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No Cost and Low Cost

Measures for Saving Energy

1. CONTENTS

2. INTRODUCTION

This document is not about investments into fancy energy saving undertakings. In any facility one can spot a number of:

- ★ ***NO COST ENERGY SAVING ACTIONS*** – those, which can be implemented immediately. They require only some of your time, attention, creativity and persistence.
- ★ ***LOW COST ENERGY SAVING ACTIONS*** – these may involve spending just small amounts of money, and
- ★ ***ENERGY SAVING ACTIONS THAT REQUIRE SOME PLANNING*** for further activities to think about.

What savings can you expect from actions listed in this document? Experience says that at least 5% savings can usually be achieved. In some cases it can be ***much*** more.

This document is intended for people who want to install an energy and water efficiency culture in their facilities, but are not sure how to do it. It is written mainly for facility leaders, but maintenance superintendents, janitors and anyone who makes decisions that affect the energy or water consumption of a facility can make use of it.

This paper includes measures that range from zero cost to those requiring minor investment; measures that can be implemented immediately to those that require some planning, but still do not require major capital investments. Some measures will involve your staff, some will not.

We do not address projects, which need serious capital investments. But zero-cost and low-cost measures can, in many facilities, represent a significant saving. What is even more important is that they create the energy and water efficiency ***culture*** in your organisation – and prepare the way for further investments.

We start with pure management steps, continue with steps for the optimization of your facilities' relations with utility providers, then we look in more detail at different systems – lighting, building envelope, doors, windows, heating, ventilation, air conditioning, office equipment, cafeteria equipment, etc. Each section contains ideas, which should prompt you to look at the various ways in which you could save.

Although a wide range of opportunities are shown, you can follow as many or as few of the actions as you chose – the more you do, the more you save. Some of the listed measures could appear too obvious, some could already be implemented, and some may not be applicable. In any case, this advice is intended to enable you to create and initiate energy saving ideas as soon as possible.

If you feel it would be difficult to persuade staff to carry out the recommended activities, it may be useful to start with a small selection of the no-cost ideas from each section. However, don't forget that your facility will gain the most if these activities are carried out continuously and that means involving ***all*** of your staff.

You will save more and guarantee the long-term success of your program if you can integrate the actions within your normal maintenance routines. When planning any refurbishment or repairs – do not forget that some ideas listed here might efficiently be put to work during these activities.

At first glance, this document could seem somewhat eclectic, since attention is paid to very diverse sides of energy consumption (or waste) in a facility. But so eclectic is energy waste itself. Eclectic, or not, the energy is consumed (or wasted) in ***your*** facility in many diverse ways, and there is no such thing as "a full list of energy saving measures". The goal of this document is to awake creativity and outline the most common no cost / low cost solutions. Finding specific cases in your particular facility is just a matter of persistence and keeping your eyes and mind open for spotting and eliminating losses. Any particular case will need a specific approach. Even the most modern facilities can be improved, either in equipment, attitudes or systematic approach.

3. MANAGEMENT

Energy management is a definite opportunity for you to reduce energy consumption, protect the environment, and save money. The savings are particularly attractive because they do not require any operational cutbacks, they are not taxed, and they continue to accrue year after year. These savings do, however, require some careful planning and habit changes.

It does not matter how much you spend on technology, if you do not manage your energy resources efficiently, you will waste money. Most energy saving activities rely on people – make sure that your staff is committed to your program.

The following are some general no cost / low cost energy savings actions:

- ★ Switch off lights when a room is unoccupied.
- ★ Switch off office equipment after business hours.
- ★ Remove unneeded light bulbs and lamps.
- ★ Reduce hours of operation of the heating or air conditioning, etc.

However, there are many possibilities scattered around ***your*** facility. The actions outlined hereafter should help you to look at your facility with fresh eyes and develop a comprehensive program to help you save energy and money. You can do as many or as few of these actions as you chose – the more you do, the more you save!

This section concentrates on management techniques. In nearly all cases you do not have to make any capital investments to save money. However, all the techniques involve people and in order to be successful, you will probably have to invest some time gaining the support of your staff.

Of course, many of the steps listed could and should be delegated to appropriate staff members.

Management: some steps to perform

	Opportunity	Reason	Action
1	Does your facility have an energy efficiency policy?	★ A simple statement of policy objectives will show management's commitment to energy efficiency. ★ The most cost effective energy efficiency programs are led by management example. ★ Effective energy efficiency programs can produce significant cost savings.	★ Formulate an energy efficiency policy and ensure that management is committed to it. ★ Produce a statement of objectives (as simple as possible) showing management's commitment to reduce energy usage and protect the environment. ★ Make sure that all your staff has a copy and hang a framed copy in a position where staff and visitors can see it. ★ Use staff meetings as means of raising awareness of the high cost of energy.
2	Include energy efficiency in all specifications for buying new plant and equipment.	★ Cost savings achieved through lower running costs can significantly outweigh higher initial purchase costs.	★ All plant and equipment specifications should include energy efficiency. ★ Staff responsible for purchasing or renting new equipment should receive training in energy efficiency awareness.

3	Make energy efficiency the responsibility of a specific person in your facilities.	★ Making a specific member of staff responsible for energy efficiency gives it a higher profile.	★ Make one member of staff responsible for energy efficiency including monitoring the cost of all energy and water. ★ Make sure that the person responsible for energy efficiency has the full backing of management. In a majority of facilities, energy management activities will only take up a small amount of time – but it will save money.
4	Make sure that you fully understand and make use of all the information on your facilities energy and water bills.	★ Energy and water bills provide information essential to help you monitor the efficiency of your facility. ★ Keeping accurate records of consumption and costs will enable consumption to be monitored and alternative tariffs or suppliers to evaluate.	★ Set up a system for recording all the relevant information from energy and water bills. ★ Record as much information as possible, noting whether bills are actual or estimated. ★ For example, the information on hydro bills will usually include: -number of units used, -maximum demand, -supply capacity, -power factor. ★ If night units are metered, check that consumption agrees with known usage. This will help you to identify if equipment is being left running overnight. ★ If other billing times are separately identified (evenings/weekends), check that usage can be accounted for. If a maximum Demand tariff is being used, make sure that you can account for the demand incurred.
5	Compare energy and water bills with the previous equivalent month or quarter.	★ This is an easy way to monitor expenditure on energy. Careful comparisons of consumption will identify changes in usage and help to identify possible areas where money is being wasted.	★ Compare consumption and costs against equivalent periods in the previous year[♣]. Investigate any unexplained increases.
6	Read and record your energy and water meters every month.	★ Regular monthly meter reading will show a pattern of usage. This information will be particularly useful when billing periods are irregular or when bills are frequently estimated.	★ Set up a routine for making and recording monthly readings.

[♣] It has to be admitted that though being very useful for quick analysis of energy efficiency performance, such comparison can provide only a very rough idea. The consumption data from different years would be affected with different weather, different occupational patterns, etc. For detailed analysis of performance one could use tools as the Metrix system.

7	Look for reasons for all increases in consumption.	★ You can only deal with energy waste if you can accurately identify and account for all change in usage. ★ Increases may be due to faulty equipment or unplanned changes in working practices.	★ Where consumption rises, check all operating procedures. ★ Check that control devices, such as timeswitches, valves and thermostats, are operating correctly. Check that any changes in working practices have taken into account possible increases in energy usage.
8	Compare the usage of your facilities with that of other facilities.	★ If you compare your energy usage with similar facilities, you will get a good indication of the current level of efficiency and the potential for improvement.	★ Compare your energy usage per square foot of floor area with other Northern facilities [1].
9	Make full use of the energy efficiency literature and videos that are available.	★ There are plenty of free educational and promotional materials available.	★ See the Info Package.
10	Ensure that your facility publicises its energy saving successes both internally and externally.	★ External publicity on energy efficiency activities can enhance the image of your facility (particularly if this is linked with environmental improvements). ★ Internal publicity maintains the high profile required to sustain effort by all staff.	★ Opportunities for cost effective external publicity can include providing stories for local papers, radio and TV. ★ Give feedback to staff through regular meetings, internal publications (memos, posters, bulletin boards, etc.)
11	When savings through energy efficiency are made, is a percentage reinvested in future efficiency methods?	★ Reinvesting a portion of savings in additional energy efficiency measures will generate further savings and show the commitment of your institution to energy efficiency.	★ When an efficiency program is being planned, make sure that a percentage of the planned savings is reserved for investment in future energy efficiency programs[2].

Your Staff Can Help

Zero-cost energy conservation measures can usually be initiated immediately, providing benefits quickly. These measures do require considerable diligence and effort in changing habits and observance of detail. Their success requires persistent attention. It is often helpful for one member of a group to remind others in a humorous way to keep up the new routine until it becomes automatic.

Staff should be encouraged to save energy, and be reassured that much can be saved in the average facilities without decreasing the comfort level or violating health and safety standards[3].

	Opportunity	Reason	Action
1	Inform the staff about your campaign.	★ It is important to create an awareness atmosphere.	★ An energy-saving campaign can be organised through your staff newsletter, ★ through e-mail.
2	Supply the employees with no cost tips and ideas.	★ The tips can help to get the effort started, and employees can find other ways to increase savings.	Examples of tips: ★ "Turn off the lights and space heaters when leaving the office for more than ten minutes or for the day." ★ "Portable heaters waste about $7.50 every night they are left on." ★ "Do not continually adjust thermostat settings." ★ "Keep vestibule doors closed."
3	Try running a staff suggestion box..	★ Encouraging staff to suggest ways of reducing energy and water costs can often produce worthwhile ideas.	★ Consider setting up a suggestion box for energy cost saving ideas. ★ It is important that all ideas are discussed with the individual.
4	Arrange for incentives to encourage good housekeeping practices.	★ Staff is more likely to carry out good housekeeping measures if they themselves are benefiting.	★ Consider setting up a campaign to maintain staff interest in energy efficiency. ★ As personal reward programs can be difficult to administer, incentives could include improvements to staff facilities or giving a donation to charities.
5	Ensure that new members of staff are informed about existing energy policies.	★ It is essential that new staff is informed about your facilities commitment to good energy management.	★ Ensure that energy efficient practices are included in all staff introduction programs. ★ Ensure that new members of staff receive and read a copy of your facilities policy on energy efficiency.
6	Try to adjust staff behaviour.	★ Gain your staff's support.	★ Try sharing an electric coffee pot, or use a thermos bottle to keep brewed coffee warm and turn off the unit after brewing. ★ Often, 150 W foot warmers can provide adequate heat instead of using 1,500 W space heaters. Thicker socks can to the same for nothing.

4. OPTIMIZING YOUR FACILITIES RELATIONS WITH UTILITIES

Making sure that you are on the right tariff can make immediate savings in your energy costs.
Money can be also be saved by reducing water and sewage bills.

	Opportunity	Reason	Action
1	Assign a staff person to be responsible for checking all bills received from energy and water supply companies.	★ It is essential that someone in your facility have a detailed knowledge of how energy and water charges are calculated. ★ Energy and water costs can be minimised by selecting the most appropriate tariff, but first you must understand how the tariff works.	★ Make sure that a staff person understands the way bills are calculated and is responsible for checking all energy and water bills. ★ Obtain a tariff brochure from your suppliers. ★ If there is any doubt about the way charges are calculated, contact suppliers.
2	Read all energy and water meters every month.	★ Monthly in-house meter readings provide data to establish patterns of energy use. ★ Knowing regular patterns of consumption is particularly useful when billing periods are irregular or when bills are frequently estimated.	★ Set up a procedure for regular monthly reading and recording for meters.
3	Check all incoming bills.	★ Even the largest utilities can make errors on bills. ★ It is important to check that estimated figures are reasonable for the period they represent.	★ Carefully check all incoming invoices against your in-house meter readings.
4	Make an annual check to make sure that you are on the correct electricity tariff.	★ The most appropriate tariffs for your facility can change from year to year. ★ The pattern of consumption in your facilities may have altered due to changed working patterns or practices.	★ Carry out the yearly review of tariffs and use the one that is most appropriate for your needs. ★ Ask your supplier for advice on tariffs. You will be able to identify the best tariff for your facility if you can supply the accurate data on patterns of demand. Here you can use the data from your own in-house readings for this purpose.

5	If your facilities is on a Maximum Demand tariff, have you reviewed your Supply Capacity recently?	★ The way in which your bills are calculated will depend on the supplier and the tariff. However, you may be paying for capacity you do not need.	★ Check whether your declared Supply Capacity (or Availability) is more than 15% higher than your highest maximum demand. If necessary, contact your supply company about reducing the Supply Capacity.
6	Look at the ways to reduce electrical demand peak periods.	★ Reducing usage during these periods can make significant cost savings.	Look for opportunities to reschedule non-essential loads in order to reduce usage during peak periods.
7	Check the power factor[4] for your site.	★ Most monthly tariffs penalise users for poor power factor. Some suppliers identify the power factor on their bills.	★ Establish your site's power factor. You may find it on your energy bills, otherwise ask your supplier for help. ★ Most suppliers of power factor correction equipment also offer free check. ★ If your factor is below 0.95, you should consider installing correction capacitors.
8	If your site has more than one meter – aggregate them into single account.	★ Aggregating the accounts may reduce standing and unit charges. ★ Aggregating minor supplies may enable you to obtain better rates.	★ Check that all metered supplies are aggregated for billing purposes. ★ This is a paper exercise that does not require any physical alteration to the meters.
9	Have a metered water supply.	★ Low quantity users paying charges based on the rateable value of their property may benefit from switching to a metered supply.	★ Check the charges on water bill. ★ Estimate the cost of your annual water consumption based on a metered supply and compare with present flat rate, if any.
10	Check carefully the "minimum charges" on your water bill.	★ The supply company may incur unnecessary minimum charges due to underestimates.	★ Check that minimum charges on estimated bills are not due to an underestimation by the suppliers. ★ If you think that you have been over charged, take meter readings and inform the suppliers. If you are right, you should obtain the refund.

