

TOWARDS CLASS A – MUNICIPAL BUILDINGS AS SHINING EXAMPLES

ENERGY WATCHERS RECOMMENDATIONS

The objective of these recommendations is to help building owners and energy managers evaluate the importance of saving energy in their buildings. Most of the tips and advice found here aim to provide professionals with practical guidance that can be implemented on a day-to-day basis.

A building that performs well will use less energy and achieve a better Display® or National energy label/certificate rating. Building energy labelling/certification is an important way to stimulate energy savings in both existing and new buildings: the potential for energy savings in buildings is considerable and by saving energy one saves money and time.

The Energy Watchers Recommendations have the following sections:

- General tips for building owners
- General tips for energy managers - day to day energy management of the building concerning:
 - Building envelope
 - Heat production
 - Heating system
 - Domestic hot water system
 - Ventilation system
 - Air conditioning system
 - Lighting system
 - Cold water supply system
 - Metering devices

General Tips for Building Owners

In order to save energy and money, the owner needs to effectively manage the building: one of the best ways of achieving this is to first appoint an energy manager; however this is not always possible. Here are some tips and advice that improve the energy performance of buildings, that a building owner should follow:

- Introduce a Maintenance Programme
- Keep all drawings of the building and its installations, all design documentation, equipment certificates and manuals, test protocols and letters of guarantee, and operation and maintenance manuals

- ❑ Encourage the occupants of the building to save energy. Behavioural change can reduce energy consumption by up to 20%.

In cases of equipment/installation replacement or purchase of new equipment:

- ❑ Contact the local Customer Center (if available) for free advice on implementing your energy saving projects
- ❑ New appliances should generally have an energy label class A (or even A++)
- ❑ In case of bigger refurbishment actions, order an energy audit and consider:
 - Taking steps to reduce energy demand (e.g. through using insulation etc, see building envelope) then consider
 - Changing of the fuel type used
 - Installation of a cogeneration plant
 - Installation of alternative heating sources such as geothermal heat pumps, solar or other renewable energy sources
- ❑ Identify the potential supplier, installer or contractor (where possible contact suppliers that have been recommended to you)
- ❑ If you consider third party financing or contracting to realise efficiency measures, ask for model contracts and contact experienced municipal energy managers
- ❑ Ensure that a controlled approach to mechanical ventilation is taken, as a minimum amount of fresh air is required for health and safety reasons

General Tips to the Energy Managers / Day to day Energy Management of the Building

It all starts or fails with the appointment of an energy manager! No energy manager means no voice to advise the owner on investments in energy efficiency and no annual budget for energy conservation measures. No annual budget means no energy efficiency measures being implemented. No implementation results in less profit and no energy cost reduction.

The general advice below is followed by tips for day-to-day activities categorised by subsystem.

- ❑ Develop and observe the rules set in operation and maintenance manuals for the building (including inspection and records of technical installations and repair, cleaning of the equipment, maps and documentation)
- ❑ Ensure correct installation and operation of equipment
- ❑ Check thermostat settings to ensure that heating and cooling systems turn on and off at the optimal programmed temperatures
- ❑ Provide a timetable for checking the building and systems for visual damage or failures
- ❑ Personal Computers (PC's) and photocopiers may represent 35% of electric consumption in offices. Advise occupiers to switch off electric equipment rather than leaving them on stand-by mode (a photocopier left on overnight wastes

enough energy to make 5,300 A4 copies; A PC monitor left on overnight wastes enough energy to laser print 800 A4 copies)

- ❑ Compare and analyze energy consumption of the building
- ❑ Break down the energy consumption by category of energy use (heating, ventilation, air-conditioning/cooling, lightening) if possible
- ❑ Measure weekly energy consumption and outdoor temperatures. Establish an Energy Temperature curve (ET-curve) of the building. (ET-diagram indicating mean outdoor temperature [°C] and the relevant energy consumption [kWh/m²week] is a basic tool in an energy management system)
- ❑ An ET-curve describes the correct energy consumption for a building. Deviation from the ET-curve indicates malfunctioning equipment. This problem should be investigated and remedied
- ❑ Have heating and cooling systems serviced every year or two and determine if a replacement is needed
- ❑ Be sure non-perishable foodstuff vending machines are switched off during weekends and holidays

Building Envelope

The building envelope includes everything that separates the interior of a building from the outdoor environment, including windows, walls, foundation, basement slab, ceilings, roof and insulation.

