

Leon County Schools
ENERGY COST CONTROL HANDBOOK
1993, Re-issue March, 2007

ENERGY COST CONTROL HANDBOOK

developed by
DIVISION OF FACILITIES
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ENERGY EFFICIENCY STANDARDS

Board Policy 1.08, "Conservation of Energy, adopted January 12, 1993, states the following:

"The School board recognizes the great need to conserve our natural resources. The Board further recognized the advantage to the Leon County School District, as well as, to the nation to employ measures in the operation of the School District that will provide for the efficient use of our natural resources. To achieve this goal the Superintendent shall develop an energy conservation program and see that the program is administered in the District according to the Leon County Schools Energy Cost Control Handbook."

The purpose of these standards is to provide a uniform basis for implementation of this policy.

COMFORT CONDITIONING:

Room temperatures shall be maintained within the following ranges:

Cooling: 74 to 77 degrees F

Heating: 69 to 71 degrees F for grades 4 thru 12

71 to 73 degrees F for grades K thru 3

HVAC REGULAR OPERATING HOURS:

Heating and cooling equipment for administrative and elementary facilities shall start early enough that buildings achieve standard temperatures by 7:30 AM. For secondary instructional spaces standard room temperatures shall be achieved by 7:00 AM. For all other facilities, equipment shall start in time to achieve standard room temperatures by the time of normal occupancy.

Except for authorized activities and summer school, equipment shall shut down on the following schedule:

Secondary: 3:30 PM in all areas except administrative and middle schools.

Middle: 4:00 PM in middle schools minus administrative areas.

4:30 PM in administrative areas.

Elementary: 3:30 PM in all areas except administrative.

4:30 PM in administrative areas.

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Air conditioning systems shall not be operated for custodial work after normal hours.

AUTHORIZED ACTIVITIES OUTSIDE OF NORMAL HOURS:

Scheduling and Authorization:

Activities outside of normal school hours shall be scheduled as far in advance as possible, but in no case less than **forty-eight [48] hours**. A written schedule shall be furnished to the maintenance department on the approved form furnished by that department.

Efficient Use of Space:

Approved activities outside of normal school hours shall be scheduled into the space that will use the least energy while accommodating the activity.

HUMIDITY CONTROL:

Extended shutdown during the cooling season:

Cooling systems shall be operated in occupied mode for two [2] hours per day beginning the fourth [4th] day after the start of the extended shutdown.

UNOCCUPIED OPERATION:

Cooling season: All systems off except as provided above for humidity control.

Heating season: Interior temperatures shall be maintained at sixty [60] degrees Fahrenheit [F].

LIGHTING:

Lights shall be off in unoccupied rooms, regardless of the time period occupied.

Outdoor lighting shall be off at all times during daylight hours.

Outdoor lighting shall be off at all times during the nighttime hours except as follows:

Lighting required for support of authorized activities.

Security lighting as agreed to by the maintenance department and site administrator.

Replacement fluorescent lamps and ballasts shall be of the energy saving type.

AIR FILTERS:

Filters in cooling and heating equipment and in dehumidifiers shall be replaced on condition. Condition shall be checked by removal and inspection at intervals not greater than thirty [30] days.

RENTAL OF FACILITIES:

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Rental of facilities to **non-school** entities shall be conducted in accordance with Board policy 5.02.

EXPLANATION OF ENERGY STANDARDS

This Handbook was first issued in April, 1991 under the title "Site Representative's Handbook" and revised in August, 1992; November, 1992; February, 1993. The principles, procedures and methods set forth at those times are still applicable. However those procedures in the context of the energy efficiency standards have been modified. Supplemental information about each of these standards will be found below.

COMFORT CONDITIONING:

The American Society of Heating, Refrigerating and Air Conditioning Engineers [ASHRAE] has determined that, for an indoor relative humidity below sixty [60] percent, a temperature range of seventy four [74] to seventy seven [77] degrees Fahrenheit [F] will produce the fewest overall complaints from persons dressed for general office work. Although complaints may not increase as temperatures are lowered, a greater number of people will resort to heavier clothing [sweater, etc.] to avoid discomfort. **There is no combination of relative humidity and temperature that will be acceptable to more than ninety five [95%] percent of appropriately dressed occupants.** The standards set forth here will be acceptable to more than ninety [90%] percent of occupants engaged in sedentary activities who are appropriately dressed.

REGULAR OPERATING HOURS:

The district maintenance staff will set those hours for facilities which are on automatic controls. Where automatic controls are not yet available, site personnel shall manually turn equipment on and off.

With students gone and doors and windows closed, classrooms will remain comfortable for several hours after equipment is turned off. Administrative areas should remain comfortable for an hour or so, even with a full staff in occupancy.

Do not use HVAC equipment solely for custodial worker comfort. Custodial staff should have an independently conditioned area for breaks and assembly and if such areas are not available at a particular site, then the facilities department will help to provide them.

AUTHORIZED ACTIVITIES OUTSIDE OF REGULAR HOURS:

It is to the advantage of the site administrator to maintain control of those activities, because they have a dramatic affect on energy use.

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A schedule of activities must be provided to the maintenance department. Schedules shall include the intended use, approximate number of persons, spaces to be occupied and/or used and planned times of occupancy. Neither the maintenance department nor the facilities energy technician will provide for operation of equipment outside of normal school hours

Without an approved schedule: Site administrators (or their designated representative) shall have sole responsibility for schedule approval. A “designated representative” shall be so designated in writing by the site administrator.

Efficiency of the space must be considered in planning activities. For example, a gathering of twenty [20] to thirty [30] persons for a sedentary meeting should not be held in the gymnasium. If a site administrator has a question about which space is the most efficient, the site administrator should contact the facilities energy technician, staff engineer or the maintenance department’s energy manager.

HUMIDITY CONTROLS:

Electronic and Sensitive Equipment:

Pianos – Site administrator is responsible for furnishing soundboard heaters.

The manufacturer’s specifications for modern non-mainframe computer equipment allow the following limits:

Operating: Thirty-two [32] to one hundred-four [104] degrees Fahrenheit, twenty [20%] to eighty [80%] percent relative humidity, with no condensation allowed.

Storage: Fourteen [14] to one hundred forty [140] degrees Fahrenheit, twenty [20%] to eighty [80%] percent relative humidity, with no condensation allowed.

Electronic equipment ordinarily used in schools should not be kept at temperatures less than seventy five [75] degrees Fahrenheit in summer because condensation can occur within the unit if doors are held open or failure of the HVAC system occurs.