5. LIGHTING

Large savings are often available through lighting changes. If electric rates are high, the cost savings can be very attractive. During your "walk-through" energy survey, notice the amount and quality of light in each area and consider the following:

Try to use natural light wherever possible. It saves energy and it is easier on the eyes.
Fluorescent lighting is more economical than incandescent lighting. Fluorescent lights use one quarter of the energy that incandescent bulbs use to produce the same amount of light. Use "T-5" or "T-10" lamps for maximum energy efficiency and improved lighting quality.

A general lighting replacement strategy could be:
★ Improve efficiency and adjust your light levels to recommended levels by using T-5 or T-10 lamps.
★ If light levels are too high, install fewer lamps per fixture; or install fewer lamps with fixture efficiency improvements.*
★ If light levels are acceptable, install T-8 lamps and ballasts, or install fewer T-10 lamps with fixture efficiency improvements.*
★ If light levels are too low, install T-10 lamps; or install T-8 lamps with fixture efficiency improvements. *
(Fixture efficiency improvements may include lens replacement, reflectors, and improved maintenance.)

See Appendix 1 for more technical details on efficient lighting.

Replacing all or part of a lighting system requires a significant financial investment. However, the energy cost savings can also be large, depending upon the efficiency of the old system, the hours of use, and the electric rates. Simple paybacks of two or three years are common.
Meanwhile, if the lights are to be replaced, the choice of efficient lamps is an obvious no-cost measure.

Certainly, there are many no cost / low cost actions to be undertaken besides just changing your bulbs.

Lighting: No cost measures

	Opportunity	Reason	Action
1	Using the T-5 or T-8 fluorescent light tubes.	★ New fluorescent tubes use less energy, but cost the same	★ Replacing the old tubes, arrange for buying only the efficient ones ★ The new efficient tubes will not operate in older fittings♣.
2	Encourage your staff to turnoff lights when leaving a room or corridor	★ It is always cheaper to turn lights off than to keep them on. ★ Improving awareness of energy wasted can save up to 15%	★ Use promotional materials ★ Use staff meetings as means of raising energy awareness

♣ See Appendix 1 for details.

3	Label light switches.	★ The individual lights are often controlled from banks of switches. Often when multiple switch banks are fitted, it is not easy for individual staff members to find their switches	★ Label light switches ★ Make sure that everyone knows there "personal" switches.
4	Switching lights off when premises are not occupied	★ A lot of money is wasted when unnecessary lights are left on when not needed.	★ Carry out an "out of hours" survey. ★ Talk to cleaning and security staff ★ Set up an arrangement for switching off lights – this can be one person responsible for this, or having the policy of "last one out, switches off"
5	Review levels of lighting in all your areas	★ Non-critical areas (e.g. corridors) are frequently over-lit ★ Areas that are usually highly lit (drawing offices, workshops, etc.) can have their lighting reduced for out off-hour activities, such as cleaning. ★ Lighting only areas of specific tasks can reduce the general level of lighting in generally lit areas.	★ Look at lighting levels and existing necessity – involve all staff in evaluation of each persons needs and requirements. ★ Decrease lighting in non-sensitive areas by selective removing tubes from multi-tube installations, or by disconnecting surplus lights. ★ Encourage staff to switch off the unnecessary lights in out off-hour periods. ★ Use task lighting for specific jobs.
6	Making the best use of daylight.	★ Most people prefer to work in natural light. ★ Interior lights will be used less when adequate daylight is available.	★ Check how often your windows are cleaned, do it more often if necessary. ★ Make sure that all window binds are open in daylight hours. ★ Move any objects (filing cabinets, plants, etc) that a obstruct windows. ★ Review the locations of staff, if possible move them closer to windows. ★ Check that any roof lights are used effectively
7	Clean the light fixtures regularly.	★ Dirty diffusers or shades greatly reduce light output. This may result in more lights being switched on.	★ Ensure that light fixtures are cleaned at least once a year.

Lighting: Low cost measures

	Opportunity	Reason	Action
8	Check if diffusers and shades are discoloured.	★ Discoloured diffusers and shades substantially reduce light output. This may result in more lights being switched on.	★ Discard and replace the discoloured items.
9	Have enough light switches.	★ To keep installation costs low, banks of lights are often controlled by a single switch – this means that working spaces are often lit on an "all or nothing basis".	★ Install switches or individual light fittings for groups of lights fittings (i.e. provide more levels of switching).
10	Provide light switches in areas that are not used frequently.	★ Normally little thought is given to lights in areas, which are not used all the time (toilets, corridors, locker rooms, store rooms, cafeterias).	★ Fit passive infra-red presence detectors to allow automatic control in areas which are not in permanent use. They also can be used to control such facilities as urinal flushing and exhaust fans, making them even more cost effective.
11	Switch off lights in boiler rooms and other areas that are normally locked when unoccupied.	★ Locked areas are often lit when not in use.	★ Install key tag operated switches in place of standard light switches in locked areas.
12	Switching off lights in displays and storage cupboards when not in use.	★ Storage cupboards and displays are often fitted with ordinary switches.	★ Fit pneumatic push-button automatic switches.
13	Use photocells to automatically control the interior lights.	★ Photocells automatically turn off lights when there is adequate natural light.	★ Fit photocells to switch off the interior lights when daylight is adequate.
14	Switch exterior lighting off, including perimeter lighting, car parking lots, etc..	★ Exterior lighting to be limited to hours of darkness. ★ It may not be necessary to operate all exterior lights continuously through out the night.	★ Carefully consider your exterior lighting needs. ★ Fit photocells to restrict exterior lights to hours of darkness. ★ Fit timing switches if exterior lights are not required through the whole night. ★ Fit movement detectors to security lighting.

15	Replace incandescent bulbs with compact fluorescent bulbs	★ Compact fluorescent bulbs use 75% less electricity, last 8 times longer and reduce maintenance costs because of less frequent bulb replacement	★ Replace incandescent bulbs with compact fluorescent bulbs (cost effective in almost all cases]

Lighting: activities that will require some planning

	Opportunity	Reason	Action
16	If you are installing new lighting, have you considered specifying high efficiency fluorescent lighting?	★ Energy costs can be reduced by around 25%. ★ Hum and flicker (causing headache and eye strain) can be eliminated. ★ Starting is more reliable and the life of tubes is longer.	★ Use high efficiency fluorescent lights and electronic ballasts for all new applications and when replacing old fittings.
17	Use mirror reflectors on twin tube fluorescent fittings.	★ Fitting mirror reflectors and removing one tube does not significantly reduce lighting levels but does save money ★ Reflectors are available as retrofit options for most popular fluorescent light fittings	★ Check whether the existing light level given by fluorescent light fixtures are satisfactory. ★ Find out if the mirror reflectors are available for your fixtures. ★ Try fitting a mirror reflector in one existing fixture on a trial basis. ★ Check whether new light levels are satisfactory, and if they are – consider a replacement program for all fluorescent fixtures. This opportunity is only practical where existing lighting levels are satisfactory and is only worth doing if the fittings to be replaced have a life expectancy of more than 5 years.
18	In warehouses, storage areas, or other areas with high ceilings – use discharge lighting	★ Discharge lighting is more efficient than most fluorescent systems and saves money ★ Higher wattage lamps mean fewer fittings and lower installation costs ★ Discharge lighting systems have a longer life, so maintenance and replacement costs can be reduced	★ Use high pressure or low pressure sodium lighting in warehouses or other areas with high ceilings ★ Sodium lights are not suitable for office use! It also takes time to warm them up to full output, and this may limit their use with occupancy detectors or infrared controls. Colours usually look different in their light which also may limit usage

19	Replacing existing mercury discharge systems.	★ Mercury discharge lamps are more expensive to run than. ★ Sodium discharge lighting will give higher light output and lower running costs.	★ Check if Sodium lights could be suitable for your application. Some systems will require fixture changes; others – only the bulb.
20	Replace tungsten halogen floodlights with discharge lighting.	★ Tungsten halogen lamps are very expensive to run. ★ Replacement will give lower running costs, particularly in the areas where the lights are switched on for long periods	★ Check where your tungsten halogen lights are switched on for long periods. ★ Check if Sodium lights would be suitable for your application. ★ Tungsten halogen lamps are ideally suited to intermittent use: security lighting controlled by occupancy detectors.
21	Setting up an awareness campaign to encourage your staff to continue making energy savings.	★ You can make savings of around 15% just by making staff aware of the need to switch off unnecessary lights. ★ Awareness of the need for energy efficiency needs to be continually maintained.	★ Use a personal approach, briefing meetings, in-house posters, etc., to demonstrate the importance of good lighting discipline ★ Use "switch off" stickers, promotional materials, booklets, posters ★ Remember, individual perception of appropriate levels of light varies. Involve the staff.

Some examples for creative thinking:

★ Remember that lights are used not only for lighting the space. Replace incandescent bulbs in the building's exit signs with light-emitting diode (LED) signs which are approximately 2Wt instead 30-50 Wt. They also have life expectancy of 25 or more years, thereby reducing labour and replacement costs.

★ Use motion detectors to turn lights on in low use areas, such as storerooms. For a building with 10 storerooms with 400 W lighting in each, left on 24 h a day, $10,000 can be saved annually.

★ Use lighting reflectors. Replacing existing 40W fixtures with reflective units using 32 W bulbs on a 20,000 sq. ft. area can save $13,000 per year

★ Replace incandescent lights in stairwells with compact fluorescents. The payback period is usually less than a year for areas where lights are left on 24 hours a day.

6. HEATNG, VENTILATING AND AIR CONDITIONING (HVAC)

HVAC systems offer many opportunities to save energy ranging from zero-cost and low-cost methods to capital investment.

The basic approaches are:

★ ***Operating Hours:*** With almost any equipment, the easiest way to save energy is to switch it off when not needed. Ensure that HVAC equipment that can be shut off during unoccupied hours is shut off promptly, without fail, after hours, including weekends and holidays. Coordinate this closely around janitorial hours. When only part of the building is occupied, switch off service to unoccupied zones.

★ ***Temperature Setpoints***: Heating temperature should be lowered very gradually to allow people to adjust without becoming uncomfortable. This may take several weeks to implement attention. Do not allow thermostats to be changed arbitrarily. Cooling temperatures should be gradually raised.
"Night setbacks" of temperature should be implemented during unoccupied hours. Heating should be setback to 55˚F, and then returned to the occupied setting in time for early morning warm-up. Cold outside air supply should be closed during the warm-up when there are few people in the building. During janitorial hours, lower temperatures may be acceptable due to the physically active nature of the work.

★ ***Air Distribution***: Uncomfortable areas often result from insufficient or excessive airflow to a space. Such buildings may need an "air balance" performed, that is, adjustment of air registers to provide the correct airflow to each space.

★ ***Maintenance:*** Routine preventive maintenance saves energy, prolongs equipment life, and reduces breakdowns.
The boiler should be tuned and cleaned before every heating season;
Air cooling and refrigeration systems should be professionally maintained;
Air filters must be replaced on a regular schedule.
Air distribution ducts should be carefully inspected and all leaks repaired.
Insulation on ducts, hot water lines, and chilled water pipes and fittings should be repaired or added where missing.

The following tables attempt to provide systematic approach to these possibilities. Please pay attention to the different technological solutions, which can be provided for hydronic and forced air heating systems. It is not uncommon that one facility has both types of systems acting simultaneously. Many of the listed ideas are applicable to any heating system. For this reason we intentionally do not separate the ideas by type of heating installation.

HVAC: no cost measures

	Opportunity	Reason	Action
1	Do not heat your buildings above 19^{o}C.	★ Many people do not realise that the maximum level recommended for heating is no more than 19^{o}C. ★ Costs rise by about 8% for each 1^{o}C of overheating.	★ Carry out regular checks on thermostat settings. ★ Discuss heating levels at staff meetings.

2	Consider reducing the level of heating in some areas.	★ Areas such as store rooms and corridors, or areas where there is a high level of physical activity, require less heat.	★ Reduce heating thermostat settings in areas which do not require full comfort heating. ★ Typical settings should be: Offices – 19°C Workshops –16°C Stores, etc. 10-12°C
3	Encourage staff to reduce their heating when they are too hot instead of opening windows or doors.	★ Money is wasted when windows and doors are opened when heating is on. Turning down heating can increase comfort and save money. ★ Saving of around 8% in costs can be made for each 1°C reduction in temperature.	★ Use promotional materials – posters, stickers♣. ★ Use staff meetings to raise awareness of energy costs.
4	Lock thermostats and thermostatic radiator valves (where applicable).	★ Thermostat controls are often abused by being used as on/off switches. This can result in discomfort for staff and money being wasted.	★ Set thermostats (or thermostatic radiator valves in case of hydronic heating system - TRVs) to give the desired temperature and make them tamperproof by using internal locking devices or exterior covers.
5	Locate thermostats and thermostatic sensors in proper places	★ Siting a thermostat in a cold or draughty place will result in overheating. Conversely, siting a thermostat near a source of heat may lead to under-heating.	★ Check thermostat locations, and where appropriate, change to representative locations. Make sure that they are in a free flow of air, but away from windows, heat sources and draughts. ★ If your heating controls incorporate an external temperature sensor, make sure it is located on a NORTH facing wall and out of direct sunlight or any other sources of heat. ★ The siting of thermostats is very often a compromise in order to achieve reasonable temperature conditions throughout the building.
6	Regularly check the settings of frost thermostats.	★ If frost thermostats are set too high, money will be wasted – if set too low, the *water based* system will be in risk of damage from frost.	★ Reset frost thermostats (if any). Typical setting should be: Internal – 4°C External – 0°C – 1°C Make sure that they are labelled “frost thermostat” Ensure they are tamperproof.

