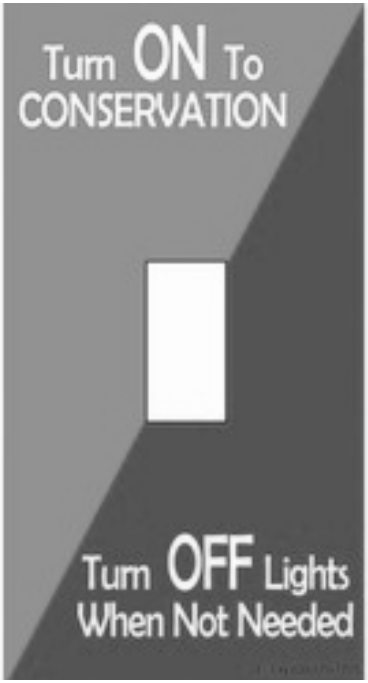
Use recycled paper. Unless you are printing a document going out to a special customer, use paper with a high-recycled content. Use the least expensive paper available for in-house written communications. Paper manufacturing along with harvesting, replanting and transporting the trees consumes a huge amount of energy. Whether in a church or school, ask everyone to go as paperless as possible by emailing rather than printing their communications. For in-house memos, make sure you use paper with a very high recycled content.

Recycle more than just paper. As industry finds more uses for recycled material, the task of recycling becomes both

easier and often a potential income stream. Call local recyclers to find new ways to recycle your trash as efficiently and inexpensively as possible. Task your Green Team to not only collect all the cans and plastic bottles generated at your facility but to also bring in the ones accumulating at home. The extra cash can help fund some of your Team's ideas. Tip: Depending on your location, other income-producing recyclables include: electronics, appliances, TVs, computers cell phones and cardboard.

Look at the recycled content. Make sure that everything you buy has the highest possible recycled content. This includes all paper products from Post-it notes to file folders and binders. Don't forget pencils, pens and even trashcans. The higher the post-consumer recycled content, the better for our environment.

Support your Green Team. A good "Green Team" can save you thousands of dollars each year. Support your team's efforts and enthusiasm by creating a signage package that effectively spreads their environment-saving message. This is easier than it sounds. Long before the environment became front-page news, awarenessideas.com (800 875–1725) created a number of energy-related programs for Fortune 500 companies. Based on those successes, they built a collection of thousands of energy-related posters, signs, decals and other clever ways to keep your money-saving message highly visible and moving vigorously forward. Check out their web site. You will be amazed at how many different and unique ways they can inexpensively support your Green Team while contributing to your bottom line. On the opposite page are just a few of the huge selection of signs, posters, decals and other items that are available.



2.25 x 4.25 red and green light switch cover

3” diameter dark blue equipment sticker

6” diameter sticker dark blue on white

12” x 18” poster two tone blue

See **awarenessideas.com** for more examples to help your sustainability program.

Create a Green Team Preventative Maintenance Schedule. Include at a minimum the following tasks: turn off all unneeded lighting, appliances and equipment every day; turn off all computers at the end of day; close all doors; turn off all faucets and report leaks and dripping. Please see Appendix A for a more complete Sample Green Team Preventative Maintenance Checklist.

Use 'Green' cleaners and insecticides. The EPA Environmentally Preferable Product Information list is your most up-to-date source of information about government approved cleaners and insecticides. Both your ecology-minded students and congregation will appreciate knowing that you are using cleaners and insecticides that are environmentally safe and listed among the EPA's Environmentally Preferred Products. The payback is more in public relations than in dollars, but well worth the trouble.

Buy only Energy Star® rated office equipment. Equipment manufacturers jump through a lot of hoops to gain an Energy Star® rating for their products. Only the best make it. When you consider the overall life-cycle cost and the number of years you will enjoy lower utility bills, it is worth any extra up-front cost. With Energy Star® rated equipment, you get more work for the same amount of energy, less required run time, less down time, less maintenance and less heat generation. There are free savings calculators available on the Energy Star® website to compute your potential savings.

Install timers on your copy machine and vending machines. A timer to shut off your copy machine overnight will only save you a little money. The real energy hogs are your soda and water vending machines. The big outdoor type work hard all night to refrigerate a lot of interior space just to keep a few sodas cold when no one is around to buy them.

Soda vendors are working to get their machines retrofitted with both sensors and timers. Approach them first to see if there are more energy-efficient machines available. If not, get a timer, then go after a possible rebate. Tip: As an interim compromise, remove the display lighting that burns 24/7.

COOKING

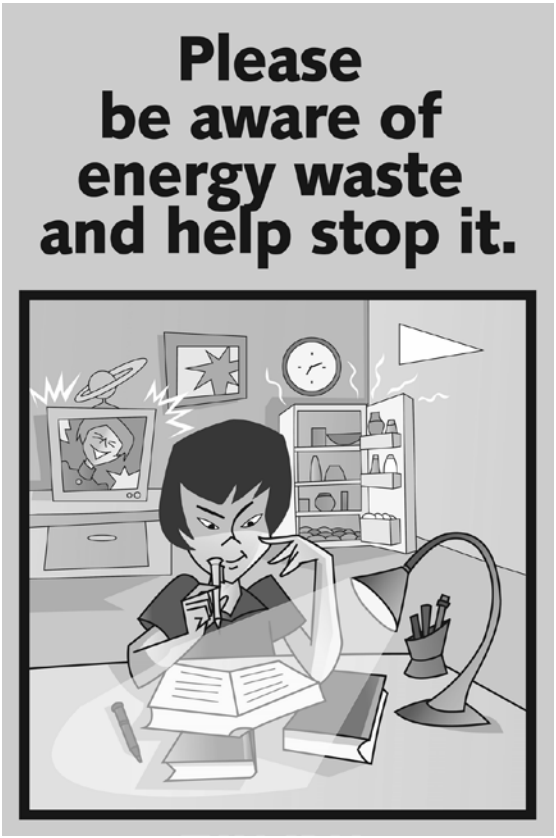
Shut off exhaust hoods when not in use. Turning off the exhaust, make-up air and lights on your 8' hood for an extra hour each day can save you about $200/year.

Use flat-bottom pans with lids. Flat bottom pans provide a larger surface area to make the most efficient use of your heat source. A lid contains the heat inside your pot where it belongs rather than allowing it to escape into your cooking area where it can raise your A/C cost.

Microwave ovens are energy savers. Use them first. Your microwave oven is one of the highest efficiency appliances in your kitchen area. Don't forget to unplug them when you are done. Most likely, you don't need the clock function and even though the phantom electrical usage is small, it adds up quickly.

Put timers on coffee makers. Use carafe-style coffee makers. If your coffee maker isn't already equipped with an automatic timer, plug it into one. Or, better yet, unplug it when you are finished. An ignored coffee pot will boil its contents down to powder, smell horribly and crack the carafe. Even if it doesn't break, it's so labor intensive to clean; you might be better off throwing it away. Carafe-style coffee makers are easier to control and when properly-timed use much less electricity.

Polish heat reflectors and clean burners regularly. Take advantage of the physics behind heat reflectivity by cleaning all the reflective surfaces inside your ovens and broilers. Clogged burner ports cause uneven heat distribution and waste gas by extending cooking times. In both schools and churches, many of the cooks are volunteers, so what ever cleaning and polishing occurs is rarely effective enough to save any energy. Even though the results aren't measurable, both these tasks are easy-to-accomplish winners for your Green Team.



12”x18” colored poster from awarenessideas.com

CHAPTER TWO

WHAT CAN KIDS DO TO HELP?

Regardless of their age, kids can become the most important element of any school or church environmental program. They are willing, able, energetic and enthused. There are hundreds of schools across the country that have harnessed their student’s youthful energy to partner with the

EPA's Service Learning Program. Other organizations that are helping kids get involved in community action by service-learning include Boy Scouts of America, Girl Scouts of America, Boys and Girls Clubs of America, The National Dropout Prevention Center and the National 4-H Council. The following is a list of EPA suggested ideas that prove how easily kids of any age can do their part to help our environment.

AT SCHOOL AND AT HOME

- **Reuse from last year.** Before starting the new year, sort through last year's remnant school supplies. Most can be reused or recycled. Notebooks, binders and folders typically can last through another year. Be careful to recycle, not just throw away old papers.
- **Buy eco-friendly school supplies.** Buy non-toxic products like vegetable-based inks and water-based paints. Make sure that your notebook paper and tablets have the highest recycled content that is available. If your store doesn't offer recycled paper, complain to the manager and then shop somewhere else.
- **Shop with a list.** When you are buying school supplies, work from a list of exactly what you need. It will save both money and time. Look for products that have a high recycled content or that are recyclable.
- **Buy in bulk.** Buy school supplies in bulk to reduce redundant excess package waste. Shop at an office supply store where the per package item counts are larger and sold in packages that are often smaller. Watch for their back-to-school sales just after summer starts to avoid the rush. Split large quantities with other students or siblings.

- **Don't lose it.** Discipline yourself not to lose pens, pencils and other small supplies by always putting them away properly in the right place.
- **Use book covers.** If your school reuses textbooks to save money, or if you believe all books should be treated with respect, creatively cover yours (perhaps with a brightly colored paper bag) so it will look clean and fresh for the next student who uses it.
- **Reuse your lunch containers.** If you bring your lunch, pack it in reusable containers.
- **Don't waste food.** If you buy lunch, or your school provides it, eat everything you take and don't waste napkins, plastic flatware or condiments.
- **Be a door monitor.** Start an "Adopt-a-Door" program at your school to help keep all the classroom and hallway doors closed. You can't heat or cool the great outdoors, so please don't try.
- **Walk or ride, don't drive.** If you live close enough, walk or ride your bike to school. You can save wear and tear on the family car while reducing your carbon footprint. If you drive, carpool.
- **Become a "Green Team" leader.** Get involved. Spread the Fourth "R" (Reduce, Reuse, Recycle, RESPOND) message by starting a recycling project or environmental club at your school. You are never too young to begin doing your part to help save the environment.
- **Get your teachers involved.** Tell your teachers that you would like to learn more about what you and your school can do to help the environment. Your school administration might be surprised to learn that "Going Green" doesn't cost more money; it can actually save your school thousands of dollars each year.

