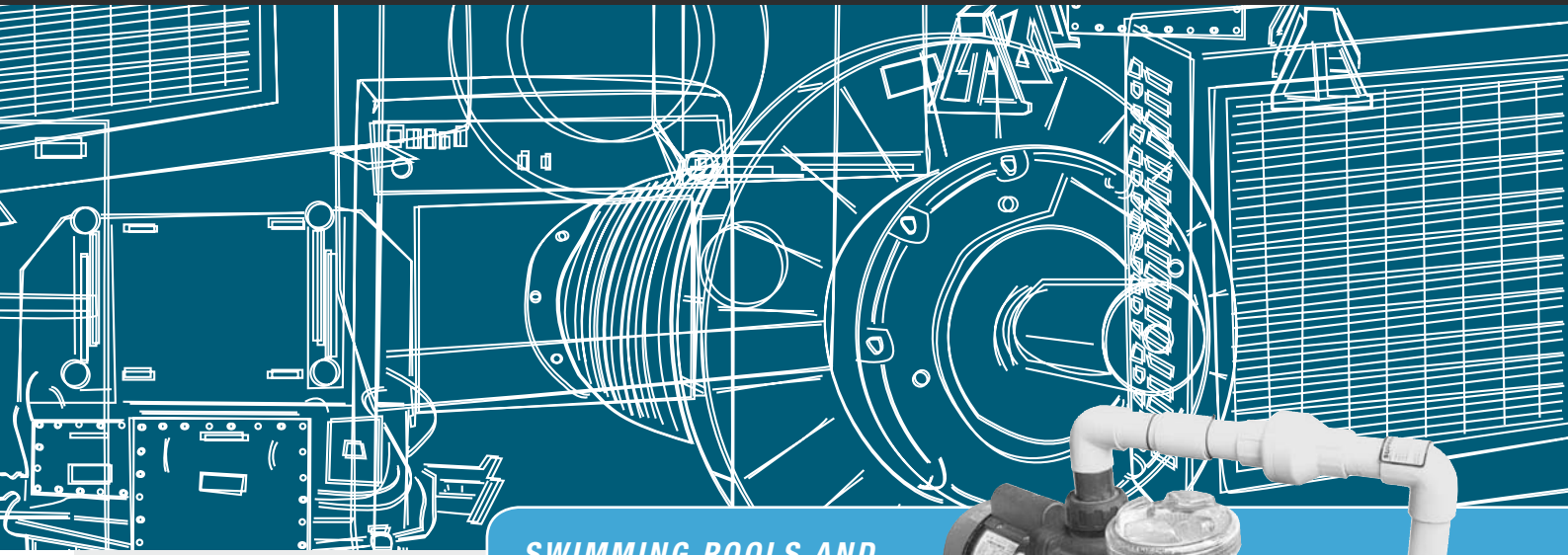


NATIONAL APPLIANCE AND EQUIPMENT ENERGY EFFICIENCY PROGRAM

Minimum Energy Performance Standards



*SWIMMING POOLS AND
SPA EQUIPMENT*



PREPARED FOR

THE AUSTRALIAN GREENHOUSE OFFICE UNDER
THE NATIONAL APPLIANCE & EQUIPMENT ENERGY
EFFICIENCY PROGRAM



Minimum Energy Performance Standards - Swimming Pools and Spa Equipment

This report has been commissioned by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) to explore the potential for energy and greenhouse savings through measures to increase the energy efficiency of domestic swimming pool and spa equipment in Australia.

It is estimated that energy use in domestic swimming pools and spa pools accounts for about 3.3% of residential sector electricity use and 0.9% of natural gas use in Australia, and for approximately 1.85 million tonnes of CO₂-e emissions annually.

Swimming pools and spa pools use as much electricity as dishwashers, clothes washers and clothes dryers combined (hot water use excluded). About 76% of the electricity used is for pumps, about 6% for chlorination cells, 14% for electric heaters (mainly resistance heating in spas, but some heat pumps as well) and 4% for timers and controls. Gas is used in pool and spa heaters, which are similar to gas instantaneous water heaters with very high gas inputs.

There appears to be significant scope to increase the energy-efficiency of the most energy-intensive components, pumps and heaters, by 10 to 15%, through measures including Minimum Energy Performance Standards (MEPS) and energy labelling for key items of equipment (see Table S1).

Pool pump energy efficiency could be improved by addressing the motor (most of which are single-phase), or the entire pump assembly. Both approaches are used in some other APEC

economies, although none have programs specifically targeting swimming pool pumps. Gas pool heaters are already subject to minimum energy performance standards (MEPS), but efficiency could be increased through the adoption of the higher MEPS levels in force in the USA.

The overall energy and water consumption of a swimming pool or spa depends not just on the efficiency of individual items of equipment but on the overall design, the selection and integration of the equipment, the controller capabilities and how the pool or spa is managed. A Pool Energy and Water Rating Scheme (PEWRS), analogous to the Home Energy Rating Schemes (HERS), could give potential pool and spa owners an indication of the energy and water consumption, based on input data about the design, the equipment, the location and the proposed pattern of use. This approach is consistent with other household water efficiency initiatives such as Water Efficiency Labelling, and so could be jointly developed with the Department of the Environment and Heritage.

Some of the energy efficiency measures could extend across different energy forms (eg gas vs solar swimming pool heating) and technologies (eg integrated electric vs external gas spa pool heating) and affect the commercial competition between them - for example, if one energy form or technology type were required to meet MEPS but not its competitors. The risk of market distortion will be much reduced with the development of the government-industry Gas Appliance and Equipment Energy Efficiency Program, but it will be necessary to ensure that all products and energy forms are fairly addressed.

STAKEHOLDER COMMENT

NAEEEC invites comments from any interested person or organisation on the measures proposed in this study. Comments should be directed to energy.rating@greenhouse.gov.au by 31 December 2004. Information sessions for industry participants can be arranged during the comment period if requested.

Electronic copies of profiles and full reports released for public discussion can be obtained from www.energyrating.gov.au

TABLE S1 MEASURES RECOMMENDED FOR INVESTIGATION

Measure	Pool & solar heater pumps		Gas pool & spa heaters	Controllers
	Pump motors	Motor-pump assemblies		
Minimum Energy Performance Standards	✓	✓	✓	
Mandatory labelling	✓	✓	✓	
Voluntary labelling	✓	✓	✓	✓
Inclusion in NAEEEP Standby Strategy			✓	✓
Pool Energy and Water Rating Scheme	✓	✓	✓	✓

The further investigation and development of the measures in Table S1 will require additional data collection and industry discussions in the short term, and possibly the development of new Australian Standards or the amendment of existing standards in the medium term. The most efficient way to proceed is via the development of a Swimming Pool and Spa Equipment Strategic Plan, addressing all technology types and energy forms. The plan should outline the investigation, consultation, decision and implementation milestones over the period 2005-10. It should be prepared following the receipt of comments on this discussion paper.

NAEEEC PLAN

This paper is the first stage in NAEEEEC’s consideration of these issues. Its publication marks the beginning of consultations with the swimming pool and spa industry and other stakeholders on whether the measures proposed are feasible and desirable.

The following stages are envisaged:

1. NAEEEEC will invite comments from stakeholders on the measures proposed in this study. Comments should be directed to energy.rating.greenhouse.gov.au by 31 December 2004. Information sessions for industry participants can be arranged during the comment period if requested.
2. Early in 2005, NAEEEEC will prepare a draft Strategic Plan for Swimming Pool and Spa Equipment, detailing a work program for the period 2005-2010 (subject to comment on this discussion paper). The Strategic Plan will address swimming pool and spa pool equipment using all energy forms.
3. NAEEEEC will seek to hold a workshop on the draft Strategic Plan in the first half of 2005,

preferably as part of a major industry event.

4. NAEEEEC will then finalise the Strategic Plan and proceed with development of the selected energy efficiency measures during 2005. This will probably involve the modification or development of one or more Australian (or A/NZ) Standards, and the preparation of a Regulation Impact Statement (RIS) formally assessing the costs and benefits of implementing mandatory measures such as Minimum Energy Performance Standards. The industry would obviously participate in any standards development, and there would be formal consultations with industry and other stakeholders during the preparation of a RIS.
5. If the RIS finds that the implementation of energy efficiency measures for swimming pool and spa pool equipment would be cost-effective and in the national interest, the matter would be considered by the Ministerial Council on Energy (MCE), which is the ultimate decision-making body in this area.
6. If MCE decides to implement any measures, there would normally be a lead time of at least a year before the measures take effect, to give manufacturers time to adjust their product specifications and to give suppliers time to run out old stocks. No regulatory action would commence before April 2007, unless the industry seeks an accelerated timetable (as has occurred with other product categories).

IMPACT OF MEPS

It is estimated that the adoption of the proposed measures should reduce annual energy consumption considerably, leading to a consequent reduction in emissions of CO₂-e. Total estimated cumulative savings will be published at a later date.



NAEEEC MEMBERS

The Commonwealth, New Zealand, and all State and Territory governments are part of NAEEEC. Representatives are senior officials from various government agencies and statutory authorities or persons appointed to represent those bodies.

