



Powersaver HVAC tip sheet

Heating, Ventilation and Air Conditioning (HVAC) Energy Efficiency

Looking at possible energy efficiency options for your buildings Heating, Ventilation and Air Conditioning (HVAC) I suggest you read over the ideas below and investigate further the options that may apply to your site with a suitably qualified technician.

HVAC system inspection points

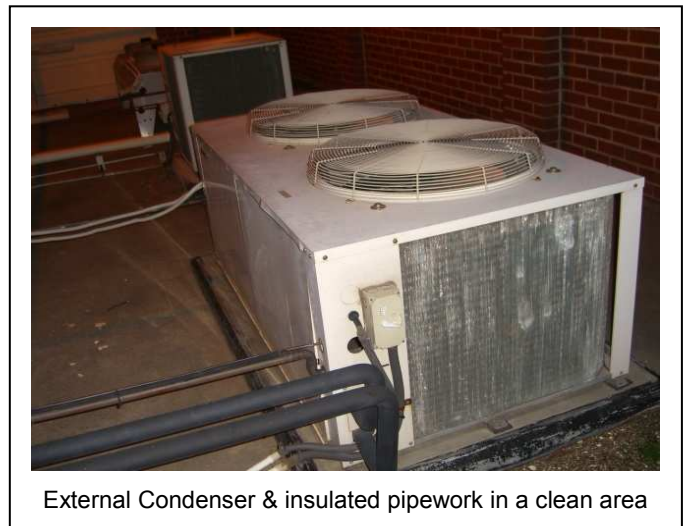
Safety: When inspecting aspects of your HVAC systems it is important to be mindful of safety. Heating and cooling equipment involves high levels of electrical current, high temperatures, fast moving motors spindles and fans, fan belts, pump motors and other equipment that can be dangerous to life and limb. Often components of HVAC systems are located on roofs or in places that expose individuals to risk of slips and falls. Take safety precautions and do not expose yourself to risk, and have any work carried out by suitably qualified individuals.

Pipework Inspect the insulation on refrigerant pipework, especially that which is outside of the building. If the installation is incomplete, or has degraded over time, it should be reinstated, preferably to a higher standard of insulation.

Sight Glass Somewhere in the refrigerant line there will be an inspection point, often called a sight glass, which will indicate the level of refrigerant coolant in the system. When the refrigerant level is low (your contractor will be able to show you how to check this) it should be topped up to keep the equipment operating at maximum efficiency.

Filters Air filters easily become clogged, slowing down the air flow, and reducing both the effectiveness and efficiency of ventilation. Some filters can easily be checked.

Condenser Air cooled condensers expel heat and require good airflow through and around them. The vanes of the heat exchanger should be clean and unclogged, the area around the units should be clean and there should be nothing obstructing the flow of air around the unit. Refer image.



External Condenser & insulated pipework in a clean area

- Ductwork Possibly not easy to inspect due to it being sealed, however if you can remove a vent cover (register) and peer inside (possibly with a mirror) you can see if the ductwork is clear of accumulated dust, cobwebs etc that are slowing down the airflow.
- Thermostat Is the thermostat away from sources of heat and cold that could be causing it to read incorrectly? Sources of heat and cold include sunlight, office equipment, heaters, windows and air vents of the HVAC system itself.
- Commissioning Are there manuals for commissioning the HVAC system? Were they followed when the system was implemented? What further instructions are there for the tuning of the system and have they been done?