Day to day activities

Field Inspection Check List:

- ❑ Window inspection – check if there are any broken windows
- ❑ Frame inspection (windows and doors) – check if there are any air leakages and whether all joints and penetrations are weather-proofed or otherwise sealed
- ❑ Insulation inspection

Recommendations, advice and tips

- ❑ Major renovation of the building should be regarded as an opportunity to implement Energy Efficiency (EE) measures
- ❑ Planning external insulation (-75% existing U value) retrofit of façade within the framework of general renovation measures may cut its cost (and amortisation time) by about 40%
- ❑ Type of insulation – select insulation depending of the place of installation (wall, floor or roof) and R-value
- ❑ Ask for a manufacturer's insulation material certificate. Resistance to heat transfer through the insulation is measured in R-value. The greater the R-value, the greater the effectiveness of the insulation.
- ❑ The thickness of the insulation should be greater than the legal requirements, so check the existing national laws, standards, and norms

- ❑ Only use qualified companies for installing insulation
- ❑ Ask for a guarantee for each contractor service
- ❑ If you are able to insulate only one surface, make it the ceiling. Adequate ceiling or attic insulation can cut heat loss by as much as 30 percent.
- ❑ Always seal air leaks before adding insulation. Silicon caulking is inexpensive and can stop leaks.
- ❑ Seal proper openings for plumbing, electricity, refrigerant, gas lines and similar openings in exterior walls, floors and roof etc. forming the building envelope

Special feature: Replacing windows

- ❑ When replacing windows, deciding on the type of windows to buy will be among the most important decisions you will make in terms of energy use. Because of the impact windows have on both heat loss and heat gain, proper selection of products can be confusing
- ❑ The three key features of window energy performance are:
 - U-value (or "U-factor")
 - Solar heat gain coefficient (SHGC) and
 - Air infiltration

The lower the U-value rating, the better the overall insulating value of the window, and the higher the SHGC the greater the solar energy that passes through the window system. Windows with high SHGC (above 0.7) are designed for colder climates, while windows with low coefficients are designed for hotter climates

- ❑ Consider different glazing for windows on different sides of your building to benefit from passive solar energy. Install the lowest U-value windows you can afford on north-facing windows. Select windows with appropriate low-e coatings for your local climate on the east, west, and south sides of your house. If you do order different glazing for your different windows, be sure to keep track of which windows have which type of glazing because they will probably look identical
- ❑ Using lower conductivity gas such as argon in a sealed insulated glass window, heat loss can be reduced significantly. Most major window manufacturers offer argon-gas fill as an option in their most popular windows. Other gases that have been or are being used in windows include carbon dioxide (CO₂), krypton (Kr), and argon-krypton mixtures
- ❑ Low-e windows with high solar heat gain coefficients are appropriate for northern climates where passive solar heating is advantageous, while “southern low-e” windows with low heat gain coefficients are appropriate in milder climates where summer cooling is more significant than winter heating.
- ❑ Look for windows with wood, vinyl, or fibreglass frames. Be aware that today the frame is the least-efficient part of the window, so check the U-value of the frame too

Heat Production

Optimised heat production is not only a question of the installed technology but also of the fuel used.. Selecting fuel sources is more complicated than simply selecting the source with the lowest price. Nowadays, fuel selection involves environmental considerations, primarily air pollution and carbon dioxide emissions. It also affects the costs associated with efficiency and maintenance requirements of your energy-using equipment.