The *Australian Greenhouse Office (AGO)* is the Australian Government agency responsible for monitoring the National Greenhouse Strategy in cooperation with State and Territory Governments and with the support of local government, industry and the community. The AGO chairs NAEEEC and other members provide support for its activities.

The NSW *Ministry of Energy and Utilities* (incorporated within the Department of Energy, Utilities and Sustainability since 1 January 2004) provides policy advice to the NSW Government and operates a regulatory framework aimed at facilitating environmentally responsible appliance and equipment energy use. The Ministry is represented on the Energy Efficiency and Greenhouse Working Group, through which the appliance and equipment related elements of the National Greenhouse Strategy are being progressed.

The NSW *Sustainable Energy Development Authority* was established in February 1996 with a mission to reduce the level of greenhouse emissions in New South Wales by investing in the commercialisation and use of sustainable energy technologies.

The *Office of the Chief Electrical Inspector* is the Victorian technical regulator responsible for electrical safety and equipment efficiency. Its mission is to ensure the safety of electricity supply and use throughout the State. The corporate vision of the Office is to demonstrate national leadership in electrical safety matters and to improve the superior electrical safety record in Victoria. The Office's strategic focus is to ensure a high level of compliance is sustained by industry with equipment efficiency labelling and associated regulations.

The *Sustainable Energy Authority* was established in 2000 by the Victorian Government to provide a focus for sustainable energy in Victoria. The Authority's objective is to accelerate progress towards a sustainable energy future by bringing together the best available knowledge and expertise to stimulate innovation and provide Victorians with greater choice in how they can take action to significantly improve energy sustainability.

The *Electrical Safety Office*, Department of Industrial Relations, is the Queensland technical regulator responsible for electrical safety and appliance and equipment energy efficiency. The office ensures compliance with electrical safety and efficiency regulations throughout Queensland.

The *Department of Energy* is the lead agency with regard to sustainable development within the

Queensland energy sector and is involved in a range of activities that reflect the importance of a sustainable approach. These activities involve developing and evaluating policies and initiatives through flexible and responsible decision making that allows economic, environmental and social outcomes from the energy sector to be maximised.

The Western Australian electricity regulator *Energy Safety* (a Division of the Department of Consumer and Employment Protection) is responsible for the technical and safety regulation of the electrical industry in WA. This includes the safety of consumers' electrical installations and appliances and the auditing of appliances and equipment to check compliance with energy efficiency and prescribed safety requirements.

The Western Australian *Sustainable Energy Development Office* promotes more efficient energy use and increased use of renewable energy to help reduce greenhouse gas emissions and increase jobs in related industries.

The *Office of the Technical Regulator* seeks to ensure the coordinated development and implementation of policies and regulatory responsibilities for the safe, efficient and responsible provision and use of energy for the benefit of the South Australian community.

The Tasmanian Government's interest is managed by the Department of Infrastructure, Energy and Resources' *Office of Energy, Planning and Conservation (OEPC)*. The OEPC provides policy advice on energy related matters including energy efficiency. Its web site is www.dier.tas.gov.au/energy/index.html.

Electricity Standards and Safety is the technical regulator responsible for electrical safety throughout Tasmania. Regulatory responsibilities include electrical licensing, appliance approval and equipment energy efficiency.

The Australian Capital Territory's interest is managed by the *Energy Policy Unit, Economic Management Branch*, Department of Treasury. The primary function of this Unit is to provide the ACT Government with advice on National and Territory energy related matters including energy efficiency.

The *Department of Infrastructure, Planning and Environment* is responsible for the administration of regulations in the Northern Territory regarding various aspects of safety, performance and licensing for goods and services including electrical appliances.

The *Energy Efficiency and Conservation Authority (EECA)* is the principal body responsible for delivering New Zealand's National Energy Efficiency and Conservation Strategy (NEECS). EECA's function is to encourage, promote and support energy efficiency, energy conservation and the use of renewable energy sources.

DRAFT 3

**Analysis of the Potential for Energy Efficiency
Measures**

for

Domestic Swimming Pool and Spa Pool Equipment

Prepared for the

**National Appliance and Equipment Energy Efficiency
Committee (NAEEEC)**

and the

Australian Greenhouse Office

by

George Wilkenfeld and Associates Pty Ltd

September 2004

GEORGE WILKENFELD AND ASSOCIATES Pty Ltd
ENERGY POLICY AND PLANNING CONSULTANTS
PO Box 934 Newtown NSW 2042 Sydney Australia
Tel (+61 2) 9565 2041 Fax (+61 2) 9565 2042 e-mail: geosanna@ozemail.com.au

Summary

This report has been commissioned by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) to explore the potential for energy and greenhouse savings through measures to increase the energy efficiency of domestic swimming pool and spa equipment in Australia.

It is estimated that energy use in domestic swimming pools and spa pools accounts for about 3.3% of residential sector electricity use and 0.9% of natural gas use in Australia, and for about 1.85 million tonnes of CO₂-e emissions annually.

Swimming pools and spa pools use as much electricity as dishwashers, clothes washers and clothes dryers combined (hot water use excluded). About 76% of the electricity used is for pumps, about 6% for chlorination cells, 14% for electric heaters (mainly resistance heating in spas, but some heat pumps as well) and 4% for timers and controls. Gas is used in pool and spa heaters, which are similar to gas instantaneous water heaters with very high gas inputs.

There appears to be significant scope to increase the energy-efficiency of the most energy-intensive components, pumps and heaters, by 10 to 15%, through measures including Minimum Energy Performance Standards (MEPS) and energy labelling for key items of equipment (see Table S1).

Pool pump energy efficiency could be improved by addressing the motor (most of which are single-phase), or the entire pump assembly. Both approaches are used in some other APEC economies, although none have programs specifically targeting swimming pool pumps. Gas pool heaters are already subject to minimum energy performance standards (MEPS), but efficiency could be increased through the adoption of the higher MEPS levels in force in the USA.

The overall energy and water consumption of a swimming pool or spa depends not just on the efficiency of individual items of equipment but on the overall design, the selection and integration of the equipment, the controller capabilities and how the pool or spa is managed. A Pool Energy and Water Rating Scheme (PEWRS), analogous to the Home Energy Rating Schemes (HERS), could give potential pool and spa owners an indication of the energy and water consumption, based on input data about the design, the equipment, the location and the proposed pattern of use. This approach is consistent with other household water efficiency initiatives such as Water Efficiency Labelling, and so could be jointly developed with the Department of the Environment and Heritage.

Some of the energy efficiency measures could extend across different energy forms (eg gas vs solar swimming pool heating) and technologies (eg integrated electric vs external gas spa pool heating) and affect the commercial competition between them - for example, if one energy form or technology type were required to meet MEPS but not its competitors. The risk of market distortion will be much reduced with the development of the government-industry Gas Appliance and Equipment Energy Efficiency Program, but it will be necessary to ensure that all products and energy forms are fairly addressed.

The further investigation and development of the measures in Table S1 will require additional data collection and industry discussions in the short term, and possibly the development of new Australian Standards or the amendment of existing standards in the medium term. The most efficient way to proceed is via the development of a Swimming Pool and Spa Equipment Strategic Plan, addressing all technology types and energy forms. The plan should outline the investigation, consultation, decision and implementation milestones over the period 2005-10. It should be prepared following the receipt of comments on this discussion paper..

Table S1 Measures recommended for investigation

Measure	Pool & solar heater pumps		Gas pool & spa heaters	Controllers
	Pump motors	Motor-pump assemblies		
Minimum Energy Performance Standards	X	X	X	
Mandatory labelling	X	X	X	
Voluntary labelling	X	X	X	X
Inclusion in NAEEEP Standby Strategy			X	X
Pool Energy and Water Rating Scheme	X	X	X	X

This paper is the first stage in NAEEEC's consideration of these issues. Its publication marks the beginning of consultations with the swimming pool and spa industry and other stakeholders on whether the measures proposed are feasible and desirable.

The following stages are envisaged:

1. NAEEEC will invite comments from stakeholders on the measures proposed in this study. Comments should be directed to energy.rating@greenhouse.gov.au by 31 December 2004. Information sessions for industry participants can be arranged during the comment period if requested.
2. Early in 2005, NAEEEC will prepare a draft *Strategic Plan for Swimming Pool and Spa Equipment*, detailing a work program for the period 2005-2010 (subject to comment on this discussion paper). The Strategic Plan will address swimming pool and spa pool equipment using all energy forms.
3. NAEEEC will seek to hold a workshop on the draft *Strategic Plan* in the first half of 2005, preferably as part of a major industry event.
4. NAEEEC will then finalise the *Strategic Plan* and proceed with development of the selected energy efficiency measures during 2005. This will probably involve the modification or development of one or more Australian (or A/NZ) Standards, and the preparation of a Regulation Impact Statement (RIS) formally assessing the costs and benefits of implementing mandatory measures such as Minimum Energy Performance Standards. The industry would obviously participate in any standards development, and there would be formal consultations with industry and other stakeholders during the preparation of an RIS.
5. If the RIS finds that the implementation of energy efficiency measures for swimming pool and spa pool equipment would be cost-effective and in the national

interest, the matter would be considered by the Ministerial Council on Energy (MCE), which is the ultimate decision-making body in this area.

