INFOSHEET 1

School heating

In schools, as in any work environment, a comfortable room temperature is essential for the productivity and general well being of students and staff. A temperature range of between 18°C and 20°C is considered ideal in winter. The cost of heating consumes an average of 36% of Victorian school energy expenditure.

TYPES OF HEATING

The common forms of heating in Victorian schools include:

Central heating

Boiler systems

Boiler systems use fuel oil or gas to heat water that is reticulated to fan coil heat exchangers. Large fans blow air through the heat exchangers and into rooms via ducts. Often there may be a fan room and heat exchanger for each wing or section of the school, each of which are supplied with hot water from a single boiler. As well as the fuel for the boiler, electrical energy is required for the pumps and fans.

Typical boiler and fan coil unit common in schools

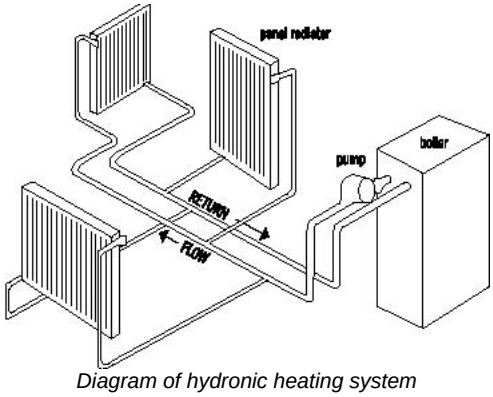


Diagram of hydronic heating system

Hydronic heating

Hydronic heating uses hot water from a boiler and passes it through radiator panels in each room. Some systems have a simple valve on the radiator to control the heat while others are more sophisticated and use thermostats.

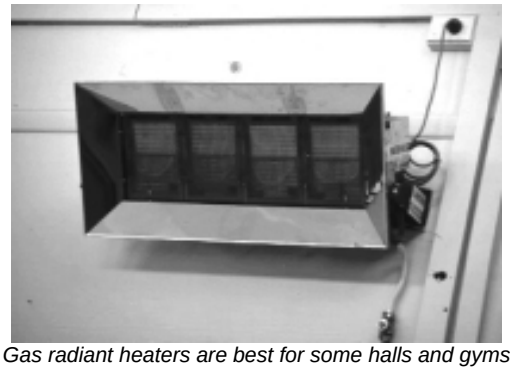
Furnace systems

Furnace systems are usually gas fired, and heat air directly which is blown into rooms via a duct system.

Individual room heaters


A typical room heater that operates efficiently on natural gas or LPG

Gas wall furnaces and console heaters use fan-assisted systems to heat the air that is drawn through the unit. These are the most common room heaters in classrooms. Gas wall furnaces commonly used in school classrooms are rated at about 40 MJ/h and cost approximately $200–$250* per year to operate on natural as. Powerflue console units with a 5 star rating in the same conditions cost about $120–$160* to run on natural gas. The cost of running a similar type of gas heater on LPG is approximately $750-$800 per year and a 5 star power flu console unit approximately $550-$600 per year. (Based on an LPG price of 70c/litre.)
NOTE: For safety reasons, all gas space heaters should be fitted with an external flue.


Gas radiant heaters are best for some halls and gyms

Radiant gas heaters

Where rooms or larger spaces such as multi purpose halls have high ceilings one or more gas radiant heaters provide the most effective heating.
Reverse-cycle air conditioners
These provide both heating and cooling from one electric unit. Split systems are best for schools however the infiltration of outside air, building occupancy and movement in schools places heavy demands on these units. Generally only smaller areas can be heated and cooled with domestic reverse-cycle air conditioners. Reverse cycle air conditioners are significantly dearer to operate than natural gas heaters however costs can be comparable where only LPG is available.

Portable heaters

These include electric fan heaters and radiators, and are often used in offices and staff areas of the school. Generally portable heaters are inefficient and expensive to operate and their use should be discouraged or eliminated.

Thin film radiant panel heaters

These electric flat panel heaters are based on a technology which produces radiant heat. Though initial purchase costs can be higher than portable heaters, they do provide a more efficient replacement for conventional electric radiators or fan heaters. Ceiling mounted panels, which can heat a whole classroom, are also available.

Heat produced by people and equipment

It is important to consider heat produced by people and equipment within school rooms. Where a thermostat does not control heating, the added heat of 25–30 human bodies in a room can significantly raise the temperature of the room.
Classrooms can easily become overheated and the air stale if ventilation systems are not functioning correctly. Extra heat will also be produced by equipment such as computers. Twenty-five desktop computers in a room will produce about the same heat as two single-bar radiators. Many schools find that heaters are often not required after about 11 am.

ENERGY EFFICIENT HEATING STRATEGIES

The following strategies are cost effective options for improving space heating in schools.

