M Efficiency Tips

Ten Steps to Energy Efficiency

Background

Achieving energy efficiency in a curling facility is critical to not only the bottom line but to the overall success of your operation... There are a number of time-proven steps developed to help you implement a sound energy management program. Rushing off without a plan or a set of objectives will often result in disappointment

Step 1 - Secure the philosophical approval of the Board of Directors.

A program to reduce energy use must be approved by the Board of Directors. An effective program can involve serious capital expenditures with payback periods over a number of years, thus the full support of senior management is essential. A "lone ranger" or "tool belt" approach in which one person tries to do everything without upper management approval may not be very successful. A good energy management program will likely involve changes in almost every room in every building; senior management **must** be on board.

Step 2 - Appoint a person who will champion the process.

As a champion you will need a goal-oriented people person, someone who can work with a variety of people and motivate them. Armchair philosophers are not recommended for the champion's position. The person need not be technically oriented, but should have a common senses interest in practical energy savings.

Step 3 - Where appropriate, appoint a steering committee.

In larger clubs, communication and implementation can often greatly be improved through use of a steering committee. Work with your "champion" to hand pick people to sit on this committee.

Step 4 - Set realistic targets for the program.

A useful target for a program is to implement energy management projects that have a rate of return or payback period that is acceptable. Five to seven years should be the maximum. If the payback is longer, reconsider the project and its longer term impact before going ahead with the project.

The simple payback period is equal to the installed cost of the measure divided by the first year savings. For example, if a project cost $9000 and had an energy saving of $3000 the first year, the simple payback period would be three years.

Step 5 – Do an energy audit of your club with recommendations for improvements.

A good audit will document all the energy using equipment in the facility, and make specific recommendations for cost-effective energy retrofits. Typical energy measures that have proven cost-effective include the following:

1. Lighting upgrades and re-lamping both in the arena or shed, lounges and locker rooms.
2. Heating and air-conditioning tune-ups.
3. Ventilation upgrades
4. Programmable thermostats

5. Scheduling of the startup and shutdown of seasonally-operated equipment to minimize electrical demand charges
6. Scheduling of daily energy use to minimize peak electrical demand charges.
7. Air sealing and infiltration control.
8. Attic insulation, if the attic is accessible.
9. Electric motor system upgrades--cogged v-belts, timer controls, and replacement of standard efficiency motors with high efficiency motors where annual hours of use are high

Some measures that are usually not cost-effective are the addition of wall and roof insulation to an existing building, unless the roof or wall needs major repairs or replacement. The replacement of windows is also usually not cost-effective unless the window needs replacement. In addition, the replacement of equipment with low annual hours of use is also usually not cost-effective.

Step 6 - Secure financing for the capital costs.
There are a number of funding sources available:
1. Capital reserves
2. Equipment supplier financing
3. Bank loans
4. Energy service companies

Step 7 - Get the audit recommendations implemented.
A well written energy audit report will often provide enough information to proceed with small projects that can be done with existing staff. For larger projects, electrical or mechanical contractors with experience in the area of energy efficiency can be hired. For very large projects, a general contractor can be hired.

Step 8 - Provide staff training.
It goes without saying that the staff must be properly trained. Devices such as time clock controls, programmable thermostats, new lighting systems, and new motor drives all require that some staff training take place. Other simple ideas such as turning off unnecessary lights and equipment **should be reinforced** with all staff members (and with volunteers if necessary).

Step 9 - Monitor the energy savings.
Energy use can be tracked using the monthly bills from the various utilities. Monthly energy use before and after the retrofit can be plotted on a graph to indicate progress in energy saving. Space heating use will vary with the coldness of the outdoor climate. One way to track the savings is to divide the annual space heating energy use by the annual heating degree-days available from Environment Canada. Unless you correct the space heating numbers to account for colder or milder winters, some errors will occur in assessing the real benefit of the energy conservation measures.

Step 10 - Provide feedback to management and rewards to staff.
The Board of Directors will want to be kept informed of progress with the energy measures. Regular reporting of energy savings will help the project along, and also build good will toward the program.

The Effect of Scheduling, Demand, and Consumption on Electrical Utility Billing

Background
In some facilities, electrical energy use changes on a seasonal basis. For example:

- ice rink plants starting up in the fall,
- air conditioning starting in spring (where applicable),
- ice rink plants shutting down for the summer (where applicable)

The **timing of starting or stopping** electrical equipment can greatly affect electrical utility charges.

Electrical Energy Consumption
Energy consumption is the amount of electricity consumed and is usually expressed in kilowatt hours (kWh).

Electrical Demand
Demand is the rate at which electric energy is delivered to a load. Demand is expressed in kilovolt-amperes (kVA) and refers to the maximum amount of power drawn through a meter during a billing period. Billing periods are usually one month long. The demand charges also compensate for having to produce the peak demand which is usually needed at the same time as other customers are registering their peak demand. Electric utilities average the power reading over a time interval, so that very short fluctuations do not adversely affect customers. For instance: after 1 minute, the demand reading is 25% of the actual demand; after 4.5 minutes it registers 50% of the actual demand; after 15 minutes, 90%; and after one half hour, 99%. Thus, the customer is billed for demand for a month based on the maximum average of their power use.

