Decision Regulation Impact Statement: Swimming pool pumps

Proposed Energy Labelling and Minimum Energy Performance Standards

Date: September 2018

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Executive summary

On 4 December 2015, the Council of Australian Governments (COAG) Energy Council committed to a new Equipment Energy Efficiency (E3) prioritisation plan. The 2015-16 plan identified six priority areas: lighting, non-domestic fans, swimming pool pumps, refrigerated storage and display cabinets, air conditioners and domestic refrigerators.

Pool pumps are not regulated for energy efficiency. Since 2010 the Equipment Energy Efficiency (E3) program has administered the Voluntary Energy Rating Labelling Program (VERLP) for swimming pool pumps. The VERLP was intended as a transitional step to mandatory labelling or MEPS requirements, which were expected in 2012.

E3 has consulted extensively with pool pump suppliers to determine the costs and benefits of introducing energy efficiency regulations for pool pumps. The electricity costs of running a pool pump can be around 18 per cent of the energy bills for households. These costs are unnecessarily high because people continue to buy, install and use pool pumps that are not the most energy efficient on the market.

Market failures and consumer behaviour in the pool pump market act to constrain the uptake of energy efficient pool pumps and impose higher than necessary costs on consumers and society more broadly. These barriers and behaviours are preventing the pool pump market from moving naturally to more efficient technologies and are contributing to unnecessarily high externality costs from greenhouse gas emissions and peak loads on electricity distribution networks.

Regulations are proposed to resolve these market failures and increase the uptake of energy efficient pool pumps on a national scale. New regulations would require minimum energy performance standards (MEPS) and mandatory labelling under the *Greenhouse and Energy Minimum Standards Act 2012*.

Five scenarios were considered: business as usual (BAU), mandatory labelling, and low, medium and high level MEPS with mandatory labelling. Under BAU there would be no regulations and the natural shift from single speed pumps to variable speed pumps is expected to be around 9 per cent to 2030. The introduction of labelling is expected to remove around 13 per cent of the least efficient pool pumps from the market. The combination of MEPS and labelling would achieve greater savings by removing more of the lower efficiency single speed pumps from the market. A low level MEPS would remove an estimated 37 per cent of the least efficient pool pumps from the market and a medium level MEPS is expected to remove an estimated 50 per cent of the least efficient pool pumps. At the top end, a high level MEPS is expected to remove around 60 per cent of the least efficient and all single speed pool pumps from the market by 2030. This high level MEPS policy option is not recommended, because single speed pumps are needed in the market for specific purposes, such as booster cleaning and solar thermal heating, and single speed pumps

may be fitted with variable frequency drives to provide comparable benefits to variable speed pumps.

A medium level MEPS would likely provide the greatest benefits compared with the costs to the market. E3 proposes a step change transition to MEPS, which would allow time for the industry to adapt to the new regulation and redesign pool pumps that do not meet MEPS. Therefore, it is recommended that a low level MEPS be introduced initially and raised to a medium level MEPS after a review of the effect of mandatory labelling and low level MEPS on the market.

Energy rating labels (ERL) provide benefits when applied with MEPS. Labelling pool pumps would improve the energy efficiency information available and allow consumers to compare products on a clear and consistent basis. It is recommended that ERLs be placed on either the product, if displayed in store, or on the packaging at the point of sale. Displaying an ERL or star rating and pump curves in brochures and online would be voluntary. Most consumers search for products online before purchasing in store and online labelling, showing stars to represent the energy efficiency of a product, would ensure energy efficiency is considered during the buying process.

The method of calculating the star rating for an ERL needs to be revised. The existing star rating index in the Australian standard gives every pool pump, regardless of wattage size, the same baseline, which makes smaller pumps appear to be more efficient than larger pumps. To more fairly measure pool pump energy efficiency E3 recommends that a MEPS level be applied, which factors in pump wattage size.

Changes are also recommended to the pool pump energy performance test standard. A Technical Working Group considered issues raised through the consultation process and suggested changes, including to the method of test and test rig setup to improve the robustness, reliability and repeatability of test results. E3 will work with Standards Australia, through its Energy Efficiency for Swimming Pool Pumps committee, to update the technical standards.

E3 recommends that a low level MEPS begin in early 2020 or 12 months after Australian standard AS 5102.1 is revised, whichever date is later. E3 also recommends that a medium level MEPS take effect in January 2022 following a review of the effect of the introduction of mandatory labelling and low level MEPS on the market.

E3 would consult with industry and other stakeholders on information that would help pool pump suppliers to comply with the new regulations. Information about proposed changes to regulation and product registration would be developed for pool manufacturers, installers, maintenance professionals, retailers and consumers.

Recommendations

1. Apply a low level MEPS and mandatory labelling to pool pumps and then move to a medium level MEPS at a later date. Introduce the low level MEPS and labelling to take effect the later of either 12 months after the test standard amendments have been finalised through Standards Australia or from 1 January 2020. Transition to a medium level MEPS in January 2022 after a review of the effect of low level MEPS on the market.
2. Update Australian Standard AS 5102.1–2009, Performance of household electrical appliances – Swimming pool pump-units, Part 1: Energy consumption and performance, to reflect the change to the:
   - method of test, to use a weighted energy factor
   - scope of pool pumps captured by the regulation
   - definition of pump classifications of single, two, multi and variable speed pumps
   - technical amendments to improve the robustness, reliability and repeatability of the test.
3. Introduce a curved line star rating with higher requirements for smaller pumps and lower requirements for larger pumps to ensure that pool pumps of all wattage sizes are rated fairly.
4. Apply minimum energy performance standards, that factor in pump input watts or amperes size, and mandatory labelling to pool pumps within the following scope.

	Input power range between:				
	Watts	Amps		Watts	Amps
Single speed	600	2.6	and	1700	7.4
Two speed	600	2.6	and	3450	15
Multi speed	600	2.6	and	3450	15
Variable speed	600	2.6	and	3450	15

5. Update the pool pump energy rating label following public consultation by E3.
6. Require the display of energy rating labels on either the product, if displayed in store, or on the packaging at the point of sale. Suppliers could voluntarily display the energy rating label or the star rating and pump curves in brochures and online.

1.1 Overview of the pool industry

The Australian pool pump market is part of a large and dynamic pool, spa and pool equipment industry. Major segments in the industry include manufacturers, builders and installers, and retail outlets.

There are five large manufacturers that supply the majority of the pool pumps to the Australian market. These are AstralPool[1], Davey, Hayward, Pentair and Waterco. All companies supply a full range of pump wattage sizes, types and technologies. In addition to the large manufacturers, 13 small and medium sized pool and spa pump manufacturers and wholesalers are active in the Australian market and five of these manufacturers sell international brands.

There are also specialist pool and spa retail shops that supply the Australian market. There are 1,053 swimming pool and spa equipment stores including, pools and spas, pool equipment and accessories, pool toys and leisure products, and chemicals. Of these, 13 per cent supply pool equipment and accessories and 37 per cent supply pools and spas. That is, up to 527 stores could supply pool pumps.

Pool and spa stores typically sell packages that include a pool, pump and cleaning accessories. Whereas, pool equipment and accessory stores sell products ranging from covers to pumps and vacuums. There has been annual revenue growth in this industry sector of 2.5 per cent over the last five years. However, IBISWorld forecasts this growth to slow to an average of 1.3 per cent over the next five years to 2023.[2]

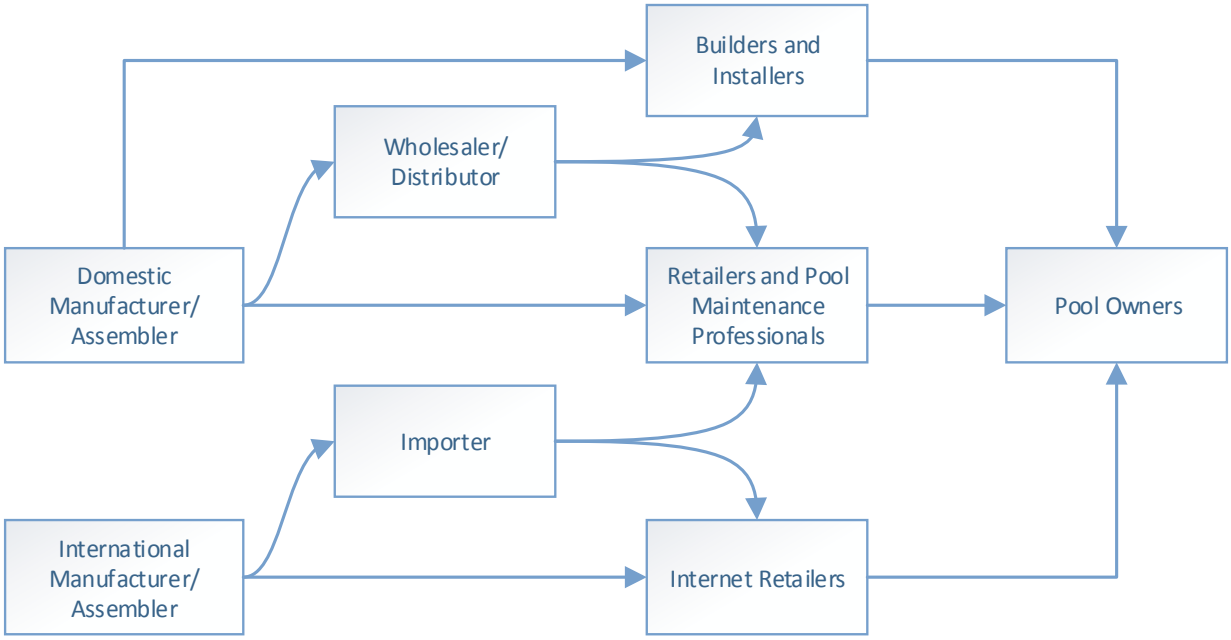
The Australian swimming pool and spa pump industry has become increasingly globalised since the early 2000s.[3] This has resulted in:

- a shift to domestic assembly of imported pool pump components (motors and pumps) by some pool pump manufacturers, wholesalers and suppliers
- some consolidation amongst Australian pool pump manufacturers and suppliers.

Pool pump and pool equipment manufacturers often have close links with industry partners. Figure 1.1 shows the supply chain relationship between pool manufacturers and installers, pool maintenance and equipment suppliers, and pool equipment distributors and wholesalers. A national survey of pool owners found that many pool industry professionals have set arrangements with manufacturers (volume deals, incentive packages), demonstrating the strong, commercial links and relationships between pool pump and pool equipment manufacturers and other industry segments.[4] The importance of these business and market relationships was also reported by Winton in 2009.[5]

Pool equipment, including pool pumps, are also available over the internet from domestic and international suppliers. However, internet sales do not account for a significant share of the pool pump market. Refer to section 1.5.

Figure 1.1: Pool pump industry and market from production to consumers



1.2 Swimming pool pumps

The purpose of a pool pump is to circulate the entire body of water in a pool at least once a day to maintain sanitation and clarity of the pool or spa water. To do this, the pool pump moves water through a filter and ensures adequate chemical dosing through a chlorinator or other sanitising system. The filter removes dirt, leaves, hair, insects and other debris. The chlorinator or other sanitising technology adds disinfectants, oxidisers and algaecides to keep the water clean and safe for human use. The pool pump can also be used to circulate water through a pool's heating system. [6]

The pool pump's task includes both filtering and cleaning applications. Filtering is the primary task of the pool pump and a filtering time needs to be selected to ensure adequate water turnover (that is, the complete turnover of the pool's water volume). The cleaning function requires high speed pump operation for a small period of time to flush the filter.[7] Pumps can also power pool cleaning equipment, such as a manual vacuum or automatic cleaning system. The pump requirements can vary from short bursts of high speed pumping for a manual clear, to extended periods of high or medium speed for automatic cleaning systems.

Pool pumps are available in single, two, multi and variable speed models. This RIS defines a single speed pump as a pump that can only be operated on one speed. The higher efficiency multi speed pumps are available in two, three or four fixed speeds and can be operated on higher and lower speeds. A variable speed pump, in contrast, has multiple speeds that can be reprogrammed.

The more energy efficient two, multi and variable speed pumps were first introduced to the Australian market in the mid-2000s. Energy efficient pumps started to become widely available from 2010 onwards. Several things came together to support this change in the market, including:

- development of an Australian test method and star rating system for pool pumps
- establishment of the Voluntary Energy Rating Labelling Program for Swimming Pool Pumps (VERLP)
- two Queensland energy utilities supporting the adoption of energy efficient pool pumps with rebate programs.

1.3 Operating time and efficiency

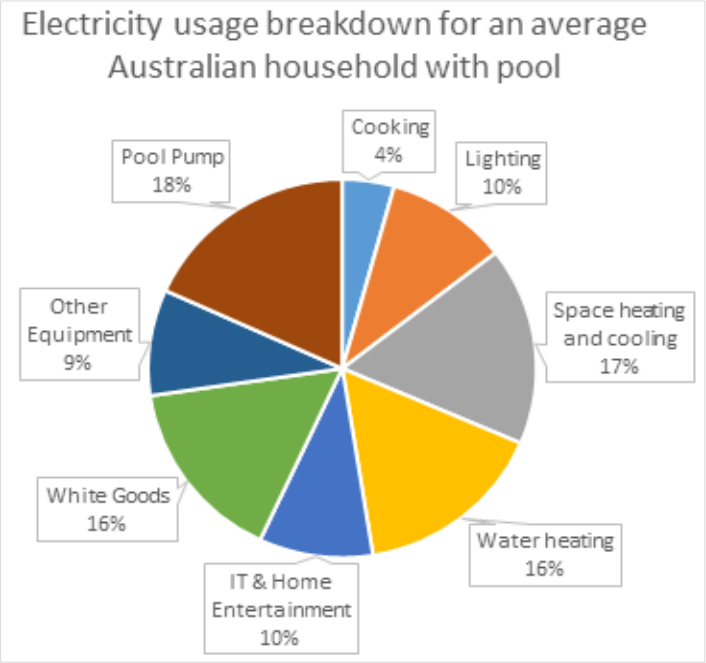
Single speed pool pumps are less efficient than pool pumps with more than one speed. Substantial energy and costs savings can be achieved by operating a pool pump at the lowest speed needed to meet its filtering requirement, even though the pump needs to run for a longer time at this reduced speed to move the total volume of water.

By operating at lower flow rates, the overall flow resistance is reduced, which results in substantial energy and cost savings. This phenomenon is described by the pump affinity laws. For example, where a pump rotor speed reduces by one-half of maximum speed, the electrical power demanded by the motor is reduced to one-eighth of its maximum. In turn, the flow through the pump would be reduced by one half, requiring the pump to run twice as long to meet the filtration task. The total power used would be only one quarter of the energy needed to move the same quantity of water at full speed.

The problem with single speed pumps is that they operate at a constant speed, which must be powerful enough to meet high speed flow requirements. They cannot drop to a more efficient operating speed for filtration. For this reason, single speed pumps are significantly less efficient, in terms of energy use, than two, multi and variable speed pool pumps.

In Australia, pool pump operation can comprise 18 per cent of the electricity bill[8] for households with swimming pools (Figure 1.2), which means that consumers can get big savings on electricity by choosing a more efficient pump. At least one in nine households have a swimming pool and the prevalence of single speed pumps (around 70 per cent of sales) means that there are large gains possible across Australia, if pool owners install more efficient pumps on their pools. However, there is a risk that pool pumps with more than one speed may not be operated efficiently. That is, the pump may be operated on high speed for longer than necessary and potential energy efficiency savings may be reduced or lost. This problem was highlighted in a national pool owner survey in 2016[9] that found around one in five respondents operate their pumps without timers, despite the Building Code of Australia requirement to install a timer on pool pumps.

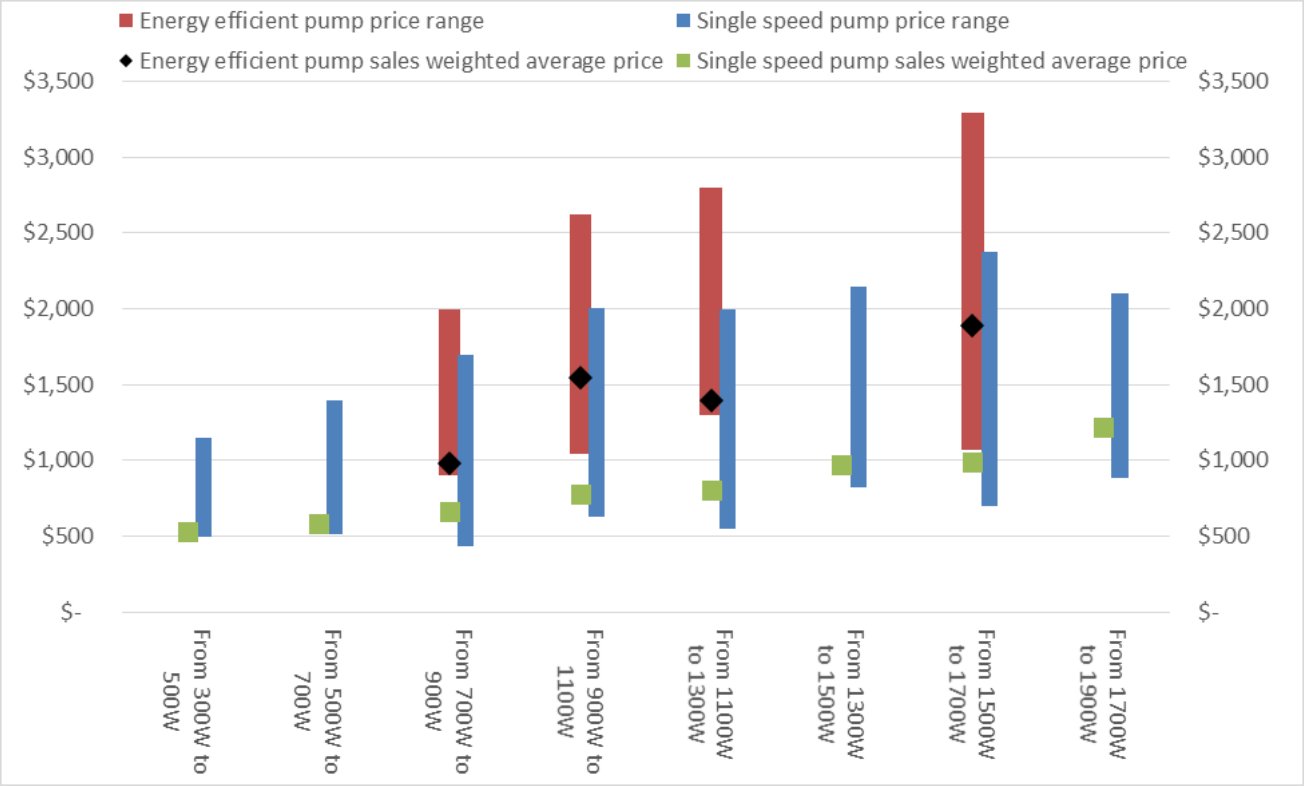
Figure 1.2: Average electricity consumption for a household with a pool (E3 analysis)



For pool pumps, modelling by E3 has shown two distinct price bands around single speed and variable speed pumps. Figure 1.3 plots pool pump prices[10] by type of pump and energy efficiency using star rating levels determined according to Australian standard AS 5102.2.

- In the first price band, over 50 per cent of pumps sold in Australia cost over $800, with varying efficiency and wattage levels between 1.5 and 8 stars.
- The second price band, which clusters around energy efficient two, multi and variable speed pumps, is for pumps over $1,500 with high star rating levels and a maximum price of $3,500.

Figure 1.3: Retail price range in each wattage range[11] by pump type



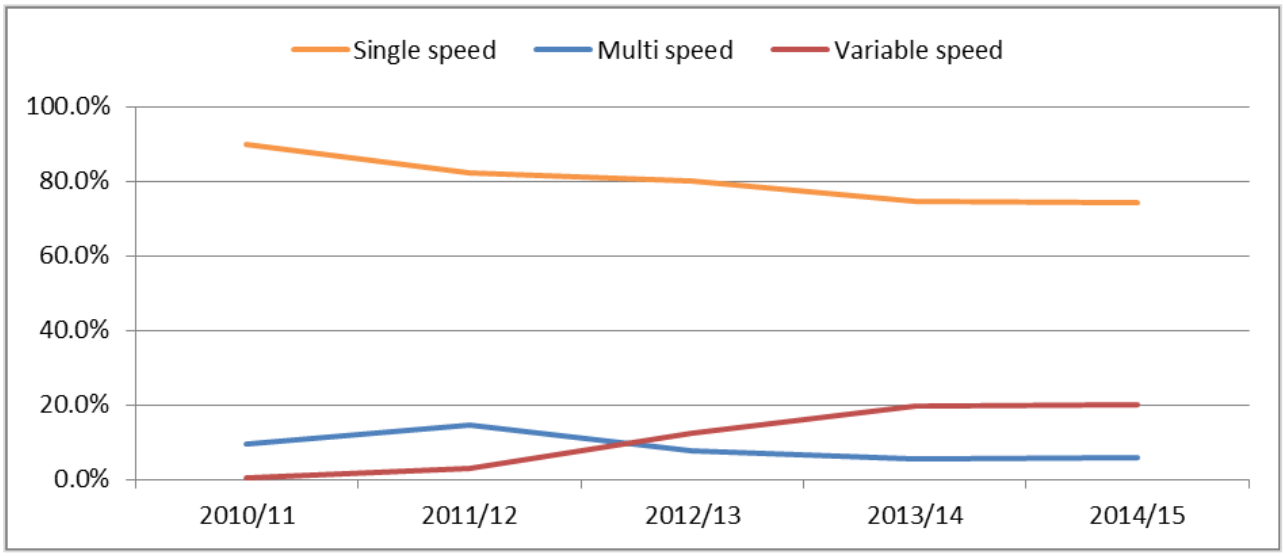
1.4 Stock and sales of pool pumps

There are approximately 1.1 million residential pools in Australia. There are, on average, 1.5 pumps for each swimming pool or spa and E3 estimates that the stock of pool pumps is growing by approximately 1.5 per cent per year. This means that by 2030 the total number of pool pumps in operation could be around 2.2 million.

Pool pumps are usually bought at the time a pool is installed or as a replacement when a pump fails. A new pool is often sold as a package comprising the pool build, pump, filtration system, water features and other equipment. The replacement market is driven by pump failure at the end of a pump's useful life. While there is some variation, E3's assessment is the average life expectancy of pool pumps sold in Australia is about 7 years. (See Appendix A, Modelling assumptions and sensitivities, for details.)

The sale of two, multi and variable speed pool pump stock has fluctuated. There was initial strong growth in the sales of these types of pool pumps in 2010-11, which then tapered off, with both single speed and the higher energy efficiency pumps continuing to show growth of around 1 per cent per annum (see Figure 1.4).

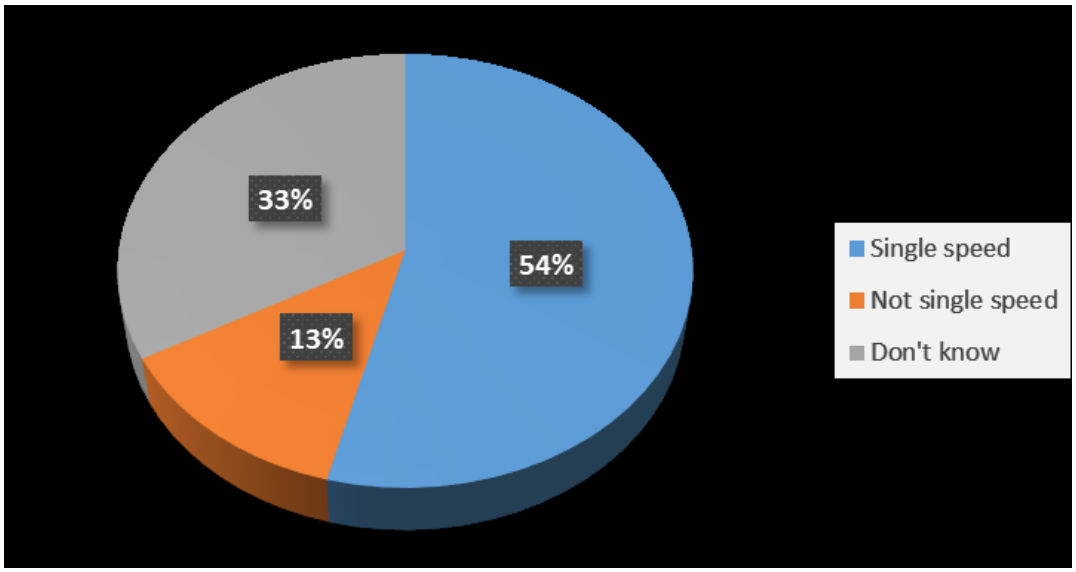
Figure 1.4: Percentage of pool pump sales by technology type



Note: multi speed pumps include two, three and four fixed speed pumps.

Sales data from major manufacturers show that energy efficient pumps (two, multi or variable speed pumps) made up approximately 30 per cent of total sales in the Australian market over the five years to 2014-15. Over this period, the majority of sales (70 per cent) were single speed pumps. This is supported by data from the national pool survey in 2016, with some 54 per cent of respondents across Australia reporting they own single speed pumps, while a further 34 per cent did not know the type of pump they own (Figure 1.5).[12]

Figure 1.5: Type of pump by speed[13]



National sales data and the results from the national survey of pool and spa owners indicate that energy efficient pumps comprise around 30 per cent of pool pump sales and this proportion is not growing as a share of national pool pump sales. Early growth in sales of energy efficient pumps between 2011 and 2013 has tapered off.