♣ However, maintaining of sufficient air quality must not be neglected.

7	Program the heating and ventilating time switches to match the occupancy patterns.	★ Money can be saved by adjusting preheat periods to match weather conditions. ★ The heat stored in (hydronic) radiators and in the building in general, is often sufficient to allow the heating to be switched off before the end of occupancy.	★ Check settings on all timing switches regularly to ensure that they display the correct time and day and that the timings correspond to the occupancy pattern. ★ Check that the heating and ventilation does turn off when the building is unoccupied.
8	Adjust heating times for holidays	★ Heating an unoccupied building to normal occupancy temperatures is wasteful.	★ Ensure that someone is responsible for switching the heating to holiday mode (i.e. frost protection level only). ★ Where the building is partly occupied during holiday periods, it may be more efficient to have local heating only in the occupied areas.
9	Check that your thermostats are clean.	★ Dust inside the thermostat will affect accuracy of its settings	★ Clean the thermostats regularly by removing the covers and carefully blowing away any dust.
10	Check that radiators and other heating surfaces are unobstructed.	★ Radiators or heating vents are often obstructed with furniture. This will reduce their output and lead to poor performance and extended warm-up times.	★ Check on the layout of working areas to ensure that all heating surfaces are not obstructed.
11	Ensure that heating surfaces and filters on fan heaters are cleaned regularly.	★ Blocked filters and dirt build-up on fan heaters reduces output and results in excessive preheat periods. ★ Long preheat times may encourage staff to use additional portable electric heaters.	★ Check that all fan heaters are fitted with filters and that they are kept clean ★ Check that the cleaning of heating surfaces, radiators, baseboards, etc., is included in all regular cleaning routines.
12	Check regularly whether heating and ventilating controls, valves and dampers are operating correctly.	★ Seized valves and dampers (or those that will not close properly) will waste money and result in discomfort for staff.	★ Check that all radiator valves work. ★ Check that motorised valves and dampers have full travel from open to closed. ★ Make sure that hot water is not passing through closed valves (hydronic systems)

13	Ensure that where heating and air conditioning units are installed in the same room, that their settings avoid simultaneous operation.	★ Simultaneous heating and cooling wastes a lot of money!	★ Set thermostats at 24°C or more for cooling and 19°C or less for heating. ★ Set units in common areas to the same mode of operation (either heating or cooling) to avoid operational conflicts.
14	Check if there are any sources of unwanted heat in air-conditioned areas.	★ Heat from uninsulated pipework, appliances, office equipment and similar sources makes air conditioning equipment work harder.	★ Check for sources of unwanted heat in air conditioned areas and remove or insulate.
15	Regularly check if staff is using unauthorised portable electric heaters.	★ Portable electric heaters are expensive to run ★ As portable heaters are usually not fitted with time switches or thermostats, they will often be left running all day.	★ Allow portable electric appliances only in exceptional circumstances as a temporary measure. ★ If staff regularly uses portable heaters, find out why – it may mean that the permanent heating system is inefficient, or that bad practices, such as opening windows and doors for cooling are taking place.
16	Keep in mind natural cooling instead of forced one.	★ You can ensure significant savings by overriding the HVAC controls.	★ During spring, summer and fall months use fans and open windows instead of running the air conditioners. ★ Keep humidity out of the building.
17	Get help from the Sun.	★ A different approach in summer and in winter time	★ ***Winter:*** keep curtains or blinds open on the South side of the building during the day. Keep them shut on the north side windows♣. ★ ***Summer***: Close curtains or blinds on the sunny side of the building; if applicable, use fans to circulate air.
18	Use ceiling fans properly	★ Ceiling fans can de-stratify the vertical warm or cold air distribution in your premises.	★ Use ceiling fans to move cool air to occupied areas in summer; ★ Reverse their blade direction to circulate warm air down in the winter time.
19	Do not run any ventilation, cooling or heating equipment on idle.	★ The simplest is the most efficient.	★ It is always the cheapest: shut down any ventilation, a/c, or heating equipment when the building (or part of it if it is zoned) is not occupied.
20	Utilise all heat sources.	★ You might have “free” heating sources in the building.	★ Utilise waste heat from compressors and/or refrigerator condensers to heat make-up air

♣ This could increase demand for artificial lighting, so the clever compromise is needed.

21	If your heating system is a steam one, make sure the steam distribution equipment is properly maintained and serviced.	★ Leaking steam distribution systems or faulty condensate traps represent extreme losses.	★ Put in place an ongoing steam trap monitoring and repair/replacement program. ★ Survey steam traps and repair malfunctioning units. ★ When surveying steam traps, survey steam valves, flanges and joints as well. ★ Repair steam/condensate leaks, regardless of size. ★ Shut down steam/condensate branch lines when not in use for a significant time period. ★ Check and maintain pressure reducing stations (valves). ★ Use the lowest pressure possible when using steam for heating. ★ Reduce system/subsystem pressure where possible. ★ Ensure appropriate and correctly functioning air vents in system. ★ Ensure correct slope to clear condensate from steam appliances. ★ Clean heat transfer surfaces regularly ★ Shut down steam-consuming equipment when not required.

HVAC: low cost measures

	Opportunity	Reason	Action
22	Install modern electronic thermostats	★ The older type of thermostats can allow room temperatures to vary by up to 3°C from the set temperature. ★ Wide variations of room temperature causes discomfort to occupants.	★ Replace any older bi-metallic type with modern electronic versions. These allow closer control, typically 0.5°C variation from the set temperature.
23	Consider fitting the thermostatic radiator valves to your hydronic radiators (if any)	★ If individual rooms suffer from regular overheating, staff will solve the problem by opening doors and windows – this wastes money!	★ Carry out a survey of rooms which appear to suffer from overheating ★ Fit thermostatic radiator valves (TRVs) which incorporate a locking mechanism – ensure they are correctly set and locked.
24	If you have radiant heaters, are they controlled by black bulb thermostats	★ Conventional thermostats are inappropriate for radiant heating systems	★ For radiant heater systems, replace conventional thermostats with *black bulb* thermostats.

25	If there are areas in your building which are sometimes unoccupied, ensure that the heating automatically adjusts to meet the reduced demand.	★ Reducing the temperature in these areas during unoccupied periods will save money. ★ Two stage thermostats provide much more flexible control.	★ Fit two stage electronic thermostat to an occupancy sensor.
26	Assure that you can accurately program the time settings on heating and ventilation systems to allow for weekends, early finishing and late evening working.	★ Some time switches of the older electro-mechanical type cannot be programmed for different daily schedules (for example, earlier switch-off on Fridays, or part day switches on weekends).	★ Install a 7 day electronic timeswitch to permit different settings for each day and individual settings of ten minutes or less.
27	Assure that the heating system is flexible enough to cope with occasional out of hours working.	★ If heating is required throughout the whole building, fitting extension timers is a more efficient option than constantly reprogramming timeswitches. ★ If only a part of the building is to be used, it may be more economic to provide local heating.	★ Fit an extension timer where appropriate ★ Provide supplementary portable heaters where required – ensure that use is limited to approved periods only.
28	If the building has electric heating – assure that it automatically switches off when not required.	★ Although direct electric heating is cheap and easy to install, it is expensive to run, particularly when not controlled. ★ Electric heaters should automatically switch off (or drop to reduced level) when areas are not occupied.	★ Fit 7 day electronic time switches to all electric heaters, ★ Or in intermittently occupied areas – install an electronic two level thermostat with an integral run-back timer to switch electric heaters off after a pre-set time. ★ Electric heat is not recommended due to the high cost of electrcity
29	Properly insulate the heat distribution pipework / ductwork	★ Heat losses from uninsulated pipework / ductwork can be reduced by more than 70% by adding insulation	★ Insulate all pipework (ductwork) except where it gives useful heat. Be sure insulation is proper in such places as attics, basements, garages, crawl spaces, etc.

30	If the building has high bays – check the difference in temperature between floor and ceiling levels	★ Warm air rises and collects in the roof space where it is not needed. ★ Large temperature differences increase heat losses through the roof.	★ If the temperature difference is excessive (more than 5^{o}C), fitting a de-stratification fan controlled by a thermostat will help bring the warm air down to working areas.
31	If the propane or oil fired air heaters are in use – service them at least annually.	★ A build –up of deposits caused by combustion will reduce heater efficiency. ★ Wear on heater controls and linkages will cause poor performance.	★ Arrange for a regular heating service and combustion check. Heaters and burners should be properly cleaned at least once a year by a qualified contractor. ★ The servicing should include a combustion efficiency check and the burner air/fuel ratio should be adjusted for optimum efficiency, according to the manufacturers instruction. ★ Instruct the contractor to maximize the heater's efficiency and to provide a test sheet showing the results of the tests, the heater efficiency and manufacturers quoted maximum efficiency.
32	Make sure the extraction fans for areas such as toilets and kitchens are time controlled and efficient, but do not contradict the heating system.	★ Running extraction fans during periods when rooms are unoccupied is generally not necessary and wastes money. ★ As warm air is extracted from the building, the heating system has to work harder.	★ Fit a 7-day timeswitch to all extraction fans, which are not needed to run overnight and at weekends. ★ Fit a humidistat to any extractor fan, which is used to remove moist air. ★ Connect exhaust fans into controlled lighting circuits (e.g. in small toilet areas). ★ Check that ventilation / exhaust rates correctly correspond to occupancy. ★ Balance air flows for appropriate zero, positive, or negative pressure.
33	Make sure that extraction fans are fitted with self-closing shutters.	★ Cold air can enter even when the fans are not running, producing heat loss.	★ Install and maintain operability of shutters – they are available for most makes of exthaust fans.
34	Block heat out of the building in summer.	★ Sun will heat up the rooms through windows and make air conditioning to work harder.	★ Install external shades, awning, lined curtains, etc. to keep direct sun from heating the interiors.
35	Avoid simultaneous heating and cooling of same premises.	★ This is just most inefficient to do.	★ Interlock heating and cooling systems to avoid their simultaneous operation.

36	Look into heat losses from steam equipment.	★ Steam equipment must be maintained to avoid heavy losses.	★ Use indirect rather than direct steam heat and then recover condensate. Process Insulation—Lower Cost ★ Repair damaged insulation. ★ Maintain safety requirements — surface temperatures must be kept below 70°C. ★ Insulate non-insulated pipes. ★ Insulate non-insulated vessels. ★ Insulate valves and flanges. ★ Paint or wrap tank and pipe surfaces with low-E aluminium paint or foil. ★ Add/upgrade insulation up to the economical thickness

HVAC: activities that will require some planning

	Opportunity	Reason	Action
37	Check if parts of your buildings are regularly too hot, while others are just only warm enough.	★ Overheating can cause a lot of discomfort for staff and wastes money.	★ Check heating levels in different parts of the building. Use this information to *re-balance the heating system*.
38	Is your heating system zoned?	★ If you divide your heating system into zones, you can ensure that heat is provided only when and where it is needed to avoid waste.	★ Fit zone valves (hydronic systems) with time and temperature controls where appropriate (make allowance for frost override)
39	Use weather compensated controls if you have the radiator systems.	★ A weather compensator adjusts flows temperature in the heating system to match variations in outside temperature. Weather compensators save money by preventing overheating during mild weather.	★ Install weather compensated controls. (Hydronic systems)
40	Have an optimum start controller	★ Heating may be turned on later in mild weather, as shorter warm-up periods are required. ★ An optimum start controller adjusts start times automatically and gives typical fuel savings of 10%	★ Install an optimum start controller. Most controllers will also provide features such as optimum stop, day economy and automatic frost protection.

41	Consider using localised heaters for areas where general space heating is not needed.	★ Spot heating of a localised area is often a much cheaper option than trying to heat a large area.	★ Install localised radiant heaters, controlled with a push-button run-on timer.
42	If you are using a lot of electric heating – are you utilising off-peak electricity?	★ Rates differ	★ Check with hydro company. ★ Install night storage heating, or change to propane or oil fired heating system ★ Consider replacing electric heat with other, more cost effective systems
43	Is a weather compensated controller fitted to your off-peak electric storage heater system?	★ Off-peak controllers regulate the amount of heat stored by relating the start of the charging period to the outside temperature. ★ This saves money and increases comfort by reducing overheating, particularly in autumn and spring.	★ Install a central weather compensated controller.
44	Check if exhaust fans take away heated air from working areas.	★ Exhaust fans often take heated air from working areas, which is a waste of money.	★ Where equipment is fitted with exhaust fans, try to arrange it near an outside wall. This will facilitate the installation of a fresh air inlet near to the exhaust. The fresh air inlet will prevent draughts and discomfort in the main area of the room and reduce the loss of warm heated air. ★ Consider recovering heat from the warm extracted air.
45	Check that the air flow from ventilation systems are not excessive and do not abuse the heating system's efficiency.	★ It is very common to find excessive rates of ventilation, which waste both heat and electricity.	★ Measure ventilation systems air flow and opportunities for reduction, such as closing dampers and changing fan pulley sizes. ★ Zone ventilated areas and sequence air flow based on contaminant levels. ★ Consider installing air-to-air heat recovery equipment on exhaust/intake systems.
46	Consider incorporating air re-circulators into ventilation systems.	★ Heating fresh air costs money.	★ Where possible, modify general ventilation systems to incorporate re-circulation of exhaust air.

