Queensland

Electricity Amendment Regulation (No. 2) 2007

Regulatory Impact Statements for* SL 2007 No. 50

made under the

Electricity Act 1994

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* Under the *Statutory Instruments Act 1992*, section 46(1)(g), a regulatory impact statement (RIS) need not be prepared for proposed subordinate legislation if it only provides for, or to the extent it only provides for, a matter arising under legislation that is substantially uniform or complementary with legislation of the commonwealth or another State.

A RIS was not prepared for the above item of subordinate legislation on the basis that it is substantially uniform or complementary with the *Electricity Safety (Equipment Efficiency) (Amendment) Regulations 2005* (Vic).

RISs in relation to the subject matter prepared under Council of Australian Governments guidelines for the Australian Greenhouse Office may be viewed at the following sites—

http://www.energyrating.gov.au/library/details200403-riswaterheaters.html

http://www.energyrating.gov.au/library/details200309-riswaterheaters.html

Copies of the RISs provided to the Queensland Government are attached.

Report No 2003/09

DRAFT

REVISED REGULATORY IMPACT STATEMENT:

Revised Minimum Energy Performance Standards and Alternative Strategies for SMALL ELECTRIC STORAGE WATER HEATERS

Prepared for the Australian Greenhouse Office

by

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Executive Summary

Electric water heating accounts for about 28% of national household electricity use and about 2% of commercial sector electricity use in Australia. Electric water heating is the largest single source of greenhouse gas emissions in the residential sector.

The energy used by electric water heaters is made up of two distinct components:

- The heat lost through the walls and fittings of hot water storage vessels; this is known as "standing heat loss"; and
- The useful energy in the hot water drawn off from the water heaters.

Useful energy is largely determined by the hot water demand, whereas the heat loss is determined by the design of the water heater itself and how and where it is installed.

There are three main groups of electric storage water heaters:
1. Conventional storage water heaters with a water delivery of less than 80 litres ("small water heaters");
2. Conventional storage water heaters with a water delivery of 80 litres or more ("large water heaters"); and
3. Unconventional electric water heaters, ie solar water heaters with electric boosting and heat pump water heaters.

It is estimated that about 32% of the energy used by small electric water heaters and 20% of the energy used by large electric water heaters was lost in 2000. Heat losses alone from small electric water heaters accounted for about 1,115 GWh of delivered electricity, costing users $134 million. The associated greenhouse gas emissions totalled over 1.1 Mt CO_2-e. The electricity consumption and costs of these heat losses are projected to increase by more than 37% by 2010, and the associated greenhouse gas emissions by more than 27% (ie less than the growth in electricity use because the greenhouse-intensity of electricity supply is projected to fall).

Minimum Energy Performance Standards

The water heater market interposes several intermediaries between the decision-maker who selects the water heater and the householder who bears the running costs. The original choice of water heater is often made by the builder or plumber. Subsequent decisions about water heater replacement are usually made by the building owner in the case of rental accommodation. Where homeowners make their own replacement choices, decisions are often made under time pressure and with limited information. Options that are cost-effective over the lifetime of the water heater are either passed up or simply not available – eg if all models are designed to the same energy performance level. Minimum energy performance standards (MEPS) for water heaters addresses these market failures directly.

In 1996, the Australian and New Zealand Minerals and Energy Council (ANZMEC) decided to adopt MEPS for all sizes of *mains pressure* electric storage water heaters, both small and large. These took effect in October 1999. The MEPS levels are expressed as maximum standing heat losses in Australian Standard AS1056.1 *Storage*

Water Heaters: General Requirements. MEPS are given effect in each State and Territory by the same regulations which govern appliance energy labelling.

The prospect of revising the MEPS levels for electric storage water heaters was first formally discussed between government and the industry in 1996, when the 1999 MEPS levels were adopted. It was agreed that the 1999 MEPS levels would not be revised before October 2004 at the earliest.

The Council of Australian Governments (COAG) requires that proposals to implement or strengthen mandatory programs such as MEPS be subject to a Regulatory Impact Statement (RIS), which must estimate the benefits, costs and other impacts of the proposal, assess the likelihood of the proposal meeting its objective, and consider a range of alternatives to the proposal.[1]

In June 2001 the AGO published, for public comment, a draft RIS which examined six options for increasing the stringency of MEPS for small electric storage water heaters. The RIS also considered a number of non-MEPS alternatives, but concluded that these were not likely to be effective. After consideration of public and industry comments, a final RIS published in October 2001 recommended a more stringent MEPS equivalent to a 30% reduction in standing heat loss compared with the present MEPS levels.

The main reason for recommending a 30% reduction in heat loss rather than a greater level was to limit exposure to three significant classes of risk:

1. The risk that customers replacing small electric water heaters currently installed in confined spaces will face substantial additional costs to accommodate units with larger external dimensions due to thicker insulation; and

2. The risks associated with the transition from hydrochlorofluorocarbon (HCFC) foam blowing agents – which are being phased out due to Montreal Protocol obligations – to other agents whose thermal performance, availability and cost are presently uncertain. In effect, the more insulating foam required, the greater the exposure to these risks.

[1] The COAG Guidelines state that:
“The purpose of preparing a regulation impact statement (RIS) is to draw conclusions on whether regulation is necessary, and if so, on what the most efficient regulatory approach might be. Completion of a RIS should ensure that new or amended regulatory proposals are subject to proper analysis and scrutiny as to their necessity, efficiency and net impact on community welfare. Governments should then be able to make well-based decisions. The process emphasises the importance of identifying the effects on groups who will be affected by changes in the regulatory environment, and consideration of alternatives to the proposed regulation.
Impact assessment is a two step process: first, identifying the need for regulation; and second, quantifying the potential benefits and costs of different methods of regulation. In demonstrating the need for the regulation, the RIS should show that an economic or social problem exists, define an objective for regulatory intervention, and show that alternative mechanisms for achieving the stated objective are not practicable or more efficient” (COAG 1997).

3. Australian industry was also concerned at the impact on export sales of increasing the price of small water heaters in overseas markets, where the units compete with less energy efficient products.[2]

The RIS recommended the option of sales-weighted compliance to give water heater manufacturers the flexibility to manage the risks in the way best suited to their business, while ensuring that the net benefit to the Australian community would be no less than if a blanket MEPS level were adopted.

In early 2002, the Ministerial Council on Energy rejected the regulatory proposal in the original RIS when the New Zealand Minister abstained from the vote. The Australian Greenhouse Office undertook to Australian jurisdictions to revise the RIS once the New Zealand MEPS came into effect. This document is the revised RIS.

Changes Since Previous RIS

During the public comment period for the original RIS the New Zealand Government decided (in July 2001) to introduce regulations for MEPS and mandatory energy labelling in New Zealand. The regulations were passed in February 2002 and MEPS for electric storage water heaters took effect in February 2003. The MEPS are based on the heat loss test in New Zealand standard NZS4602, which differs somewhat from the test is AS1056. The New Zealand MEPS levels are more stringent than the new levels recommended for Australia in the previous RIS. The extent of the difference is uncertain because the differences in the test methods and in laboratory testing practices make direct comparisons difficult, but is likely to be about 40-50% lower heat loss than the present Australian MEPS level.

The New Zealand government has made a Temporary Exemption Regulation under the Trans-Tasman Mutual Recognition Act applying to water heaters and lighting ballasts. This means that water heaters cannot be imported from Australia in the period 1 February 2003 to 31 January 2004 unless they meet the New Zealand MEPS requirements, or unless the importer purchased them under a contract entered into before 1 February 2003.[3] The Australian and New Zealand government positions on aligning standards for small water heaters are still being developed.