There is some unevenness in the distribution or take up of variable speed pumps. Queensland consumers appear to be more receptive and have a greater uptake of variable speed pumps, compared with consumers in other states.

Evaluation by E3 of the Queensland pool industry and the Queensland rebate programs indicate that there has been a shift in the state's energy efficient pump market near to saturation point. Given energy efficient pumps comprise around 30 per cent of pool pump sales, this would mean that the sales of energy efficient pumps in other parts of the country may be below the level to be expected in an efficient market. The data implies that a strong market intervention may be needed to achieve efficient rates of sales of energy efficient pumps.

A small increase in variable speed pump sales is projected to 2030, without any intervention in the market. Single speed pumps comprised approximately 70 per cent of pumps sold in 2015. Manufacturers project the market share of single speed pumps to decline gradually to 60 per cent of total pump sales by 2030.

1.5 Internet sales and markets

There is no sales data and limited price information available for the internet sales of pool pumps. A review of internet prices for swimming pool pumps by E3 showed that the majority on offer are priced significantly below retail prices in Australia at specialist pool retail outlets, and that most are single speed pumps of various sizes and power.

A national survey in 2016[14] showed that about 10 per cent of respondents from Australia were buying their pool pumps online. In contrast, almost 80 per cent of people reported that they buy their pumps from a specialist pool shop or from a pool maintenance professional. Major manufacturers also report that they do not see internet sales as a major feature of the Australian market.

Pool pumps are also sold by large, diversified retailers, such as Bunnings and ALDI, but the pool industry reports that these outlets are not a major pathway for sales. This is supported by the national survey in 2016, where approximately 4 per cent of respondents in Australia reported having bought their pool pump at a diversified retailer.

1.6 Voluntary labelling program

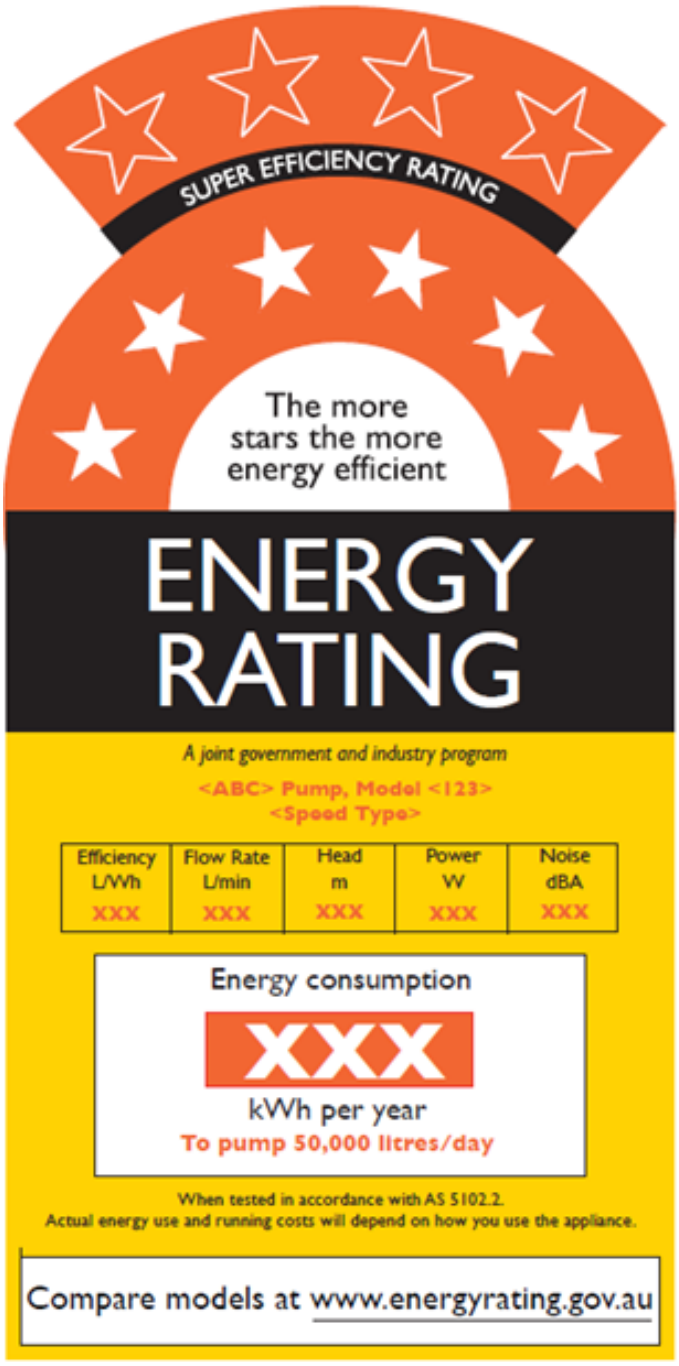
Pool pumps are not regulated for energy efficiency. Instead, the E3 Program administers the VERLP, which enables manufacturers and suppliers of pumps to register their products and display an energy rating label (ERL).

The VERLP began in April 2010 and is administered by the Department of the Environment and Energy (DEE) for the E3 Program. It was intended as a transitional step prior to consideration of mandatory labelling or MEPS requirements, which were expected to come into force in 2012. The VERLP at this time was seen as a means to:

- establish an independent and credible energy rating label scheme for pool pumps

- use the government backed star label (Figure 1.6) to promote the uptake of energy efficient pumps by providing comparative information to consumers on the relative energy efficiency of pumps being sold in Australia
- introduce a new testing method (AS 5102) for pool pumps
- obtain detailed market and performance information, through the registration process, which would assist in the development of MEPS for pool pumps.

Figure 1.6: The VERLP energy rating label[15]



Benefits of the program

Although the VERLP has been in existence for eight years, the benefits of the program are limited.

- Industry players with more energy efficient pumps register them under the VERLP and use the label to promote their products.
- The rebate and pool pump subsidy programs operated by Queensland energy companies Ergon and Energex used registration under the VERLP as an eligibility requirement.
- Governments have used VERLP registration as part of the eligibility requirements for pool pumps under various energy efficiency programs, such as the Victorian Energy Upgrades program.
- The VERLP is also referenced in energy efficiency information and educational material, such as Ausgrid's pool pump energy calculator.

The experience in administering the VERLP program has also been valuable in identifying limitations and opportunities to improve technical test standards.

Limitations of the program

Most pool pumps are not registered under the VERLP. Typically, more energy efficient pumps are labelled, leaving around 70 per cent without a label. Limited registration of products is a common feature of voluntary labelling or rating schemes, both in Australia and overseas.[16] Due to the partial coverage of pumps on the market, the consumer benefits of the labelling scheme are limited.

The VERLP sits outside the compliance structure for products regulated under the GEMS Act. The program predates the introduction of the Act in 2012 and administrative arrangements are different. The practical effect is that the voluntary scheme's energy rating label is not backed by independent compliance and reporting requirements. This presents broader program risks and allows industry to gain the advantage of an energy rating label, which is less rigorous and robust than normally applies to labelled products.

ERLs allow consumers to compare the energy consumption of similar products and factor lifetime running cost into their purchasing decision. The partial coverage of the VERLP prevents consumers from comparing the range of products, because only the most efficient products are labelled, leaving less energy efficient products unlabelled in lower price bands.

Standards

The Australian standard for pool pumps (AS 5102) may contribute to the lack of support for energy efficient variable speed pumps and the ineffectiveness of the voluntary label. The standard allows manufacturers to claim a star rating level for two, multi and variable speed pumps based on continuous running at low speed. This means that the rating makes no allowance for the greater energy use needed for higher speed operation, such as cleaning of the filter and to operate

manual cleaning equipment. Any discrepancy in savings promised and the pump's actual performance detracts from the integrity of the VERLP and the ERL more broadly.

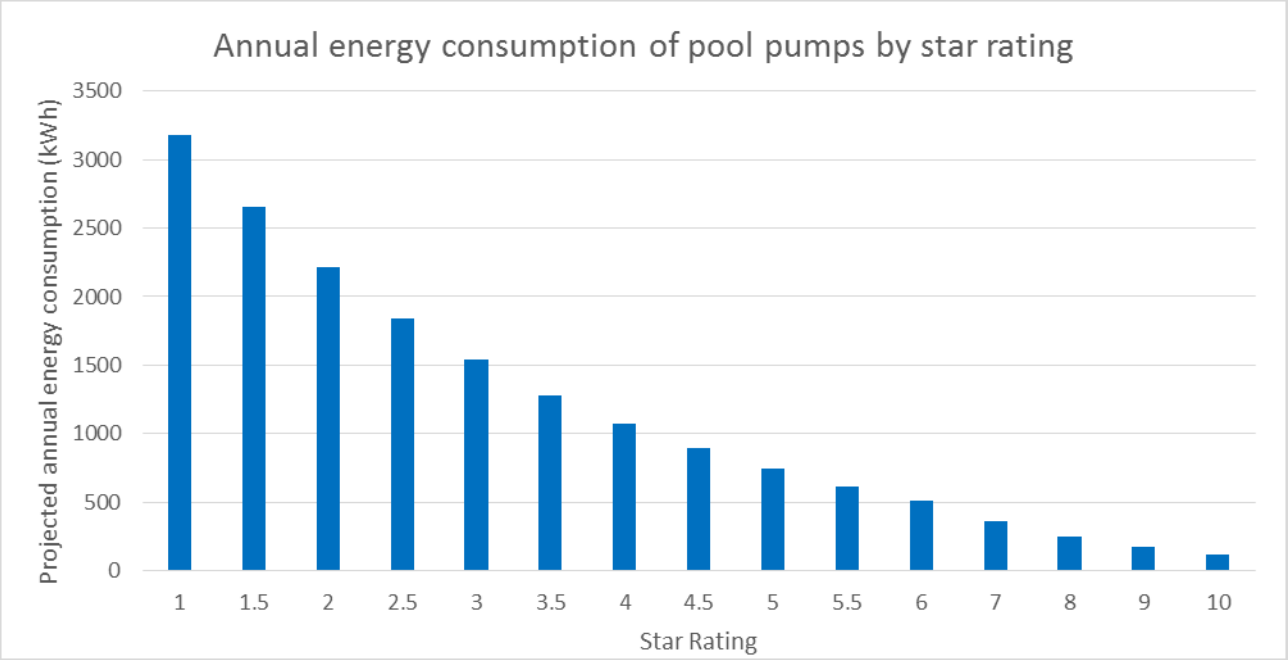
Program valuation

Under a business as usual scenario, there is no reason to expect a substantial change in the energy efficiency of pool pumps on the market, or in buyer preferences. The way the industry has used the VERLP over eight years is consistent with the experience of similar voluntary labelling schemes. Partial coverage of the pool pump market registered under the VERLP limits its value for consumers and industry in terms of understanding and getting access to reliable, comparative information on the energy efficiency of different pool pumps. The compliance, reporting and cost recovery arrangements for the VERLP are also not consistent with the practice in the broader GEMS program. Overall, voluntary labelling schemes are limited in their ability to overcome information failures. For these reasons, E3 does not support retention of the VERLP and the program will cease.

1.7 Comparing energy consumption of pool pumps

The pool pump market offers pumps with varying levels of energy efficiency, with some using more energy than others, to perform the same function. Prior to 2009, there was no established method of comparing the energy efficiency of different pumps. In 2009, Standards Australia released the Australian Standard AS 5102.1 and 2: 2009 *Performance of household electrical appliances – Swimming pool pumps*. These standards describe a set of formal methodologies that allow for the testing of the energy efficiency of different pool pumps for comparison. The standards also established an index for allocating 'star ratings' for pool pumps, where pumps of different energy efficiencies are given a rating from 1 – 10 (1 being least efficient and 10 being the most efficient). The standard was reviewed in 2012-13 by a Standards Australia working group, with a draft of a modified standard prepared, but not released. The relative energy efficiency of pumps with different star ratings is illustrated in Figure 1.7.

Figure 1.7: The annual energy consumption of pool pumps by star rating



1.8 Purchase and operating costs

Electricity used by pool pumps is primarily for the circulation of water through the filtration, water treatment and water heating systems. The filtration function accounts for between 70 and 90 per cent of total pool electricity consumption for pools without water heating. Pool pumps can also perform other functions, including running spa jets, water features, or high pressure cleaning systems.

The amount of electricity used by a pool pump is measured in units of Watt hours (Wh) or Kilowatt hours (kWh), where 1 kilowatt = 1,000 watts (W). Different types and models of pool pumps have different operating costs. The amount of electricity a pool pump uses depends on:

- how many hours a day the pump is run and for how many days per year
- the power consumption of the pump, measured in watts.

Apart from pool water heating systems, the energy consumption of a pool is affected by:

- the size of the pool
- the plumbing set up (the number of bends in the piping and the diameter of the pipe)
- the number of pumps installed
- how much wind-borne detritus and other matter is carried to the pool
- the use of the pool
- how well and how often pool maintenance is carried out.

Depending on the model and type, a pool pump can use anywhere between 100 kWh and 3,500 kWh of electricity per year (Figure 1.7).

The most commonly sold pool pumps have a retail price between $500 and $1,500.[17] In general, the more energy efficient a pool pump, the more expensive it will be to purchase (the capital cost). In contrast, the cost of the electricity to run a pool pump for filtration (the operating cost) can range between $60 and $700 per year. Operating costs can be several multiples of the upfront capital cost over the expected life of a pump.

1.9 New Zealand market

New Zealand participates in the Equipment Energy Efficiency (E3) program with Australia to align energy efficiency requirements as closely as possible in both countries, and thereby uphold the principles of the Trans-Tasman Mutual Recognition Arrangement (TTMRA) and the Australia New Zealand Closer Economic Relations Trade Agreement (ANZCERTA).

DEE analysed the pool pump market in both Australia and New Zealand in 2016. On the basis of this analysis, New Zealand decided that energy efficiency regulation of pool pumps would have minimal benefits, because of the small number of residential pools in New Zealand and the consequent low number of sales of pool pumps.

If MEPS and mandatory labelling is introduced in Australia only, the Australian market could be exposed to non-compliant products imported from New Zealand under the Trans-Tasman Mutual Recognition Arrangement (TTMRA).[18] Advice from the pool pump industry is that it is unlikely that non complying pool pumps would be imported into New Zealand and then exported to Australia.

Problem statement

2.1 Overview

Pool pumps use more energy than necessary. There are opportunities to improve energy efficiency, while reducing electricity bills, energy consumption and carbon emissions, through the use of more energy efficient pumps.

The benefits of energy efficient pumps include: reduced operating costs, reasonable payback periods that offset higher purchase prices and noise reduction. Given these benefits, there is an expectation of continued growth in sales of energy efficient pumps as a share of the national pool pump market.

However, national sales data shows that after an initial period of strong growth from around 2010, sales of energy efficient pumps as a proportion of total sales plateaued around 2013. After this time most pool owners reverted to buying the more energy intensive, single speed pool pumps. Based on historic sales data and manufacturer's advice, the share of single speed pumps compared to variable speed pumps will increase slightly to 2030. This projection is consistent with the trend line for single, multi and variable speed pumps in Figure 1.4.

Based on the national pool survey in 2016, it is clear that consumers are interested in reducing the energy costs of their pools, but they have limited knowledge about the role of pumps and the best or most energy efficient pump for their pool or spa. Nor do there appear to be quality or technical barriers limiting greater use of energy efficient pumps that explain the predominance of single speed pumps in national sales. While in some circumstances, single speed pumps may be more suitable for specific purposes, this does not explain the limited uptake.

Overall, the lack of growth in the market share of energy efficient pumps and the resulting lower benefits obtained by pool owners is best explained by market arrangements, including industry practices. It took a major market intervention in the form of high cost rebate programs to overcome market problems in Queensland. Once the rebate programs ended, the underlying market features have come into play and these act to limit efficient investment by consumers in multi-speed and variable speed pumps.

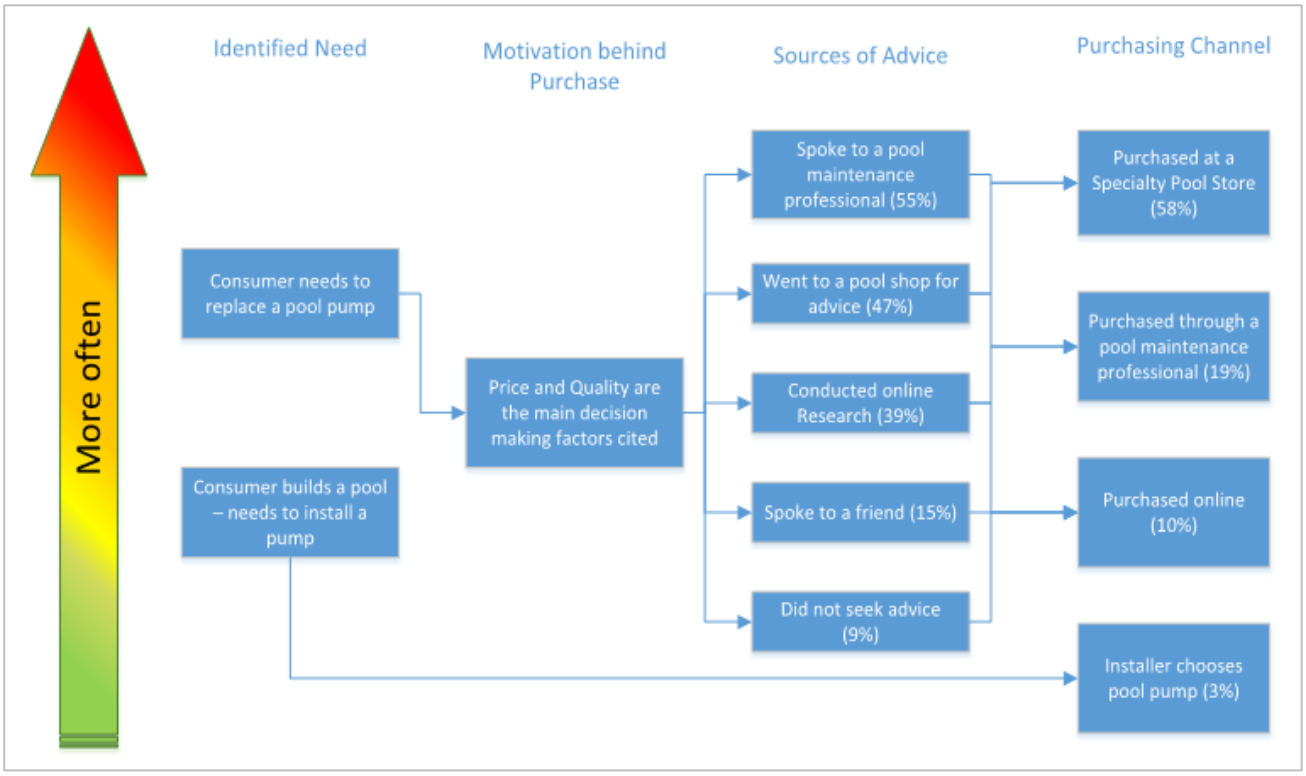
The problems in the pool pump market are:

- the lack of good quality information for consumers on the comparative energy efficiency of different types of pool pumps
    - This lack of information is exacerbated by consumers' reliance on industry professionals and retail outlets for advice and guidance, when industry professionals and retailers have uneven knowledge about the energy efficiency of different pool pumps[19]
- commercial tie-ins with specific brands and product types
- the existence of split incentives, particularly in the building and installation sector and for property managers or landlords, where the decision makers' interests do not align with the user of the pool pump
- externalities, such as greenhouse emissions and electricity peak loads, which are not included in the costs of buying pumps with differing levels of energy efficiency.

2.2 Consumer pathways for buying a pool pump

Consumer behaviour can lead to less than optimal choices. Market failures and aspects of consumer behaviour in the pool pump market constrain the uptake of energy efficient pool pumps, driving higher than necessary costs for consumers and for society more broadly. Figure 2.1 below shows the considerations consumers make when buying a pump. It is based on the results of the national pool owners' survey in 2016 and industry focus group discussions.

Figure 2.1: Purchase decision tree



Consumers rely on advice from industry professionals[20], when selecting a pool pump. However, intermediaries may not have the best interests of the pool owner in mind, in terms of balancing the upfront costs with ongoing operating costs. Commercial tie-ins with manufacturers and supplier pathways are common and an important feature of the pool industry. These tie-ins and pathways strengthen the controls intermediaries have over information flows to consumers and reinforce the primary advisory role of pool industry professionals.

Alongside the national survey of consumers, E3 commissioned focus group interviews with 30 pool industry professionals. These focus group interviews revealed that the pool industry has a wide range of views on the energy efficiency of different pool pumps.[21] This suggests that consumers are relying on advice from experts that is inconsistent, because the experts, themselves, have uneven knowledge about the energy efficiency of different pumps.

2.3 Split incentives

A split incentive arises when the interests of the final user of the pool pump differ from those of the intermediary or agent, who either decides on the pump to be installed or is influential in the final decision.

Most consumers rely on intermediaries to guide them when buying a pool pump. These intermediaries may or may not have in mind the best interests of the pool owner, when balancing the upfront costs with the ongoing operating costs. As indicated earlier, commercial tie-ins with manufacturers or a group of pump suppliers are common in the pool industry, increasing the scope for split incentives between pool industry experts and consumers.

This poses a problem for consumers, because the price of the pool pump is only a small component of the final cost of a new pool. In these circumstances, the pool buyer is in the hands of the builder or installer, in terms of the pump selected for the pool. While some builders may promote energy efficient pumps as part of their business, it is clear that not all do.

For households that are renting, or for commercial properties like hotels, gyms or serviced apartments, it is usually the property manager or landlord's responsibility to replace a pool pump. The property manager or landlord do not pay the operating costs of the pump and are indifferent to the effect of different pumps on an electricity bill. In deciding between pumps, there is likely to be a focus on the upfront capital cost of a replacement pump and its reliability and durability, rather than energy efficiency. The market for swimming pool and spa equipment is split between home owners (65.8 per cent) and property managers (34.2 per cent).[22]

2.4 Information failure

There is a lack of consistent, reliable and independent information for consumers on the energy consumption and comparative energy performance of competing pool pumps on the market.

Since 2010, the VERLP has been available for pool pumps. The registered pool pump models[23] consist of the more efficient pumps available in the market. This leaves the large number of high selling, less efficient pumps not labelled for their energy efficiency. Anecdotal evidence indicates that the display of the energy rating label on the physical product is inconsistent, which contributes further to the information failure and asymmetries between consumers and pool professionals.

Consumers do not have easy access to information about how they can reduce the electricity used by their pool pumps. The national pool owners' survey in 2016 showed 60 per cent of people were concerned about the amount of electricity their pool pump used and around 90 per cent reported taking at least one action to reduce energy use by their pool. At the same time, 53 per cent of respondents had a single speed pump installed and 34 per cent did not know what type of pump they had. Only around 30 per cent of respondents identified energy efficient pool pumps as a measure they took to reduce the energy used by their pool or spa.

In terms of people's perceptions of pool pumps and the relative energy efficiency of different types, 60 per cent did not know what type of pump was the most efficient (among single speed, two speed, multi speed and variable speed pumps). Among respondents who indicated they did know:

- 14 per cent thought variable speed pumps were the most efficient
- 7 per cent thought multi speed pumps were the most efficient
- 6 per cent thought two speed pumps were the most efficient
- 13 per cent thought single speed pumps were the most efficient.

The 2016 national survey of pool owners reported a high level of interest in energy efficiency among those that had replaced their pool pump (Table 2.1). Of these, less than a third drew a link between the energy efficiency of the pool pump and opportunities to make cost and energy savings. This is consistent with other responses in the survey, which, taken together, suggest that pool owners have a low level of knowledge about pool systems and pool pumps.

Table 2.1: Pump electricity use by region – energy efficiency awareness

Location	*NSW (n=543)* *per cent*	*Victoria (n=236)* *per cent*	*South Australia (n=87)* *per cent*	*Western Australia (n=213)* *per cent*	*Queensland (n=416)* *per cent*	*Australia (n=1531)* *per cent*
Concerned about energy efficiency	61	55	66	62	63	61
Identified an energy efficient pump as a way of reducing energy use	25	25	34	28	32	27

The lack of information of the relative energy efficiency of pool pumps limits the opportunity for consumers to take the ongoing running costs (up to 80 per cent of the total lifetime cost of the product) of different pumps into account in their purchasing decisions. This leads to a greater and disproportionate emphasis on the upfront (known) cost of pool pumps, the cheaper of which, are often the least energy efficient.

2.5 Consumer behaviour and bounded rationality

Even where people have access to sufficient information, they may make decisions that are not optimal from an economic point of view. In buying a pool pump, this could occur when a consumer knowingly chooses a pump that will cost them more over the life of the pump, than the more energy efficient model beside it on the shelf. This bounded rationality could stem from:

- the consumer not being able to afford the upfront cost of the more energy efficient pump
- the consumer considering the effort required to obtain and understand information about the energy efficiency of different pumps to be too great and not worth the savings derived from a more efficient pump, or
- the consumer being biased toward the 'status quo' or the risk averse option.
    - for example, the replacement of a pool pump with the same model would be a more comfortable decision, than switching to an unfamiliar pump.