Books and other materials:

Mildew is unlikely to occur during extended storage when relative humidity is less than seventy [70%] percent or for short periods at higher levels. Formation of mildew or other evidence of a humidity above seventy [70%] percent for extended periods is evidence of equipment malfunction or a breached building envelope. Contact the maintenance department immediately.

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STATEMENT OF INTENT AND COMMITMENT

An Action Plan for energy conservation has been devised for site administrators. This booklet contains the “Who”, “What”, “Where” and “How” of keeping our energy budget from encroaching on other parts of the overall monies at the Leon County School Board [LCSB]. The success of this energy conservation program will rely on the concern and cooperation of everyone from the LCSB to the students. This handbook was designed as a starting point for each facility. The district energy management coordinator shall assist each facility in the implementation on an individual basis; it shall be the site administrator’s responsibility to continue to follow through with the procedures implemented.

The LCSB and Superintendent have backed this conservation effort by writing Board Policy 1.08 “Conservation of Energy”, refer to page 1.

The site administrator shall adopt as many recommendations found within this handbook as may be practical for their particular site. Implementing these energy savings procedures may have a direct impact on each schools budget dollars.

ACTION PLAN

The site administrator shall be responsible for meeting the intent and commitment of this energy cost control handbook and may designate, in writing, a site energy representative [SER] to follow through with the implementation of the site energy conservation plan.

The Site Energy Representative should:

1. Have a genuine interest in energy conservation and work towards a better facility and have the administrative authority and site administrator’s support in implementing recommended energy saving practices and measures.
2. Have some knowledge of building construction or willing to learn about same, be familiar with the site and facility layout and have access to and knowledge of schedules of operation.
3. Have knowledge of or be willing to achieve a basic understanding of the HVAC equipment, energy management and lighting devices; their locations and operation.
4. Be able to spend the necessary time for: initial orientation; a weekly site inspection; interact with staff in a friendly, non-offensive manner, being a leader; learning maintenance department procedures and personnel; interact with outside contractors; build confidence in your ability to assist the other site staff members.
5. Able to secure keys for access to the entire site.

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ENERGY MANAGEMENT PRACTICES

I HEATING, VENTILATING AND AIR CONDITIONING [HVAC]

A. CONTROLLING YOUR HVAC SYSTEM:

1. Problems: Who to call!

- a. Maintenance Department, 488-1685 and/or write work orders for routine repairs when:
 - 1) HVAC unit not running. You have physically checked the breaker and controller.
 - 2) HVAC unit runs continuously and will not turn off. Never reaches desired temperature.
 - 3) HVAC unit making odd noise: Example: squeaking, grinding, howling, rumbling, thumping, hissing, etc.
 - 4) Water leaks: water leaks may be identified visually or by the sound of running water. Leak source may be overflowing condensate pans and/or condensate drain lines [improperly slopped pans or drain lines; improper trap design], stopped up drain piping, leaking pipes [pin holes, joint leaks, broken pipes], etc. or a combination of several problem areas.
- b. LCS Energy Management Coordinator [617-1800] or Staff Engineer [617-1800] Assistance on understanding questions concerning HVAC efficiency, how run times impact your utility budget, understanding kilowatt-hour [KWH], KWH demand charges & metering, etc. may be supplied by these individuals.
- c. Industrial Hygienist [488-1685] Assistance on understanding "Indoor Air Quality [IAQ]", its causes and impact on the environment inside the school, what to look for, possible causes, possible steps for correcting a problem.

NOTE: The primary cause of IAQ problems is the introduction of moisture into a space through open windows, doors, etc. resulting in higher latent loads than the air conditioning equipment is designed for or capable of handling. "Latent load" refers to the moisture content of air circulating through an air conditioning unit or system, in its simplest terms. All air contains a certain amount of water vapor. Unconditioned or outside air normally contains excessive water vapor, beyond the removal capability of the HVAC system.

2. Facts and/or Regulations:

- a. Make sure that room temperatures are kept within the range specified in this Energy Cost Control Handbook.

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- b. LCSB Energy Policy and Federal, State and Local laws, rules, regulations and mandates:

Automatic and/or manual HVAC System shut-down is mandatory during off hours. If the site administrator finds that the system must be run during periods outside the approved run time / schedule to maintain temperatures within the approved temperature range, there is a problem with the system. Refer to the "Problems: Who to call" section (page 7).

- c. Override of Automated System Operation: Temporary Action!

1) If your system is equipped with any of the following:

- a) Wall Timer: This looks like a turn-dial type arrow switch that is usually located next to the wall mounted thermostat. Turn the dial [normally clockwise, to right] to the desired run time. This should be done approximately Ninety [90] minutes prior to the start of an event.
- b) Clock Timer: This is usually a gray wall mounted box [approximately 8 inches x 10 inches] located in the same location as the HVAC unit serving that space. Contact the "SUR". Request the "SUR" to assist you in tripping the internal toggle switch that will turn the HVAC unit on until the next "off" tripper. Note: Detail operating instructions may be found inside the clock timer box, normally glued to the inside face of the door.
- c) Electronic Energy Management Controller or Programmable Thermostat:

These units are normally mounted in the administrative Main Office or the mechanical room; follow the override instructions inside the door panel.

- d) Direct Digital Control (DDC) System:
Facilities that do not have thermostats, but have a small blank-faced wall mounted sensor in a space are controlled by a DDC system. The system is controlled remotely from the maintenance department utilizing computers and the internet [or a phone line connection]. Follow the procedures set forth in the "Energy Efficiency Standards" for operation outside approved operating hours.
- e) **CAUTION:** Do not attempt any more than the directions for Override function. Do not start the Override function if you do not fully understand the instructions. Damage to expensive HVAC equipment may result from faulty operation.

Refer to: PROBLEMS: Who to call! (page 7)

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d. Thermostats

- 1) Operation: Both normal wall mounted thermostats and electronic energy management type thermostats have delay timers built into their operation, Meaning that if you walk into a hot [cold] room and turn on the HVAC system in HEAT mode by mistake, then switch the lever to COOL, the unit will go into a timed delay of up to five [5] minutes. This delay is a safety feature to prevent damage to the equipment. Do not panic, wait a few minutes and reset the unit. If the unit still does not operate, notify the "SUR" regarding the room number for your location. The SUR may choose to notify the maintenance department if they are unable to solve the problem.
- 2) Internal workings of thermostats and reprogramming energy management computers: Do not adjust the internal workings of the thermostats or to reprogram the energy management computer, notify the SUR that you have a problem. The SUR will then contact the proper personnel for making the repairs. Operation of the HVAC system is critical during the heating season to prevent freezing.