Since the publication of the original RIS, a common water heater standing heat loss test method has been developed which, if adopted by both Standards Australia and Standards New Zealand, would enable the one test to be used to determine a model's compliance with MEPS in both Australia and New Zealand (although the two countries could continue to operate different MEPS regimes for water heaters, as they do now). A further advantage of a unified test is that the relationship between different MEPS levels could be calculated with precision, which is not now the case.

Another development has been the reconsideration of the potential role of energy labelling for water heaters. Mandatory energy labelling was originally rejected in favour of a MEPS-only strategy because all electric water heater models conformed to

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[2] This category of risk could not be substantiated by publicly available data (unlike the two other categories), so was given less weight.
[3] It is understood that importers did enter such contracts, so the exclusion intent of the exemption has limited effect.

the same maximum heat loss standard. This is no longer the case. There is at least one model now on the Australian market with a substantially lower heat loss, and if suppliers took up the option of sales-weighted MEPS compliance then more models of different heat loss levels would become available. In addition, new models have now been introduced in New Zealand to meet the NZ MEPS, and if these were to be introduced in Australia they would constitute another heat loss class.

On the other hand, the main risk factors apparent at the time of the previous RIS have not changed. The phaseout of HCFCs is still subject to uncertainty: in fact the resolution of the issue may have been delayed because of the ability of water heater manufacturers (in both Australia and NZ) to take advantage of ODP tonne quotas released through technological changes or reductions in business activity by other foam users. The dimensional constraint issue is still present.

The risk to Australian exports may have increased now that the largest manufacturer of electric storage water heaters in Australia (and its subsidiaries in NZ and China) has been purchased by an international water heater manufacturer, which has the option of supplying markets from a greater number of plant in a greater number of countries.

Revised Proposals

This revised RIS has considered the following options:

1. Status quo (termed business as usual, or BAU): maintaining the MEPS levels introduced in October 1999;

2. An increase in the stringency of the existing MEPS levels, effective October 2005;

3. Voluntary MEPS;

4. Product labelling;

5. A levy on less efficient equipment to fund greenhouse reduction programs;

6. A levy on electricity reflecting it greenhouse gas emissions.

It was found that increasing the stringency of the 1999 MEPS levels by mandatory means is the only option likely to be effective on its own in achieving objectives stated for the regulation: reductions in greenhouse gas emissions and reduced life cycle costs to users.

Cost-benefit analysis was carried out for three MEPS options, the main characteristics of which are summarised in Table S1:

1. A revised MEPS level for small water heaters that would require a 30% reduction in the current maximum standing heat loss for all units sold, to take effect at the end of 2005 (the earliest practicable implementation date, given the lead times required for compliance);

2. A revised MEPS level for small water heaters that would require a 50% reduction in the current maximum standing heat loss for all units sold, to take effect at the end of 2005. This is roughly equivalent to the New Zealand MEPS levels, the most stringent currently in force for water heaters of this type; and

3. A flexible sales-weighted MEPS regime supplemented with energy labelling designed to inform buyers about different heat loss levels. A heat loss level of 50% lower than the 1999 MEPS level would be designated as 5 star or "High Efficiency" (HE), a heat loss level of 30% lower than the 1999 MEPS level would be designated as 3 star or "Moderate Efficiency" (ME) and the 1999 MEPS level would be designated as 1 Star or "Low Efficiency" (LE). The flexible regime would terminate after 5 years and revert to Option 1.

Table S1 Characteristics of MEPS options

MEPS option	Can current (1999) MEPS models stay on market?	Is there High Efficiency designation?	Do suppliers have compliance options?	Likely efficiency levels on market	Scope for labelling?
1. 30% reduction (as in last RIS)	No	No	No	2	Yes
2. 50% reduction (proxy for NZ MEPS)	No	No	No	1	No
3. 30% reduction with compliance flexibility & endorsement label	Yes	Yes (NZ MEPS level)	Yes	3	Yes

Table S2 summarises the projected reductions in electricity use and greenhouse emissions. The financial benefit is the value of the electricity that would be saved (Table S3).[4] No monetary value is given to greenhouse gas reductions (illustrated in Figure S1).

The monetary cost is made up of the following components:

- The increase in the average purchase price of small electric water heaters, due to increased material content and the capital costs of retooling. These are incurred by manufacturers, but are passed on (with retail markup) to buyers. Although there are many technical pathways to achieve heat loss reductions, one pathway – increasing the thickness of insulation – is used as a proxy to calculate costs.
- The costs of altering some of the enclosures in which small water heaters are now installed, to accommodate larger units than otherwise. The number of installations where this is likely to occur, and the average costs of the alterations, are estimated from surveys commissioned by the AGO, using information provided by the industry.

Table S3 indicates the projected costs and benefits to the extent that these can be quantified. The costs of overcoming the dimensional constraint risk are estimated as a cost of enclosure change, but the risks from foaming agent uncertainty and loss of exports cannot be quantified and must be weighed qualitatively.

The projected benefit/cost ratios are higher for Options 1 and 3 (4.8-5.1) than Option 2, but the net national benefit is highest in Option 2 ($356 million net present value at

[4] A resource cost based analysis has also been carried out (see Appendix 4).

10% discount rate). The value of the future stream of electricity savings is more heavily discounted than the capital costs, which are incurred in one lump. Hence the higher the discount rate, the lower the benefit/cost ratio. At a 5% discount rate, the benefit/cost ratio of Option 2 is 5.1, whereas at 10% it is 4.1.

Table S2 Projected energy and greenhouse savings, 2001-2021

MEPS option	Total GWh saved, 2001-2021	Total kt CO_2-e saved, 2001-2021	Avg kt CO_2-e saved/yr 2008-12	Avg reduction below BAU 2008-12
1. 30% reduction in heat loss	6589	5615	255	16%
2. 50% reduction in heat loss	10982	9358	426	27%
3. 30% reduction with flexible compliance & labelling	8786	7486	341	22%

Note: All energy and greenhouse estimates refer to heat loss only, and exclude the energy delivered as useful hot water.

Figure S1. Projected greenhouse savings from MEPS options, 2001-2021

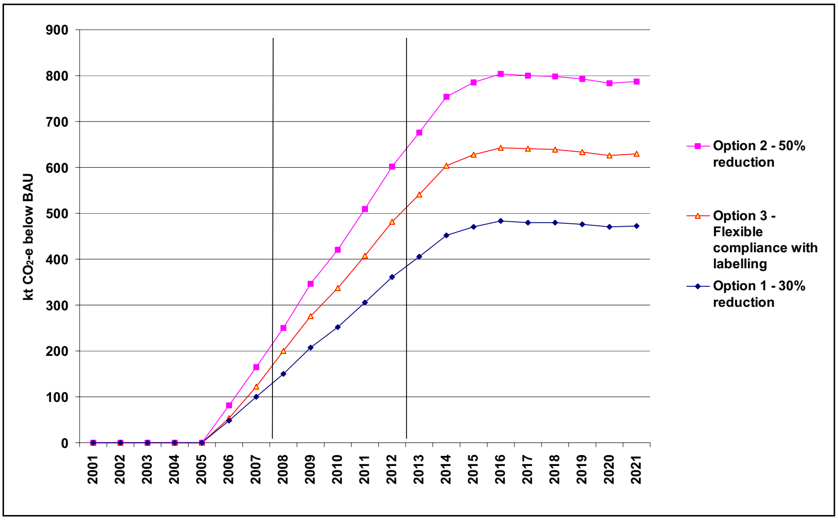

Table S3. Projected national costs and benefits, MEPS options

Options	NPV purchase costs $M	% of enclos-ures changed	NPV enclosure costs $M	NPV total capital costs $M	NPV energy costs $M	Capital cost increase $M	Energy saving $M	Net benefit $M	Benefit/ cost (10% discount)	Benefit/ cost (5% discount)	Benefit/ cost (0% discount)
BAU	$449	NA	NA	NA	$1,534	NA	NA	NA	NA	NA	NA
Option 1	$505	1%	$3	$507	$1,254	$59	$281	$223	4.8	5.7	7.0
Option 2	$539	8%	$22	$562	$1,067	$113	$469	$356	4.1	5.1	6.4
Option 3	$520	1%	$3(a)	$523	$1,160	$74	$375	$301	5.1	6.1	7.4

