EQUIPMENT ENERGY EFFICIENCY PROGRAM

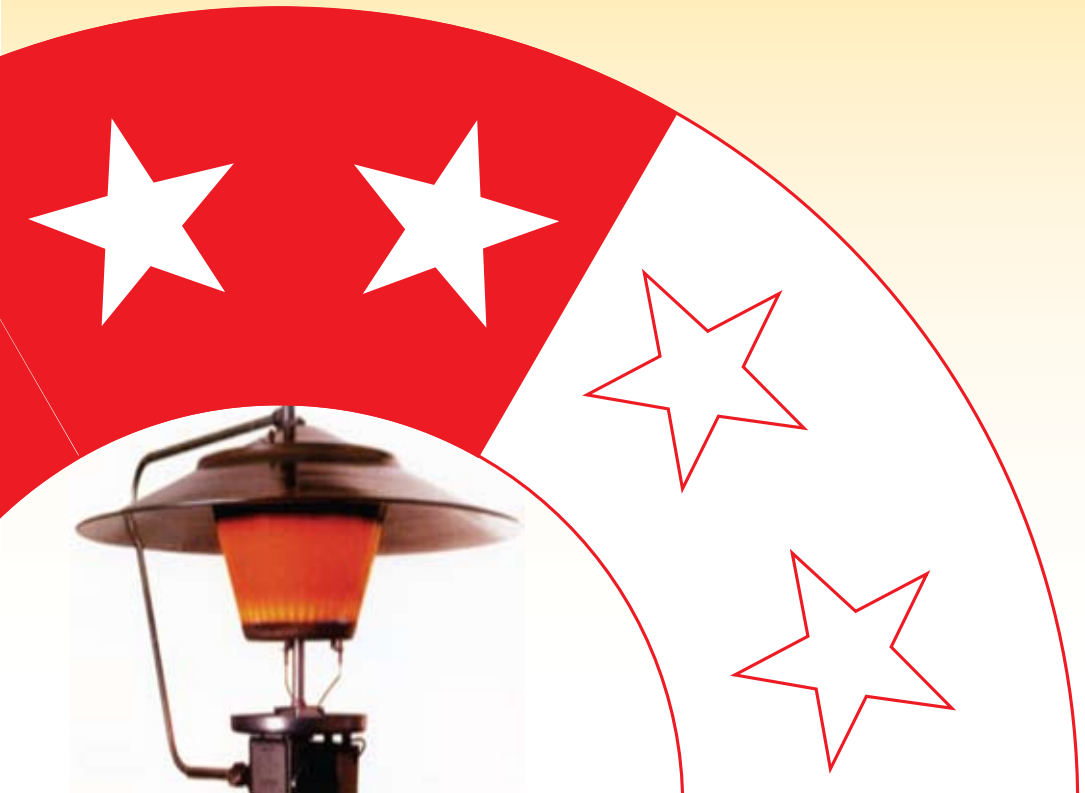
Product Profile

Outdoor radiant gas heaters

This Product Profile has been prepared for the Equipment Energy Efficiency Committee under the auspices of the Australian and New Zealand Ministerial Council on Energy.

September 2010

A joint initiative of Australian, State and Territory and New Zealand Governments



This Report is available at

www.energyrating.gov.au

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1 Executive Summary

There are more than 200 different types of radiant gas heaters offered in all types of configurations in the Australian market place. These heaters have been designed for specific applications ranging from very small, portable, butane-fired camp heaters to very large, natural gas-fuelled heaters used for heating large, open-plan workshops, factories and even livestock pens.

Three major types of technology dominate the market for outdoor radiant gas heaters (ORGH): radiant panel, radiant tube and patio heaters. The main applications for outdoor heating are in hospitality, residential, industrial, agricultural (brooder) and outdoor leisure.

For the purposes of this assignment the definition of ORGH are flue-less, portable and fixed heating appliances, intended for use in outdoor areas and non-residential indoor areas, fuelled with natural gas, town gas, liquefied petroleum gas (LPG) or tempered liquefied petroleum gas (TLP), and with gas consumption not exceeding 70 megajoules per hour (MJ/h) as described in *AS 4565-2004*.

There are at least 24 manufacturers and suppliers of ORGH in Australia. The large majority of these products are imported from China. The market for ORGH has been about 100,000 units per annum for the past three or four years with some markets such as the catering and hospitality sector reaching saturation and possibly declining. Sales of patio heaters started in 2000 but the product only started to become popular around 2003. This suggests the total stock of ORGH in Australia is about 500,000 units.

The catering and hospitality sector is estimated to have less than 180,000 units based on the assumption the average venue has less than five devices per venue. ORGH in residential applications in Australia is estimated to be almost 250,000. The remaining stock of 70,000 units is dispersed across other commercial, industrial and agricultural applications.

The catering and hospitality sector has, to a large extent, reached saturation and only modest growth of 2 per cent per annum and replacement is expected over the next decade. The residential sector has significant growth potential and is forecast to reach 900,000 units in 2020, which equates to about 9 per cent of all households. Despite this potentially significant growth in the residential sector, the operational hours per annum are typically low, and emissions from all ORGH in 2020 are estimated to be only 139 kilotonnes CO_2-e. Aggregate emissions for the period 2010 to 2020 are expected to be approximately 1,240 kt CO_2-e.

The potential greenhouse reductions and savings in fossil fuel use from the introduction of minimum energy performance standards (MEPS) or other forms of regulation are not expected to be justifiable, given the cost of such a program to the public and industry. However, should authorities believe action is required, options that could be explored include: one-hour cut-off timers for all ORGH sold, mandatory energy warning labels and introduction of voluntary bans with major retailers.

2 Introduction

This report was commissioned by the Equipment Energy Efficiency Committee (E3) to explore the potential for energy and greenhouse savings through improvements to outdoor radiant gas heaters (ORGH) in Australia.

The objective of this report is to further advance the minimum energy performance standards (MEPS) process for these products, and to provide updated information relating to ORGH in Australia, in order to help informed decision making. Key information presented includes:

- overview and description of current ORGH technology
- current market and stock estimates, as well as an assessment of market trends
- energy consumption estimates by type and application
- analysis of the potential to reduce energy consumption and greenhouse emissions
- international trends and standards applicable to ORGH
- current efficiency regulation and test standards applied to these products
- conclusion and future options.

This report builds on the review, *Energy Labelling and Minimum Performance Standards for Domestic Gas Appliances* by Ellis, Wilkenfeld et al. in 2002.[1] It defines an effective energy efficiency program as a coordinated strategy to increase (or accelerate the increase of) the overall efficiency of the appliance stock (gas and electric appliances), beyond that which the market would produce without intervention (often described as 'business as usual'). Efficiency intervention measures or bans on ORGH should consider the mix of available products used in outdoor heating applications and take into account the emission impact of substitute products.