NOTE: You may cause damage to the HVAC equipment.

- 3) Do not push thermostat settings to extremes. Never raise thermostat settings more than three [3] degrees at any one time. The primary reason for raising the thermostat incrementally is to utilize the most cost efficient means for heating the space. Moving the thermostat to its highest setting in one move will result in the supplemental heating devices [usually electric strip heat] coming into operation. The supplemental heating devices are the most costly means of providing heat and may result in a "KWH demand charge".

B. TYPICAL PROBLEMS – POINTS TO CHECK

1. Mechanical Considerations

- a) HVAC Filters: These should be changed monthly in normal rooms. This duty shall be performed by the building maintenance supervisor, under the direction of the site administrator. Clean filters will allow the HVAC system to run at peak performance resulting in keeping space IAQ at its optimum cleanliness & dehumidification.
- b) HVAC Grilles, Diffusers & Registers: Blocking these devices with furniture, file cabinets, displays, etc. impedes the distribution of conditioned air and reduces the ability of the HVAC system to either heat or cool the space served. Additionally, you may be causing a fire hazard.

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- c) Heat sources Adjacent to Thermostats: Computers, printers, lights, tools, etc. will cause the thermostat to respond to a false signal for the space served, resulting in overcooling of the space.
- d) Exterior HVAC Condensing Units: The building maintenance supervisors shall keep these units clear of weeds, debris, storage items and chain link fencing. Keep enclosure fencing locked to prevent vandalism.
- e) Automatic Door Closers: Check for proper operation. Do not use door stops and chairs to hold doors open, this will result in indoor air quality problems and prevent the HVAC system from functioning properly.
- f) Operable Windows: Keep windows **TIGHTLY** closed at all times. Opened windows will result in indoor air quality problems and prevent the HVAC system from functioning properly.

2. Unacceptable Human Actions:

The LCSB Energy Policy **does not** permit the use of portable electric space heaters. Portable electric space heaters are a proven fire hazard.

C. SITE USAGE SCHEDULING – COST EFFECTIVE USE OF HVAC EQUIPMENT

- 1. Special Functions: This may require HVAC system operating schedule changes that should be enacted ninety [90] minutes prior to an approved event. Only events having the written approval of the site administrator shall be classified an approved event and be provided with use of the facility and HVAC.
- 2. Small Groups: Provide a space in accordance with the size and usage of the group.
- 3. Peak Demand Usage Avoidance: Avoid holding large assemblies at times when HVAC demands are high. Example: In the winter, hold assemblies in the middle of the day. In the summertime, hold assemblies in the early morning.
- 4. Assemblies: Whenever the weather allows, hold pep rallies and assemblies outdoors to avoid the high cost of heating or cooling a gymnasium or auditorium.
- 5. Using Classrooms: Use the fewest number of classrooms necessary for summer school and night time programs.
- 6. Portable Classroom Units: Use portable classrooms when possible for support services or small group meetings after hours.
- 7. Student movement patterns: The site administrator shall be aware of the occupant traffic pattern at their facility. Are occupant traffic patterns in and out of the buildings purposeful, haphazard or casual? Can they be changed to a more purposeful pattern to save energy? Are doors held open, causing excessive energy use?
- 8. Fire Drills: A fire drill constitutes that the entire building population exits, then re-enters the building. This procedure results in an additional large load on the HVAC system and increases the system run-time. It is suggested that fire drills be scheduled when out door temperatures are between forty five [45] and eighty five [85] degrees Fahrenheit.

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9. End of day "Double Check": The site administrator shall institute a window, door and transom check at the end of each day to ensure that these devices are closed. This is both an energy conservation measure and a security measure.
10. Proper clothes for weather: It is expected that students, teachers and staff will wear proper clothing for the weather at hand.

II LIGHTING

A. REGULAR HABITS and CHECKS

1. Implement a Lighting Policy: The site administrator shall be responsible for this action. Primary action: Keep lights off when a space is unoccupied.
2. Night Lighting of Buildings: Time clocks shall be checked and reset after a power failure. Adjust the off/on settings to correspond to sunrise and sunset times. Manually operated lights should be turned off as soon as possible each day. The energy management department shall work towards having all outdoor lighting operations automated as soon as funds become available. Check automatic photo cell sensors weekly for proper operation. Do not compromise safety or security by turning off lights.
3. Clean Light Fixtures: Clean light fixture reflectors and lens every 120 days and / or replace fixtures that are rusted or lens that are yellowed in compliance with Department of Education standards.
4. Burned out Lamps: Report number and location of burned out lamps [bulbs] to the maintenance department.

B. EFFECTS OF NATURAL LIGHT

1. Negative effect: Use of natural light can supplement artificial light, but when operating the HVAC system, close blinds, shades, draperies, etc. on windows that receive direct sunlight for prolonged periods of the summer days. This usually occurs on the south and west side of building during morning hours and east side during afternoon hours.
2. Positive effect: Solar gain helps to offset the heating load during the winter. Keep blinds, shades, draperies, etc. open on building windows facing the sun during winter months. Because the sun is at a very low angle during the winter sunlight is available on all sides of the building.

C. AUTOMATIC ON / OFF LIGHTING CONTROL

Schools originally equipped with these devices were Godby, Lincoln, Main Lively Campus, and Lively Air.

These devices are activated by motion sensors, photocell sensors, time clocks, etc. Many of these devices have sensitivity adjustments. Call the maintenance department if

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they are overly sensitive to movement or light. The exterior of the sensor should be cleaned by the building maintenance supervisor every sixty [60] days.

III PLUMBING

- A. Cost Impact on Site: Potable water, sanitary sewer, storm sewer, irrigation water and fire protection water are second largest component of the utility budget after electricity and should be monitored continuously by the site administrator.
- B. Inside Water Leaks: Check all lavatories, water closets, urinals, sinks, water coolers, hose bibs, water heaters, ice machines, whirlpools, bathtubs, showers, etc. for leaks on a weekly basis. Un-repaired water leaks can cause irreversible damage to the facility in addition to the cost of the water.
- C. Outside Water Leaks: Check all wall hydrants, hose bibs, backflow preventers, irrigation system [sprinkler heads, piping, etc.], water meters, vacuum breakers, drinking fountains, etc. on a weekly basis.
- D. Setting Hot Water Temperature: Water supplied to sinks, showers, bathtubs and dishwashers may not exceed 110 degrees Fahrenheit. Hot water for cleaning food service utensils, equipment and serving pieces shall have the temperature boosted to 180 degrees Fahrenheit by a point of use hot water booster heater for sterilization. Chemical sterilization is an option to be considered.
- E. Irrigation: A separate water meter should be installed on irrigation systems to avoid sewer charges by the utility provider. Avoid extensive irrigation during the winter when grass is dormant.