All Net Present Values at mid 2003, at 10% discount rate. Projections have been tested for sensitivity to a range of assumptions regarding material costs, discount rates, water heater service life and enclosure alteration costs. (a) 1999 MEPS models may be retained for a period to minimise these costs.

Supplier and Trade issues

There are two major manufacturers in Australia of small mains pressure electric storage water heaters in the size range 18 to 80 litres delivery: Paloma Industries (Rheem Brand) and GWA International (Dux brand). There are several other suppliers of niche products, including Edwards Energy Systems and Zip Heaters, but these have a very low market share. There are negligible imports of small water heaters, and limited exports, mainly to New Zealand. New Zealand has only one manufacturer of main pressure electric storage water heaters - Rheem NZ, a subsidiary of Rheem Australia. Other New Zealand water heater manufacturers concentrate on low pressure units, which are outside the scope of this RIS.

The adoption of more stringent MEPS is not likely to reduce the number of suppliers or models on the Australian market, and may perhaps increase it. The impact on trans-Tasman product flows would vary with the MEPS option and according to whether there is an effective and permanent exemption under TTMRA which blocks exports from Australia which fall short of the New Zealand MEPS levels.

Whether or not NZ secures a TTMRA permanent exemption for water heaters not meeting its MEPS level would have minimal impact on the pattern of public costs and benefits in Australia, and only limited impact on the costs and benefits for Australian suppliers exporting or intending to export to NZ, given that NZ is such a small proportion of the ANZ market for these products. The issue of exemption may have significant impact on NZ manufacturers of electric storage water heaters, and on prices and competition in the NZ water heater market, but this is outside the scope of the present RIS, which is limited to Australia alone.

Australian manufacturers were able to implement the 1999 MEPS levels by increasing the insulation thickness of products and passing on the greater material costs in price increases (as was expected) and without disruption to the market. There is no reason why this should not also be the case with more stringent MEPS.

The current MEPS regime is not inconsistent with the GATT *Technical Barriers to Trade* Agreement, and there is no reason why more stringent MEPS would be so.

Consultations

The views of the major Australian water heaters manufacturers and some New Zealand suppliers were sought during the revision of the RIS. They confirmed that the risk factors identified during the original RIS were still present, especially the uncertainty regarding foam blowing agents. They also confirmed agreement on the value of the sales-weighted compliance option proposed in the previous RIS (whether or not it is taken up). They also confirmed their opposition to the adoption of the NZ MEPS levels for Australia. Further public and industry consultations are planned following the release of this revised Draft RIS.

Assessment

In relation to the assessment criteria applied in this revised RIS:

Does the option address market failures, so that the average lifetime costs of water heating are reduced, when both capital and energy costs are taken into account? All options based on more stringent MEPS are likely to be effective in meeting the objectives stated for the regulation: reductions in greenhouse gas emissions and reduced life cycle costs to users. Option 2 has the highest ratio of benefits to costs (closely followed by Option 1), whereas Option 2 has the greatest net monetary benefit (followed by Option 1).

Does the option minimise negative impacts on product quality and function? Option 3 rates best on this criterion, since it allows for the widest range of small electric water heater types on the Australian market, and hence increases the probability that buyers will be able to find a model that best meets their requirements.

Does the option minimise negative impacts on manufacturers and suppliers? Option 3 rates best on this criterion because it offers the widest range of compliance options.

Is the option consistent with other national policy objectives, including in this case reduction in the emissions of ozone depleting substances and the objectives of the National Appliance and Equipment Energy Efficiency Program to match "world best practice" standards? There is a conflict between these objectives. Option 3 offers the greatest chance that the MEPS levels can be met and will not need to be revisited, whatever foaming agents are eventually adopted. On the other hand, the NZ 2003 MEPS levels set regulatory standards at the equivalent of a "world best practice" standard that did not exist when the original RIS was prepared, and Option 2 would force Australian regulatory levels to match them.

NAEEEP has a policy of "matching the best MEPS and mandatory labelling levels of our trading partners", which on the face of it would indicate Option 2. However, the level of trade for the products in question is modest and essentially one-way (to NZ). It is of greater advantage to Australian industry and the Australian economy to align MEPS levels with the best regulatory practice among trading partners from which there are significant imports, because this reduces the risk that less efficient models will be diverted to the Australian market, and – with more complex products – would also bring to the local market the benefits of the overseas research and development prompted by those more stringent energy standards. The case for matching MEPS levels for products that are less traded, which are relatively simple in technology (such as water heaters) and which differ in design from country to country is less clear.

Option 3 could create incentives to import higher efficiency NZ products because they could fill the HE niche. Option 2 would probably not create the same incentives, since if all models made in Australia were forced to the same heat loss level as in NZ, the higher production volumes would probably give them a substantial price advantage over imports.

Conclusions

On considering the three options for more stringent mandatory MEPS levels for electric mains pressure storage water heaters, it is concluded that:

1. More stringent MEPS is likely to be effective in meeting the objectives stated for the regulation: addressing market failure, reducing life cycle costs to users and reducing greenhouse gas emissions.

2. None of the alternatives examined appear as effective as MEPS in meeting all objectives, some would be ineffective with regard to some objectives, and some appear to be far more difficult or costly to implement.

3. Of the three MEPS options analysed, Option 3 (30% reduction heat loss, with the option of sales-weighted compliance and supported by indelible labelling of products with their energy efficiency) gives the highest ratio of benefits to costs.

4. The option with the highest net benefits and greenhouse savings is Option 2 (50% reduction in standing heat loss, which is roughly equivalent to the MEPS levels adopted in New Zealand in 2003). This also leads to the greatest increase in total water heater costs, with about four fifths of the increase coming from higher manufacturing costs and one fifth from the cost of changing enclosures to accommodate larger water heaters.

5. The greater the volume of insulation foam that will be required, the greater the exposure to uncertainties regarding foam availability, cost and characteristics and the costs of rebuilding enclosures or relocating water heaters. The higher MEPS level (Option 2) would require significantly greater increases in foam volume than Options 1 or 3 and so carries a significantly higher level of risk.

6. A "sales-weighted target" approach (in which some higher heat loss units could be sold provided that enough lower heat loss units were also sold) would give suppliers greater flexibility to address the dimensional constraint issue than a regime in which every unit sold would have to meet the nominated MEPS level.

7. Given that there is likely to be no more than 3 discrete levels of heat loss under Option 3, a simplified form of energy labelling which identifies High Efficiency, Medium Efficiency and Low Efficiency models of electric mains pressure storage water heater, may be as effective as a full comparative scale.

