



Department of the Environment and Heritage // Australian Greenhouse Office
John Gorton Building Parkes ACT 2600 // GPO Box 787 Canberra ACT 2601 Australia
Telephone 02 6274 1229 // Facsimile 02 6274 1913
www.greenhouse.gov.au/challenge

GREENHOUSE CHALLENGE PLUS



ENERGY AUDIT TOOL AIR CONDITIONING SYSTEMS

06



Australian Government
Department of the
Environment and Heritage
Australian Greenhouse Office



ENERGY AUDIT TOOL AIRCONDITIONING SYSTEMS

06



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The Communications Director, Australian Greenhouse Office
Department of the Environment and Heritage
GPO Box 787

Canberra ACT 2601

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Effective management of your organisation's energy usage is good business sense. It can produce both environmental and economic benefits – and importantly reduce your greenhouse gas emissions. The Greenhouse Challenge Plus Energy Audit Tool has been developed to assist non-technical or semi-technical energy managers in small to medium organisations:

- identify actions to improve energy efficiency through the use of a simple but detailed audit checklist; and
- develop plans for implementing energy efficiency actions.

The checklist contains notes supplying the auditor with further explanation or hints on how to complete the tasks. It should be possible to complete the majority of tasks through simple observation.

The energy efficiency action plan – can also be utilised in the preparation of or alternatively form part of your organisation's annual progress report to the Greenhouse Challenge Plus programme—which details abatement actions.

The energy audit tool has been designed as a modular system. This means that you can utilise each of the volumes as stand-alone independent units or in combination with the other units.

This is *Volume 06 — Airconditioning systems* of the Greenhouse Challenge Plus Energy Audit Tool, which includes the following 11 volumes:

- Volume 01** — Lighting (indoor and outdoor)
- Volume 02** — Lighting control
- Volume 03** — Chillers
- Volume 04** — Boilers and steam systems
- Volume 05** — Ventilation systems
- Volume 06** — Airconditioning systems
- Volume 07** — Office equipment
- Volume 08** — Domestic hot water
- Volume 09** — Building insulation
- Volume 10** — Infiltration (air leakage into buildings)
- Volume 11** — Compressed air

Your challenge to reduce energy consumption and greenhouse gas emissions starts now!

Need more information?

If you require additional information about the Greenhouse Challenge Plus Energy Audit Tool, contact your Industry Adviser on 02 6274-1229 or at email greenhouse@greenhouse.gov.au. Additional copies of the Greenhouse Challenge Plus Audit tool can also be downloaded from www.greenhouse.gov.au/challenge

A:

BACKGROUND INFORMATION

Airconditioning accounts for approximately 10% of a typical small organisation's energy bill. Substantial energy savings can be made if the airconditioning system is correctly sized, installed, maintained and operated.

There is a wide variety of airconditioning systems available, ranging from reverse cycle (cooling and heating) airconditioners and small refrigerative wall units known as room airconditioners, to large packaged refrigerative systems, which provide central cooling via outlets throughout the building. Evaporative cooler systems, which utilise outdoor air drawn through water-soaked filters, are the most energy efficient systems available, but only work in areas with low humidity.

The following checklist will allow you to evaluate the energy efficiency of your airconditioning system, and gives clues on how to maximise efficiency by improving operation and maintenance. You will recognise some simple changes as well as more complex ones with regards to building design, which can be made to save energy and money.

Each question in the energy audit checklist, which follows, has a space where you can write your energy efficiency improvement ideas. You should refer to the explanatory notes when considering what can be done to improve energy efficiency. You may need to take additional notes and attach them to the checklist, or attach other relevant documentation (such as instruction sheets and site plans) in order to support your improvement ideas and completely document your audit.

Remember these are ideas, not decisions. When you have completed the energy audit checklist, select the energy efficiency improvements that are viable and enter them into the energy efficiency action plan in section C of this volume.

OPERATION AND USE

QUESTION 1: What type of airconditioning system is used in the building? Please tick the appropriate box below.