6. If MCE decides to implement any measures, there would normally be a lead time of at least a year before the measures take effect, to give manufacturers time to adjust their product specifications and to give suppliers time to run out old stocks. No regulatory action would commence before April 2007, unless the industry seeks an accelerated timetable (as has occurred with other product categories).

Contents

SUMMARY	2
INTRODUCTION.....	6
<i>The NAEEEP</i>	6
<i>Purpose of this study</i>	7
ENERGY AND WATER USE IN POOLS AND SPAS	9
<i>Swimming pools</i>	9
<i>Spa pools</i>	11
<i>Indoor spa tubs</i>	12
RESOURCE IMPACTS	13
<i>Energy</i>	13
<i>Water</i>	14
EQUIPMENT INVOLVED.....	16
<i>Pumps and motors</i>	16
<i>Pool and spa heaters</i>	18
Solar heaters	18
Gas heaters	19
Heat pump heaters.....	20
Comparing modes of pool and spa heating.....	20
<i>Other pool equipment</i>	21
Sanitising equipment	21
Controllers.....	21
THE MARKET	23
<i>Ownership and Purchase</i>	23
<i>Suppliers and Associations</i>	23
ENERGY EFFICIENCY MEASURE OPTIONS.....	25
<i>Measures targeting pumps and pump motors</i>	25
<i>Measures targeting gas heaters</i>	26
<i>Measures targeting time clocks and controllers</i>	27
<i>Pool Energy and Water Rating Scheme (PEWRS)</i>	27
RECOMMENDATIONS	28
<i>References</i>	29

Introduction

The NAEEEP

This report has been commissioned by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) to explore the potential for energy and greenhouse savings through measures to increase the energy efficiency of swimming pool and spa equipment in Australia. NAEEEC is the administering body for the National Appliance and Equipment Energy Efficiency Program (NAEEEP) which comprises representatives from the following government agencies:

- State and Territory regulatory agencies responsible for administering the mandatory energy efficiency labelling and performance standards called into legislation in their respective jurisdictions; and
- Commonwealth, State and New Zealand agencies with a mandate to encourage sustainable energy use and reduce greenhouse gas emissions.

NAEEEC reports to the Ministerial Council on Energy (MCE) through the Energy Efficiency and Greenhouse Gas Working Group. The activities of NAEEEP flow from the requirements in the National Greenhouse Strategy (NGS 1998) to improve the energy efficiency of energy-consuming household appliances, and industrial and commercial equipment.

NAEEEP work programs cover three-year cycles. The first work program, covering the period 1999 to 2001 inclusive, included High Priority, Medium Priority and Low Priority tasks. The low priority group of task was to “review existing or develop new strategies (regulatory and/or voluntary) to improve the energy efficiency of [among other products] swimming pool equipment (ie motors, pumps, gas and solar pool heaters)” (NAEEEP 1999). Swimming pool and spa equipment was not addressed during the first work program, partly because the NAEEEP did not cover gas appliances at the time.

In 2002, NAEEEP published a document signalling its future activities, *Work Plan and Policies 2002 to 2004* (NAEEEP 2002). This second Work Plan included a table of products “to be considered for inclusion in the program in 2002 to 2004. NAEEEC considers that these products may meet the selection criteria although they have not been subject to detailed analysis, cost benefit justification or community consultation. This table forms the basis for planning expansion of the regulatory program over the next three years. Programs to be considered include mandatory energy labelling, MEPS and endorsement labelling”.

Although swimming pool and spa equipment as such was not listed in the 2002-04 NAEEEP work plan, several elements of the Plan were directly relevant to pool and spa equipment (see Table 1):

- Pumps and small motors: the great majority of swimming pool and spa energy is used in small (0.5 – 2.0 kW) single phase electric motors driving water pumps;

- Water heaters: the main energy use in swimming pools and spas after pool pumping is for water heating. The fossil fuel energy use of solar pool heating is determined by the pump. Thermal water heaters are also used: electric heat pumps, electric resistance heaters (mainly in spa pools) and high-output natural gas instantaneous water heaters. Gas appliances are being brought within the scope of a Gas Appliance and Equipment Energy Efficiency Program (GAEEEP) modelled on and linked to the NAEEEP;
- Timers and Controllers: nearly every pool has one or more timers, which are energised all the time, and one or more controller (for the chlorinator cell, and for the solar heater if present), which is in standby mode for most of the time. Sometimes the functions are combined. These products may be suitable for inclusion in the existing ‘Standby Power’ strategy.

Addressing these products as a single category of ‘domestic swimming pool equipment’ has several advantages:

- It is possible to identify the interrelated energy consumption of the products and to estimate the combined impacts of potential measures;
- The target group of decision-makers is the same (ie the owners and prospective owners of swimming pools and spas); and
- There is a high degree of overlap in product suppliers, importers and manufacturers.

Table 1 Elements of NAEEEP work plan relevant to pool and spa equipment

End use group	Priority	Appliance or equipment type	Energy type	Current status
Water heating	2	Commercial and other non-household	Various	Covered by some OECD countries, revised US MEPS 2001
Other	3	Small motors	Electric	MEPS covered by parts of APEC
Other	4	Pumps	Electric	MEPS covered by parts of APEC
Standby power	Current	Consumer products	Electric	Range of product specific measures within the umbrella concept of the ‘One Watt Initiative’

Extracted from *Work Plan and Policies 2002 to 2004* (NAEEEP 2002)

Purpose of this study

The purpose of this study is to

- Identify the ways in which the operation of domestic swimming pools and spa pools gives rise to the consumption of energy and water;
- Estimate the total national energy consumption of domestic swimming pool and spa pool equipment, and the associated greenhouse gas impacts;
- Give an overview of the market for swimming pool and spa pool equipment;

- Estimate the potential for reducing energy consumption and greenhouse gas emissions through measures to increase the energy-efficiency of equipment; and
- Recommend energy-efficiency measures for further investigation.

Swimming pools and spa pools installed in public or commercial premises are beyond the scope of the present study, although some of the energy efficiency measures recommended for further investigation would, if implemented, also impact on some non-domestic pools.

This paper is the first stage in the NAEEEC's consideration of these issues. Its publication marks the beginning of consultations with the swimming pool and spa industry and other stakeholders on whether the measures proposed are feasible and desirable.

The following stages are envisaged:

1. NAEEEC will invite comments from stakeholders on the measures proposed in this study. Comments should be directed to energy.rating@greenhouse.gov.au by 31 December 2004. Information sessions for industry participants can be arranged during the comment period if requested.
2. Early in 2005, NAEEEC will prepare a draft *Strategic Plan for Swimming Pool and Spa Equipment*, detailing a work program for the period 2005-2010 (subject to comment on this discussion paper). The Strategic Plan will address swimming pool and spa pool equipment using all energy forms.
3. NAEEEC will seek to hold a workshop on the draft *Strategic Plan* in the first half of 2005, preferably as part of a major industry event.
4. NAEEEC will then finalise the *Strategic Plan* and proceed with development of the selected energy efficiency measures during 2005. This will probably involve the modification or development of one or more Australian (or A/NZ) Standards, and the preparation of a Regulation Impact Statement (RIS) formally assessing the costs and benefits of implementing mandatory measures such as Minimum Energy Performance Standards. The industry would obviously participate in any standards development, and there would be formal consultations with industry and other stakeholders during the preparation of an RIS.
5. If the RIS finds that the implementation of energy efficiency measures for swimming pool and spa pool equipment would be cost-effective and in the national interest, the matter would be considered by the Ministerial Council on Energy (MCE), which is the ultimate decision-making body in this area.
6. If MCE decides to implement any measures, there would normally be a lead time of at least a year before the measures take effect, to give manufacturers time to adjust their product specifications and to give suppliers time to run out old stocks. No regulatory action would commence before April 2007, unless the industry seeks an accelerated timetable (as has occurred with other product categories).

Energy and water use in pools and spas

Swimming pools

About 10% of Australian households have a swimming pool or spa. This ratio has been fairly constant over the past decade. Increases in ownership in the warmer states (WA, Queensland and NT) have been countered by static ownership in NSW and declining ownership in the cooler states (Victoria, SA, Tasmania and the ACT) (Figure 1). It is estimated that there were about 650,000 swimming pools installed in mid-2004: about 540,000 in-ground pools and 110,000 above-ground pools. About 20,000 new pools are installed each year.

In-ground pools are larger (typically 30,000 to 70,000 litres) and more expensive, since they require on-site excavation. They are generally of reinforced concrete construction with painted, tile or pebblecrete finish, although the smaller ones may be delivered to site as a large fibreglass tub. Above-ground pools tend to be smaller (15,000 to 30,000 litres), cheaper and quicker to erect. They typically consist of a flexible or semirigid waterproof liner contained in a rigid steel or timber frame. Their advantages are lower cost, quicker erection and, in some local council areas, they require a lower level of planning approval than in-ground pools.¹

The water quality in swimming pools is maintained by a combination of physical filtration and chemical treatment, which work together to kill water-borne bacteria, control algal growth, trap particles and litter and generally keep the water clean and safe for swimming. In nearly all cases the management of the pool depends on the release of free chlorine from chlorine compounds added to the pool in liquid or granular form, or from the electrolysis of chloride salts in the water (in so-called 'salt water' pools). Other chemicals are also used to control pH, clarity and other aspects of water quality.