47	Consider improvements in the steam heating system	★ Because of high energy value, steam is a valuable energy carrier, but for the same reason inefficiency of steam systems can be very costly.	★ Consider condensing steam rather than using only the superheat for heating. ★ Recover flash steam if a suitable use can be found. ★ Use only steam as a heat source if it is appropriate (use the lowest form of energy possible to avoid downgrading high quality [temperature] energy). ★ Recover heat from contaminated condensate that must be dumped. ★ Monitor steam and condensate flows continuously to ensure a balance. ★ Track down imbalances in steam and condensate flows. ★ Replace PRVs with small steam turbines if appropriate.

7. WATER

This section deals with two issues:
1. using less water and
2. using less hot water and/or less energy to heat it.

Water: no cost measures

	Opportunity	Reason	Action
1	Make your staff aware that the water supply is metered	★ Very often staff is unaware that water supply is metered	★ Use promotional materials, posters, stickers, booklets, etc. ★ Use staff meetings to raise awareness of the cost of water
2	Make your staff aware of the importance of such simple measures as turning off taps.	★ Taps that are not properly closed, waste water. One leaky faucet can waste 2,000 gallons of water per year, sending your savings down the drain. ★ Dripping hot water taps also waste energy.	★ Initiate "good housekeeping" campaign to encourage staff to turn taps off completely
3	Make sure that dripping taps are repaired immediately	★ The dripping taps are obviously costly, but if they are not repaired immediately – the credibility of your savings campaign will be diminished!	★ Carry out regular checks on outlets. ★ Act on all reports on dripping taps immediately – you can not expect the staff to act responsibly if you don't set the example
4	Check water systems for leaks, including sections running underground	★ Leaks in visible pipes are obvious, but hidden leaks can go undetected for years.	★ Carry out regular checks on visible pipes ★ Encourage staff to report any visible leaks immediately
5	Where showers are used, check the average time of use.	★ An average shower uses 30% less water than a normal bath. An energy-saving shower uses only 2 to 3 gallons of water per minute instead of 5 to 7 gallons, saving 20 to 40 gallons of water over a 10-minute shower.	★ Encourage the shower users to get in the habit of taking quick showers.

6	What is the temperature of your hot water?	★ Hot water is often overheated – every 10°C reduction in Hot water temperature saves 15% of energy. ★ Lowering the hot water temperature would also reduce the risk of scalds♣.	★ Reduce immersion thermostat settings to 60°C. ★ **IMPORTANT**! To avoid the possibility of legionella, do not reduce the temperature of stored water below 60°C !
7	Check if hot water is used unnecessarily	★ Hot water is always more expensive to produce than cold water. ★ Hot water is sometimes used where cold water would be equally effective (for example, washing floors or rinsing)	★ Check the different ways that hot water is used in your facilities. ★ Always use cold water for cleaning, etc., unless hot water is absolutely necessary.
8	Switch off the hot water system during holiday periods.	★ There is no need to run hot water systems over nights, weekends and holiday periods – it just wastes money. ★ In oil fired water heaters the pilot lights may remain burning over off periods, wasting significant amounts of oil.	★ Make someone responsible for switching off the water heaters before the start of holiday periods. ★ If your facility is operating the oil fired water heaters, make sure that the pilot lights are also switched off.
9	Set controls of water controls correctly.	★ A lot of heat is lost from the boiler and distribution pipes. ★ Running the boiler all day is usually uneconomical.	★ Reset timeswitches to provide one or two separate 2 hour heating periods during the day. ★ Set immersion heater timeswitches to switch off about an hour before the end of daily occupancy. This makes the best use of stored hot water.

♣ The following chart will show you how quickly very hot water can cause serious burns:

Temperature setting on water heater:	**The time it takes to produce 2nd and 3rd degree burns on adult skin:**
Approximately 160F (very hot)	About 1/2 second
Approximately 150F	About 1 1/2 seconds
Approximately 140F	Less than 5 seconds
Approximately 130F	About 30 seconds
Approximately 120F (hot)	More than 5 minutes

10	If the electric water heater is used to generate hot water during summer, - is the circuit from the heating boiler isolated?	★ Water heated by an immersion heater can pass heat to the boiler and its water, which wastes money.	★ Check the pipework that links the hydronic heating boiler to the hot water cylinder during summer. If the pipes are warm, isolate the primary circuit (boiler plant to hot water storage cylinder) ★ Carefully label and record all valves that have been closed. ★ It is possible to fit a non-return valve, but there will be some cost for this action. ★ An energy efficient alternative is to install local water heaters where required. ★ Electric water heaters are not recommended for use due to the high cost of electricity
11	If several water heaters with hot water storage cylinders are used in the same location – check if their number can be reduced.	★ Storing too much hot water is generally wasteful.	★ Check how many hot water cylinders are necessary ★ If it is possible to reduce the number used, identify, isolate and drain redundant cylinders.
12	Encourage the cafeteria staff (if any) to use water economically.	★ "Good housekeeping" routines in kitchens can significantly reduce water consumption. This can save both water and energy.	★ Initiate and encourage "good housekeeping" routines for efficient use of water in kitchens
13	Do not allow the sediment to collect in water heaters.	★ The sediment will lower the heater efficiency as well as speed-up its aging.	★ You can lengthen the life of your water heater and maintain storage capacity along with maintaining its designed efficiency by draining the sediment from the bottom of the tank at least once or twice a year.

Water: low cost measures

	Opportunity	Reason	Action
14	Insulate hot water tanks.	★ Insulating the hot water tanks will reduce heat losses by up to 75%.	★ Insulate all hot water tanks, preferably with kits recommended by manufacturer.
15	Insulate all hot water pipes.	★ Insulating pipes will reduce heat losses by up to 70%.	★ Insulate all pipes!
16	Fit all immersion heaters with timers.	★ A timer can be used to ensure that hot water is not generated when not required	★ Install a heater timer.

17	Are hot water circulating pumps time controlled?	★ If secondary circulating pumps are run at night, any heat stored in the cylinder is lost. ★ Money is also wasted in running the pump	★ Check whether secondary pumps need to run at night. ★ If not, fit a timer to prevent night use.
18	Are flush controllers installed on urinal systems in gents' toilets?	★ Uncontrolled urinals normally flush every 20 minutes – often wasting money. ★ Controllers can limit flushing to periods when the building is occupied	★ Install electronic urinal flush controllers incorporating passive infra-red occupancy sensors to trigger flush cycle.
19	Check if all Cisterns hold only 7 litres of water	Excessive capacity in Cisterns wastes water	★ Fit water dams or volume reducers in Cisterns. (these should not be installed where there has been persistent drain blockage.)
20	Check if all washroom taps turn off properly.	★ Taps left dripping will waste water. ★ Hot water taps left dripping will also waste energy.	★ Consider converting to push button taps to provide an automatic shut-off.
21	Fit tap restrictors.	★ Many taps and/or shower heads give an unnecessary high flow after only a quarter of a turn.	★ Fit flow restrictors to all taps, shower heads or to supply pipes. ★ Low flow aerators on faucets are a good idea.
22	Turn off the hoses immediately after use.	★ Hoses left on after use waste a lot of water.	★ Fit spring loaded pistol grips to hoses to provide automatic cut-off.

Water: activities that will require some planning

	Opportunity	Reason	Action
23	Heat water at points close to where it is used.	★ Long pipe lengths result in significant heat losses. ★ It is cheaper to heat water where it is used.	★ To provide small quantities of hot water (for hand washing, etc.) use wall mounted electric water heaters. ★ To provide larger quantities of hot water (for kitchen, shower, etc.) use free standing gas fired water heaters.
24	Consider replacing existing hot water storage tanks with a plate heat exchanger	★ Plate heat exchangers are very efficient and produce rapid response. They have minimal heat losses, minimize the risk from legionella and are cheaper to run.	★ Consider installing plate heat exchangers as part of hydronic heating system when replacing obsolete or failed storage tanks, or in new installations.

8. BOILERS AND FURNACES

Boilers are not 100% efficient – around 20% of heat generated is lost up in the chimney.
Heat loss can increase to 30% or more if the boiler is poorly maintained or operated.
For safety reasons boilers must be maintained to the best condition and only by professionals.

Boilers and Furnaces: no cost measures

	Opportunity	Reason	Action
1	Check your boiler plant weekly	★ A Boiler operating inefficiently will waste a significant amount of money. ★ Weekly checks on the boiler will quickly detect any problems.	★ Arrange for a weekly check on a boiler plant. ***Check for:*** • Any warning lights; • Signs of leakage from pipework, valves, flanges, boilers. • Any gas smell; • Damage and burn marks to boilers and flues; • Undue noise from pumps and burners; • Blockage in air vents.
2	Check that your boiler room is adequately ventilated with all louvers and vents open and not obstructed.	★ Restricting the supply of air to a boiler will result in loss of efficiency due to incomplete combustion. ★ Inadequate ventilation can allow the release of potentially dangerous gases, therefore boiler house ventilation is vital for health and safety.	★ Conduct regular checks to ensure that ventilation openings are kept free and clear at all times.
3	Regularly check the hydronic heating system for leaks.	★ Leaking system requires water losses to be compensated. Adding water can result in corrosion, scaling and loss of efficiency.	★ Check the feed and expansion tank regularly. If you can hear water filling the tank through the ball valve, it is likely that the system is leaking. ★ If you suspect a leak, call a contractor immediately to investigate!
4	If you have a multiboiler installation, turn off superfluous boilers during mild weather.	★ Multiboiler installations are designed to cope with highest levels of heat demand. ★ Running the full system during milder weather wastes money.	★ Turn off superfluous boilers during mild weather. ★ Close isolating valves to stop water flowing through them. ★ Label boilers and valves to indicate that they are isolated. ★ Don't forget to reopen valves before attempting to re-start boilers.
5	If you have the a multiboiler installation, use the smallest boiler during summer.	★ Larger boilers lose more heat than smaller boilers.	★ During summer, only use the smallest available boiler for generating hot water.

6	If you have a multiboiler installation, fit with boiler sequencing controls.	★ To avoid wasting heat, the minimum number of boilers should be firing at any one time.	★ Check that boilers are not firing-up and closing down simultaneously. ★ Set individual boiler thermostats to fire on an increasing range from 60°C to 85°C. This will ensure that the minimum number of boilers are firing to meet demand. ★ Consider installing sequencing controls (see low cost ideas)
7	Turn off the heating boilers and their pilot lights during summer.	★ Leaving boilers on during the summer is wasteful.	★ Arrange for someone to turn off boilers and pilot lights in the summer and to re-light them when required.
8	Check if your boilers continue to fire when there is no demand for heating	★ Boilers can continue to fire even when the room thermostat or heating timer shuts off the pump.	★ Arrange for the wiring to be altered so that the thermostat and heating timer shut off both the circulating pump and the boiler(s).
9	Check if furnace filters are cleaned or changed frequently.	★ Dirty filters block the airflow of forced air heating systems, thus making them less efficient.	★ Have somebody responsible for regular cleaning / changing of filters.
10	Keep burners efficient	★ Maintaining all your combustion systems for maximum combustion and heat production efficiency	★ Regularly check combustion efficiency. ★ Regularly monitor excess air and ensure that it meets manufacturers specifications. ★ Relocate combustion air intake to increase temperatures. ★ Manage load/condition swings to maintain optimal conditions ★ Ensure clear and unhindered exhaust stream in reciprocating engines. ★ Keep burner assemblies in proper and regular adjustment. ★ Maintain seals, air ducts, access doors.
11	Maintain water quality in boilers.	★ Poor water quality results in loss of efficiency and premature ageing of boiler	★ Utilise and check proper water treatment procedures. ★ Maintain dissolved solids at an appropriate level and monitor regularly.

Boilers and furnaces: low cost measures

	Opportunity	Reason	Action
12	Service your boilers at least once a year.	★ A build-up of deposits caused by combustion will reduce boiler efficiency. ★ Water in controls and linkages will result in poor combustion.	★ Burners and boilers should be properly cleaned and serviced at least once a year by a qualified contractor. ★ Servicing should include a combustion efficiency check and adjustment of the burner air/fuel ratio for optimum efficiency in accordance with manufacturer's instruction. ★ Tell the contractor to maximize the boiler efficiency and provide a boiler test sheet showing the results of the tests, the boiler efficiency and the maker's quoted maximum efficiency. ★ For boilers with gas atmospheric burners, combustion checks can be limited to testing gas pressure.
13	Monitor the performance of your boilers.	★ Combustion deposits cause an increase in flue gas temperatures and result in more heat being lost through the flue. ★ Water scale build-up can also cause the flue gas temperature to increase.	★ Consider installing a flue gas thermometer. The boiler is ready for cleaning again when the maximum temperature of the flue gas rises by over 40^{o}C since last service.
14	Insulate all your boilers.	★ Boilers which are not insulated lose heat into surrounding areas. This is a significant waste of money.	★ Check that boilers are adequately insulated (minimum 50mm thick insulation). ★ If they are not insulated, fit 50 mm thick mineral fibre mat with foil laminate to the inside of boiler casing (many manufacturers can supply purpose made boiler insulating units). ★ Make sure that insulation does not interfere with burner or air supply to the boiler.
15	Insulate all heat distribution pipes, valves and flanges.	★ Heat losses from hydronic heating system's pipes can be reduced by over 70% by insulation. ★ Significant heat is lost from valves (equivalent to the heat lost from 1 m of pipework). And flanges (equivalent of 0.5m of pipework)	★ Check all pipes, valves and flanges around the boiler area. ★ Insulate all distribution pipework which is not contributing useful heat to work areas. ★ Insulate all valves and flanges (50 mm or larger) with quick release valve jackets.