2.6 Externalities

Pool pump use creates externalities or indirect costs that are not borne by the owner of the pool. These externalities include greenhouse gas emissions, peak loads on electricity networks and noise in residential areas. Two, multi and variable speed pumps have lower power consumption and

noise levels, when run on their lowest speed settings, than single speed pumps. The indirect costs of pool pump use are higher than they need to be, due to the prevalence of less energy efficient pumps and the resulting higher costs that are borne by the wider community and the environment, not by pool owners alone.

Greenhouse emissions

The greenhouse gas emissions from the use of a pool pumps depend on the source of electricity used. In Australia, approximately 0.83 kilograms of greenhouse gases are produced on average for each KWh of electricity consumed.[24] Applying this figure, E3 estimates that 1.3 million tonnes of greenhouse gases were released in 2015 from the generation of electricity to support the operation of pool pumps in Australia. E3 modelling (refer Chapter 4) for the period 2018 – 2030 projects[25] that Australia could save 5.63 million tonnes of greenhouse gas emissions, if pumps above a high level MEPS rating were sold, instead of single speed pumps. Likewise, savings of 2.21 million tonnes of greenhouse gas emissions for a medium level MEPS and 1.86 million tonnes for a low level MEPS, if pumps below these levels were no longer on the market. These projections are for pool pumps within the scope of the proposed regulations. (Refer to Figure 4.11 for the scope of regulation.)

Peak load costs for electricity networks

Pool pumps add to electricity network costs through their contribution to peak demand. Heat waves, cold snaps and other short-lived and infrequent spikes in electricity use create peak demand on the electricity network.[26] Despite these spikes in demand occurring for short periods of time, they can make up a significant element of consumer bills. In NSW, the Productivity Commission reported that the capacity to cater for less than 40 hours a year of electricity consumption (less than 1 per cent of time), accounted for around 25 per cent of retail electricity bills. The investment required to establish this capacity increases the price of electricity for all consumers.[27]

The significance and cost of peak load conditions to a network depends on the nature of the network, the degree of congestion or load, the effect on services under peak load conditions and the cost of available response measures.

Ergon and Energex, two electricity network operators serving Queensland, ran extensive demand management programs between 2011 and 2013 to reduce the contribution to peak load from pool pumps. The companies found that investment in pool pump energy efficiency rebates was effective and delivered strong value in terms of reductions in network management costs.[28]

The Ergon Energy program evaluation:

- found that the non-network solution (or cost of the pool pump program) was 30 per cent cheaper than the equivalent network cost, based on supplying a 1 kW pool pump over its typical life.

- estimated that, in the first seven months of the program, 47 per cent of participants were in network constrained areas, implying a higher and more immediate value in terms of network infrastructure costs.

In contrast, Ausgrid[29], an electricity network operator in New South Wales, found that:

- approximately 180,000 residential customers on their network had pools, and approximately 40 per cent of these were on a time of use tariff
- pumps contributed to peak load conditions, which occurred between 2.00 pm and 8.00 pm on the Ausgrid network
- pool pump loads were too disbursed within sub-zones to warrant investment by Ausgrid in specific peak load measures targeted at pool pumps.

Research by E3 suggests that nearly all networks allow for pool pumps to use a concessional electricity tariff, either through a time of use tariff or a dedicated controlled load tariff, as exists in Queensland. It appears that the use of concessional tariffs or controlled load tariffs by pool owners is negligible across most electricity networks (albeit with greater use in NSW and Queensland) and pool pumps are not seen as a priority by network companies for demand management.

Noise pollution

Local or residential noise pollution can reduce the quality of life and amenity for those affected, as well as undermining good relations between neighbours. Discussions with state and territory agencies in Australia indicate that pool pumps are a source of noise pollution in residential areas, but not a major cause of noise complaints.

Pool pumps are included in state, territory or local government regulation in Australia governing the time of use of residential equipment and acceptable noise limits and effects on neighbours. While the details vary, a common approach to noise regulation is that the specified equipment cannot be heard in a room of a neighbouring house. Other regulatory approaches include: noise reading limits at the boundary of properties or banning the use or operation of specified equipment between certain hours.

State and local government noise regulations

State Environmental Protection Authorities (EPAs) and local councils have varying concerns about noise pollution and pool pumps. In most states, environment protection acts and regulations are set and enforced by either the EPAs, or local councils. Penalties set out in noise regulations vary from mediation to fines of up to $11,000.

In Tasmania, New South Wales and the ACT, the noise from pool pumps was considered to be a serious issue. It was thought that labelling of noise levels on pool pumps would be useful for consumers and the community, because consumers would be made more aware of the problems with noise that could be caused by their pool pumps.

2.7 What has been tried previously?

Pool pumps have been a focus for energy efficiency, emissions reduction and energy demand management programs of governments and electricity providers at various times and in various places.

Standards. An Australian Standard was developed in 2009 to measure the energy efficiency of pool pumps, including a system of 'star ratings' and the development of an energy efficiency label.

Rebates. Queensland energy companies Energex and Ergon, which serve southeast Queensland and regional Queensland respectively, offered rebate programs between 2011 and 2013 giving customers cash incentives to purchase energy efficient pumps that were registered on the VERLP, or to connect their pool pumps to a 'controlled load' tariff.

Energex and Ergon found these programs to be cost effective and resulted in drops in energy consumption and a shift in electricity demand from peak load periods.
The rebates were supported by effective information campaigns in Queensland.
The effect of the rebates and the information campaigns on consumer perceptions and understanding of the relative energy efficiency of different pool pumps appears to have fallen, now that the rebates and campaigns have ended.[30]

Energy efficiency programs. Energy efficient pool pumps are included in energy efficiency schemes in the Australian Capital Territory, New South Wales, Victoria and South Australia. For example, under the Victorian Energy Efficiency Target (VEET) scheme, households can earn Victorian Energy Efficiency Certificates (VEECs) by switching to energy efficient pool pumps.[31]

Labelling. The Voluntary Energy Rating Labelling Program (VERLP) operates under the E3 Program and is administered by DEE. The program is open to all pool pump models on the market, but generally only the most energy efficient models are registered. In particular, there are no pumps rated below five stars on the register.

Studies and trials. Sustainability Victoria and Ausgrid (NSW) conducted studies into the energy efficiency of pool pumps in 2013 and 2015 respectively. The Sustainability Victoria trial showed that most participating households made considerable energy savings by retrofitting higher energy efficient pumps.

<u>Swimming Pool Pump Retrofit Trial (Sustainability Victoria)</u>

During 2013 and 2014, Sustainability Victoria ran a small Swimming Pool Pump Retrofit Trial. In the trial, eight households in Melbourne had their existing single speed pool pump (for filtration) replaced with a higher efficiency (8 star), three speed pump. The pumps that were replaced were between five and 30 years old. Power and energy consumption and operating time of the pool pumps before and after the retrofits was measured using detailed interval metering. Householders were also surveyed about usage patterns and other factors before and after the retrofits.

The results of the trial show the energy efficient pumps delivering annual pump energy savings to households of up to 73 per cent in the best cases. Once one outlier household was removed from the analysis, the average saving was 50 per cent[32]. Overall, the trial found the replacement of inefficient pool pumps with higher efficient pool pumps to be a cost effective approach for reducing household energy use and associated costs.

The trial also illustrated the importance of consumer behaviour. Some houses operated the pumps for most of the time on their lowest speed setting, some on a combination of the low and medium settings, and some mostly on the highest speed setting. Operating the pumps for extended periods on the medium or high speed settings reduced the energy savings achieved.

Ausgrid

Ausgrid is the network operator that provides electricity to Sydney and the surrounding region. In 2015-16, Ausgrid undertook an investigation into the potential for a pool pump rebate program for their customers. Ausgrid found that the option for a rebate program was not the most cost effective demand option available. However, Ausgrid recognised the benefits of reducing loads from pool pumps, and the lack of information available to customers. As a result, it provides a 'pool pump calculator'[33] that can calculate an estimate of the annual cost of running a pool and makes available an Ausgrid Guide to *Swimming pool efficiency*[34]. The guide gives advice on how to save energy from pool pumps and how to use the VERLP to choose higher energy efficient models.

Other solutions. After-market products and services are available to pool owners, such as variable frequency devices[35] and a growing set of smart information technology and communications products, platforms and software, which integrate and better manage pool systems and components.

Pooled Energy in Sydney provides electricity retail services bundled with pool maintenance and management services.

- The company's focus is on consumers willing to pay for energy savings and pool maintenance cost reductions.

Other emerging businesses providing variable frequency device products and pool automation services are SplashMe Smart Pool Automation Controller and Simply Better Pool Savings.

Table 2.2: Current and previous measures to improve pool pump energy use

Program/Activity	*Why it doesn't solve the problem*
Voluntary Energy Rating Labelling Program (VERLP)	VERLP registered products are the more efficient pumps available on the market. The program does not resolve information failures, because the less energy efficient pumps do not participate.
State Energy Savings Efficiency Incentive Schemes	There has been limited take-up of pool pump installations under these schemes, although the Victorian Energy Upgrades program has had around 900 pump replacements generating around 7,000 certificates. These schemes are also not available in all jurisdictions and do not overcome information failures.

Program/Activity	*Why it doesn't solve the problem*
Ergon/Energex Rebate Programs (Queensland)	While these rebates were successful in reducing peak load, they have now run their course. They were also expensive compared with other measures and unlikely to be cost effective for other networks.
Ausgrid Study (Sydney, NSW)	This study showed pool pumps contribute to peak load costs, but benefits from a rebate program were not significant and widespread enough to warrant Ausgrid taking action.
Jemena trial (Victoria)	This trial ran during March 2018 and tested smart swimming pool pumps through direct load control. Results of this trial are not available.
Sustainability Victoria Pool Pump Retrofit Trial (Victoria)	This study was on a micro scale and would be costly to implement more broadly, despite showing that retrofitting less efficient pumps saved consumers money.
Aftermarket and Emerging Private Sector Activity	Private sector initiatives appear to have limited take up and target market segments, rather than the national product market.

2.8 Conclusion

The measures to improve pool pump energy use described in Table 2.2 highlight that there are potential benefits from intervening in the market to improve the energy efficiency of pool pumps. Despite the success that has been obtained in some areas, none of the measures have been successful on a national scale. They have inherent limitations in program objectives and design, cost effectiveness, and an uneven or lack of general relevance in all jurisdictions. In particular, none of the programs overcome the market barriers and failures active in the pool pump market, nor do they offer comprehensive or sustained solutions to reducing the wider social costs and inefficiencies of the pool pump market. The limitations of existing and past programs include:

- the information produced by the standard and the VERLP are not provided to all consumers purchasing a pool pump
- the various voluntary energy efficiency programs are limited to just one state or region, as are the rebate programs for pool pumps
- the measures are voluntary, or are implemented without ongoing compliance and enforcement capacity
- rebates are difficult to target to consumers, who would otherwise not replace their pool pump with an energy efficient model
- the measures are intended to remove particular externalities or market barriers, such as peak electricity demand or energy efficient pumps being too expensive for some consumers. They do not deal comprehensively with all the market barriers and failures limiting the use of energy efficient pumps.

Governments are successfully overcoming market barriers facing energy efficient products and equipment with two measures:[36]

1. Mandatory energy rating labels (ERL) - the requirement for the disclosure of energy efficiency information by sellers or producers of certain products; and
2. Minimum energy performance standards (MEPS) - the prevention of access or sale of products below a specified level of energy efficiency.

MEPS set a standard for performance and energy consumption that a product must meet to be able to be sold in Australia. Effectively, a product, such as a swimming pool pump, that does not meet the standard, as measured by the prescribed method of test, would be removed from the market. In this way, MEPS is an effective mechanism to overcome market barriers to the adoption of more energy efficient appliances and equipment.

These two policy interventions have not been applied to pool pumps. This RIS proposes both an ERL and MEPS as interventions that could provide a solution to the problem described in this section. Details of ERLs and MEPS options are presented in Chapter 4.

Consultation

3.1 Consultation Regulation Impact Statement

On 4 December 2015, the Council of Australian Governments (COAG) Energy Council committed to a new Equipment Energy Efficiency (E3) prioritisation plan. The 2015-16 plan identified six priority areas: lighting, non-domestic fans, swimming pool pumps, refrigerated storage and display cabinets, air conditioners and domestic refrigerators.

On 14 November 2016, E3 published the swimming pool pump consultation RIS[37]. Comments and discussion were invited from consumers, industry and other interested stakeholders on proposals to resolve market failures and increase the uptake of more energy efficiency pool pumps. Specifically, eight questions were asked about support for MEPS and labelling, the scope of regulation, perceived opportunities and difficulties, adjusting to new regulations, the data and assumptions and New Zealand opting out of the regulation. Submissions were open until the end of January 2017.

During the consultation period, public meetings were held in four locations and were attended by 42 people.

Schedule of public meetings

- Melbourne – 29 November 2016
- Perth – 2 December 2016
- Sydney – 5 December 2016
- Brisbane – 7 December 2016

Individual meetings were also held with four suppliers, who were unable to attend the public meetings.

Written submissions were received from a range of suppliers, industry groups and individuals. The 21 submissions[38] provided policy input and technical information about the RIS proposals, as well as feedback on the data and assumptions that underpinned the cost benefit estimates.

Submissions to the consultation RIS contained a range of views on MEPS and labelling. Some stakeholders wanted to keep the existing label, because it is recognised, others thought it was too big and some stakeholders did not see value in labelling pool pumps at all. Most stakeholders generally supported MEPS for pool pumps, as long as the regulation only captured pool filtration pumps. Of the stakeholders who commented on the level of MEPS, most wanted a medium or high level MEPS, because a low level MEPS would not remove enough pumps from the market. Of the few stakeholders who commented on noise, they supported its reporting.

The wattage and the range of pumps were mentioned in responses to scope. The majority of stakeholders who commented on scope only wanted filtration pumps covered and wished to exclude special purpose pumps, like booster pumps or solar thermal pumps. With respect to the wattage, there were suggestions about the range, including the exclusion of smaller and larger filtration pumps.

Comments received in response to the method of test were broad and varied. Two stakeholders supported adoption of a weighted energy factor and two supported using system Curve G, proposed in the 2013 draft review of AS 5102.1. Other comments noted the risk around calibration of instruments and the need for repeatable and reproducible test conditions.

Views varied between smaller and larger manufacturers about the transition timeline. The majority of stakeholders who commented on the implementation timeline preferred a 12 month implementation period. Fewer submissions requested an 18-24 month transition, with one submission wanting alignment with implementation of the US standard.

Most stakeholders did not see a problem with New Zealand not participating. Some stakeholders noted that it would mean that pumps not allowed in Australia, due to MEPS, will no longer be available in New Zealand.

The submissions were published on the energy rating website, with the exception of five confidential submissions.

3.2 Working Groups

The consultation RIS invited participation from interested stakeholders to be on working groups to consider matters raised in the RIS. E3 established two working groups to support the consultation process; by considering in detail the matters raised in submissions: the Technical Working Group (TWG) and the Pool Industry Advisory Group (PIAG). Working group meetings were held between June and November 2017.

Technical Working Group

The TWG was formed to consider a method of test to measure energy efficiency that is robust, reliable and repeatable. The working group included 14 members, two industry body observers and E3 representatives. Members were from manufacturing companies, electricity retailers, a pool energy solutions provider, testing laboratories and technical consultants. Four meetings[39] were held between June and August 2017.

Pool Industry Advisory Group

PIAG was formed to consider policy issues. The advisory group included 16 member and E3 representatives comprising of manufacturing companies, industry bodies, electricity retailers, pool energy solutions providers and technical and forecasting consultants. PIAG considered the implications of the introduction of ERLs and MEPS for pool pumps. Four meetings[40] were held between August and November 2017.

3.3 Policy paper update

An updated policy proposals paper was published on 11 December 2017. The paper provided an update to swimming pool pump stakeholders following submissions on the consultation RIS and decisions and outcomes from the subsequent TWG and PIAG meetings held between June and November 2017. Topic updates included:

- method of test
- minimum energy performance standards (MEPS)
- labelling products
- scope of regulation
- transition timeline; and
- product registration.

The paper was open for submissions on the Energy Rating website for seven weeks from 11 December 2017 until 29 January 2018. One submission was received from a manufacturer. No changes were suggested to the proposed policies in the paper.

Policy options

4.1 Introduction

The consultation RIS in 2016 proposed the introduction of MEPS and mandatory labelling for pool pumps. Consideration and development of these options has relied on information provided in submissions to the consultation RIS, discussion in working group meetings, discussions with other stakeholders and input and analysis by technical consultants and testing laboratories.

Introducing MEPS and mandatory ERLs entails two costs. Firstly, small manufacturers producing mostly single speed pumps would face adjustment costs, such as the cost of designing new products or redesigning existing ones. Secondly, consumers would face higher prices for new pool pumps as the least efficient pumps are withdrawn from the market. E3 assumes that pool pump suppliers would adjust to new regulatory settings and pass on increased costs to consumers in the form of higher prices. On this basis, E3 considers that it is reasonable to assume that consumer capital costs incorporate industry adjustment costs.

4.2 MEPS and labelling policy options

MEPS are the most efficient and effective way to increase the energy efficiency of pool pumps in Australia and to support efficient decision making by consumers. This RIS examines five scenarios applying MEPS and mandatory labelling: business as usual (BAU), mandatory labelling alone and low, medium and high level MEPS with mandatory labelling. MEPS would increase the energy efficiency of pool pumps used in Australia, while reducing externalities, such as peak loads on the electricity network. These externalities are discussed in this RIS, but are not included in the cost benefit analysis.

Applying MEPS and mandatory labelling to pool pumps would incur regulatory costs for manufacturers and retail suppliers. These could include administrative costs attributed to understanding and complying with proposed policies, paying registration fees and purchasing copies of standards. Depending on the policy option selected, businesses would incur cumulative costs of up to $0.93 million per year, complying with the regulations.

Business as usual – no regulations and the VERLP would be discontinued.

Labelling – no energy performance standards would be applied and pool pumps would not be removed from the market. Pool pumps that have an input wattage range within the proposed scope would be labelled saving 1,127 GWh of electricity and reducing emissions by 0.90 Mt to 2030.

If pool pumps are labelled, it is expected that consumers would choose the most efficient model, where the additional upfront cost is small. It is likely that labelling products would not increase variable or multi speed pump sales significantly, because of the large difference in the price of a single speed pump, compared with a more efficient pump in the same wattage size category.

Low level MEPS and labelling would remove an estimated 37 per cent of the least efficient pool pumps from the market from 2018 to 2030 saving 2,332 GWh of electricity and reducing emissions by 1.86 Mt to 2030. There would also be a reduction in noise pollution and electricity network infrastructure investment, due to reduced peak demand.

Low to medium level MEPS and labelling would remove an around 50 per cent of the least efficient pool pumps from the market from 2018 to 2030 saving 2,767 GWh of electricity and

reducing emissions by 2.21 Mt to 2030. There would also be a reduction in noise pollution and electricity network infrastructure investment, due to reduced peak demand.

High level MEPS and labelling would remove around 60 per cent of the least efficient pumps from the market, including all single speed pool pumps within scope, saving 7,066 GWh of electricity and reducing emissions by 5.63 Mt to 2030. There would also be a reduction in noise pollution and electricity network infrastructure investment, due to reduced peak demand.

Business as usual

Under BAU, pool pumps would not be subject to mandatory labelling or minimum energy performance standards and the VERLP would be discontinued. That is, no regulations would be applied to pool pumps in Australia. The natural uptake of the more energy efficient pumps would drive moderate reductions in electricity use and emissions reductions.

Modelling by E3 indicates that the market share of single speed pool pump sales would fall from 2017 to 2030. The reduction in single speed pump sales is expected to be replaced by sales of more efficient two, multi and variable speed pumps.

Labelling

Consumers are interested in reducing energy costs for their pool, although they generally know little about the energy efficiency of their pumps and don't have easy access to information on how to reduce their electricity usage. Labelling of pool pumps would improve the energy efficiency information available to consumers. It would allow consumers to compare pool pumps on the basis of consistent and clear energy efficiency information in the form of star ratings.

Submissions to the consultation RIS contained a range of views on labelling pool pumps. Some stakeholders wished to keep the existing label, because it is recognised, while others did not see value in labelling pool pumps at all. Reasons against labelling included: because consumers do not typically buy pumps from retail stores and the technical factors do not allow for an accurate comparison. Others felt the label was too large for the product.

Mandatory pool pump labelling for pool pumps, within scope, sold in Australia would provide consumers and industry with three benefits. It would:

- tackle information barriers, gaps and failures facing consumers.
- replace the partial coverage provided by the VERLP with comprehensive coverage of pool pumps sold in Australia.
- introduce formal compliance and registration requirements, which would create a level playing field for manufacturers and distributors.

If approved by the COAG Energy Council, mandatory labelling would be required for all pool pumps within the scope of regulation, which is most pumps used for residential pool filtration.

E3 considers that ERLs, by themselves, would not remove major market barriers, including:

- removing split incentives that operate within the market
- ending divergent views within the industry around the value and suitability of variable speed pumps
- reducing the large price differentials between more energy efficient and less energy efficient pool pumps
- reduce significantly the externalities (greenhouse gas emissions, peak electricity demand and noise) arising from the use of less efficient pool pumps.

Nevertheless, labelling products would have flow on benefits. State and territory governments and electricity companies will be able to continue using star ratings as eligibility requirements to encourage, through rebates or other means, the installation and use of more energy efficient pool pumps.

Labelling would also help educate consumers. ERLs would overcome an information failure where consumers have inaccurate, incomplete or ambiguous information about the energy consumption of a pool pump. They would provide a clear and easy to understand star rating to ensure pool pumps can be compared on a common basis. Consumers would have more accessible information to help them purchase a more efficient single speed pump, than they otherwise would. The initial purchase price of a more efficient single speed pump would not be a significant burden on consumers in a labelling only scenario, because the price difference between single speed pumps of similar wattage is small.

Labelling can also help consumers to pick the best pump for their pool. TWG and PIAG members support the labelling of pool pumps. Likewise, submissions in response to the consultation RIS showed that five out seven respondents, who commented on labelling, support the mandatory labelling of pool pumps. Those against labelling had concerns about the electricity use reported on the label, due to differing pool set ups, or the size of the label may be too large for the pump. More discussion of these issues and more information on labelling can be found in Section B5 in Appendix B.

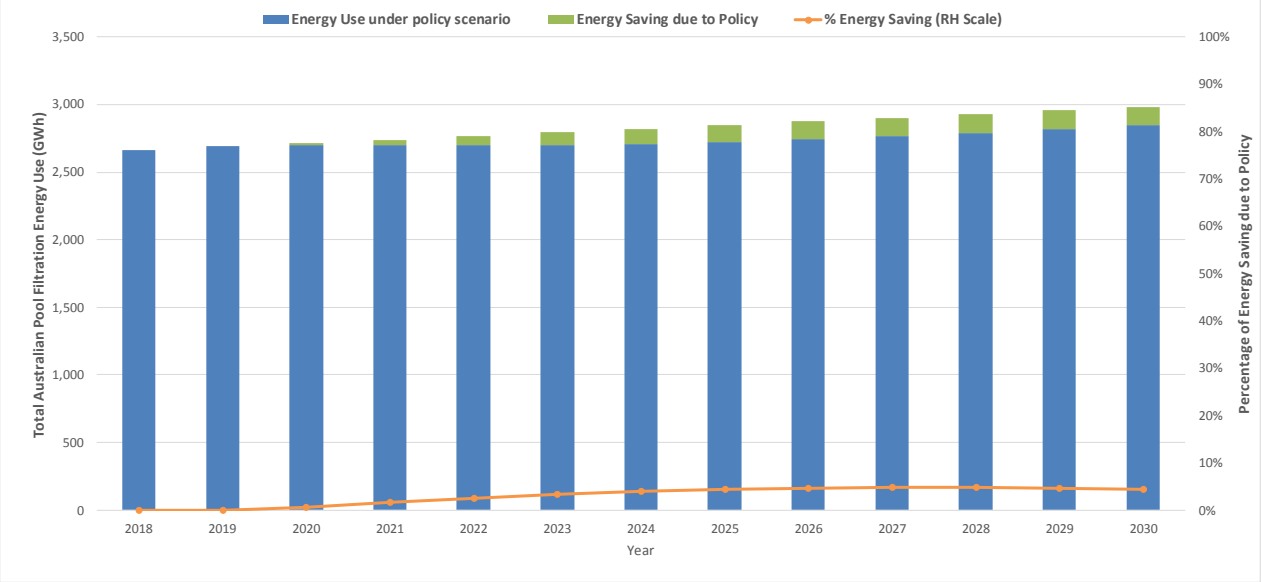
Cost benefit analysis

Analysis by E3 estimates that there are net benefits from introducing mandatory ERLs for pool pumps. The central[41] estimate in Table 4.1 shows total consumer net benefits of $218.5 million over the forecast period from 2018 to 2030, with a reduction in greenhouse gas emissions of 0.9 million tonnes of CO2 equivalent. Electricity savings of 1,127 GWh are shown in Figure 4.1. The electricity savings increase to 2025, before flattening out. This reflects the estimated 7.25 year life span of a pool pump and the replacement of less efficient pumps currently in use.