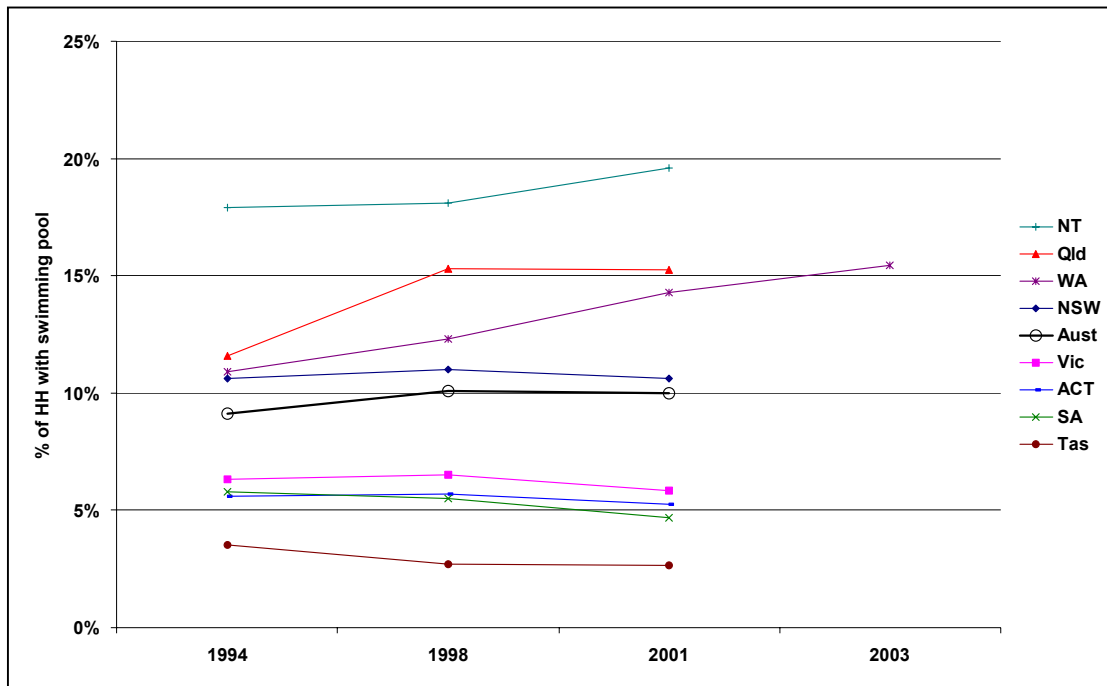
Nearly all pools have a pump, which circulates the water through a filter (a large container of sand or other media such as zeolites) and returns it to the pool. In salt-water pools the water also circulates through an electrolytic cell which breaks down the salt to free chlorine. Salt-water pools need less user maintenance, since they only need the occasional addition of salt, whereas during the swimming season a chlorine pool may need daily dosage. In addition, free chlorine levels are lower and water density is higher in salt water pools, making swimming more comfortable. About half of existing pools are salt water, as are most new pools.

The great majority of swimming pool energy use is for pumping. A pump powered by a typical 1,000 W electric motor can recirculate (or 'turn over') the entire volume of a 50,000 litre pool in 3 to 4 hours. The recommended run time during the height of the swimming season in the summer is 6 to 8 hours per day: one full turnover in the morning and one in the evening. The recommended run time in winter is 2 to 3 hours per day. The most common mode of run time control is an electro-mechanical time clock with two presets, which the householder sets the start and end of the morning and

¹ Demountability is usually not a factor - once erected, many above-ground pools are surrounded by decking and planting, and become as permanent a feature as an in-ground pool.

evening pump sessions. In a salt water pool the electrolytic cell is energised whenever the pump is operating.

Figure 1 Swimming pool ownership, Australia



In addition to pumps and electrolytic cells, the other major pool-related energy use is for heating, which is installed in about 5% of pools. The length of time that an unheated pool is at comfortable swimming temperature (24-28°C) depends on its orientation, exposure and shading, and on the weather. For some pools in Sydney and Melbourne, the swimming season in cooler years can be as short as 3 months. The season can be extended by covering the pool at night to retain heat, and extended further still if an active heating system is installed. Solar pool heating will typically extend the season by up to 2 months either side of summer, and fossil fuel heating can allow year-round use.

The energy consumption of solar pool heaters is determined by the pumping arrangements. If the heater circuit is added to the main pool pump circuit the total run time may need to be increased somewhat, since the pump will have to work at a higher head to raise the water to the solar collectors at roof level, so lowering the flow rate and increasing the time for pool turnover. It is more usual to install a separate pump for the solar heater circuit, operated by a temperature-sensing controller which only operates the pump when the solar gain exceeds the potential for heat loss from the pool water in the collectors. A separate motor may reduce the overall energy penalty of solar heating by allowing the smaller secondary pump to operate only when required, rather than forcing the main pump to operate for longer to meet the needs of the solar heating.

Several models of gas-fired pool heaters are available (ranging in output from about 58 MJ/hr – 16 kW – to about 430MJ/hr – 120 kW), and at least one range of electric heat pumps. Electric resistance heating is rarely used for swimming pools, because the need for very heavy duty wiring would make installation costly and the operating costs would be prohibitive. Electric resistance heaters up to 5 kW are often used in spa pools.

Lighting and cleaning are other areas of pool energy use, although minor in comparison with pumps and heating. Where underwater lighting is installed the hours of use are generally short. Most pool cleaners are operated by the water flow created by the main pump. A few cleaner types have their own dedicated pumps. Again, this may reduce overall energy consumption by taking the cleaner resistance load from the main pump, and allowing the cleaner pump to operate independently - generally for less run time than main pool pumps.

Spa pools

Spa pools are intended for bathing rather than swimming. About 13,000 new spa pools are installed in Australia each year (compared with 20,000 swimming pools). They are typically designed to accommodate 4 to 10 seated persons, with a volume of 1,000 to 2,000 litres.² The water is usually heated to about 34-38°C, and introduced at high pressure through multiple inlet nozzles designed to massage the occupants. The need to heat the water relatively quickly (the usual requirement is not more than one hour) means that almost every spa pool requires some form of fossil fuel heating.

Some swimming pools are designed with an inbuilt spa pool, with the two zones sharing the one water circulation system. When the spa pool is in use, the heated water is introduced into that zone first, and then circulates to the rest of the pool.³ However, most spa pools are sold as independent units, with their own pumps, filters and heaters, and as relocatable above-ground units (which may be installed indoors or outdoors) rather than in-ground.

It is difficult to estimate spa pool energy consumption. Unlike swimming pools, where pump operation essentially determines energy use and there are typical seasonal pump operating patterns, the energy consumption of a spa pool depends on design, heat loss and usage patterns, all of which vary widely.

Spa pumps are usually higher power than swimming pool pumps (typically 1.5 to 2.4 kW) because of the need for high water flow through multiple nozzles while the pool is in use. Larger spas may have two pumps. Heating arrangements also vary. Some spa pools have dedicated external heaters (usually gas), while others rely on an initial fill from the house hot water system. Some have three-phase electric element heaters (up to 5 kW) designed to heat water from cold (over several hours), while others have lower element heaters designed to maintain temperature after a hot fill. Most stand-alone spa pools are sanitised by dosing with chlorine compounds, but some use ozone generators, which also draw energy.

Stand-alone spa pools which are used only occasionally will be left empty for much of the time, and the only energy use is for heating the water and for a few hours of pump operation while the spa is occupied. Conversely, spas which are kept filled ready for

² AS 2610-*Spa Pools* defines a spa pool as 'a water retaining structure with a capacity of not less than 680 L with which is associated the facility for heating the water contained in it and injecting air bubbles or jets of turbulent water.'

³ Pool heaters must be fitted with a thermostat so that the temperature at the outlet to the swimming pool or spa is limited to 40°C, and with a high temperature control so water cannot be heated above 45°C.

use will need constant low-level pump operation to circulate the water through a small filter, and constant heat top-up. The heat loss will depend on whether the spa pool is indoors or outdoors, on how exposed its position is, on the quality of the tub insulation and, more importantly, on the insulation value and fit of the thermal cover and how long the spa is left uncovered.

Indoor spa tubs

Indoor spa tubs are essentially larger than usual bathtubs designed to accommodate one or two persons, with a pump (typically 900 W) to circulate the water at high pressure through multiple inlet nozzles to massage the occupants. They may also have a small resistance heater (typically 1 kW) to maintain heat after the initial fill. They are normally installed in the bathroom, in place of a conventional bathtub.

There is no need for a chlorine treatment or other means of sanitising, since the water is emptied after use. There are about 3 million spa tubs in Australia, with about 70,000 installed each year.

Industry sources estimate that spa tubs are operational (with the motor and heater in use) for about 20 minutes per week on average, or about 17 hours/yr. This would mean a relatively modest energy consumption of about 33 kWh per year during spa operation. However, because spa tubs hold more water than normal bathtubs, there would also be some additional energy (and water) penalty when the spa is used as a conventional bath – as it would be on more occasions than it is used as an operating spa.