- **Help the homeless.** Coordinate monthly used clothing and recyclables collection days with all proceeds going to homeless shelters. Create and distribute flyers to increase local participation.
- **Become a teacher.** Volunteer to help teach lower grades about the concepts and benefits of reducing, reusing and recycling. There is no better way to learn than to teach.
- **Twitter your environmental message.** Use Twitter, blogging, U-tube and other social media to spread your environmental message from your school to others in (or even better, outside) your area.
- **Recycle.** Recycle your cans, bottles, printer cartridges, white paper, electronics and dozens of other things. Many items that we typically throw away can be a potential income stream. Call your local trash hauler for a complete list.
- **Take everything home at the end of the school year.** Even if you are graduating, clear out everything from your locker or desk when the year ends. If you don't want your educational residue, give it to someone who does. Remember: Reduce, Reuse and Recycle.

SCHOOL SUSTAINABILITY

A Success Story

In order to teach environmental awareness and conservation through service-learning and to save money a Georgia Military Academy recently initiated a multi-faceted sustainability program.

In Phase One, separate electrical meters were installed in each building, including the dorms and dining hall to measure exactly where the biggest energy-saving opportunities existed. Next, the local power supplier was notified to see what incentives and rebates were available to help fund the upgrades.

Phase Two was in-depth Energy Awareness Training for the staff and student population focused on the campus' six main groups. The six targeted groups were: dining hall staff, TAC Officers, security personnel, cleaning crews, teachers and cadets. An "Energy Captain" was appointed for each group.

In Phase Three, the "Energy Captains" were tasked with reinforcing the new policies and practices. They tracked their progress on-line against the base line usage that was measured and established by the metering done in Phase One. The Captains hung posters, installed light switch cover stickers and equipment stickers in their assigned areas to ensure the cadets and staff would continue to support the program and stay interested and involved.

Some of the most effective low cost energy-saving upgrades included:

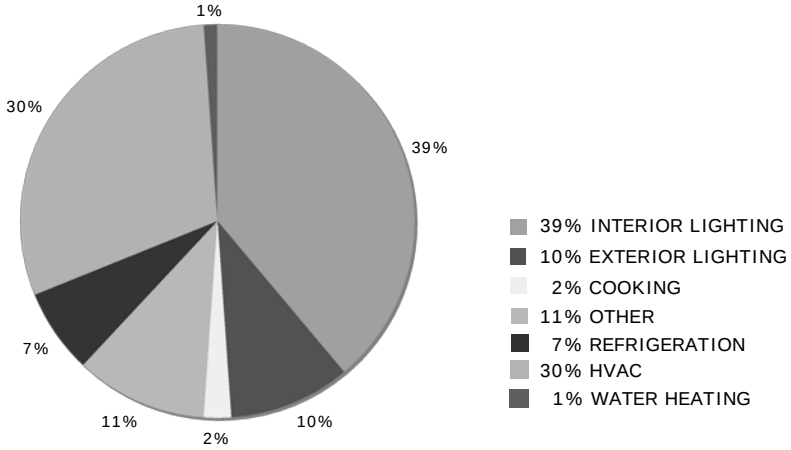
1. Correcting and controlling areas of the school that were over-lit as measured both in brightness and in burn time.

2. Installation of CO2 sensors in dorms to optimize HVAC efficiency.
3. Shutting down all campus computers through a central server.
4. Program selected water heaters and recirculation pumps to stay dormant during furloughs.
5. Manually controlling the exhaust fans and all the other kitchen equipment.
6. Creation of a long-term recycling program for all plastic, glass, metal and paper starting in the kitchen and offices.

Potentially, the money saved can be used to fund even more energy-saving projects like:

1. Replacing all the old computers and monitors with high efficiency models.
2. Replacing older HVAC and refrigeration motors with high efficiency ECM (Electronically Commutated Motors) motors.
3. Installing LED lighting where appropriate.

Full support of the school's administration, in-depth training, visible and measurable goals leading to obtainable rewards for the students were key to the success of the program. Appointing students as "Team Captains" taught valuable leadership and environmental lessons that everyone involved could use to save precious resources both on and off campus.



SCHOOL/CHURCH ELECTRICAL USAGE

Source: 2006 California End Use Survey

CHAPTER THREE

INVESTING IN YOUR GREEN FACILITY

It's time to get serious about saving money and energy. Depending on your location, many of the upgrades listed below have ROIs of between six months and three years. Based on the pie chart above, 49% of your energy is attributed to lighting alone. HVAC uses 30% of your total energy. For the biggest and most recognizable impact, start with upgrading your lighting, especially inside.

Sustainability isn't an all or nothing proposition. It is simply a slow-growing philosophy that is the right thing to do both globally and for your bottom line. Even when the technology and the return on investment are well tested and proven, there is no reason to commit huge amounts of capital to a big remodel. Since schools and churches are notoriously underfinanced, start with three or four fast payback, high

visibility projects that your staff, students or congregation will instantly notice and appreciate. Then slip in a completely invisible, slightly higher ROI project like commissioning and/or a new EMS system.

Review and prioritize the "Easy Savings Checklist" list below. For some of the tasks, you simply have to wait until something breaks and then replace it with energy-efficient equipment. We realize that some of these corrections seem like pipe dreams, but others you can start today even if you are not mechanically inclined and have no maintenance budget.

Easy Savings Checklist

LIGHTING

- Clean light fixtures and lamps.
- Install exterior timers.
- Replace mercury vapor lights.
- Replace neon and accent lighting with LED (Light Emitting Diode) lamps.
- Install 'second generation' T-8 lamps.
- Replace yellow or hazy lenses, diffusers and globes.
- Review sanctuary and auditorium lighting.
- Replace all T-12 fluorescent lamps with T-8 or T-5 lamps.
- Replace all magnetic ballasts with electronic ballasts.
- Install dimmable ballasts.
- Install bi-level switching.

- Install HID (High Intensity Discharge) lamps in your warehouse or gymnasium.
- Control daylighting and optimize daylight harvesting.
- Install LED accent lighting.
- Replace parking lot lighting with LED lamps.
- Paint walls a light color.
- Install motion detectors, timers or photocells on exterior wall pack fixtures to control lighting when your facility is closed.
- Change out lighting in groups.
- Utilize automatic lighting controls.

HVAC

- Set economizers properly.
- Install automatic shut-off devices.
- Install Carbon Dioxide sensors.
- Install adjustable speed drives on HVAC equipment.
- Balance air handler.
- Install an EMS (Energy Management System) system capable of separately controlling both lighting and HVAC.
- Install power factor increasing devices.
- Install an evaporative cooler. (Best in dry climates only.)
- Install multi-pane windows.
- Install special window coverings and/or awnings.
- Install low-emissivity windows.
- Seal and insulate A/C ducts in unconditioned areas.

- Install a light colored, preferably snow white, roof membrane.
- Install reflective tint on windows.
- Purchase Energy Star® rated equipment.

WATER HEATING AND PIPE INSULATION

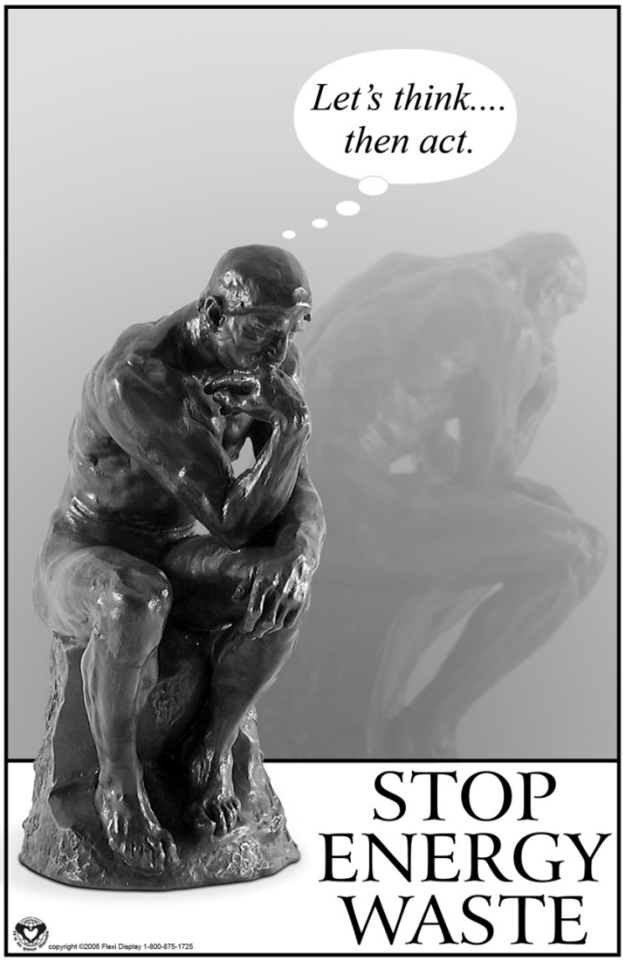
- Install EPA approved WaterSource® flow restrictors and aerators.
- Install pipe insulation and a water heater blanket.
- Repair all leaks.
- Install water-efficient faucets and toilets.
- Install instant-hot water heaters.
- Install an Energy Star® rated water heater.