The *Switch on Gas Strategy*, endorsed by the Ministerial Council on Energy and published in December 2004, was a blueprint jointly endorsed by government and industry outlining the actions to enhance energy efficiency of gas appliances and equipment over the next 10 years. This report explores the items raised in the ORGH section of the work plans developed to deliver the strategy.

[1] See link: http://www.energyrating.gov.au/library/details200217-gasreview.html

3 Technical description

3.1 General description

Outdoor heating can be provided from gas appliances (patio, radiant panel, radiant tube, mobile 'rocket' type or outdoor decorative), electrical resistive devices (patio, radiant panel or strip, infrared radiation) or fuel burning fireplaces. The main applications for outdoor heating are in hospitality, residential, industrial, agricultural (brooder) and outdoor leisure.

For the purposes of this assignment the definition of ORGH are flue-less portable and fixed heating appliances intended for use in outdoor areas and non-residential indoor areas for use with natural gas, town gas, liquefied petroleum gas (LPG) or tempered liquefied petroleum gas (TLP) with gas consumption not exceeding 70 MJ/h as described in *AS 4565-2004*.

These appliances may be portable or fixed, free-standing, mounted or suspended overhead, floor mounted, attached to, or built into, furniture or fixtures. They may be connected to a fixed piping system or to a separate or integral refillable LPG cylinder.

The main types of ORGH are patio and radiant panel. Indoor radiant tube gas heaters are not covered by this definition of ORGH. They are discussed in this document as they are closely related and are part of the product offering to commercial customers.

3.2 Patio heaters

Patio heaters are used to provide warmth to any outdoor area (deck, patio or screened-in porch). They are offered in a wide variety of configurations including free-standing, table, column, area and several more, with different styles, finishes and colours. The most common types are illustrated in Figures 1.1 to 1.11.

Patio heaters are commonly used in pubs, clubs, hotels, cafes and bars as commercial outdoor heaters. They are used by catering companies for outdoor functions (party hire) to provide comfort for patrons or extend the outdoor entertainment season, and are considered a luxury domestic item to create a balmy outdoor environment when ambient temperature is low.

The capacities of patio heaters range from small table-top units (see Figure 1.10) with heat inputs of 19 MJ/h to free-standing models providing 45 MJ/h. Typical features include:

- manual piezo direct ignition (LPG only)
- adjustable heat input/output
- 40 MJ/h input models casts an approximate three-metre circle of radiant warmth, (see Figure 1.12)
- safety 'tip-over' switch that halts supply of gas to the unit should it be accidentally knocked over
- flame safeguard system for enhanced safety
- durable and weather resistant
- wheels to make moving patio heater easy
- complete with hose and regulator
- sectional reflector
- table clamp on table-top heaters
- most are portable and operate on LPG (plumbed in models operate on natural gas).

The majority of these appliances are certified to *AS 4565-2004* for 'external use only' as they are flue-less and can result in suffocation when used indoors. State government regulators frequently remind consumers of the dangers of using outdoor gas appliances such as patio heaters and barbecues indoors.[2]

Some patio style appliances (see Figure 1.11) are certified for external and non-residential indoor use. These products are applied indoors in large well-ventilated areas greater than 200 m^3.

2 Gas safety regulator, Energy Safe Victoria (ESV) stresses the importance of never using outdoor gas appliances such as patio heaters and BBQs indoors. The warning follows the death of a 33-year-old man in a unit behind a property in the Melbourne suburb of Altona Meadows in July 2008.

Figure 1.1: classic

Figure 1.2: entertainer

Figure 1.3: basic

Figure 1.4: drinks table

Figure 1.5: promotional

Figure 1.6: radiant cone: patio style

Figure 1.7: area

Figure 1.8: column

Figure 1.9: wall mounted

Figure 1.10: table-top

Figure 1.11: hanging indoor/outdoor

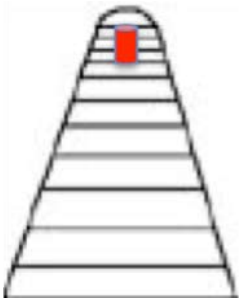


Figure 1.12: radiant heat pattern

3.3 Radiant panel heaters

Radiant panel heaters are used to provide warmth to outdoor and non-residential indoor areas as wall mounted, ceiling hung or portable models with moveable trolleys.

They are designed for commercial applications such as hospitality (pubs, clubs, hotels, restaurants, bars and terraces), warehouses, shops, schools, halls and factories and are available in various numbers of radiant tiles (such as two, three, four, five or six) to expand the range of heat input per unit. The most common models are illustrated in Figures 2.1 to 2.4.

Radiant panel heaters are generally plumbed in and claim to be more efficient than traditional patio style heaters. The sizes range from two-tile units with heat inputs of 16 MJ/h that heat approximately 19 m^2 to larger models that provide 45 MJ/h to heat areas up to 74 m^2.

Figure 2.1: radiant panel (3 tile)

Figure 2.2: radiant panel with heat shield

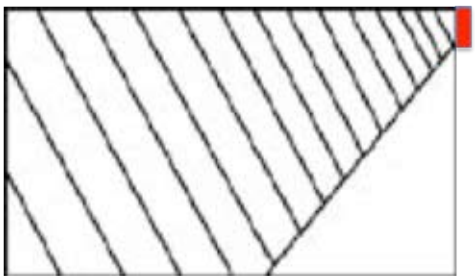


Figure 2.5: directional (side-spread) heat pattern

The typical range of features includes:

- directional (side-spread) radiant heat distribution (see Figure 2.5)
- manual piezo direct ignition (LPG only) or electric ignition (240V)
- flame safeguard system to ensure safety
- stainless steel reflector
- wall mounting brackets with optional moveable trolley and stand
- safety 'tip-over' switch on portable units
- LPG or natural gas
- optional heat shield for low clearance ceilings
- optional ball guard for schools or sports areas
- can be operated individually or in groups and can be interlocked with a building energy management system if required.

The majority of these appliances are certified to *AS 4565-2004* for 'internal and external use' with some models certified for 'internal use only'. These devices are flue-less and must be installed by an authorised person in accordance with *AS 5601-2004 (Gas Installations)*.