Resource impacts

Energy

The annual electricity consumption of a pool can be estimated from the run times, the power of the pump motor (typically about 1 kW for a 50,000 litre pool), the time clocks and other controls (about 10W) and the salt electrolysis cell, if present (about 180W). A salt water pool run for the recommended times will use about 2,200 kWh annually (Table 2), about three quarters of it for the pump. Some householders will over- or under-run their pools. If householders do not bother to reset the time clock, and retain the summer settings all year round, electricity use could go up to 3,100 kWh per year. Even at 2,200 kWh the pool would be the largest single electricity user in the average household, unless there is an electric water heater present.⁴ If all swimming pools in Australia used 1,780 kWh per year for pumping, the total pump energy used would be about 1,150 GWh (Table 3). About half of all pools also have salt water electrolytic cells, and these would use about 104 GWh.

Table 2 Typical energy consumption of a salt-water pool

Season	Recommended run times						No-reset run times (a)					
	Hrs/ day	Hrs/ season	Pump kWh	Cell kWh	Timer kWh	Total kWh	Hrs/ day	Hrs/ season	Pump kWh	Cell kWh	Timer kWh	Total kWh
Summer	7.0	637	637	115	22	774	7.0	637	637	115	22	774
Spring & autumn	5.0	915	915	165	44	1124	7.0	1281	1281	231	44	1555
Winter	2.5	228	228	41	22	290	7.0	637	637	115	22	774
Annual total	4.9	1780	1780	320	88	2187	7.00	2555	2555	460	88	3103

Assumes 750W pump motor and 180W electrolytic cell (a) Assumes summer settings all year round.

Because of the wide range of heating options and possible usage patterns, it is very difficult to estimate electricity and gas consumption for pool heating. However, even a moderate size pool heater, with a gas input of 120 MJ/hr would, if operated for 500 hrs at full load, consume 60 GJ of gas, the average total annual gas use of a Victorian household. Assuming that half the pools with heating use gas and the rest solar, about 0.6 PJ of gas and 24 GWh of pumping energy would be used in pool heating.⁵

It is even more difficult to estimate the energy used in spa pools, given the large range of usage patterns and heating modes. The estimates in Table 3 are based on the assumptions that:

- Half the spa pools use gas for their main water heating and half use electricity;
- All spa pools, including those with gas main heating, have an electric resistance maintenance heater; and

⁴ Many swimming pools would be in higher income households with higher than average electricity consumption. It is possible that other high electricity users such as whole-house airconditioning would also be present, so reducing the pool's share of total electricity.

⁵ Where year round operation is desired, gas and solar pool heating may be installed together, with the gas used only when the solar heating cannot maintain the desired pool temperature on its own.

- The spas are occupied for an average of 200 hrs/yr, during which the pumps operate at full power

Under these assumptions, spa pools used about a fifth as much electricity as swimming pools, and about the same amount of gas.

The electricity consumption of indoor spa tubs is estimated by multiplying the stock (about 3 million) by the estimated average electricity use (about 33 kWh per year).

The estimate of total energy use in swimming pools and spa pools is surprisingly high – about 3.3% of residential sector electricity and 0.9% of natural gas (or 2.2% of the gas used for water heating). On this estimate, swimming pools and spa pools would as much electricity as dishwashers, clothes washers and clothes dryers combined (excluding the hot water use of the latter) (see NAEEEP 2004). About 76% of the electricity used (1,302 GWh out of 1,720) is for pumps, about 6% is for salt chlorination cells, 14% for electric heaters (mainly resistance, but some heat pump as well) and 4% for timers and controls.

It is estimated that home swimming pool and spa pool energy use accounts for about 1.85 million tonnes of CO₂-e emissions per annum.

Table 3 Estimated annual energy consumption and greenhouse gas emissions, Swimming pools and spa pools, Australia 2004

	Number	Pumping GWh	Salt cell GWh	Solar pump GWh	Timers GWh	Resistance heat GWh	Electricity GWh	Gas heat PJ
Swimming pools - unheated	610,000	1087	98		53		1238	
Solar heated	30,000	52	5	24	3		84	
Gas heated	10,000	17	2		1		20	0.6
Total, swimming pools	650,000	1157	104	24	57		1342	0.6
Spa pools - electric heating	70,000	37			6	158	201	
Spa pools - gas heating	70,000	37			6	35	79	0.6
Total, spa pools	140,000	75			12	193	280	0.6
Total, indoor spa tubs	3,000,000	47				52	99	
Total, all pools & spas	3,790,000	1278	104	24	69	245	1720	1.2
Total PJ							6.2	1.2
Total residential sector PJ							190.0	131.0
Share residential energy							3.3%	0.9%
Greenhouse gas emissions	Coeff	kt CO ₂ -e	kt CO ₂ -e	kt CO ₂ -e	kt CO ₂ -e	kt CO ₂ -e	kt CO ₂ -e	kt CO ₂ -e
Elec (kg CO ₂ -e/kWh)	1.036	1324	108	25	72	253	1783	
Gas (kg CO ₂ -e/GJ)	60				10			73

Water

Swimming pools and spa pools are significant consumers of water. Although swimming pools are rarely emptied completely, they are subject to water loss through evaporation and have to be topped up regularly in hot weather. Water is also lost to the drain during the filter cleaning and backwashing process. A 50,000 litre pool in Sydney may need 20,000 to 30,000 litres top-up in a typical year – in hotter areas, the full volume of the pool may be lost each year

Spa pools are much smaller and generally lose very little water to evaporation, either because they stand empty or, if they are left full, they are often covered to conserve heat. However, many are emptied and refilled on a regular basis: 20 annual fills of a 1,500 litre spa would use 30,000 litres.

Average Australian household water use is about 250,000 litres per year (GWA 2004), so the presence of a swimming pool or a regularly emptied spa would account for about 10-12% of this in the average household. (As only 12% of houses have pools or spas, however, their total contribution to residential water consumption is only about 1.2%).

Equipment Involved

Pumps and motors

The energy efficiency of a pool pump depends on the performance of two distinct components: the electric motor and the pump. A more efficient pump design will move more water for a given motor power, and the energy consumption of a pump will fall if a more efficient motor is substituted.

The standard AS2147:2001 *Rotodynamic pumps – Hydraulic performance acceptance tests* specifies hydraulic performance tests for acceptance of rotodynamic pumps (centrifugal, mixed flow and axial pumps). It is identical to ISO 9906:1999, and is applicable to pumps of any size. The major pool pump suppliers carry out flow rate performance tests on every pump manufactured (not just type tests), during which energy consumption is also often recorded.

The only other Australian/New Zealand standards covering pool pumps (as distinct from general electrical equipment) is AS/NZS 3136:2001 *Approval and test specification – electrical equipment for spa and swimming pools*, which covers safety, not performance.⁶

Most suppliers offer a number of different model ‘ranges’ or ‘series’, distinguished by features such as durability, quietness and of course price. Some suppliers nominate ‘energy-efficiency’ as a feature of some models ranges, but without providing information that would enable prospective buyers to readily assess or compare models.

It is possible to make a preliminary assessment of energy efficiency from the performance curves of flow rate (in litres per minute) against head (in metres of water column) which pool pump suppliers publish. Figure 2 plots the performance data for 29 pumps in the capacity range 0.5 kW to 2.3 kW. The data represent 7 different model ranges, from 3 different suppliers. As expected, the larger the motor power the higher the pumping volume, but the relationship is not constant, suggesting that there is significant efficiency variation.

The energy implications of the different efficiency levels are illustrated in Figure 3, which shows the energy that each pump would use to perform the seasonal pumping task in Table 2 (corresponding to an average 55,000 litres per day, or 1.1 turnovers of an average sized swimming pool). For the 5 models of 0.75 kW capacity, a popular size for smaller pools, the annual energy use would range from about 1,000 kWh to 1,600 kWh, costing between \$120 and \$190 per year if the energy is purchased at day rate (some utilities offer access to off-peak tariffs for pool pumps operated outside peak hours). A 0.75 kW swimming pool pump costs about \$600, so the energy cost over a 10 year operating life would be between twice and three times the capital cost.

⁶ Items of swimming pool and spa equipment are ‘declared articles’ under electrical safety regulations. Apart from AS/NZS 3136 they need to comply with AS/NZS 3100 *Approval and test specification – general requirements for electrical equipment* and AS/NZS 3350 *Safety of household and similar electrical equipment*.