OUTSIDE

- Change to a drip irrigation system.
- Plant greenscaping, xeriscaping.
- Utilize renewable energy sources.

OFFICE AND OPERATIONS

- Install only Energy Star® rated office equipment.
- Don’t forget your Green Team.
- Use dustless chalk.



12" x 18" black and white poster from awarenessideas.com

Checklist Suggestions and Tips

COMMISSIONING AND RETROCOMMISSIONING

You can't fix what you don't know is broken! Or, more appropriately, you can't manage what you don't measure. Too many small churches and schools are limping

along burdened by huge monthly energy bills and don't even have an inkling that anything is wrong or fixable. Depending on your facility, its age and how poorly your equipment works together, commissioning can net you an instant 10 to 20% reduction on your energy bill. Why not free up these funds for ministry outreach or educational upgrades?

Commissioning is a very methodical process that verifies that all the facility equipment, especially in interdependent systems, is operating together as designed. This review should include rooftop A/C units, lighting, alarms, fans, hoods and your energy management system.

Retrocommissioning is simply the process of commissioning an existing building. It's a documented process by an experienced contractor focused on balancing mechanical equipment, lighting and the related controls. The results can include improved indoor air quality and lighting, comfort, energy management controls and resource efficiency. Most importantly, retrocommissioning exposes operational and maintenance improvements that can be inexpensive to install and often have a payback of less than two years.

The most common, simple-to-fix problems uncovered during the retrocommissioning process include: miscalibrated or improper HVAC temperature set points, nonfunctional humidity sensors, poorly timed lighting, inoperative fan motors and broken belts.

Retrocommissioning should be among your top ten energy-saving upgrades and definitely be a part of every remodel. The paybacks are too significant to pass up. Go to your local utility or www.aztec-energy.com for advise on all your commissioning and recommissioning questions.

LIGHTING

LAMP TYPE	RATED HOURS	TYPICAL APPLICATION
T-5, T-8 Fluorescent	20,000 to 30,000	General lighting, offices, classrooms, high bay areas
Compact Fluorescent	6,000 to 12,000	Incandescent replacement
Quartz pulse-start metal halide	20,000	Outdoor lighting, high bay and remote-source lighting
Ceramic pulse-start metal halide	20,000	Color-critical high bay and retail applications
High pressure sodium	24,000	Non-color critical outdoor and high bay
LED (Light Emitting Diode)	50,000	Exit signs, traffic lights, vehicle tail lights, task and accent lighting

Typical lamp applications and rated useful life.
Source: Courtesy of E source

Clean light fixtures and lamps. Warning: This job is too dangerous for your Green Team. Save it for the professionals. Next time you have your ceiling lamps replaced or changed out to CFLs, make sure the contractor also properly cleans the reflectors. Just having clean reflectors or light fixtures can brighten your facility by 10 to 20%. Tip: Very few contractors do a really satisfactory job of cleaning reflectors. Don't settle for less.

Install exterior timers. If you don't have a properly programmed EMS lighting control system, replace the old, worn or malfunctioning pin-timers for your parking lot and other exterior lighting. This will save electricity during the day and reduce light pollution at night. Tip: If you are plagued with occasional power outages, invest in a solid-state timer backed up by a rechargeable battery so you don't have to reset it after every electrical incident.

Replace mercury vapor lights. Mercury vapor lights are such notorious energy hogs that the federal government has outlawed their manufacture. There are two good replacement options. 1) High Pressure Sodium Vapor (HPSV) lamps for outside with a rated life of over 24,000 hours. 2) In applications that don't require good color definition use Pulse Start Metal Halide lamps with a rated life of 30,000 hours.

Replace neon and accent lighting with LED (Light Emitting Diode) lamps. Old exterior signage is typically illuminated by neon. Replacing the illumination elements with the new generation LED lights reduces your electrical usage by up to 80%. Inside the building, LED lights work well as track light accents or as the long-lasting light source in over-the-door emergency exit signs.

Install 'second generation' T-8 lamps. Suppose you were wise enough to have already replaced your T-12 lamps with T-8s a few years ago and you are now due for a lamp change-out. Make sure that the new lamps being installed are 'second generation' (AKA Super T-8s) T-8 lamps. Lamp technology is evolving so fast that the new ones will save you about 20% more than the ones you are using now. If you still have T-12 lamps, replacing them with the newer T-8s and electronic ballast combination will multiply your savings. Tip: If your existing fluorescent system is

dimmable, make sure that the new generation tubes will be dimmable too. Most are not.

Replace yellow or hazy lenses, diffusers and globes. Your image with both your students or parents and your congregation is the best reason for having clean, clear lenses, diffusers and light globes. Saving money is the second reason. Retrofitting will save you money only if the new (or clean) fixtures allow you to install a lower wattage lamp while maintaining the same light output.

Review sanctuary and auditorium lighting. Lighting plays a critical role in defining the warmth and tranquility of your sanctuary. It needs to be both bright enough to read comfortably and dimmable enough for a candle light ceremony. School auditoriums create almost the same demands. Enough light to take detailed notes during an important lecture yet flexible enough to show a movie. Consider installing the latest generation of dimmable CFLs when replacing lamps in recessed cans, pendant fixtures, accent, spot and track fixtures. Tip: Even when they are designated dimmable, test the dimmability of your new CFLs before committing to replacing them all.

Replace all T-12 fluorescent lamps with T-8 or T-5 lamps. Replacing all of your old fashioned fat T-12 (1.5" diameter) lamps can be pricey but instantly worthwhile. T-8s (1" diameter) and T-5s (5/8" diameter) are thinner, more efficient, have a higher efficacy (brightness, measured in lumens per watt) and render truer color than T-12 lamps. Tip: Ask for "second generation" T-8 lamps because they use 20% less electricity than the original T-8s. Depending on the ballasts, they burn 20 to 40% fewer watts and last longer. Since the smaller diameter lamps are also brighter, you can use fewer lamps to get the same light saturation. You gain further, but harder to document, savings because the T-8s and T-5s generate less heat and therefore reduce your A/C

costs. Tip: Have a lighting professional verify that your ballasts are compatible with your new lamps before you start the replacement work.

Replace all magnetic ballasts with electronic ballasts. Changing to T8s necessitates replacing the old (first used in 1939) magnetic ballasts with new electronic ballasts as part of a system. The combination of new lamps and complementing ballasts almost doubles your savings. Even though your existing ballasts may have a number of remaining service years, it will pay to replace them. The newest generation ballasts are virtually flicker-free and burn up to 30% less energy. Tip: Make sure that your old ballasts are disposed of properly. They may contain PCBs, Polychlorinated Biphenyls, a government-banned hazardous material.

Install dimmable ballasts. If you have (or are going to install) skylights, then dimmable ballasts are a must. The light brightness (efficacy) is controlled by light sensors mounted in the skylights. Dimmers are also used in conference rooms, auditoriums, sanctuaries, eating areas, libraries and classrooms. Better dimmable ballasts can lower light levels using such minute incremental changes that your students or congregation will never notice. Tip: Fluorescent lamps usually die from cathode failure caused by repeatedly turning them on and off. Since the electrical usage is so minimal, it pays you to dim the lamps down to about 10% but never to turn them off until the end of the day.

Install bi-level light switching. In some lighting situations, the quantity of dimmable ballasts that are needed is cost prohibitive. It may be more prudent in a classroom or corridor to rewire a long line of T-8 ceiling lights to an A/B configuration. Simply stated, a row of lights can be either on or off (A or B) but not dimmed. Since each row is controlled separately with different activation/deactivation points, they

can be turned off without as much impact on your students. The downside of a photometer or motion sensor activated A/B configuration is that fluorescent lamps typically die as a result of cathode failure due to being turned off and on too many times. Look into the long-term cost of each alternative before committing to the work.

Install HID (High Intensity Discharge) lamps in your warehouse or gymnasium. Because these lamps can be so bright, they are best used for lighting large areas from high ceilings. Their typical usage is in garages, warehouses, gymnasiums, and for exterior safety and security lighting. Because of their long strike and restrike times (i.e. the number of minutes the lamp takes to illuminate after power is supplied) HID lamps should never be used where they would be turned on and off frequently.

Control daylighting and optimize daylight harvesting. Even in buildings without skylights, proper lighting controls can significantly lower your electrical usage. Depending on the amount of glass in your classroom or office, you can turn off or dim as much as a third of your ceiling lights during part of the day. Aside from the money saved, a number of studies have shown a positive correlation between the use of natural light and improved student grades and higher office productivity.

Install LED accent lighting. New potential applications for LED (Light Emitting Diode) lighting are evolving every day. LED lamps burn cooler, and look brighter using up to 65% less power and last over ten times longer than incandescent lamps. Their estimated useful life is unaffected by lower temperatures so they are well suited for exterior applications. Their directional versatility and low-cost light intensity make them an obvious choice for track and accent lighting. There are hundreds of buildings across the country, especially retail stores, that have now successfully and profitably switched to

100% LED lighting. An added bonus is that, unlike CFLs, they don't use mercury with its hazardous material disposal issues. Tip: When given a choice between CFLs and LEDs, go with LED lighting. It is the inexpensive wave of the future.

Replace parking lot lighting with LED lamps. LED lights are also great for parking lots because of their reduced glare, minimal light trespass and accurately defined angle of illumination. They are the perfect answer for locations that are particularly sensitive to light pollution like a discontented neighbor's back yard or bedroom window.

Paint walls a light color. Dark colors suck up light. The lighter your walls, ceiling and floors, the less light you need. High reflectivity guarantees a lower lighting cost, so don't use a matte (flat) finish paint.