Monthly Scheduling
Example: Two ice rinks are identical to each other and both have their electrical demand meters read at the end of the month. Both rinks start making ice at the end of October.

- Rink 1 turns on its ice plant October 30, one day before the demand meter is read.
- Rink 2 turns on its ice plant October 31, five minutes after the demand meter has been read.

The electrical bill for October for Rink 1 is much higher than Rink 2 because it incurred demand charges in October. Both rinks have the same billing throughout the winter because they operate their rinks in the same way and both rinks shut off their ice plants at the end of March.

- Rink 1 shuts off its ice plant March 31, one day after the meter was read.
- Rink 2 shuts off its ice plant, March 30, 1 hour before the meter was read.

Rink 1 has a much higher electrical bill in April because of demand charges.

Key Point Attention to when demand meters are being read and when starting large seasonal equipment such as ice plants, large air conditioners, and fans can make a big difference in electrical billing. Contact your local electrical provider and find out when your meter is scheduled to be read.

Summary
1. Always co-ordinate the seasonal shutdown and startup of large electrical equipment with the electrical demand meter readings.
2. Operate electrical equipment in your facility to minimize the peak electrical consumption. Demand charges are important!

Energy Efficient Electric Motors and Drive Systems

Background

Conventional electric motors are large users of energy. Your compressor is operated by such a motor. Increasing the efficiency of drive power systems can save large amounts of energy and money. Motors are parts of drive power systems.

Electric Motor Efficiency

Most electric motors in use today are standard efficiency. There are several advantages to high efficiency motors:

1. Lower energy costs.
2. Higher power factor. With higher power factor, the amperage draw of the high efficiency motors is lower, and the electrical demand charges are reduced.
3. High efficiency motors tend to run cooler. As a consequence, the life of the motor is expected to be longer.
4. Smaller, less expensive power factor correction equipment is needed with high efficiency motors.

Although the cost of high efficiency motors is greater than standard efficiency motors, the incremental cost for the high efficiency motor is usually paid back in a short time. The longer the run-time of the motor each day, the shorter will be the payback period on the incremental cost.

An example for a 10 horsepower, 2 pole, totally-enclosed fan cooled, electric motor is as follows:

Comparison of Energy Efficient and Standard Efficiency Electric Motors

	Energy Efficient Motor	Standard Efficiency Motor
Full load efficiency	91.1%	84.8%
Capital Cost	$840	$700
Full load speed (rpm)	3510	3480
Power factor at full load (%)	89.7%	86.9%
kVA demand at full load	8.32	8.58
Annual energy cost at 3.72 cents/kWh for 4000 hours at full load	$1219	$1277
Annual demand charge at $14.53 per kVA per month	$1451	$1496
Total annual energy plus demand charges	$2670	$2773

The simple payback period on the incremental cost = ($840-$700) / ($2773-2670) = 1.4 years

Points to consider

- Note that for the example used, the annual electricity cost ($2670) of the motor is considerably higher than the motor purchase price ($740)
- The energy savings ($103 per year) are paid back in about 1.4 years, for a 73% annual return on the incremental cost ($140) of the energy efficient 10 horsepower motor.
- The energy efficient motor has a higher full load speed (3510 rpm) compared with the standard efficiency motor (3480 rpm). Higher efficiency motors have less slip than the standard motors. As a consequence, the v-belt sheaves should be changed to lower the speed of the fan to its original value. If this is not done, the greater load on the motor from the higher fan speed will tend to negate the efficiency improvement.
- The high efficiency motors of some companies are less efficient than the standard efficiency motors of other companies. Buyers beware. The following companies have high efficiency motors in the 1-200 hp range which are endorsed by the Power Smart Organization.

Company Name	**Brand**
Baldor Electric Co.	Super-E
GE Motors Energy	$aver
Leeson Canada Inc.	Wattsaver

<u>Use of Variable Speed Drives for Electric Motors</u>

In many applications, the use of a variable speed drive can be cost-effective. With many pump and fan loads, the power required to run the motor increases as the cube of the speed. Another E-note has further information on this technology.

An energy efficient drive system is more than an efficient electric motor. Wire sizing, power factor correction, careful end load designs, drive belt selection, reducing unnecessary operating hours--these are all important elements in an efficient drive power system.

Reducing Energy Consumption of Drink Coolers

<u>Background</u>

Drink coolers can use a considerable amount of electrical energy. Modern coolers incorporating lighted fronts have peak amperage varying between about 6 amps and 12 amps (120 volts) depending on the size and manufacturer of the machine.

A machine running 24 hours per day throughout the year will use a lot of electricity. Some recent measurements done on a drink cooler rated at 8.5 amps indicated that the unit has an average power consumption of 220 watts. (With the compressor on, the consumption was 525 watts). If operated 365 days per year at an average consumption of 220 watts, the electricity consumption would amount to $135 at an electricity cost of 7 cents per kilowatt-hour.

<u>Energy Efficiency Measures</u>

There are a number of low-cost energy efficiency measures that can be implemented on the drink coolers to lower the electricity bills.

1. De-lamp the light fixtures inside the units.
2. Use a good quality appliance timer on the unity. The timer can shut off the cooler during the period that the building is unoccupied. If the unit is off for 12 hours per day, the annual electrical bill will be cut in half.
3. If the drink cooler is seasonally operated, ensure that the cooler is unplugged during the months when the facility is vacant.

