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GREENHOUSE CHALLENGE PLUS



ENERGY AUDIT TOOL COMPRESSED AIR

11



Australian Government
Department of the
Environment and Heritage
Australian Greenhouse Office



ENERGY AUDIT TOOL

COMPRESSED AIR

11



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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 11 — Compressed air* 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

Almost every industrial plant uses compressed air to power pneumatic tools, packaging and automation equipment and conveyors, or to supply breathing air to hoods on helmets. Many manufacturing industries also use compressed air and gas for combustion and process operations such as oxidation, cryogenics, refrigeration, filtration, dehydration, and aeration. Compressed air is used in non-manufacturing industries as well.

Compressed air systems vary in size from small, 2.5 horsepower units to large systems (over 50,000 horsepower) that supply high-demand industries. Generating compressed air consumes large amounts of energy, approximately 10% of the total industrial electricity consumption in Australia.

Using compressed air systems efficiently, can therefore have a significant impact on the running costs of the whole site, as well as increase the productivity and reliability of the equipment. For a compressed air system to work efficiently and reliably, both the supply (the compressors and air treatment equipment) and the demand (the distribution and storage systems and the end-use equipment) must be managed and maintained. This volume discusses how this can be achieved through implementing simple energy efficiency options such as repairing air leaks, reducing intake air temperature, optimising system pressure, managing compressor operation and eliminating inappropriate uses of compressed air.

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 types of compressors are used on the site?

- Reciprocating compressor
- Screw compressor
- Vane compressor
- Centrifugal compressor
- Other:

Improvement ideas and notes:.....
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- Use the correct type of compressor for your operation. The two most common types of compressors are reciprocating compressors (best used for fluctuating loads or short-term use) and screw compressors (best used for constant base-load demands).
- The main types of compressor are mentioned above. If unsure about the compressor type, contact maintenance personnel or the manufacturer.

QUESTION 2: Are pressure settings on air compressors adjusted to the minimum pressure required to complete the task?

- Yes No

Improvement ideas and notes:.....
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- Pressure settings may be adjusted at the compressor itself, through the use of a control panel or through throttle control. Compressed air should be delivered to the point of use at the desired pressure — too low a pressure will impair tool efficiencies and affect process time, while too high a pressure requires more energy than necessary, may damage equipment through wear and vibration, will promote leaks, and thus increase operating costs. Reduce pressure settings to the minimum required to complete the tasks. At a nominal pressure of 700kPa, every 50kPa increase in the pressure of compressed air increases energy use by 4%.

B: ENERGY AUDIT CHECKLIST



QUESTION 3: Which treatment devices are connected to the compressed air system? Please tick the appropriate boxes below.

- Dryers (refrigerated condenser or desiccant)
- Filters
- Heaters
- Oil separators
- Other:

Improvement ideas and notes:.....
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→ Air-treatment equipment such as that mentioned above can reduce the pressure of the compressed air system. It is typically used where the compressed air must be of a certain quality, filters for example may be required to remove solids or liquids. The equipment is not built into the compressor but put onto the air-line at some points. Use high quality air only where necessary as air filters and dryers reduce the pressure, thus additional energy is required to maintain the operating pressure.

MAKE SURE YOU: Consult maintenance or engineering personnel.

QUESTION 4: Are the devices listed in Question 3 used only when necessary to minimise pressure drop caused by them?

- Yes No

Improvement ideas and notes:.....
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→ Automatic or manual shut-off valves should be in place and used to shut air-treatment devices off whenever they are not needed, rather than have the devices operate continuously.

MAKE SURE YOU: Consult maintenance or engineering personnel, or the air treatment operator manual.

QUESTION 5: Are compressors operating at zero capacity for extended periods of time?

Yes No

If so, when does this occur?

- Equipment downtime
- Maintenance periods
 - Daily
 - Weekly
 - Other:
- Overnight
- Holiday periods
- Long weekends

Improvement ideas and notes:.....
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→ Turn compressors off when not in use. Note that a shutdown timer may be used, which can shut off a compressor when it has run unloaded for a nominated time period.

MAKE SURE YOU: Consult operating and maintenance personnel about periods when the compressed air is not in use or has a low load demand.