Figure 2.3: basic mobile

Figure 2.4: radiant panel patio style

3.4 Radiant tube heaters

Radiant tube gas fired heaters provide low-intensity heating for a wide range of commercial and industrial space heating applications, offered as linear-straight tube (up to 18 metres) and U tube configurations (up to nine metres). They can be roof-suspended or wall mounted low-intensity gas fired radiant tube heaters designed for all indoor commercial and industrial space heating applications. A technical diagram is provided in Figure 3.1 and illustrations of linear and U tube configurations in Figures 3.2 and 3.3.

These illustrations help visualise why radiant tube heaters are suited to applications that require a long linear strip area to be heated. They are commonly used in large warehouses and hardware stores. For example long radiant tube heaters can be found in retail hardware stores above the checkout registers and customer service areas. Smaller models may also be used for outdoor smoking areas, restaurants etc. These heaters typically feature a compact burner and fan assembly, aluminised steel emitter tubes, stainless steel tube couplings and brushed aluminium high-efficiency profiled reflectors.

Radiant tube heaters are flued appliances certified to *AS 4643* for internal use only and as such are not the focus of this study. They are sometimes used in large, well-ventilated areas with an open flue and outdoors in well-sheltered areas.

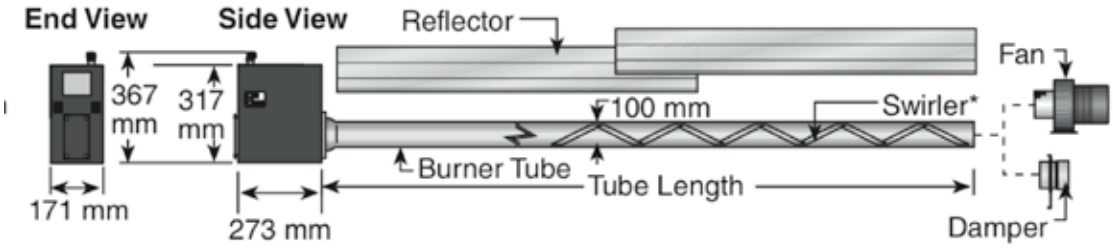


Figure 3.1: technical diagram of linear radiant tube heater

Figure 3.2: radiant tube - linear configuration

Figure 3.3: radiant tube - U configuration

3.5 Other radiant gas heaters

There are more than 200 different types of radiant gas heaters offered in all types of configurations, each with its own advantages and disadvantages designed for specific applications. Some examples of different configurations are illustrated in Figures 4.1 to 4.5.

The Kromschroeder 'infra-conic' infrared (brooder) heater illustrated in Figure 4.2 is certified under *AS 4565-2004* for 'indoor use only' and is predominantly applied in livestock applications. The large majority of livestock and industrial indoor heaters are not certified under *AS 4565-2004* and can be found under *AG 403*, *AG 404* and *AS 4643-2007*, which are outside the scope of the assignment. Further details can be found on these appliances in Appendix B under industrial direct-fired air heaters.

3.6 Definition of an outdoor area

The application of different types of radiant heaters to indoors or outdoors is specified by *AS 5601-2004 (Gas Installations)* and supplier installation instructions, which are dictated by protection from the weather and ventilation rather than the general community perception of what is indoors or outdoors. This is why radiant heaters certified for 'external use only' can be perceived to be used for indoor applications and heaters certified for 'internal use only' outdoors.

The definition of outdoor areas is defined in *AS 4565-2004*, which is described with five illustrations provided in Appendix C.

Figure 4.1: fan heater

Figure 4.2: infra-conic brooder

Figure 4.3: bottle mount camping

Figure 4.4: radiant cone: lamp style

Figure 4.5: camping heater

4 Market Profile

4.1 Market history and trends

Radiant panel heaters have been around for more than 50 years, mostly in schools, churches, halls, warehouses, factories and sports stadiums to provide comfort to occupants during the winter months. Over the past decade outdoor heating has become very popular with the rapid expansion of hotels, restaurants and cafes with alfresco outdoor dining.

The introduction of smoking bans in the hospitality sector and the need for outdoor smoking areas has added to this demand.[3] These trends have encouraged a greater use of radiant panel heaters in outdoor terrace applications and the rapid emergence of patio heaters to provide the ambience of a balmy climate for patrons on cold winter nights.

The main application segments for ORGH are:

- catering and hospitality
- residential outdoors
- commercial and industrial space heating
- indoor agricultural (livestock brooder).

4.2 Sales, application segments and existing stock

The market for ORGH has been about 100,000 units per annum for the past three or four years with some markets such as the catering and hospitality sector reaching saturation and are possibly in decline. Sales of patio heaters started in 2000 but the product only started to become popular in about 2003. This suggests the total stock of ORGH in Australia is about 500,000 units.

The catering and hospitality sector is estimated to be less than 180,000 units based on the assumption the average venue had less than five devices per venue. The number of catering venues in 2008 is listed below in Table 1. The large majority of heating devices used in these applications are ORGH with some venues using radiant tube heaters.

Table 1: Number of catering and hospitality venues in Australia

Catering and hospitality[4]	Quantity
Restaurants	15,140
Cafes	7,090
Hotels, pubs, motels	9,130
Clubs	4,200
Function centres	830
Total venues	36,390

The market segment with almost untapped growth potential is the residential outdoor heater segment, which is dominated by patio heater operating on LPG. With about 8.2 million households and the large majority of them having outdoor areas, the stock in this segment has potential to grow significantly.[5]

A survey in 2007 conducted by the United Kingdom's Green Barometer interviewed 1,192 UK households. Researchers found that colder regions Yorkshire and Humberside had the highest rate of current or intended patio heater with 18 per cent. The lowest rate was in the east of England with 3 per cent. Two-thirds of patio heater owners said they used theirs once or twice a week and half of the owners switched theirs on during the hottest months of the year. Based on survey results they estimated the current stock of 1.2 million to almost double to 2.3 million in the near future.[6]

The penetration of patio heaters is estimated at almost 9 per cent in the UK.[7] The existing stock of ORGH in residential applications in Australia is estimated to be almost 250,000. This equates to 4 per cent of Australian households owning patio heaters, a rate of ownership that presently lags the UK but has every potential to catch up given the extremely low prices people now have to pay for these devices.

The remaining stock of 70,000 units is dispersed across other commercial, industrial and agricultural applications.

3 Smoking bans commenced across Australia in 2002. In Victoria smoke-free reforms to the Tobacco Act 1987 commenced on 1 March 2006, banning smoking in enclosed workplaces.

4 Source: Compilation of data from Foodservice Equipment in Australia 2007-2011, BIS Shrapnel, May 2007 and ABS 8165.0 Counts of Australian Businesses. This data excludes 'non employing' enterprises as they are less likely to have ORGH. All data was adjusted with 1.5% growth per annum to harmonise 2008 estimates.