Savings from Efficiency Measures

1. If two 40 watt fluorescent tubes are removed, the annual electricity saving will be $49 using electricity at a price of 7 cents per kilowatt-hour.
2. A good quality industrial timer costs about $75. If the timer is placed on a drink cooler that uses $135 a year, and the drink cooler is off for half the time, the simple payback period is just over one year. Less expensive automotive block heater timers are available for about $35.

Points to Watch

1. If your facility does not own the drink cooler, let the drink cooler supplier know that you are implementing these energy measures because of the energy cost savings.
2. Purchase a high quality timer. Inexpensive residential timers available for less than $15 are not likely to give the trouble-free years of service you desire.
3. Because of the stored heat in the drinks, one can set the timer to turn off the drink cooler one or two hours before the facility closes in the evening. By the same token, one should also set the timer to turn on the drink cooler one or two hours before the facility opens in the morning.
4. Do not use a timer on any food appliance such as a freezer or refrigerator where there is a possibility of food spoilage.

Furnace Maintenance for Energy Efficient Operation

Save money

There are three ways to reduce your natural gas bill for space heating.

1. Proper Furnace Servicing: It is recommended to have a furnace inspected and serviced on a regular basis (once a year) to ensure it is running at peak efficiency.
2. Thermostat set back: Turn the thermostat back by a few degrees during the night and during hours the building is unoccupied. This energy saving measure can save over 10% on your annual heating bill. This can be accomplished by remembering to manually turn the thermostat back or by the use of a programmable thermostat.
3. Improved Building Insulation and Air Sealing: Improving a building's insulation, installing high insulation value windows, and installing weather stripping on doors, windows, etc., will lower heating loads. (Note: It is costly to improve an existing building's insulation and windows, therefore an estimate of energy savings versus installation cost should be performed before making decisions.)

Annual servicing

A furnace should be inspected once a year by a qualified service person to ensure it is operating safely and efficiently. The following items should be checked:

1. The combustion efficiency should be checked. A thorough combustion efficiency check involves measuring both the flue gas temperature and carbon dioxide concentration. High flue gas temperatures and low carbon dioxide levels mean poor efficiency.
2. The vent connection allows combustion gases to be vented to the outside. The draft hood is a safety device that ensures combustion products can escape the furnace in case the chimney is obstructed, prevents back draft from entering the combustion chamber, and maintains the efficiency of the furnace by ensuring there is enough air for the chimney to draw from.
3. The burner flame should be made up of little blue cones. If there is yellow streaking in the flames, the burner might need to be cleaned or the air controls might need adjustment.
4. The heat exchanger should be inspected for corrosion or soot deposits on the surface of the exchanger and be cleaned if necessary.

5. The drive motor should be inspected for worn bearings, improper belt tension, and bearings should be lubricated if necessary (some motor bearings are sealed and do not require lubrication).
6. The air filter should be cleaned or replaced every three months or as specified. The fan blades should be cleaned if necessary.

Things you can do yourself

1. Keep registers clean and free of obstructions to allow proper air flow. The furnace requires unobstructed flow for proper heat transfer from the combustion chamber to the supply air.
2. Keep the furnace filter clean. A clogged filter decreases the furnace's overall efficiency and should be cleaned or replaced depending on the type of filter.
3. Make on-going visual checks. If you notice a belt is bouncing or a bearing is squeaking or if the combustion flame is irregular or showing streaks of yellow, have the problem corrected by a qualified service person.

Set Back Thermostats for Reducing Space Heating Costs

Background

Setting back the room temperature is one of the most effective means of reducing space heating costs in buildings not occupied 24 hours a day. Many commercial and recreational buildings are unoccupied for substantial periods each day. By reducing the temperature of the building for the unoccupied hours, substantial energy can be saved.

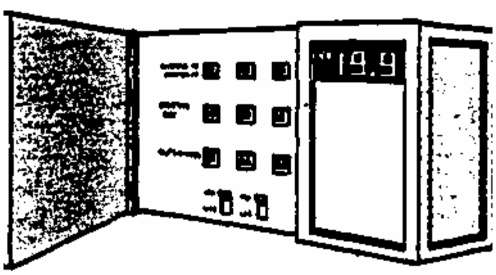

Figure 1. Programmable Set-back thermostat

Temperature set-back can be done either by manually adjusting the thermostat or by using a programmable (sometimes called a clock) thermostat. The programmable thermostats work best where there is a regular pattern of activity in the building. Many buildings have a regular weekday and a regular week-end schedule.

Savings from Set-back

On an annual basis the savings from night set-back can be substantial. For example, if the building temperature is set back 5 degrees C for 12 hours each day, the annual savings on heating cost would be about 8%. Increasing the hours of setback, or further reducing the room temperature, will improve the annual savings.

If the thermostats are manually adjusted each day for set-back, there is no capital cost involved. Residential quality programmable thermostats with 7 day programs (weekdays and weekends) are available for about $75. For commercial buildings, more elaborate energy management systems are available. In almost all buildings, the cost of the set-back thermostats will be repaid in less than a year if the thermostats are properly installed, programmed, and maintained.