Install motion detectors, timers or photocells on exterior wall pack fixtures to control lighting when your facility is closed. A generation ago, exterior wall pack lighting was installed for aesthetic reasons. Depending on safety and security issues in your neighborhood, it might be worthwhile to install sensors on each fixture allowing them to be off each night only when no one is near. If local conditions disallow turning off any exterior lights, at least make sure that whatever type of controller you are using (i.e. EMS, timers etc.) shuts off your lights during the day.

Change out lighting in groups. Both incandescent and fluorescent lamps typically lose 20 to 30% of their brightness over their service life. Compared to the labor to install them, lamps are very inexpensive. Replacing all the lamps in an entire lighting system (i.e. a classroom, corridor, auditorium or sanctuary) saves labor, maintains the design lighting standard and doesn't over-stress any ballasts with dying

lamps. When changing out lamps, consider the following: initial lamp cost, anticipated useful life, energy consumption per lamp and maintenance cost. Tip: Make sure that your old lamps are disposed of properly.

Utilize automatic lighting controls. Lighting controls perform two basic functions. 1) Turn lights off when not needed. 2) Adjust lighting so that no more light than needed is produced. The most efficient light control is accomplished by occupancy sensing, scheduling, tuning and light harvesting.

HVAC

Set economizers properly. An economizer is an add-on to typical package-unit A/C systems that saves money by providing free cooling. Through the use of dampers and automatic temperature-activated controls, the quantity of fresh air entering the space can be adjusted. In locations where the outside temperatures and humidity are nearly equal, this saves the cost of conditioning the air by not passing it through the A/C unit but instead simply pumping fresh air into the space.

Install automatic shut-off devices. Some elements of your EMS controlled A/C system are better handled by simple automatic shut-offs. (Bathroom fans are a prime example. It is far less expensive to tie your bathroom fans to a motion-activated light switch than to try to manage them through your EMS system.)

Install Carbon Dioxide sensors. Traditional HVAC systems import fresh air based on an assumed occupancy. Newer technology allows your A/C unit to react efficiently to the Carbon Dioxide concentration in your space. This type of sensor is particularly effective in seldom-used meeting

rooms. The net result is both a more energy-efficient operation and better air quality.

Install adjustable speed drives on HVAC equipment. Adjustable Speed Drives, ASDs, (also known as Adjustable Frequency Drives, AFDs, and Variable Speed Drives, VSDs or Flow Modulators) are used to adjust the speed on your HVAC unit's fan, blower, compressor and pump motors to reduce your electrical usage by matching the fluctuating loads. Since most HVAC units are oversized, running them at a reduced load extends the life of the motors and all the driven equipment. ASDs can reduce A/C electrical usage by up to 30%. Tip: The payback on replacing a seldom-used motor is very poor. Install ASDs only in motors that are being replaced or that are used nearly every day.

Balance air handler. Have your qualified contractor balance all aspects of your air handling system including offices, classrooms, sanctuary, auditorium, food service and food prep areas, storage areas, hoods and restrooms. This should be done as part of your retrocommissioning process.

Install an EMS system capable of separately controlling both lighting and HVAC. If you don't already have an EMS system capable of controlling all aspects of your energy savings, look into installing one as soon as possible. EMS benefits include: Reduced energy costs, improved facility management, reduced manpower requirements and faster and better response to emergency and trouble situations. A properly tuned and implemented EMS system typically reduces your electrical costs by 10 to 20%.

Install power factor increasing devices. In an electric power system, a load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. This is only important in

areas where the utility company charges a penalty to facilities with a low power factor. A high Power Factor is worth considering in some lighting situations but really pays for itself when replacing motors or when it is a major element on your energy bill.

Install an evaporative cooler. (Best in dry climates only.) Evaporative cooling uses about 25% of the energy of a typical A/C unit. These “swamp coolers” evaporate moisture into the air stream increasing its humidity and lowering the temperature. Raising the humidity to the preferred range of 50 to 60%t is what makes the space more comfortable. This works best in dry climates.

Install multi-pane windows. Double or triple-paned windows have the highest payback only in the most intemperate areas. They make the most sense when installed as part of the original building. Except in the harshest environments, cost wise, they are hard to justify as a retrofit energy-saver. The payback is simply too long. If you do install any new windows, look for the Energy Star® label and investigate utility company rebates.

Install special window coverings and/or awnings. Often a cheaper and more versatile alternative to multi-pane windows is to cover or somehow shade your existing windows. Deciduous trees, horizontal, vertical or roller blinds, shade screens or awnings are good energy compromises. Awnings create predictable shade to save energy, but don’t skimp on the up-front cost with cheap canvas or plastic and don’t forget to factor in the cost of periodically cleaning them. Window tinting is an even cheaper option. These films dramatically reduce building heat gain in the summer and “bounce” the heat back into your facility in the winter. Check with your property manager and local authorities to see if there are any restrictions.

Install low-emissivity windows. High performance, gas filled, double-paned "low emissivity" (Low-E) windows are quickly becoming a standard in the industry. They insulate as well as triple-paned glass but cost less. These windows are an excellent choice as new equipment, but not as a quick ROI retrofit.

Seal and insulate A/C ducts in unconditioned areas. One of the biggest causes of run-away A/C costs are damaged air conditioning ducts leaking expensive conditioned air into intentionally unconditioned areas of your building. This is especially true in older facilities where the ducts are hidden above the ceiling. Tip: Look for a dust build-up as an indication of an air leak.

Install a light-colored, preferably snow-white, roof membrane. A new roof is a huge capital expense; so when the time comes for a replacement, look into a TPO roof. They are bright white and reflect sunlight more efficiently than any other type of roof. In many areas, they are also cheaper than any other roof type. Depending on your location, a white roof can reduce your cooling energy cost by 15 to 20%. Tip: Look for the Energy Star® label and make sure you hire an experienced, competent, financially stable installer to support the TPO's long warranty.

Install reflective tint on windows. There are dozens of different varieties of reflective window tinting that can help you lower your A/C cost by redirecting the sun's heat away from your building. At the same time, in winter, correctly chosen and installed tinting material bounces the heat back inside. Some manufacturers claim that 100 square feet of the correct tinting can replace one ton of air conditioning. Depending on your weather, it may be cost effective to tint only south and west-facing windows. Tinting installed by reputable contractors should be warranted for five to ten years. Tip: Check with your property manager and local

authorities to make sure there are no tinting restrictions or ordinances.

Purchase Energy Star® rated equipment. The Energy Star® rating is based on the standards set by the EPA (Environmental Protection Agency) and the DOE (Department of Energy). Energy Star® has already done the research to raise the quality standards of the energy-saving products you need. They can help whether you are in the market for roofing, windows, HVAC equipment, automatic controls or any other equipment that might even remotely be considered a user or waster of energy.

12"x 18" colored poster from awarenessideas.com

WATER AND WATER HEATING

Install EPA approved WaterSource® flow restrictors and aerators. Besides the obvious cost of just purchasing your water, there are two hidden charges. 1) The cost to heat it. 2) The cost to dump it into your sewer. Don't waste water! EPA approved WaterSource® aerators and flow retarders are quick, inexpensive, easy to install and can reduce your water consumption by up to 30%.

Install pipe insulation and a water heater blanket. Most heat loss from your water heater occurs within the first three to six feet of the "out" pipe. Insulate as much as possible, but definitely the first six feet. Wrapping your water heater with a heat blanket is a good idea both in your building and at home especially if the unit is more than seven years old. Water heater blankets are easy to install and are available at your local hardware store.

Repair all leaks. Compared to electricity, your water cost seems so miniscule that it's hardly worth bothering about, but leaking or dripping faucets can waste hundreds of gallons of water every day. Throwing away cold water is bad enough but a moderately fast flowing hot water leak will quickly cost you more than a visit from your plumber.

Install water-efficient faucets and toilets. Even though the cost of water is only a small part of your total energy bill, it is well worth careful scrutiny. Beyond the dollar figure on your utility statement, there is the hidden cost to heat it and the ignored cost of flushing it into the sewer system. Fixing the drips and leaks is the first and most obvious step. The more costly second step is to replace the faulty or marginal faucets and to install low water usage toilets. Careful attention to detail can reduce your water consumption by half. More importantly, water conservation creates a highly visible message for both students and a congregation about

how important ecology is to you. Tip: One of the biggest water wasters is a kitchen pre-rinse sprayer for cleaning dishes. There are new highly-efficient models with surprisingly low-flow rates. Some offer significant rebates.

Install instant-hot water heaters. Instant-hot water heaters are a perfect solution for sink locations that are remote from your master water heater (i.e. restrooms). There are a number of tankless models available that will help save both the cold water you throw away waiting for the hot water to travel to your sink and the electricity or gas you use to keep the water hot in a large tank. When you consider that you also waste the cost of heating all the hot water that is left in the pipe between the end-point sink and the hot water heater when you turn the hot water off, the cost of an instant-hot water heater becomes even more sensible. Tip: There are rebates attached to many Energy Star® tankless water heaters.

Install an Energy Star® rated water heater. Just as with their lighting specifications, Energy Star® has stringent requirements for the construction and working specifications of their industrial water heaters. Take the time to shop around before your water heater crashes to find a qualified Energy Star® model and a reputable installer. Tip: You can extend your water heater's life by draining out the sediment twice each year.

OUTSIDE

Change to a drip irrigation system. With a drip irrigation system, you solve a number of problems, both ecologically and operationally. Since the entire water dispensing part of the system is underground, you have no more sprayed cars or broken sprinkler heads fountaining into your parking lot. Whereas a standard sprinkler type system delivers water with only about 60% efficiency, a drip irrigation system puts up to 95% of the supplied water exactly where it is needed. If you

can tap into your city's non-potable water system, you will save even more.