Table 4.1: Mandatory labelling cost benefit analysis (2018-2030)

AUSTRALIA		*Discount rate AUS 7 per cent*				
Policy option Label only		Electricity saved (cumulative GWh to 2030)	Emission reduction (cumulative Mt to 2030)	Total benefits (NPV, $M)	Total Cost (NPV, $M)	Net Benefit (NPV, $M)
	Upper	2,254	1.80	$642.8	$95.4	$547.4
	Lower	-	0.00	$0.0	$29.1	-$29.1
	Central	1,127	0.90	$280.7	$62.2	$218.5

Figure 4.1: NPV range under label only policy[42] (2018-2030)



E3 does not support introducing mandatory labelling without MEPS. Mandatory labelling would complement pool pump MEPS by helping consumers to identify the pump that best meets their needs. However, the benefits of labelling alone are limited and would not remove market barriers to the purchase of more energy efficient pool pumps.

Low level MEPS and labelling

A low level MEPS combined with mandatory labelling would have greater benefits than labelling alone. Low level MEPS would remove some of the least efficient pool pumps from the market and begin to reduce the major market barriers (externalities and split incentives) affecting the purchase of more energy efficient pool pumps. As a result, it would have benefits for consumers and the wider community. The policy would:

- remove the worst performing pumps from the market
- have a minor effect on pool pumps suppliers

- provide a modest signal to industry on future requirements to provide more energy efficient products to the market.

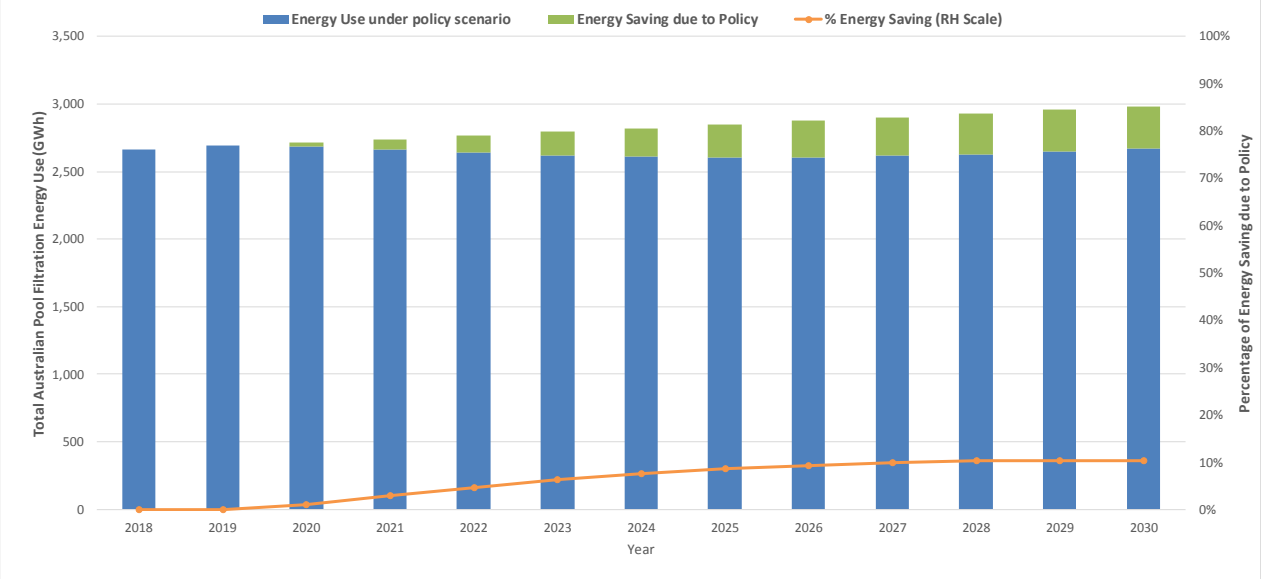
Cost benefit analysis

Low level MEPS and mandatory labelling would remove from the market around 37 per cent of the least efficient single speed pool pumps used for residential pool filtration.

Table 4.2: Low level MEPS cost-benefit analysis (2018-2030)

AUSTRALIA		*Discount rate AUS 7 per cent*				
Policy 8. Low level MEPS curve		Electricity saved (cumulative GWh to 2030)	Emission reduction (cumulative Mt to 2030)	Total benefits (NPV, $M)	Total Cost (NPV, $M)	Net Benefit (NPV, $M)
	Upper	4,665	3.72	$1,406.5	$116.3	$1,290.3
	Lower	0	0.00	$0.0	$53.9	-$53.9
	Central	2,332	1.86	$614.3	$85.1	$529.2

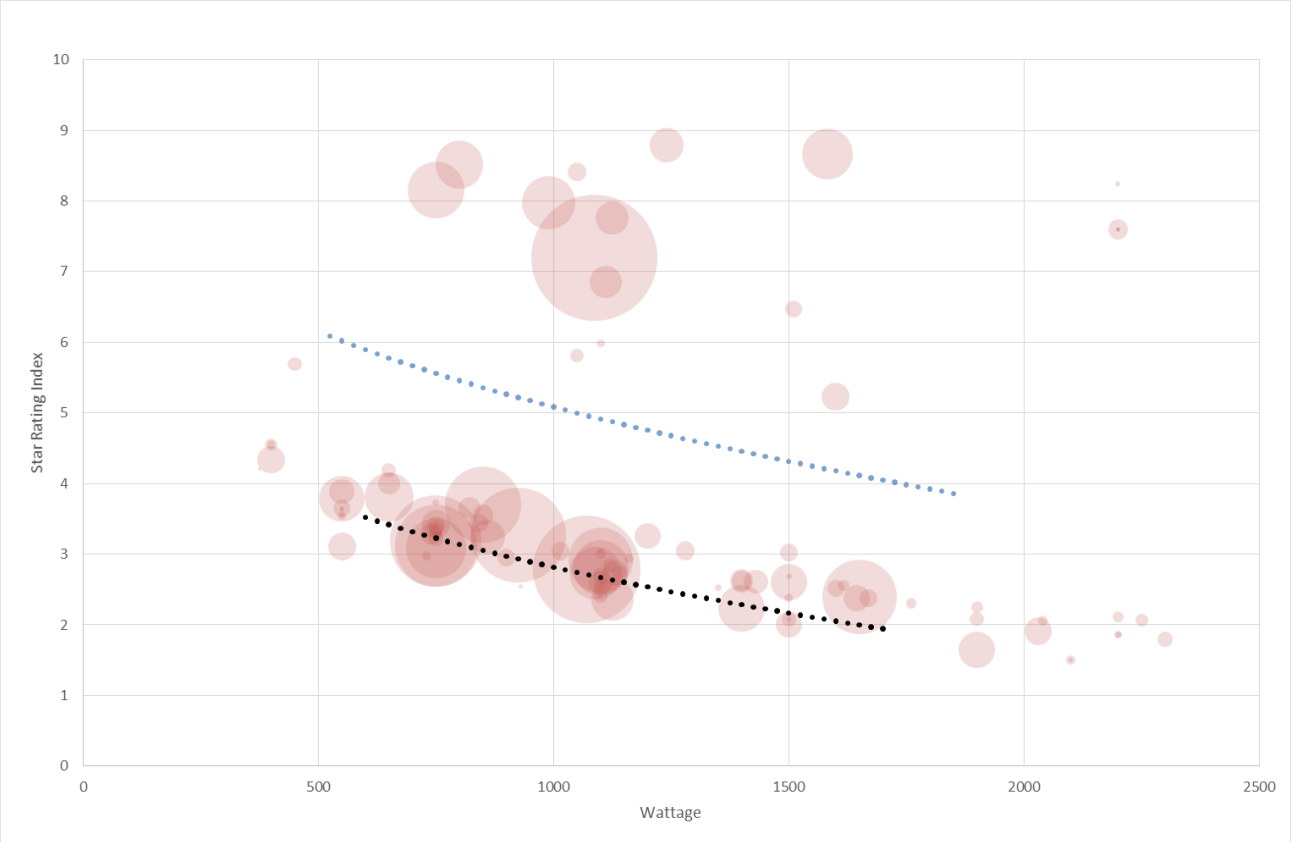
Figure 4.2: Low level MEPS effect on total electricity use (2018-2030)



Analysis by E3 estimates that there are net benefits from introducing low level MEPS and mandatory ERLs for pool pumps. The central estimate in Table 4.2 shows total consumer net benefits of $529.2 million over the forecast period from 2018 to 2030, with a reduction in greenhouse gas emissions of 1.86 million tonnes of CO2 equivalent and electricity savings of 2,332 GWh. A low level MEPS would have a marginal effect on the market and, as such, the benefits of reducing market barriers and externalities are limited.

Figure 4.3 shows the concentration of pool pump sales by wattage and star rating index. The top line in the graph represents a high level MEPS and the bottom line represents a low level MEPS. Pumps below the lines would be removed from the market, if such a MEPS was introduced.

Figure 4.3: Low level and high level MEPS curve for pool pump scope



E3 considers that a low level MEPS and mandatory labelling have value, but would not do enough to reduce market barriers, because most single speed pumps would remain on the market.

Medium level MEPS and labelling

A medium level MEPS would provide greater benefits than a low level MEPS and these benefits would be shared by consumers and the wider community. This policy option would remove around 50 per cent of the least efficient pool pumps from the market from 2018 to 2030.

Large manufacturers, who market a wide range of pool pumps of different types and technologies, would be able to adapt to a medium level MEPS, as long as they are given sufficient time to adjust production schedules and product ranges ahead of the start date.

Small manufacturers would have greater difficulty. They may produce only single speed pumps and may need more time to develop higher efficiency pumps and bring these to market. The effect of a medium level MEPS on small manufacturers would depend on the capacity of these businesses to adjust, the time frame for the introduction of the new regulation, and the scope and coverage of the MEPS regulation.

Therefore, E3 has modelled the medium level MEPS option with a step change from low level MEPS. Stakeholders generally supported this MEPS approach for pool pumps. At its 31 October 2017 meeting, PIAG member agreed that a low level MEPS that factors in pump wattage size (more electricity use allowed for bigger pumps) would be the most appropriate starting point for

the introduction of MEPS with a transition to a medium level MEPS two years later. Public consultation was undertaken on the proposed regulations and no objections were received. Section 5.2 contains more information about the proposed transition timeline.

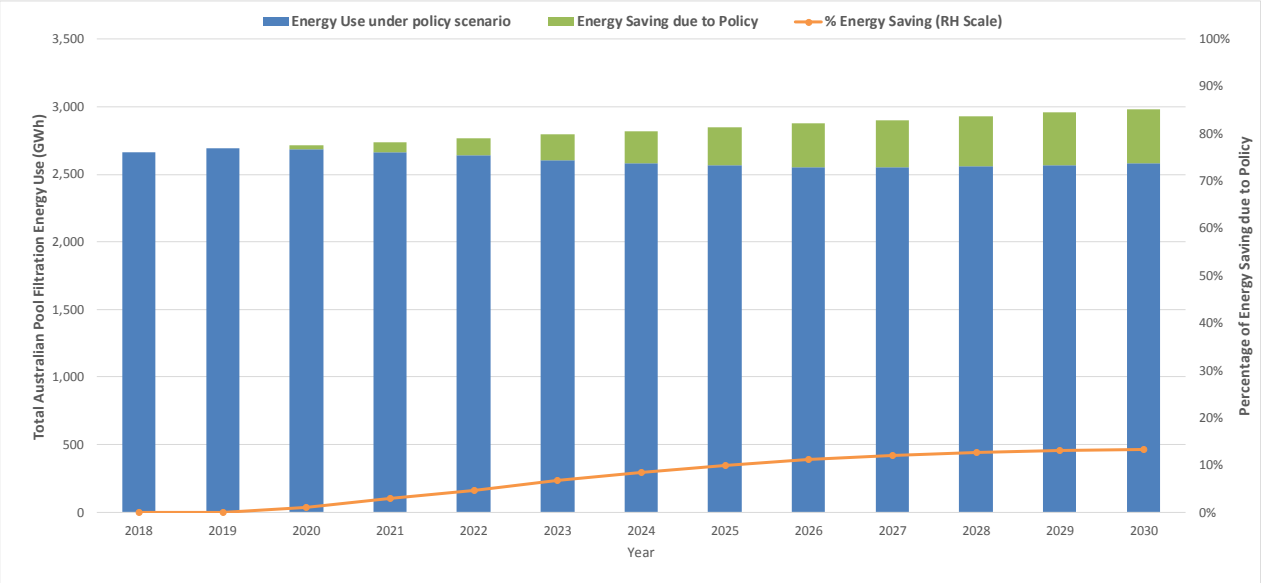
Cost benefit analysis

The central estimate contained in the cost benefit analysis of medium level MEPS with mandatory labelling shows total consumer net benefits of $658.4 million over the forecast period 2018 to 2030. Electricity savings of 2,767 GWh and greenhouse emissions reductions of 2.21 million tonnes are forecast over the same period. Refer to Table 4.3 and Figure 4.4.

Table 4.3: Low – Medium level MEPS cost-benefit analysis (2018-2030)

AUSTRALIA		*Discount rate AUS 7 per cent*				
Policy Option: Low level MEPS curve 2020 and Medium Level MEPS curve 2022		Electricity saved (cumulative GWh to 2030)	Emission reduction (cumulative Mt to 2030)	Total benefits (NPV, $M)	Total Cost (NPV, $M)	Net Benefit (NPV, $M)
	Upper	5,399	4.30	$1,627.0	$121.1	$1,505.9
	Lower	135	0.11	$87.0	$59.1	$27.9
	Central	2,767	2.21	$748.6	$90.1	$658.4

Figure 4.4: Low – Medium level MEPS effect on electricity use (2018-2030)



A low to medium level MEPS would increase the energy efficiency of pool pumps used in Australia substantially, while reducing externalities, such as peak loads on the electricity network. These benefits are not included in this cost benefit analysis.

In addition to having a positive net present value, a low to medium level MEPS would deal directly with market barriers, such as split incentives, that are limiting the uptake of energy efficient pumps by consumers.

E3 considers that a low to medium level MEPS with mandatory labelling would remove most of the least efficient pool pumps from the market. It would reduce the major market barriers (externalities and split incentives) affecting the purchase of more energy efficient pool pumps and it would avoid the problems associated with high level MEPS.

High level MEPS and labelling

A high level MEPS would largely align with the US pool pump standard. The US Department of Energy (DOE) will introduce national energy efficiency performance standards for pool pumps, along with a national test method. The US will introduce a lower MEPS requirement for smaller pumps and a higher MEPS requirement for larger pumps. This would allow some small, single speed models to remain in the market, for at least the initial rulemaking round. TWG members generally considered that the weighted energy factor, combined with a scope that captures predominately filtration pool pumps, would be sufficient to allow the necessary single speed pumps to remain in the market.

On the information available to E3, no single speed pump would be able to meet a high level MEPS. As a result, the high level MEPS and mandatory labelling option would remove all single speed pumps within scope from the market. All market barriers and externalities, within the scope of the change, would also be removed under this option. However, there would be major consequences in the swimming pool industry from removing all single speed pumps.

Most stakeholders do not support removing all single speed pumps from the market. Only two submissions to the consultation RIS suggested that a high level MEPS or a medium to high level MEPS would be appropriate. No PIAG or TWG member supported a high level MEPS.

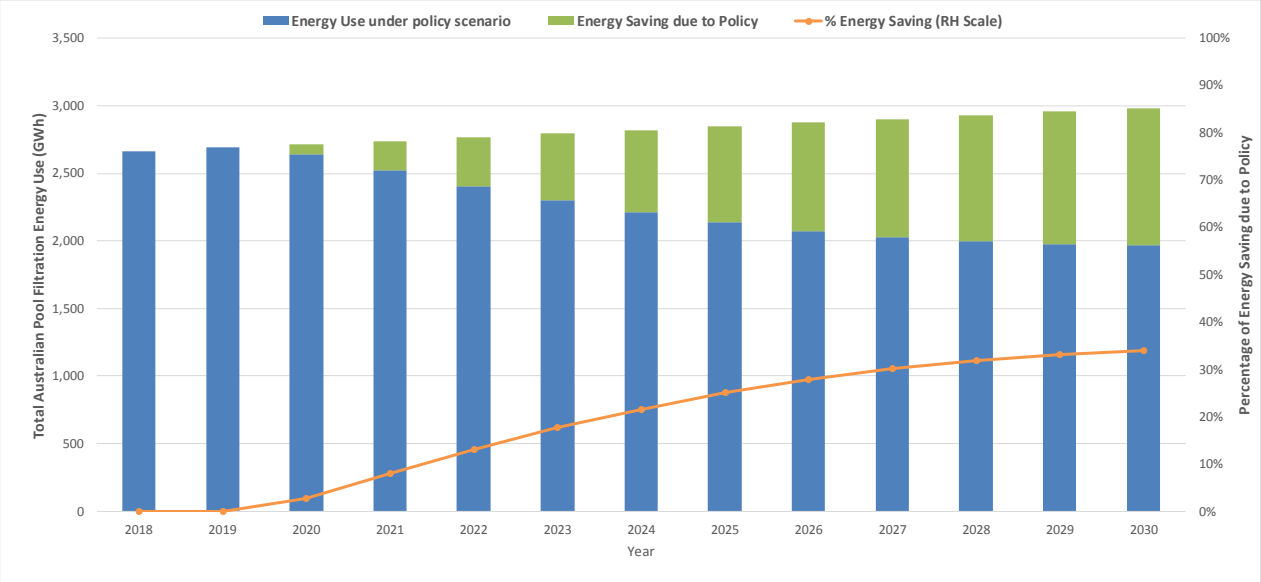
Cost benefit analysis

Analysis by E3 estimates that there are net benefits from introducing high level MEPS. The central estimate in Table 4.4 shows total consumer net benefits of $1506.6 million over the forecast period from 2018 to 2030. This policy option would remove around 60 per cent of the least efficient pool pumps from the market, including all single speed pool pumps within the recommended scope, saving around 7,066 GWh of electricity and reducing emissions by 5.63 Mt to 2030. The yearly electricity savings to 2030 are shown in Figure 4.5.

Table 4.4: High level MEPS cost-benefit analysis (2018-2030)

AUSTRALIA		*Discount rate AUS 7 per cent*				
Policy Option: High Level MEPS		Electricity saved (cumulative GWh to 2030)	Emission reduction (cumulative Mt to 2030)	Total benefits (NPV, $M)	Total Cost (NPV, $M)	Net Benefit (NPV, $M)
	Upper	10,126	8.09	$3,136.3	$454.2	$2,682.2
	Lower	4,007	3.18	$1,280.0	$390.1	$890.0
	Central	7,066	5.63	$1,928.7	$422.1	$1,506.6

Figure 4.5: High level MEPS effect on electricity use (2018-2030)



A high level MEPS would have the largest energy efficiency benefits, but it would also have indirect costs that are not captured by the cost benefit analysis. A high level MEPS would remove all single speed pumps, within scope, from the market. This would affect small businesses that sell a limited range of single speed pumps, remove a range of pumps used for solar heating, and undermine the market for variable frequency drives (VFDs) and the growing automated pool services market. Figure 4.6 shows the pool pumps removed from the market by a high level MEPS, compared with the effect of a medium level MEPS.

A VFD is an adjustable speed device that can be attached to a single speed pump to control its speed and thereby, improve its energy efficiency. These devices have been in the Australian market since around 2010. A report for E3 on VFDs,[43] modelled the effect of MEPS on the market for VFDs for use with pool pumps. The report found that the market for VFDs has grown with consumers seeking energy and cost savings and rebates for specific VFD products. In particular, two Queensland electricity retails – Energex and Ergon Energy - offered rebates to encourage the installation of variable speed pool pumps. More recently, there has been growth in VFD sales as third party providers offer combined VFD and pool automation services. These services range from whole of pool management systems, including a retail electricity provider, to self-managed, app

controlled devices. The third party services cannot be provided if VFDs are not available. The controller unit in variable speed pumps are locked by the manufacturer and cannot be accessed by third parties.

Figure 4.6: Medium and high level MEPS curve for pool pump scope

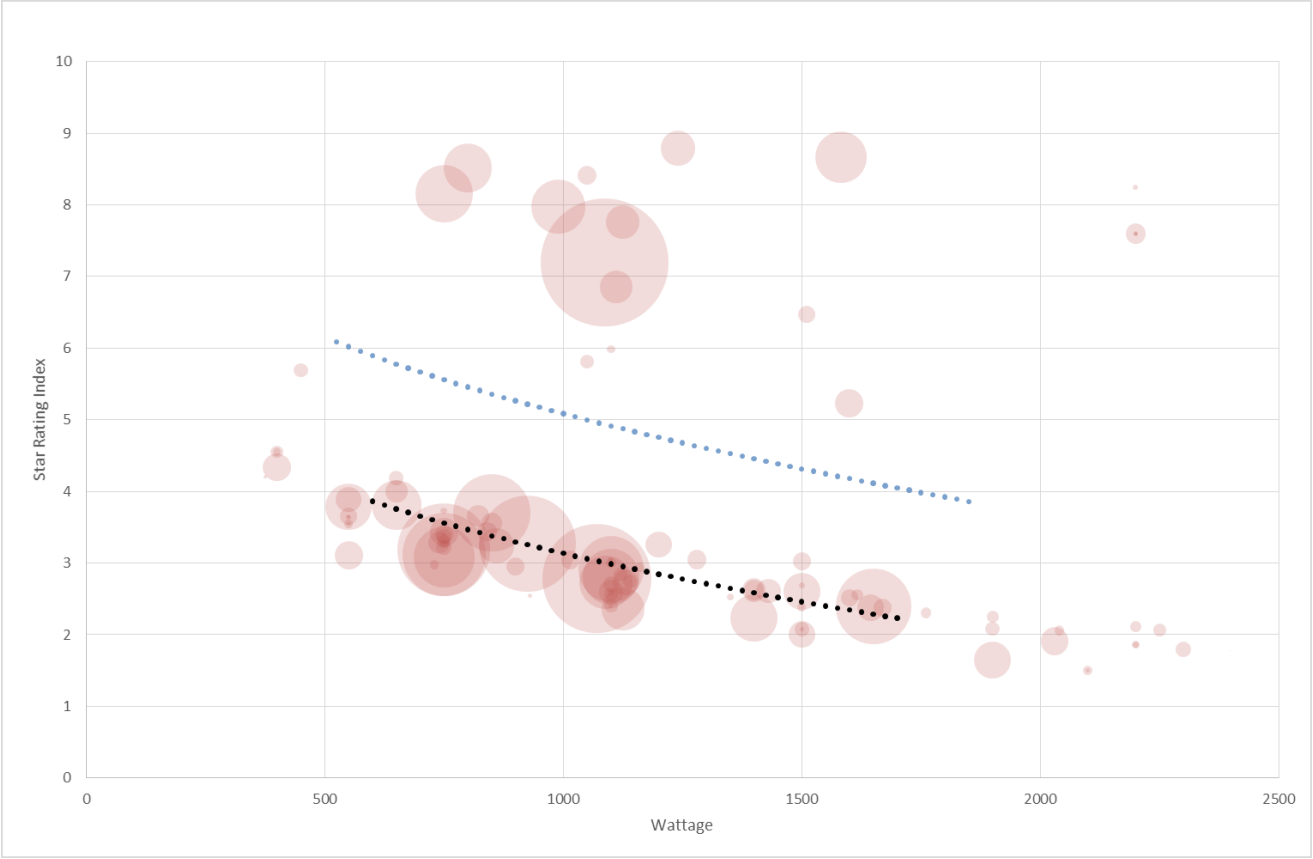
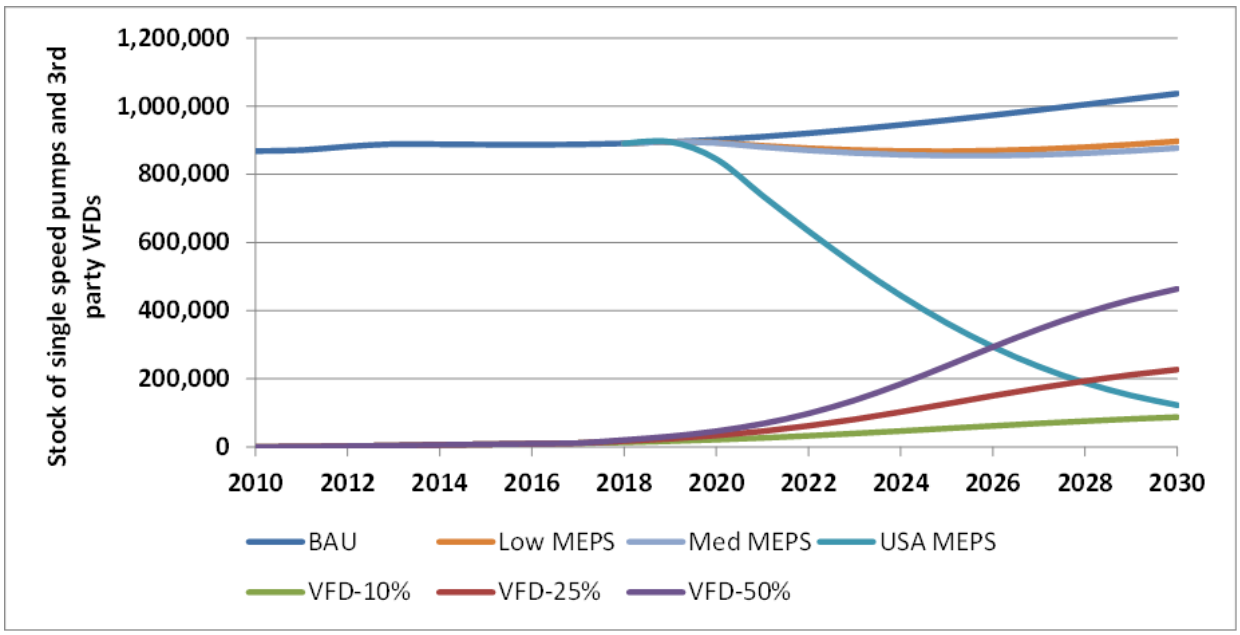


Figure 4.7: Installation of VFD and single speed pump stock under policy scenarios



Source: VFDs and single speed pool pumps – markets characteristics and modelling impacts, EnergyConsult.