Points to watch

1. All staff (or volunteers) must be made aware of the fact that the night set-back thermostat is in operation, and their help sought in implementing the use of set-back. Without the co-operation of staff (or volunteers), this energy saving measure will fail.
2. A means of readily increasing the temperature in the building must be known to most staff (or volunteers).
3. In buildings with leaky or poorly insulated walls and ceilings, care must be taken in colder weather that pipes do not freeze.
4. The heating system for the building must be of a large enough capacity that the building can be re-heated in a reasonable length of time. If the building in its existing state has trouble maintaining room temperature in very cold weather, it is not a good candidate for temperature set-back during that time of the year. Normally, starting the furnace about 2 hours before the building is to be occupied will allow enough time for the building to reheat.
5. Heavy masonry buildings will not cool off as rapidly, nor re-heat as rapidly, as light frame buildings.
6. Window condensation and frost problems are more likely to occur in very cold weather in buildings that use night set-back. However, where there is low interior humidity level, condensation problems are not likely.
7. In commercial buildings with mechanical ventilation systems, it is usually possible to turn off or reduce the ventilation system during the set-back period.
8. As with most conservation measures, it is important that a person be identified who will be responsible for implementing the night set-back strategy. It is not a simple task to program some of the set-back thermostats; organizations should allot some time for staff to become familiar with the use of these thermostats.
9. A battery-backed thermostat which retains the programmed set-back information is preferable to one without a battery.
10. A programmable thermostat with a weekly program capability (5 days and 2 days, etc) is preferable to a thermostat that has only a daily program. The thermostat with the weekly program will be able to save more energy.

Availability

Programmable thermostats are available from several sources: building supply companies, electrical distributors. Commercial programmable thermostats are available from electrical distributors or electrical control companies.

Other Energy Saving Tips for Heating

Some Power Smart tips

- Keep filters and heating surface clean.
- Do not block radiators and vents.
- Install automatic controls in washroom area.
- Clean excessive paint from grills and heating register.
- Reduce temperatures when building is vacant.
- Install reflective screens on windows.
- Clean chimney flues.
- Reclaim heat rejected from cooling equipment (such as exhaust air and refrigeration plant condenser heat).
- Set and lock thermostats at minimum comfort levels - storage areas may be kept cooler.
- Thermostats should not be on outside walls or in direct sunlight.

- Having double-glazed glass between viewing areas and ice surface provides comfort for spectators and overall energy savings.
- Seal windows and install weather stripping around windows and doors.

Reducing Energy Use for Potable Hot Water

Background
Potable hot water use in buildings includes the hot water used for flooding, wash basins, dishwashers, cleaning, and other uses. The energy used for producing hot water is often the second or third highest consumer of energy in curling buildings. Wise use of hot water involves both efficient heating and transport of the hot water, as well as efficient water using devices.

Efficient Heating of Water
There are a number of technologies that can be used to lower the energy cost of hot water. These include:
1. Conservation technologies - improved tank thermal insulation, heat traps, efficient circulating systems, pipe insulation, and controlling the water temperature
2. Heat pump electric water heaters -- exhaust air, outdoor air source, or ground source
3. Solar water heaters
4. Recovery of heat from condensers of refrigeration systems (heat exchangers)
5. Most water heaters are either natural gas or electric units. Heat pumps, solar water heaters, and heat recovery systems have all been used in Canadian curling clubs, but their use is not widespread. Under some circumstances, their use can be cost-effective.

The main conservation measures include
1. **Improved tank insulation.** Most existing hot water tanks have only about one or one and half inches (25 to 38 millimetres) of glass fibre insulation with a thermal resistance of about R 3.5 to R 5.2. Additional insulation can be added to the tank to reduce heat loss. One relatively inexpensive way of adding additional insulation to the tank is to use R20 (RSI 3.5) batts placed vertically around the perimeter of the tank. The batts should be cut in a barrel-stave fashion so as to fit neatly around the tank. Foil backed insulation can then be used to cover the batt insulation. Duct tape backed up with metal wire should be used to hold the insulation on the tank walls. It is very important that the air supply to the burners and the air supply to the draft hood of the water heater are not obstructed. Carbon monoxide can readily form if the air supply to the water heater is blocked. As a safety precaution, a carbon monoxide detector is recommended for use with all combustion equipment.

2. **Heat trap.** The purpose of the heat trap is to reduce the heat loss by convection out of the piping leading to or from the water heater. Heat traps on both the inlet and outlet pipes on the water heater.

3. **Improved pipe insulation.** The Canadian National Energy Code for Buildings recommends a minimum of 25 mm of insulation on new piping systems for water temperatures between 41 and 60°C. Higher insulation levels can often be justified.

4. **Timer on the circulation pump**. In commercial, industrial, and multifamily buildings, a circulation pump as shown in figure 1 is often used to distribute hot water throughout the building, and to reduce the length of time for hot water to reach the taps. In buildings which are not occupied 24 hours a day, the circulation pump does not have to run continuously. A timer on the circulation pump motor can be used to provide circulation of the hot water only when the building is occupied. By running the pump only when the building is occupied, the heat loss from the re-circulation piping is avoided. The life of

the pump will also likely be extended. Battery backed clock timers that will control the pump using either daily or weekly schedules are available.