Central heating systems

Fuel conversion

Convert oil or LPG heating to natural gas. Fuel conversion requires significant capital outlay but provides large cost savings because of the much lower price of natural gas. Payback periods are usually about two years. Efficiency is not necessarily improved but energy costs are reduced. If not already fitted, timers and temperature control systems should be installed at the same time as the fuel conversion.

Maintenance

Regular maintenance is essential for maximum efficiency. Ensure boilers are regularly serviced by qualified heating and air conditioning personnel (Victorian government schools should refer to the *Specification for cooking appliances, oil and gas-fired heaters and hot water maintenance [BSA]*). Any leaks in the pipe work require urgent attention. Heat exchangers and fans should be checked and air intake filters cleaned or replaced regularly. Air distribution should be balanced so that all rooms are at a comfortable temperature. Poorly maintained or disconnected thermostats and central control systems are one of the most common sources of poor temperature regulation and high energy use in school central heating systems. Ensure your maintenance contractor checks and reports on the heating control system and seek specialised advice.

Upgrades

Upgrading central heating systems that do not have effective thermostats or timer controls save energy and is often economical with older boiler systems.
Timers and temperature controls that optimise the performance of boilers and heat exchangers can be fitted by heating and air conditioning engineers. These systems can be programmed to respond to outside and inside air temperature and time of day.
Boilers can shut down automatically early in the afternoon or when the outside temperature indicates heating is unnecessary.
Fans can be programmed to run after the heating system has shut down to ensure ventilation. Effective control systems will ensure minimal fuel waste and reduced electricity consumption from fans and pumps.

Recycle hot air

Many fan rooms draw all air for heating from outside the building where winter temperatures can be very low. This places heavy loads on the heating system and is not necessary to meet ventilation requirements. A significant energy saving can be achieved by recycling a percentage (50–80%) of the warmer internal air back through the heating system. This results in less fuel being used for heating. Consult a heating and air conditioning engineer about converting your system so that internal air can be recirculated.

Return air grille retro-fitted into Victorian LTC School


Thermostats control valve actuators or dampers

Zone controls

Most central heating systems incorporate zone controls that maintain different parts of the school at the correct temperature. These are linked to a thermostat and often utilise valves that are fitted to the heating pipe work or ducting of the heating system. Ensure these controls are operational and well maintained.

Timers

All pumps, fans, boilers and furnaces should be switched by an automatic timer. Ensure also that the system does not operate over holidays and weekends. A 7-day timer can be programmed to eliminate weekend operation however an out of hours override switch should be installed for the occasional night time use.

Evening heating

Run evening classes and meetings in rooms with their own heaters, so the central heating does not need to operate.

Hydronic heating panels

Heat loss through the wall behind hydronic radiator panels can be reduced by placing an insulated sheet of aluminium foil against the wall behind the panel. This is cost-effective for all types of wall construction with the largest returns expected with solid, uninsulated walls through which the rate of heat loss is greatest.

Individual heaters

Turning off gas heater pilot lights over summer and during holidays saves about $1* per week per unit. Turning off heaters when a room is vacant saves up to $0.50* per hour.
Consider fitting locks to heaters so that only staff can turn them on and change thermostat settings.
Minimise (if possible eliminate) the use of electric fan heaters. Portable bar heaters cost $0.25* per hour per bar while fan heaters can cost $0.40* per hour (expensive).
If portable heaters are in common use this is an indication of an underlying problem in the main heating system.
Where individual heaters are required in small rooms or near staff desks, consider installing low power radiant panels fitted with a time switch.

Example:
Replacing fan heaters with a 160W thin film desk heater saves about $3.50* each week based on 20 hours use per week. If such heating is required for about 20 weeks of the year, the payback period is about 2 years.

*Based on a assumed electricity tariff of peak rate 16c/kWh and natural gas tariff of 95c/MJ.

Thermostats

Controlling room temperatures is an important way of saving energy. A 1°C reduction in room temperatures can lower heating costs by about 10%. The calibration of room thermostats can be checked by reading room temperatures with a thermometer placed next to the thermostat. Control panels can be enclosed or protected so that only authorised personnel can change the settings.

Use thermostat controls to prevent over- or under-heating. Over heating can be a problem during spells of mild weather. Under heating can also be an expensive problem if portable electric heaters are used to top up the main heating system. Set thermostats at the lowest comfortable temperature in winter (18°C–20°C). Staff and students should dress for the season. Temperatures in changing rooms need to be set slightly higher at about 21°C. Corridors can also be at a lower temperature provided this does not result in cold draughts into the classrooms.

Check that thermostats are located in a position representative of the zone being heated, and that they are not affected by draughts. This will prevent overheating and will improve comfort as well as providing worthwhile cost savings.