16	Consider adding a humidifier to your heating system if your facility is not equipped with one.	★ Humidifier adds moisture to the air in the winter and makes the building "feel" warmer at a lower temperature.	★ If possible, install a humidifier.

Boilers and furnaces: activities that will require some planning

	Opportunity	Reason	Action
17	Are heating and hot water supplied from different boiler plants?	★ Where possible, hot water and heating should be supplied from different boilers. ★ Dividing the system allows the boilers used for heating to be switched off in the summer – and saves money.	★ Check your existing installation. ★ Consider the possibility of installing a dedicated hot water boiler or hot water generator.
18	Is your boiler plant the right size to meet the current needs of your facilities?	★ You may have moved to premises which already had a boiler. ★ Having a larger than necessary boiler wastes money	★ Check whether your boiler is the right size to meet your needs. ★ Consider replacing plant if it is too big.
19	Have you looked at the operating efficiency of your existing boiler?	★ Older systems are usually less efficient than modern systems (10-30%)	★ Check your present boiler plant. ★ If it is an old system, consider the benefits of replacing/updating it ★ Install air pre-heater. ★ Install new combustion controls. ★ Consider flue gas heat recovery with or without condensation.
20	Consider using a condensing boiler	★ Condensing boilers are more efficient as they recover as much of the heat as is practically possible from the flue gas.	★ Check whether you have a condensing boiler. ★ Look at the possibility of fitting condensing gas boilers when existing plant is due for replacement.

9. BUILDING ENVELOPE, DOORS, WINDOWS

This section deals with the way you look after your building(s) and shows various actions you can take to reduce losses and draughts.
Do not forget, that to ensure the health of staff, all buildings need adequate ventilation.

The building: no cost measures

	Opportunity	Reason	Action
1	Do staff keep windows and doors closed when the heating system is operating?	★ Windows are often opened because rooms are too warm. ★ Doors are often wedged open for convenience. ★ Up to one third of heating costs can be saved by reducing the amount of cold air that enters your building.	★ Use promotional materials (posters, booklets, etc.) to encourage staff not to leave doors and windows open when heating is on. Use staff meetings to raise awareness of the high cost of heating.
2	Are all unused doors and window permanently sealed?	★ Unused doors and windows are a source of drafts which cause discomfort and waste money.	★ Identify and seal doors and windows that are no longer used. Carefully check that apparently unused doors and windows are not required for safety reasons (e.g. fire escapes).
3	Have a maintenance program for doors, windows, roofs.	★ Drafts from windows and doors cause discomfort. ★ The resulting “chill factor” often prompts staff to raise room temperatures to compensate.	★ Before the start of each heating season, make a careful check of all doors and windows and carry out necessary repairs. ★ Your check list should include: • Window panes, • Window components: frames, pull cords, etc., • Door components: frames, hinges, closers, letter box flaps. • Plastic strip curtains, • Rapid action doors, • Roller shutter doors, • Concertina doors, • Eaves, roof lights, etc.
4	Are ventilators that are used for summer cooling closed off before the heating season begins?	★ It is wasteful to allow cold air into the building or to extract warm heated air unnecessary.	★ Make someone responsible for closing off all ventilators used for summer cooling. Carefully check that ventilators are not needed for essential purposes such as removing fumes, dust or odours.
5	Check your buildings for drafts from redundant fireplaces, flues, stacks and chimneys.	★ A lot of heated air can escape from buildings through these pathways.	★ Carry out a check to identify redundant fireplaces (if any), etc., Blank off or remove all redundant fireplaces, flues, stacks, exhaust vents and chimneys.

6	Regularly check your buildings for signs of dampness.	★ Dampness causes damage to the building structure and severely reduces the insulating properties of building materials.	★ Check for faulty damp proof courses, leaking gutters from pipes, broken and missing roof tiles, etc. ★ Repair all necessary items. Set up a system of regular checks for blocked gutters.
7	Does your facility use window mounted air conditioning units?	★ Out of air conditioning season, the window-mounted units can be sources of draughts.	Make sure that window mounted air conditioners are properly covered, thermally insulated and sealed when not in use.

The building: low cost measures

	Opportunity	Reason	Action
8	Insulate adequately all accessible attic spaces	★ Uninsulated attic spaces are a major cause of heat loss. ★ Insulation applied to unisulated areas will reduce heat losses significantly (for example 100 and 150mm of glass fibre can reduce losses by up to 90%).	★ Identify uninsulated attic areas and apply insulation where appropriate (different insulating materials have different insulating values, but between 100 and 150 mm of most materials is recommended. ★ When applying, ensure that there is sufficient ventilation at the eaves. ★ Remember to insulate any water tanks and pipes in the loft space to reduce the risk of freezing.
9	Seal the windows, roof lights and doors.	★ Draft proofing is a cheap and very effective means of reducing heating costs and improving staff comfort.	★ Carry out a survey of buildings to identify where draft proofing is needed. ★ Fit draft proofing to all external doors and all internal doors that separate cold and warm areas. ★ Caulk and weather-strip and draft proof all windows. ★ Ensure that all combustion appliances are adequately ventilated (including gas fired catering equipment).
10	Fit your external doors with door closers.	★ People often fail to close doors properly, resulting in significant heat losses.	★ Fit spring loaded door closers.
11	Separate effectively heated areas from unheated areas.	★ If heated and unheated areas are effectively separated, drafts will be reduced. This will result in improved staff comfort and reduced costs.	★ Fit plastic strip curtains, swing doors, or other suitable partitions between cold and warm areas.

12	Provide for heaters to automatically switch off when doors in loading bays, garages, workshops are opened.	★ Large open doors result in substantial heat losses. ★ If heat is cut off when doors are opened, there is an incentive for staff to keep door closed.	★ Interlock the operation of heaters and large opening doors, such as doors of garages, workshops, etc.
13	Search for- and seal cracks	★ Cracks may occur in foundations, walls, roofs and around openings (windows, doors, skylights, etc.). Due to normal use, thermal expansion and contraction, material aging, foundation settling, or earthquake damage can cause these cracks. ★ Cracks become effective source of cold air leaks.	★ Arrange for regular checking and filling of cracks (if any) with glass fibre, expanding foam, silicone, and sealants. These materials can be used to repair cracks or restore damaged seals in the building envelope.

The building: activities that will require some planning

	Opportunity	Reason	Action
14	Insulate all cavity walls.	★ Heat loss through cavity walls can be reduced significantly (up to 2/3) by installing cavity wall insulation in older buildings.	★ Install cavity wall insulation where appropriate.
15	Insulate all roofs properly	★ Some roofs will have a very high rate of heat loss. These include roofs made of single skin corrugated iron. ★ Losses can be as much as 15 times that of a modern, well insulated roof.	★ Look at the possibility of insulating roofs that suffer high heat losses. Suitable methods include lining, over-spraying and under-spraying.
16	Consider insulating flat and pitched roofs during re-roofing work.	★ Older types of flat and pitched roofs often have poor insulating qualities.	★ Take the opportunity to install additional insulation to both flat and pitched roofs during re-roofing operations.

17	Consider installing suspended ceilings.	★ Suspended ceilings reduce the volume of air to be heated. ★ They provide additional insulation against heat losses. ★ Installing suspended ceilings could also reduce lighting costs.	★ Look at possibility of installing suspended ceilings.
18	Fit all windows with double or triple glazing.	★ Heat losses through windows, can be halved by fitting double or triple glazing. ★ The comfort of staff working near windows is improved. ★ Noise levels from outside are considerably reduced.	★ Look for opportunities to fit double or triple glazing. ★ This option has to be considered when upgrading a heating system or replacing windows as an extra cost of additional glazing can not normally be justified by energy savings alone.
19	Install secondary glazing under roof lights.	★ Heat losses will be reduced by up to a half. ★ Staff comfort will be improved by eliminating of down-draughts.	★ Investigate opportunities to install polycarbonate secondary glazing under roof lights.
20	Consider applying solar film to windows in air-conditioned areas.	★ Heat is gained through windows not fitted with solar film. The additional heat means that the air conditioning system has to work harder and costs more to operate. ★ Staff can suffer from both glare and heat in rooms which face the sun and are not fitted with solar film.	★ Investigate opportunities to fit solar film to windows receiving direct sunlight in air-conditioned areas. ★ ***BUT*** be aware that fitting solar films reduces light levels and may result in an increased use of artificial lighting.
21	Look at ways of reducing draughts coming from large doors in garages or workshop areas.	★ Draughts from large open doors are likely to cause discomfort to staff and can promote the use of additional expensive heaters.	★ There are a number of options which you might consider, including: ★ Using partitioning to create a draft lobby with inner and outer doors. ★ Fitting rapid action automatically closing doors. ★ Fitting plastic strip curtains. ★ Installing air curtains. ★ Installing wind breaks if the opening faces prevailing wind.

10. ELECTRIC EQUIPMENT

Electricity is both easy to use and easy to waste. Some simple no cost and low cost actions will help to save money.

This section looks into problems related to office equipment and commonly used electric appliances, such as kitchen or laundry installations. More tips on specific office equipment can be found in Appendix 2.

Electric equipment: no cost measures

	Opportunity	Reason	Action
1	Switch off all computers, printers and associated equipment when not in use.	★ Leaving computer equipment switched on for long periods when they are not in use wastes money♣. ★ The heat given out by computer equipment may encourage the use of electric fans and may add to air conditioning costs.	★ Identify equipment that can be switched off when not in use. ★ Use green and red labels to indicate which equipment can be switched off and which must stay switched on. ★ Make appropriate staff aware that green-coded equipment must be switched off when not in use.
2	Switch the photocopiers to stand-by mode when not in use for long periods.	★ Many photocopiers have a stand-by mode ("sleep") which will reduce the power without switching off the machine.	★ Encourage staff to switch photocopiers to standby mode during long periods when they are not in use.
3	Check regularly whether there is any use of unauthorised portable electric heaters.	★ Portable electric heaters are very expensive to run. Generally, they do not have timeswitches or thermostats and are often left running continuously by staff.	★ Check regularly for use of unauthorised portable electric heaters. ★ If staff is regularly using portable heaters, check the heating arrangements for that area.

♣ Experts agree that turning off personal computers, copiers and printers at the end of the workday does not adversely affect them. Savings of up to $200 per year can be achieved by turning off each computer every night, and an additional $10 to $15 a year can be saved by simply turning off the monitor when it's not in use. Turning the computer off once a day should not decrease its life. A power surge is more likely to happen if the computer is constantly left on. Giving the computer a nightly rest saves energy and dollars. The two primary concerns about turning computers off daily are first, whether the read drives are damaged if they meet when the cushion of air is shut off and second, if computer components wear out sooner due to the power surge when the computer is turned on. The read drives should not be damaged unless the computer is malfunctioning.
Leaving some computer equipment overnight is, certainly, justified in case of systems which require constant access – such as servers, library systems, network routers, etc.

4	Look for areas to use less powerful heat sources	★ Often the 150W foot warmers would provide adequate comfort instead of using 1500 W space heaters.	★ Discuss the possibilities with staff.
5	If you have soft drink vending machines, or other sales machinery, in your facilities building, have a close look at them for energy saving.	★ The vending machines often have lots of lights, whose sole purpose is to advertise the soda, boost cooling costs for the machine, and are usually left on twenty-four hours a day. It costs $75-$100 per year per machine to support this advertising campaign	★ Have the lights removed and post a sign confirming that the machine is in working order.
6	Regularly check the seals on refrigerators and freezers.	★ Worn or damaged seals increase refrigeration costs by allowing warm air to enter into refrigerating space and cold air to leak out.	★ Set up a programme for regular inspection of seals. ★ Replace all seals which show any signs of wear or damage.
7	Check how refrigerators and freezers are used.	How you use refrigerating and freezing equipment dramatically impacts their energy efficiency.	★ Freezers work most efficiently when full. ★ Refrigerators should be full but not overcrowded. Air circulation is needed. ★ Set the refrigerator and freezer at the highest possible settings that will still preserve food quality. ★ Cool foods to room temperature before putting them in the refrigerator. ★ Cool foods in the refrigerator before placing them in the freezer. ★ Check the door gasket for air leaks with the $1 bill test. Close the door with the bill half inside the refrigerator. Pull on the bill. There should be resistance; it should not slip out easily. ★ Limit the number of times you open and close your refrigerator. ★ Vacuum the condenser coils on the bottom or back of the unit twice a year to maintain peak operating efficiency. ★ Never allow excess frost in the freezer. Heavy frost overworks the equipment. ★ Try to provide cool air to the condenser
8	Encourage staff to switch off the electric equipment when idling.	★ Most equipment consumes significant quantity of energy even idling.	★ Make staff aware of the cost of leaving machinery running when not needed. ★ Set up a procedure to ensure that equipment is switched off during stoppages – lunches, etc.)