5. **Limiting the water temperature.** To avoid legionella contamination, the hot water temperature should be greater than 50˚C (122 ˚F); to minimize scalding, the temperature should be less than about 60◦C (140 ˚F). Lower water temperatures reduce the standby heat loss from the storage tank, and also the losses from the circulation loop pipes.

6. **Avoiding Pilot lights.** A typical natural gas pilot light on a small water heater will use about 8 million BTUs per year. Choose a water heater that does not use a pilot light. If the water heater is not used for part of the year (a dedicated water tank for ice flooding) the pilot light can be turned off for the summer months.

7. **High efficiency water heaters.** The most efficient natural gas water heaters are those that condense the exhaust gases. Although these water heaters are initially more expensive, the incremental cost can often be justified where water use is substantial.

Efficient Water Using Devices

1. **Wash basins** - Spring return valves can be used.
2. **Showers -** Low flow shower heads should be used. The shower head should have a flow less than 9.5 litres per minute. Many older shower heads have peak flows that are double that amount.
3. **Dishwashers -** When selecting dishwashers, choose the brands with the lowest Energuide ratings. The biggest energy use with dishwashers is the water consumption.

Water Re-circulating

Cold Potable Water Conservation Measures

Water use in curling facilities can be a significant operating cost. Water use includes both cold water and hot water use. While no energy cost is charged to the building owner for cold water use, the cost of the cold water itself is a concern. The major cold water uses in curling facilities include the following: flooding, toilets, urinals, wash basins and cooling water for refrigeration equipment.

Cost-Saving Opportunities for Cold Water

1. **Toilets -** Toilet water consumption is a large user of cold water. New toilets are available that use only 6 litres per flush. Older toilets with tanks generally use either 13 or 20 litres per flush. There are a number of retrofit devices that can inexpensively reduce toilet water use. One of the most popular devices is a retrofit flapper valve for tanks that closes more readily, and reduces the volume of water per flush. One unit that has been used successfully is the "Frugal-Flush™" flapper. The cost is less than $10 per unit, and in most cases the money will be paid back in less than one year. An added benefit of using less water in the toilets is the reduction in “sweating” or condensation on the outside of the tank wall. In toilets that use pressurized “flush-o-meter” valves, the valves should be adjusted for adequate, but not excessive flushes.
2. **Urinals -** Many older buildings have urinals with tanks. The tanks continually fill, empty the water into the urinal, and then repeat the cycle 24 hours per day. A very cost-effective retrofit is the use of lever pull manual valves, along with removal of the tanks (or bypassing of the tanks). The simple payback period on such a retrofit is generally less than a year.
3. **Cooling Water for Refrigeration Units -** A number of older refrigeration units use cold potable water to remove heat from the condensers. In addition, many ammonia refrigeration compressors use cold water for cooling the cylinders. An alternative method of cooling is to use a closed loop with an

air-cooled heat exchanger. In many buildings, the heat rejected from the condensers and cylinders can be used for space heating during the heating season.

4. **Wash Basins -** Spring return faucets are a relatively simple means of reducing unnecessary water use in public facilities. Some new facilities use infra-red controls which provide water only when someone is using the lavatory.

Fluorescent fixture reflectors and T8 lamps

Fluorescent Fixture Reflectors

The efficiency of fluorescent light fixtures can be greatly improved with the use of reflectors. The most common type of reflector is shown in Figure 1. The reflector is usually made of a stamped aluminum sheet with or without a silver coating. The reflector serves to direct the light out of the fixture toward the work area. There are two basic types of reflectors:

- Anodized aluminum reflectors; these have an average total reflectivity of about 90 to 91%
- Silver film reflectors; these have an average total reflectivity of about 94 to 97%

Common reflector sizes are as follows:

- Single reflectors -- 4' or 8' long for use with one lamp
- Double reflectors -- 4' or 8' long for use with two lamps, side by side
- Recessed reflectors -- for 2' by 2' or 2' by 4' fixtures

The reflectors can be used for fixture retrofitting or for new energy-efficient fixtures

Savings from reflectors

A typical application is the installation of a recessed reflector in a 2' x 4' fixture, with removal of two of the four lamps. The reflectors are efficient; typically a 4-lamp fixture can be reduced to a 2-lamp fixture with a reduction of about 30% in effective luminance on the work surface. If, however, the lamps are cleaned at the same time, or replaced, the reduction in luminance is more in the range of 15 to 25%.

The retrofit is often coupled with a changeover of the lamps and ballasts. Typically T-12 lamps and magnetic ballasts are changed over to T-8 lamps with electronic ballasts. The smaller diameter T-8 lamps (1.0 inch diameter) tend to work better with reflectors than do the T-12 lamps (1.5 inch diameter). A recent retrofit of a 4-lamp (T-12) 2' by 4' fluorescent fixture with silver reflectors and electronic ballast was measured to have the following performance:

		Relative Light Level	Relative Energy Consumption
1. Initial luminance on work surface	824 lux	1.0	1.0
2. Luminance after silver reflector installed and two lamps removed	580 lux	0.7	0.5
3. Luminance after two T-8 lamps and electronic ballast installed	742 lux	0.9	0.33

The energy consumption of the fixture dropped from 186 watts to 93 watts after the two T-12 lamps were removed. When the T-8 lamps and the electronic ballast were installed, the energy consumption dropped to 62 watts. The greatest saving came from the installation of the silver reflector.