IV SPECIAL USE AREAS

Staff Break Areas: Centralize food preparation, duplication of coffee makers, toasters, refrigerators, etc. increases utility costs and should be avoided. The site administrator shall be responsible for restricting the location of devices that consume electricity.

V MISCELLANEOUS EQUIPMENT

- A. Exhaust Fans: Exhaust fans used for the ventilation of toilet rooms, shower rooms, etc. are required by building codes and required to operate when the space is occupied. These units may be switched on/off with the lights. Keyed light switches are required in gang toilet and shower rooms. Building energy management systems may also be used to control these fans.

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- B. Water Heaters: Visually inspect all water heaters every 30 days for operation, leaks, pressure and temperature valve operation.
- C. Fire Extinguishers: The building maintenance supervisor shall monitor the inspection tags on each fire extinguisher and notify the site utility representative (SUR) immediately upon finding an expired inspection tag. The SUR shall in turn notify the maintenance department.

VI MISCELLANEOUS BUILDING PROBLEMS

- A. Building insulation, caulking and weather-stripping: The building maintenance supervisors shall make repairs and report the repairs to the SUR.
- B. Door Closers: The building maintenance supervisor shall keep all door closers in good working condition. If parts or replacement closers are necessary report this to the SUR.
- C. Windows and Doors: The building maintenance supervisor shall repair damaged windows and doors immediately or alert the SUR to the problem and a work order request will be forwarded to the maintenance department.

VII LUNCHROOM MANAGERS – SPECIAL CONSIDERATION

A. MISCELLANEOUS MECHANICAL

- 1. Kitchen hoods, hood supply / exhaust fans, grease filters shall be provided with routine maintenance, in accordance with the manufacturer's recommendations, by the building maintenance supervisor. When the maintenance requirements exceed the building maintenance supervisor's knowledge and capabilities the SUR shall initiate a work order with the maintenance department. The kitchen staff shall be responsible for cleaning the kitchen hood grease filters and the grease collection bottle.
- 2. Grease Traps: The building maintenance supervisor shall monitor the accumulation of grease in the traps and the maintenance department shall be notified when the grease trap requires cleaning.
- 3. Kitchen Hood Fire Protection System: Notify the SUR and maintenance department immediately when any problem with this system occurs.
EMERGENCY REPAIRS ARE REQUIRED!

B. KITCHEN FUNCTIONS

- 1. Kitchen Refrigeration [Freezers, Refrigerators, Ice Machines, etc.]:
 - a) During school year: Keep refrigerators and freezers as full as possible.
 - b) Off season: Turn off, clean and keep doors open for ventilation purposes.

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- c) Ice Makers: Keep in proper working order and service in accordance with manufacturers' recommendations. Service should be performed by a qualified technician. The building maintenance supervisor shall keep drain line open at all times.
 - d) Operating Temperatures: Maintain operating temperatures at 40 degrees Fahrenheit for refrigerators and other cooling equipment. Freezers shall be kept at 10 degrees Fahrenheit.
 - e) Weekly Records: Keep a running record of refrigerator and freezer temperatures. Report any temperature deviations from 40/10 to the SUR.
 - f) Ventilation: Keep stored products away from cooling coils [looks similar to car radiators]. Make sure there is adequate space around refrigerators and freezers for ventilation; do not store anything on top of these appliances.
 - g) Walk-in Lights: Turn off lights when leaving walk-in refrigerators or freezers. Notify the maintenance department when lights do not work.
 - h) Food Placement: Allow hot foods to cool not more than 20 minutes prior to storing them in refrigerators.
 - i) Defrosting: The need to defrost equipment depends on the number of times and duration that the door is open. If frost has built up to ¼ inch thickness the unit shall be defrosted. Follow manufacturer's recommendations for defrosting.
2. Cooking Functions:
- a) Plan menus: To minimize cooking, especially in warm weather.
 - b) Consolidate Baking: Limit the number of days per week for baking when possible.
 - c) Range Top Cooking: Keep pots and pans covered when cooking.
 - d) Ranges: Keep burners clean. Make sure ranges are turned completely off when not in use.
 - e) Oven Doors: Keep clean, including seals. Avoid opening. Use timers.
 - f) Daily Checks: Verify that all appliances are turned completely off.
 - g) Boiling Myth: When food boils, turn down the heat to simmer position. More heat will not cook food faster, it only wastes energy.
 - h) Pre-heat Ovens: Keep pre-heating to minimum. Bake with a full oven.
 - i) Cooking Temperature: Cook at the lowest temperature that will yield a satisfactory result. Slow cooking conserves energy and also reduces meat shrinkage and preserves maximum nutrition.
 - j) Dishwashers: Use only when full. When hand washing, use a full sink or pan. Do all rinsing at one time.
 - k) Steam Tables: Turn on 30 minutes prior to use and keep covered. Turn off steam tables and food warmers as soon as possible.

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3. Gas Ranges and Appliances:

- a) Gas Range Flames: Adjust flame so it is “*blue*”. If you cannot get a blue flame, clean the burner. If you still cannot get a blue flame, have the range serviced by an authorized manufactures service representative.
- b) Cleaning Gas Burners: Clean encrusted food from burner by soaking burners in water and a good grease solvent. Boil burners in a solution of salt, washing soda or detergent at least twice a year.
- c) Oven Cleaning: Keep ovens clean to maximize the heat transfer. Clean the heating elements.
- d) Oven Temperature: Verify temperature with a thermometer. Have thermostat re-calibrated on a regular basis.
- e) Gas Flame: Adjust gas flame to just cover the bottom of the pot. Match pot and element size on electric units. On all ranges, the base of the pot should be in complete contact with the heating surface.