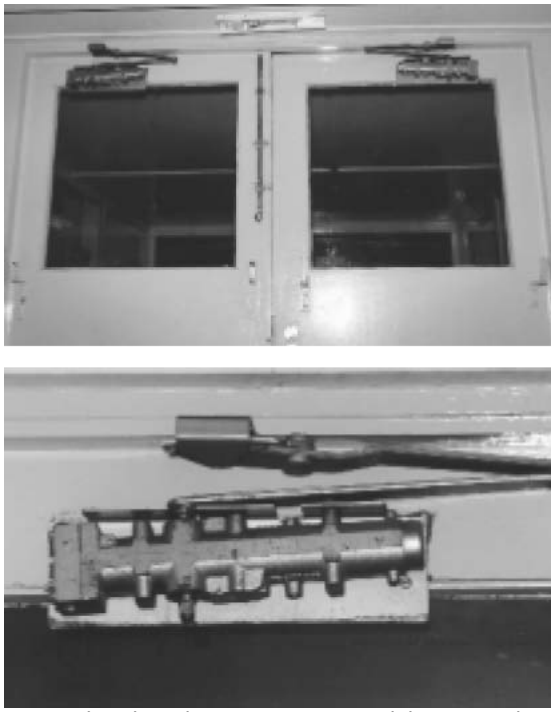
Draughts

Excessive and uncontrolled infiltration of air is often the largest source of avoidable heat loss from school buildings. It can account for 60% of total heat loss. Cold air infiltrates through the cracks that surround all doors and windows, while warm air escapes through vented skylights and fans. About a third of the energy used to heat a school is used to heat the infiltrating air.

Draughts can be detected by hanging a piece of plastic food wrap film over a pencil and holding near areas of potential heat loss.

Reduce draughts by:

- weather stripping;
- fitting heavy-duty closers to external doors;
- erecting windbreaks near exposed doorways;
- ensuring skylight vents and fans are closed off during winter.



Heavy duty door closers ensure external doors stay shut

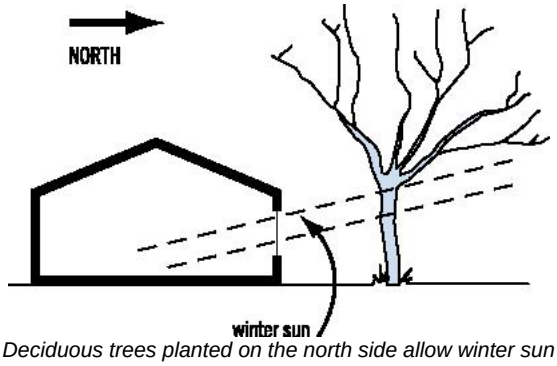
Insulation

Many school buildings are inadequately insulated.

Retro-fitting insulation can dramatically improve comfort and save energy but may be difficult or too expensive in some types of constructions. In colder climates insulation of walls and floors in south facing rooms will bring further savings.

In rooms with large glass areas, cover some windows with insulated panels (such as notice boards) to reduce winter heat losses and summer heat gains.

Heavy drapes and tight fitting blinds reduce heat loss through windows but shut off natural light. Consider having the cleaners close curtains at the end of the day to retain some heat overnight. Vertical blinds and venetians do little to reduce heat loss.

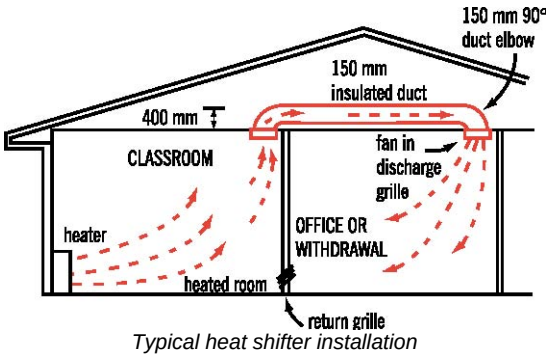


Deciduous trees planted on the north side allow winter sun to warm rooms

Building use

Utilise passive solar heating from north-facing windows. A typical 10 m2 classroom window in a north-facing wall has the same heating effect at midday in winter as two 2-bar radiators.

In rooms with high ceilings, a slow-moving ceiling fan will recirculate warm air from the ceiling— saving up to 20% of the room heating costs.
The use of a heat-shifting fan can move warm air from a heated classroom to a cooler adjacent room.