The longer that the light fixture is energized, the shorter will be the payback period. A retrofit of a 4-lamp T-12 4' fluorescent fixture to a 2-lamp T-8 fixture with a reflector would cost about $80 per fixture including labour. The annual energy savings would amount to $30, for a simple payback period of 2.7 years with an energy cost of 7 cents per kWh based on 3,500 hours of lamp operation per year (typical office building).

Points to watch

1. Silver reflectors, which offer higher reflectivity, are more expensive than anodized aluminum reflectors. In many cases, the extra cost is justified.
2. When reducing the number of lamps in a fixture, the remaining lamps must be repositioned to avoid an asymmetric distribution of light from the fixture. Kits are normally supplied with the reflectors for repositioning the lamps.
3. While any reflective surface will assist somewhat in increasing the fixture efficiency, it is important to choose a reflector that is designed for the specific fixture. Professional help is recommended.
4. Reflectors tend to direct the light in a more concentrated manner.
5. Dust will readily accumulate on an upward-facing reflector. A downward-facing reflector is much more likely to stay free of dust.

T-8 Fluorescent Lamps

T-8 lamps (1.0 inch diameter) are generally more efficient than the T-12 (1.5 inch diameter) lamps. For instance, the light output for a 32 watt 4 foot T-8 lamp is 69 lumens/watt. For a 40 watt T-12 lamp, the light output is about 50 lumens/watt, or about 28% less. In other words, the T-8 lamp is about 28% more energy efficient than a T-12 lamp.

Electronic Ballasts

A ballast is a device used with fluorescent lamps and other gas discharge lamps to provide the necessary starting and operating electric conditions. Standard ballasts consist of a core and coil assembly. On a typical fixture with two 4 foot 40 watt T-12 fluorescent lamps, the ballast consumes about 13 to 16 watts of electricity. Thus the total consumption of the two lamps plus the ballast is about 93 to 96 watts.

The most efficient ballasts are electronic or high-frequency ballasts. These typically boost the frequency of the electricity from 60 cycles per second (hertz) to between 25,000 to 40,000 Hz. At the higher frequency, the fluorescent lamps are more efficiently excited. Coupled with the T-8 lamps, the electronic ballasts are very efficient. On a fixture with two 4 foot 32 watt T-8 cool white fluorescent lamps and electronic ballast, the total consumption of the fixture can be as low as 60 watts. (In other words, the total consumption of the fixture is less than the nominal consumption of the two lamps. This unusual effect occurs because of the very high efficiency of the electronic ballast in exciting the lamps.)

In comparison with standard ballasts, electronic ballasts weigh less, operate at lower temperatures and at a lower audio noise level, are more energy efficient, but cost approximately two to three times as much as standard ballasts.

Points to watch

1. Electronic ballasts tend to have greater electrical noise than conventional ballasts. Choose ballasts with low harmonic distortion for electronically sensitive areas. (For instance, a TV set with a rabbit ear antenna will pick up the electrical noise from some electronic ballasts.)
2. Some T-8 lamps have an improved design which maintains a higher lumen output from the lamp over the total life.
3. Dimming electronic ballasts are available where adjustable light levels are desired.
4. T-8 lamps are available in a range of colour rendering index values.

5. When retrofitting fluorescent fixtures, always measure the light levels and provide only the appropriate amount of lighting. Over lighting is expensive.
6. When retrofitting fluorescent fixtures, the use of reflectors should always be considered as a means of reducing the number of lamps and ballasts.

Savings from T-8 lamps and electronic ballasts

The more operating hours per year that a fixture is energized, the shorter will be the payback period on the extra costs for T-8 lamps and electronic ballasts. Silver or anodized aluminum reflectors are also frequently used with the T-8 lamps and electronic ballasts to provide extra savings.

T-8 lamps are more expensive than the T-12 lamps. The cost of T-8 lamps has been declining, however, as their use increases. The cost of 4 foot T-8 32 watt lamps was about $3.25 each including taxes.

Electronic ballasts are available for one-lamp, two-lamp, three-lamp, and four-lamp fixtures. The most cost-effective electronic ballast is generally the four-lamp type. The cost of a four lamp electronic ballast to excite 4 foot T-8 lamps was about $40; and the cost of two-lamp or one-lamp electronic ballast was about $31.

Take steps to save energy and save money

Make your curling rink Power Smart

Being Power Smart and using energy efficient products is a sure way to save money on your utility bill. Canadian curling clubs can actually lower overall operational costs by introducing Power Smart energy efficient management practices in their facility. By lowering operational costs clubs can minimize increases to membership fees and at the same time provide better services to their members. Energy conservation practices will help clubs save money while at the same time making a contribution to environmental conservation. Members of your curling club will be supportive and proud to participate in such efforts.

The Canadian Curling Association also recognizes the value and importance of effective energy management practices within curling facilities of this country. With ever-increasing financial demands placed on curling clubs, The Business of Curling program of the CCA looks to provide assistance and resources to help clubs meet these demands and build for the future.

The Canadian Curling Association and *Power Smart Inc.* have teamed up to provide energy conservation information for your club. The following outlines some of the areas you should consider to save energy, to make your curling facility more efficient and comfortable, and to reduce utility costs. The information is presented as follows:

- Lighting
- Mechanical Systems - Ventilation, Refrigeration and Heating
- Project Planning - Where to start?
- Key Contacts - Who can help?