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SUGGESTED CLASSROOM PROJECT

NAME: _____ DATE: _____ CLASS: _____

HOME ENERGY AUDIT: MEASUREMENT WORKSHEET

DIRECTIONS:

Let's calculate the annual cost to run an appliance for a year.

$$\frac{\text{Wattage} \times \text{Hours Used Per Day} \times \text{Days Used Per Year}}{1000} = \text{Kilowatt-hour (kWh) consumption}$$

Multiply this number by your local utility's rate per kWh consumed (In Denver the cost is 8.9 cents/kWh) to calculate annual cost.

EXAMPLE

If John uses a window fan (200 watts) 4 hours a day for 120 days per year, how much does it cost him to run his fan per year?

$$\frac{200 \times 4 \times 120}{1000} = 96 \text{ kWh}$$

$$96 \text{ kWh} \times 8.9 \text{ Cents/kWh} = \$8.16 \text{ per year}$$

PROBLEMS TO SOLVE

After school each day, Sally uses her computer to do her homework. If she has an average of two hours of homework per night for 180 days of school per year, how many Kilowatt-hours are consumed and what is the annual cost of using her computer? A CPU and monitor use 270 Watts.

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PROBLEM TO SOLVE

On January 1, the meter looked like this:



On January 31, the meter looked like this:



How many kilowatt-hours of electricity were used during January?

If the cost of electricity in Denver is \$.089 per kWh, how much did electricity cost for January?

What is the average cost of electricity per day during January?

HOMEWORK:

Choose a home appliance that you use and calculate your own energy consumption.

Appliance: _____

Wattage: _____

Hours used Per Day: _____

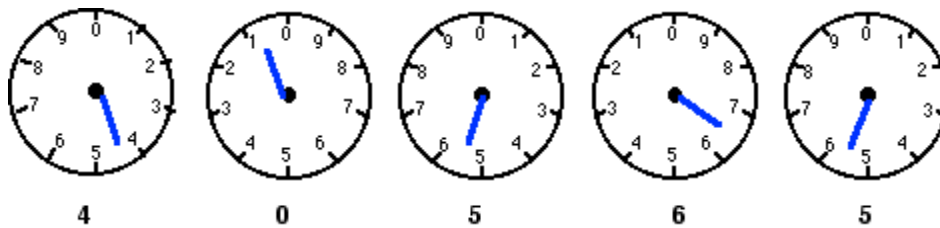
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Appendix A1

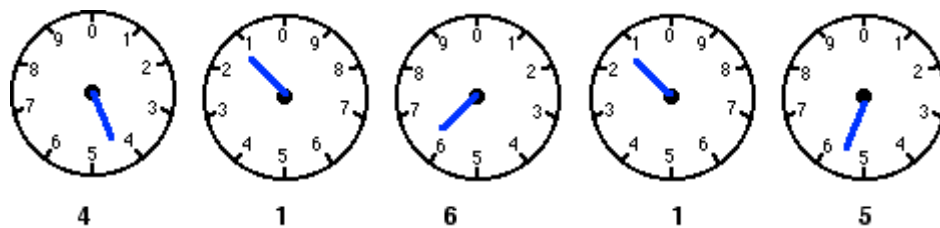
READING ELECTRIC METERS

EXAMPLE

Monday morning the meter looked like this:



Friday morning the meter looked like this:



The meter reading Monday would be 40565 and on Friday it would be 41615

To figure out how much electricity was used, subtract Monday's reading from Friday's reading

Example:

$$41,615 - 40,565 = 1,050 \text{ kilowatt-hours}$$

Based on electricity costs in Denver of \$.089 per kilowatt-hour, the total cost would be:

$$1,050 \times \$.089 = \$93.45$$

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Appendix B1

DAILY ELECTRICITY USAGE LOG for : _____ [name of school]									
Month & Year: _____									
Site Administrator: _____				Phone: _____					
Site Utilities Representative: _____				Phone: _____					
Account Number: _____									
Rate:				Readings taken @:				AM	PM
A	B	C	D	E	F	G	H	I	J
1	Date	Day of Week	Max. Temp. Degrees F	Min. Temp. Degrees F	Atmospheric Conditions	Meter Reading	KWH Used	Remarks	Misc.
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

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30									
31									
TOTAL KWH USED for MONTH:								Month:	

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Appendix C1

EXAMPLE OF COSTS versus TEMPERATURE

COOLING:

Cost of maintaining
 room temperatures above
 and below
 76 degrees Fahrenheit

HEATING:

Cost of maintaining
 room temperatures above
 and below
 68 degrees Fahrenheit

	Temp. Deg F	
34 % Less	80	125 % More
26 % Less	79	112 % More
18 % Less	78	99 % More
10 % Less	77	87 % More
COOLING COMFORT ZONE	76	75 % More
10 % More	75	64 % More
21 % More	74	54 % More
32 % More	73	44 % More
45 % More	72	34 % More
58 % More	71	24 % More
73 % More	70	14 % More
88 % More	69	7 % More
100 % More	68	COMFORT HEATING ZONE
113% More	67	6 % Less
126 % More	66	12 % Less

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Appendix D1

How much does a water leak cost?

Water Costs Money, Don't Waste It!						
This table reflects wasted water from a continuous leak resulting from a hole this size at an average water pressure of 60 pounds per square inch (psi) over a 90 day or 3 month period !	Diameter of Water Leak Stream in:		Waste over a 90 day period @ 60 psi water pressure!			
	Inches	millimeters	Gallons	Liters	Cubic Feet	Cubic Meters
	1/4	6.5	1,181,500	4,472,000	158,000	4,475
	1/8	3.2	296,000	1,120,360	39,400	1,115
	1/16	1.6	74,000	280,100	9,850	200
1/32	0.8	18,500	70,020	2,465	70	