On/Off and temperature control settings;

- Timer If there is no timer that's an obvious place to start. Timers should be set to give the equipment time to condition the air before occupants arrive and no more. You could try setting the start time later and see if it makes any difference to comfort. You could also try setting the shut-off time earlier and monitoring any feedback. What you are trying to find is the 'optimum start' and 'optimum stop' times.
- Days on/off Does the timer allow for weekends (7 day timer)? What measures are in place to ensure the HVAC doesn't activate on public holidays?
- Zones Do you have multiple zones? Are they set appropriately? Are thermostats in the appropriate locations? Often after building refurbishments the zone controls will need to be relocated to account for changes.
- Dead Band Is the control set with a 'dead band' or 'comfort zone' where neither heating nor cooling will operate? A comfort zone of about 5 degrees is appropriate in most buildings and allows for people wearing warmer clothing in winter and lighter clothing in summer.
- Setting Thermostats should not be set to extremes. Heating and cooling will work at full tilt until the desired temperature is met and then stop. If the temperature setting in summer is set to 15 degrees the cooling will be overworked and the environment may become unhealthy and so cold that people shiver. The heating system may even kick in to combat the low temperature. The opposite is true in winter where heating costs rise by about 8% for every degree of overheating.
- Control Are occupants 'fiddling' with the settings and creating issues? Controls can be isolated so that occupants cannot change them.

Questions to ask your occupants

- Need Are there areas that need little or no need for conditioned air where air flow could be reduced or vents could be closed completely?
- Temp Band Is it appropriate to widen the temperature band (to five degrees, say 19-24 degrees) and for the occupants to allow for this by dressing for the season?
- Appliances How can the energy use of appliances such as computers and office equipment be reduced to lower the amount of heat they generate?

Questions for the Maintenance Contractor

Energy consumption can increase by 30% if regular maintenance is not undertaken.

If you think your system is not operating correctly or if occupants complain contact your maintenance technician with your concerns.

Metering	Can an electricity and/or gas meter be easily fitted to the HVAC equipment to measure energy usage? (This is called sub-metering and doesn't effect billing)
Boilers	Gas fired boilers should be serviced once a year, oil fired boilers twice a year.
Filters	Filters should be regularly cleaned to ensure good air flow.
Cleaning	Fans, grills and air ducts also need to be periodically cleaned.
Insulation	Boilers, hot water tanks, pipes and valves should be insulated. Payback can be usually be expected within a few months.

Refrigerant Gasses

There is a confusing range of gasses on the market. Particular gasses work with certain equipment and are suited for different applications. The 'Friendly Five' refrigerants are;

1. **Air**, such as natural ventilation
2. **Water**, for example evaporative cooling and cooling towers.
3. **Ammonia**, naturally occurring with no ozone depleting or global warming potential 'GWP'
4. **CO₂**, has a GWP of 1 compared to regular refrigerants that are around 1500 to 4000.
5. **hydrocarbons** (propane, isobutane and cyclopentane) which have very minor GWP.

Source: www.greenpeace.org f-gas-solutions.pdf

Most countries have changed over to refrigerant gasses that don't deplete the ozone layer, however many of those replacement gasses (such as R22) have huge global warming potential.

When buying new refrigerated cooling equipment look for the hydrocarbon refrigerant gasses R290 (propane) and R600a (iso-butane). These gasses are the most gentle in small equipment.

Things to discuss with a HVAC designer

Your HVAC maintenance company may not be the best person to ask about design elements. If you don't have a designer you could contact the Australian Institute of Refrigeration, Airconditioning and Heating on 03 8623 3000 www.airah.org.au Tell your designer you are looking to save energy and what size budget you have. The enhancements below would suit a modest budget and most would still continue to save energy after an upgrade to the main plant.

Controls	Are the controls adequate? Could the thermostats be better positioned? Could interlocked controls be fitted to prevent heating and cooling operating when not required? Is there an interlock to prevent the heating and cooling working at the same time?
Timers	Standard time clocks have their drawbacks. They are often located in inconvenient places, may be hard to change and often overridden so that the HVAC is operating all of the time.
Modem	If the digital control is linked to a TCP/IP modem you can monitor the system using a web browser and change settings at will. Others in the building can have input to the control of their areas and you can even change the settings from off-site. At home on a public holiday and remember you forgot to turn the HVAC off? No problem, just log on and switch it off remotely.