5 ABS 3236.0-2006, Household and Family Projections, Australia, 2001 to 2026.

6 See link www.energysavingtrust.org.uk

7 Office for National Statistics UK state there were 24.7 million households in the UK in 2004. Based on this data, assuming 1% growth p.a. we estimate the number of households in the UK to be 25.7 million in 2008 with a penetration of almost 9% patio heaters per dwelling.

4.3 Manufacturers, suppliers and key stakeholders

There are at least 24 manufacturers and suppliers of ORGH in Australia with more than 200 models available. A listing of all suppliers with certified appliances is provided in Appendix A. The large majority of these products are imported from China; the major suppliers are as follows:

- Sitro Group (Gasmaster, Gasmate, Jumbuck, Star, Del Terra, Coolabah Outdoor, Maxi Heat, Jackeroo and Blackridge)
- Arlec Australia (Sunshine, Homemaker Lifestyle and Jackeroo)
- Bromic (Coolabah, Helios and Bromic)
- Hurll Nu-Way (SBN and Roberts Gordon)
- Celmec International (Heatray).

The peak body for the gas appliance industry is the Gas Appliance Manufacturers Association of Australia (GAMAA), whose primary activity is to review industry issues and in some instances participate in technical standards committees to voice its members' position. The Australian Gas Association (AGA) transferred its standards-writing function to Standards Australia in 2003 and in 2004 became a certification body only along with SAI Global. IAPMO R&T Oceana is an additional gas certification body for Australia and New Zealand. The AGA dominates the certification of gas products with IAPMO R&T Oceana certifying only three types of ORGH and SAI Global only certifying one type in Australia.

The state regulators such as Energy Safe Victoria (ESV) have a charter to promote safe use of gas and have inspectors to investigate gas compliance issues. ESV takes an active interest in ORGH and recently published safety guidelines for using patio heaters in public places.[8] At present suppliers confirmed that very few patio style heaters are connected to natural gas, with almost all models using LPG. The Liquefied Petroleum Gas Association of Australia will take great interest in any measures that switch off, or migrate patio heaters to other sources of energy.

4.4 Retailers and consumers

Outdoor radiant heaters were originally designed to extend the usability of outdoor restaurant and cafe seating areas into the cooler months. In recent years major retailers have aggressively marketed patio heaters to householders. With the increase of cheap Asian imports, prices for standard patio heaters have tumbled from above $700 to below $200 maintaining sales levels at 100,000 units per annum despite the hospitality and catering sector reaching saturation.[9]

The major retail chains with outdoor living sections such as Bunnings, Barbecues Galore, K-Mart and Rays Tent City sell large numbers of outdoor heaters. Following a debate in the European Parliament in early 2008 on the potential of a ban on the sale of these heaters, some retailers in the UK have stopped selling them. In Australia the Origin Energy Shop initially promoted patio heaters as a luxury outdoor product. However, it is now the first Australian retailer to withdraw from the patio heater market due to sustainability concerns.

8 ESV Gas information sheet number 11.

9 Bunnings advertised basic patio heater with 37 MJ/h input similar to illustration in Figure 1.3 for $116 without a bottle, July 2009.

5 Energy consumption and greenhouse gas emissions

It is estimated that ORGH consume 1.34 petajoules (PJ) of gas and produce 82 kilotonnes (kt) CO_2-e of greenhouse gas emissions per annum. These estimates were calculated by multiplying the existing stock of the most common commercial and residential ORGH by the relevant energy consumption (gas input multiplied by typical operating hours). Table 2 provides a summary of estimated gas consumption and emissions for both commercial and residential applications.

Commercial heaters tend to be more robust and used more frequently, potentially several hours per day, seven days a week, for several months of the year. These heaters also tend to be larger and have a gas input of about 40 to 50 MJ per hour. Estimates of commercial ORGH energy consumption and emissions were based on an average of 100 operating hours per annum and an average capacity of 45 MJ per hour.

Residential heaters are generally smaller, consuming about 35 to 40 MJ per hour and are used much less frequently, possibly about five times per year. Industry stakeholders reported that they tend to be a product that people must have but rarely, if ever, use. Estimates of residential ORGH energy consumption and emissions were based on 25 operating hours per annum and an average capacity of 35 MJ per hour.

Suppliers confirmed that very few heaters are connected to natural gas, with almost all residential models sold using LPG. The emission calculations were based on the assumption that 100 per cent of residential and 80 per cent of commercial heaters operated on LPG. The gas consumption of ORGH is minimal when compared to other uses. The Liquefied Petroleum Gas Association of Australia claims 1,907 kt of LPG is consumed per annum, with nearly 65 per cent used in the automotive industry, and the remainder used in recreational (barbecues, caravans, camping stoves, marine), residential (heating and cooking) and commercial/industrial (as a fuel) applications. ORGH consumption of approximately 26 kt of LPG per annum accounts for less than 1.4 per cent of all LPG consumption and less than 4 per cent of all non-automotive applications.

The greenhouse gas emission factors used in the calculations were the same as those used by the Equipment Energy Efficiency (E3) Program for Regulatory Impact Statements (RIS). The emission factor used for LPG is 59.9 kg CO_2-e/GJ, which is the same as the full fuel cycle emission factor prescribed by the National Greenhouse Energy Reporting System technical guidelines. The E3 RIS utilised state-based average fuel cycle emission factors for natural gas. A weighted average emission factor of 67.6 kg CO_2-e/GJ based on state population was used to estimate the emissions for the small portion of heaters operating on piped in natural gas. See Appendix D, Emission factors, for more detail.

It is estimated that emissions of ORGH will reach 1.7 times current levels by 2020, or approximately 139 kt CO_2-e. Sales of ORGH are expected to continue at about 100,000 units per annum or slightly less due to the saturation of the catering and hospitality sector. Based on predictions that the commercial stock will grow by 2 per cent per annum, this segment is estimated to grow to almost 320,000 and produce 88 kt CO_2-e per annum by 2020. Without any intervention measures the residential stock is expected to grow rapidly due to aggressive marketing and low prices offered by major retailers. The number of Australian households is projected to be 9.6 million in 2020 and a saturation rate of 10 per cent of all households by 2020 is foreseeable with an estimated stock of more than 960,000 units producing 51 kt CO_2-e per annum. Total emissions generated by ORGH between 2010 and 2020 is projected to be 1,240 kt CO_2-e. Table 3 provides a summary of estimated emissions in 2020 and cumulative emissions based

Table 2: Gas consumption and emissions from ORGH in Australia in 2009

Application	Existing stock	Energy consumption (GJ p.a.)	Emissions (kt CO_2-e p.a.)
Commercial	250,000	1,125,000	69
Residential	250,000	218,750	13
Total	500,000	1,343,750	82

Table 3: 2020 emissions and cumulative emissions 2010-2020 from ORGH in Australia

Application	Projected stock	Emissions (kt CO_2-e)	
		2020	Cumulative
BAU Commercial	317,000	88	927
BAU Residential	964,000	51	314
Total	1,281,000	139	1,241

on a 'business as usual' (BAU) scenario for both commercial and residential applications for the period 2010 to 2020.