QUESTION 6: Is the temperature of the air intake controlled in any way?

Yes No

If so, how?

- Ventilated room
- Ducted intake (using cooler outside air)
- Other:

Improvement ideas and notes:.....
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→ If the compressors are located in a dedicated compressor room with little ventilation, the intake air (that is the air being sucked into the compressor) may be warm and therefore reduce compressor efficiency. Control the temperature of the air intake as energy efficiency is reduced when warm air is taken in. Where possible, use cooler outside air for the intake.

B: ENERGY AUDIT CHECKLIST



QUESTION 7: Has an assessment been made to identify areas of potential pressure drop in the air line(s)?

Yes No

Improvement ideas and notes:.....
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- Areas of potential pressure drop include bends in pipework, scaling on the inside of the pipes, and pipework servicing unused equipment (often called 'deadlegs'). Identify and minimise these areas, as they will reduce the efficiency of the unit.
- Maintenance personnel, compressor operators or an external contractor may have made an assessment.

QUESTION 8: Do operating procedures ensure compressed air is used only where necessary?

Yes No

If no, which activities do not need to use compressed air?

Improvement ideas and notes:.....
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- Eliminate inappropriate use of compressed air such as using compressed air instead of fans and blowers for cooling, mixing or inflating. Other inappropriate uses include use of compressed air to drive motors where electrical drives can be used, and cleaning or dusting with compressed air. Operational procedures (documented or verbal) should ensure that compressed air is not used for activities which do not require it.

MAKE SURE YOU: Examine the activities on the site using compressed air to determine whether alternatives may be used.

STRUCTURE

QUESTION 9: Are sequenced or multi-staged compressors used on the site?

Yes No

Improvement ideas and notes:.....
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- Large compressed air systems should be designed as modular units, with isolation points that allow independent operation of different parts of the system.
- If more than one compressor is present on the site, control usage of compressors by installing a timer to control compressor sequencing. This allows the most appropriate unit to be the lead supply unit. For example, larger units will be operated during periods of high consumption with smaller machines operating in periods of low-demand such as nights and weekends.
- The use of sequenced or multi-staged compressors also provides additional efficiency when the compressed air cools down between compression stages.
- Different sized compressors connected to each other may indicate a sequenced or multi-staged build-up.
Make sure you: Consult maintenance or engineering personnel, or the air compression equipment operator manual.

QUESTION 10: Are variable output compressors used on the site?

Yes No

If so, how many?

..... No. of compressors in total No. of variable output compressors

Improvement ideas and notes:.....
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- Normal compressors operate most efficiently when running close to full load. Use of variable output compressors allows you to better match the compressor loads to output requirements, avoiding energy-extensive part-load operation as much as possible.

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

B: ENERGY AUDIT CHECKLIST

MAINTENANCE

QUESTION 11: Are regular inspections of the compressed air-lines undertaken to detect leaks and other pressure losses?

Yes No

If so, how often?

Every shift

Daily

Weekly

Monthly

Other:

Improvement ideas and notes:.....
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→ Check for leaks and pressure losses throughout the system by implementing a regular (at least monthly) inspection or examining compressed air issues as part of an existing inspection. Inspections should include piping, joints, drain valves, flexible hoses and the like. Leaks can be found in a number of ways including shutting down equipment and listening, spraying joints with soapy water (looking for bubbles), and using ultrasonic testing equipment. A pressure loss of less than 10% of the discharge pressure is considered normal for efficient compressor operation. Consider establishing a defect tagging system for tagging leaks in the compressed air system if not already set up. Ensure identified leaks are reported to maintenance personnel and fixed as soon as possible.

MAKE SURE YOU: Consult with personnel using compressed air and maintenance personnel.

QUESTION 12: Are pressure drops across treatment devices such as filters, dryers and oil separators monitored on a regular basis?

Yes No Not applicable (no treatment devices)

Improvement ideas and notes:.....
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→ It is important to monitor pressure drops across filters to determine whether a filter element is in need of being replaced. Typically a pressure drop of 40 to 70 kPa (6 to 10 psi) indicates the filter needs to be replaced.

MAKE SURE YOU: Consult maintenance or engineering personnel to determine whether site personnel or external contractors carry out regular monitoring.