Figure 2 Stated pumping output (at 8 metres head) for selected pool pumps

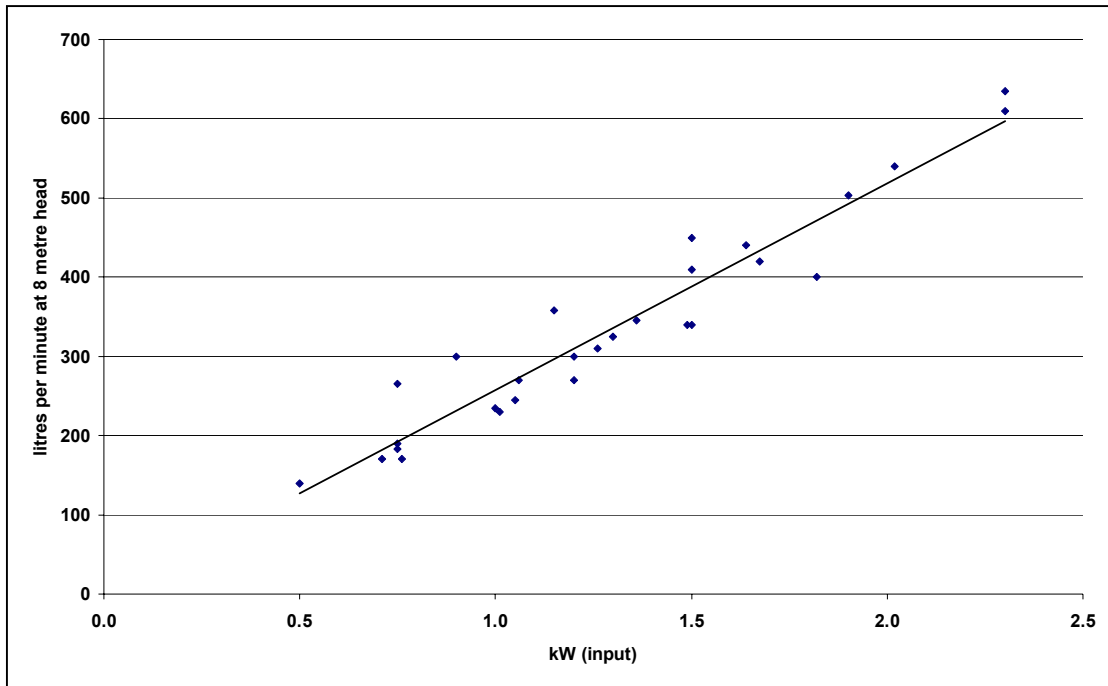
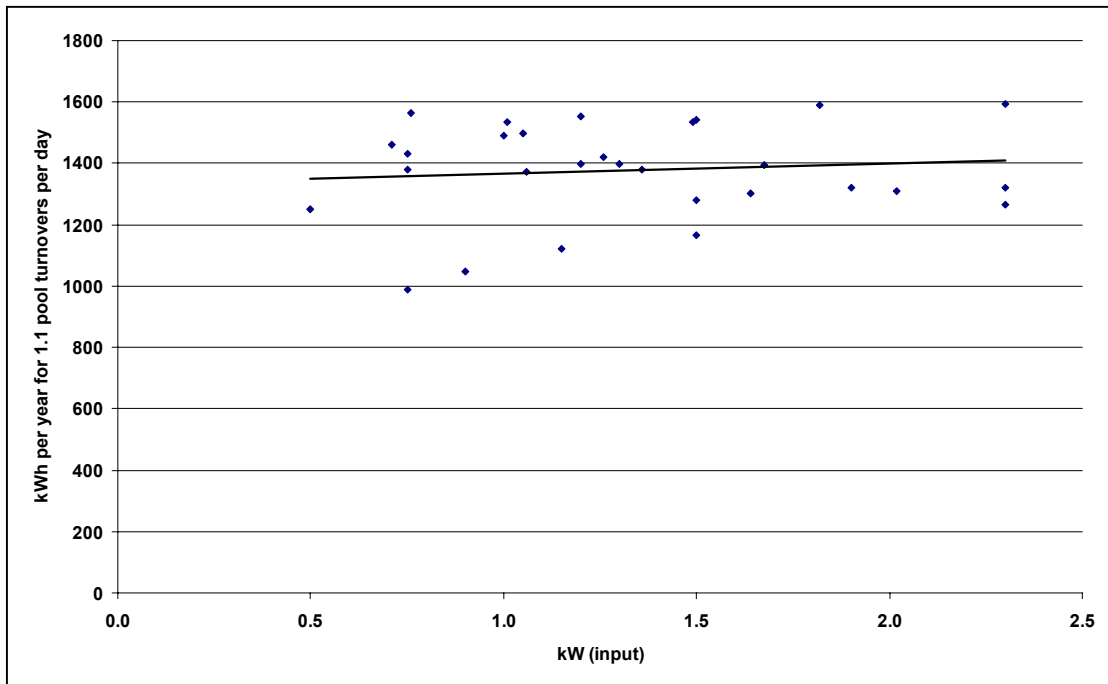


Figure 3 Calculated annual energy consumption for selected pool pumps (based on 55,000 litres pumped per day against 8 metre head)



The consumption range (600 kWh) is comparable to the entire annual energy use of a medium size household refrigerator. Selection of the most efficient pool pump rather than the least efficient could save a household as much energy as is used by the refrigerator: about \$70 annually, or \$700 over a typical 10 year operating life. Given efficiency differences of this magnitude, there may be a case for at least energy labelling, and perhaps MEPS for swimming pool pumps.

If the energy efficiency of the swimming pool pump stock in Australia could be increased by, say, 10% the potential energy saving would be about 130 GWh per year, or 0.47 PJ of delivered electricity, representing about 1.5 PJ of Fossil Fuel Primary Energy, or 180 kt CO₂-e per annum. This order of improvement appears quite realistic. Some pump suppliers publish input and output power for the electric motors in their pumps, and these indicate an efficiency range from as low as 47% up to 75%. By contrast, the Australian MEPS level for 0.75 kW three-phase motors is currently 74%, and is proposed to raise it to 78.8% from April 2006 (Syneca 2003).

As most domestic swimming pool pumps are single phase, they are not covered by Australia's electric motor MEPS, which only cover 3-phase motors. No APEC economies have MEPS or energy labelling for swimming pool pumps as such. Mexico has MEPS and labelling for centrifugal, deep well, submersible and vertical pumps. Several other economies have programs covering three-phase electric motors, and several have, or are considering, programs for single-phase motors as well.(Table 4)

Table 4 Status of Motors and Pumps MEPS and labelling, APEC economies

	Pumps		3-phase motors		Single-phase motors	
	MEPS	Labelling	MEPS	Labelling	MEPS	Labelling
Australia			M			
Canada			M	V		
Chile		U	U	U	U	U
China					U	V
Korea						V
Malaysia			U	U		
Mexico	M	M	M	V	M	V
Philippines					U	U
Singapore						V
Chinese Taipei			M			
Thailand					U	V
USA			M			
Vietnam						

Source: www.apec-esis.org September 2004. M = Mandatory, V = Voluntary, U = Under consideration

Pool and spa heaters

Solar heaters

Solar pool heaters on their own are only suitable for swimming pools, not spas, since they are not capable of rapid temperature rise, fine temperature control or year-round heating. The only energy-consuming parts of the system are the circulating pumps (usually separate from the main pool pump) and the timer/controller. The energy-efficiency is determined by the same design factors as other pool pumps: the motor efficiency and the pump design. Indeed, many solar heater pumps *are* pool pumps: most pump suppliers recommend the smallest pumps in their general model series as suitable for solar heaters. Thus energy efficiency programs targeting pool pumps would also cover solar pool heater pumps.

There are several Australian Standards dealing with the collectors of solar pool heaters: AS 3634:1989, *Solar heating systems for swimming pools*, AS 2369.1:1990, *Materials for solar collectors for swimming pool heating – rubber materials*, and AS 2369.2:1993, *Materials for solar collectors for swimming pool heating – flexible or plasticised polyvinyl chloride*.

While the performance of the solar collector array in combination with the controller affects the amount of useful solar heat added to the pool water, the consequences of poor system design or performance is likely to be a reduction in the period of the year that the pool temperature is comfortable for swimming, rather than an increase in the use of fossil fuel standby energy, as would be the case with a poorly performing household supply solar water heater. Therefore there is less of a case for an energy efficiency program for solar pool heaters than for domestic solar water heaters.

Gas heaters

Gas pool heaters are essentially very large capacity instantaneous water heaters, with input gas consumption of up to 500 MJ/hr, compared with about 150-180 MJ/hr for general purpose instantaneous gas water heaters at full load. Their safety and performance requirements are specified in AS4560:2004 *Gas Pool Heaters*, which supersedes AG110-1998 *Approval requirements for pool heaters*.

One of the requirements of AS4560 is that thermal efficiency “shall be not less than 70%”. As the standard is given mandatory force by State and Territory gas safety regulations, this effectively constitutes the Australian MEPS level. The only other country known to have MEPS for pool and spa heaters is the USA, which adopted a minimum thermal efficiency level of 78% in 1990.

Some models on the US market are significantly more efficient than the MEPS level. The California Energy Commission (CEC) publishes the thermal efficiencies over 300 gas pool and spa heater models. Figure 4 illustrates the efficiencies of the 250 or so models on the CEC register with input ratings up to 500 MJ/hr (the limit of the scope of AS4560). The efficiency range is 78.5 to 88.5%.⁷ A unit of 88.5% efficiency would use 20% less gas than a unit just meeting the AS4560 MEPS level (assuming the method of test is similar).