- Digital Digital control gives you more control and flexibility. Program hours of operation, automatically reset overrides, look at the units load and energy use dynamically, investigate any excessive use of energy, program maintenance for each unit, etc.
- Economy Economy cycles running ambient air take advantage or free heating and cooling by holding off the DX (compressor) stage or using a 'boiler lockout' to till when it's needed. Also to stop the heater from kicking in on warm/hot days.
- Zone Control Is it appropriate to put occupancy sensors in little used rooms (such as meeting rooms) to shut off, or substantially reduce, the conditioned air entering that space?
- Ventilation Are ventilation flow rates matched to demand?
- Weather Would weather compensation and optimum start controls suit the building?
- Boilers Replacing conventional boilers with condensing boilers can save energy.

Passive heating and cooling;

- Insulation Where can insulation be applied to the building? The cheapest energy savings can be had from quality insulation and air-tightness.
- Drafts How can gaps around doors, windows and other openings be blocked? You are paying for heated/cooled air and wasting money if you let it just blow away.
- Passive Are there options to make use of passive heating and cooling that will reduce the load on the HVAC system?
- Cross breeze In some buildings windows and doors can be opened to utilise a cross breeze to cool a building's interior. Ensure the aircon is switched off when doing this.
- Night Purge Is it appropriate over summer to (either naturally or artificially) bring cool outside air in overnight to cool the interior prior to the next day's use?
- Roof cavity Ventilating the roof cavity with whirlygigs and vents reduces the summer heat gain and the energy needed to cool a building. What are the pros and cons?
- Shading Would the outside refrigeration equipment benefit from shading? Can you shade the building and windows from the summer sun with trees or window awnings?
- Ceiling Fan Where you have high ceilings would a ceiling fan add comfort by cooling in summer and moving warm air downwards during winter?

Lighting

- Bulbs Swapping old incandescent light bulbs with modern fluorescent, compact fluorescent or LED lights reduces the heat generated by lighting and lowers the aircon load. This provides a double win for lighting energy savings.
- Downlights Despite their name 'low voltage' halogen downlights are very energy hungry. Replacing them with miniature fluorescent equivalents is a cost effective and cooler alternative. Cooler still are LED Downlights, available from Powersaver, that consume less energy, generate less heat, provide more useable light and last five times longer than fluorescent downlights.
- Fluoro's By applying voltage reduction to fluorescent lighting you can save around 25% to 30% of the energy going to the lighting and at the same time reduce the heat generated by the lighting by a similar proportion and consequently reduce the load on air cooling. With this technique and high performance magnetic ballasts a higher light power density can be achieved than using less reliable electronic ballasts.

Contact Powersaver for more lighting information sales@powersaver.net.au
 Phone +61 3 9563 3300 Fax +61 3 9563 3221 www.powersaver.net.au

Motors

Motors comprise a large portion of energy use in HVAC systems.

VSD Variable Speed Drives are the most efficient type of motor. If replacement is not feasible fixed speed motors should be tested for optimisation opportunities.

Direct Drive Direct drive is always more efficient than belt drive.

Optimise Compressor motors (and potentially chilled water motors) should be tested for optimisation opportunities. Optimising motors with PowerBoss Integra can save around 10% of the energy used with appropriate motors.

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Other Solutions

Hydronic Heating

TRV's Consider fitting Thermostatic Radiator Valves (TRV) to radiators to provide localised control.

Check the insulation on all pipes to and from the boiler.

Solar As hydronic heating uses a closed loop solar water heating may not be practical. Cold mains water can be pre-heated with a solar hot water panel before entering the hydronic system, however the small amounts of water involved may not warrant solar heating.

With the right plumbing, pumps and control gear a solar hot water panel could be used to boost the heat of water within the circuit prior to it entering the boiler. This is the field for a specialist in the area, not your average plumber.