Day to day activities

Field Inspection Check List

- ❑ Insulation of the pipes
- ❑ Pipe leakages
- ❑ Insulation of the equipment
- ❑ Boilers
- ❑ Burners

Recommendations, advice and tips

- ❑ Carry out general maintenance checks once a year:
 - Boiler: Conduct combustion efficiency test at full- and part-load firing rates
 - Heat exchanger: after cleaning, the efficiency of the equipment might increase by up to 50%
 - Burner: Check four times per year, with the change of seasons. (A change in weather results in a change in combustion) A dirty burner causes improper operation which is less safe and less efficient
- ❑ If your boiler is over ten years old you will benefit from replacing it with a modern, high efficiency boiler, but consider at this moment also:
 - Upon exchange of boilers, always check the real heat demand of the building; boiler output must be sized accordingly
 - If boilers are still up-to-date, they may be upgraded with EE burners (modulated flame type)
 - The most efficient type of boiler is a condensing one. By extracting more heat from the gas, they can cut your fuel bills by up to 30%. Condensing boilers are highly efficient boilers that have much lower fuel and running costs than conventional boilers. In a system with several boilers, the base load should be met using a condensing boiler
 - Installation of a cogeneration unit to produce heat and power – the efficiency is up to 95% and production losses are only between 5 and 12%
 - Change of the fuel towards biomass (or gas)
- ❑ Change from electricity to gas or wood depending on your geographical location
- ❑ Installation of automatic controls to an existing boiler to improve the operation – it is not very expensive but may reduce consistently heat losses; be sure boiler,

burner and control chain (particularly when existing) are adequate to it.
Generally new energy efficient boilers are sold with integrated heat controller

Heating System

Energy conservation measures apply to hot water heating also. Water heating is a significant energy user in almost all facilities as it is a major part of total energy costs. Water heating systems usually operate continuously, so their losses are continuous. Inefficiency in water heating is caused primarily by inefficiency of the heating equipment and distribution pipes.

Day to day activities

Field Inspection Check List

- Leakages - check all pipe connections and valves
- Filters – inspect, clean or change
- Pumps
- Ensure thermostat is set according to ‘best practice’
- Timer (time, mode (day/night, holidays) set back
- Actual room temperature

Recommendations, advice and tips

- Regularly clean the pipe system
- Avoid unnecessary use of energy and maintain comfortable indoor climatic conditions in relation to the outside temperature
- The thermostat should be set according to best practice guidance (This will vary from country to country)
- Thermostats should be checked, cleaned and calibrated periodically
- In public areas, Thermostatic Radiator Valves (TRV’s) should be locked or not used
- Switch off extractor fans (in kitchens and toilets) if possible, especially overnight and in weekends (they also extract heat)
- Insulate all pipes and equipment in unheated areas
- Installing proper heating and hot water controls can reduce the running costs of your central heating system by up to 20%
- Open south-facing blinds on sunny winter days
- Plant deciduous trees on the sunny façade side
- Use highly efficient electric motors

Domestic Hot Water System

The cost of water includes the cost of the water itself, the cost of heating hot water, and the cost of pumping water. Next to heating or cooling, water heating is typically the largest energy user and during the past 20 years, the fraction of energy used for water heating has steadily increased.

Day to day activities

Field Inspection Check List

- Leakages
- Filters
- Pumps
- Thermostat setting

Recommendations, advice and tips

- A highly efficient natural gas water heater can provide plenty of hot water at a much lower operating cost than an electric unit.
- Heat pump water heaters use less than half as much electricity as conventional electric resistance water heaters. If you use electricity for water heating, consider installing a heat pump water heater
- For buildings with a high demand for sanitary hot water, the installation of a solar water heater should be examined
- Insulate all pipes and equipment. An insulating jacket will reduce standby heat loss - heat lost through the walls of the tank - by 25-40%, saving 4-9% on your water heating bills
- Replace old showerheads. Efficient shower heads can reduce the hot water used by typical shower by about one half
- Shut down domestic hot water circulating pumps during unoccupied hours
- Use highly efficient electric motors

Ventilation System

The main opportunities for saving energy with ventilation systems are eliminating unnecessary conditioning and reducing fan energy consumption.