QUESTION 13: Are the compressed air units maintained and serviced according to the manufacturers instructions?

Yes No

Improvement ideas and notes:.....

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→ Belts should be regularly tightened on belt driven compressors.

MAKE SURE YOU: Consult maintenance or engineering personnel or the service records for the units.

PURCHASING

QUESTION 14: Are energy efficiency options taken into account when purchasing or replacing compressed air units?

Yes No

Improvement ideas and notes:.....

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→ Check that the size of your compressors meet current demands only and that they run as closely as possible to full load capacity. It is more energy and economically efficient to purchase correct sized compressors, than to anticipate a higher future load and run a compressor at part-load. Consider variable speed drives (or variable outputs) when purchasing compressors. Energy savings of up to 50% may be achieved over conventional compressors.

→ Also consider the efficiency of air tools and other items, which require compressed air.

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. Compressed Air Calculator.

NSW Department of Energy, Utilities & Sustainability,
WA Sustainable Energy Development Office.
Quantifies the potential energy, dollar and greenhouse gas savings made by making changes to a compressed air system.
<http://www.energysmart.com.au/sedatoolbox/compressedAir.asp>

3. Energy Smart Compressed Air Systems.

Sustainable Energy Authority of Victoria (SEAV).
Part of Module 5 in the series 'Best Practice Design, Technology and Management Fact Sheets'.
http://www.seav.vic.gov.au/advice/business/infosheets/compressed_air.asp

4. Preventive Maintenance Strategies for Compressed Air Systems.

US Department of Energy.
A best-practices program tip sheet about preventive maintenance on compressed air systems.
<http://www.nrel.gov/docs/fy04osti/36142.pdf>

5. Improving Compressed Air System Performance: A Sourcebook for Industry.

US Department of Energy.
http://www.oit.doe.gov/bestpractices/compressed_air/pdfs/compressed_air_sourcebook.pdf.

6. Compressed Air Tip Sheets.

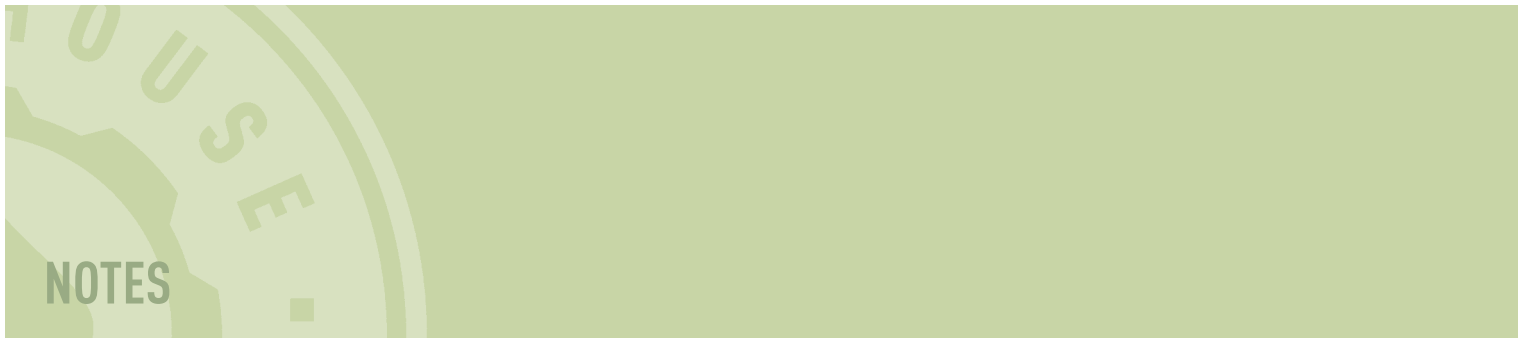
US Department of Energy.
Provides an overview of compressed air system information resources (15 fact sheets on compressed air).
http://www.oit.doe.gov/bestpractices/compressed_air/

7. Steam Systems Software Tools.

US Department of Energy.
A collection of free tools to help you identify and analyse energy system savings opportunities in your plant.
http://www.oit.doe.gov/bestpractices/software_tools.shtml.

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NOTES



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