Under a high level MEPS (US equivalent) policy option, the number of VFDs that could be sold and installed are reduced significantly. Whereas, under the low and medium level MEPS policy options, there is little effect on the VFD market (see Figure 4.7).[44]

In addition to affecting the market for VFDs and automated pool services, a high level MEPS would remove single speed pumps from the market, within scope, which are used for special purposes, such as booster cleaning or solar thermal heating. A range of pumps are needed in the market for these functions. Pool pumps used for solar thermal heating are the same as those used for pool filtration and they are generally single speed pumps. Using two, multi or variable speed pumps for solar thermal heating is inefficient as they need high pressure (head). The Woolcott survey found that 35 per cent of pools are heated and of those 26 per cent use solar thermal heating. With 1.1 million pools in Australia, this equates to approximately 286,000 pumps.

Pool pumps used for solar heating would generally be outside of the scope of MEPS, because of their wattage size. However, pumps used for solar heating that are within the scope would need to be tested, because there are no physical characteristics to distinguish pumps used for solar thermal purposes, from those used for filtration. This would not be a fair and reasonable test, because a pump intended for solar heating would be required to produce higher pressure, than one intended for filtration. This higher pressure may be required to start the circulation through solar collectors mounted on a roof, for example. Such a pump would produce a different system curve, from the pool filtration pump system curve used in AS 5102.1, and cannot be measured against this standard.

4.3 Summary – MEPS and labelling policy options

The introduction of MEPS and mandatory labelling would reduce identified market failures and increase the uptake of energy efficient pool pumps. The four scenarios considered - labelling alone and labelling with low, medium and high level MEPS – would produce a range of modelled costs and benefits to 2030. Additionally, there would be a reduction in noise pollution and electricity network infrastructure investment due to reduced peak demand.

Under BAU there would be no regulations and the VERLP would be discontinued. There would be natural and gradual shift in sales from single speed pumps to variable speed and other more efficient pumps. Labelling would give consumers accurate and consistent information and provide a basis for energy efficiency program eligibility requirements. E3 estimates that low level MEPS would remove 37 per cent of the least efficient pool pumps from the market and a medium level MEPS would remove 50 per cent of the least efficient pool pumps from the market. At a high level MEPS, around 60 per cent of the least efficient pumps including all single speed pool pumps would be removed from the market[45].

Modelling shows the greatest net benefit is obtained by a high level MEPS, but this modelling does not capture all the effects of removing all single speed pumps, within scope, from the market. For this reason, a high level MEPS is not recommended, because there is an identified need for single

speed pumps for use with variable frequency drives and for special purpose uses, such as solar heating of pools.

Once a high level MEPS is excluded from consideration, the greatest net benefits would be obtained by establishing a medium level MEPS, but introducing such a measure by way of an intermediate step of moving first to a low level MEPS, which would then be used to establish a one star rating benchmark. This approach would retain a range of single speed pool pumps in the market and allow time for manufacturers to adjust to the new regulations.

There was support from the pool pump industry and other stakeholders to introduce MEPS for swimming pool pumps.[46] The transition from a low level MEPS to a medium level MEPS was posed at the 31 October 2017 PIAG meeting. The majority of stakeholders agreed to the introduction of a low level MEPS and labelling followed by a medium level MEPS two years later, subject to a review. The transition timeline was open for public consultation in the *Update: proposed changes to pool pump regulations* policy paper on the Energy Rating website. No objections were received.

Recommendation

Apply a low level MEPS and mandatory labelling to pool pumps and then move to a medium level MEPS at a later date. Introduce the low level MEPS and labelling to take effect the later of either 12 months after the test standard amendments have been finalised through Standards Australia or from 1 January 2020. Transition to a medium level MEPS in January 2022 after a review of the effect of low level MEPS on the market.

4.4 Technical and other changes

To support the introduction of MEPS and mandatory labelling, changes are recommended to the pool pump standards. The consultation RIS asked a series of technical and administrative questions, not only about MEPS, but opportunities or difficulties created by mandatory labelling and measures to overcome the stated problems. Issues raised through consultation RIS submissions, TWG and PIAG meetings and identified by E3 technical consultants are described in more detail in Appendix B.

Method of test

Testing against AS 5102.1-2009 is likely to give a variation in results that is too large to be relied upon for MEPS and mandatory labelling. This was highlighted by pool pump manufacturers and testing houses raising various concerns, when applying the standard in seeking registration under the VERLP.

Testing against AS 5102.1-2009 is limited to measuring the performance and efficiency of two, multi and variable speed pumps at their lowest speed. Two, multi and variable speed pumps need to operate at higher speeds for some operations, such as cleaning the filter and running a cleaning

system. To reflect the energy efficiency and performance of a pump across its likely pattern of use, the performance and efficiency of the pumps at higher speeds needs to be measured and incorporated in the star rating index for the pump.

Weighted energy factor

A weighted energy factor (WEF) is the weighted average of the volume of water pumped in litres per watt hour of electrical energy consumed by the pump, based on the pump operating 80 per cent of the time at the lower speed setting tested, and 20 per cent of the time operating at 80 per cent of the maximum speed. This method would provide a way for the performance of two, multi and variable speed pumps at their higher speeds to be included in the projected annual energy consumption, star rating index and MEPS.

Applying a WEF to the method of test would provide a fairer comparison between single speed and other pool pumps. On 12 July 2017, TWG members agreed to use a WEF as part of the method of test. This approach also aligns with the US test method.

System Curve

A system curve is used to represent the resistance to flow of a typical swimming pool filtration system to assess pool pump energy consumption. The current standard uses Curve D to represent the resistance of a typical pool. During a review in 2013, the Standards Australia working group decided that an alternative filtration resistance curve with higher resistance at low flow (Curve G) would be more appropriate. At its 20 June 2017 meeting, TWG members considered the most appropriate pool system curve that should represent the average pool system. The TWG discussed advantages and disadvantages of retaining Curve D, moving to Curve G or using two categories: Curve D for single speed pumps and Curve G for pumps with multiple speeds. After voting, the TWG agreed that Curve D would be retained. This also aligns with the US test method.

Noise

Pool pumps are often sold with noise information contained in the manufacturers' brochures or model materials. Anecdotal evidence from the pool industry indicates that some consumers value information about the noise produced by different pool pumps.

Increasing consumer awareness of the noise produced by different pool pumps could have several benefits including:

- reduced neighbourhood noise pollution
- encouraging consumers to choose quieter models of pump to avoid the risk of fines or conflict with neighbours over noisy pool pumps
- informing consumers early on in the installation process of the level of noise their pump is likely to make, so that they can take steps to reduce noise pollution by housing the pump in a casing, away from windows, or set up on a timer, to avoid sensitive times of the day.

Stakeholders who commented on noise reporting in their consultation RIS submissions, either supported the introduction of noise reporting or were supportive of further discussion about displaying noise levels. It was noted that requiring noise measurements would allow for a quantitative comparison. During working group meetings, there was general agreement to include noise measurements in the GEMS registration system.

There is no single Australian standard for measuring pool pump noise. A technical report[47] by Vipac Engineers and Scientists reviewed the acoustics component of standard AS 5102.1 and assessed the suitability of different acoustic tests. The report found that tests of various pool pumps showed consistently close results between three standards: AS 1217.2-1985, ISO 3741:2010 and ISO 3743-1:1994.

The three noise standards suggested by Vipac would be recommended as an update to standard AS 5102.1 and test measurements would be included in the GEMS registration system to enable consumers to compare the noise levels of pool pumps.

Other technical changes

The TWG considered other improvements to the standard to ensure the reliability, robustness and repeatability of the method of test. Energy Analysis and Engineering (EnergyAE) was commissioned by E3 to review the AS 5102.1 method of test[48] in collaboration with testing laboratories and to propose options for improving test repeatability. The report reviewed and analysed related work on laboratory pool pump testing and the draft 2013 revision of AS 5102.1. On 30 August 2017, TWG members considered the report and made decisions on changes to the test rig setup and test procedure measurements.

More broadly, between June and August 2017, the working group made decisions to update test point operating conditions, pump categories, flow rates, measurement tolerances, pump run-in times, water and air requirements, test rig construction and electrical requirements. These changes would be recommended as an update to standard AS 5102.1-2009 during the Standards Australia process. Further information on technical changes are at Appendix B, Section B2.

Recommendation

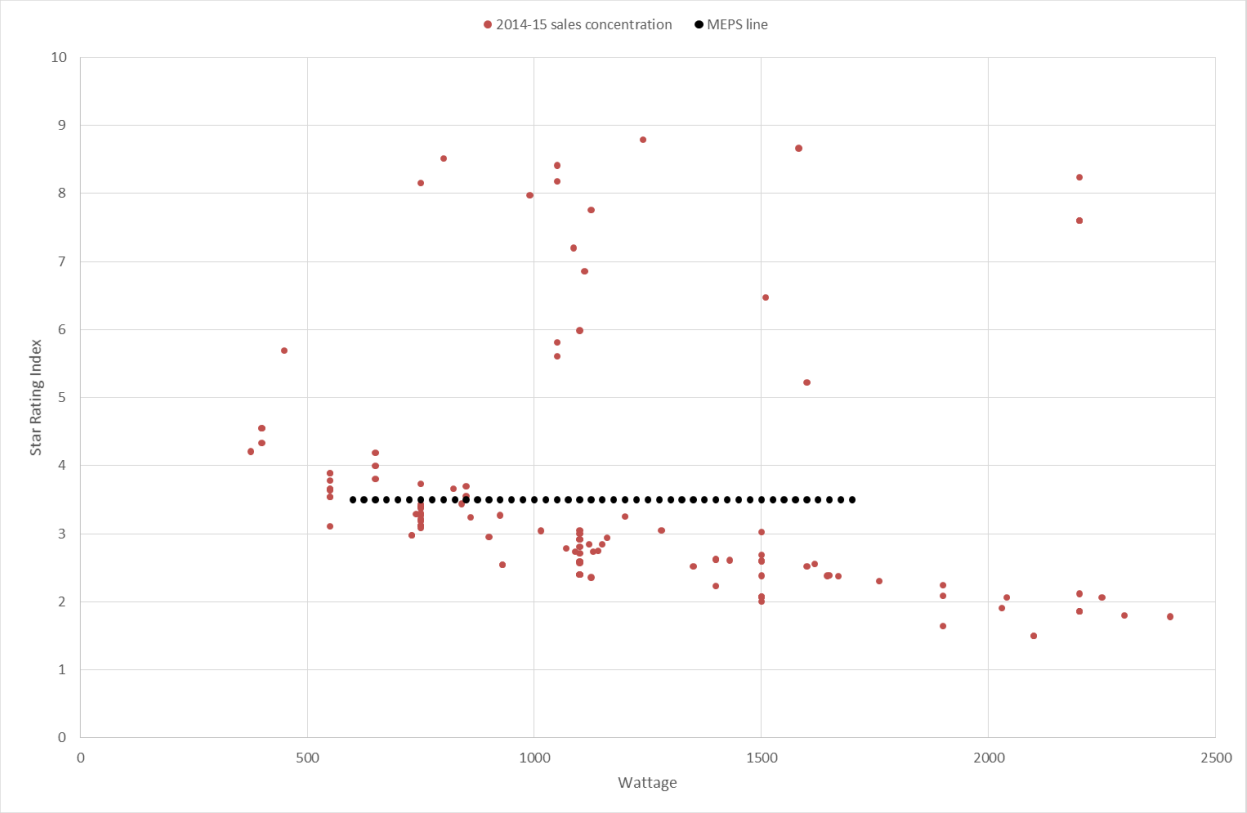
Update Australian Standard AS 5102.1–2009, Performance of household electrical appliances – Swimming pool pump-units, Part 1: Energy consumption and performance, to reflect the change to the:

- method of test, to use a weighted energy factor
- scope of pool pumps captured by the regulation
- definition of pump classifications of single, two, multi and variable speed pumps
- technical amendments to improve the robustness, reliability and repeatability of the test.

Star rating

A star rating is the number of stars that can be displayed on the energy rating label for a product. The rating is calculated from the star rating index to identify the energy efficiency of a product. The method of calculating (flat line) pool pump star ratings is set out in AS 5102.2-2009. In this standard, the rating used means that every pool pump, regardless of wattage size, has the same benchmark, which does not reflect the inherent differences in energy efficiency between pumps of different sizes - that is, larger pumps tend to be less efficient. A curved star rating index will mean that the more efficient larger pumps are not disadvantaged.

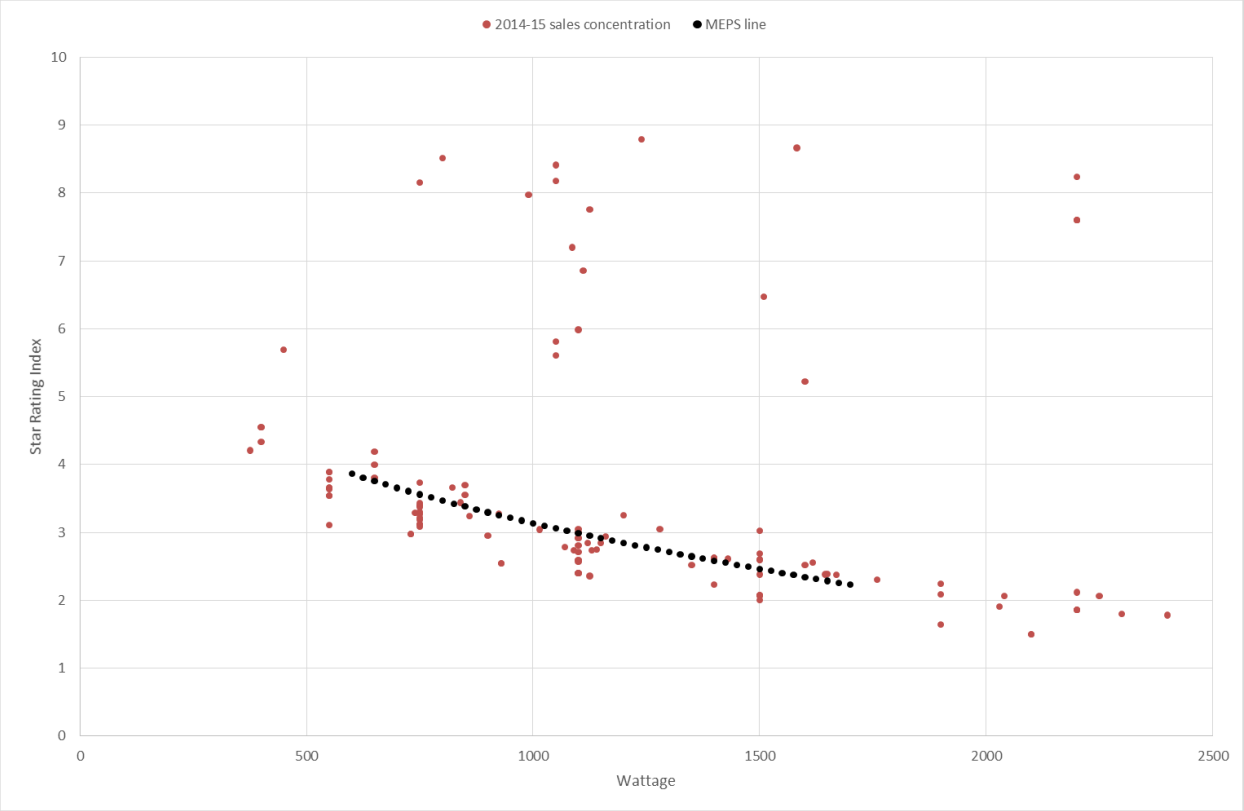
Figure 4.8: Flat line 3.5 star rating



At the 31 October 2017 meeting, PIAG members considered that larger pumps would be intrinsically disadvantaged, if the star rating index remains the same (flat line). This is shown in Figure 4.8, which shows the pool pumps that would be removed from the market under a flat line 3.5 star rating MEPS level. In comparison, a curved medium level MEPS is shown in Figure 4.9. Only the least efficient pool pumps for pumps at each wattage size point would be removed from the market. PIAG agreed that a MEPS level that factors in pump wattage size (more energy use allowed for bigger pumps) would be the most appropriate approach.

More information on star ratings is in Appendix B, Section B.3.

Figure 4.9: Medium level curved star rating line



Recommendation

Introduce a curved line star rating with higher requirements for smaller pumps and lower requirements for larger pumps to ensure that pool pumps of all wattage sizes are rated fairly.

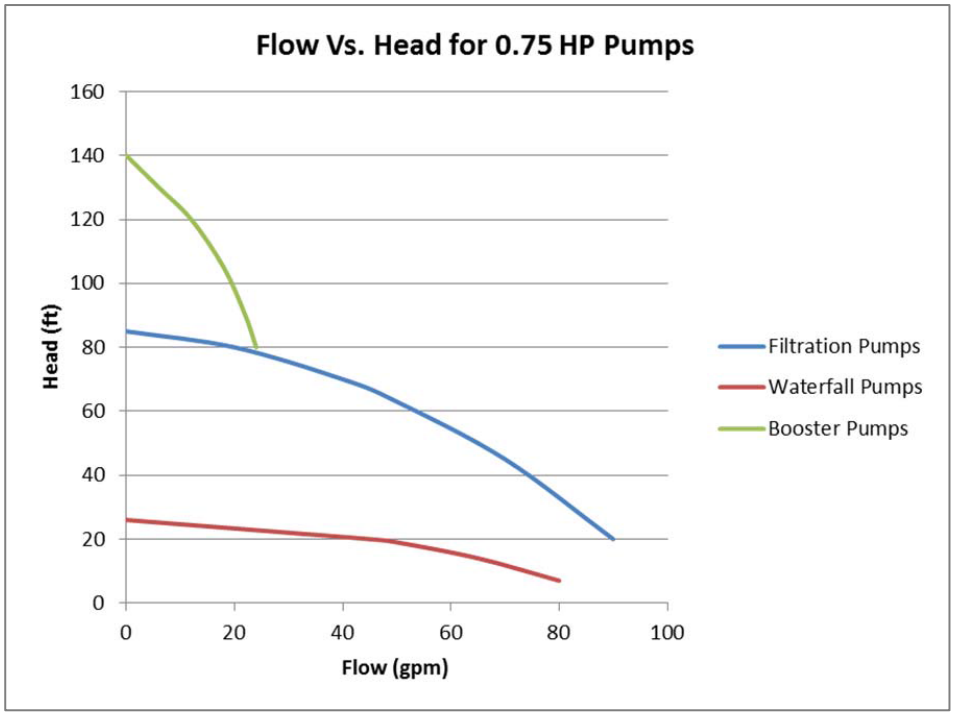
Scope

The majority of single speed pool pumps sold in Australia for the residential pool market are sized between 600 W and 1700 W and operate on single phase power. Single speed pool pumps over this wattage size are used on larger, commercial pools or for other specific purposes and sold in low volumes.

There are a range of smaller, single speed pumps that are used for specific purposes, such as: some spa or swim jets, waterfall pumps, solar thermal heating or cleaner booster pumps. Likewise,

some larger single speed pumps need higher pressure and are used for specific purposes, such as solar thermal heating. Manufacturers have designed combinations of motors and pumps optimised for the intended use of these pumps. Such pumps may not be interchangeable with filtration pumps and may not provide satisfactory performance for some tasks. This effect is shown in Figure 4.10, which plots the performance curves for different types of pool pumps. Such pumps may not run for extended periods and typically have lower wattage. Overall, the functions these pumps perform represent a small part of the total energy used by pool pumps and are outside of the scope of regulation.

Figure 4.10: Performance curves for different pump applications



The majority of stakeholders who commented on the scope of regulation in their consultation RIS submissions requested the exclusion of booster, solar thermal heating and other special purpose pumps, such as operate in floor systems and pumps for above ground pools. A scope was also specified by some stakeholders, with suggestions of an input wattage range between 370 W to 1500 W or 1800 W for single speed pumps and up to 3800 W for larger pumps.

E3 understands that there is limited scope to improve the energy efficiency of special purpose pumps. However, there are no physical characteristics that distinguish a filtration pump from a special purpose pump. Single speed filtration pumps for residential pools generally have a capacity between 600 W and 1700 W. Single speed pumps outside this wattage size range are rarely used for filtration on residential pool other than above ground pools.

The PIAG meeting on 31 October 2017 considered the appropriateness of the input power figure being used to determine whether a pump was in scope and, in particular, using the nominal figure, including tolerance according to the electrical safety standard requirements for inclusion on the

product nameplate. At the 28 November meeting, PIAG agreed to a scope of the rated input (or rated current in amperes) as reported on the nameplate, 600 W to 1700 W for single speed pumps and 600 W to 3400 W for two, multi and variable speed pumps.

Figure 4.11: Scope of regulation

	Input power range between:				
	Watts	Amps		Watts	Amps
Single speed	600	2.6	and	1700	7.4
Two speed	600	2.6	and	3450	15
Multi speed	600	2.6	and	3450	15
Variable speed	600	2.6	and	3450	15

There was general agreement to define the scope as a pump that is capable of running with a rated input power (or rated amperes) within the specified range. Minimum energy performance standards (MEPS) and mandatory labelling would apply to pool pumps for the rated input, as reported on the nameplate.

E3 considers that the proposed limit to the scope of pool pumps required to meet MEPS captures pump types and wattage sizes that would provide most of the benefits of the regulation, while avoiding imposing energy efficiency requirements on low volume, specialist pumps, which are needed for specific applications.

Recommendation

Apply minimum energy performance standards, that factor in pump input watts or amperes size, and mandatory labelling to pool pumps within the following scope.

	Input power range between:				
	Watts	Amps		Watts	Amps
Single speed	600	2.6	and	1700	7.4
Two speed	600	2.6	and	3450	15
Multi speed	600	2.6	and	3450	15
Variable speed	600	2.6	and	3450	15

Label design

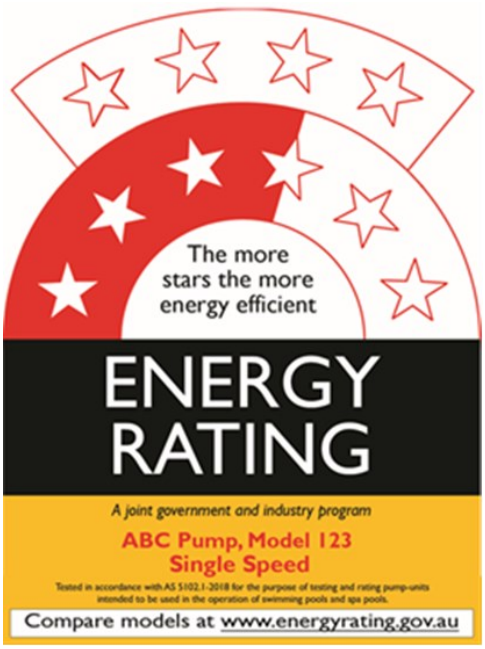
The design of the pool pump ERL was highlighted in the consultation RIS. In particular, it displayed a horizontal label that incorporated a map and climate specific information, noting that either the existing arch layout or the horizontal star layout could be used for pool pumps. Submissions generally agreed that the coronet style label used in the VERLP should be retained. Stakeholders also commented on the size of the ERL being too large for a pool pump and the usefulness of including a wattage range on the label.

On 24 October and 9 November 2017, PIAG considered if there was value in labelling pool pumps and considered potential label designs for mandatory and voluntary labelling. PIAG considered that the existing VERLP energy rating label is not practical for a pool pump. The label is too large to place on a pump and the technical information is too complex for consumers. PIAG members decided that mandatory labelling should be applied to swimming pool pumps packaging and brochures at the point of sale and generally agreed on the proposed label shown in Figure 4.12. PIAG considered displaying ERLs or star rating and pump curves in brochures and online should be voluntary.[49]

The label design in Figure 4.12 was developed with advice from the pool pump industry and has the characteristics of the typical ERL: displaying the standard colours, stars, energy efficiency messaging and product details. However, it differs by not displaying the annual energy consumption (kWh). The label has a 10 star arch for all star ratings.

E3 is undertaking testing of the proposed label design at Figure 4.12. The research will test components of the proposed label and other ERL characteristics, such as energy consumption, to ensure that it is easy for consumers to understand and interpret the label correctly. The research will examine the ERL format that would best influence consumer choices and lead pool owners to purchase a more energy efficient pool pump. If the COAG Energy Council decides to introduce mandatory labelling for swimming pool pumps, the proposed design and recommendations from the label research would inform the final label design to ensure it is effective and easy to understand.

Figure 4.12: Proposed pool pump energy rating label



Recommendations

Update the pool pump energy rating label following public consultation by E3.