Recommendations

It is recommended that:

1. States and Territories implement more stringent mandatory MEPS for storage water heaters of less than 80 litres delivery (as defined in AS1056.1 *Storage Water Heaters Part 1: General requirements*).

2. The MEPS levels be set at a 30% reduction of the current maximum standing heat loss in AS1056.1-1991.

3. The scope of AS1056.1-1991 should be expanded to cover water heaters of delivery smaller than 25 litres delivery (the current lower limit).

4. The mode of implementation be through the existing regulations governing appliance energy labelling and MEPS in each State and Territory.

5. The revised MEPS levels take effect on 1 October 2005 and not be revised for at least 4 years.

6. The basis of MEPS should be the revised heat loss test recently developed for use in the proposed joint Australian and New Zealand standard for heat loss testing, and the recommended MEPS level should be adjusted should the joint test method result in different standing heat loss results from the current AS test (ie so that the objective of at least 30% reduction in maximum heat loss is maintained).

7. Governments allow the option of "sales-weighted" compliance, for water heaters of 50 litres delivery volume only. Suppliers who take this option could continue to sell water heaters which meet only the current (ie 1999) MEPS level for up to 5 years, so long as the sales-weighted average heat loss of all of that supplier's sales of 50 litre models over the period is no higher than the revised (ie 2005) MEPS level for 50 litre delivery water heaters.

8. Participation in the sales-weighted compliance option should be subject to the agreement of annual weighted heat loss targets and sales reporting arrangements. Failure to meet the annual targets should trigger the abandonment of the sales weighted scheme and the adoption of a more stringent universal MEPS level, so that the foregone energy savings are achieved.

9. Water heaters whose heat loss meets the New Zealand MEPS level (once the precise equivalence using the new test is determined) should be designated as "High Efficiency" and display a label to that effect, using the design currently being developed by the AGO.

10. In the event that companies opt for "sales-weighted" compliance, any 1999 MEPS models remaining on the market after the commencement of the new MEPS regime should be designated as "Low Efficiency" and display a label to that effect, using the design currently being developed by the AGO. This will assist label-aware buyers, specifiers and planning authorities to identify and avoid these models, thereby also assisting suppliers to meet their compliance targets.

11. The Ministerial Council on Energy should initiate a review of the optimum joint MEPS regime for Australia and New Zealand combined, no later than 2007 (to facilitate possible further revision of MEPS levels in 2010), or earlier in the event that a major exporting economy makes a significant change in its MEPS regime for electric storage water heaters.

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Contents

Glossary

AEEMA	Australian Electrical and Electronics Manufacturers Association
AGO	Australian Greenhouse Office
ANZMEC	Australian and New Zealand Minerals and Energy Council
APEC	Asia-Pacific Economic Cooperation
AS/NZS	Australian Standard/New Zealand Standard
BAU	Business as usual
CFC	chlorofluorocarbon
COAG	Council of Australian Governments
DISR	Department of Industry, Science and Resources
EC	Council of the European Union
GATT	General Agreement on Tariffs and Trade
GWP	Global warming potential
HCFC	hydrochlorofluorocarbon
HE	High efficiency
HFC	hydrofluorocarbon
HLF	Heat loss factor (ratio of proposed maximum heat loss to current maximum heat loss)
HWS	Hot water system
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers (USA)
IPCC	Intergovernmental Panel on Climate Change
LE	Low efficiency
LP	Low pressure
MCOE	Ministerial Council on Energy
ME	Medium efficiency
MEPS	Minimum energy performance standards
MP	Mains pressure
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NAEEEP	National Appliance and Equipment Energy Efficiency Program
NGGI	National Greenhouse Gas Inventory
NGS	National Greenhouse Strategy
ODP	Ozone depleting potential
OP	Off-peak (electricity tariff)
PRV	Pressure relief valve
RIS	Regulatory Impact Statement
SWH	Storage water heater
T&PRV	Temperature and pressure relief valve
TTMRA	Trans-Tasman Mutual Recognition Agreement
UNFCCC	United Nations Framework Convention on Climate Change

1. The Problem

COAG Guidelines:

- ***Statement of the problem:*** *why is government action being considered in the first place? What is the problem being addressed? For example, this should state the market failure that the proposal seeks to remedy.*

The standing heat loss from electric storage water heaters accounts for a significant share of greenhouse gas emissions from electricity use. Although Australia has undertaken to reduce greenhouse gas emissions the cost of emissions is not included in the electricity price.[5]

The inclusion of greenhouse costs in electricity pricing would not necessarily advance national environmental policy objectives. Water heater buyers as a group do not appear to be responsive to the existing energy price signals. Many electric water heater buyers are builders or plumbers, whose concern is with capital cost rather than lifetime ownership cost. Even for buyers who are concerned with running costs, the contribution of standing heat loss to lifetime ownership costs is poorly understood.

1.1 Energy-Related Greenhouse Gas Emissions

In recognition of the risks and costs of climate change, the Australian government is cooperating with other countries on a global strategy to reduce greenhouse gas emissions below what they would otherwise be. The Commonwealth, State and Territory governments have adopted a National Greenhouse Strategy to give effect to this objective (NGS 1998).

The United Nations Framework Convention on Climate Change (UNFCCC) was agreed in 1992 and came into force in 1994. It places most of the responsibility for taking action to limit greenhouse gas emissions on the developed countries, including Australia, which are referred to collectively as Annex I countries. Annex I countries are required to report each year on the total quantity of their greenhouse gas emissions and on the actions they are taking to limit emissions.

The Kyoto Protocol to the UNFCCC was agreed in December 1997, but has yet to be ratified by its signatories, which include Australia. If ratified, it would place a legally binding obligation on Annex I countries to limit their average annual greenhouse gas emissions during the "first commitment period" 2008 – 2012 to agreed targets, expressed as a proportion of their 1990 emissions. Australia has indicated that it will not ratify the Protocol, but would nevertheless take steps to meet its target, which is 108% of its 1990 emissions. This represents a reduction of more than 20% compared with business-as-usual projections (NGS 1998).

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[5] In January 2003 the State of NSW implemented a regulatory regime in which greenhouse gas emissions above a given baseline will be subject to fines, but these will bear on electicity retailers rather than on end users directly, and at this early stage the overall impact is impossible to predict.

Table 1 summarises Australia's greenhouse gas emissions in 1990 and 2000, the latest year for which a national greenhouse gas inventory (NGGI) has been prepared. Net emissions increased by 6.3% over the period, and the increase would have been far greater except for the effects of reduced emissions from land clearing. Electricity sector emissions increased by 35.6% over the period: this sector alone accounted for 9.1% growth on *total* 1990 emissions.

ABARE (2001) projects total electricity use to increase by a further 26% between 2000 and 2010, the mid-point of the Kyoto protocol commitment period. Electricity use in agriculture, mining and manufacturing is projected to increase by 27%, commercial sector electricity use by 27%, and residential electricity use by 25%. Slowing, and ultimately reversing the growth in electricity-related emissions is thus a high priority in Australia's greenhouse gas reduction strategy.