Plant greenscaping, xeriscaping. Xeriscaping is the technical term for utilizing a dry landscape design with water conservation as its primary objective. Typically, you plant drought resistant native plants that are already acclimated to both local climate and insect predation. Greenscaping also includes the concept of planting on the south, east and west sides of building to create shade that cools your building envelope to reduce your A/C cost.

Utilize renewable energy sources. The renewable energy field is evolving exponentially. Information that is only a month old is often outdated and equipment that was manufactured only six months past is already obsolete. The most exciting new technologies applicable to facility operations, as of this writing, are LED lighting and Photo Voltaic Power Generation. For an overview of some of the best-updated information about what is new in energy that would be best for your facility, see the on-line resources listed in Appendix D.

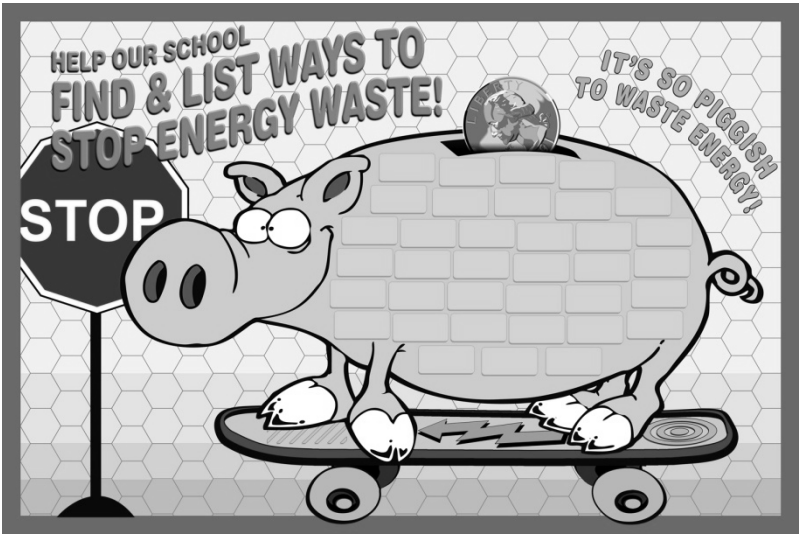
OFFICE AND OPERATIONS

Install only Energy Star® rated office equipment. When you look at saving energy through your office equipment, you only have two real choices: 1) TURN IT OFF! 2) Buy Energy Star® rated equipment. Manufacturers all over the world are rushing to get an Energy Star® rating on the equipment they sell. Fortunately, there is nothing automatic about the approval process so spending a little extra money for better equipment quickly pays for itself in saved electricity. The DOE (Department of Energy) through their Energy Star® program maintains a growing list of the best energy efficient equipment available for your office. Many

of the listed items carry rebates, so don't miss out when they are available.

Don't forget your Green Team. All through this book we've stressed the importance of your Green Team. Sustainability is too big of an issue to tackle alone. Take advantage of every resource possible to make the job easier for you and everyone involved. Considering the bottom line potential and the positive environmental impact, sustainability can easily become one of the most important money-saving programs ever started in your church or school. Unfortunately, even for a cause as important as the environment, people's enthusiasm will wane. But there is an easy fix. Using the expertise available at awarenessideas.com, you and your team can create dozens of high-visibility, energy-saving programs that will keep your message alive and growing and your savings accumulating.

Use dustless chalk. If you still have old-fashioned chalk boards, and use the less expensive old fashioned chalk, they present two problems few people ever consider. One) If the erasers are clapped together inside the building, the chalk dust floats onto the inner workings of the computers and other classroom electronics, which shortens their life. Two) Asthma is one of the major causes of absenteeism among students. Chalk dust has been shown to irritate asthmatic kids.



To encourage your students' participation, the small rectangles on this pig are designed to hold removable labels to display their energy-saving ideas.

2' x 3.5' laminated sign from awarenessideas.com

CHAPTER FOUR

WHERE SHOULD YOU START FIRST?

HERE'S OUR TOP TEN FAVORITE MONEY-SAVING TIPS

The pie chart at the beginning of Chapter Three shows lighting and HVAC as your biggest cost. So concentrate your spending there. The following are our top ten picks to get your money-saving sustainability project into high gear.

1. Task your Green Team to complete all the no-cost upgrades on the Chapter One "Easy Savings Checklist." Let them learn first-hand how cost avoidance is the first rule of saving energy dollars.

2. Invest in a coordinated conservation program to support and motivate your Green Team. Go to www.awarenessideas.com for a complete listing of thousands of inexpensive motivational tools to sustain the momentum of your church or school's cost-savings program.

3. Contact your local utility to see what money-saving programs, rebates or other support is available to lower your energy bill. You will be surprised how many different energy-saving services they offer and how happy they are to help you.

4. Replace every possible incandescent lamp with comparable CFLs (compact fluorescent lamps) and/or LED lighting.

5. Turn off unneeded classroom, auditorium, sanctuary, accent and specialty lighting.

6. Install LED (Light Emitting Diode) lights in all EXIT signs.

7. Install occupancy sensors in every room with a closeable door (i.e. closets, restrooms, classrooms, offices, stairwells and hallways).

8. Adjust both interior and exterior timers to accommodate weekends, the seasons, daylight savings and summer and Christmas breaks.

9. Install Energy Star approved programmable thermostats.

10. Commission or recommission your entire facility. This will show you where your biggest opportunities for savings can be found. This can be as minimal as a simple walkthrough with an energy-savvy electrician or a fully comprehensive system-by-system, room-by-room energy audit. Depending on the age and energy efficiency of your facility, you can expect an immediate payback.

WARNING:

Our government's unprecedented support of energy conservation and the rising cost of electricity has unearthed a whole new generation of green, flag-waving scam artists. If whatever they are selling sounds just like the perfect answer to solve your energy problems and it's just too good to be true, it's probably another crook after your money. Please contact your local utility most of whom can provide a list of qualified and approved contractors.

SUMMARY

If you are only going to "take away" one money-saving idea from everything we have discussed in this book, please make it TURN IT OFF! It's a simple message that is easy for your Green Team to sell either to a congregation or all over your campus. Start with wasted light energy. Lighting alone is nearly 50% of your energy cost, and therefore the easiest place to make a noticeable impact. Whether you use just simple light switches or a sophisticated EMS system, everyone can relate to flipping off a light switch or shutting down a computer station. Air conditioning and refrigeration are harder to comprehend but, since they account for nearly 40% of your energy cost, once your Green Team gets on your program, the savings are huge.

There is no question that the cost of energy is going to continue to increase forcing people from all walks of life to become more deeply involved. By using the techniques that we have outlined in this book, you can create a firm ecological foundation for the youth you serve. The lessons they learn saving energy (and money) at your church or school could splash into their home lives and save energy there, too. As your facility's overall carbon footprint shrinks, not only will you be doing the right thing ecologically for now and the future, but you will also significantly cut your expenses.

We have shown you nearly one hundred obvious and measurable ways to save both money and energy in your facility. By making a small change in environmental philosophy and by buying into a few carefully chosen upgrades, you can reduce your energy consumption (and electric bill) by as much as 50%. Many of the upgrades we discussed have an ROI of less than two years, some as little

as six months. Beyond the money, the impossible-to-measure attributes include happier, healthier staff, students and congregation who are aware of, and appreciate, your environmental sustainability contribution.

In order to keep it quick, efficient and easy to read, this book only scratches the surface of sustainability. Our research was based on data collected from literally hundreds of articles, web sites and books about saving energy. By far the three best sources of current, unbiased information we found are the Environmental Protection Agency website www.epa.gov, the Energy Star® website www.energystar.gov and the Southern California Edison website www.sce.com. Whether you are looking for more energy saving information for your facility or your home, spend some quality time on all three of these sites.

APPENDIX A

GREEN TEAM CHECKLIST

DAILY

- Turn off office lights when unoccupied.
- Close exterior doors, including warehouse doors.
- Turn off classroom lights when not in use.
- Verify that all power strips are being properly utilized to stop phantom loads. Especially on TVs, VCRs, DVDs, projectors, radios, CD players, microwaves, coffee makers, and toaster ovens during weekends and vacations.
- Verify that all power strips are not overloaded beyond rated capacity.
- Verify supply of recycled paper for in-house memos.
- Turn off copy and fax machines. PM
- Turn off computers and printers. PM
- Turn off task, track and accent lights. PM
- Check all toilets for leaks.
- Close walk-in freezer and cooler doors.
- Turn off unnecessary lighting.
- Turn off janitor room lighting and faucets.
- Turn off vending machines.
- Replace easily accessible burned out lamps.
- Verify that the proper cleaning supplies are readily available.