Require the display of energy rating labels on either the product, if displayed in store, or on the packaging at the point of sale. Suppliers could voluntarily display the energy rating label or the star rating and pump curves in brochures and online.

Implementation and review

5.1 New regulations

If the COAG Energy Council agrees to the introduction of MEPS and mandatory labelling for pool pumps, a determination would be prepared by E3 and *Part 1: Energy consumption and performance* of Australian standard AS 5102 would be updated.

GEMS determination

Standard AS 5201.2-2009 contains pool pump energy labelling and MEPS requirements. It is used for star rating, labelling and registration system requirements. These E3 Program requirements would be moved to a GEMS determination.

A GEMS pool pump determination would be made under section 23 of the GEMS Act. Stakeholders would have the opportunity to review and provide comments on exposure drafts of the determination. The draft determination would be submitted to the Senior Committee of Officials (SCO), under the COAG Energy Council, for final review and approval. Once SCO has approved the draft determination, it would be submitted to the Commonwealth Minister for the Environment and Energy for final approval and signature.

Standards Australia

The method of test and other technical requirements for pool pumps in AS 5102.1-2009 would need to change. Standard AS 5102.1-2009 sets out the requirements for pool pump energy performance and consumption. The amendment process is managed by Standards Australia and considered by committee EL-058, Energy Efficiency for Swimming Pool Pumps. E3 has submitted a project proposal, as described in Chapter 4 and Appendix B, to amend the standard.

As per the Standard Australia process, the amended standard would be published for public consultation. After a nine week consultation period, committee members would consider and resolve comments received and update the standard. After agreement by the committee, the revised standard would be published and available for use. This process could take between eight and 12 months.

Competition effects of MEPS

E3 does not expect the introduction of a low to medium level MEPS with mandatory labelling to reduce competition in the pool pump market. There are a large number of firms supplying the market and a range of products sold, from both Australian and overseas suppliers in Asia, Europe and the US. There may be some reduction in contestability, if small or medium sized firms, who stock a small number of single speed pumps, withdraw from supplying the market, because they are unable to meet the proposed MEPS levels. Two consultation RIS submissions noted that there is potential for smaller companies to withdraw from the market, if regulation costs were too high or if all single speed pumps were withdrawn from the market. A reduction in firms supplying the market is unlikely to occur, because the MEPS scope will keep some single speed pumps in the market and the transition period to low and then medium MEPS will allow time for suppliers to transition their stock to more efficient pumps. If suppliers do leave the market, due to removal of the less efficient single speed pumps or high compliance costs, it is not expected this will have a material effect on competition because of the number of suppliers in the market.

There is some analysis to suggest that the introduction of MEPS for appliances has supported reductions in prices of higher energy efficient products, along with an increase in the quality and features of the regulated products.[50] The introduction of MEPS, while precluding some products from sale, has not prevented sustained reductions in the prices of other MEPS compliant products; nor has it prevented suppliers from improving the quality or other features of their products.

The introduction of mandatory labelling and the associated costs of testing and registering products may discourage some suppliers from offering products for sale. This might occur where the market potential is small or unknown, such as special offerings by chain retailers.

5.2 Transition timeline

The introduction of a low to medium level MEPS would not start immediately, to allow time for industry to prepare for the regulation. Submissions to the consultation RIS showed the majority of stakeholders who commented on the implementation timeline preferred a 12 month implementation period. Fewer submissions requested an 18-24 month transition, with one submission wanting alignment with implementation of the US standard on 19 July 2021. Manufacturers of various sizes were split evenly on a shorter or longer implementation timeframe.

The PIAG recommended, at its meeting on 28 November 2017, that a low level MEPS and mandatory labelling should take effect the later of either 12 months after the test standard amendments have been finalised through Standards Australia or on 1 January 2020. PIAG also recommended that a medium level MEPS should take effect on 1 January 2022, following a review of the effect of mandatory labelling and MEPS prior to this date.

The commencement date of January 2020, or 12 months after the test standard is published would allow industry around 12-18 months to prepare for the new regulations, including:

- to test and verify pool pumps
- sell out existing stock
- transition from the VERLP
- update websites, packaging and product information
- reengineer products.

Products imported into or manufactured in Australia from the commencement date would be required to comply with the new regulations, before they could be offered for sale. Products that are manufactured or imported into Australia prior to the commencement date would be allowed to be offered for sale until sold out. In addition, suppliers would be able to voluntarily register products before the commencement date.

The VERLP would be redundant once mandatory labelling and MEPS are introduced. The program was intended as a transitional step, prior to consideration of mandatory labelling or MEPS, and it sits outside the compliance structure for products regulated under the GEMS Act. Regardless of whether the COAG Energy Council decides to introduce mandatory labelling or MEPS, E3 will close the VERLP to new applications once the Energy Council considers the decision RIS recommendations. Owners of VERLP registered products will be notified by E3 of the closure of the program.

5.3 Product registration

Products regulated for energy efficiency must be registered, before they can be sold or offered for supply in Australia. Registration requirements for pool pumps would be outlined in the GEMS determination and applicants would need to pay a registration fee as part of the application process. The fees would be determined by the GEMS Regulator. To assist with the transition, the new label would be automatically generated as part of the registration process. This would save pool pump suppliers the cost of laying out the labels for their products.

Family of models

The GEMS Act specifies that a registered product may cover more than one model in a family of models. This means that if there are two or more pool pumps, with the same characteristics, they may be grouped together in a family and registered as a single product. The existing standard, AS 5102.2-2009 (Section 1.5.5 – model), defines a model as, 'pump-units of one brand, to which a single set of test reports is applicable and where each of the pump-units has the same relevant physical characteristics, comparative energy consumption, energy efficiency rating and performance characteristics'. As agreed by PIAG on 28 November 2017, the GEMS determination would adopt the family of models definition contained in AS 5102.2-2009, but this definition would be widened to allow pumps of different brands, but which otherwise have the same relevant physical and performance characteristics and the same comparative electricity consumption.

Public information

As part of the registration process, some information about registered pool pumps would become public and some information would be kept confidential. Applicant details and test information to remain confidential. However, energy performance and product information would be available to the public. Pump curve data would be included on the public registration database, on a voluntary basis, as agreed by PIAG members on 28 November 2017.

If the COAG Energy Council decides to introduce MEPS or mandatory labelling for pool pumps, E3 would consult with industry on the development of the registration database to refine the type and form of information on registered pool pumps to be collected and made available to the public and that information, which would remain confidential.

Information about proposed changes resulting from new regulations would be prepared for pool pump manufacturers, pool builders, maintenance professionals, retailers, industry groups and consumers to explain the new regulations. At the 28 November 2018 meeting of PIAG, it was agreed that E3 and the Swimming Pool and Spa Association (SPASA) would work cooperatively to develop a plan to disseminate pool pump energy efficiency information to industry professionals and consumers.

The aim of disseminating information to industry and consumers would be to raise awareness of the savings to be made by using more efficient pool pumps with a view to changing behaviour in

the buying and selling of pumps. E3 would also raise awareness in the pool industry of legislative changes that would affect the type of pumps that can be sold and how pump suppliers can comply with the new regulations.

5.4 Implementation risks

There are some risks with introducing MEPS and mandatory labelling for pool pumps. The first risk, which is considered low, is with not allowing enough time for industry to adjust before the new regulations would take effect. This decision RIS proposes a minimum of twelve months, on the basis that pool pumps suppliers would need time to prepare for MEPS and labelling, but most suppliers have a full range of products that would meet the proposed requirements. While half the manufacturers indicated in their consultation RIS submissions that a 12 month lead time would be sufficient, other manufacturers indicated that they may need up to 24 months. E3 understands that most companies' production and ordering cycle for pool pumps operate on an 18 month lead time. The limitations of a twelve month period before the regulations would take effect would be lessened by allowing product imported or manufactured in Australia, prior to the regulation start date, being allowed to be sold until the stock is exhausted. In addition, industry would have notice of the impending regulation from the time that the COAG Energy Council announces its decision to introduce MEPS or mandatory labelling for pool pumps.

Another risk is the potential for confusion between the VERLP label and a new label. Registrants of VERLP products will be advised that the program will cease and new registrations would not be accepted, once the COAG Energy Council considers the proposed regulations. Providing a lead time of 12 months, prior to the start of the new requirements, would allow manufacturers to factor the new labelling requirements into their production and ordering cycles. Training and education material would also be made available to the pool industry explaining the change. The differences in the size and appearance between the two labels should also reduce the risk of confusion.

If MEPS and mandatory labelling regulations are not implemented, there would be a gap in energy efficiency information that is currently filled by the VERLP. As mentioned in Chapter 1, state and territory governments and electricity companies use the VERLP as part of their energy efficiency program eligibility requirements. This information will no longer be available, if no MEPS or labelling requirements are introduced and the VERLP is closed.

5.5 Review

The introduction of a low level MEPS with mandatory labelling would be reviewed by E3, prior to the MEPS level being raised to a medium level in 2022. This review would consider the effect of MEPS and mandatory labelling on the market, consumer behaviour in response to the regulation, difficulties encountered by the pool pump suppliers during the transition and any concerns or other issues identified by stakeholders.

Compliance monitoring

Once the standard and the determination are published, products can be registered. All products are to be registered by the date of commencement of the regulation. The GEMS Regulator is responsible for monitoring and enforcing compliance of GEMS products. In doing so, the Regulator would:

- assist the industry with understanding the requirement of the GEMS Act
- monitor compliance
- pursue those who contravene the Act.

The Regulator would, as part of the GEMS Compliance Monitoring program:

- check test products to verify MEPS energy efficiency claims and other performance measures are met
- conduct market surveillance of products to verify models are correctly registered and display the appropriate energy rating label
- respond to allegations of non-compliance.

The GEMS Regulator would work with industry groups and, by sharing information, inform pool pump manufacturers, distributors, suppliers and retailers of their obligations under the Act.

Evaluation

The E3 Program uses various sources of information to evaluate the effectiveness of the program and product requirement. These sources include:

- retrospective reviews, to compare the effect of policies, versus what was projected
- analysis of sales data to understand consumer awareness and the use of energy efficiency information and labelling
- monitoring of activity on the Energy Rating website.

Appendix A: Modelling assumptions and sensitivities

A.1 Methods and key inputs for cost benefit analysis

This appendix explains the methods used for the cost benefit analysis (CBA) of pool pump policy options and documents data sources and steps used for the analysis.

A financial analysis model has been built to review the overall costs and benefits with each proposal being considered in this RIS. Each of the proposals is compared to business as usual (BAU) where there is no policy intervention in the pool pump market. Both costs and benefits are evaluated for products purchased from 2018 to 2030. They include the following:

Benefits:

Energy saving for consumers due to improved efficiency of pool pumps and the resulting avoided electricity cost.

Reduced emissions as a result of energy savings from intervention. (These benefits are not monetised as part of the CBA).

Costs:

Extra upfront capital cost for consumers to purchase energy efficient pumps when regulation restricts sales of single speed pumps.

Regulatory cost for the industry (including additional administrative resources and registration cost).

Data sets and reference materials used in this CBA

Five years of pool pump sales data collected from 2010 onwards, from four manufacturers (AstralPool, Davey, Pentair and Zodiac) which cover around half of the estimated pool pump sales.

Pool pump test reports from Vipac laboratory, Austest laboratory and Waterco.

Woolcott swimming pool pump survey conducted in 2016.[51]

Household pool penetration survey published by Roy Morgan Research Group (2015).

Australian Bureau of Statistics (ABS) household pool penetration survey in 2001, 2004 and 2007.

ABS household number projection and measurements from 2001 to 2016.

Energy use in the Australian residential sector 1986 – 2020 by the Department of the Environment, Water, Heritage and the Arts (2008).

Wholesale and retail prices forecast from 2017 by AEMO (2017).

Ergon Energy pool pump program post implementation review by Ergon Energy (2016).

Other key inputs and list of assumptions

Electricity prices

Separate retail tariff rates for each Australian state and territory, along with projected tariff values, are applied to energy savings to calculate the benefits. Electricity prices by state are shown in Table A1.

Table A1: Electricity prices by state[52]

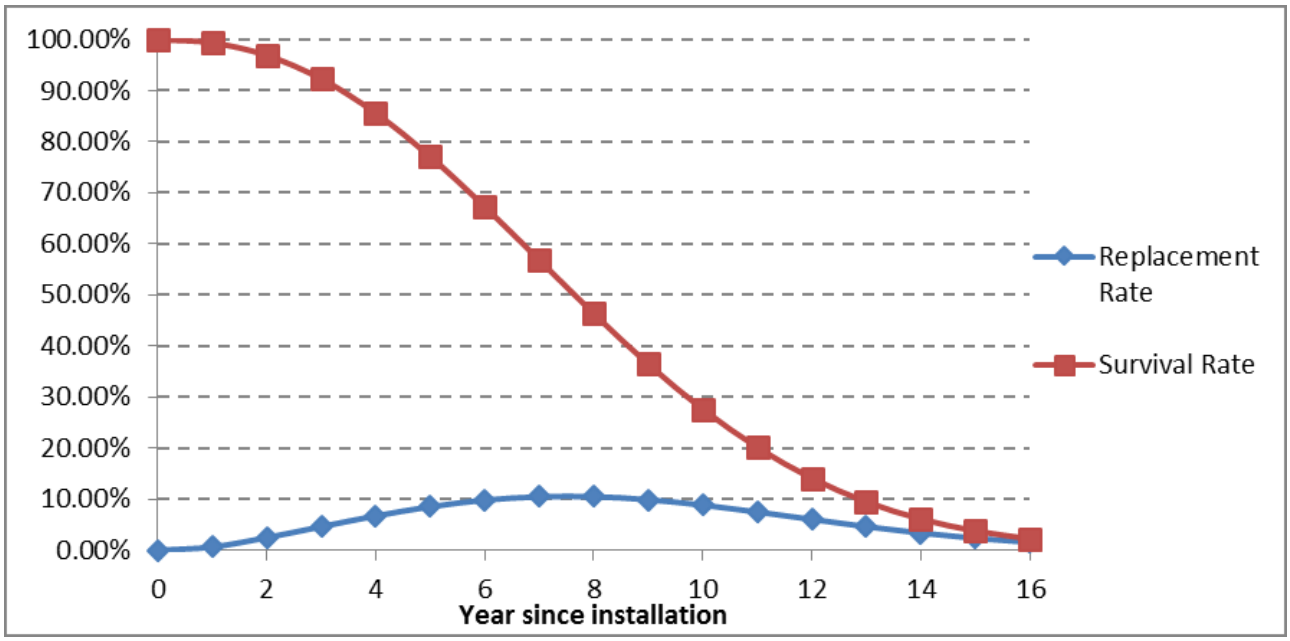
Electricity Prices (Cents/kWh)								
Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
2018	32.43	35.28	35.35	42.59	27.40	35.02	26.43	21.73
2019	34.08	39.46	36.00	44.48	28.09	38.94	27.09	22.84
2020	33.30	39.65	35.13	44.27	28.79	39.66	27.77	22.31
2021	32.43	38.58	34.64	41.94	29.51	41.24	28.47	21.73
2022	32.29	37.29	34.71	40.89	30.25	40.32	29.18	21.64
2023	32.96	36.13	35.24	38.72	31.00	39.36	29.91	22.08
2024	33.47	35.18	34.44	37.21	31.78	38.25	30.66	22.42
2025	31.92	33.66	33.83	35.61	32.57	37.35	31.42	21.39
2026	30.37	32.01	33.51	34.21	33.38	36.06	32.21	20.35
2027	29.65	30.59	32.81	33.41	34.22	34.22	33.01	19.86
2028	29.89	30.32	32.78	33.63	35.08	33.23	33.84	20.02
2029	30.90	31.59	32.86	34.88	35.95	33.19	34.68	20.70
2030	31.45	33.29	33.02	36.07	36.85	33.94	35.55	21.07

Lifetime of a pool pump

The average lifetime of a pool pump is estimated based on the findings of the Woolcott consumer survey. By fitting a Weibull distribution curve to the survey findings for age of pump when replaced, a survival rate curve can be produced for pool pumps (shown in Figure A1). This survival rate is an important input for the cost benefit analysis, because it is used to calculate the pool pump replacement rate and the size of tailing benefits. On average a pool pump will have a lifetime of 7.25 years.

Based on the Woolcott survey, among respondents in Australia who were replacing their pool pumps, 20 per cent were replacing pumps 0-5 years old, 42 per cent were replacing pool pumps 5-10 years old, 23 per cent were replacing pool pumps that were more than 10 years old. The remaining 15 per cent did not know the age of the pump they were replacing.

Figure A1: Replacement of Pool Pumps



Assumptions

1. Sales distribution within each star rating band from collected sales data (more than 50 per cent of the entire market) is representative for the entire filtration pool pump sales market. The BAU distribution of pumps by single speed compared to multi and variable speed shifts from 70 per cent single speed and 30 per cent multi and variable speed pumps in 2017 to 60 per cent single speed and 40 per cent multi and variable speed pumps by 2030.
2. The BAU energy use includes the energy saving benefits of up to 10 per cent of the stock of single speed pumps having third-party installations of variable frequency drives (VFD) by 2030.
3. Pool filtration pumps available to consumers in the market are similar in performance when compared to those tested by Vipac Testing Laboratory (utilising AS 1502:2009). That is, pumps sold in the market and tested pumps form the same regression in terms of Pd vs star rating index (SRI), Qd vs Pd and Pd vs SRI.
4. Measured Qd from the pump performance curves is used to estimate the SRI and Pd of each pump model using regression relationships derived from the Vipac tests. These estimated SRI and Pd values are used for the analysis.
5. Sales distribution for pool pumps in terms of star rating is assumed to be same between different regions in Australia.
6. Retail price of pool pumps will remain static in real terms. (This is likely to be a conservative assumption).
7. The percentage of pool pump buyers who will have exposure to the energy rating label while purchasing is 70 per cent.

8. The energy rating label will not promote more sales in variable or multi speed pumps due to a large upfront cost difference between single speed pumps and variable and multi speed pumps (approximately $700).
9. Consumers who are exposed to and can understand the energy rating label will maximise the effect of the label by choosing the most efficient model, where excess extra capital investment is not required.
10. The additional financial benefits of greenhouse gas emission reductions are not considered in this analysis.
11. The rebound effect is assumed to be not applicable to pool pump use.

Understanding the pool pump market

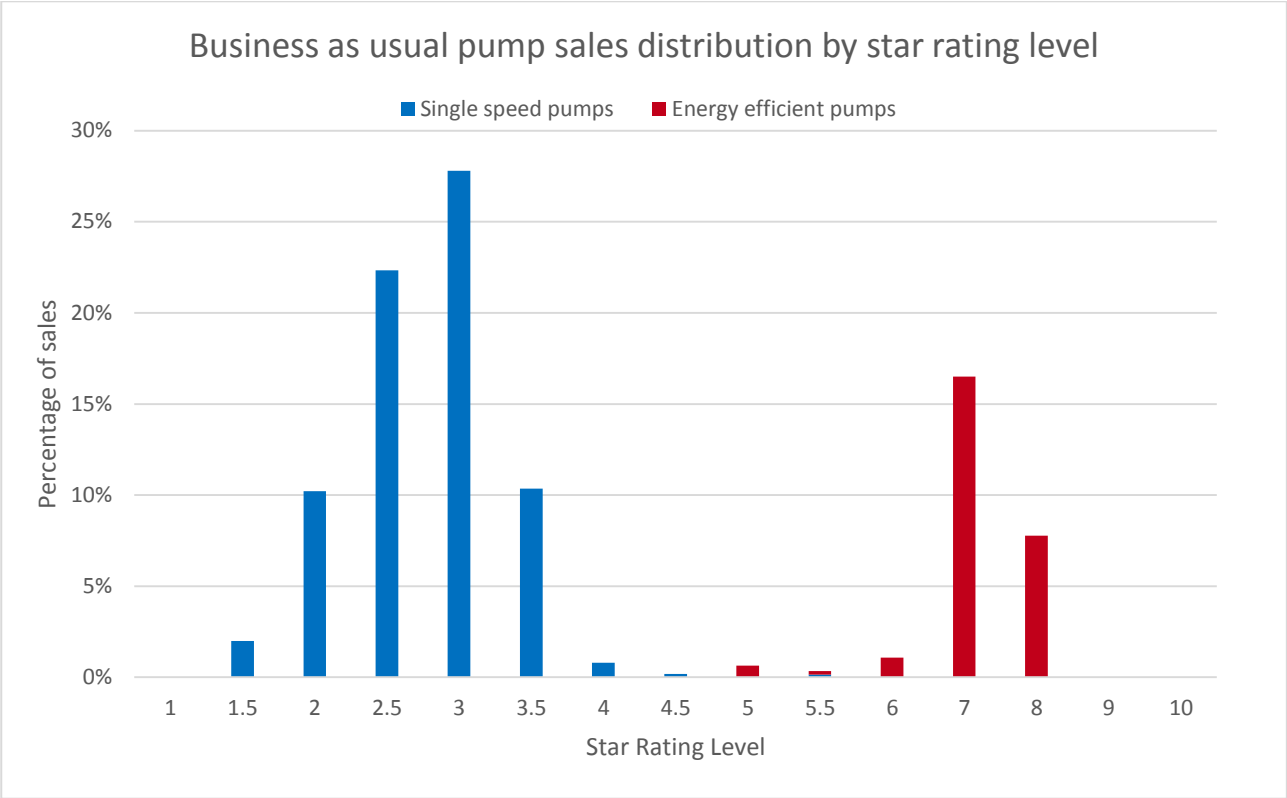
The only publicly available information about pool pump energy consumption comes from manufacturer guides and products that are covered by the Voluntary Energy Rating Labelling Scheme (VERLP). Participation in the VERLP is voluntary and registered models (mostly energy efficient multi speed or variable speed pumps) can only provide energy efficiency specifications for a small fraction of the collected sales data, as most of the sales are single speed pumps. This prompted E3 to commission more laboratory tests to understand the energy efficiency distribution of pool pumps sold in the market.

Between 2014 and 2016, E3 commissioned Vipac laboratory to conduct 54 pool pump tests according to *AS 5102.1-2009 Performance of household electrical appliances – Swimming pool pump-units Part 1: Energy consumption and performance*. The tested pumps were:

28 models with the most sales from collected sales data
15 models to verify reported data on the voluntary register
11 models selected to provide a representative sample of the proportion of the market that did not provide sales data (including three New Zealand manufactured pumps).

The test reports provided energy efficiency data corresponding to around 85 per cent of collected sales data for pool pumps. For the remaining models without tested data, the energy efficiency specification is assigned by finding Q_d through the product performance curve and Pd through the relationship between P_d and Q_d (taken from regression analysis from 54 tested models). After assigning efficiency specifications for all models, either through direct testing or estimation through regression, a market sales distribution by efficiency level was produced. Refer to Figure A2. The star rating distribution is based on AS 5102.1-2009.

Figure A2: Pump sales distribution – Business as usual



Energy efficiency specification for a pool pump is measured in terms of Energy Factor (EF), which is energy consumed per litre of water pumped (derived from Q_d and P_d). To present energy efficiency specification in a manner that is easily understandable for consumers, *AS5102.2 Performance of household electrical appliances – Swimming pool pump-units Part 2: Energy labelling and minimum energy performance standard requirements* assigns a star rating to a pump according its EF value. For the purpose of this RIS, E3 has modelled the WEF according to the proposed star rating algorithm and uses the star rating of a pump to represent its energy efficiency level, in order to present the data in a simple and uniform manner.

Calculating energy consumption of pool pumps used for filtration

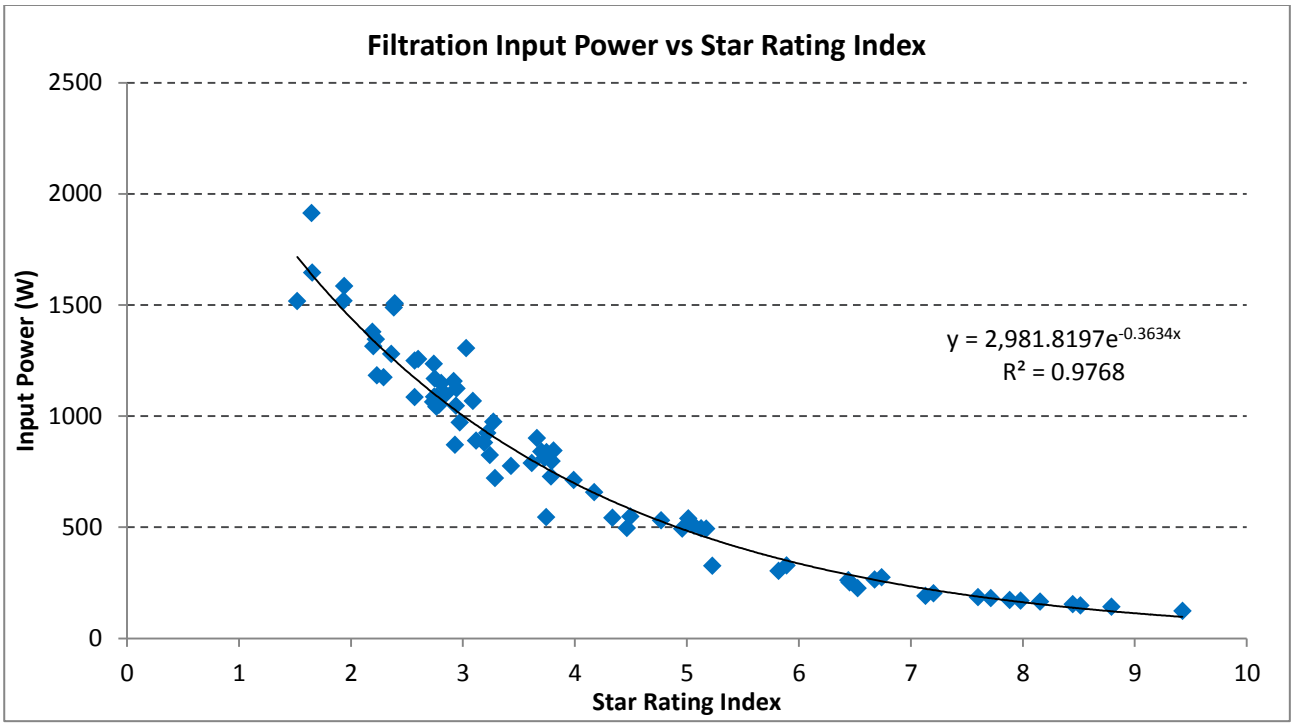
The total annual energy consumption of pool pumps used for filtration is the product of the electrical power input of pool pumps used in Australia, multiplied by the total number of hours of operation in a year, and then multiplied by the total number of pool pumps in use.