Table 1 Change in Greenhouse Gas Emissions, 1990 to 2000

	1990 Mt CO_2-e	2000 Mt CO_2-e	Change 90 to 2000 Mt CO_2-e	Change 90 to 2000 %	% of Energy Sector change
1A Fuel Combustion	270.0	340.3	70.3	26.0%	96.2%
1A1 Energy Industries	142.3	192.1	49.8	35.0%	68.1%
Electricity generation	129.1	175.1	46.0	35.6%	62.9%
Other	13.2	17.0	3.8	29.0%	5.2%
1A2 Manufacturing & Construction	50.3	52.5	2.2	4.3%	2.9%
1A3 Transport	61.5	76.3	14.9	24.2%	20.3%
Road	54.8	68.8	14.0	25.5%	19.1%
Other	6.6	7.5	0.9	13.3%	1.2%
1A4 Small combustion	14.2	17.0	2.8	19.6%	3.8%
1A5 Other	1.7	2.4	0.7	42.7%	1.0%
1B Fugitive	28.8	31.5	2.8	9.6%	3.8%
Solid Fuels	15.8	18.4	2.6	16.4%	3.5%
Oil and Natural Gas	12.9	13.1	0.2	1.4%	0.2%
Sector 1. All Energy (sum of 1A, 1B)	298.7	371.8	73.1	24.5%	100.0%
Sector 2. Industrial Processes	12.0	10.3	-1.7	-14.3%	
Sector 4. Agriculture	91.3	98.4	7.1	7.8%	
Sector 5 Land Use Change & Forestry	85.9	38.0	-47.9	-55.8%	
Sector 6. Waste	15.3	16.7	1.4	9.2%	
Net emissions	503.3	535.3	32.0	6.3%	

Source: AGO 2002c (a) Land use change excluded. Sector 3, Solvent and Other Product Use, contains only indirect greenhouse gases that fall outside the scope of the Kyoto Protocol.

1.2 Contribution of Electric Water Heaters to Emissions

The National Greenhouse Gas Inventory does not indicate directly the contribution of economic sectors (eg the commercial or manufacturing sectors) or end uses (eg water heating) to national greenhouse gas emissions. Further analysis is required, especially the allocation of electricity use to sectors, end uses and technology types.

Most of the energy consumption for electric water heating occurs in the residential sector, with the rest in the commercial and manufacturing sectors.[6] EES (1999) and EMET (1999) are the most detailed recent studies of energy use in the residential and the commercial sectors respectively.

Table 2 summarises estimated energy use for all purposes in the residential and commercial sectors in 2000 and 2010. In 2000, electric water heating accounted for about 28.1% of household electricity use and 2.1% of commercial sector electricity use – a total of 48.4 PJ (13,450 GWh). It is projected that the energy consumed by electric water heating will fall by about 4% between 2000 and 2010, largely because of the shift to gas water heating which is discussed later in this RIS. Even so, electric water heating is projected to remain the largest single source of greenhouse gas emissions in the residential sector (see Table 3).

Table 2 Estimated end uses of residential and commercial energy, 2000 and 2010

	2000 Res	2000 Com	2000 Tot	2010 Res	2010 Com	2010 Tot	Change
HVAC (a) - electric	8.4	83.3	91.7	9.1	110.3	119.4	30.3%
Heating - fuels	121.8	65.0	186.8	143.3	85.5	228.8	22.5%
Water heating – electric	45.5	2.9	48.4	42.6	4.0	46.6	-3.8%
Water heating - fuels	44.6	2.3	46.9	54.1	2.8	56.9	21.3%
Cooking - electric	8.3	1.0	9.3	9.8	1.3	11.1	20.0%
Cooking - fuels	6.9	6.9	13.8	8.2	8.5	16.7	20.5%
Lighting	15.8	35.3	51.1	17.7	52.5	70.2	37.5%
Appliances, other (b)	84.2	18.3	102.5	94.5	24.0	118.5	15.6%
Total	335.5	214.9	550.4	379.3	288.9	668.2	21.4%
Electricity	162.2	140.3	302.5	173.7	191.7	365.4	20.8%
Fuels	173.3	74.6	247.9	205.6	97.2	302.8	22.1%
WH/total energy	26.9%	2.4%	17.3%	25.5%	2.4%	15.5%	
Elect WH/tot elect	28.1%	2.1%	16.0%	24.5%	2.1%	12.7%	

All values PJ. Extracted from EMET (1999), EES (1999) (a) Heating, ventilation and air conditioning. (b) Comprises a large number of products and technology types.

Table 3 Estimated greenhouse gas emissions by residential and commercial energy use, 2000 and 2010

	2000 Res	2000 Com	2000 Tot	2010 Res	2010 Com	2010 Tot	Change
HVAC (a) - electric	2.3	24.4	26.7	2.4	32.4	34.8	30.2%
Heating - fuels	5.6	4.1	9.7	6.5	5.3	11.8	21.7%
Water heating – electric	12.4	0.9	13.3	10.9	1.2	12.1	-9.0%
Water heating - fuels	2.8	0.2	3.0	3.4	0.2	3.6	21.1%
Cooking - electric	2.4	0.3	2.7	2.7	0.4	3.1	14.0%
Cooking - fuels	0.4	0.5	0.9	0.5	0.5	1.1	16.9%
Lighting	4.6	10.5	15.1	4.8	15.7	20.5	35.8%
Appliances, other	24.2	5.4	29.6	25.7	7.1	32.8	10.7%
Total	54.7	46.2	101.0	56.9	62.8	119.7	18.5%
Electricity	45.9	41.4	87.3	46.2	56.7	102.9	17.8%
Fuels	8.9	4.8	13.7	10.4	6.1	16.5	20.4%
WH/total energy	27.7%	2.2%	16.1%	25.3%	2.2%	13.1%	
Elect WH/tot elect	27.0%	2.1%	15.2%	23.6%	2.1%	11.7%	

All values Mt CO_2-e. Extracted from EMET (1999), EES (1999) (a) Heating, ventilation and air conditioning.

[6] The water heaters covered in this RIS are of the type designed to deliver water at 70-80°C for general kitchen, bathroom and laundry purposes in households and in commercial establishments. It does not cover products intended to supply super-heated water or steam for industrial purposes.

There are three distinct groups of electric storage water heaters:[7]

1. Conventional storage water heaters with a water delivery of less than 80 litres ("small water heaters");
2. Conventional storage water heaters with a water delivery of 80 litres or more ("large water heaters"); and
3. Unconventional electric water heaters, ie solar water heaters with electric boosting and heat pump water heaters.

It is projected that the shift from electric to gas water heating currently under way will impact on large water heaters but not on small ones, because small water heaters are more likely to be installed in locations where gas is not available, space is restricted, flue access is unavailable, hot water demand is moderate and/or minimising initial capital cost is the dominant decision factor (see following section). As the average number of persons per household declines, the market for small electric water heaters will grow. Therefore energy use by small electric water heaters is projected to increase by more than 41% between 2000 and 2010, whereas energy use by large electric water heaters is projected to fall by nearly 20% - due to both declining market share and to the impact of MEPS, which took effect in October 1999 (see following section).

The energy used by electric water heaters is made up of two distinct components:

- The heat lost through the walls and fittings of hot water storage vessels; this is known as "standing heat loss";
- The useful energy (UE) in the hot water drawn off from the water heaters: most of this is delivered to the draw-off point (eg shower head or faucet), but some of this is lost from pipes between the water heater and the point of draw-off.

Useful energy is largely determined by the hot water demand, whereas the heat loss is determined by the design of the water heater itself and how and where it is installed. Table 4 disaggregates the electricity consumed by small and large water heaters into useful energy and energy losses (energy use by unconventional water heaters is included with large water heaters). It is estimated that about 32% of the energy used by small electric water heaters and 20% of the energy used by large electric water heaters was lost in 2000. It is estimated that by 2010, losses for small water heaters will increase by about 37%, but losses for large water heaters will fall by about 44%.