5.1 Energy reduction opportunities

An investigation into the potential opportunities to reduce energy consumption and greenhouse emissions from ORGH identified the following main categories:

- user behaviour and operating hours
- consumer demand and market trends
- product efficiency improvements
- applications, heat patterns and target area.

Each of these opportunities will be discussed in the sections that follow.

5.1.1 PRODUCT EFFICIENCY IMPROVEMENTS

There is little documented evidence or test data available on the efficiencies of different types of ORGH. Some suppliers attempt to substantiate claims of higher efficiency by quoting gas consumption rates (time to consume a 9kg bottle of LPG) and describing the benefits of directional heat distribution patterns. In most instances the consumer or purchaser has insufficient information to make an informed decision about the operational efficiency, heat effectiveness or environmental impact of their decision.

The efficiency of conversion of fuel to radiant heat is unlikely to vary significantly between brands or types of ORGH. There is potential scope for developing a test that rates a heater on its ability to concentrate/focus its heat pattern over the occupied area (for example patio heater over one table only or radiant panel over a target area).

The technical nature of these products suggests there is scope for some to be more effective than others. A patio heater with the highest radiant output and most effective operation would exhibit the following characteristics:

- **largest and hottest radiant emitter.** The surface area and temperature (typically 500°C) of the mesh determine the radiant emitting power. Effective operation can be observed by a bright red glow across the mesh as opposed to bright red at the top and dull at the bottom
- **largest canopy or reflector plate.** A puddle of hot gases is caught under the reflector umbrella, which acts as a reflector of radiant heat. An effective design will maximise the spread of the infrared warmth towards the target area
- **highest gas input**. Assuming similar operational efficiencies gas input has a direct correlation with heat output
- **effectiveness to heat target area.** This depends on the application and the ability of the product to effectively deliver heat where it is required and minimise energy wasted heating areas unnecessarily
- **susceptibility to drafts.** Some designs are affected by drafts, which can result in a reduction in radiant emitting power and blowouts.

A comparison of the radiant heat effectiveness and gas consumption of a conventional patio heater and ceramic radiant panel is provided in section 5.1.4. This analysis explains why radiant panel heaters have potential to consume significantly less energy than patio heaters in certain applications.

5.1.2 CONSUMER DEMAND AND MARKET TRENDS

The fastest growing segment of ORGH is residential patio heaters, which could potentially grow from 250,000 units to more than 960,000 by 2020. This is partially attributed to Australian consumers' limited understanding of the poor efficiencies, operating costs and emissions produced from these devices. Consumers and retailers have a significant opportunity to reduce future gas consumption and emissions from ORGH. Major retailers could introduce voluntary bans, which would restrict the flow of product into the market. With education, consumers could reduce demand in retail outlets.

Consumer education on the environmental impact of ORGH could be communicated through a variety of methods:

- star rating gas energy labels to make consumers aware of efficiency choices and which appliances are the most efficient (for example one star for a 40 MJ/hr commercial product that distributes heat over 20 m^2, four stars for 10 MJ/hr household product that distributes heat over 5 m^2)
- running cost information to assist consumers understand how operating costs compare to other common appliances such as indoor space heaters
- mandatory 'energy warning' labels similar to the 'water warning' label required under the Water Efficiency Labelling and Standards (WELS) scheme for products not meeting minimum water efficiency standards. This would prompt prospective buyers to consider the wider social and environmental implications. In the current retail climate of 'green consumerism', retailers would find it difficult to promote products that are not considered environmentally responsible.

With our estimate of cumulative emissions to 2020 exceeding 1,200 kt CO_2-e (residential accounting for 360 kt CO_2-e) consumers and retailers can play a critical role in reducing emissions. Suppliers report that the average lifespan of a patio heater is five years or less and any action to slow the flow of products into the existing stock would have a timely effect on the future stock of patio heaters.

5.1.3 USER BEHAVIOUR AND OPERATING HOURS

The behaviour of owners and operators of outdoor heaters significantly influences the energy consumption and greenhouse emissions from ORGH. The reasons that motivate operators to switch on the appliance (customer request, smoker comfort or outdoor event) and the frequency of operation and length of operation, all impact on the annual operating hours and subsequent emissions.

The *Switch on Gas* work plan suggests there might be scope to introduce timer-controlled operation (for example timer with a maximum dial-up of six hours, after which the product cannot be restarted for an hour). Industry specialists suggest it might be difficult to source and apply a suitable timer to achieve this and it could raise safety issues. This may or may not be the case but perversely timers might also promote leaving devices running when an area is vacated because the timer will eventually turn it off, rather than consumers turning off devices as they leave. The introduction of timers on ORGH in public places could also encourage members of the general public to move heaters or attempt to relight heaters.[10]

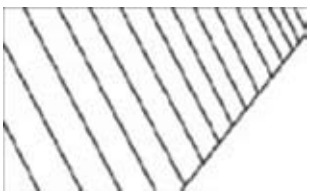
Ultimately the less these appliances are used the lower the energy consumption. A timer might limit some operation, however, the practicalities and benefits of timers are not conclusive. Educating the owner, operator and consumer not to switch on the device in the first place could have more impact. The Energy Saving Trust in the UK claims that consumers can make a big difference by voting with their feet by only using pubs, bars and restaurants that don't use patio heaters.[11] Educated consumers have the potential to minimise demand to switch on outdoor heating appliances or unnecessarily operate them.

5.1.4 APPLICATIONS, HEAT PATTERNS AND TARGET AREA

The best performance measure of an outdoor heater is its effectiveness to heat the target area relative to its gas consumption. Operational effectiveness of outdoor heaters is dependent on the application, expertise of installer and awareness of the operator. The example below in Table 4 demonstrates how a directional radiant panel heater with a side spread heat pattern could heat a target area for a fraction of the running costs and emissions of a conventional patio heater.

This example does not imply that radiant panel heaters with a side spread pattern are more efficient or deliver more heat than heaters with a radial heat pattern, it demonstrates how energy can be used more effectively by focusing it on a target area. This is similar to using a spotlight that effectively shines light on a target area without wasting energy lighting up unnecessary areas. Similarly a single patio heater located centrally could have the same heating effect as several patio heaters with the same heating intensity located on the periphery of the area to be heated.

