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GREENHOUSE CHALLENGE PLUS



ENERGY AUDIT TOOL INFILTRATION (AIR LEAKAGE INTO BUILDINGS)

10



Australian Government
Department of the
Environment and Heritage
Australian Greenhouse Office



ENERGY AUDIT TOOL

INFILTRATION (AIR LEAKAGE INTO BUILDINGS)

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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 10 — Infiltration (air leakage into buildings)* 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

Infiltration refers to the uncontrolled entry of outside air and water into a building through structural gaps, window and door openings, exhaust fans, vented downlights and fixed wall vents. This volume focuses on air leakage into buildings as this increases the need for supplementary heating in winter and cooling in summer, resulting in excessive use of energy. Reducing infiltration and including controllable ventilation in a building can save up to 20% on heating and cooling costs and significantly improve comfort.

This volume highlights where infiltration into a building commonly occurs and presents simple methods to prevent it such as:

- installing closing mechanisms (dampers or shutters) on various components of the mechanical ventilation system (like wall vents, exhaust fans, ceiling grilles or ducts) and sealing any unnecessary components
- sealing gaps and cracks around various structures in the building
- making a habit of closing doors between heated and unheated zones, and doors leading to ventilated areas and outside.

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.

STRUCTURE

QUESTION 1: Does the building have any open fireplaces?

Yes No

If yes, how many?:.....

Improvement ideas and notes:.....
.....
.....

→ Fireplace chimneys increase the draughting effect that occurs when hot air rises and is replaced by colder air entering the building through gaps. Therefore, dampers should be installed in fireplace chimneys. These act as lids, which can be installed at the top or in the throat of the chimney to seal it off. Dampers usually have a control chain or handle, which is used to open and close it. Alternatively, tight fitting screens can be installed at the base of the chimney and on the face of the fireplace to seal it off when not in use.

MAKE SURE YOU: Consult maintenance or engineering personnel or building plans if needed.

QUESTION 2: Does the building have any natural lighting design features? If yes please indicate the type and number of each.

Yes No

- Skylights..... No.
- Water chiller No.
- Other No.

Improvement ideas and notes:.....
.....
.....

→ Natural lighting design features such as skylights often have vents, and over time gaps or cracks appear. All this will allow air and water to infiltrate into the building. Gaps and cracks should be resealed with a silicone sealant, which is waterproof. If ventilation is not required by regulation, vents in an existing skylight should be blocked off and sealed, or a diffuser (a sheet of clear plastic) installed at the base of the skylight shaft. Skylights with permanent vents should not be installed unless required by building regulations.

MAKE SURE YOU: Consult maintenance or engineering personnel or building plans if needed.

B: ENERGY AUDIT CHECKLIST



QUESTION 3: Are there any recessed downlights in the building?

Yes No

If yes, how many?:.....

Improvement ideas and notes:.....

.....

.....

→ A recessed downlight is a light installed in a hole in the ceiling. It requires ventilation for fire safety reasons, which increases the draughting effect in buildings. These cannot be sealed or covered due to the safety regulations and therefore the installation of recessed downlights should be avoided where possible, particularly in heated areas of the building.

MAKE SURE YOU: Consult maintenance or engineering personnel or building plans if needed.

QUESTION 4: Can the various components of the building's ventilation system be automatically or manually closed when necessary? Please indicate by filling out the table below.

System component	Total number	Number with closing mechanism
Exhaust fans
Ceiling mounted ducts or grilles
Wall vents
other (specify)

Improvement ideas and notes:.....

.....

.....

→ Various components of the ventilation system may have shutters or dampers that can be closed manually or automatically when needed. Ensure that all existing wall vents, ceiling mounted ducts and exhaust fans in the building are necessary. Fixed wall vents in certain areas are often no longer required by building regulations. If so, they should be sealed off with caulking compounds (see question 5) or plaster, or removed altogether and the opening sealed. Disused exhaust fans and ceiling ducts should also be removed and the openings sealed. Exhaust fans with closing mechanisms should be installed to replace the existing operating exhaust fans if possible, in order to prevent unnecessary air infiltration into the building when they are not in use (such as in winter).

MAKE SURE YOU: Consult maintenance or engineering personnel if needed.

QUESTION 5: Have all gaps in the building around the structures listed been sealed? Please tick the appropriate columns.

Building structure	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Door frames	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Window frames	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Architraves	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Skirting boards	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Ceiling cornices	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Construction joints	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Floor boards	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Plumbing pipes	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Exposed rafters and beams	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
In-built heaters and air conditioners	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Between masonry walls and other materials	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

Improvement ideas and notes:.....
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→ All gaps and cracks around the structures mentioned here (and in questions 2 and 4) should be sealed with caulking compounds, such as silicone or latex based fillers. Silicone sealers are weather resistant and should be used in areas exposed to the elements.

MAKE SURE YOU: Consult maintenance or engineering personnel and/or carry out a detailed inspection.

QUESTION 6: Have all external doors and all doors leading to ventilated areas been draught proofed?

Yes No

Improvement ideas and notes:.....
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→ External doors and doors leading to ventilated areas such as toilets, bathrooms and laundries should have draught excluders firmly attached with screws at the door base, and draught strips attached between the door and its frame — unless air is meant to be able to enter through the door in order to enable ventilation. In this case a ventilation system with closeable openings should be considered.

→ Other internal doors can be equipped with lightweight stick-on draught excluders on their base to further prevent excessive airflow throughout the building. When adhesive draught excluders are used, good surface preparation is essential.

B: ENERGY AUDIT CHECKLIST



QUESTION 7: Have all external windows been draught proofed?