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Appendix E1

GLOSSARY OF TERMS

ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BALLAST	Device used for starting fluorescent and other types of lamps [bulbs, lights].
BUILDING PROFILE	Description of all facilities in a school district by energy use and consumption characteristics [EUI].
BTU	British Thermal Unit. A standard measure of energy that allows comparison of two different energy sources. One BTU is the amount of energy required to raise the mean temperature of one pound of water one degree Fahrenheit.
BUILDING ENVELOPE	The outer shell of a building consisting of the roof, walls, windows, doors and floors exposed to the outside environment.
CAULKING	A flexible compound applied to cracks surrounding door and windows to minimize the leakage of air and water.
CHILLER, aka “water chiller”	Refrigeration equipment used to transfer heat from a fluid [such as water in a chilled water HVAC system] to another fluid.
COIL	Heat exchanging device which usually contains an arrangement of tubing with thin copper or aluminum plates secured to it. Most common example is an automobile radiator.
CONDENSER	Heat exchanger that removes heat from a vapor, changing the vapor back into a liquid state.
COOLING TOWER	Device that cools water by evaporation.
COOLING LOAD	Amount of heat that must be removed from a building by an HVAC system as a result of heat gain, normally caused by the sun [solar], into a building.
CTS	Channels or passageways through which air is delivered in HVAC systems.
DAMPER	Gate device that controls the volume of air passing through a duct, duct outlet or inlet device.
DECAT	Driver’s Education Conservation Awareness Training Program
DEMAND USAGE [ELECTRICITY]	The maximum electric load in kilowatts that a building imposes on the electric utility serving a given facility. “Demand” is averaged over each period of one half hour and report monthly for billing. Normally results in a higher KW cost.
DEGREE DAY	The difference between the mean daily temperature and 65 degrees Fahrenheit. Example: If the mean temperature is 80 degrees, the difference between 80 and 65 is 15 or 15 degree days for that one day period. Degree days are provided for various localities throughout the US and foreign countries by the US Weather Service.
DEMAND FACTOR	The ratio between the demands placed on an HVAC system and its rated capacity.
DISTRIBUTION SYSTEM	System of ducts, blowers, diffusers, grilles, dampers, etc. that form a means of delivering conditioned air to a given space as part of an HVAC system.
DRY BULB TEMPERATURE	Temperature of air measured by an ordinary thermometer; temperature taken when the thermometer is not in contact with water and is not affected by

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radiated heat.
ENERGY The work that an HVAC system is capable of doing.
ENERGY CONSERVATION Any activity that results in the reduction of energy consumption in all energy using systems, devices or equipment.
ENERGY MANAGEMENT PROCESS Management technique for arriving at the most energy-efficient operation of a facility or facilities.
ENERGY AUDIT [EA] Any organized, detailed review of a facility and its energy using systems that identifies opportunities for reducing energy consumption. Normally the amount of money to be spent is compared to the pay back period for making the expenditure based on the cost of money.
ENERGY AUDITOR Individual certified by the Governor's Energy Office (Florida) or possessing a particular expertise in the area of energy consuming systems acceptable to the authority having jurisdiction.
ENERGY MANAGEMENT COMMITTEE Committee formed by LCS to formulate guidelines and give direction to the energy management effort.
ENERGY MANAGEMENT COORDINATOR Individual in charge of coordinating and implementing LCS's district wide energy management efforts.
ENERGY DEPARTMENT LCS Employees charged with energy management at the school level.
ENERGY USE INDEX [EUI] An indication of energy consumption of a facility expressed in BTU's [thousands per square foot per year]. EUI equals the total energy consumption in BTU's divided by total number of square feet of conditioned space divided by 1000.
EVAPORATOR Heat exchanger that adds heat to a liquid converting it to a gas.
FOOTCANDLE Measure of light output. One foot-candle equals the light output of a standard candle at one foot.
HEAT GAIN Amount of heat gained by a space from all sources, sun, people, equipment, computers, lights, cooking, etc. Also, the amount of heat that must be removed to maintain comfort cooling by the HVAC system.
HEAT LOSS Amount of heat that must be added to a space to maintain comfort in winter. Also, the cooling effect of the outdoor climate on a building.
HEAT PUMP Refrigeration equipment that is capable of reversing its cycle so that it may heat or cool a space.
HEATING LOAD Amount of heat that must be supplied to a building to account for the total heat loss due to conduction, convection, radiation, infiltration and ventilation during the winter.
HVAC Heating, Ventilating and Air Conditioning.
IES Illuminating Engineer's Society
INFILTRATION Leakage of outside air into a building without being conditioned by the HVAC system; normally caused by a "negative" pressure in the building.
IMMEDIATE ACTION LIST Low or No Cost actions than can be taken to immediately save and reduce energy consumption.
KILOWATT [KW] Unit of electrical power. 1,000 Watts. 1 KW equals 3,413 BTUH
KILOWATT-HOUR [KWH] Amount of energy consumed when 1,000 watts of electrical power is dissipated over a period of one hour. 1 KWH equals 3413 BTUH.
LIFE CYCLE COST Total cost of an item or system over its total life span, including initial cost, operating costs, repair costs and maintenance costs.

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LIGHT METER	Device that measures light energy in foot-candles. Operates by using a photovoltaic or similar cell to convert radiant energy into electrical energy.
LUMEN	Unit of luminous flux used to measure light output.
LUMINAIRE	Lighting unit designed to produce a specific lighting effect. Luminaries may be simple or complex. The term is usually applied to outdoor lighting fixtures or to units designed for a special purpose.
MISSION STATEMENT	Adopted statement of support, commitment and goal initiated and approved by the authority having jurisdiction, in this case, Leon County School Board.
NECPA	National Energy Conservation Policy Act. Federal act establishing programs to assist various institutions in analyzing and providing funding energy for conservation activities; normally through Federal Grants applied for.
PEAK DEMAND	Highest power demand experienced by a system. A large power [electrical] demand that generally exists for a short period of time when large number of equipment are started up at the same time.
POWER FACTOR	Ratio of Volt-Amperes to Voltage.
PREVENTIVE MAINTENANCE	System of planned maintenance, performed at regularly scheduled intervals to prevent equipment failure.
R-VALUE	Measure of resistance to heat flow through a material or "sandwich" of materials.
RADIATOR	Equipment designed to dissipate heat, consisting of interconnecting tubes or pipes with very thin copper or aluminum plates fastened to the tubes or pipes. Heat is transferred to space by radiation and convection when no forced air flow is present.
REGISTER	Combination of a grille [diffuser] and damper in an HVAC air distribution system.
RELATIVE HUMIDITY	Moisture content of air expressed as a percentage of saturated air.
SUPPLY AIR	Air delivered to a space by an HVAC system.
TASK LIGHTING	Providing light to a specific area to meet the requirements of a particular job or task which producing reduced lighting levels in the surrounding areas.
TECHNICAL AUDIT [TA]	Detailed engineering study of energy conservation measures [ECM's] identified in an energy audit. These activities require capital expenditures for implementation. Technical Audit's identify cost payback periods for the proposed ECM.
UNIT VENTILATOR	HVAC equipment containing a coil, fan, filters and motor; its principal function is to provide ventilation air in summer [no refrigeration cooling] and space heating in the winter.
WEATHERSTRIPPING	Gasket installed between two mating surfaces to prevent leakage of conditioned air.
WET BULB TEMPERATURE	Lowest temperature obtained by evaporating water in air without adding or removing energy from the air. Temperature taken with a thermometer whose bulb is enclosed in a wet sock. Used as a means of determining the humidity of air. Wet bulb is ordinarily a lower temperature than dry bulb. When wet bulb temperature equals dry bulb temperature, the relative humidity is 100 percent.