Lighting

Lighting makes up a significant portion of a curling clubs overall operational expenditures. Saving on your lighting bill can dramatically reduce the annual expenses at your club.

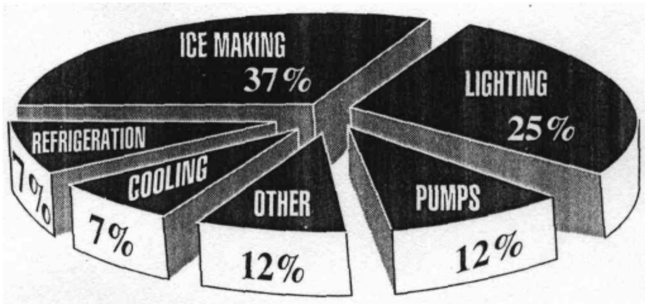

Figure l. Curling rink energy consumption

<u>A few *bright* ideas to help save energy and money</u>

- Organize a regular lighting maintenance program.
- Keep lights clean. Dirt accumulation on lamps, fixtures and surroundings can reduce overall effectiveness by up to 50%.
- Use natural reflectance. Clean walls and ceilings can make your lamp light go a long way.
- Reduce lighting in corridors and other low-use areas and save energy.
- Turn off lights in non-working areas (except security and safety lights).
- Use efficient light sources and fixtures.

Lighting

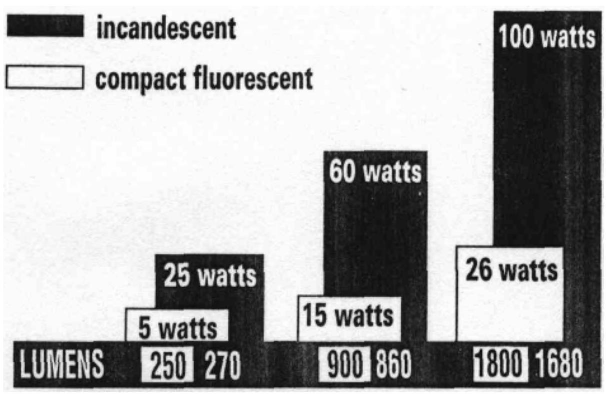

Fig. 2 Comparison of incandescent and compact fluorescent bulbs. Watts are a measurement of the amount of energy consumed by a light bulb. Lumens are a measure of how much light is produced by a light bulb.

<u>Some more serious savings</u>

- Replace inefficient incandescent lighting with compact fluorescent lighting. You can save up to 75% on lighting energy costs.
- Fluorescent lamps last 10 times longer than incandescent bulbs. Imagine not having to change bulbs so often.
- Replace mercury vapour lamps with metal halide lamps. Existing ballasts and fixtures can remain and you can save up to 20% on energy consumption.
- Install energy saving ballasts - lighting costs will be reduced with no effect on lighting quality.
- Use group re-lamping. Replace all lamps at 80% rated lamp life on a group basis.
- Remove unnecessary lamps.
- Install lighting timer controls.

Mechanical Systems: Ventilation, Refrigeration, Heating

The biggest energy consumers in any curling facility are the mechanical systems: refrigeration, heating, and ventilation. Here are some Power Smart tips to help you make your systems more energy efficient, but first you should look at how these systems are performing now.

1. Your systems' maintenance and operating records are the key to instituting substantial energy and financial savings measures. You should know how the system is doing now in order to determine where significant savings can be achieved in the future. It would pay to start and maintain a good record-keeping procedure before initiating any mechanical changes to the system.
2. Mechanical systems are power hungry machines, but with a little care and attention they can become energy efficient.
3. Determine where and how much energy is being consumed now. Before initiating energy saving changes to mechanical systems, a three to six months energy maintenance log should be kept, including a record of:
   - Hours of operation of all motors.
   - Suction and discharge pressures and temperatures.
   - Brine temperatures in and out of the ice sheet.
   - Compressor and condenser temperatures and water
4. Evaluate areas where you think energy use can be reduced or made more efficient. Involve your staff and ask for suggestions.
5. Contact your local utility or provincial/territorial curling association to discuss your next steps. They may be aware of programs available to assist you in becoming Power Smart.

Ventilation

All buildings require proper ventilation to maintain good air quality, but effective ventilation is especially important for curling rinks. Curling rink conditions are very sensitive to temperature fluctuations and humidity. When warm humid air enters curling clubs and temperatures are lower inside than outside, moisture problems, such as condensation, can occur. Excessive humidity can lead to structural problems such as rusting or wood rot. High humidity can cause excess moisture to condense directly on the ice surface as frost or drip from overhead girders, causing problems for curlers.

Some Power Smart suggestions

- Consider using the outdoor air when the weather is cool to minimize mechanical air conditioning.
- Wire washroom fans to operate only when lights are turned on.
- Shut down ventilation when not required.
- Shut off exhaust systems when area not in use.
- Use exterior shading/window film to shade windows thereby reducing air conditioning requirements in the summer.
- Reduce ventilation operating hours to match time and occupancy requirements.
- If high humidity is a concern, incorporate a mechanical dehumidification system with heat reclaim or install a chemical dehumidification system.