Table 5 indicates that in 2000, small water heaters consumed about 3,484 GWh of electricity, with a value of $420 million, and caused the emission of 3.6 million tonnes CO_2-equivalent. This greenhouse impact was equivalent to all of cooking and greater than the greenhouse impact of all water heating by natural gas and other fuels (see Table 3).

Heat losses alone from small electric water heaters accounted for 1,115 GWh of delivered electricity in 2000, costing $ 134 million. The associated greenhouse gas

[7] Storage water heaters account for the great majority of electric water heaters. Non-storage instantaneous water heaters account for a negligible share of electric water heating energy.

emissions totalled over 1.1 Mt CO_2-e. The electricity consumption and costs of these heat losses are projected to increase by more than 37% by 2010, and the associated greenhouse gas emissions by more than 27% (ie less than the growth in electricity use because the greenhouse-intensity of electricity supply is projected to fall).

Table 4 Components of annual electric water heater energy use, 2000 and 2010

	2000 Res	2000 Com	2000 Tot	2010 Res	2010 Com	2010 Tot	Change
Small WH - useful	7.7	0.8	8.5	10.9	1.4	12.2	43.6%
Small WH - losses	3.6	0.4	4.0	4.9	0.6	5.5	37.1%
Small WH - total	**11.4**	**1.2**	**12.5**	**15.8**	**2.0**	**17.7**	**41.5%**
Large WH - useful	27.3	1.5	28.8	23.1	1.8	24.8	-13.7%
Large WH - losses	6.8	0.3	7.1	3.8	0.2	4.0	-43.9%
Large WH - Total	**34.1**	**1.7**	**35.9**	**26.8**	**2.0**	**28.8**	**-19.6%**
Total useful energy	35.0	2.3	37.3	34.0	3.1	37.1	-0.6%
Total heat losses	10.5	0.6	11.1	8.6	0.8	9.5	-14.6%
Total water heating	**45.5**	**2.9**	**48.4**	**42.6**	**4.0**	**46.6**	**-3.8%**
% heat loss	23.0%	21.8%	22.9%	20.3%	21.0%	20.4%	

All values PJ. Author estimates for total stock, based on ES (1999)

Table 5 Annual electricity consumption, energy costs and greenhouse gas emissions for small electric water heaters, 2000 and 2010

	2000 Res	2000 Com	2000 Tot	2010 Res	2010 Com	2010 Tot	Change
	GWh electricity consumed (a)			GWh electricity consumed (a)			
Useful energy	2149	220	2369	3021	381	3402	43.6%
Standing heat loss	1011	104	1115	1357	171	1528	37.1%
Total energy	3160	324	3484	4378	552	4930	41.5%
	$M electricity cost (a)			$M electricity cost (a)			
Useful energy	$ 256	$ 30	$ 285	$ 360	$ 51	$ 411	44.0%
Standing heat loss	$ 120	$ 14	$ 134	$ 162	$ 23	$ 185	37.5%
Total energy	$ 376	$ 44	$ 420	$ 521	$ 75	$ 596	41.9%
	kt CO_2-e emissions (a)			kt CO_2-e emissions (a)			
Useful energy	2224	228	2451	2906	366	3272	33.5%
Standing heat loss	1046	107	1154	1306	165	1470	27.4%
Total energy	3270	335	3605	4211	531	4743	31.6%

Author estimates for total stock, based on ES (1999). Cost/benefit analyses cover only stock installed after 2000

1.3 Water Heater Technology and Energy Efficiency

Water heater technology

Unlike the range of cycles and options provided by some other appliances, the energy service provided by water heaters is very simple: the supply of hot water at the water heater outlet, whence it can be distributed by a system of pipes to a number of draw-off points. (In older installations the heater outlet was often the only draw-off point - the typical "sink" or "bath" heater - but this is now uncommon).

There is a wide range of fuel types and technologies on the Australian market which can provide this basic service, and their present market shares are largely a result of historical water heater and energy prices, the promotional efforts of the various utilities, and the consolidation of manufacturing. The main types on the market are:

- **electric storage:** an insulated tank of water is kept at a preset temperature (typically 60-80°C) by one or more electric resistance elements. These come on when the tank temperature drops below the thermostat set point, as occurs when hot water is drawn off and replaced by cold, or heat is lost by conduction through the tank walls and the pipe connections;

- **electric instantaneous:** an electric resistance element heats cold water as required; there is no store of hot water kept ready for use;

- **electric heat pump:** performs a task comparable with that of the conventional electric storage type, except that the water is heated by a heat pump which concentrates ambient energy, on the same principle as a reverse cycle air conditioner. Electricity is required to power the pump which circulates the heat exchange fluid, but not for resistance heating;

- **gas storage:** this operates on the same principle as the conventional electric storage, except that the water is heated by a gas burner;

- **gas instantaneous:** a gas burner heats the incoming cold water as required;

- **solar:** water is passed through rooftop collectors where it is heated by solar energy, and stored in an insulated tank ready for use. In most parts of Australia, the tank would need to be impractically large and/or highly insulated to provide for all hot water use at the times of the night or the year when solar input is insufficient. Therefore most units have an electric resistance element to provide "boost" energy at those times. Gas boosted systems are also available.

Each type of water heater has its particular energy efficiency, cost and technological characteristics. For example, the energy input rates of storage heaters can be smaller, since the stored hot water provides a time buffer. Storage water heaters are divided into a number of important subgroups, differentiated by the pressure at which the water is stored, and the energy type. Further details re given in Appendix 3.

Energy efficiency levels

The efficiency of energy transfer from the electric resistance heating element immersed in a storage water heater is close to 100%. Therefore the effective energy efficiency of a given model is determined almost entirely by the rate at which it loses heat. The established method for determining this rate is the standing heat loss test in Australian Standard AS1056.1 *Storage Water Heaters: General Requirements.*

AS 1056 also publishes the maximum rates of heat which water heaters should achieve (Table 6). These heat loss rates vary with the size of the water heater, as measured by its "hot water delivery" – the volume of water that can be drawn off before the water temperature falls below a specified level. In practice, the delivery volume is 4 to 6 litres less than the actual storage volume.

AS 1056 specifies maximum heat loss levels for three types of storage water heaters: "unvented" (ie mains pressure), "vented without attached feed tank" and "with attached feed tank." The two latter groups of values apply to low pressure units only, since mains pressure units have neither vents nor feed tanks.

As with any other aspect of Australian Standards, the heat loss levels in AS1056 are advisory only, unless backed by regulation or unless the supplier wishes to voluntarily use the Standards Australia compliance mark. Since 1 October 1999, it has been mandatory for unvented water heaters sold in Australia to comply with the maximum heat loss requirements in Column 2 (see following section).