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Appendix F1

ENERGY CONSUMPTION IN BUILDINGS

If an attempt to achieve energy conservation is to be successful, it must be made with the full knowledge of the many factors which affect energy consumption and the **full cooperation of the occupants of the buildings, in this case, the administrators, staff, teachers and students. In the final analysis, the building occupants totally control the success of any conservation effort put forth.** Unless all factors are considered and understood and fully supported by all parties, changes may result in short term achievement at a budgetary cost that will negatively affect the LCS for many years to come; energy conservation must be an on-going and continuous program to be fully successful.

Energy use in buildings is determined basically by the climatic conditions of the area in which the building is located, its site orientation, the working environment, the equipment required by the occupants and the attitude of the occupants toward the goal or mission.

The efficiency of energy use is determined by the three basic systems which comprise any functioning building:

- | | |
|---------------------------|--|
| Energy using systems: | HVAC, lighting, plumbing, food service, information technology, fire protection, communications, secretarial equipment, audio-visual equipment, etc. |
| Non-energy using systems: | Quality of floors, roofs, walls, windows, ceilings, insulation, construction as a whole. |
| Human systems: | Administrators, staff, teachers, students, visitors. |

Effective energy usage requires that the entire pattern of energy consumption be modified and adapted to “energy conservation”. Accordingly, the following discussion is presented to provide a basic understanding of certain factors and provide site administrators with a means of making judgments in regard to the condition of each school and what possible options exist for improving the situation at a given school.

It is appropriate to begin with the subject of HVAC this is normally the largest single expense of any school and managing the HVAC systems yields an immediate reduction in energy use and costs.

To start, one should not think of HVAC simply in terms of adding or removing heat from a building. To do so would ignore what is really involved, compensating for heat loss or heat gain in a building.

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Realizing that a building undergoes a substantial heat loss during the winter and substantial heat gain during the summer, the impact of these conditions can be controlled substantially as we will discuss.

Appendix G1

PRIMARY FACTORS AFFECTING HVAC SYSTEMS THROUGHOUT THE SCHOOL YEAR:

INFILTRATION AIR: Infiltration air involves the leakage of outside unconditioned air into the building through apertures such as cracks around windows door jambs, open doors and windows, etc. The amount of infiltration air depends largely upon the impact of wind on the building and the integrity of the building envelope. All infiltration air eventually raises or lowers space temperature and relative humidity. **Infiltration air is the single largest contributor to reduced indoor air quality and mold growth through the introduction of water vapor into the building.**

Infiltration Air Checkpoint No. 1: Have all doors been inspected recently?

Corrective Measures:

- ✓ Replace worn or broken weather stripping.
- ✓ Re-hang misaligned doors.
- ✓ Caulk or re-caulk around door frames.
- ✓ Install signs next to doors, reminding occupants to keep doors closed.
- ✓ Direct all personnel to keep doors closed for all air conditioned and heated spaces.

Infiltration Air Checkpoint No. 2: Have exterior surfaces been inspected for cracks and open joints?

Corrective Measures:

- ✓ Caulk; provide gasket or weather stripping to all exterior joints such as those between walls and foundations, roof and walls.
- ✓ Caulk or seal all openings around pipes, conduit, louvers, HVAC units, fans, etc.
- ✓ Cover all window & thru-the-wall units with fitted covers when not in use.
- ✓ Repaint or clean exterior walls and roofs to improve reflective characteristics.

Infiltration Air Checkpoint No. 3: Have windows and skylights been inspected recently?

Corrective Measures:

- ✓ Replace broken or cracked window panes.
- ✓ Replace worn or broken weather stripping.
- ✓ Caulk or re-caulk around window frames.
- ✓ Re-hang misaligned windows.
- ✓ Make sure all operable windows have sealing gaskets and latches [dogs].

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- ✓ Install signs to remind occupants to close windows.

HEAT TRANSMISSION: Heat is transmitted into [or out of] the building through various components of the building envelope; exterior walls, windows, doors, roof, floor. The difference in the outdoor and indoor temperature and the resistance to heat transmission of the building envelope determines the amount and rate of heat transmitted in either direction.

Heat Transmission Checkpoint No. 1: Has the building insulation been inspected?

Corrective Measures:

- ✓ Inspect insulation in roof, ceilings, and walls and under floor [when possible].
- ✓ Make insulation corrections on the basis of an expert technical analysis.

Heat Transmission Checkpoint No. 2: Have drapes, blinds, shades, etc. been installed?

Corrective Measures:

- ✓ Keep shading devices in good repair; saves up to 50% of energy.
- ✓ Keep shading devices closed during hours of direct sunlight when HVAC is in use.
- ✓ Keep shading devices closed at night.
- ✓ Install opaque or translucent shading materials on windows.

Heat Transmission Checkpoint No. 3: Is the landscaping planted with energy savings in mind?

Corrective Measures:

- ✓ Plant trees to provide shade in summer, sun in winter.
- ✓ Plant evergreens to provide wind breaks.

VENTILATION: Ventilation systems provide a building with fresh or outside air by exchanging inside air for outside air. The rate of exchange is measured in cubic feet per minute [CFM]. During the winter, unconditioned cold air is brought into the building while an equivalent volume of warm air is exhausted. Obviously the greater the rate of ventilation and the greater the indoor / outdoor temperature difference, the more energy will be consumed by the HVAC system to compensate. State of Florida regulations require a minimum of 15 CFM per building occupant at all times. There is some small mitigation of this requirement allowed, but this is very limited due to indoor air quality concerns. The most pressing problem when providing ventilation [toilet rooms and kitchens are the best examples] in a building is maintaining a positive pressure in the building to avoid the intrusion of unconditioned outside air into the building; not that all air exhausted from a building must be replenished with conditioned outside air.

Ventilation Checkpoint No. 1: Has mechanical ventilation systems been inspected?
Has routine maintenance been performed on a timely schedule?