Table 4: Operational effectiveness of patio heater versus radiant panel heater

	Conventional patio heater	Radiant panel heater
Type of burner	Atmospheric gas burner	High efficiency ceramic infra-red burner
Heat Reflection	Downward focus	Side spread
Heat pattern		
Unit positioning	Close to occupants (between tables)	On periphery (out of the way)
Capacity	40 MJ per hour	11.5 MJ per hour
Safety shut-off	High winds and unit tilt	High winds and unit tilt
Fuel	LPG	LPG
Bottle size	9 kg	13.5 kg
Bottle cost	$35	$50
Cost per kg	$3.90	$3.70
Bottle refill	10 hr	60 hour
Running cost	$3.50 per hour	$0.83 per hour

10 ESV Gas information sheet number 11 states that operation or relocation of a heater in a public place by members of the public should not be permitted.

11 See link: www.energysavingtrust.org.uk

6 Standards and policies

6.1 Australian standards

The current Australian standards are as follows:

- *AS 4565-2004, Outdoor radiant gas heaters* (formerly *AG 403*), which is to provide manufacturers, designers, regulatory authorities, testing laboratories and similar organisations with uniform minimum requirements for the safety, performance and use of radiant gas heaters for outdoor and non-residential indoor use. This standard covers a basic performance and gas consumption test for patio style and radiant panel described in sections 3.2 and 3.3. It does not provide a comprehensive efficiency test to allow performance comparisons
- *AS 4643-2007, Overhead Radiant Tube Gas Heaters*, which specifies the uniform minimum requirements for manufacturers, designers, regulatory authorities, testing laboratories and similar organisations for the safety, performance and use of overhead radiant tube gas heaters intended for use with natural gas, town gas, TLP gas and LPG. This standard covers radiant tube heater as described in section 3.4, which are flued products sometimes used outdoors. The standard covers basic performance tests similar to *AS 4565*, plus tests to evaluate flue operation, thermal efficiency (flue loss) and flue gas temperatures.

A previous standard *AG 103-1993* included a radiant heat test that would allow performance comparisons. This is discussed in more detail in section 5.1.4.

6.2 Overseas standards and policies

The main overseas standards are as follows:

- American National Standards Institute (ANSI) offers *ANSI Z83.26-2007/CSA 2.37-2007, Gas-fired outdoor infrared patio heaters*. This publication provides a standard for safe operation, substantial and durable construction, and acceptable performance of gas-fired low-intensity infrared heaters. Its intended purpose is to reduce such risks while retaining the normal operation of the appliance. The standard does not provide a comprehensive efficiency test to allow performance comparisons. Other relevant standards are *ANSI Z83.19 Gas-fired high-intensity infrared heaters* and *ANSI Z83.20 Gas-fired low-intensity infrared heaters*
- ASTM International, originally known as the American Society for Testing and Materials, one of the largest voluntary standards development organisations, has *ASTM F 2644-2007, Standard test method for performance of commercial patio heaters*. This standard covers the heating performance and energy consumption of commercial radiant patio heaters. The performance results allow the food service operator to select a commercial patio heater and understand its energy performance and effective heated area. Manufacturers are the most likely users of this standard as a tool to validate performance claims to compare products and examine the merits of different design strategies for patio heaters.

The Underwriters Laboratories Certification, an independent product certification organisation, is in effect for both the United States of America and Canada, where suppliers claim products conform to UL certification and meet or exceeds the requirements of ANSI/CSA Standards. There are no energy performance requirements in the US on these appliances.

In Europe suppliers claim products are CE approved and there are no energy performance standards. Outdoor heaters or patio heaters have been receiving bad press internationally for being highly inefficient and a wasteful form of heating. A number of major retail chains in the UK have voluntarily stopped selling these heaters due to their environmental concerns.

The EU Eco-Design Directive plans to review small sundry space heaters later in 2009. There is uncertainty as to whether this study will include patio style heaters. The concern about these products does not appear to be widespread outside of Europe and MEPS or energy labelling of these products does not appear to be required in any country.

6.3 Test standards and facilities

The following laboratories are accredited by the Australian Gas Association (AGA) to conduct and report on AGA certification testing:

- Enertech
- Gas Technology Services (Vipac Engineers & Scientists)
- APA Group Appliance Testing Laboratory (formerly Origin Energy)
- SP Ausnet Technical Services.

Both Enertech and Vipac claim to have facilities and test capabilities to undertake radiant heat performance tests. Radiant heater tests have not been performed since it was not a legal requirement under AGA standard *AG 103-1993*. The test method previously undertaken is described in detail in *AS 4553-2008* Gas space heating appliances.

ASTM F 2644-2007, Standard test method for performance of commercial patio heaters, provides a test method for measuring the heating performance and energy consumption of both gas and electric radiant patio heaters. A complete copy of the standard is provided in Appendix D.

The test method of these standards differs considerably in that *ASTM F 2644-2007* is dedicated to patio heaters and measures across a two-dimensional grid (20 ft square area, 3 ft off the ground) by moving a ping pong ball containing a thermocouple around to generate sample temperatures in four quadrants of the test grid. The outcome is rings of radiant heat intensity used to calculate a heat flux. Whereas *AS 4553-2008* measures across a three-dimensional grid and is suitable for testing radial (patio), directional (radiant panel) or linear (radiant tube) heat patterns from gas or electric appliances.

Further investigation would be required to establish which test method would be best suited to the Australian market as each has its advantages and disadvantages. If a test method standard was adopted in Australia, harmonising *AS 4565-2004* and *AS 4643-2007* with a test method that covers all types of radiant heaters would seem more logical.

7 Conclusion

The total greenhouse gas emissions from this class of technology is currently estimated to be only 82 kilotonnes (kt) CO_2-e per annum. It is estimated that this will reach 1.7 times that level in 2020, or approximately 139 kt CO_2-e.

Therefore the potential greenhouse reductions and savings in fossil fuel use from the introduction of MEPS or other forms of regulation are not expected to be justifiable, given the cost of such a program to the public and industry.

The existing stock of ORGH in Australia is estimated to be about 500,000 units with 180,000 units in the catering and hospitality sector, 250,000 units in residential applications and the remaining stock dispersed across other commercial, industrial and agricultural applications. The catering and hospitality sector has, to a large extent, reached saturation and only modest growth of 2 per cent per annum and replacement is expected over the next decade. The residential sector has significant growth potential and is forecast to reach 900,000 units in 2020, which equates to about 9 per cent of all households. Despite this potentially significant growth in the residential sector, the operational hours per annum are typically low, and the emissions from all ORGH in 2020 are estimated to be only 139 kt CO_2-e. Aggregate emissions for the period 2010 to 2020 are expected to be approximately 1,240 kt CO_2-e.