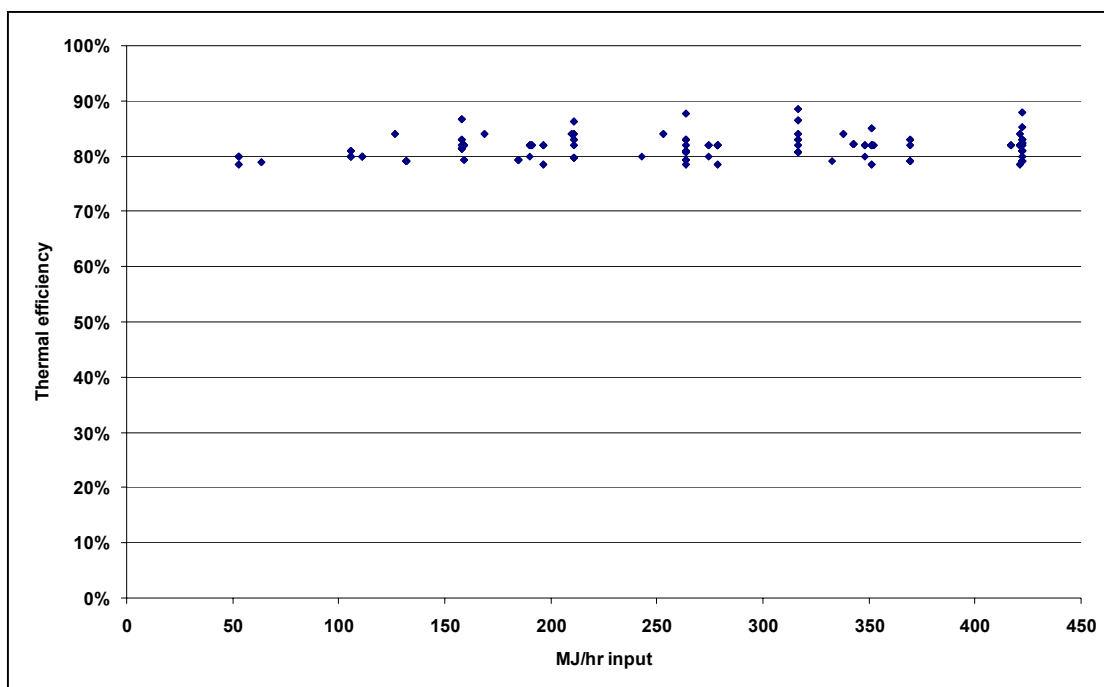
It is likely that the adoption of a higher MEPS level in Australia would increase the average efficiency of gas pool and spa heaters sold here, but the extent of the increase is uncertain. Some models are imported from the USA, and they already meet the higher US MEPS level rather than the levels in AS4560.⁸ However, most models sold here are locally manufactured, and if their efficiency is closer to the AS4560 MEPS level there may be significant scope for reducing gas consumption by adoption of the US MEPS level. The potential for including gas pool heaters in the gas energy labelling program is also worth investigating. A 10% reduction in gas use for pool and spa heating could save at least 0.1 PJ of gas annually, and more in future as spa pool numbers increase.

⁷ There are 6 models from the one manufacturer with efficiencies indicated of about 95%, but these seem anomalous.

⁸ The advertisements for these models state that their “efficiency is 17% greater than the Australian performance code requires”.

Some gas pool heaters are installed with separate circulating pumps to heat the pool water without the main pool pump operating (and so bypassing the filter). A general energy efficiency program covering pool pumps would be effective in these cases.

Figure 4 Thermal efficiency of gas pool heater models listed by California Energy Commission (up to 500 MJ/hr input)



Heat pump heaters

Heat pump pool heaters tend to have higher coefficients of performance (COPs) than air-to-water heat pumps designed for domestic water heating because the temperature rise required is relatively modest. They are the most energy-efficient way of heating pools for year round use. However, even at COPs of 5 or so they are no less greenhouse gas-intensive than gas pool heating.

There are only a few models of pool heat pumps available and annual sales are low, so even if an energy labelling program were developed to allow buyers to compare the COP of different models it would have only limited market impact.

Comparing modes of pool and spa heating

If there were an accepted common heating task for pools and spas, it might be possible to have a common energy labelling program covering all forms of pool heating. However, this is not the case. The heating task depends on the surface area of the pool as well as the volume, and is highly variable in terms of annual hours of heating and – for spas – the frequency of cold fills and the management of the thermal cover. Not all technologies are equally capable of meeting all heating tasks at all times of the year.

These complexities prevent a common labelling approach, so information about the comparative efficiency, running costs and greenhouse gas emissions of alternative modes of pool and spa heating is best given by means other than energy labelling – as is the case with information about the comparative efficiency, running costs and greenhouse gas emissions of alternative means of domestic water heating. There are already many sources of information on these matters, including the swimming pool and spa associations, energy suppliers, agencies and equipment suppliers, but the quality of information is uneven and much of it has a commercially interested bias.

Other pool equipment

Sanitising equipment

Sanitising equipment includes electrolytic cells for salt water pools, ozone generators and dispensers for liquid or solid chlorine compounds.

There is no information available about the comparative energy efficiency of different electrolytic cells. Suppliers publish the approximate power consumption when operating (about 150-200W) but it is not known how this varies from model to model, or whether there is significant energy consumption on standby.

Ozone (O₃) generators have also entered the market. They are particularly suitable for spa pools, where chlorine odours can build up under the thermal covers and in confined indoor spaces. Unlike free chlorine, ozone is considered toxic and must be removed from the water stream before it re-enters the pool. Ozone generators consume somewhat more power than electrolytic salt cells.

Further investigation is necessary to determine whether it is feasible or desirable to develop energy-efficiency measures for electrolytic and ozone cells. They are a lower order of priority than pool pumps, however, since they use about a sixth as much energy during normal pool operation.

Controllers

Swimming pool pumps and sanitising equipment are generally operated by simple time clocks. The energy consumption of time clocks is about 10W continuous, and amounts to a significant standby loss which should be addressed by the NAEEEP's standby strategy.

Solar pool heaters are generally operated by intelligent controllers rather than simple time clocks. The controller must integrate information about the pool temperature, the desired temperature and the temperature of the solar collectors, so it can determine the optimum combination of pump operation and valve settings. Thus the intelligence and capability of the controller has a far greater effect on overall pool energy consumption than does its own energy use, which is likely to be less than 5W.

This may well become the case with pool pump control as well. Pool suppliers recommend simple seasonal rules for run times, and most pool owners are happy to follow these. If pool motors become more energy-efficient, they will use less energy during the same run time. However, if the efficiency gain comes via the pump design,

the unit will use the same amount of energy but move more water. Thus the full potential of measures to increase the energy efficiency of pool pumps will not be realised unless run times are adjusted – otherwise much of the benefit will be taken up as increased (and unnecessary) water flow.

This adjustment can take place in two ways:

- More detailed advice from pump suppliers about the run times required for different models (ie lower run times for more energy-efficient pumps); or
- More automated control of run times.

At the very least, an intelligent pump controller could adjust run times according to a seasonal schedule of daily turnovers (eg 2 in summer, 1.5 in spring/autumn, 1 in winter), monitor water flows and adjust each pumping session to achieve the target turnover. This may mean that operating sessions become longer as the filter load increases, and shorter immediately after cleaning (the controller can also indicate the need for cleaning more precisely than the current practice, which relies on visual assessments and a pressure gauge). The process could become even more automated if the controller directly monitors the chlorine levels and other aspects of water quality.

The potential of intelligent pool controllers to save energy in the operation of pool equipment could be indicated by the availability to suppliers of a voluntary label, such as the Top Energy Saver Award Winner (TESAW).

The Market

Ownership and Purchase

Most new pool owners order their pools from specialist pool constructors, who will recommend an equipment package of filters, pool pumps and sanitising systems and perhaps heating from a supplier or suppliers with which they have commercial arrangements. The great majority of the contract value will be in the pool construction, fencing and landscaping, and energy use and efficiency is likely to be of limited concern to the buyer (expect with respect to the choice of a solar water heater if heating is to be installed).

After the pool is installed the equipment will have to be replaced from time to time. Pool pump motors last about 10 years at normal use. When they need to be replaced the cheapest option may be a rewind motor, although as the cost of small electric motors declines the option of a new motor is becoming cost-competitive. Pump components such as bearings and seals may also need replacement, but it is comparatively unusual to replace an entire pump body.

Each new pump installation and each motor replacement represents an opportunity to select a more energy-efficient option in preference to a less efficient one. Replacements are more frequent than new installations – if 10% of Australia's 650,000 or so pools needs a new motor each year, the annual market would be 65,000 replacement motors compared with 20,000 new installations. With spa pools included, the total Australian 'leisure pump' market is about 150,000 unit per annum.

For spas, the lifetime energy efficiency potential of the unit is pretty well determined at the time of purchase, since run times are so much lower than for pool equipment that the same motors and pumps are likely to remain in use for the entire service life. As discussed, the actual energy consumption is likely to be determined far more by usage patterns than by the characteristics of the equipment itself.

Suppliers and Associations

There is no single industry association representing the Australian swimming pool and spa industry. There are independent Swimming Pool and Spa Associations in Queensland, NSW, Victoria and WA. The associations represent the interests of pool and spa constructors as well as equipment suppliers. They tend to work together on national and regulatory issues, although their technical resources are limited.