Input power

The input power of pool pumps during filtration varies by its star rating, which is a system to rank energy efficiency of a filtration pump set out in AS 5102.2 2009.[53] Figure A3 depicts pump filtration input power in terms of star rating. It is based on 54 sets of individual pump specifications tested by Vipac laboratory and 6 sets of additional pump specifications tested by Austest laboratory and Waterco. It illustrates a clear trend between the star rating of a pump and its input power while

filtering. The trend line in the chart is used to estimate input power of a pool pump during filtration for all star rating ranges.

Figure A3: Power of pumps by star rating



Hours of operation

From the Woolcott consumer survey, it is clear that operating hours for household pool filtration pumps vary by season, with more hours of use in summer and less in winter. This seasonal variation is aggregated into an annual daily average hours of operation distribution, applied to all filtration pool pumps. This approach sets the daily average hours of operation for a filtration pump at 4.2 hours.

Note that AS 5102.1 calculates run time and estimates annual energy use of a pump by requiring it to circulate 50,000 litres of water daily. This does not produce a fixed run time and requires the owner of a pool to calculate run time according to the pump flow rate. In these calculations, the number of hours used is the number of hours owners claimed to operate their pumps, according to Woolcott survey data from 2016.

Sales volume for pool pumps used for filtration

The annual sales volume of pool pumps used for filtration is derived from:

household number projections by the Australian Bureau of Statistics (ABS)
penetration of household pools in the each capital city and state (surveyed by Roy Morgan Research Group in 2015)
historic Australian household pool penetration (ABS survey in 2001, 2004 and 2007),

average lifetime of filter pumps (7.2 years)

the ratio of sales between newly installed pool pumps and replacement pool pumps (extracted from historic pool numbers surveyed by ABS).

Pool penetration numbers are calculated from Woolcott survey (2016). It was projected that 2017 sales of filtration pumps would be 170,300 in Australia, with an annual rate of growth of 1.8 per cent in 2017, tapering to 1.5 per cent in 2030. Refer to Figure A4 for projected annual filtration pool pump sales.

Figure A4: Projected annual filtration pool pump sales

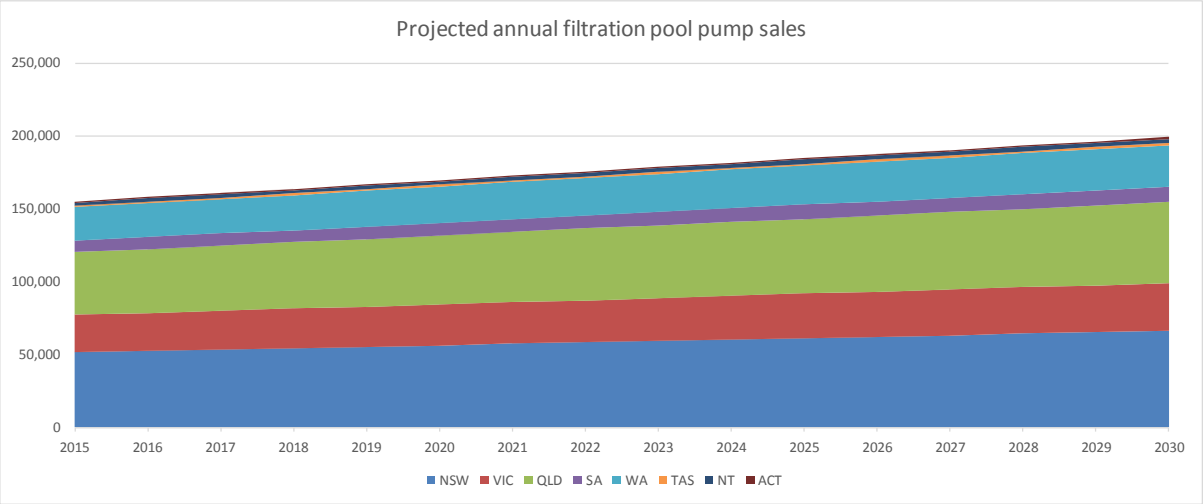


Table A2: State and Territory share of national pool pump sales

State or Territory	*Percentage of total Australian pool pump sales*
NSW	33.1 per cent
VIC	16.5 per cent
QLD	27.9 per cent
SA	5.1 per cent
WA	14.6 per cent
TAS	0.7 per cent
NT	1.4 per cent*
ACT	0.6 per cent*

*Roy Morgan survey did not cover household pool pump sales in the ACT or NT, figures from these two territories are estimated based on Energy Use in the Australian Residential Sector, published in 2008.

The 2015 survey on household pools conducted by Roy Morgan Research Group reveals the percentage of household pool penetration in each Australian state and territory. Combined with the 2015 ABS household data projections, the percentage share of household pools in each state

and territory (thus percentage of total pool pump sales by state or territory) can be produced, as shown in the Table A2.

The sales distribution of pool pumps by star rating level is calculated by analysing sales data collected from four large pool pump manufacturers (AstralPool, Davey, Pentair and Zodiac), and has been presented earlier in this appendix. This distribution is applied to the total projected annual sales to obtain estimated annual pump sales within each star rating category. The share of energy efficient pumps increased steadily from 2010 to 2013, possibly due to rebate programs in Queensland for energy efficient pumps. Over the past two years suppliers were interviewed and have reported an increase in the share of sales of variable and multi speed pumps (which have higher star ratings). It has been assumed that these shifts will continue without any further policy intervention for the BAU projections.

Calculating energy and greenhouse gas emissions savings from the measures

Annual pool pump energy consumption for filtration under the BAU scenario can be derived by using the method above. Annual energy consumption for pumps within each star rating level is calculated by multiplying the number of pump sales within each star by the corresponding filtration power input, average daily operation hours and days in a year. Total BAU annual pump filtration energy consumption for all filtration pumps is the sum of all energy consumption within each star rating. Annual sales figures are used rather than total stock in calculations, because any proposed measure will not be retrospective and hence only affects future sales, not any existing pool pump stock.

When a new policy proposal is considered, such as labelling of pumps or MEPS, the policy will have little to no effect on total volume of sales or average hours of operation. Both labelling and MEPS will have significant influence on the percentage distribution of sales of pool pumps by star rating level. Each policy proposal will have its own pump sales distribution by star rating, and thus a different annual total energy consumption (using the same method for calculation as BAU). The difference between total BAU energy consumption and energy consumption under the proposed measure will be the projected annual energy saving under that measure. By multiplying projected energy savings by the electricity price used for the CBA, a monetary value is applied to energy saving and this value becomes the ‘financial benefit’ of each proposal.

Knowing the percentage of pump sales by state, the annual energy savings of a measure can be split between each state and territory in Australia. Emissions savings in each state or territory are the result of multiplying energy savings in each state by the electricity emissions factors in each region, as listed in Table A3.

Calculating the costs of the proposed measures

The costs considered in this CBA include:

- extra capital costs for consumers when they purchase an energy efficient pump
- regulatory costs for manufacturers and retail suppliers of pool pumps, including additional administrative costs attributed to understanding and complying with proposed policies, paying registration fees and purchasing copies of standards.

Additional capital cost of energy efficient pumps compared to single speed pumps

From sales data collected, there is a clear price difference between single speed pumps and energy efficient pumps, which include two speed, multi speed and variable speed pumps. The sales weighted average price for a single speed pump is $775, whereas the sales weighted average price for an energy efficient pump is $1,492. This means an average energy efficient pump costs almost twice as much as a typical single speed pump.

Due to this large initial investment difference and consumer's preference for cheaper pumps when looking for a replacement (findings from Woolcott survey, 2016), it is reasonable to assume that the labelling proposal for pool pumps will not shift consumer behaviour away from purchasing a cheaper single speed pump. Instead, the labelling proposal is likely to encourage more consumers to purchase a more efficient single speed pump. The initial purchase price difference will not be a burden on consumers in a labelling only scenario, because the price difference between single speed pumps of similar wattage is insignificant, despite the variation in energy efficiency within this category.

In the MEPS scenarios, each proposed minimum energy performance level constrains the market to a certain level of performance. Depending on the level of MEPS, a quantity of single speed pumps will be excluded from sale, and hence replaced by energy efficient models. Each different MEPS level will incur a capital cost burden for consumers based on the proportion of single speed pump sales affected by MEPS, and the price difference between single speed and energy efficient pumps within the affected category. Both of these quantities are calculated from sales data analysis. The extra capital cost burden will be accounted every year after the introduction of regulation, according to the proportion of the sales market to be replaced by energy efficient pumps. This is the dominant component of the cost of introducing MEPS.

Table A3: Emission Factors for Grid Electricity Use

Projected Emission Factors for Electricity by State (Tonne CO2eq/MWh)

Year	*NSW*	*VIC*	*QLD*	*SA*	*WA*	*TAS*	*NT*	*ACT*
2018	0.94	1.03	0.94	0.29	0.74	0.00	0.89	0.94
2019	0.90	0.99	0.92	0.21	0.73	0.00	0.96	0.90
2020	0.89	0.95	0.90	0.18	0.70	0.00	0.93	0.89
2021	0.89	0.94	0.90	0.18	0.69	0.00	0.90	0.89
2022	0.88	0.93	0.89	0.18	0.69	0.00	0.89	0.88

2023	0.86	0.93	0.89	0.20	0.68	0.00	0.88	0.86
2024	0.84	0.92	0.89	0.19	0.68	0.00	0.88	0.84
2025	0.83	0.91	0.89	0.19	0.68	0.00	0.87	0.83
2026	0.83	0.90	0.88	0.19	0.68	0.00	0.87	0.83
2027	0.83	0.89	0.88	0.19	0.68	0.00	0.87	0.83
2028	0.82	0.88	0.87	0.20	0.67	0.00	0.86	0.82
2029	0.82	0.88	0.87	0.21	0.67	0.00	0.86	0.82
2030	0.82	0.87	0.86	0.22	0.66	0.00	0.85	0.82

Regulatory cost on industry

By introducing regulation for the pool pump industry, businesses involved in pool pump supply and sales will be required to meet the cost of complying with the program, such as testing and registering products, administration and additional training. These costs are also deemed as costs of introducing new regulation.

Emission factors for grid electricity use

Emission factors for each state and territory in Australia are based on projections from the Department of the Environment and Energy and use the Scope 1, 2 + 3 emission factors from the National Greenhouse Accounts Factor published by E3. These figures are summarised in Table A3.

Sensitivity analysis

The benefits of each of the policy options were tested for their sensitivity to discount rates and hours of pool pump use. Benefits were calculated at each discount rate at Table A4 and positive benefits were found at each rate. Pool pump usage hours considered industry recommendations and survey results (refer Table A5). The Woolcott report[54] survey results found that pool owners operated their pumps for six hours per day in summer – 2 hours on high speed and 4 hours on low speed. Whereas, the pool pump industry recommended usage is eight hours per day – 2 hours on high speed and 6 hours on low speed. To reflect different pool usage between states, each state was assigned seasonal usage based on average monthly temperature recorded by the Bureau of Meteorology.

The cost benefit analysis uses 7 per cent discount rate and industry recommended usage hours as default.

The low to medium level MEPS has been calculated for a low level MEPS transitioning to a medium level MEPS in 2022.

Table A4: Discount Rate

Summary Australia	*0 per cent discount rate*	*4 per cent discount rate*	*7 per cent discount rate*	*11 per cent discount rate*
Total Benefits (NPV, $M)	*$1,744.3*	*$1,054.8*	*$748.6*	*$493.2*
Total Costs (NPV, $M)	$132.2	$105.3	$90.2	$74.6
Net Benefits (NPV, $M)	$1,612.1	$949.5	$658.4	$418.6
Benefit Cost Ratio	13.2	10.0	8.3	6.6

Table A5: Hours of Use

Using a 7% discount Rate

Summary Australia	*Hours = Industry Recommendation*	*Hours = Woolcott survey results*
Total Benefits (NPV, $M)	*$748.6*	*$550.8*
Total Costs (NPV, $M)	$90.2	$90.2
Net Benefits (NPV, $M)	$658.4	$460.6
Benefit Cost Ratio	8.3	6.1

Appendix B: Technical details and changes

B.1 Overview

Testing against AS 5102.1-2009 was found to give a variation in results that is too large to be robust for MEPS and mandatory labelling. Pool pump manufacturers and testing houses raised a number of concerns when applying the standard in seeking registration under the VERLP. These technical issues were examined in the consultation RIS, which asked a series of technical and administrative questions, not only about MEPS, but opportunities or difficulties created by mandatory labelling and other measures to overcome the stated problems.

B.2 Method of test

Australian Standard AS 5102.1 – 2009 sets out the test and measurements for swimming pool pumps to determine compliance with minimum energy performance standards and mandatory labelling. Opportunities were identified for reducing the variability and improving understanding and consistent interpretation of the method of test.

Comments received in response to the consultation RIS method of test matters were broad and varied. Two stakeholders supported adoption of a weighted energy factor and the same number supported using the system curve (Curve G) proposed in the 2013 draft review of AS 5102.1. Other comments noted the risk around calibration of instruments and the need for repeatable and reproducible test conditions.

Weighted Energy Factor

E3 commissioned EnergyAE to review the US DOE Energy Conservation Standards for Dedicated Purpose Pool Pumps (DPPP). In particular, to consider whether a WEF would be appropriate in the Australian context.[55] A WEF is the weighted average of the volume of water pumped in litres per watt hour of electrical energy consumed by the pump-unit. The WEF is similar to measuring the energy factor as described in standard AS 5102.1. However, the WEF could calculate a more accurate average performance of two, multi and variable speed pumps. The WEF would not apply to single speed pumps, because they only have one speed.

A WEF would measure a pump's performance at low and high (80 per cent of maximum) speeds to determine a more accurate projected annual energy consumption for MEPS and calculating star ratings. Multiple speed pumps typically operate at a lower speed for most of their operating time and at a higher, less efficient, speed for a shorter period.[56] In the current standard, all pumps are measured at their lowest speed. Using a WEF would mean that two, multi and variable speed pumps would obtain a lower star rating, than under standard AS 5102.1-2009.

TWG members discussed issues surrounding use of a WEF at the 20 June, 12 July and 30 August 2017 meetings. At its July meeting, TWG agreed to use a WEF based on the pump operating 80 per cent of the time at the lower speed setting tested, and 20 per cent of the time on a high speed (80 per cent of maximum speed) setting, tested at a minimum flow rate of 120 L/min for multi and variable speed pumps. No flow rate limits would apply to single and two speed pumps.

System Curve

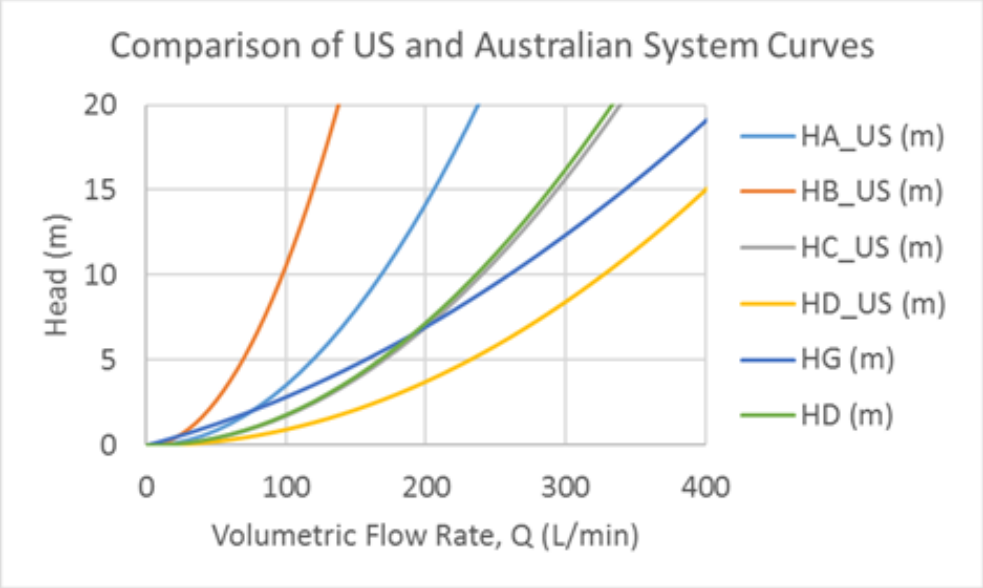
A system curve is used to represent the resistance to flow of a typical swimming pool filtration system to assess pool pump energy consumption. EnergyAE was commissioned to compare Curve D from AS 5102.1-2009 with the proposed Curve G from the draft revision of AS 5102.1-2013, and to propose options for the AS 5102.1 pool system curve.[57] The potential for adjusting the minimum flow rate, in conjunction with shifting from Curve D to Curve G was also considered.[58]

At its 20 June 2017 meeting, TWG members considered the most appropriate pool system curve that would represent the average pool system. TWG discussed the advantages and disadvantages of retaining Curve D, moving to Curve G or using two categories – Curve D for single speed pumps and Curve G for pumps with multiple speeds. The effects of using each curve were considered against possible head and flow requirements. The difference between the filtration characteristics

expressed by Curve D and Curve G is that Curve G imposes a higher filtration resistance at low flow rate but a lower resistance at high flow rates. Curve G was proposed to highlight problems that may occur when variable speed pumps are started with a low speed setting[59]. Alternative system curves that have been considered for pool filtration pump testing are shown in Figure B1. Australia system curves D (HD) and G (HG) are compared with the US Department of Energy (DOE) Curve C (HC_US) and Curve D (HD US) in Figure B1. AS 5102 Curve D and the US Curve C are essentially the same.

To determine the system curve to be used for the method of test, TWG members voted on their preference for either Curve D, used in the existing standard, or Curve G, which was proposed in the 2013 review of the standard. Between mid-July and mid-August 2017, seven votes were received from TWG members, six votes for Curve D and one vote for Curve G.

Figure B1: Comparison of United States and Australian System Curves[60]



Pump classification definitions

Pool pumps are generally classified as single, two, multi and variable speed. However, the terminology used by industry is not consistent and is not defined in the Australian standard. It is proposed that pool pumps be classified according to the following criteria.

Single speed pump - have a single discrete motor speed that is fixed by the manufacturer.

Two speed pump - have two discrete motor speeds that are fixed by the manufacturer. The speed settings may be selectable by the user or installer, but the user or installer cannot change the speed assigned to each discrete speed setting.

Multi speed – have three or more discrete nominal motor speeds that are fixed by the manufacturer. The speed settings may be selectable by the user or installer or control system,

but the user or installer or control system cannot change the speed assigned to each discrete speed setting.

Variable speed pump - continuously variable speeds, where the speed may be set or reset by the user or installer or control system.

Other technical changes

Other improvements to the standard were considered to ensure the reliability, robustness and repeatability of the method of test. EnergyAE was commissioned by E3 to review the AS 5102.1 method of test[61] in collaboration with testing laboratories and to propose options for improving test repeatability.

The report reviewed and analysed related work on laboratory pool pump testing and the draft 2013 revision of AS 5102.1. The outcome of questions, comments and recommendations were developed into options for consideration by the TWG. On 30 August 2017, TWG members considered the report and made decisions on changes to the test rig setup and test procedure measurements. In particular, pump classification definitions, measurement tolerances, pump run-in times, water and air requirements, test rig construction, instrument calibration and accuracy and electrical requirements would be modified.

Overall, it was agreed that the pool pump test would apply a WEF based on measurements of pump performance when operating at the intersection point with Curve D for MEPS reporting. The full pump-unit performance curves (head versus flow rate and input electrical power versus flow rate) should be tested and reported for industry best practice. Pump and power curve graphs including data points should be required to provide a test check, and pumps should be tested to '0' flow rate, to illustrate their maximum head capability.

The method of test would apply to pool pumps intended to be used in the operation of swimming pools and spa pools, within the recommended electricity input range. For single and two speed pumps, there would be no minimum flow rate requirement. For multi and variable speed pumps, a minimum flow rate of 120 litres per minute (L/min), when operating with the specified flow resistance (Curve D), must be met for at least one speed. The test procedure for two speed pumps is to be repeated for each speed. The testing of multi and variable speed pumps would include measurements for maximum speed, high speed (below 80 per cent of maximum speed) and low speed operation. The WEF is calculated from performance measurements at the high speed and low speed settings.

B.3 Star rating

Star rating calculations identify the energy efficiency of a product. Australian Standard AS 5102.2-2009[62] specifies the calculation of the star rating index value and the method of calculating star ratings. The calculations are based on the method of test described in AS 5102.1. Pool pumps can

obtain between 1 and 10 stars, with half stars available up to 6 stars. The higher the stars, the more efficient the pump.

Star rating measure – straight line

The star rating, as described in AS 5102.2 (refer Equation B1), is calculated from a formula. The formula uses the pool pump's energy factor, as determined by the method of test in AS 5102.1, and each additional star represents a 25 per cent reduction in energy use from the previous star rating.

Equation B1: AS 5102.2 star rating measure

$$SRI = 1 + \frac{\ln\left(\frac{EF_{D(av)}}{9.0}\right)}{\ln(1.25)}$$

A straight line MEPS as described above gives every pool pump regardless of size, the same baseline energy factor to meet. However, there is a distinct difference between pumps of different sizes. Due to the nature of how impeller pumps work, smaller pumps would always have a better energy factor figure from test results, than larger pumps. Hence larger pumps will be intrinsically disadvantaged, if MEPS on energy factor is a flat line. As a consequence, the star rating system favours smaller pumps and gives them a higher star rating than larger pumps, even though small and large pumps can be equally efficient.

The star rating is derived from the star rating index using Table B1 (from AS 5102.2).

Table B1: Derivation of star rating

DERIVATION OF STAR RATING Star Rating Index (SRI)	Star rating
SRI < 1.5	1.0
1.5 ≤ SRI < 2.0	1.5
2.0 ≤ SRI < 2.5	2.0
2.5 ≤ SRI < 3.0	2.5
3.0 ≤ SRI < 3.5	3.0
3.5 ≤ SRI < 4.0	3.5
4.0 ≤ SRI < 4.5	4.0
4.5 ≤ SRI < 5.0	4.5
5.0 ≤ SRI < 5.5	5.0
5.5 ≤ SRI < 6.0	5.5
6.0 ≤ SRI < 7.0	6.0
7.0 ≤ SRI < 8.0	7.0

8.0 ≤ SRI < 9.0	8.0
9.0 ≤ SRI <10.0	9.0
10.0 ≤ SRI	10.0

Star rating measure – curved line

To more fairly measure pool pump energy efficiency, a curved MEPS, which factors in pump wattage size should be applied. The use of a curved MEPS with higher requirements for smaller pumps and lower, less stringent, requirements for larger pumps would provide a fairer comparison of the energy efficiency of pool pumps of different sizes.

The proposed curved star rating would be calculated from a revised formula (refer Equation B2). The formula uses the pool pump's weighted energy factor with each additional star measurement representing a 25 per cent reduction in energy use.

Equation B2: Proposed weighted energy factor star rating measure

$$SRI = \quad 1 + \frac{\ln(\frac{WEF}{Baseline})}{\ln(1.25)}$$

Where $Baseline = -4.5 \times \ln[Input\ Power(kW)] + 13.5$

A curved MEPS would give consumers a fairer comparison between all pool pumps. For example, rather than having a 3.5 star smaller single speed pump compared to a 2 star larger single speed pump (on the current scale), the new curved MEPS would make both pumps 2.5 star, because they are equally efficient for their purpose. Large pumps would be compared against other large pumps, for use with large pools, and likewise, small pumps would be compared against other small pumps, used with small pools.