However if the Australian Government felt that something should be done in this area then the options, prioritised on a matrix of least cost, greatest impact, are as follows:

1. Explore the practicalities of insisting that all ORGH sold have a one-hour cut-off timer so that they cannot be left operating unattended
2. Application of mandatory 'energy warning' labels to inform consumers of gas consumption and operational costs per hour at a set price for LPG and to warn them of the wider environmental implications
3. Initiate discussions with major retailers to introduce voluntary bans to restrict merchandising of ORGH and other outdoor heaters (including electric) with poor sustainability credentials
4. Regulation for efficiency of performance of ORGH is the least preferred option as there are limited efficiency gains that can be achieved at product level. Introducing these measures would require testing a range of ORGH to establish the range of performance differences and the development of a new test method standard. Justification for such measures would be difficult given the small quantity of energy consumed and emissions generated
5. Schedule a detailed review of developments in the technology and market dynamics in three years' time in case changes in either should threaten rapid increases in ownership.

Finally, it is sensible to maintain a watching brief on market penetration of the technology over the coming years, particularly to be aware of regulatory developments overseas that may close major markets, which could lead to product dumping into Australia.

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Australian Bureau of Statistics, 2006, *3236.0 - Household and Family Projections, Australia, 2001 to 2026*

Australian Gas Association, 2009, *Directory of Certified Gas Appliances*

Australian Gas Association Standard,1993, *(AG 103) Gas Space Heating Appliance*

Australian Natural Gas and Electricity, 1993, *Gas Chemistry Handbook*

American Society for Testing and Materials, 2007, *2644 - Standard Test Method for Performance of Commercial Patio Heaters*

Australian Standard, 2008, *AS 4553 - Gas space heating appliances*

Australian Standard, 2007, *AS 4643 - Overhead radiant tube gas heaters*

Department of Climate Change, 2008, *National Greenhouse Accounts Factors*

Department of the Environment, Water, Heritage and the Arts, 2004, *Switch on Gas Australia's strategy to improve the energy efficiency of gas appliances and equipment 2005-2015*

Department of the Environment, Water, Heritage and the Arts, 2006, *Switch on Gas Revised Work Plan for 2007 to 2007/08*

Energy Safe Victoria, 2006, *Gas information sheet number 11*

Appendix A: Suppliers with products certified to AS 4565/AG 403/AG 405

Supplier	Brand or description	Use
Certified to AS 4565/AG 403/AG 405		
Aira Pty Ltd	Super Ray	Internal use only
Hurll Nu-Way Pty Ltd	Portable Overhead Radiant Heater Infrared Livestock Heater	
System Control Engineering Pty Ltd	Kromschroeder Infraconic Infrared Brooder Heaters (for Agricultural use)	
Arisit Pty Ltd	Atika portable outdoor radiant gas heater	External use only
Arlec Australia Pty Ltd	Sunshine, Homemaker Lifestyle and Jackeroo Outdoor Radiant Patio Heaters	
Aussie Outdoor Imports and Exports Pty Ltd	Aussie Outdoor Patio Heater	
Bromic Pty Ltd	Bromic and Coolabah Radiant Patio Heater Helios Outdoor Heaters	
Changzhou Gardensun Furnace Co Ltd (Agent: Sino Trade Winds Inc)	Gardensun or Jumbuck Outdoor Patio Heater	
Changzhou Hongmaoxinda Furnace Co Ltd	Koch and Gasmate Outdoor Radiant Patio Heaters	
Changzhou Wujing Health Equipment Co	Health Equipment Outdoor Patio Heaters	
Focus Lifestyle Products Pty Ltd	Grand Hall Portable Outdoor Patio Heater	
Garden Flame Gas Appliances Co Ltd	Outdoor Patio Heaters	
GLG Australia Pty Ltd	Maxiheat and GLG Outdoor Domestic Patio Heater	
Ningbo Innopower Hengda Metal Products Co Ltd	Innopower Patio Heater	
Pecan Engineering Pty Ltd	Nectre Outdoor Decorative Fire (coal effect)	
Real Fires New Zealand Ltd	Real Fires Outdoor Decorative Flare	
Shinerich Industrial Limited (Agent: Sitro Group Australia Pty Ltd)	Gasmaster, Gasmate, Jumbuck, Star, Del Terra, Coolabah Outdoor, Maxi Heat, Jackeroo Patio	
Sitro Group Australia Pty Ltd	Gasmaster, Gasmate, Jumbuck, Star, Del Terra, Coolabah Outdoor Maxi Heat, Excalibur, Sunburst, Entertainer, Jackeroo and Blackridge Patio, Table Top and Radiant Tile Heaters	
Sierra Space Heating Ltd (UK) (Agent: Sierra Products Pty Ltd)	Sierra Patio and SA8 Portable Infra-Red Outdoor Patio Heater	
Technika Pty Ltd	Technika External Patio Heaters	
United Four Co Ltd (Agent: Aussie Outdoor Imports and Exports Pty Ltd)	Solimar Patio Heaters	
T/as Garth Sheetmetal	Garth and Sunco Outdoor Balcony Heater	
Aira Pty Ltd	Indoor/Outdoor Infrared Overhead Radiant Heater	Internal and external use
Changzhou Wellife Furnace Co Ltd (Agent: Sitro Group Australia Pty Ltd)	Same brands as above	
Hurll Nu-Way Pty Ltd	SBM Overhead Infrared Radiant Heater	
Parasol Heaters Australia Pty Ltd	Parasol Ozglow Portable and Fixed Patio Heaters and Hot Spot Overhead Radiant Heater	
~~Techrite Controls~~ Australia Pty Ltd	Infrared Dynamics Sunpack Model S34 Patio Heater	

Note: This list is a summary of suppliers with certified appliances by AGA and SAI Global.