Table 6 Electric Water Heaters – Maximum Heat Loss

1	2	3	4
Hot water delivery	**Maximum heat loss, kWh/24 hr (a)**		
	Water heaters without attached feed tank		**Water heaters with attached feed tank**
L	**Unvented (b)**	**Vented**	
25 (c)	1.4	1.4	—
31.5	1.5	1.5	—
40	1.6	1.6	—
50	1.7	1.7	—
63	1.9	1.9	—
80	1.47	2.1	—
100	1.61	2.3	2.6
125	1.75	2.5	2.8
160	1.96	2.8	3.1
200	2.17	3.1	3.4
250	2.38	3.4	3.7
315	2.66	3.8	4.1
400	2.87	4.1	4.4
500	3.15	4.5	4.8
630	3.43	4.9	5.2

Source: AS1056.1-1991 Storage Water Heaters Part 1: General requirements, Amendment No 3. Published 5 August 1996. (a) These values apply to water heaters with a single heating unit and may be increased by 0.2 kWh/24 h for each additional heating unit. (b) the values in Column 3 may be used instead of the values in Column 2 for unvented water heaters without an attached feed tank that are manufactured in Australia before 1 October 1999 or imported before 1 October 1999. The values for unvented water heaters without an attached feed tank may be increased by 0.2 kWh/24 h for each temperature/pressure relief valve mounted on a hot-water fitting, but not for any valve mounted on a cold-water fitting. (c) Existing 18 litre delivery models are outside scope of current standard.

Previous and Current MEPS

In the early 1990s the Australian and New Zealand Minerals and Energy Council (ANZMEC) commissioned a study on the benefits and costs of implementing minimum energy performance standards (MEPS) for household electrical appliances in Australia. At the time, the maximum heat loss levels for unvented storage water heaters were equivalent to those specified in Column 3 of Table 6.

The findings and recommendations concerning electric storage water heaters included the following:

> "It is recommended that the following minimum energy performance standards be adopted for electric storage water heaters:
>
> - the standing heat loss as measured in accordance with AS1056.1 shall be no greater than 55% of the corresponding standing heat loss, for models of 80 litres delivery or more (as defined in AS1056.1); and
> - the standing heat loss as measured in accordance with AS1056.1 shall be no greater than 70% of the corresponding standing heat loss, for models of less than 80 litres delivery (as defined in AS1056.1);
> - the ratios of new to existing heat loss limits should be based on the total heat loss of a single-element water heater with a hot-side temperature and pressure relief valve; the new limits should be global limits, without additional allowance for extra elements or valves. This will give additional incentive for innovative design." (GWA et al 1993)

Discussions between the water heater industry and ANZMEC led to the following agreement:

- The MEPS level for models of 80 litres delivery or more would be 70% of the then maximum heat loss in AS1056.1, rather than the 55% recommended;
- The MEPS level for models of less than 80 litres delivery would be 100% of the then maximum heat loss in AS1056.1, rather than the 70% recommended – this still represented a more stringent requirement, since prior to the agreement most small water heater models had a higher heat loss than the maximum in AS1056.1;
- The MEPS levels would take effect for products manufactured or imported after 1 October 1999; and
- The MEPS levels would not be increased before 1 October 2004 at the earliest.

The revised MEPS levels were given effect by amending AS1056.1 in August 1996 so that the maximum heat losses for 80 litres and over became 70% of the previous values, to take effect October 1999 (see Table 6). The regulations under State and Territory energy labelling legislation were amended to make compliance with AS1056.1 mandatory, with effect from the same date (see example, Appendix 1). These maximum heat loss values are known as the "1999 MEPS levels".

Tested and in-use heat loss

The Energy Test

The standing heat loss test in AS1056 is carried out with the water in the storage tank maintained at a constant temperature of 75°C over a 24 hr period in a test room maintained at 20°C (with tolerances for both set out in the Standard). The inlet and outlet pipes are disconnected, and the sockets are plugged with 12.5 mm of hair felt insulation or equivalent. The temperature and pressure relief valve (T&PRV) is fitted, but without a drain line.

New Zealand test standard for determining the heat loss of electric water heaters is similar, but not identical. The NZS4602 test is conducted over a temperature rise of 55.6°C (100°F) whereas the AS1056 test is conducted over a temperature rise of 55°C. There are also differences in the way the units are prepared for test, in the instrumentation used and the tolerances allowed. These differences have made it difficult to compare the results of heat loss tests conducted in the two countries, and to determine the precise relationships between the current and proposed MEPS levels in Australia and New Zealand.

In 1999 the two Standards bodies agreed that the standards should be harmonised into a joint standard. As part of this process, the NAEEEC funded a series of tests on a range of models from Australia, New Zealand and the USA. A revised test has now been developed and proposed for incorporation in the joint Standard (EES 2003).

The relationship between tested heat loss and MEPS

The adoption of a joint test will mean that a water heater model will need to be tested only once to determine its heat loss for purposes of establishing compliance with heat loss-based MEPS in either country. However, the adoption of a unified test method – even combined with the adoption of the same nominal maximum heat loss value – would not completely align the MEPS regimes in the two countries, so long as the following differences remain:

- A different basis for determining the capacity of the water heater. Currently, AS1056 uses delivery capacity (the volume of hot water that can be drawn off before the temperature falls below the required minimum) whereas NZS4602 uses storage volume. Delivery is a better indication of performance; and

- Whether the maximum heat loss value is to apply to every unit of each model (as in Australia) or to the mean of units of each model produced (as is understood to be the case in New Zealand). This leads to key differences in the protocol for testing additional units in the event that a check test on one randomly selected unit indicates a higher heat loss than the maximum specified in the standard. If the maximum value is intended to apply to the mean of production, the number of additional units that will need to be tested will have to be determined by statistical techniques, and the greater the production variability (ie if there is poor quality control on the production line) the more units will need to tested and the greater the scope for legal challenge. In other words, the compliance regime involves higher costs and less certainty.

The “absolute” MEPS approach transfers risk from the buyer (who under the “mean” approach could have an even chance of obtaining a unit with *higher* heat loss and hence higher running costs) to the manufacturer. In order to ensure compliance with an “absolute” MEPS level, the manufacturer will have to over-design the water heater, so that the mean heat loss is lower than the MEPS level, and/or maintain very high quality control, so that every unit produced is capable of passing (or at least, that the probability of failure is so low a supplementary unit test is near certain to pass). Both of these strategies are to the benefit of the buyer.

The differences in approach affects the apparent difference between MEPS regimes. If for example the Australian MEPS were revised so that the maximum heat was 30% lower than the 1999 MEPS levels, the value applying to a 50 litre delivery unit would be 1.19 kWh/24 hrs (ie 70% of the value in Table 6). If the water heater had a storage volume of 54 litres the maximum heat loss value under the MEPS regime introduced in New Zealand in February 2003 would be about 0.85 kWh/24 hrs. On the face of it, the Australian MEPS level would allow unit with a 40% higher heat loss.

However, the fact that the Australian regime is “absolute” means that the manufacturer will probably have to design the unit and control the production process so that the mean heat loss off the production line is about 5% below the MEPS level (say 1.13 kWh/24 hrs). This reduces the mean heat loss margin above the NZ level from 40% to 33%.

In-use energy performance

As the energy test does not replicate actual conditions of installation and use, it is necessary to consider what effect these may have on actual energy performance. EP et al (2000) found that pipes running upwards from the water heater allow the water in the pipe to convect and increase the effective conductivity of the copper pipe. Each upward 12.5 mm pipe connection added 20.6% relative to the heat losses of the disconnected tank. Pipes running horizontally or downward from the container (or incorporating a convection trap, ie running downward first before changing direction) add 14.8%. These values increase if the water heater is installed in an exposed location. Thus, the worst case for an internally installed unit is for two upward pipe connections and one downward (dry) drain from the T&PRV, for a total additional loss of around 55%. This situation is representative of the common past practice of installing under a suspended timber floor. Insulating those pipes (or substituting a PVC pipe in the case of the drain) reduces these additional heat losses by about half.