- Reverse cycle
- Refrigerative wall unit
- Refrigerative central system (split or packaged system)
- Chiller central system
- Evaporative system
- None
- Other:

Improvement ideas and notes:.....
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- Refrigerative wall and split system airconditioners are suitable for small to medium sized areas such as small retail stores. They can be reverse cycle, therefore providing heating or cooling. Wall units are also known as room airconditioners. In a split system, an outdoor cabinet contains the condenser and compressor and an indoor cabinet contains the evaporator. These systems are not as energy efficient as packaged system airconditioners.
- Refrigerative packaged system airconditioners are suitable for medium sized areas such as restaurants and fast food outlets. They often have many energy saving features such as zoning and economy cycles and can be reverse cycle. The compressor, condenser and evaporator are all located in one cabinet in a packaged system, which is located on the roof or next to the building. Packaged and split system airconditioners have a refrigerator unit that is much smaller than that of a chiller and use only a single compressor.
- Chiller systems are suitable for large areas such as hotels, hospitals and large office buildings. They consist of a large refrigerator unit that includes a condenser, evaporator and multiple compressors. They are discussed in detail in *Volume 3 — Chillers*.
- Evaporative systems are available to suit different applications. They can be portable, a wall unit, or a central system with ducts throughout the building. They draw air from outside through wet filters to cool the building. They only work effectively in areas with low humidity and are suitable for poorly sealed buildings, or for businesses where doors need to be left open such as retail stores. They are the most energy efficient method of cooling.
- A central airconditioning system circulates air throughout the building by a system of supply and return ducts (openings in the walls, floors or ceilings that are covered by grilles).

MAKE SURE YOU: If needed, consult maintenance or engineering personnel and if possible obtain or make a plan showing the locations of all airconditioning units, air ducts, outlets and inlets.

QUESTION 2: Is your airconditioning system more than ten years old?

- Yes No

Improvement ideas and notes:.....
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B: ENERGY AUDIT CHECKLIST



→ If your airconditioning system is more than ten years old you should consider installing a new, more energy efficient model suitable for the building design and size. The investment will pay back in just a few years. Refer to the resources page (section D) for information on appropriate airconditioners and supplier contacts.

MAKE SURE YOU: Consult maintenance or engineering personnel, contact the supplier, review purchasing records or consult personnel who have worked at the site for a long time.

QUESTION 3: Does your refrigerative airconditioner have an economy cycle?

Yes No

Improvement ideas and notes:.....
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→ Consider purchasing an airconditioner with an economy cycle that will utilise outside air for cooling purposes and therefore use less energy. Older airconditioners may have an economy cycle not labelled 'economy cycle', but something else like 'fan'. Use the function that utilises outside air to cool the building whenever outside temperatures are cooler than inside temperatures. An economy cycle is also known as 'free cooling'.

MAKE SURE YOU: Consult the operating manual or maintenance personnel.

QUESTION 4: When is the economy cycle of your refrigerative airconditioner utilised?

Time of use (for example every morning at 7am):

Improvement ideas and notes:.....
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→ The economy cycle should be used whenever outside temperatures are lower than inside temperatures. It should replace early morning airconditioning.

MAKE SURE YOU: Consult the operating manual or maintenance personnel.

QUESTION 5: How is your airconditioning system controlled? Please tick the appropriate box below.

- Automatically
- Manual switching
- Other:

Improvement ideas and notes:.....
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- Consider installing controls for the thermostat (temperature), airflow speed (fan speed) and air-vent direction. To achieve higher energy efficiency, set the thermostat temperature higher for cooling, lower for heating, reduce airflow speed, and ensure even distribution of cool or warm air via the air vents. Controls for the airconditioning system may be part of a building management system (BMS) using a computer programmed to control a variety of functions in the building.
- Use the energy efficient features of your airconditioning system. For example, use the zoning function to ensure only occupied spaces are conditioned. Zoning can also be achieved manually by using or installing screens or doors to close off the conditioned areas. This will allow cooling at a higher thermostat temperature, or heating at a lower heating temperature, and using a lower fan speed because less space requires conditioning.

MAKE SURE YOU: Consult personnel responsible for turning airconditioners on and off (morning shift, cleaning staff etc), and maintenance or engineering personnel.