Figure B2: Curved star rating lines

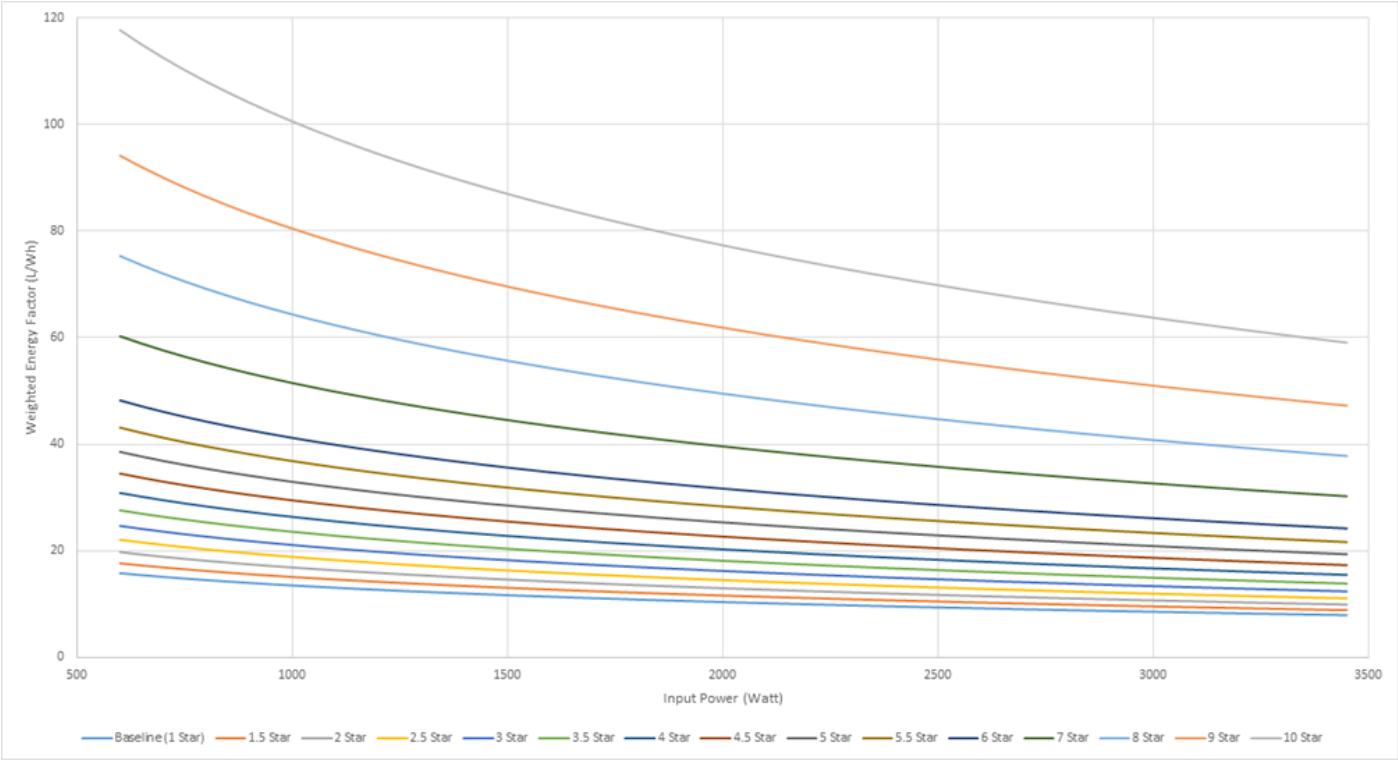
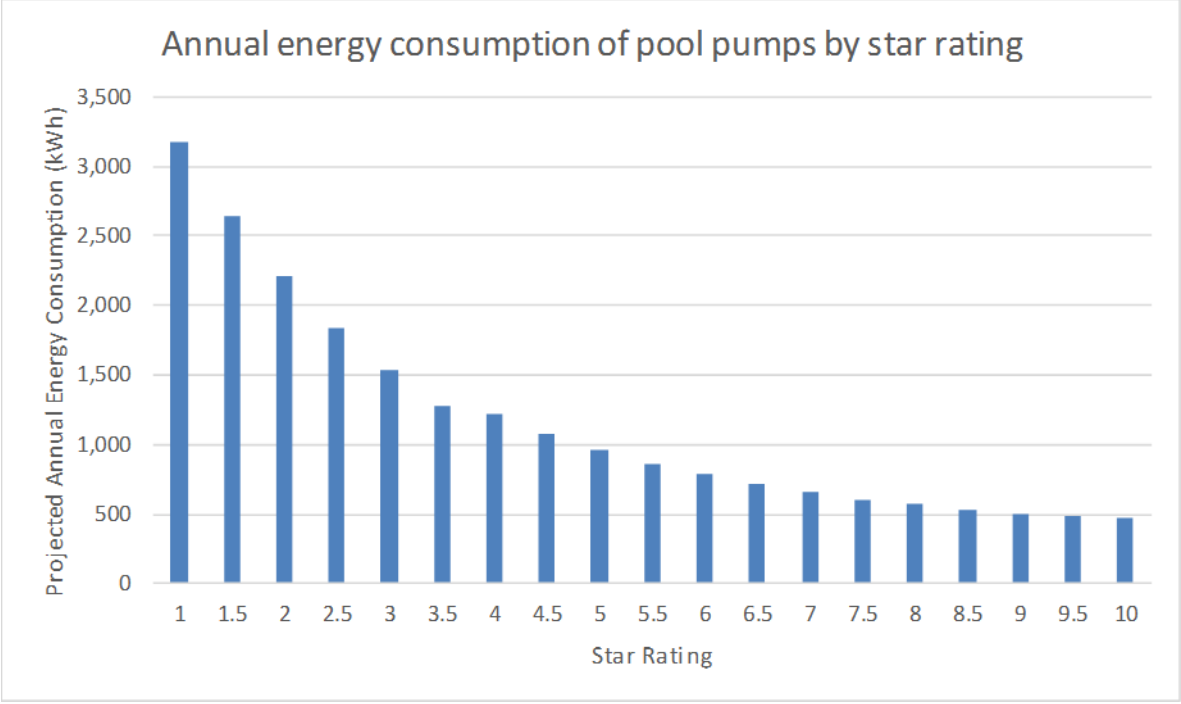


Figure B3: The annual energy consumption of pool pumps by star ratings[63]



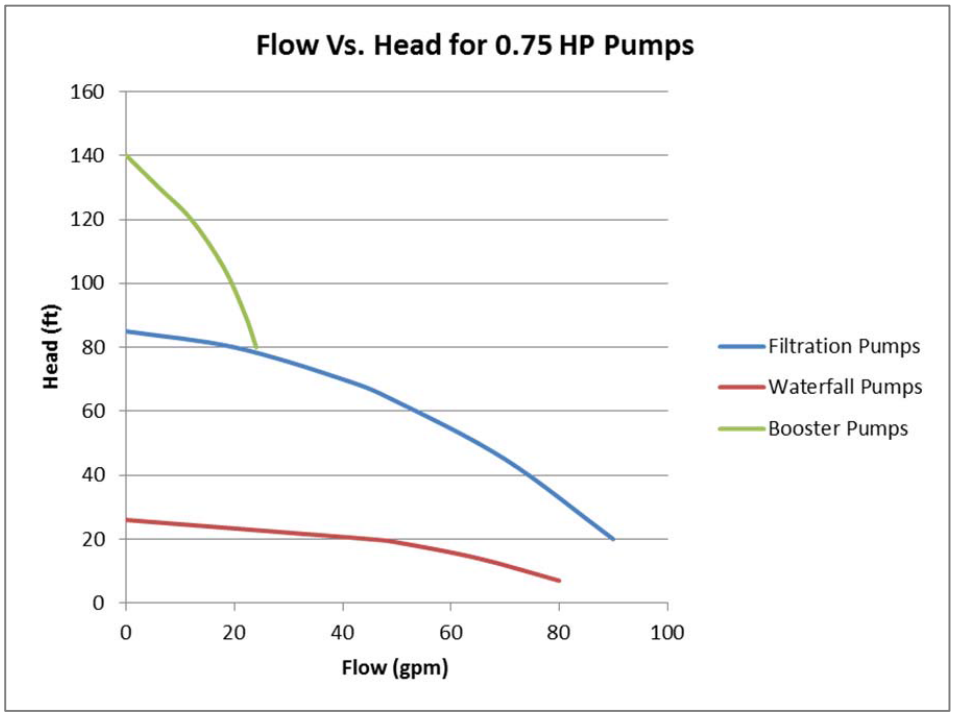
B.4 Scope

The scope of MEPS on single speed pool pumps would differ from two, multi and variable speed pumps. The majority of single speed pool pumps sold in Australia for the residential pool market

are sized between 600 W and 1700 W and operate on single phase power. Single speed pool pumps with an input capacity greater than 1700 W tend to service larger, commercial pools or are for other specific uses and sold in low volumes. Conversely, two, multi and variable speed pumps for residential pools are sized up to 3450 W. Regulation to limit the scope of pool pumps required to meet MEPS captures the majority of residential filtration pool pumps and maximises potential energy savings.

There are a range of smaller, single speed pumps that are used for specific purposes, such as some spa or swim jets, waterfalls, solar thermal heating or cleaner booster pumps. Likewise, some larger, single speed pumps need higher pressure and are used for special purposes, such as solar thermal heating where the solar collectors are mounted on a high roof and a high lift pump is required to start the circulation through the solar collectors. Manufacturers have designed specific combinations of motors and pumps optimised for the intended use of these pumps. Such pumps may not be interchangeable with residential filtration pool pumps and may not provide satisfactory performance for some tasks. This effect is shown in Figure B4, which plots performance curves for different types of pool pumps. Such pumps may not run for extended periods and typically have lower wattage. Overall, these functions represent a small part of the total energy used by pool pumps.

Figure B4: Performance curves for different pump applications



B.5 Labelling

Mandatory ERLs are designed to overcome an information failure where consumers have only inaccurate, incomplete or ambiguous information about the energy consumption of a product, by

requiring the label to be used for all products sold. Selecting a pool pump on the basis of its purchase price, without considering running costs, may be an example of information failure, particularly where operating costs are much larger than the upfront price of a product. Without an ERL, information on the energy used by an appliance may be unavailable, inconsistent or difficult to obtain. Mandatory ERLs allow a fair comparison across all products sold.

Lack of accurate information limits efficient decision making by consumers. Furthermore, disparate information sources and varying levels of technical knowledge mean that industry professionals play a crucial role as advisers to consumers, however, industry professionals have differing views on the benefits of more energy efficient pool pumps.

A mandatory ERL allows comparison of like products by providing a rating of their energy efficiency between one and ten stars. The greater the number of stars on the ERL, the more efficient the appliance, compared with appliances of the same type with fewer stars. By providing consumers and industry experts with comprehensive, transparent and credible information of an appliance's relative energy efficiency, the consumer is provided with a tool to factor energy efficiency into their purchasing decision. Improved energy efficiency information also sends a market signal to manufacturers to develop more efficient products.

E3 has reviewed the effectiveness of ERLs applied to products regulated under the GEMS Act to determine if they are effective in shifting consumer purchases to more energy efficient products. The review found that ERLs work best, when consumers are required to make a decision between two or more similarly priced products. The review also showed that, for some appliances, labels and MEPS measures working in tandem can produce better results than either working alone.

Consumers are interested in reducing energy costs for their pool, although they generally know little about the energy efficiency of their pumps and don't have easy access to information on how to reduce their electricity usage. The proposed label would provide clear and easy to understand information to enable pool pumps to be compared on a common basis.

A mandatory pool pump labelling scheme applied to all pool pumps sold in Australia would benefit consumers and industry.

It would tackle information barriers, gaps and failures facing consumers.

It would replace the partial coverage provided by the VERLP, with comprehensive coverage of all pool pumps sold in Australia.

It would also introduce formal compliance and registration requirements, which would create a level playing field for manufacturers and distributors.

The pool pump energy rating label has been used for the VERLP since its inception in April 2010. Prior to the introduction of the VERLP, E3 commissioned a report[64] that found consumers agreed that pool pumps should display labels, although the information provided in the boxes[65] of the VERLP label was found to be confusing and consumers questioned the purpose of the information.

The VERLP label design and size is shown in Section 1.7, Figure 1.6 and the requirements are described in AS 5102.2.

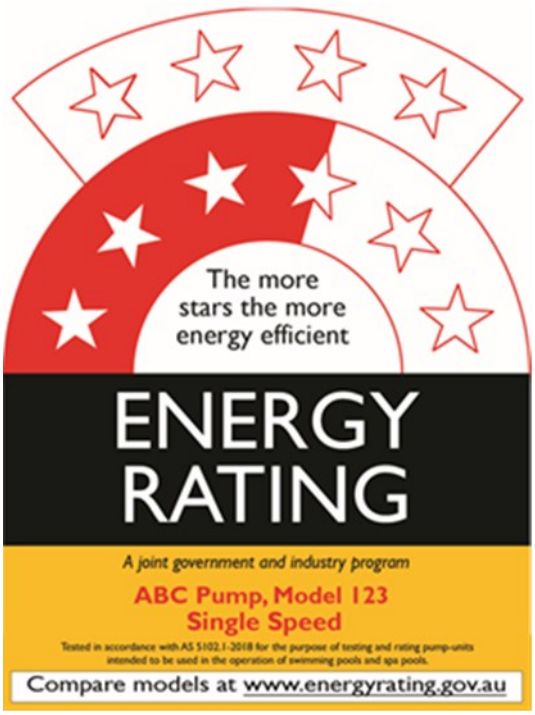
The PIAG considered that the VERLP energy rating label is not practical for a pool pump. The label is too large to place on a pump, which does not have as much space to place a label as other appliances covered by the GEMS program. The technical information on the label was also considered to be too complex and could be simplified. Information such as flow rate and head would not be information a consumer would understand or consider when purchasing a pool pump. It is likely consumers would seek advice on these characterisitics from a retailer, builder or installer, who would obtain this information from product literature and provide advice about fitting the pump to the pool setup. At the 31 October 2017 PIAG meeting, it was decided that mandatory labelling should be applied to swimming pool pumps packaging and brochures at the point of sale. The form of the label should be simpler than the current voluntary ERL.

As discussed in Section 1, the amount of electricity a pool pump uses depends on many factors. The electricity consumption of a pool pump could change, due to the size of the pool, the plumbing set up (such as, the number of bends in the piping and the diameter of the pipe), the number of pumps installed and other factors. With respect to the pool size, a pump will operate for less time when circulating water in a 20,000 litre pool, compared to a 60,000 litre pool, and the energy consumption would vary accordingly. In contrast, when purchasing a white good, such as a refrigerator or washing machine, an entire unit is sold – the motor and the body – and the combination is not interchangeable.

For this reason, the energy consumption figure (kWh per year to pump 50,000 litres/day) on the existing pool pump VERLP label would not be accurate for all pools and the energy consumption figure might be misleading for consumers.

After consideration of various label designs, PIAG decided a smaller ERL should be used for pool pumps. This label design is shown in Figure B5. It was developed with advice from the pool industry and has the characteristics of the typical ERL, displaying the standard colours, stars, energy efficiency messaging and product details. However, it differs in that it does not display the annual energy consumption (kWh). The label also has a 10 star arch for all star ratings. The approximate size of the label would be 94 mm (height) by 70 mm (width).

Figure B5: Proposed pool pump energy rating label



E3 is undertaking testing of this label design to ensure that it is easy for consumers to understand and interpret correctly. The research will test components of the proposed lable and other ERL characteristics, such as energy consumption, to ensure that the label is easy for consumers to understand and interpret. The research will examine the ERL format that would best influence consumer choices and lead pool owners to purchase a more energy efficient pool pump. If the COAG Energy Council decides to introduce a mandatory ERL for swimming pool pumps, this design would form the basis for the ERL required.

For pool pumps, an ERL would be required to be affixed to every pump before sale. The ERL would be required to be displayed on either the product, if displayed in store, or on the packaging at the point of sale. Pool pumps are not always displayed in store, on shelves, or out of their box. To ensure consumers are able to compare the star ratings of pumps, the packaging would be labelled at the point of sale. Displaying ERLs or star rating and pump curves in brochures and online would be voluntary.

A mandatory labelling scheme under the E3 program includes:

- registration requirements, including performance information against the required test method, with penalties applying, if incorrect information is provided to the GEMS Regulator
- compliance testing, to confirm that claimed performance is realised
- recovery of registration costs by E3 in the form of a registration fee.

B.6 Noise

Pool pumps are often sold with noise information contained in the manufacturers' brochures or model materials. Anecdotal evidence from the pool industry indicates that some consumers value information about the noise produced by different pool pumps. There is no single test standard for measuring pool pump noise; nor are there comprehensive noise labelling requirements. A research report[66] by Vipac Engineers and Scientists recommended the use of standards AS 1217.2, ISO 3741 and ISO 3743-1. Tests of various pool pumps showed consistently close results between these three standards.

Increasing consumer awareness of the noise produced by different pool pumps would have several benefits including:

- reduced neighbourhood noise pollution
- empowerment of consumers to choose quieter models of pump, to avoid the risk of fines or conflict with neighbours from noisy pool pumps
- informing consumers of the level of noise their pump is likely to make, so they can take steps to reduce noise pollution by housing the pump in a casing, away from windows, or set up on a timer to avoid sensitive times of the day.

Noise measurements will be recommended to updated standard AS 5102.1-2009 and test measurements will be included in the GEMS registration system, to enable consumers to compare the noise levels of pool pumps.

[1] On 2 July 2018, Fluidra (AstralPool's parent company) closed a merger with Zodiac, another of Australia's large pool pump manufacturers.
[2] IBISWorld Pty Ltd, IBISWorld industry report OD4034, Swimming pool and spa equipment stores in Australia, August 2017.
[3] See, for example, http://energyrating.gov.au/document/meps-profile-swimming-pool-and-spa-equipment Report Nos: 2004/12: National Appliance and Equipment Energy Efficiency Program. Minimum Energy Performance Standards - Swimming Pools and Spa Equipment.
[4] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[5] Winton Sustainable Research Strategies, Energy efficiency labeling of swimming pool pump units, report on research to assist with their marketing and promotion, conducted for: Department of the Environment, Water, Heritage and the Arts, June 2009.
[6] Chapter 3 of the Californian Energy Commission: 2016 staff report- Revised Analysis of Efficiency Standards for Pool Pumps and Motors, Spas – Draft Staff Report.
[7] Ibid.
[8] E3 analysis - Australian households with a pool use on average 1352KWh per year powering pool pumps used for filtration.
[9] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[10] Based on manufacturers' recommended prices
[11] References to watts throughout this document refers to the rated input in watts on the pool pump nameplate.
[12] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[13] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[14] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[15] The size of a one to six star label is 90 mm wide by 160 mm high and a seven to ten star label is 90 mm wide and 173.9 mm high.
[16] For example, the Water Efficiency Labelling and Standards (WELS) scheme which rates the water efficiency of products started as a voluntary scheme. Following a review, the partial coverage and limited take up by industry was one factor leading to the adoption of the current mandatory legislated WELS scheme.
[17] Department of the Environment and Energy modelling (2016).
[18] The TTMRA supports the free movement of goods across the Tasman and pool pumps imported from or via New Zealand would be exempt from GEMS regulations.
[19] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016, pp 86-88.
[20] Intermediaries include pool builders and installers; pool retailers and pool maintenance and service people.
[21] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[22] IBISWorld Pty Ltd, IBISWorld industry report OD4034, Swimming pool and spa equipment stores in Australia, August 2017.
[23] There are 71 pool pumps registered under the VERLP as at 19 June 2018.

[24] E3 estimates that pool pumps use over 1500 GWh of electricity per year in Australia. The amount of electricity consumed by pool pumps is likely to rise as the number of pools installed and pool pumps increases.
[25] E3 modelling throughout this document is for the period between 2018 to 2030.
[26] Electricity Network Regulatory Frameworks Volume 2 2013.
[27] Productivity Commission 2013, Electricity Network Regulatory Frameworks, Report No.62.
[28] Confidential evaluation program reports: Ergon and Energex – provided to E3 in April 2016.
[29] Confidential research report - Ausgrid, October 2016.
[30] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[31] www.veet.vic.gov.au/Public/Public.aspx?id=Home, accessed 20 September 2018.
[32] For unknown reasons this household operated the pump for much longer hours after the retrofit and ran the pump almost entirely on the highest speed setting.
[33] http://www.ausgrid.com.au/Common/Customer-Services/Homes/Energy-efficiency/Energy-efficiency-at-home-tips/Energy-usage-calculators/PoolPumpCalculator.aspx
[34] https://www.ausgrid.com.au/-/media/Documents/energy-use/Swimming-pool-efficiency
[35] Variable frequency devices allow consumers to adjust the speed of their single speed pump.
[36] For example, the International Energy Agency, *4E Program Report: Achievements of appliance energy efficiency standards and labelling programs – A Global Assessment*.
[37] E3 Equipment Energy Efficiency, Consultation regulation impact statement – swimming pool pumps, proposed energy labelling and minimum energy performance standards, November 2016.
[38] Submissions were received from: retail (3), manufacturers (7), council (1), testing laboratory (1), electricity suppliers (2), consumer (1), industry associations (2), research institution (1) and consultants (3).
[39] TWG meetings – 9 June (teleconference), 20 June (day meeting - Melbourne), 12 July (teleconference), 30 August (day meeting - Sydney). TWG members were also invited to visit one of the following pool pump testing laboratories - Vipac, CalTest and Waterco. Visits were held on 2, 22 and 29 August respectively.
[40] PIAG meetings – 18 August (teleconference), 31 October (day meeting - Melbourne), 9 November (teleconference), 28 November (day meeting - Sydney).
[41] The upper, lower and central rows in the cost benefit analysis tables represent the sensitivity analysis for all assumptions outlined in Attachment A. The central band is used for cost benefit analysis in this RIS.
[42] The estimates of consumer net benefits do not include the monetary benefits of: the value of reductions in peak load management costs for electricity networks through an improvement in the average energy intensity of pool pumps; or the value of reductions in greenhouse gas emissions.
[43] VFDs and single speed pool pumps – markets characteristics and modelling impacts, EnergyConsult, 21 November 2017.
[44] Three scenarios of take-up (10 per cent, 25 per cent and 50 per cent) were modelled with the likely scenario being 10 per cent.
[45] Total sales of single speed pumps in the Australian market over the five years to 2014-15 was approximately 70 per cent. Manufacturers project the market share of single speed pumps to decline gradually to 60 per cent of total pump sales by 2030.
[46] The majority of stakeholders, through consultation RIS submissions and working group meetings, indicated a strong preference to introduce MEPS and labelling, rather than labelling only or no action. Stakeholders who commented on MEPS (straight line) levels in their submissions to the consultation RIS supported either a medium or higher level MEPS and there was limited value in adopting a low level MEPS.
[47] Vipac Engineers and Scientists Limited, review of the acoustics component of standard AS 5102.1-2009 Performance of household electrical appliances-swimming pool pump-units, Part 1: Energy consumption and performance, 16 August 2017.

[48] Energy Analysis and Engineering, AS 5102 method of test presentation, 30 August 2017.
[49] E3 notes that the GEMS Review report recommends that the Commonwealth Government request the COAG Energy Council continue to examine the costs and benefits associated with mandatory disclosure of energy rating information online and in print advertising.
[50] A survey of this work is at: Houde, S, & Spurlock, C.A. (2016). Minimum Energy Efficiency Standards for Appliances: Old and New Economic Rationales. *Economics of Energy and Environmental Policy, 5(2)*
[51] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[52] Electricity Prices by State, (Residential) Electricity price: AEMO Wholesale and retail prices EFI 2017.xlsx - Neutral Scenario.
[53] Performance of household electrical appliances – swimming pool pump-units, Part 2: Energy performance standard requirements.
[54] Woolcott Research & Engagement, Pool Pumps: an investigation of swimming pool pumps in Australian and New Zealand; a research report prepared for the Department of the Environment and Energy, August 2016.
[55] Energy Analysis and Engineering, Summary of US DOE pool pump standards and weight-energy factors, 8 June 2017.
[56] Energy Analysis and Engineering, Summary of US DOE pool pump standards and weight-energy factors, 8 June 2017.
[57] Energy Analysis and Engineering, Summary of comparison between curve D and curve G, 8 June 2017.
[58] Energy Analysis and Engineering, Minimum flow rates for pool pump performance testing, 5 July 2017.
[59] Energy Analysis and Engineering, AS 5102.1 Curve D vs Curve G presentation, 19 June 2017.
[60] Energy Analysis and Engineering, Summary of comparison between Curve D and Curve G, 8 June 2017.
[61] Energy Analysis and Engineering, AS 5102 method of test presentation, 30 August 2017.
[62] AS 5102.2-2009, Australia standard, Performance of household electrical appliances – Swimming pool pump-units, Part 2: Energy labelling and minimum energy performance standard requirements.
[63] E3 modelling calculated the relative energy efficiency of pumps on the basis of 80 per cent in low speed and 20 per cent in high speed, using the power input of the 1200 watt pump for high speed, and the actual power input of the unit for low speed.
[64] Winton Sustainable Research Strategies, Energy Efficiency Labeling of Swimming Pool Pump Units, report on research to assist with their marketing and promotion, conducted for: Department of the Environment, Water, Heritage and the Arts, June 2009, http://www.energyrating.gov.au/sites/new.energyrating/files/documents/200906-pool-pump-labelling_0.pdf.
[65] The information displayed in the boxes were energy consumption, efficiency, flow rate, head, power and (not mandatory) noise.
[66] Vipac Engineers and Scientists Limited, review of the acoustics component of standard AS 5102.1-2009 Performance of household electrical appliances-swimming pool pump-units, Part 1: Energy consumption and performance, 16 August 2017.