Yes No

Improvement ideas and notes:.....
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→ Windows should have draught strips attached between the openable sash and the frame. Draught strips for windows and doors include adhesive foam, flexible plastic or polypropylene pile strips. When adhesive strips are used, good surface preparation is essential.

QUESTION 8: What types of doors remain permanently open or open for long time periods?

- Doors leading outside
- Doors to ventilated areas
- Doors between heated and unheated zones
- Other:

Improvement ideas and notes:.....
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→ Doors leading outside, to ventilated areas (such as bathrooms and stair wells) or between heated and unheated zones should have automatic door closers installed to minimise air infiltration into the building. These are available for swing and sliding doors. For doors that are used very frequently, such as main entrance doors, consider installing automatic doors.

QUESTION 9: Does the building have any automatic doors leading outside?

Yes No

If yes, how many?:.....

Improvement ideas and notes:.....
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.....

→ If only one external automatic door exists, consider the installation of another automatic door which a person must pass through before reaching the second automatic door, in order to provide an 'air lock'. Two sets of automatic doors opening at different time intervals prevents excessive air infiltration as people enter and leave the building.

QUESTION 10: Are there any sliding doors in the building?

Yes No

If yes, how many?:.....

Improvement ideas and notes:.....

.....

.....

→ Sliding doors can be difficult to seal, particularly those that slide into wall cavities. Avoid using sliding doors in heated and airconditioned areas.

QUESTION 11: Are there any large factory or warehouse doors in the building?

Yes No

Improvement ideas and notes:.....

.....

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→ On large factory and warehouse doors, rollfast doors or clear plastic strips should be fitted as appropriate to prevent draughts from occurring.

QUESTION 12: Are any windows in the building permanently open and unable to be closed?

Yes No

Improvement ideas and notes:.....

.....

.....

→ Windows which are unable to be closed (as in bathrooms) should be replaced with closable windows in order to control draughts and rain infiltration.

MAKE SURE YOU: Consult maintenance personnel or those who work in the particular areas of the site.

B: ENERGY AUDIT CHECKLIST



QUESTION 13: Do any windows in the building not have blinds or curtains?

Yes No

Improvement ideas and notes:.....

→ Blinds or curtains should be installed on all windows, especially those with single glazing and those that receive sun during the day and early evening, this is to help prevent draughts as well as heat loss in winter and heat gain in summer from occurring. In addition, pelmets can be installed above curtains to further prevent draughts and heat loss.

QUESTION 14: Are there any combustion heaters that have external air supplies, and can these supplies be closed when needed?

Heater Type	Air supply (yes/no)	Closable (yes/no)
Solid fuel heater	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
Gas space heater	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
Water heaters	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
Large cooker	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
Other (specify)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

Improvement ideas and notes:.....

→ External air supplies to heaters should have closing mechanisms to prevent unnecessary infiltration of air into the building from occurring when the heater is not in use.

MAKE SURE YOU: Consult maintenance personnel, the operating manual, or those who work in particular areas of the site.

QUESTION 15: Do windbreaks exist around the building?

Yes No

If yes, indicate the type below:

- Vegetation
- Other buildings
- Large fences or walls
- Other:

Improvement ideas and notes:.....
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→ Wind breaks such as thick vegetation, other buildings, or fences and walls all help to reduce air infiltration into a building. Consider establishing appropriate windbreaks where none exist.

MAKE SURE YOU: Obtain a site plan and carry out an inspection.

QUESTION 16: Is the prevention and minimisation of air and water infiltration into the building taken into account when renovations or new buildings are in the planning stages?

Yes No

Improvement ideas and notes:.....
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→ Methods to prevent and minimise the infiltration of rain and air into a building should be taken into account when renovations or new buildings are being planned.

MAKE SURE YOU: Consult engineering personnel, or existing procedural requirements for environmental considerations in new or modified buildings.

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. Your Home

Department of the Environment and Heritage (Australian Greenhouse Office) Is a suite of consumer and technical guide materials and tools developed to encourage the design, construction or renovation of homes to be comfortable, healthy and more environmentally sustainable.
<http://www.greenhouse.gov.au>

2. Energy Smart Booklet: Sealing Out Draughts.

Sustainable Energy Development Authority of NSW (SEDA).
Describes the sources of air infiltration into a building and the specific products to use on each source to seal it. It also outlines some design features of a building that can prevent air infiltration.
<http://www.energysmart.com.au/brochures/draughts.pdf>

3. Energy Smart Brochure: Draught-Proofing Your Home.

Sustainable Energy Development Authority of NSW (SEDA).
Gives information about the origin and prevention of unwanted air infiltration into a house.
http://www.energysmart.com.au/brochures/draught_proofing.pdf

4. Information Fact Sheets: 1 — Air Movement, 2 — Window Protection.

Sustainable Energy Authority of Victoria (SEAV).
The first sheet provides detailed solutions to unwanted air infiltration into the home. The second discusses various window fittings and instalments that help to reduce heat loss through windows.
<http://www.sustainable-energy.vic.gov.au/seinfo/downloads/index.asp#Building>

5. Air Infiltration and Ventilation Centre (AIVC): Publications Page.

International Energy Agency.
Lists many technical and discussion documents on air infiltration and ventilation systems. Only subscribers to the centre can view the entire text of the documents. A fee must be paid to subscribe.
<http://www.aivc.org/frameset/frameset.html?../publications/publications.html~mainFrame>

6. Energy Smart Allies Directory.

Directory of suppliers of energy services and products including information regarding unwanted infiltration of air and water into a building.
www.energysmartallies.com/esa/middlesub.asp

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