9	Check if air-conditioned computer rooms are being maintained at the correct temperature.	★ Many computer rooms are maintained at unnecessary low temperatures, which wastes money. ★ Stable temperatures are usually more important than high or low temperature.	★ Check and adjust computer room temperatures to about 25^{o}C. ★ BUT before making adjustments, check the precise system requirements.
10	Check if cooking appliances are efficiently used in staff rooms and/or canteen kitchens.	★ Heating appliances are responsible for a large percentage of daily consumption.	★ Use the microwave oven or small appliances instead of the oven or range top whenever possible. ★ Whenever using the oven, cook as many items in the oven as is practical. ★ Use pots closest to the burner's size. ★ Keep pots covered when cooking. ★ Use the exhaust over the range when heat and steam are being produced. ★ Do not open oven doors or remove pot lids until cooking is complete
11	Check how the dishwashers are used in the cafeteria kitchen, if any.	★ Dishwasher usage should follow the following guidelines for efficiency.	★ Make sure the operating staff is aware of the following rules. Use promotional materials, posters for this. ★ Scrape and rinse dishes before putting them in the dishwasher. Cold water can be used to rinse dishes immediately after a meal. ★ Make sure your dishwasher is fully loaded. By doing so, you save water, detergent and the energy required to heat the water for a number of loads. ★ Newer dishwashers have energy-saving cycles which allow dishes to dry without additional heat. You might want to try this to see if this feature meets your needs. ★ To reduce heat and humidity in the summer, operate the dishwasher during the cooler morning and evening hours.

12	Check how the laundry equipment is used, if any.	★ Washers and dryers are significant electricity consumers.	★ Make sure the operating staff is aware of the following: ★ Ninety percent of the energy for laundry goes to heating the water, so use an appropriate wash temperature and a cold rinse. ★ When possible, use cold or warm instead of hot water. ★ Place different-sized garments in a single load for better water circulation. Wait until you have a full load but don't overload the machine. Overloading reduces efficiency. ★ Use the proper water-level setting for your load size. ★ Always clean the lint filter before and after drying. ★ Don't over dry clothes. In some cases, removing clothes while they are slightly damp allows for easier ironing. ★ Make sure your dryer is vented outside to reduce excess heat and moisture. ★ Don't overload the dryer. It overburdens the machine, and the clothes take longer to dry.

Electric equipment: low cost measures

	Opportunity	Reason	Action
13	Replace old metal kettles with modern jug kettles.	★ Older kettles can not heat a small quantity of water. If you boil twice the amount of water you need, it will cost twice as much.	★ Replace old kettles with modern jug types if small amounts of water are being heated.
14	Provide for efficient use of existing motors.	★ Motors in refrigerator and freezers run at very low loads for most of the time. ★ Motor controllers improve the efficiency of motors operating at low load. ★ Slipping belts, etc. dramatically reduce efficiency of motors ★ Motors are source of power factor corruptions.	★ Install motor controllers to refrigerator and freezers where appropriate. ★ (BUT check with equipment vendors if this is applicable to specific units.) ★ Correct motor power factor ★ Replace V belt with cog drive belts or tighten and adjust drive belts ★ Correct power factor at service entrance ★ Correct point-of-use power factor ★ Correct power factor in distribution system
15	Fit night blinds or chiller strips to refrigerated display cabinets.	★ Chiller strips and night blinds reduce cold air losses from display cabinets..	★ Install chiller strips or night blinds.

16	Fit automatic controls which will turn off idling electrical plant.	★ Automatic controls are more reliable than manual. ★ Automatic controls can be set to switch off plant after a predetermined period of idling	★ Check which machines are suitable for automatic switches and fit where appropriate.

Electric equipment: activities that will require some planning

	Opportunity	Reason	Action
17	Think of buying energy efficient computers and office equipment♣.	★ The energy efficiency of equipment varies. ★ Some equipment switches to stand-by mode when not in use.	★ Make sure that energy efficiency is always included into buying specifications.
18	Arrange for pumps, and similar items to switch off when the equipment they serve is not in use.	★ Ancillary equipment often accounts for significant proportion of energy costs.	★ Investigate opportunities to install interlocks – these will automatically control ancillary equipment.
19	Measure running currents on motors larger than 5 kW.	★ Oversized motors run at reduced efficiency.	★ Measure peak running currents on motors over 5 kW. ★ If a motor is running at less than 50% of its nameplate rating, consider replacing it with a smaller motor.
20	Consider avoiding peak demand from large loads as motors.	★ Scheduling / sequencing of starts of heavy loads as powerful motors would reduce one-time peak demand.	★ Schedule large loads or groups of loads ★ Co-ordinate start-up ★ Use a peak demand alarm ★ Interlock motor starters on large equipment ★ Use an automatic load shedding device ★ Shave peaks with emergency generators.

♣ See Appendix 2 for more tips on energy efficient office equipment and habits of using it.

11. COMPRESSED AIR

Probably, the compressed air installations are not the most common type of equipment in Institutional Facilities. However, they are used in boiler rooms and workshops and their inefficiency, especially leaks of compressed air can be very costly.

Compressed air: no cost measures

	Opportunity	Reason	Action
1	Is your staff aware of high cost of producing compressed air?	★ Producing compressed air is very expensive.	★ Use staff meetings as means of raising awareness. ★ Use promotional materials.
2	Arrange an effective system for reporting leaks.	★ Leaks should be repaired immediately to minimise losses and to demonstrate your facilities commitment to energy saving.	★ Set up a system for reporting leaks. ★ Make sure that leaks are repaired immediately
3	Arrange a regular leak test and repair program.	★ Leaks are responsible for the largest part of waste (typically, about 40% of all losses), but are simple to control.	★ It is easier to check leaks on compressors during periods when there is no demand for air. ★ During quiet periods listen for loud hissing noise from obvious leaks and repair them immediately. ★ Smaller leaks can be easy detected with ultrasonic leak detectors (which are expensive), but simple water and soap solution would help too. ★ Check all joints, plug-in connections, other fittings. Inspect all flexible hoses. Check pneumatically operated cylinders for worn seals. ★ Schedule the quarterly leak test / repair programme.
4	Insulate permanently unused air pipework.	★ Redundant air pipework is a potential source of significant leakage. ★ Unless it is correctly isolated, it has to be pressurised at the start of each working period. This wastes money!	★ Identify redundant pipework. ★ Permanently blank-off or remove all redundant pipework. ★ Remember that isolating only with valves is unreliable as they can leak.
5	Check automatic drain traps regularly.	★ Faulty drain traps can waste large quantities of compressed air.	★ Check that drain traps are not passing air. ★ Check that drain traps have not been bypassed.

6	Compressed air should be generated at the lowest possible pressure.	★ The higher the pressure the more the cost of compressed air generating. ★ Typical pressure is 100 psi (7 bar). If pressure of 85 psi (6 bar) is sufficient, this will reduce costs by 4%.	★ Check all used compressed air applications for minimal required pressure. ★ The pressure on many compressors can be easily adjusted.
7	Avoid use of blowguns wherever possible, do not use them for cleaning.	★ Due to high costs of generating compressed air and meeting high safety and health requirements, use of blowguns has to be avoided.	★ Use alternatives, such as industrial vacuum cleaners, or even dustpan and brush.
8	Assure that compressors are always switched off when there is no demand for compressed air.	★ Running compressors for long periods when there is no demand, wastes energy.	★ Check that compressors are switched off at the earliest opportunity. ★ Check that compressors are switched off during lunch breaks, etc. ★ Check that compressors are not switched on earlier than needed.
9	Clean or replace air inlet filters regularly.	★ Dirty filters result in pressure drops and thus waste energy.	★ Set up system for regular checking air inlet filters regularly. ★ Clean reusable filters and replace the disposable ones.
10	Be sure that intake air is drawn directly from outside of your building.	★ The cooler the intake air, the more efficiently your compressor operates. ★ Compared with in-taking air from inside of the building, taking it from outside can reduce general operating costs by up to 3%.	★ Where feasible, arrange for air to be drawn from outside of the building.
11	Make sure that the air treatment system is regularly checked and maintained.	★ Lack of regular correct maintenance of air treatment plant can increase compressed air costs by as much as 30%	★ Check that pre-filters and after-filters are cleaned or replaced at regular intervals. ★ Check that condensate traps are operating correctly. ★ Check efficiency of air dryers. ★ Check that heat exchangers are clean.

Compressed air: low cost measures

	Opportunity	Reason	Action
12	Consider alternatives to compressed air tools.	★ Electrically powered tools are 90% cheaper to operate than compressed air tools.	★ Consider replacing compressed air tools with equivalent electrically powered tools. Most often it is safe and convenient to do so.
13	If different sections of your compressed air system have different operating hours, they should be separated.	★ Zoning may separate areas, which are not in use all the time. ★ Zoning will reduce wastage by leakage or possible misuse.	★ Check if there are any significant areas which are not in use throughout the day. ★ Where appropriate, install zone valves. They can be either manually operated, or automatically controlled by timeswitches.
14	Do all the sections of your compressor system require the same pressure?	★ The whole system might be operated at higher pressure just to meet requirements of a few appliances. ★ Reducing the pressure in the rest of the system will reduce air consumption and leakages.	★ Consider zoning of the system to supply high pressure only where needed. ★ Where possible install pressure reducing valves to supply lower pressure to the rest of the system.
15	Consider replacing manually operated drain valves.	★ Manually operated drain valves are an inefficient way of removing water. ★ They are often opened for excessively long periods, or even left permanently open.	★ Check whether manually operated valves are still being used. ★ Fit and regularly maintain automatically operated drain valves.

Compressed air: activities that will require some planning

	Opportunity	Reason	Action
16	Make sure that your air compressors are operated on a “demand controlled basis”.	★ Compressors can use as much as 70% of non-load power when idling.	★ Some compressors can be set to switch off automatically after a set period of idling.
17	If you have a multi-compressor installation, make sure that the compressors are sequenced to meet demand.	★ It is more efficient to run the minimum number of compressors at near full load than to run extra compressors on part load.	★ Seek professional advice.

18	Consider installing a local compressor for equipment which requires a significantly different pressure or is operating for different periods of time than the rest of the system.	★ It may be more economic to install a discrete compressor to serve appliances that need higher pressure.	★ Carefully monitor the operation of all appliances. ★ Look for opportunity to install dedicated compressors.
19	Revise the size of air receivers.	★ An undersized air receiver will result in frequent compressor loading and unloading.	★ Consider if the bigger capacity air receiver is needed.
20	Ensure all pipework is the correct size.	★ Undersized pipework results in energy losses due to friction. ★ Due to pressure drops, air has to be generated at higher pressures to compensate.	★ Seek professional advise on sizing of your pipes.
21	Consider fitting a heat recovery system to your compressor.	★ Over 90% of energy used by compressor is dissipated as heat and often wasted.	★ Look for possibility of recovering heat from compressor for space heating of heating water. ★ Consider ducting warm cooling air from compressor to nearby working area to supplement the main heating system. ★ Consider if water-cooled oil coolers could be fitted to your compressor to generate hot water.
22	Check the quality of air treatment.	★ Excessive levels of air treatment increase compressor operating costs.	★ Determine the minimum acceptable level of air quality ★ Consider changing the treatment plant if it is currently over-treating air. ★ Check the air quality requirements of all appliances; if requirements vary, consider providing basic air quality to the whole system and installing high quality treatment plant for specific applications.
23	When choosing a new compressor, consider the efficiency over the whole system and over its entire operating range.	★ Compressors vary considerably. Selection of the most suitable type will have a significant influence on future operating costs.	★ Make sure that energy efficiency is a key selection criterion. ★ Use screw compressors with capacity control. ★ Consider two stage compression with cooling

12. BUILDING MANAGEMENT SYSTEMS

The modern building automation systems, or Building Management Systems (BMS), or Energy Management Systems (EMS) are intended to optimise virtually all aspects of energy efficiency discussed above.

In theory, the highly sophisticated computerised BMS would take care of all tuning, timing and temperature setting aspects listed (however, everything related to sealing, shading and other maintenance items would still remain the human responsibility anyway).

In practice, though, the computers are programmed, maintained and operated by humans. It can happen that having been once installed, the BMS become out of date for current state of particular building.

In practice it is also not uncommon that facilities have no documentation, user's manuals or technical description of the system. You can live with this if there is a trustworthy service provided. But sometimes this is just not the case, and your custodian might expect the system to be wisely maintaining the most energy efficient building functioning possible, while in reality it is not so.

The systems should be professionally serviced and updated. But it would be very useful if your staff responsible for the building state can understand the system's logic, watch, if it really acts in accordance with listed guidelines, can fine tune it, override some of the parameters, and get historical information from it. Therefore be sure that your staff is properly trained to operate the system and to check how it is working.

If you do not have the BMS, or you have an old one, the control system installation or upgrade can become the best financial investment in a building.

13. APPENDIX 1. SOME TECHNICAL DETAILS ON EFFICIENT LIGHTING

Fluorescent lamps, or "tubes", are made in a variety of shapes and sizes. "T-8" and "T-10" lamps - so-named because of the diameter of their bulb - offer significant increases in energy efficiency. These new lamps give off more light per watt than the conventional T- 12 lamps now used in most buildings. And with the use of "rare-earth triphosphor coatings", these new lamps produce light that is more flattering to your surroundings. T-8 and T-10 lamps can be used in a variety of settings to reduce energy use and reduce pollution, and increase light levels without adding fixtures.

T-5 LAMPS

T-8 lamps must be used with compatible T-8 ballasts.
T-8 systems provide 98 percent of the light produced by conventional T- 12 systems.
T-8s have a colour rendering index of about 75 on a scale of 1 to 100 (vs. about 60 for a T-12 cool-white).
T-8 systems consume up to 40 percent less energy than conventional T-12 systems.
Lamps come in 2-, 3-, 4-, and 5-foot straight versions, and 10-, 16-, and 22-inch U-shaped versions.