Appendix B: Suppliers with products certified to AS 4643/AG 403/AG 404

Supplier	Brand or description	Use
Certified to AS 4643/AG 403		
Detroit Radiant Products Company	Re-Veber-Ray EHL and EDX Series Radiant Tube Heaters	Internal use only
Celmec International Pty Ltd	Radiant Tube Heaters Heatray Series (forced and induced draft) and Heatray	
Gas Fired Products (UK) Ltd (Agent:Patarker Pty Ltd)	Space-Ray Brooders	
Roberts-Gordon LLC	Val-Co Overhead Radiant Tube Heating Systems and Blackheat Overhead Radiant Tube Heating Systems	
Saacke Australia Pty Ltd	Ambi-Rad Models	
Sierra Space Heating Ltd (UK) (Agent: Sierra Products Pty Ltd)	Sierra Overhead Indoor Radiant Cone Heater	
Industrial Direct-Fired Air Heaters (AG 404)		
Agricultural Automation Pty Ltd	Tecnoclima Cikki	
Applied Investments Pty Ltd	Jetaire Industrial Mobile Air Heater	
Heating Australia Pty Ltd	Zoneray Mobile Industrial Direct-Fired Air Heater	
Hired Hand Inc	Hired Hand Model Super Saver Outdoor Mounted Agricultural Heater	
Imexco Australia Pty Ltd	Airstream Pura-Fire Agricultural Heater	
Spitwater Australia Pty Ltd	Jetfire	

Note: This list is a summary of suppliers with certified appliances by AGA and SAI Global.

Appendix C: Diagrammatical representation of outdoor areas

The following figures are diagrammatical representations of outdoor areas as described in *AS 4565-2004*. Rectangular areas have been used in these figures, the same principles apply to any other shapes.

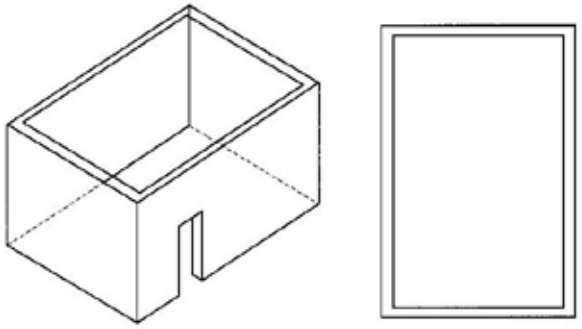

FIGURE E1—OUTDOOR AREA–EXAMPLE 1

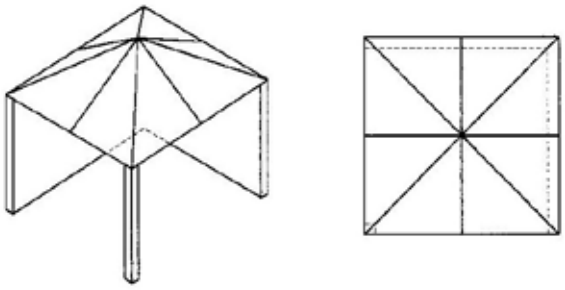

FIGURE E2—OUTDOOR AREA–EXAMPLE 2

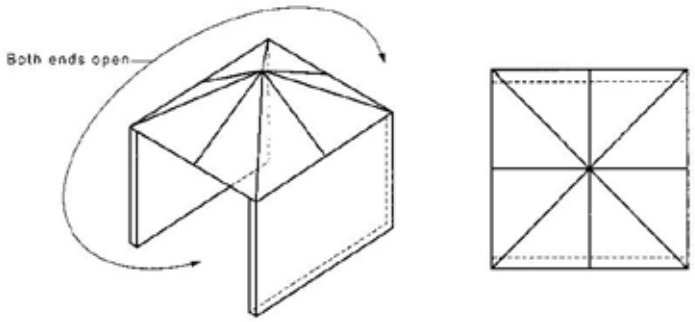

FIGURE E3—OUTDOOR AREA–EXAMPLE 3

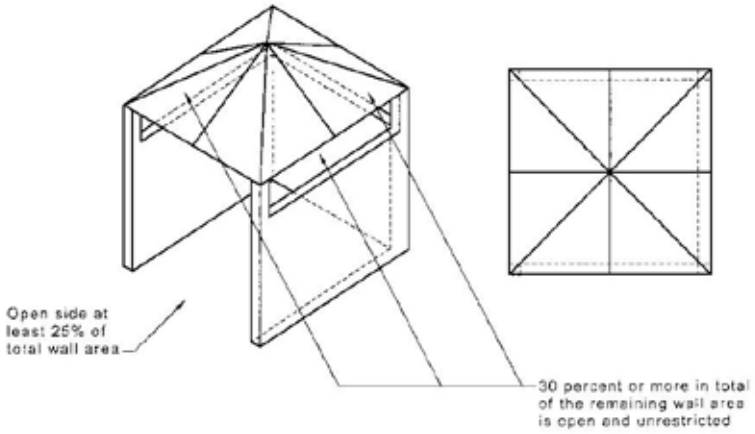

FIGURE E4—OUTDOOR AREA–EXAMPLE 4

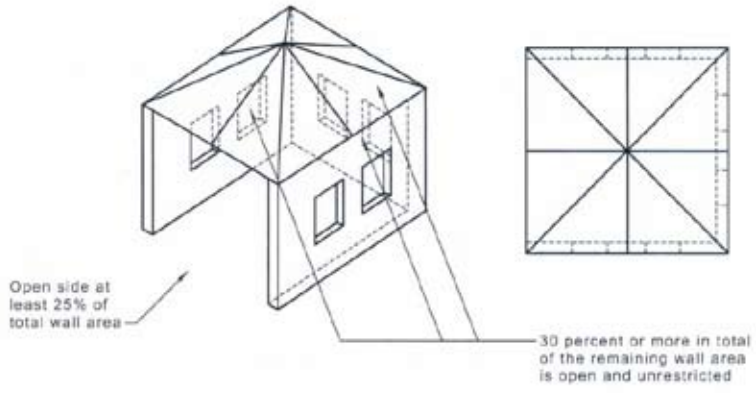

FIGURE E5—OUTDOOR AREA–EXAMPLE 5

Appendix D: Emission factors

The greenhouse gas emission factors used were the same as those used by the Equipment Energy Efficiency (E3) Program for Regulatory Impact Statements (RIS). The emission factor used for LPG is 59.9 kg CO_2-e/GJ, which is the same as the full fuel cycle emission factor prescribed by the National Greenhouse Energy Reporting System technical guidelines. The E3 RIS utilised state-based average fuel cycle emission factors for natural gas. A weighted average emission factor of 67.6 kg CO_2-e/GJ was calculated based on state population (ABS estimates at 31 December 2007), which is shown in Table 5.

Table 5: Weighted average emission factor based on state population

State	Emission factor (Kg CO2-e/GJ)	Population by state (000's)
Vic	63.6	5,246.1
NSW & ACT	71.3	7,267.8
Qld	68.8	4,228.3
SA	73.8	1,591.9
WA	60.7	2,130.8
Tas	60.0	495.8
NT	53.6	217.6
National	67.6	21,178.3