There are several brands of swimming pool pumps including Aquaswim, Aquaquip, Davey, Hurlcon, Monarch, Onga, Poolrite, Speck, Sta-Rite, Stroud and Waterco. The six largest suppliers account for over 80% of pump sales. Some suppliers manufacture both motors and pumps locally (about 40% of all sales), some import the entire assemblies (about 25%) and the rest fit local motors to imported pumps or vice versa.

There are several solar pool heater suppliers. Some of the pump suppliers also sell and install solar heating packages including collectors, pumps and controllers and there are also several solar specialists (eg Zane). Gas pool and spa heater suppliers including Bosch, Hurlcon, Raypak and Waterco.

The spa market is the most diverse, with dozens of brands offering hundreds of models between them. Most companies build the tubs themselves, but source motors, filters and controllers from other suppliers.

Energy Efficiency Measure Options

A number of the measures within the National Appliance and Equipment Energy Efficiency Program could be successfully applied to swimming pool and spa equipment.

Based on the estimated energy use, any measures should target the following in order of priority:

1. Pumps and pump motors for swimming pools, spas and solar water heating systems;
2. Gas-fired pool and spa heaters; and
3. Time clocks and controllers.

It would be feasible to develop specific measures targeting the design and selection of each of these product groups, as well as wider strategies covering the selection of entire systems.

Measures targeting pumps and pump motors

It is feasible to develop measures that address the energy efficiency of motors only, or of entire motor-pump assemblies. A small proportion of swimming pool pumps are already affected by MEPS for three-phase electric motors, but most are unaffected because

1. the motor is single phase, or
2. if the motor is three-phase, it is exempt from MEPS because the pump is locally manufactured as a combined assembly (where the motor is not separable from the pump), or exempt because it is imported as a built up motor-pump unit (ie 'original equipment').

These exemptions could be addressed through measures that target all single-phase motors of the capacity commonly used in pool equipment (eg 0.4 to 2.4 kW), measures which target all motors used in pool equipment assemblies, but only when used in those assemblies, or measures that target the performance of the entire pump.

It may be possible to develop MEPS for all single-phase motors supplied in Australia of, say, 0.4 kW and above, analogous to the MEPS program for 3-phase motors. This would catch practically all swimming pool pumps. However, it would also catch a large range of other equipment, much of which will be used less intensively than pool pump motors, and for which it may be difficult to demonstrate that the benefits outweigh the costs. It may also require a large number of exemptions for specialised applications, which will make administration and enforcement more difficult and costly. Conversely, one great advantage is that it would catch new replacement motors as well as the original motors, since no motor below the MEPS level could be supplied in Australia.

A more narrow targeting is to set MEPS levels only for motors *where used in swimming pool pumps*, with no exemptions for imported motor-pump units. However, this does

not address differences in the efficiency of pump designs, or the argument that there should be exemption where the motor is not separable from the pump, and so cannot be check-tested on its own using a standard test method. It also does not prevent the later replacement of the original motor with a less efficient one.

The most precise targeting would be to set MEPS levels for entire pump assembly. This would give suppliers more flexibility, since they could meet the minimum performance criteria through different combinations of motor efficiency and pump design. It would also avoid the need for an exemption where the motor is not separable from the pump. In cases where the motor *is* separable, however, there would be nothing to prevent the later replacement of the original motor with a less efficient one.

All of the above measures would require the development of new AS (or AS/NZS) test standards. The single-phase motor efficiency test could be modelled on AS/NZS 1359, which specifies the tests for three-phase motors, or based on an overseas standard (eg JIS C 4203:2001: *Single phase induction motors for general purposes*). There are also several precedents for pumps standards, although it would be necessary to establish the appropriate pumping task (in meters head) on which the MEPS level would be based - some models perform better at high or low pressures than others.

Once a test standard is available, there would also be other options in addition to, or as alternatives to MEPS:

- Mandatory comparative star labelling for pool pumps (entire assembly);
- TESAW labelling for pool pumps (entire assembly);
- Mandatory comparative labelling for pool pump motors only; or
- TESAW labelling for pool pump motors only.

Measures targeting gas heaters

Gas-fired pool and spa heaters are already part of the gas appliance energy efficiency program. There is a standard (AS4560) with a MEPS level, which appears to be less stringent than the US MEPS levels for the same products. The following issues should be addressed:

- Would it be cost-effective to align the MEPS levels in AS4560 with the US MEPS levels?
- Would it be cost-effective to implement mandatory star rating labelling for gas pool and spa heaters, similar to the program in place for domestic gas water heaters? If so, what should be the rating algorithms?
- Should Top Energy Saver Award Winner (TESAW) labelling be made available to gas pool and spa heaters, and if so what should be the TESAW level?

- Should the standby electricity consumption of gas pool and spa heaters be included in the NAEEEP standby program, as is the case with domestic gas instantaneous water heaters?

Measures targeting time clocks and controllers

Most of the direct energy use of pool pump timeclocks and controllers occurs when the equipment they control (pool pumps, solar heater pumps) is not actually operating. Therefore it would be appropriate to include this equipment in the NAEEEP standby energy strategy.

In addition, some controllers have capabilities which allow the equipment they control to operate in a more energy-efficient manner. It would be useful for buyers to be able to identify these through a special label, such as TESA W, the criteria for which would be the presence of particular capabilities rather than direct energy use.

Pool Energy and Water Rating Scheme (PEWRS)

The overall energy and water consumption of a swimming pool or spa depends not just on the efficiency of individual items of equipment but on the overall design, the selection and integration of all equipment and how the pool or spa is managed.

A Pool Energy and Water Rating Scheme (PEWRS) could give potential pool and spa owners an indication of the energy and water consumption, based on input data about the design, the equipment, the location and the proposed pattern of use. It would be analogous to the Home Energy Rating Schemes (HERS). Indeed, as dwellings become more energy-efficient, the quantity of primary energy used by a pool may approach and even exceed the primary energy used for heating and cooling the home. Similarly, as indoor water use become more efficient the pool or spa could become the largest single water user.

A PEWRS rating would be most useful at the time of intended pool construction or spa purchase, so that the prospective buyer can appreciate the energy and water consequences of alternatives and make decisions that lead to greater resource efficiency. It would also be useful whenever equipment needs to be replaced or the installation of new systems such as pool heating is contemplated. PEWRS could also demonstrate the energy consumption associated with alternative patterns of pool and spa management (eg the use of pool covers, or keeping spas filled vs emptied after each use).

For established homes with a pool, a PEWRS report could give prospective buyers valuable information to take into account in considering the purchase, along with – or as a component of – the HERS report.

This approach is consistent with other household water efficiency initiatives such as Water Efficiency Labelling, and so could be jointly developed with the Department of the Environment and Heritage.

Recommendations

The further consideration and development of the measures proposed in the preceding section will require a co-operative effort by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC), pool and spa constructors, equipment manufacturers and other stakeholders.

There are several potential measures and approaches, some mutually exclusive but mostly mutually reinforcing (Table 5). They extend across a number of products, types of measures and even energy forms (electric, gas and solar). The further investigation and development of the measures would require further data collection and industry discussions in the short term, and possibly the development of new Australian Standards or the amendment of existing standards in the medium term. The most efficient way to proceed may be via a Swimming Pool and Spa Strategy, which sets out a timetable for investigations, milestones and decision points.

If any regulatory actions were contemplated, it would be necessary to prepare Regulation Impact Statements and to formally consult with stakeholders on the proposals.

Table 5 Measures recommended for investigation

Measure	Pool & solar heater pumps		Gas pool & spa heaters	Controllers
	Pump motors	Motor-pump assemblies		
Minimum Energy Performance Standards	X	X	X	
Mandatory labelling	X	X	X	
Voluntary labelling	X	X	X	X
Standby			X	X
Pool Energy and Water Rating Scheme	X	X	X	X

References

ABS (2001) *Environmental Issues: People's Views and Practices* ABS 4602.0, March 2001

ABS (2003) *Domestic Water Use Survey Western Australia*, ABS 4616.5.55.001, October 2003

AS2147:2001 *Rotodynamic pumps – Hydraulic performance acceptance tests*

AS2369.1:1990, *Materials for solar collectors for swimming pool heating – rubber materials*

AS2369.2:1993, *Materials for solar collectors for swimming pool heating – flexible or plasticised polyvinyl chloride.*

AS3634:1989, *Solar heating systems for swimming pools*

AS4560:2004 *Gas Pool Heaters*

AS/NZS 3136:2001 *Approval and test specification – electrical equipment for spa and swimming pools*

GWA (2004) *Regulation Impact Statement: Proposed National System of Mandatory Water Efficiency Labelling for Selected Products*, George Wilkenfeld and Associates for the Department of the Environment and Heritage, Australia, May 2004

NAEEEP (1999) *National Appliance and Equipment Energy Efficiency Program*

NAEEEP (2002) *National Appliance and Equipment Energy Efficiency Program (NAEEEP) Work plan and policies for 2002 to 2004*, April 2002

NAEEEP (2004) *National Appliance and Equipment Energy Efficiency Program (NAEEEP) - Coverage of the Residential, Commercial and Manufacturing Sectors*, George Wilkenfeld and Associates for the Australian Greenhouse Office, August 2004

Syneca (2003) *Minimum Energy Performance Standards for Electric Motors: Regulatory Impact Statement (Draft)* Syneca Consulting for the Australian Greenhouse Office, December 2003