There are three basic types of fluorescent lamps' ballasts:

Magnetic: traditional 60 cycles per second, core-and-coil ballasts consisting primarily of a steel lamination surrounded by two aluminum or copper coils. All high-power factor versions contain a capacitor.

Hybrid (Heater Cutout): traditional core-and-coil magnetic ballasts with an electronic switch that disconnects the power to the cathodes at each end of the lamp once the lamp starts. This saves the two watts per lamp required to continually heat the cathodes. Hybrid ballasts are available as partial-output (low-power) and full-output units.

Electronic: operate fluorescent lamps at frequencies greater than 20,000 cycles per second. The resulting increase in lamp efficacy combined with reduced ballast losses boosts fluorescent efficacy by up to 30 percent.

The following factors should be considered when selecting a full-size, non-dimming fluorescent ballast for either retrofit or new installation.

Lamp-Ballast System Efficacy
Select the combination of lamps and ballasts that is most efficient in converting electricity into light. For example, the four-lamp electronic ballast used with 32-watt T-8 lamps is one of the most efficient fluorescent systems, producing approximately 90 lumens per watt. By comparison, standard 40-watt lamps operating with "energy-efficient" magnetic ballasts produce less than 70 lumens per watt.

Lamp Flicker and Ballast Hum
Lamp flicker and ballast hum are annoyances commonly associated with fluorescent systems that operate at 60 cycles per second on magnetic or hybrid ballasts. At this operating frequency, fluorescent lamps are turned off and on 120 times per second. This stroboscopic effect is enhanced when viewing computer screens, which also turn off and on 120 times per second. Although lamp flicker may not be noticeable to some individuals, many complain about the distraction and discomfort that it can cause. Electronic ballasts solve the flicker problem by operating fluorescent lamps at a much higher frequency of 20,000 times per second.

Power Quality
All types of fluorescent ballasts produce some degree of total harmonic distortion (THD), which, if severe, has the potential to interfere with the operation of sensitive electronic equipment. Harmonic distortion of less than 20% assures good power quality. Some electronic ballasts with integrated circuits produce less than 5 percent THD. Because electronic ballasts require reduced current, maintaining the same percent THD will yield a reduction in the harmonic current. Therefore, installing low-harmonic electronic ballasts can significantly reduce the total harmonic current on the transformer circuit that serves the lighting system.

Lamp Compatibility
Not all lamps work with all ballasts. For example, T-8 (265mA (milli-ampere)) lamps are designed to work with T-8 (265mA) ballasts, and high-output T-12 (800mA) lamps are designed to work with high-output (800 mA) ballasts. Some electronic ballasts with integrated circuits can adapt to operate both T-8 (265mA) and T-12 (430mA) lamp types. Also, lamps with only one electrical contact at each end require operation with an instant-start ballast.

T-8 Instant-Start versus T-8 Rapid-Start
Although T-8 lamps are classified as rapid-start lamps, electronic ballasts can be designed to start these lamps in either the rapid- or instant-start mode. T-8 lamps operating on instant-start ballasts produce about 6 percent more lumens per watt (are more efficient), but reduce lamp life. In most cases, the financial advantage of using more efficient instant-start ballasts easily offsets costs associated with reduced lamp life. However, when occupancy sensors are expected to result in frequent switching, consider using rapid-start ballasts.

Parallel Versus Series Wiring
A feature available in several models of T-8 electronic ballasts is parallel wiring. Parallel circuits operate each lamp independently. If one lamp fails, the others continue to burn. If one lamp burns out in a series circuit, all lamps in the ballast circuit go out. All instant-start ballasts operate lamps in parallel, and most rapid-start ballasts are series type.

Number of Lamps per Ballast
Although most magnetic and hybrid ballasts operate only two lamps at a time, some electronic ballasts operate up to four lamps at a time. Using three- and four-lamp ballasts instead of two-lamp ballasts (where feasible) will yield savings in material, labour, and energy costs because fewer ballasts will be required, and because these ballast systems are more efficient. In applications with two-lamp fixtures, consider "tandem wiring" pairs of two-lamp systems to share single four-lamp ballasts.

Ballast Life
Ballast life is primarily affected by operating temperature. Operating temperature varies with the type of ballast, the heat retention characteristics of the luminaire enclosure, and the fixture mounting method. This variation makes ballast life difficult to predict. Electronic ballasts generally operate longer than magnetic ballasts because electronic ballasts produce less heat. Although electronic ballasts have a longer average life span, they also exhibit a higher incidence of premature failure during the first year of operation. Generally, a ballast that survives the first year can be expected to provide many years of reliable operation. Electronic ballast warranties typically provide the replacement ballast and a labour cost allowance should any ballast fail during the warranty period. Typical life expectation (years): Magnetic: 10 –14; Efficient Magnetic: 12 –15; Cathode Cutout (Hybrid) 15 –17; Industry-Standard Electronic 15 - 20

GENERAL OFFICE LIGHTING FIXTURE COMPARISON

	BASE CASE	**OPTION A**	**OPTION B**	**OPTION C**	**OPTION D**
	Current four lamp fixture	**Electronic two lamp fixture**	**Electronic three lamp fixture**	**Electronic four lamp fixture**	**Electronic two lamp fixture**
Maintained Lumens	8096	5220	7830	10400	7296
Watts Consumed	182	59	87	111	84
Maint. Lumens/Watt	44.48	88.47	90.00	93.69	86.86
Kwh/yr	582.4	188.8	278.4	355.2	268.8
Roughly payback (yrs, based on 3200 hr/yr)	-	1.02	1.39	1.98	1.47

Base your decision to invest in a fluorescent lighting system on an analysis of life-cycle costs. Consider energy costs and the materials and labour for periodic lamp replacement. T-8 and T-5 upgrades offer very attractive financial returns.

14. APPENDIX 2. SOME DETAILS ON EFFICIENT OFFICE EQUIPMENT

The energy efficiency of office equipment can be influenced by two major issues: Select the most energy efficient units when you make a buying decisions. Use the existing units wisely.
There are many sources for advice on this[5]. The following is a brief overview of what to look in. One must be aware that since the technology is developing very rapidly, the following should be considered only as general guideline. Please investigate the energy efficiency of advanced systems at the time of planned purchase.

Labels to look for

There are two North American labelling programs to help you identify energy-efficient and environmentally friendly office equipment.

EcoLogo (left illustration) is the mark of Environment Canada's Environmental Choice Program. The EcoLogo can be found on fax and photocopy machines and even on the supplies you will need to operate your equipment - paper, envelopes, and printer and toner cartridges.

The Energy Star Program, sponsored by the United States Environmental Protection Agency, has signed partnership agreements with leading manufacturers to promote the development of energy-efficient equipment. These companies have introduced more than 2 000 desktop computers, monitors and printers that have earned the right to bear the Energy Star logo (Illustrated on the right).
The Energy Star Program was recently expanded to include photocopiers and fax machines.

Computers

In a typical facilities environment, computers far outweigh all other office equipment in terms of energy consumption. This allows for significant opportunities to achieve energy savings by taking advantage of energy-efficient computers and energy-saving devices.

Laptops use 10 per cent or less of the power required by current desktop units. Among the developments that have helped achieve this energy efficiency are advanced power management, low-voltage architecture. However, their lower energy consumption does not necessarily mean that laptops will save you money in the long term. Laptops can be more expensive to purchase than comparable desktop units.

Considered individually, most of a computer's internal components account for only a small proportion of the system's total energy consumption (the hard drive is the most energy-intensive component, accounting for up to 20 per cent of total energy consumption). As a result, individual components do not generally offer significant opportunities for energy savings. Given the ever-increasing functionality of today's computers, the addition of hardware is likely to have a greater impact on energy requirements than the choice of a particular level of power or brand of component.

There are many *myths* about computers. Here are a few that may be making the rounds in your facilities.

Fiction: “Computers use large amounts of energy when starting up. It is more cost-effective to leave them running.”
Fact: A personal computer uses about one second of running-time energy when starting up. It is far more cost effective to turn it off when you finish using it.

Fiction: “The heating /cooling cycles that result from turning computers on and off damage their components”.

Fact: Switching a machine off for a number of hours when it is not needed actually extends the machine's life by reducing mechanical wear.

Fiction: “Turning off machines causes hard drives to crash”.
Fact: This is a fallacy dating from the days of old mainframe hard drives lubricated by soap, which would congeal if the drive were stopped. This is not a problem today because of modern lubricants. The unnecessary wear and tear that results from leaving systems on when they aren't in use is more likely to cause problems.

Fiction: “Screen savers save energy”.
Fact : Some screen savers are now so complex that they consume a lot of energy. Screen savers were designed for black and white or green screens to stop the menu bar from being burnt into the screen. Modern screens don't need screen savers, which are now used more for their entertainment value. In fact, the screen savers cost as much to run a full screen of work. The best way to save energy is to turn your monitor off when it is not in use.

Fiction: “Computers and other office equipment are small energy users”.
Fact: A personal computer left on continuously consumes between $100 and $150 worth of electricity per year (at eight cents per kilowatt-hour). A large photocopier consumes close to $250 for the same time frame. Since these machines generate heat while operating, they increase air conditioning costs too.

Fiction: “Turning off computers or letting them go into sleep mode causes network problems”.
Fact: Properly configured networks should allow users to turn off their computers and printers when they wish and should accommodate energy-efficient machines that sleep when they are not in use. Servers must always be left on.

Monitors and displays

The type of display technology you choose for a computer system has an important impact on energy consumption.

For desktop computers, the most common displays are still cathode ray tubes (CRTs), which typically consume about half (or more) as much electricity as the computer itself. As indicated in the chart below, CRTs consume significantly more energy than liquid crystal display (LCD) monitors.

Flat screen technologies consume considerably less energy than CRTs. They are typically found on portable computers, where their light weight, small size and low energy consumption make them an ideal choice. Flat screen monitors can be used instead of CRTs for desktop systems, but they have not been widely adopted yet for this purpose because of their greater cost. These issues are gradually being improved upon.

LCD monochrome backlit (consumes two to five per cent of the electricity of a colour CRT);
LCD colour active matrix (consumes 10 to 20 per cent of the electricity of a colour CRT); and monochrome CRT (consumes 50 to 65 per cent of the electricity of a colour CRT).

Printers

Most printers, photocopiers and fax machines now on the market use one of only a few common imaging and printing technologies. Because of the distinct processes involved, these technologies consume dramatically different amounts
of electricity. Often, energy efficiency must be sacrificed for print quality or speed — or vice versa. The purchase price of machines and the cost of supplies (paper, ribbons/ cartridges, etc.) may also vary dramatically from technology to technology.

Laser/LED (used in printers, fax machines)
How it works: Forms an image using light from a laser (or an array of light-emitting diodes in the case of an LED printer) cast onto a photosensitive member. Uses heat and pressure fusing to affix toner to paper; also requires

heat during idle periods to maintain temperature. Some models are more energy-efficient than others; energy-saver features may be available in some models. Printing is of extremely high quality, but at the expense of high energy consumption. Sales of low-end models are growing rapidly.

Heat and Pressure Fuser (used mainly in Photocopiers.)
How it works: Similar processes to laser printers. Instead of a laser, uses a high-temperature tungsten-halogen exposure lamp for imaging. Heat and pressure fuser (180°C) used to affix toner to paper.
Electricity requirements during printing far exceed any other office machine, even laser printers. This type accounts for the
majority of photocopiers sold today.

Inkjet (used in: printers, photocopiers and fax machines)
How it works: Ink is sprayed onto paper to match a digital image. No heat or pressure used for fusing; however, colour
printers use a fan and heat to dry the ink. The heat lamp is kept warm in standby mode. Laser-like print quality, but at a lower purchase price and operating costs. Capturing a rapidly growing share of the market, at the expense of low-end laser printers. Special paper recommended for photocopiers.

Impact: Dot Matrix and Daisy Wheel (Printers).
How it works: Direct impact leaves impression on paper. No heat but mechanical components consume significant
amounts of energy. Energy consumption is greater than for inkjet technology but much less than for laser technology.

Thermal (Fax machines.)
How it works: Image generated on heat-sensitive paper. Uses modest heat to generate image. Paper is extremely sensitive, which often results in recopying of facsimile messages onto plain paper (this, in turn, means greater use of energy and paper). Paper is expensive and not recyclable.

Surface Fusing (Photocopiers.)
How it works: Similar to heat and pressure fusing. Fusers are smaller and are heated only as needed. Lower print quality than conventional or inkjet copiers.

Liquid Ink (Photocopiers.)
How it works: Heat fusing. Uses heat to affix toner to paper. Low volume; not commonly found in the marketplace.

Unlike computers and monitors, electricity consumption by printers varies significantly in different operating modes. As would be expected, power consumption peaks during the printing process itself, when it can almost reach the nameplate rating. However, even when idling, laser and inkjet printers consume between 30 and 35 per cent of their peak power
requirement. Since many printers are idle for long periods of time, it is often in this mode that the most electricity is consumed. To prevent this unnecessary use of energy, some laser printers are equipped with an energy-saver feature that drops their consumption in standby mode to 10 per cent or less of peak consumption. With such a feature, a short delay will occur before a print job begins as the fuser temperature is brought up to its operational level. However, the impact
of this feature on total energy consumption can be dramatic, and will more than make up for the minor inconvenience of waiting for the printer to warm-up.