Day to day activities

Field Inspection Check List

- Duct insulation
- Duct leaks
- Fans
- Dampers
- Air grills
- Air filters – clean or change

Recommendations, advice and tips

- ❑ Clean the system regularly – ducts, air grills, air filters
- ❑ Insulate supply ducts. Wherever heating ducts are exposed to unheated areas, there is potential for heat loss
- ❑ Lubricate all moving parts
- ❑ Upon exchange of fan, the new fan should be highly efficient, with variable speed control
- ❑ If possible, occupancy sensors installed for lighting control can also be used for ventilation control
- ❑ Upon installation of heat recovery equipment, the recovery unit should have an efficient coefficient above 0.8
- ❑ Electric motors should be highly efficient

Air Conditioning System

Many people buy or use air-conditioners without understanding their design, components and operating principles. Proper sizing, selection, insulation, maintenance and operation are key to cost-effective use and lower overall costs.

Day to day activities

Field Inspection Check List, including a regular cleaning of the system

- ❑ Duct insulation
- ❑ Duct leaks
- ❑ Ducts connections
- ❑ Fans
- ❑ Condensate drain
- ❑ Coils

Recommendations, advice and tips

Before installing any air-conditioning system:

- ❑ Radiant or solar heat gain through windows can cause occupant discomfort and increased air conditioning costs. The more glass the building has, especially on east, west, and south-facing exposures, the more important window shading is to improve comfort and reduce air conditioning bills. Please note:
 - Interior shading devices can block up to 65% of the sun's heat that would be otherwise transferred through the window
 - Exterior shading can block up to 95% of the sun's heat
 - Any shading device that can be removed during the heating season is desirable over a permanent device, particularly on southern exposures. South-facing windows can be a good source of "free" heating in winter. The best type of shading will depend on site-specific factors and requirements

When opting for an air-conditioning system:

- ❑ Obtain information regarding cooling/heating output; energy efficiency ratio; energy consumption; and energy efficiency class, before buying an air-conditioner
- ❑ Install outdoor units out of direct sunlight
- ❑ Consider the installation of a heat pump. High-efficiency heat pumps also dehumidify better than standard central air conditioners, resulting in less energy usage and more cooling comfort in summer months:
 - The most common type of heat pump is the air-source heat pump, which transfers heat between your house and the outside air. If you heat with electricity, a heat pump can trim the amount of electricity you use for heating by as much as 30%–40%. However, the efficiency of most electricity-driven air-source heat pumps drops dramatically at low temperatures, generally making them unsuitable for cold climates.
 - Higher efficiencies are achieved with geothermal (ground-source or water-source) heat pumps, which transfer heat between your building and the ground or a nearby water source. Although they cost more to install, geothermal heat pumps have low operating costs because they take advantage of relatively constant ground or water temperatures

To improve the performance of an existing system:

- ❑ Enable cooling equipment only if sun blinds are activated but temperatures remain above 26°C.
- ❑ Clean indoor and outdoor coils before warm weather starts: A dirty coil causes more energy consumption and decreases the life of the equipment
- ❑ Thermostats should be checked, cleaned and calibrated periodically
- ❑ Insulate supply ducts in unconditioned space
- ❑ Seal leaks and connections with mastic, metal tape or with an aerosol-based sealant. (Poorly performing ducts can leak conditioned air and reduce a system's efficiency by as much as 20%.)
- ❑ Check air conditioning filters every month. A filter clogged with dust and lint reduces the unit's cooling ability; include a new filter as part of any duct system improvements
- ❑ Repair or replace damaged, disconnected, or undersized ducts
- ❑ Use high-efficiency electric motors

Lighting System

Lighting energy conservation offers major savings in almost any facility. In public buildings lighting typically accounts for 30% to 80% of total energy consumption. Lamps act as electric space heaters, so lighting energy conservation may substantially reduce air conditioning costs.