QUESTION 6: What functions does your airconditioner have controls for? Please tick the appropriate boxes.

- Temperature (thermostat)
- Time of use
- Zones of use
- Air flow speeds of fan (high, medium, low)
- Air vent direction
- Other:

Improvement ideas and notes:.....
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MAKE SURE YOU: Consult the operating manual or maintenance or engineering personnel. See also question 5.

B: ENERGY AUDIT CHECKLIST



QUESTION 7: Are the airconditioner controls easily accessible?

Yes No

Improvement ideas and notes:.....
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- Controls to the airconditioner should be easily accessible by relevant personnel (not necessarily all personnel). This will allow the settings to be easily adapted to prevailing needs and therefore ensure greater energy efficiency.
- Make a subjective assessment on the accessibility of the controls.

QUESTION 8: Are the airconditioner controls clearly labelled with their appropriate functions?

Yes No

Improvement ideas and notes:.....
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- Controls should be clearly labelled with their appropriate functions to minimise any misuse that results in excessive energy use.
- Make a subjective assessment on the labelling of the controls.

QUESTION 9: What temperature is the thermostat set to on the airconditioner when cooling or heating the building?

Thermostat temperature:

Improvement ideas and notes:.....
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- The thermostat should be set between 24°C and 27°C for cooling purposes. The higher the temperature the more energy you will save. Conversely for heating, the lower the temperature the more energy you will save.
- The thermostat can be found on the controls for the airconditioner and should be labelled. Consult maintenance or engineering personnel if needed.

QUESTION 10: When is the airconditioning system turned off? Please tick the appropriate box below.

- End of the day
- Weekends
- Public holidays
- When the room or area is unoccupied
- Never
- Other:

Improvement ideas and notes:.....
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→ The airconditioning should be switched off when not needed. This includes at the end of the working day, on weekends, public holidays and when a room or area is unoccupied (if use of zoning is possible, see question 5). Outside-temperature sensors can also be installed which will allow the airconditioner to switch between the economy cycle and the cooling cycle, maintaining the desired temperature in the building in the most energy efficient manner.

MAKE SURE YOU: Observe all relevant rooms and areas at varying times if room airconditioners (wall or portable units) are used. Consult maintenance or engineering personnel, and cleaning or security staff regarding times when building is unoccupied.

QUESTION 11: Are any external windows or doors left open in airconditioned rooms?

- Yes No

Improvement ideas and notes:.....
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→ Open external windows or doors severely affect the efficiency of airconditioning systems. They should only be left open if an evaporative airconditioner is used or a refrigerative airconditioner runs on the economy cycle. If a refrigerative airconditioner is working on the cooling cycle, all external windows and doors should be closed, assuring the airconditioner does not have to compete with warm outside air. The same applies conversely to a reverse cycle system heating the air inside when the outside air is colder.

B: ENERGY AUDIT CHECKLIST



QUESTION 12: Are there any objects blocking the air-flow from the airconditioning system?

Yes No

Improvement ideas and notes:.....
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→ Any objects obstructing the air-flow from the airconditioner should be removed to ensure that air can disperse evenly around the room or area. This will avoid the need for the airconditioning to be turned up.

MAKE SURE YOU: Observe all relevant rooms and areas at varying times. Consult maintenance or engineering personnel if needed.

QUESTION 13: Can the amount of heat-producing equipment in airconditioned rooms be minimised?

Yes No

Improvement ideas and notes:.....
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→ Office equipment such as photocopiers, facsimiles, lights, computers, refrigerators and water chillers produce heat when they are operating. Photocopiers, faxes, printers and scanners should be placed in non-airconditioned, rarely occupied, naturally cool rooms if possible, to ensure that the heat produced by the equipment does not result in excessive need for airconditioning.

QUESTION 14: Is lighting and office equipment switched off when not used, where possible, to minimise room heating?

Yes No

Improvement ideas and notes:.....
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→ All personnel should ensure that lights and office equipment are switched off when not in use. This will reduce the need for airconditioning.

MAKE SURE YOU: Observe all areas of the building at varying times.