MONTHLY

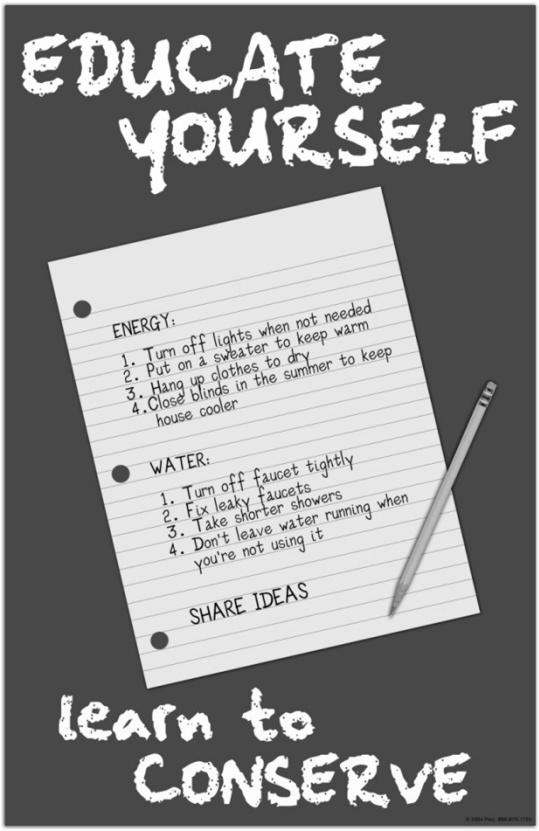
- Check for broken or burned out exterior lamps.
- Audit all new plug loads.
- Verify that the parking lot and exterior lighting on/off schedules match the season.
- Verify that all interior and exterior motion sensors are working properly.
- Calibrate all thermostats and set to proper temperatures, especially in portable classrooms.
- Vacuum all freestanding and self-contained freezer and refrigeration coils including personal refrigerators.
- Flush and clean ice freezer.
- Clean and unblock all registers and grills.
- Clean stove burners.
- Inspect door sweeps on exterior doors.
- Clean ice maker

ANNUALLY

- Inspect all safely accessible A/C duct for leaks.
- Install fresh batteries in all battery-operated thermostats.
- Check all doors and windows for air leaks and damaged weather stripping.
- Remove all leaves and debris from around roof drains and gutters.
- Review your local utility and state rebate programs.
- Turn off heater pilot lights and timers in summer.

- Perform “dollar bill” test on all freezer and cooler doors.
- Request vendors clean coils on all cold vending machines.

Note: A free printable copy of this form is available from: www.quickandeasygreenbooks.com.



12" x 18" colored poster from awarenessideas.com

APPENDIX B

TERMS and DEFINITIONS

- **Accent lighting** – draws attention to special features or enhances the aesthetics of both indoor and outdoor environments.
- **Adjustable Speed Drives (ASD**) - are also called variable frequency drives or variable speed drives.

Their primary function is to match the motor's speed to fluctuating loads.

- **Air Conditioning –** describes the creation of both cool and warm air, not just cooled air.
- **Air Mixing Plenum –** One of the key components of your HVAC unit where the return air and the outside air intake are mixed.
- **Ambient lighting** – the general illumination in an area, both indoors and outdoors, excluding task and accent lighting.
- **Amperes (Amps)** – a measure of electrical current. An increase of either amps or volts increases wattage as follows: Watts = Volts x Amps.
- **Ballast** – a piece of electrical equipment that properly controls the current flow to both fluorescent and HID lamps.
- **Ballast Efficacy Factor (BEF) -** is used to compare lighting effectiveness between systems with the same number and type of lamps.
- **Ballast Factor (BF)** - the light output of a commercial ballast / the light output of a reference ballast. BF is a measure of the light output of an integrated lamp and ballast combination. The lower the BF the more efficient the system.
- **BTU** - One BTU equals the amount of energy required to raise the temperature of one pound of water by 1°F at sea level.
- **British Thermal Unit per Hour** – (BTUH) Cooling and Heating capacity measured per hour.
- **Bulb size** – the maximum diameter of a light bulb expressed in eighths of an inch. (i.e. a T-8 fluorescent tube has a one-inch diameter).

- **Candela (cd)** – a measure of luminous intensity in a given direction.
- **Cogeneration** – is the term describing a unit that generates and utilizes both electricity and heat at the same time.
- **Color Rendering Index (CRI)** – on a scale of (1-100), a measure of how accurately a light source renders colors. Higher numbers describe truer colors. A CRI of 100 has no color distortion.
- **Compact Fluorescent Lamps (CFL) –** are lower wattage replacement lamps that now are available in sizes to retrofit nearly all standard usage incandescent lamps. They produce the same light levels while consuming up to 85% less energy and lasting at least ten times longer.
- **Conduction** – The process by which heat transfers along or through a substance (i.e. electric blanket).
- **Convection** - The process of transferring heat by movement of a gas (i.e. air) or a fluid.
- **Correlated Color Temperature (CCT)** – a measure of how warm (yellow to red) or cool (green to blue) a light appears (e.g. Warm is below 3000 K, cool is above 5000K.). Astronomers use the same Kelvin scale to describe star color.
- **Cost of light replacement formula:** approximately 88% = cost of electricity; 8% = labor cost; 4% = cost of lamps.
- **Cubic Feet per Minute (CFM)** – a measurement of the movement of air within a space.
- **Current** - is the flow of electrons and is measured in Amperes. (I)

- **Daylight harvesting** – building design that takes advantage of outdoor lighting to reduce electrical usage.
- **Demand** – (On your electric bill) is the total value of power over a specified short interval of time, generally 15 minutes.
- **Diffuser** – spreads conditioned air from the end of an air duct into a space.
- **Driver** – an electrical device that works much like a ballast to provide the correct voltage to activate an LED light.
- **Direct Digital Controller** – a control system capable of controlling VAV (Variable Air Volume).
- **Economizer** – an A/C device that controls damper blade positions to regulate the outside air flowing into a system. It saves energy by bringing in 100% fresh air to replace the exhausted air when the condition of the exterior air (both temperature and humidity) closely approximates the interior air.
- **ECM (Electronically Commutated Motor)** – An extremely efficient brushless, permanent-magnet DC motor that has a money-saving application in both HVAC and refrigeration.
- **Efficacy** – The efficiency of a light source measured in lumens/watt.
- **Electric Motor Efficiency** - the useable horsepower that is obtained as a percent of the power that goes into a motor.
- **Electroluminescence** – the process of directly converting electrical energy into visible light, which is the basis for LED technology.

- **EIS (Energy Information Systems)** – is a communication tool that meshes together input from internal systems with external data like weather, electricity prices and real-time power consumption.
- **EMI (Electromagnetic Inference)** – high frequency radio waves are generated by some electronic ballasts that can interfere with radio and TV transmission. This becomes critical in buildings using radio frequency driven equipment.
- **EMS system** – A computer-based device that controls HVAC, lighting and other building systems.
- **Energy Efficiency Ratio (EER)** - is a measurement of A/C cooling capacity in systems with greater than 65,000 BTU/hr (5.4 tons). The current California minimum EER Rating is 11.5.
- **Enhanced Automation** – is an umbrella term that includes BAS (Building Automation Systems), EMS (Energy Management Systems) and EIS (Energy Information Systems). BAS and EMS are essentially the same. (See EMS.) Some of the controllable elements include: thermostat settings, supply air, occupancy controls, demand control ventilation, lighting controls and ASD fans.
- **Evaporative Coolers** – AKA "swamp coolers" pull warm, dry exterior air through moist pads to condition the air, then blow the newly cooled air into a space with a simple fan.
- **Floodlight** – is a luminaire/lamp that disperses a bright light in a beam over 20° wide. (See also Spotlight.)
- **Fluorescent Lamp** – a high efficiency lamp that sparks an electric discharge through a mixture of

inert gas and mercury vapor to produce ultraviolet (UV) energy. Phosphors on the interior lamp surface convert the energy to light.

- **Footcandle (FC)** – Measure of incident light. One footcandle is the amount of light generated by one candle hitting a surface from one foot away.
- **Frequency** – the rate of alternation of AC current expressed in Hertz (Hz).
- **Fuel Cells** – is a galvanic cell or "battery" that continuously converts chemical energy to electrical energy and heat without combustion. It is two or three times as efficient as an internal combustion engine and never needs to be recharged.
- **HEPA (High Efficiency Particle Absorption) -** a measure of the effectiveness of air filters.
- **High-Bay lighting** – lighting designed typically for industrial use in ceilings at 20' or more.
- **High Intensity Discharge Lamps (HID)** – produce light with an electric arc in a small tube within the body of the lamp.
- **High Power Factor** – is accomplished in a ballast by using a capacitor to increase its efficiency to over 90%.
- **High Pressure Sodium Lamps** – emit a golden color that still distorts colors but not as much as low pressure sodium. They are best in applications where color is not critical to task performance (i.e. a warehouse).
- **Hot Restart Time** – the time it takes an HID lamp to reach a 90% light output after being turned off, then on.

- **Incandescent Lamp** – invented by Thomas Edison, is a generally inefficient light source that drives electricity through a very thin (usually tungsten) wire causing it to glow white-hot.
- **Indirect Lighting** – points luminaries toward the ceiling which produces a softer, more diffused light scattered over a wider area.
- **Induction Lamps** – are essentially electrodeless fluorescents lamps with an anticipated useful life of 100,000 hours.
- **Infiltration** – the unwanted intrusion of air through cracks around doors, windows and any other weak areas between conditioned and unconditioned spaces.
- **Instant Start Lamps** – are ignited by high voltage without preheating the filament.
- **Integral** – is a term used to describe the built-in ballast or drive in a Compact Fluorescent Lamp (CFL).
- **Kilowatt (kW)** = volts x amps / 1000.
- **Kilowatt Hour (kWh)** – the standard billing unit used by utilities for electrical usage. (i.e. Ten 100 watt lamps burning for one hour consumes one kilowatt hour of electricity.)
- **Lamp** – Consumers refer to an incandescent light as a light bulb and a fluorescent light as a tube. The lighting industry calls them both lamps.
- **LED** – Light emitting diode.
- **Light** – radiant energy that can be seen by the human eye.