In practice – when buying, consider the many benefits of an inkjet printer. They have low energy consumption, are inexpensive and permit the re-use of paper, saving on costs and reducing environmental impacts.

If you are purchasing a laser printer, look for one with an energy-saver feature that reduces its energy use when idle by at
least 50 per cent.

Consider a printer that has the capability to print on both sides of the paper. This reduces direct paper costs and the energy use associated with paper production.

Photocopiers

Photocopiers are by far the most energy-intensive type of office machine. Heat and pressure fusing is the most common photocopying technology, especially for high quality and high volume copying, but it also consumes the most energy. Other photocopying technologies may be suitable for less demanding needs, and certainly will consume less energy (particularly inkjet systems).

Consider a machine that does not use heat and pressure fusing. Unless high quality or high volume copying is required, the energy cost incurred can be excessive.

Choose a correctly-sized machine. The purchase price and energy costs will rise with the copier size, but can decline on a
per sheet basis if the proper machine is selected.

Keep in mind that different machines using the same technology may have substantially different energy requirements. And unlike computers and printers, the power ratings on photocopiers provide an accurate means of comparing energy consumption. This is because the ratings are based on standardized test methods, established by the American Society
for Testing and Materials (ASTM). When purchasing a photocopier, ask the vendor for the ASTM ratings and compare different machines in five operating modes:

- ★ plug-in mode, which is essential for maintaining certain electronic components when the machine is shut off;
- ★ warm-up mode, a short period when the fuser is being made ready for printing;
- ★ printing mode;
- ★ idling mode, which is the normal state when sitting unused for extended periods; and
- ★ energy-saver mode, a low-energy "sleep mode" that is reached after a set period of idling.

Obtain ASTM ratings. Once you have targeted a general size range, these ratings will help you compare energy consumption by different machines.

Look for a machine with an energy-saver feature that reduces energy use in the idling mode by at least 50 per cent.

When selecting a photocopier, however, energy requirements should not be considered in isolation. Rather, energy consumption during the course of a work day should be estimated and evaluated on a per copy basis. High quality or high speed photocopying usually require larger amounts of electricity, as shown in the chart. However, it is possible that the
top-end machines capable of providing this service may in fact use less energy per copy than a smaller machine. If this is the case, it would obviously be counter-productive to purchase a smaller machine.

Ensure that the vendor incorporates electricity consumption into the cost comparison. This could easily affect your choice, even between machines that offer the same basic technology.

Fax Machines

Energy consumption by fax machines is generally measured in four distinct modes:
standby, transmitting, receiving and copying.
For most machines, electricity requirements tend to be similar during the transmitting, receiving and copying modes, and significantly reduced in the standby mode. Energy consumption also varies depending on the technology used and the
product brand. Use stick-on fax routing slips rather than full cover sheets when appropriate. You will save on paper and transmission costs.

Thermal fax machines consume less energy than their laser counterparts, but thermal paper costs more than plain paper. It is difficult to write on, has a short life, and can be ruined if exposed to heat. Thermal paper fax messages therefore tend to get re-copied onto plain paper, a practice that adds to energy and paper costs. Also, it is not recyclable. Although the initial cost of a thermal machine may be much less than a plain paper fax, its long-term operating cost (the second price tag) can be greater.

Inkjet technology is far superior to laser printing in terms of energy efficiency. Inkjet fax machines use much less energy in both the printing and idling modes, while producing near laser-like quality. You can also reuse paper in inkjet machines.

In the case of laser machines, for example, an inefficient fax can use as much as 50 per cent more energy than an efficient machine. You should also look for a standby mode that offers low energy consumption, and preferably an energy-saver feature.

Human Factor and habits of users

The inherent efficiency (or inefficiency) of any office machine clearly has a fundamental impact on its energy consumption. But there is another important variable — the human factor.
You can implement many operating practices to maximize energy savings. However, the success of these efforts will ultimately depend on strong staff commitment and participation.

Planning

As a starting point, review the extent to which your office uses overnight operations. In the facilities, you probably do not have too many. Ask yourself:
★ Are your computers backed-up in the middle of the night, and could this be done just as easily during normal business hours?
★ Do you receive fax messages at 8:00 p.m. or 4:00 a.m.; if not, does your fax machine need to be turned on at these times, or could you install a call-activated switching device?
★ Can you reduce the number of hours during the night in which office machines must be running?

Education and policy

As with all other no cost / low cost measures, an awareness and promotional effort will be required to make staff aware of the issues, opportunities and actions needed to achieve energy savings. Bad habits are hard to break, and some staff may be sceptical.
Nevertheless, a well-organized initiative with a credible message and long-term commitment stands a good chance of being successful. Keep it simple, perhaps beginning with only one or two initiatives. It could be something as elementary as designating an individual in each work unit to shut off the photocopier at day's end.

Use the equipment properly

If your computer and software has integrated power management capabilities, make sure you are fully aware of how to configure the system for energy savings and to meet your performance requirements.
Make sure intelligent switching devices are programmed to minimize inconveniences and frustration for the user. Dissatisfied users may eventually turn off these devices. An issue of potential concern is the computer's rebooting speed.
If you are considering automatic or computer-controlled on/off switching for your printers, determine the time it now takes (i.e. when the printer is already running) for jobs to be sent to the printer, completed and picked up by the sender. By comparison, the printing time from a cold start-up is unlikely to cause significant inconvenience or loss in productivity.
Keep in mind — and inform your staff — that frequently switching equipment on and off will not damage the components.

Turn it off manually !

Turning equipment off manually is the most cost-effective way to reduce energy consumption. The challenge lies not in the difficulty of the task, but rather in the attitudes and willingness of employees to perform it. With this in mind, it may be worthwhile to establish an awareness program that reminds staff to shut off equipment when it is not in use. A creative program that offers incentives or rewards may offer the best chances of success.

Remember that the screen-saver on your monitor protects the phosphors in your screen (an important function) but does not reduce energy consumption. Similarly, a lit-up "Energy Saver Mode" button on your photocopier means that less electricity is being consumed – but electricity is still being consumed. When practical, turn it off!

Minimise printing, use paper wisely, involve the paperless office technologies

In a typical facilities environment, a great deal of energy is used to reproduce information on paper. In fact, some printing technologies are among the most energy-intensive processes in the office. By comparison, the management of information using electronic means requires very little electricity.

Try to orient your facilities to managing ***information***, rather than ***paper***. In many cases, this will require major changes in the
way you operate.

Use electronic communications channels, such as E-mail and fax/modems, to accomplish your communications and data
distribution needs. This will reduce your energy and capital costs and increase your competitiveness, productivity and profitability.

LANs offer many energy efficiency benefits, including:
★ reduced energy costs (the sharing of computer resources means that fewer machines are operating, although a file server must be left on 24 hours a day);
★ reduced paper costs (the electronic transfer of messages, documents and other files means less paper is used); and
★ reduced capital costs (sharing means less equipment is needed).

Printer sharing is another common network application. By connecting several users to one or more printers, you can reduce the number of printers needed in your office, as well as the energy cost of having more machines than necessary sitting idle between jobs. For network printers, the last person within each group to leave the office should be given the responsibility to turn the printer off so that it won't be left on 24 hours a day. In an effective office, at least one of the printers on the network will offer a reasonably efficient means of printing draft or internal documents.

Information storage: Many offices still rely heavily on paper for storing and delivering mass volumes of information. This is in spite of the fact that a wide range of electronic information processing equipment and storage media are available. In fact, it has been argued that offices generate more paper today than ever before – largely because more information is available through electronic means. Encouraging the use of electronic information storage, such as CD ROM or DVD recording and exchange technologies is clearly a major behavioural challenge.

15. APPENDIX 3: THE STANDARDS AND CODES REFERENCE.

Reducing the energy consumption, changing temperatures and lighting levels should not, of course, go beyond limits of reasonable comfort and health requirements.

The following is the reference from ASHRAE <etc.> standards which define some vital parameters which MUST be maintained in facilities buildings.

Generally, the ASHRAE and/or IES standards are used as references and there are different standards for different areas in facilities. The best source for some information is the CBIP from NRCan - see their website.

16. APPENDIX 4: INVOLVING YOUR STUDENTS INTO ENERGY SAVING PROCESS

Not only your staff can help in your energy saving campaign.
The students can be involved into this process as well.

Why not encourage the students to look for energy saving possibilities in the school building as well as in their homes?
Teaching them the principles of energy efficient behaviour would impact their families and position your facilities as a community leader in promotion of environmental protection and energy efficient lifestyles.

The following is just an example of how the no cost / low cost energy saving ideas, actually described along with others in this document, could form the material for a special education program[6].

Topic: No Cost Energy Saving Ideas

Goal: The student will become familiar with and will put into practice no cost and low cost energy saving ideas.

Objectives: The student will be able to:
1. Discuss the 6 basic areas of energy use in the home.
2. List no cost and low cost energy saving ideas that most people can put into practice.

Lesson/information*:* There are many people who want to save energy but cannot afford to build an energy efficient home. Fortunately, there are many no cost and low cost practices that can help everyone reduce energy waste and save energy dollars. Once consumers realize where their energy dollar is going, they are better able to put conservation ideas into practice.

Activity 1:
Print this lesson and using a black and a red ink pen, go over this list of hints.
1. Use the black ink pen to circle the numbers in front of the hints that you already practice.
2. Use the red ink pen to circle the numbers of the hints that you plan to put into practice in the near future.

INFORMATION CHECK

Choose the answer that best completes the statement.

1. About ___% of energy costs go to heating and cooling and ___ % to water heating.
a. 25%, 10%
b. 50%, 50%
c. 50%, 20%
d. 25%, 20%

2. In the winter, dress in ___ clothing.
a. wool
b. warm
c. layered
d. b and c

3. In the summer, turn the cooling unit down and ___.
a. use fans
b. open attic door
c. use humidifier
d. a and c

4. Most hot water heaters can be turned down to:
a. 160° F
b. 120° F
c. 105° F
d. none of the above

5. Which of the following cannot be done with cold water?
a. wash clothes
b. garbage disposal
c. wash dishes
d. brush teeth

6. Save money on lighting by
a. using fluorescents
b. using lower wattage
c. using natural light
d. all of the above

7. An energy saving way to prepare potatoes would be to
a. microwave them
b. bake in oven
c. boil on range top
d. all of the above

8. Refrigerators should
a. allow air circulation
b. be very full
c. be on coldest setting
d. a and c

9. Exhaust fans over the range help to remove
a. heat
b .humidity
c. odours
d .all of the above

10. It is best to dry clothes
a. on the highest setting
b. in a cool dryer
c. one load after another
d. all of the above

Teacher's Notes

Activity 1:
Have students report how many of these hints they already follow and how many they plan to start doing. Perhaps plan a follow-up session a week or two ahead to check up on their progress.

Answers to information check:
1. c ; 2. d 3. a 4. b 5. c 6. d 7. a 8. a 9. d 10. c

17. REFERENCE

Please find enclosed some sources where you can look for more no cost / low cost ideas to be implemented in your facilities:
Though these resources are interesting and information from them was partly used for assembly of this document, they by far do not represent the vast array of similar information available world-wide.
Please follow the links provided on listed web facilities and do your own searches.

http://oee.nrcan.gc.ca/oee_e.cfm
http://www.ene.gov.on.ca/
http://www.uottawa.ca/services/immeub/eneman.htm
http://www.ase.org/
http://www.etsu.com/
http://www.facilitiesnet.com/NS/NS3b96i.html
http://www.energyusernews.com/797test.htm
http://www.emnrd.state.nm.us/ecmd/html/Publications/teeo/zerocost.htm
http://www.txses.org/epsea/nocost.html
http://www.les.lincoln.ne.us/Energy/Audit/cost.php
http://www.ci.irvine.ca.us/about_irvine/econ-dev/lowcost.htm
http://ecep1.usl.edu/ecep/intro/intro.htm
http://ecep1.usl.edu/ecep/hvac/hvac.htm
http://www.21design.com/free/teestat.html
http://www.energyvic.vic.gov.au/facilitiess/essindex.htm
http://www.energyvic.vic.gov.au/facilitiess/essgrants.htm
http://www.bre.co.uk/bre/otherprg/eebp/pubs/GPCS099.htm
http://www.commerce.state.mi.us/opla/erd/shep.htm
http://www.commerce.state.mi.us/opla/erd/cstudy.htm
http://www.wpcorp.com.au/education/worldofenergy/eskfs.html
http://www.eren.doe.gov/buildings/tools_directory/software/cbip_comply.htm

NRCAN's Energy Management Series Handbooks
#5 .Combustion
#6 .Boiler Plant Systems
#7 .Process Furnaces, Dryers and Kilns
#8 .Steam and condensate Systems
#9 .Heating and Cooling Equipment
#10 .Heating, Ventilating and Air Conditioning Systems
#18 .Architectural considerations

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[1] RICK: National averages for facilitiess – source ???
[2] RICK: Are principals able to invest/reinvest anything, or only boards?
[3] AHRAE, Etc… <INSERT REFERENCE!>
[4] Rick: Not very applicable for facilitiess ?
[5] For example, see "Program for efficient office" at http://office.nrcan.gc.ca/office_e.htm

[6] RESOURCES: Energy Conservation for Limited Income and Senior Citizens. SLEMCO, Lafayette, LA, n.d.; Saving Energy at Home. Florida Governor's Energy Office. Tallahasse, FL, 1989. ; Your Lifestyle Can Make a Difference. SLEMCO. Lafayette, LA, n.d. ; Comments or questions to: energy-mail@dnr.state.la.us . Some useful information can be found also at www.facilitiesnet.org.