STRUCTURE

QUESTION 15: Are ceiling fans installed in the building to enhance cooling and reduce the need for airconditioning?

Yes No

If yes, how many:

Note: You may have this answer from question 6 in the energy audit checklist from volume 5.

Improvement ideas and notes:.....

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→ Ceiling fans will allow the airconditioner to operate at a higher thermostat setting and a lower fan speed which saves energy. If combined with good natural ventilation, airconditioning may not be needed as often or at all.

MAKE SURE YOU: Check each room and area and tally ceiling fans. Mark the locations of the ceiling fans on a plan of the building if possible. Consult maintenance or engineering personnel if needed.

QUESTION 16: Is the building adequately insulated to enhance cooling and reduce the need for airconditioning?

Yes No

Improvement ideas and notes:.....

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→ The roof and ceiling should be well insulated, as this is where most heat enters or escapes from the building. Refer to Volume 9 for more information about insulation.

MAKE SURE YOU: You will need to complete the checklist for *Volume 9 — Building insulation* before answering this question.

QUESTION 17: Has the building been adequately sealed to prevent the unwanted infiltration of warm air?

Yes No

Improvement ideas and notes:.....

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→ The building should be adequately sealed if a refrigerative airconditioner is used to cool the building. Please refer to Volume 10 for more information about draught proofing. The infiltration of warm outside air into an airconditioned building will make the airconditioner work harder and therefore use more energy to maintain the desired temperature. Conversely, infiltration of cold air into a heated building creates the same effect.

MAKE SURE YOU: Complete the checklist for *Volume 10 — Infiltration* before answering this question.

B: ENERGY AUDIT CHECKLIST



QUESTION 18: Does the building have adequate shading for areas or rooms that receive a lot of sun?

Yes No

If yes, what type of shading is employed?

- Trees
- Indoor curtains and shades
- Outdoor awnings
- Other:

Note: You may have this answer from question 10 in the energy audit checklist in volume 5.

Improvement ideas and notes:.....
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→ Adequate shading from blinds, curtains, outdoor awnings and trees should be provided for all rooms or areas which receive a lot of sun. This will reduce the need for airconditioning and therefore save energy.

MAKE SURE YOU: Survey each room and area in the building to evaluate the levels of sunlight and check for shading. Visit certain areas at different times of the day to cover the sun at different angles.

MAINTENANCE

QUESTION 19: Is the airconditioning system maintained according to the manufacturer's instructions?

Yes No

Improvement ideas and notes:.....
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→ The airconditioning system should be maintained according to the manufacturer's instructions to ensure it is operating efficiently. This includes:

- checking and repairing any refrigerant or air leaks from the ducting system or elsewhere,
- cleaning filters,
- cleaning evaporator and condenser coils,
- repairing bent evaporator and condenser fins.

MAKE SURE YOU: Consult maintenance or engineering personnel or records about external contractors.

QUESTION 20: In what time frame are repairs of the airconditioning system undertaken? Please tick the appropriate box below.

- Within 24 hours
- Within a week
- Within a month
- Greater than a month

Improvement ideas and notes:.....
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→ Repairs of the airconditioning system should be undertaken as soon as possible to ensure that operational efficiency of the system is resumed.

MAKE SURE YOU: Consult maintenance or engineering personnel, or an asset or defect management system.

PURCHASING

QUESTION 21: Do you obtain professional advice about the size and design of the airconditioning system most suitable to the building or space before purchasing?

- Yes No

Improvement ideas and notes:.....
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→ Before purchasing an airconditioning system, a supplier who uses a computer program or written calculation procedure to size the airconditioner to the building requirements should be consulted. The supplier should provide a written contract concerning the design and installation of the airconditioning system, which includes the results of the cooling load calculation. Alternatively a qualified energy consultant can be commissioned to provide recommendations for the correct airconditioning system for the desired purpose.

MAKE SURE YOU: Consult purchasing procedures, guidelines or policies.

QUESTION 22: Is energy efficiency taken into account when designing, purchasing and installing an airconditioning system?