- **Light Pollution** – light directed to where it is unneeded. The most common light pollution is directed skyward which hides starlight.
- **Light Trespass (spillage)** – misdirected light that is disturbing, irritating and/or potentially dangerous.
- **Load Shedding** – reducing lighting or other electrical usage in response to a need in support of the grid.
- **Low Pressure Sodium Lamps** – Introduced in 1932, are the most efficient lighting source with the longest life. However, their monochromatic yellow color restricts their usage to street lamps and outdoor parking or storage areas where distinguishing color is not important.
- **Lumen** – a measure of quantity of light emitted by a source.
- **Luminaire** – a lighting industry term for the fixture that encompasses the entire lighting system.
- **Luminous Efficacy** – is a measure of lamp brightness measured in lumens per watt. The higher the lumens per watt, the more light you are getting for the amount of electricity you are using.
- **Make-up Air (Outside Air)** – Air brought in from outside to replace air that has been removed by exhaust fans.
- **Mercury Vapor Lamps** – are the oldest type of HID lamp. Because of the huge energy savings, they are being systematically replaced by newer metal halide lamps or high pressure sodium lamps.
- **MERV (Minimum Efficiency Reporting Value)** – a rating for air filter efficiency. Air filters with a

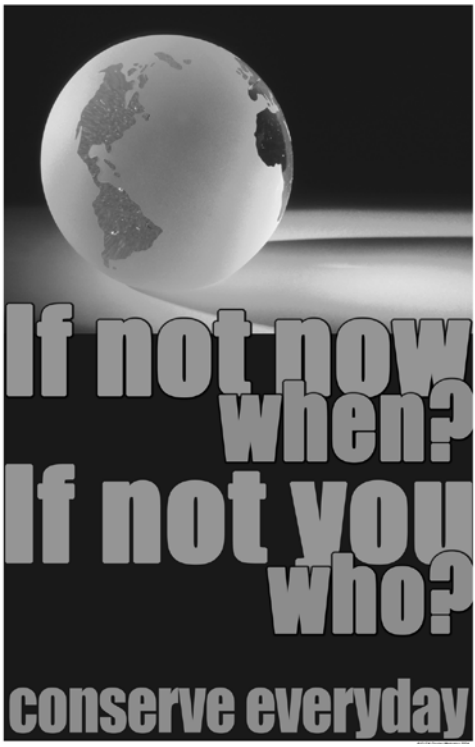
MERV rating over 8 are recommended for supermarkets, schools and churches.

- **Metal Halide Lamps** – these newer generation lamps are available in two main types. 1) Pulse-start metal halides which use about 20% less energy than the traditional metal halides and 2) Ceramic Metal Halides (CMH) which are used where high quality, directional light is needed.
- **Microturbines** – are small, (under 500 kW) highly efficient combustion turbines that can run on a variety of fuels and can fit in small spaces. They are used to generate electricity, heat or cooling.
- **MR-16** – a common 2" diameter mirrored reflector halogen or ceramic metal halide lamp.
- **Occupancy Sensors** – A device that activates lighting A/C or both after sensing the presence of a person to switch on only when a room is occupied. There are four main types: Passive Infrared, Ultrasonic, Microphonic, and Hybrid.
- **Operating or Burn Position** – Certain lamps are made to burn in specific orientations (i.e. facing up or down). The wrong orientation shortens the rated life of the lamp and may create safety issues.
- **PCB (Polychlorinated Biphenyls)** – A class of organic compounds used in old style ballasts. It is extremely hazardous to the environment because it is cumulative and does not break down in nature.
- **Photo Detector (Photometer)** – A device that measures light often used in daylight harvesting situations.
- **Photometrics** – is the measure of the intensity of light measured at specified angles around the fixture.

- **Photovoltaics** – unlike solar power technologies, a photovoltaic system converts light directly into electricity using a chemical reaction in semiconductor materials.
- **Power (P)** - is measured in horsepower or watts. (W)
- **Programmable Thermostat** – gives you the option of setting different room temperatures based on time of day and day of the week.
- **Programmed Rapid Start** – a lamp starting method that preheats the lamp filaments before ignition. This type of lamp/ballast combination has a longer life.
- **Radiation** – As it relates to temperature, radiation is the use of energy waves to change the temperature of solid objects (i.e. sunlight).
- **Rated Lamp Life** - the number of hours 50% of a test sample of lamps burned before burning out.
- **Relative Humidity** – the measure of how much moisture the air is holding as a percentage of how much it could hold.
- **Relief Air** - Air exhausted outside to allow fresh make-up air to enter the space.
- **Resistance (R)** - is the property of a conductor that restricts electric current flow.
- **Restrike Time** – The amount of time for a lamp to cool down enough to reilluminate after being turned off. This is an issue with metal halide and several other types of lamps.
- **Return Air** – Untreated air that is returning to the A/C unit from the space.

- **ROI** – (Return on Investment) – typically noted as a percentage or as a function of time.
- **Seasonal Energy Efficiency Ratio (SEER)** - applies to both commercial and residential systems with capacities less than 65,000 BTU/hr (5.4 tons). The minimum SEER rating in the United States is 13. The maximum is 21.
- **Self-ballasted Lamps** – a discharge lamp (e.g. HIDs or CFLs) that has a ballast incorporated into the lamp allowing for direct connection.
- **Sick Building Syndrome** – is the result of, among many things, poor ventilation, carbon dioxide build-up, mold, ineffective lighting and generally poor design. It is particularly prevalent in older buildings.
- **Spot Light** – a reflector lamp with a tight beam of light, typically around 10°. (See also Flood lamp.)
- **Strike Time** – The amount of time between powering up a lamp and the time it comes to full brightness. This is important when considering installing occupancy sensors or metal halide lamps.
- **Supply Air** – Air that is leaving the A/C unit and being introduced into the space.
- **Sustainability** – is a philosophy that seeks to find ways to reduce or eliminate the negative impact of buildings on the environment and its occupants.
- **T-5** – a 5/8" diameter fluorescent tube created in Europe on a metric scale. They are more efficient than both T-8's and T-12's but are not a viable retrofit option because of their shorter length and optimum compatibility with high frequency electronic ballasts.

- **T-8** – a 1" diameter (8/8") fluorescent tube. They burn about 23% less electricity than a T-12 while producing the same light levels.
- **T-12** – a 1.5" diameter (12/8") fluorescent tube. They are available in a variety of lengths and are the least efficient of the typically used fluorescent lamps.
- **Task lighting** – is the lighting used by workers to perform a particular task that requires more light than is provided by the ambient light source.
- **Ton of cooling** - one ton equals the amount of heat required to melt one ton of ice in 24 hours or 12,000 BTU per hour. Note: a one-ton cube of ice measures 5.6' on each side.
- **Transients** – High voltage surges that can be caused by electrical events ranging from lightning strikes to in-store short circuits.
- **Troffer** – a long, recessed lighting unit typically installed in a T-bar ceiling.
- **Up Lighting** – accent lighting and/or wall-wash lighting shining up toward the ceiling.
- **Valance Lighting** – above-eye-level wall lighting typically shielded by horizontal panels.
- **Volt** – a measure of the electrical potential between two points.
- **Voltage -** is the electrical pressure that causes current to flow. The unit of measure is volts. (E)
- **Watts** – a unit of electrical power indicating the rate at which electricity is consumed.



12" x 18" colored poster
from awarenessideas.com

APPENDIX C

ENERGY FACTS

GENERAL

- The number one best way to save energy is to TURN IT OFF!
- Sustainability isn't an all or nothing proposition. The building owner/operator can choose how far to go and how much to spend.

- If you design for human health/comfort, you will be designing for efficiency – but not the other way around.
- No building should ever be designed or maintained that significantly sacrifices personal comfort to save energy.
- Henry Ford first created the definition of horsepower. One horsepower is the work required to lift 550 lb. one foot in one second.
- The medical profession is using colored light to treat a wide range of disorders including depression, migraines, ulcers, arthritis, high blood pressure and anxiety.
- Fuses were created by the Fire Captains of America first, to save fireman's lives and secondly to save buildings.
- Energy efficient equipment produces more work for the same amount of current.
- Most energy is lost in the form of heat.
- Three phase systems are more efficient than one phase systems because they are easier to balance, reduce line loss, and create better motor operation.
- A single watt is equal in both AC and DC and in single or three phase conditions.
- Generators and motors operate essentially the same but opposite. Generators convert mechanical energy to electrical energy. Motors convert electrical energy to mechanical energy.

CONDITIONED AIR

- The typically preferred Relative Humidity range is 40 – 60%.

- The optimum air motion in an occupied space is 15 to 25 feet per minute.
- One person generates a 450 BTU/hour total heat gain. (latent + sensible)
- A one horsepower motor generates a 2,545 BTU/hour heat gain.
- A recent study showed that after only 18 months, only 10% of the test study thermostats were calibrated correctly.
- Typical office equipment generates .85 to 8.5 BTU/hour per square foot.
- Depending on your kitchen area, the airflow around kitchen exhaust hoods should be about 2500 CFM.
- Rigid, round air ducts are the most efficient.
- Three thousand watts of light generates 3400 BTUs.

LIGHTING AND ELECTRICITY

- User satisfaction increases when an occupant has control over the level of lighting in their workspace. Most people lower the lights below the design level and save energy by accident.
- One single 100-watt light bulb burning 18 hours a day for a year costs $100. Simply put, 100 watts cost $100/ year.
- Replacing one 100-watt incandescent screw-in lamp with a 23 watt CFL can save $77/ year.
- The first LED light was created during the 1920's. Their popularity soared in the 1990's when white

and blue LED technology became more affordable.