Day to day activities

Field Inspection Check List including a regular cleaning

- Lighting fixtures

Recommendations, advice and tips

- Advise occupants to switch off lighting if not needed instead of leaving lighting on all day
- Major energy savings can be achieved from lighting since lighting accounts up to 40% of electricity used in non-residential buildings
- By investing in an energy-efficient lighting system, between 30% and 80% of electricity used for lighting could be saved
- Make sure that light bulbs installed are rated Class A
- Use compact fluorescent lamps with electronic gears. They are more expensive, but can use 75% less electricity and last years longer. Pay back is usually achieved between less than one year and up to three years
- In larger rooms, lighting should be made separately switchable for different zones (i.e. window and wall sides)
- Lighting for bathrooms, toilets, or dressing rooms have to be motion controlled
- Exterior lighting must be controlled via light sensors, timers, and maybe in combination with motion sensors, for security reasons
- The motion sensor keeps the lights on as long as there is movement. After motion has stopped (time lapse is adjustable), the detector switches the lights off
- With timers, you can save energy and control your interior or exterior lighting, or even appliances, by turning them on and off at determined times. Most modern timers are digital, easy to operate, affordable and can be programmed from 24 hours to 7 days and according to seasonal daylight schedules

Cold Water Supply System

In public facilities, service water is used in three main areas: (1) sanitary applications; including lavatories, showers, toilets, and urinals, (2) food and beverage applications; including food preparation, dishwashing, and drinking fountains, and (3) lawn and plant watering. These applications provide significant opportunities for energy saving.

Day to day activities

Field Inspection Check List, including regular cleaning

- Leakages (from pipes, valves, taps, toilets, etc.)
- Filters
- Pumps
- Water meter

Recommendations, advice and tips

- A tap leaking at the rate of one drip per second will waste more than 12,000 litres of water a year
- Fix leaking toilets immediately. A slow, barely visible leak can waste more than 4,000 litres per year. Visible, constant leaks can waste over 95,000 litres
- Repair or replace leaking hoses and sprinklers
- The shower is one of the easiest and most cost effective places to reduce your water use
- An inefficient showerhead can use more than 20 litres of water every minute while an efficient rated one will provide a high quality shower using a maximum of 6 litres every minute
- Don't over tighten taps. This can wear the washer and cause leaks
- Upon replacement, ensure that all new taps are water efficient

Metering Devices

By reading your electric, gas and water meters first thing in the morning and last thing in the evening, you can determine the quantity of electricity, water and fuel used overnight. High water use may be due to leaks. High electric use may be due to outside lighting, refrigeration, lights in vending machines and other controllable loads. High gas use may be due to warmer than necessary interior temperatures. Your clock thermostat may not be saving you as much money as it could.

Day to day activities

Field Inspection Check List

- Read meters morning and evening
- Keep records as you cannot properly monitor and control your consumption without recording energy use from day to day, month to month or year to year

Recommendations, advice and tips

- ❑ For all separate buildings, individual meters should be installed
- ❑ Metering and sub-metering of energy and resource use is a critical component of a comprehensive O&M program. Metering for O&M and energy efficiency refers to the measurement of quantities of energy delivered; for example kilowatt-hours of electricity, cubic meters of natural gas, or cubic meters of water
- ❑ Install meters with data collecting and cost allocation software
- ❑ Simple whole-building metering coupled with cost-allocation and energy-use tracking can save the building owner/operator 4% of annual energy bills.
- ❑ Modern BEMS (Building Energy Management System) offer a range of connectivity options for both metering devices and data transfer. BEMS are found in larger buildings where technical installations have a level of complexity that requires intelligent control
- ❑ BEMS systems often have unused logging and logic capability which means that additional energy monitoring can be incorporated into existing infrastructure. Many solutions are available for connecting meters and extracting logged data. Furthermore, the BEMS provides access to control and condition information, which can be used in the analysis of energy consumption patterns