The chilly reality about refrigeration systems

Refrigeration

The refrigeration system is the most important equipment in the building, without which there would be no ice rink at all. It consists of:

1. a compressor
2. a condenser
3. an evaporator
4. related piping and valves

How it works

Brine is chilled by the system and circulated through the piping grid laid out under the ice sheet base. Heat removed from the ice surface is rejected outdoors to a cooling tower or a similar heat rejection device. With the help of some careful engineering, this heat could be recycled and used to heat hot water for ice melting or provide space heating.

Energy efficiency and energy savings are achieved by consistently maintaining the ice sheet at the proper temperature. A refrigeration system which is not well maintained will use much more energy than a refrigeration system which is well maintained. It pays to retain a competent and knowledgeable refrigeration engineer to supervise the refrigeration plant.

Hot Ideas for Cool Savings

To maintain the ice sheet at a constant temperature and avoid unnecessary energy loss, changes should be made in the following areas:

Brine

- Keeping brine at a constant temperature of 18°F to 20°F (-8°C to -7°C) will save energy costs.
- Check brine quality to ensure its best heat-carrying capacity. Specific gravity should be between 1.20 and 1.22.
- Ensure brine balance is maintained. An expansion tank in the brine circulation circuit helps prevent piping damage caused by expansion of brine in pipes.

Condensers

- Supervise condensing pressure. An increase in pressure could indicate tube fouling or a slipping drive belt.

Drive Belts

- Check belt tension regularly. Improper tensions will require more energy. Belts which are too tight can cause bearing failure.

Motors

- Use high efficiency motors when replacement is required.
- Ensure proper motor sizing for compressors.

System Maintenance

- Keep system clean to maintain efficiency.
- Repair all system leaks.
- Lock thermostat to prevent tampering.
- Have a refrigeration company recalibrate and adjust controls.

Insulation

- Start by repairing faulty insulation.
- Insulate around the edges of the rink.
- Insulate brine piping in the header trench and piping between the ice rink and the refrigeration plant.

Reduce heat gain to ice surface

- Maintain as low a temperature in the ice area as is comfortable for participants.
- Insulate rink wall and roof to save heating costs.
- Consider installing a false ceiling with acoustic tile or a 'low emissivity', reflector-like, ceiling to reduce rink heat gains from the warmer ceiling. Savings of 20 - 40% are possible.

Ice Sheet

- A sheet 3/4 -1 1/4 inches thick is adequate. A thicker ice sheet will only require more energy.
- Where possible, use de-ionized water when making your ice. Impure water requires more energy to freeze.
- Reduce the load on your refrigeration system by re-flooding only when necessary.

Reduce Electrical Demand Charges

- Start ice plant AFTER a monthly meter reading in the fall and stop ice plant PRIOR to a monthly meter reading in the spring. These two simple steps could result in significant savings on the electrical bill for your club.

How warm is cool

For your information, the following are suggested heating levels for your curling facility:

During Curling Season	Daytime	Night-time
Lounge, Lobby and Locker Areas	20-22° C	15-17° C
Storerooms & areas seldom used	13-15°C	13° C
Ice/playing area	*5°C	-3°

- *Air temperature in the ice area should be comfortable for curlers but need not exceed 5°C five feet above the ice surface. Never go lower than -3°C even when the ice is not being used.
- Consider using 7-day programmable thermostats to synchronize heating needs with ice utilization periods.
- Ice area heating efficiency will be greatly improved by maintaining low humidity levels. Proper ventilation and de-humidification are important.

Summer

- When using air conditioning in lounge and locker areas, heating temperatures should be allowed to rise at night.

Let's Recap

Where to start?

1. Establish a historical log of various system operations:
   - Lighting
   - Heating
   - Refrigeration
   - Ventilation
2. The log doesn't need to be complicated, but should include:
   - hours of operation of lights and equipment

- temperatures being maintained indoors and by equipment and ice surface
- outdoor temperatures and weather conditions

3. Contact your local energy utility or engage a qualified consulting engineering firm to conduct an energy audit. The consultant will outline the next steps for your club to become Power Smart. (Your local electrical utility will know of any special utility programs or local engineering firms who could help.)
4. Involve your staff. Keep them informed. Make them aware of equipment energy consumption levels and the associated costs. This way you can encourage and help each other become Power Smart. Make it fun.
5. Advertise your efforts among membership! Gain their support and get them involved. Along with contributing to the financial stability of your club, your members can make a real contribution toward environmental conservation. Perhaps combine your Power Smart efforts with other environmental initiatives such as recycling wastes.
6. Begin project implementation and you're on your way!

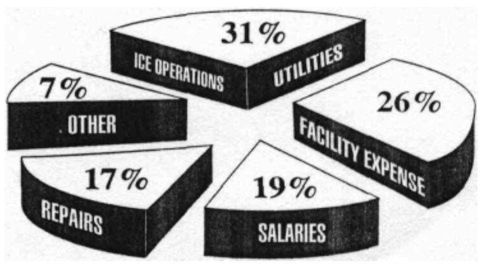

Fig. 3 Typical curling facility operating expenses. (Source: 1991 Survey of Canadian Curling Facilities)

M Efficiency Tips

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