- LED lighting does best in cold conditions. As temperatures rise, light output, efficacy, anticipated useful life and color quality all decrease.
- Replacing the lamps in your emergency exit signs with LEDs can save you $50/ sign each year.
- LED lights are more environmentally friendly than many other types of lamps because they contain no Mercury.
- LED estimated useful life figures are approximations since the technology is evolving so quickly.
- One footcandle of light is bright enough to see in a dim room. You need three footcandles of light to move around safely and twenty to thirty to read a newspaper.
- A recent study showed that 90% of the population would not notice a 10% in-store light reduction.
- Incandescent and fluorescent lamps lose 20 to 30% of their light output over their service life.
- Incandescent light bulbs are the least efficient light source because they convert about 90% of the energy used to heat. Another negative is their relatively short lamp life.
- Fluorescent lamps are more efficient than incandescent lamps because they convert a smaller proportion of the energy to heat and more to light.
- Most lamps must now be disposed of as hazardous waste.

- Lamp disposal is legally the generators' responsibility (i.e. the owner, not the installer).
- Metal Halide lamps are fast-starting/restriking, have a high CRI and good color rendering.
- Blue – green spectrum light is the most healthful because it enhances, not suppresses, serotonin production that affects cancer probability.
- Quartz Halogen lamps work essentially the same as regular incandescent lamps except they are filled with Halogen. These lamps reduce energy consumption by 25 to 50% and have an anticipated useful life of about 30,000 hours that more than offsets the higher initial cost.
- Programmed Start Ballasts are preferred in combination with occupancy sensors because they ensure optimum lamp life.
- Replacing T-12 lamps and their magnetic ballasts with T-8 lamps and electronic ballasts typically saves 30%.
- Occupancy sensors typically have a less than one-year payback.
- Background lighting should not be less than 1/3 to 1/2 of the required task lighting.
- Lamp diameters are measured in 1/8-inch increments. Therefore a T-12 has a 1.5" diameter and a T-5 has a 5/8" diameter. This system is also used to measure and describe a bulb-shaped lamp.

APPENDIX D

ON-LINE RESOURCES

Awarenessideas.com – Has the widest selection of energy-saving programs that we were able to find anywhere in the country. If they don't have exactly what you envision among their hundreds of thousands of items, they can help you design a custom program that exactly fits your needs. www.awarenessideas.com

Aztec Energy Partners - Aztec Energy Partners, Inc. specializes in providing "Total Energy Program Management Solutions" and consulting services to improve and sustain energy efficiencies for the Retail, Supermarket, and Commercial Properties markets. Customers benefit from high-energy savings, reduced operational costs, and a significant decrease in their site carbon footprint. Count on their expertise in design and engineering services, field-based services and technology-based services. www.aztec-energy.com

Better Bricks – A Portland, Oregon-based resource dedicated to helping companies and/or stores reap the bottom line benefits of intelligent energy management. A good source of ideas from store design to operations on how to reduce your energy consumption. www.betterbricks.com/subHomepage

BOMA – Building Owners and Managers Association – One of the nations leading resources to help building owners and managers wade through the sea of "green wash" to identify the best solutions to save money and energy. www.boma.org

CTAC – Consumer Technology Application Center – In Southern California, CTAC is the best source of in-depth information about all aspects of saving energy. Operated by

SCE, their programs include: seminars, workshops, displays, demonstrations, technical consultations and facility presentations. www.sce/ctac.com

EPA – Environmental Protection Agency. The EPA website lists thousands of energy-saving tips, technical papers, teaching aids and web links along with a virtual mountain of other well-maintained environmental information for everyone from kids to engineers. Start your information quest at www.epa.gov.

Energy Star® – A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy dedicated to helping both businesses and homeowners save money and protect the environment through energy-efficient products and practices. The Energy Star® website has more useful, easy-to-access energy-saving information than any other web site that we have seen. www.energystar.gov

Energy Star® Portfolio Manager – The Energy Star Portfolio Manager is a free on-line tool that allows you to track, monitor and assess energy and water consumption and costs in your store. www.energystar.gov/benchmark

Food Services Technology Center – the industry leader for testing appliance performance and commercial kitchen energy efficiency. Besides being a clearinghouse of information on equipment performance, the FSTC also has expertise in commercial kitchen ventilation and building energy efficiency, including lighting, glazing and HVAC. www.fishnick.com

Quickandeasygreenbooks.com – This book is one of several dealing with easy, inexpensive ways to save money and energy. Other books address grocery stores, drug stores, convenience stores, dollar-type stores, and at home. See www.quickandeasygreenbooks.com for more information.

APPENDIX E

SAMPLE

VENDOR PREVENTATIVE MAINTENANCE CHECKLIST

REFRIGERANT LEAK CHECK (HVAC)

- Repair all refrigerant leaks as part of this PM.
- Inspect A/C compressors and related components.
- Inspect cooling coil and related piping.
- Inspect condenser (while all related compressor equipment is shut down).
- Inspect ductwork for leaks and blockage, especially the 90° turns.

CONDENSERS (AIR COOLED AND EVAPORATIVE)

- Inspect shaft and bearings and LUBE.
- Inspect belts – Replace and adjust as needed. (DO NOT OVERTIGHTEN)
- Inspect all motors. Verify they are operational.
- Inspect evaporative condensers for calcium buildup.
- Confirm pumps and sprayers are operational on evaporative condensers.
- Evaporative condenser last date of service: _____

HVAC

- Exercise A/C compressor and verify unloader valve setting.
- Inspect direct drive compressors for coupling damage.
- Verify that store does not have negative pressure.
- Confirm rooftop exhaust and make-up air units are working.
- Inspect all rooftop units for bearing wear and worn belts or pulleys.
- Lubricate all motors.
- Replace all air filters as scheduled.
- Replace worn belts. (DO NOT OVERTIGHTEN BELTS.)
- Inspect condenser motors and replace as needed.
- Verify condition of contactors and motor starters for pitting. Replace as needed.

GENERAL

- Clean all self-contained condensers.
- Remove old parts, compressors, used oil, refrigeration cylinders from store.
- Below list all open issues to discuss with management.

APPENDIX F

SCHOOL AND CHURCH ENERGY SURVEY

This survey form is available for free at www.quickandeasygreenbooks.com

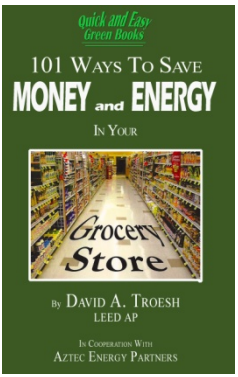
	NONE	LOW/NO	SO-SO	GOOD/YES	EXCELLENT
How would you rate your school (or church's) management commitment to enrgy consevation?					
Do you know the energy consevation goals of your school (or church)?					
Are your school's (or church's) energy goals very well articulated?					
What is the consistency of the energy messages from management?					
What is the level of visible attempt to communicate energy messages?					
Does the level of energy communication demonstrate strong management support?					
Do the messages being used have impact?					
Do energy messages get changed often?					
Is there more emphasis on energy consevation than needed?					
Is there good awareness of our energy projects?					
Are successful energy projects given much acknowledgement?					
Does management give much opportunity to participate in energy projects?					
Are the energy projects in progress recognizable?					
Do you volunteer to participate in energy projects?					
Would more emphasis on energy conservation be meaningful to you?					
Would more emphasis on energy conservation benefit your school (or church)?					
Woud you like to see more visible reminders of where to look for energy waste?					
Have you noticed much increase in energy conservation activities?					
Would you like to volunteer for an energy project?					

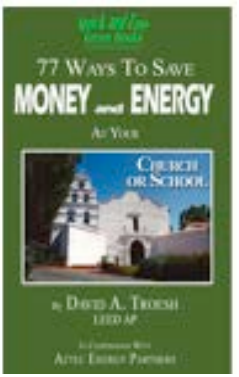
Please put an X in the column that best matches your opinion for each question. Your answers will help shape our energy conservation efforts. Plan on taking this survey again in six months to measure our progress.

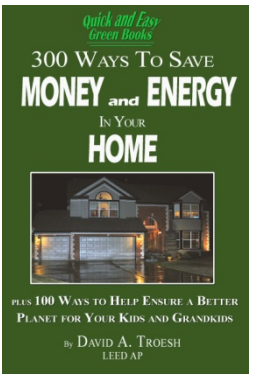
Quick and Easy Green Books

Money and Energy-Saving Tips for Sustainability

by DAVE TROESH LEED AP

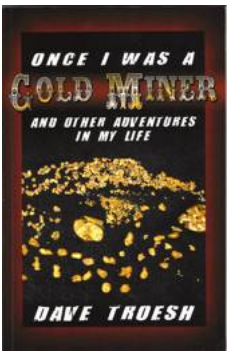






Upcoming books in our
Quick and Easy Green Book Series
will address money and energy-saving techniques for a variety of store types and businesses.

Also available from Quickandeasygreenbooks.com:



Dropping into leech infested ice water just after sunrise to move a dozen tons of rock to improve fish habitat and perhaps dredge up a few flakes of gold isn't everyone's idea of a great job. But it is by far, the best job that I ever had! This book tells the best stories of my life. The most outrageous came from the three gold mining years. The most important tales are from the decades before and after.

To order these and other energy-related books please visit our web site at
www.quickandeasygreenbooks.com

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-See how being green saves far more than it costs
-Learn to reduce your energy cost by up to 50%

This book was written specifically for churches and schools. It is short, concise and easy to understand. Every pastor or principal who follows even a few suggestions will instantly reduce his energy expense.

Dave Troesh, LEED AP, and author of the Quick and Easy Green Books Energy Series, has saved energy and money managing over 200 Big Box construction projects. During a recent LEED Certified supermarket remodel, his team sliced over $100,000 from the store's annual electric bill. The same techniques and technologies easily transfer to both churches and schools. With a ten-year goal of saving churches and schools $100,000,000, he constantly researches the latest in low-cost, cutting-edge, energy-saving technology. Dave considers an enthusiastic, management-backed Green Team to be the most important element of a successful and profitable environmental upgrade.

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