Typical heat shifter installation

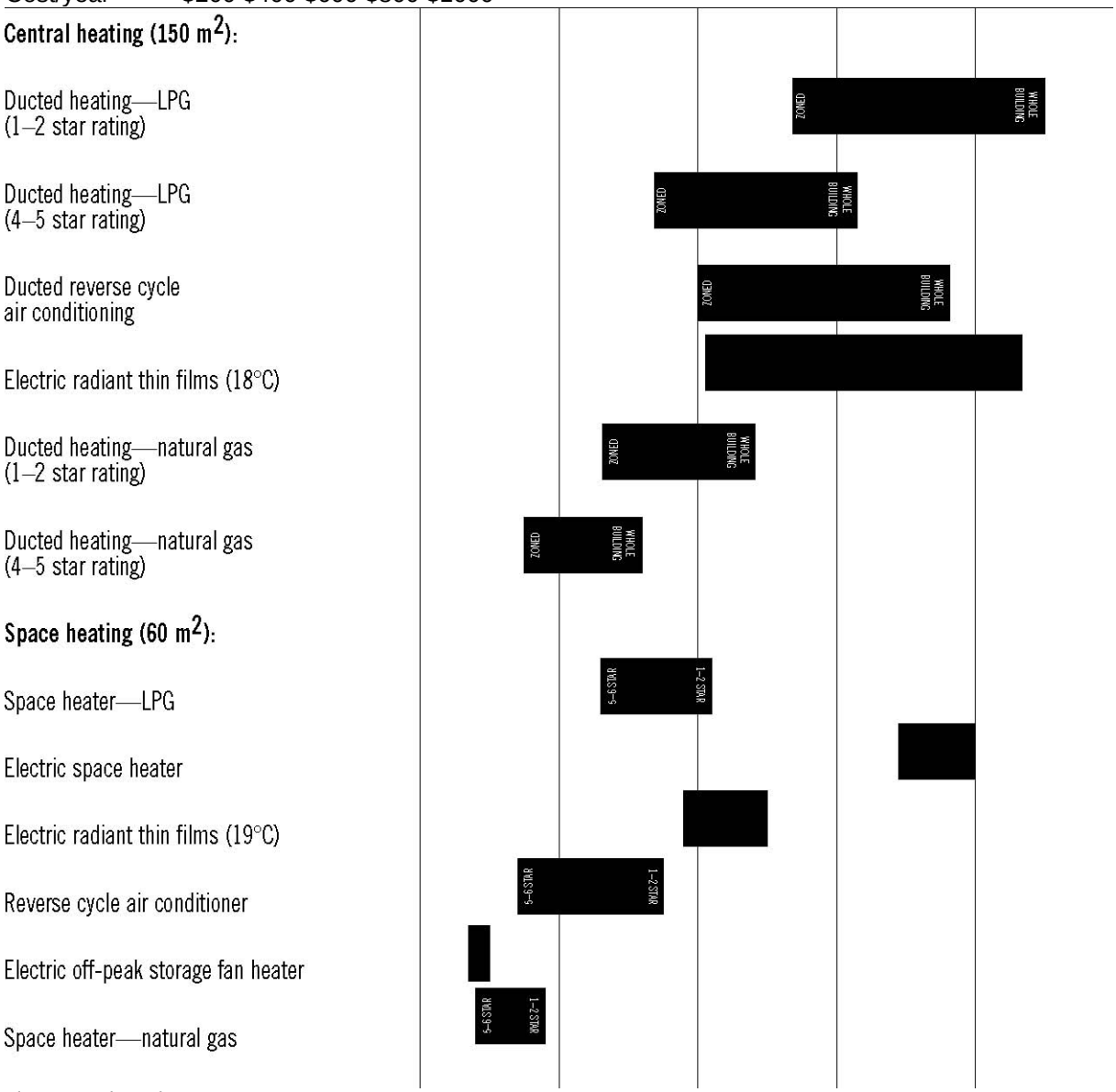
Review the layout of classroom furniture. Check that bookshelves, cabinets and other furniture do not impede the flow of heated air. Move desks and chairs away from cold or draughty areas and install bookshelves or partitions to protect people from the movement of cold air.
Schedule classroom activity to ensure continuous occupancy. Energy can be saved by more effective scheduling of activities, including organising cleaning of rooms soon after classes finish.

ENERGY PRICING

All operating cost quoted in these info sheets are based on a standard school day and are approximate only. The operating costs are based on an assumed peak electricity tariff of $0.16/kWh , natural gas tariff of $0.95/MJ and a LPG prince of $0.70/litre. Schools should check with their electricity and gas retailer for tariffs applicable to their particular schools.

ANNUAL HEATING COSTS (These figures are a guide only)

Note: For 24 hour heating, double these costs. Every 1°C increase in operating temperature, increases costs by about 10%.



Figures are based on:

- NatHERS' thermal simulation program for a typical uninsulated building in a strip shopping centre.
- The building is assumed to be heated for ten hours a day (8 am to 6 pm), seven days a week to 19°C for radiant thin film heating, and 21°C for all other forms of heating.
- Tariffs assume electricity at 16c/kWh, and natural gas at 0.95 c/MJ and LPG price of 70c/litre.