Corrective Measures:

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- ✓ Limit outside air supply to properly balance the HVAC system air.
- ✓ Inspect, repair and/or adjust outside air dampers.
- ✓ Close outside air dampers during first and last one half hour of occupancy.
- ✓ Close dampers on exhaust vents when the unit is off.
- ✓ Shut down mechanical systems when building is closed for extended periods.

- ✓ Regulate rest room exhaust by wiring the exhaust fans to light switches.
- ✓ Consider eliminating outside air ducted from the outside to rest rooms [other areas] for ventilation air and allow air to be drawn from other parts of the building.
- ✓ Inspect and replace filters on a set schedule.

Ventilation Checkpoint No. 2: Is natural ventilation used to maximum practical extent?

Corrective Measures:

- ✓ Open windows to use natural air movement when building design and weather permits. Note: Consider outside relative humidity as well as temperature.
- ✓ Open interior doors necessary to create a natural air flow for ventilation.
- ✓ Supplement air movement with fans where practical and possible.

LIGHTING: Lighting contributes to a building's heat gain in direct proportion to the wattage of the lamps being used at any given time. Turning off lamps will reduce the heat gain and save energy and reduce the utility bill. The heat gain from lamps is beneficial during the winter heating season by supplementing the building HVAC system. Note: When the HVAC system is malfunctioning during the winter, one may often provide adequate heat for the facility by leaving all the lights on overnight. During the cooling season the HVAC system must compensate for the building heat gain from lights.

Lighting Checkpoint No. 1: Is artificial light used in an efficient manner?

Corrective Measures:

- ✓ Use natural light to maximum practicable extent.
- ✓ Place "Turn Lights Off" sign near all light switches.
- ✓ BMS shall keep windows and skylights clean to maximize available natural light.
- ✓ Establish light usage program that includes a lighting schedule corresponding to occupancy patterns of the facility. Use only the number of lights necessary. Turn lights off in all unoccupied spaces, except exit paths.
- ✓ Align desks to take advantage of natural light sources. Natural light from right angles to work surfaces is the desired effect.

Lighting Checkpoint No. 2: Are lamps and fixture selected, installed, operated and maintained to promote energy efficiency?

Corrective Measures:

- ✓ Use lower wattage energy efficient lamps for replacement lamps when desired lighting output is met. Note: Must meet Department of Education foot-candle

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requirements. Example: 35 watt fluorescent lamps use 20 percent less energy than 40 watt fluorescent lamps.

- ✓ BMS shall keep lamps, fixture lens and reflective surfaces clean. Clean lamps lens, walls and ceiling on a regular schedule approved by site administrator.
- ✓ Replace defective ballasts with high-efficiency electronic type.
- ✓ Use only lamps approved by LCS.

Lighting Checkpoint No. 3: Are D.O.E. required lighting levels being maintained?

Corrective Measures:

- ✓ If you question the existing lighting level, call the Energy Management department and request that they verify the lighting level and take appropriate corrective measures.
- ✓ Use dimmers where available.

SOLAR HEAT: Solar heat, as with heat from light sources, contributes to heat gain throughout the year. In winter this heat is an asset, in summer it is an expense. The specific affect of solar heat depends on factors such as 1) geographical location, 2) intensity and direction of solar rays, 3) color and texture of exterior and interior walls, 4) color of roof, 5) type of solar screening, shading and control. "Solar heat checkpoints and corrective measures" are essentially the same as those listed under "Transmission".

OCCUPANTS: The number of people in a building or in a given area [space] of the building adds significant heat gain because human beings give off heat to room air wherever the temperature around them is lower than their body temperature. They also contribute moisture [water vapor] content through perspiration and breathing. Additionally, the occupants control how a given facility is operated through scheduling and use. Scheduling and using a facility without regard to energy conservation is negligence, that is not to say that all operational functions at a facility may be scheduled at the "ideal time of day", that would be impossible. However every effort shall be made to "schedule" when the least energy will be used. In the long term this type of energy conscious scheduling provides financial benefits for both the LCS and the facility at hand.

Occupant Checkpoint No. 1: Does the site administrator's "Energy Use Plan" promote maximum energy conservation?

Corrective Measures:

- ✓ Schedule cleaning and maintenance activities during daylight hours.
- ✓ Consolidate activities to reduce energy usage.
- ✓ Use lights and equipment only in areas where personnel are working.
- ✓ Reduce thermostat settings to 50 degrees Fahrenheit during the winter when the building is unoccupied.
- ✓ Turn off all air conditioning when the building is unoccupied.

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Occupant Checkpoint No. 2: Has the facility interior space been inspected, evaluated and had the necessary corrective measures taken to promote energy conservation?

Corrective Measures:

- ✓ Adjust “use schedules” so that rooms are in continuous use.
- ✓ Eliminate tasks and instructional elements that cause the consumption of excessive amounts of energy.
- ✓ Turn off HVAC systems in unoccupied areas when nothing in the space(s) served will be adversely affected.

Occupant Checkpoint No. 3: Have all facility personnel been instructed in the site administrator’s “Energy Use Plan” and the steps required for implementation? Have all facility personnel been provided with this “Handbook” by the Site Administrator?

Corrective Measures:

- ✓ Distribute “LCS’ Energy Cost Control Handbook” to all personnel.
- ✓ Hold instructional sessions for all facility, administration and staff. Use LCS Energy Cost Control Handbook for instruction.
- ✓ Post thermostat temperature setting reminders.
- ✓ Post chart “Example of Costs versus Temperature” next to thermostats in all classrooms.
- ✓ Use plaques and signs to remind students and personnel about the benefits of energy conservation; EXAMPLE: Saving barrels of oil!
- ✓ Keep all building occupants informed about LCS’ energy conservation effort and guidelines.

SUMMARY: In almost all cases, those factors which contribute negatively to heat loss and heat gain can be mitigated by the building occupants. Modification of occupant behavior can reduce the load placed on the HVAC systems and impact the amount of energy used by any facility.

Adjustment and modification of the HVAC equipment can achieve substantial economies. It has been shown, for example, that HVAC systems of even the most modern and up-to-date schools often have extensive inefficiencies, usually due to faulty installation, maintenance or operation. Correction of these problems can result in substantial energy savings.

Any and all changes and modifications must be evaluated based on their affect and interaction on other systems and components. As an example, reducing the lighting level to save energy may impact the work product by creating an environment not conducive to performing the task at hand.

There are numerous publications available over the internet providing current and up-to-date information on methods and means of saving energy and what works and what doesn’t work.