- Yes No

Improvement ideas and notes:.....
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→ Energy efficiency should always be taken into account when designing, purchasing and installing an airconditioning system, as this will result in long-term savings. Seek advice from suppliers and pay attention to the efficiency-level indicated by the energy star-rating sticker. Refer to the resources page (section D) for further information.

MAKE SURE YOU: Consult purchasing procedures, guidelines or policies.

C: ENERGY EFFICIENCY ACTION PLAN



Note: As an alternative to using this action plan, you can also enter your energy efficiency actions as objectives and targets in an environmental management system, as a work order in your maintenance management system, or in another process that ensures nominated personnel complete the actions.

GOALS AND METHODS FOR ENERGY EFFICIENCY

Your energy efficiency goals

Example: "Reduce the energy use for lighting by 10% compared to last year's consumption." Be specific where possible taking into account technical, financial and operational inputs. Goals should be measurable where practicable.

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Your preferred energy efficiency options

Chosen from 'Improvement ideas and notes' in section B.

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Target completion date

Person responsible

Goal(s):.....

ACTION STEPS TO BE TAKEN *Specific steps needed to implement the preferred energy efficiency actions stated under 'goals and methods'.*

No.	Action	Person responsible	Due date	Date completed	Initials

COMPLETION *To be signed by person nominated under 'goals and methods'.*

Signature.....

Print Name.....

Title..... Completion Date.....

Please photocopy this form if additional action steps are required. Complete the page numbering and action numbering on all forms.

Page..... of.....

D: RESOURCES

National Energy Efficiency

A comprehensive guide to the latest Commonwealth, State and Territory regulations, standards and guides on energy efficient appliances
www.energyrating.gov.au

A SELECTION OF OTHER USEFUL LINKS

1. Energy Smart Allies Directory.

Directory of suppliers of energy services and products including information regarding air compressors and their components.
www.energysmartallies.com/esa/middlesub.asp

2. Business Information Sheets: Airconditioning.

Sustainable Energy Authority of Victoria (SEAV).
Provides links to a number of information sheets covering topics such as different types of refrigerated airconditioning systems and cooling hints for small businesses.
www.seav.vic.gov.au/advice/business/infosheets/airconditioning.asp

3. Energy Saving Manual, Section 9: Heating, Ventilation & Airconditioning (HVAC).

Department of Energy, Utilities & Sustainability of NSW (DEUS), and Sustainable Energy Development Office of WA (SEDO).
Provides tips on how to improve your existing HVAC system in order to save energy and money.
www.energysmart.com.au/sedatoolbox/esm9.asp

4. Sustainable & Renewable Energy Publications.

Energy South Australia.
Provides links to a variety of brochures about heating and cooling systems (includes airconditioning systems) in residential, commercial and industrial buildings. Also contains measures that can be taken to enhance the energy efficiency of your airconditioning system.
www.sustainable.energy.sa.gov.au/pages/general/publications.htm

5. Energy Smart Booklet: Choosing a Cooling System.

Sustainable Energy Development Authority of NSW (SEDA).
Describes different types of cooling systems, how they operate and their energy efficiencies.
http://www.energysmart.com.au/brochures/cooling_system.pdf

6. Energy Smart Information Sheets.

Sustainable Energy Development Office of WA (SEDO).
Describe the different types of airconditioners available and provide guidance with choosing a suitable, energy efficient airconditioner.
Choosing an Airconditioner:
http://www1.sedo.energy.wa.gov.au/uploads/Air-Conditioner_64.pdf
Your Guide to Energy Smart Airconditioners, http://www1.sedo.energy.wa.gov.au/uploads/Air-Conditioners_65.pdf
Commercial Heating, Cooling & Ventilation, http://www1.sedo.energy.wa.gov.au/uploads/comm_heat_27.pdf

7. Information Sheet: Energy Efficient Airconditioning.

US Department of Energy (DOE).
Provides detailed information about the different types of airconditioning systems and how they operate, provides guidance on purchasing, installation and maintenance of airconditioning systems.
<http://www.eere.energy.gov/consumerinfo/pdfs/aircond.pdf>

8. Energy Smart Allies Directory.

Directory of suppliers of energy services and products including information regarding airconditioning systems.
www.energysmartallies.com/esa/middlesub.asp

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