Standing heat loss tests are generally carried out with new water heaters, in which the insulation foam is at its optimum performance. Over time the blowing agent tends to migrate out from the foam, to be replaced with air which has a lower insulating value. The rate of degradation depends on many factors including the foam cell structure and the airtightness of the metal casing around the foam. Consequently any apparent performance difference between foams when tested new tends to decrease over time.

As no hot water is drawn off during the standing heat loss test, it is possible to maintain a steady water temperature of 75°C and a constant differential of 55°C between the water and the air in the test room. In actual use however, hot water is drawn off constantly and is replaced by cold water. As reheat is not instantaneous, the average temperature of the stored water is lower than the thermostat setting, so the average standing heat loss would be lower than under test conditions, even if the ambient temperature remained at 20°C. The difference is greatest with water heaters connected to off-peak tariffs, since reheat is often delayed for several hours after draw-off and the tank may become stratified, with a large temperature difference from top to bottom. With water heaters connected to the continuous tariff (which includes all smaller water heaters) reheat commences immediately draw-off begins and there is less stratification, so average storage temperature is closer to the thermostat setting.

In actual installations, the ambient temperature around the water heater is not likely to be a constant 20°C, or even an average of 20°C. Mains pressure water heaters are often installed outside or in ventilated sub-floor spaces, where the combined effects of low temperature and high air movement could increase heat loss. Conversely, they may be installed in cupboards, where temperatures could well rise above 20°C and so reduce heat loss.

In summary, some aspects of actual water heater installation and use will increase heat losses when compared with the AS1056 test, while others will reduce it. Installation in an enclosure, and reduced average water storage temperature due to drawoffs, will lead to *lower* in-use losses. On the other hand, the connection of pipes, installation in an exposed location, and – over time – degradation of insulation performance – will lead to *higher* in-use losses. In the absence of detailed information on the circumstances of water heater installation and on hot water use, the AS1056 heat loss will be used as a reasonable proxy for heat loss in the field.

Scope for Energy Efficiency Increases

Measures impacting on heat loss

There is still considerable technical scope for reducing heat losses below the 1999 MEPS levels. A study commissioned by the AGO (EP et al 2000) considered improvement options for smaller water heaters within the following constraints:

- allowing for a reduction in the insulation value of blown polyurethane foam insulation, as would occur once the manufacturers phase out low-ozone-depleting hydrofluorocarbon (HCFC) foam blowing agents in favour of zero-ozone-depleting foaming agents such as cyclopentane or hydrofluorocarbons (HFCs)[8];
- maintaining the external rectilinear dimensions of the water heater (ie allowing a prismatic casing rather than a cylindrical one, but within the same height and width).

The measures examined (by computer simulation), and the impact of each measure on reducing standing heat loss, are summarised in Table 7. The study found that:

[8] The use of the highly ozone-depleting CFC-11 was phased out in the mid 1990s.

- the combination of a number of minor changes could more or less compensate (ie within 2%) for the greater heat loss due to a more conductive foam; but

- if heat loss were to be brought below the 1999 MEPS level, changes to the tank configuration and the casing would most likely be necessary.

The findings of the study indicate that there is significant technical scope to reduce water heater standing heat loss, but a number of uncertainties remain:

- Because the nature and characteristics of the HCFC-replacing foam are still not known, the heat loss penalty (ie the "Starting Point" in Table 7) may be turn out to be significantly higher or lower than assumed here;

- Some of the measures proposed may have safety implications, and so would not be applicable even though they would reduce heat loss;

- Some measures that could be applied to the particular model analysed may already be incorporated into other water heater models, so the further scope for heat loss reduction in those models would be less.

Nevertheless, specific measures that are technically feasible and that would result in a heat loss about 30% below current MEPS levels have been identified and modelled.

This suggests that a setting a target heat loss about 30% below the 1999 MEPS level carries a relatively low level of technical risk – indeed it is possible that manufacturers could achieve a still greater reduction in heat loss if forced to do so by MEPS, but the risks from the uncertainties above would increase.

Table 7 Combined heat loss savings from potential design changes to small electric water heater, within the dimensional constraint.

Possible Modification	Loss, Wh/24h	Additional Saving, Wh/24h	% below Starting Point	Compared with 1999 MEPS level
1999 MEPS level	**1,700**			
Starting point (a)	**1,985**	NA	NA	
Insulate anode access cover	18 (c)	10	0.5%	
Insulate element access cover	20 (c)	66	3.3%	
Insulated (or stainless steel) valve (b)	132 (c)	42	2.2%	
PVC inlet and outlet connections (b)	75 (c)	48	2.5%	
Relocate polyester compression wad	153 (c)	80	4.1%	
Total of changes not involving casing	**1,739**	**246**	**12.4%**	**+ 2%**
Change outer casing to square in plan	968 (c)	357	17.4%	
Reshape tank bottom like tank top	483 (c)	180	9.4%	
All measures combined	**1,202**	**783**	**39.4%**	**- 29%**

Source: EP et al (2000). (a) Based on a 1999 MEPS-compliant 50 litre delivery model with 25mm of foam in the walls, but with a less insulating blowing agent. (b) Reduction when tested to AS1056, ie with fittings disconnected. Actual savings greater when water heater is connected to conductive pipes. (c) Heat loss from this element before modification.

Other Measures

There are many other measures that could be taken to reduce water heating energy demand. These include:

- locating the water heater closer to the main draw-off points to reduce pipe losses;
- locating the water heater indoors or in a sheltered location to reduce heat loss;
- better installation practices – heat traps on connections to the water heater and insulation of pipes;
- reducing the demand for hot water through installation of low-flow shower heads and more water-efficient clothes washers and dishwashers;
- reducing the demand for hot water by washing clothes in cold water;
- wrapping existing water heaters with flexible insulation to reduce heat loss.

These measures are being promoted by a number of State and Commonwealth agencies, with the aim of minimising energy use, water use and greenhouse gas emissions. They are independent of the proposals considered in this RIS, in that the energy savings from reducing the standing heat loss of new small electric water heaters would be additional to the savings from these programs.

1.4 The water heater market

Product Supply

Manufacturers

The electric storage water heater (SWH) market is now dominated by mains pressure (MP) systems, which account for well over 95% of sales nationally. There is still a large installed stock of low pressure (LP) units, because of their longevity, but sales are declining.[9] The only significant remaining LP markets are parts of Victoria, SA and WA, where the water supply is low pressure and/or poor water quality shortens the service life of main pressure units. (See Appendix 2 for further background on the characteristics of MP and LP types.)

The brand with the largest share of the MPSWH market is Rheem Australia, which manufactures Rheem and Vulcan brand units in Sydney. In December 2001 the previous owner, Southcorp, sold the Rheem operations in Australia, New Zealand and China to the Japan based Paloma Industries Limited and to Paloma's US subsidiary, Rheem Manufacturing Company.[10]

The next largest Australian supplier of electric MPSWHs is GWA International, which manufactures Dux brand units in Moss Vale. Both Rheem and Dux make a full

[9] The LP share of the water heater market is much higher in New Zealand than in Australia.
[10] Paloma is a world-scale manufacturer of instantaneous gas water heaters, which are sold in Australia under the Paloma and now the Rheem brands. The Rheem Manufacturing Company of the USA originally owned the Rheem brand, but was otherwise unrelated to Rheem Australia. In April 2002 Southcorp sold its US water heater subsidiary, American Water Heater, to the Canadian water heater manufacturer GSW Incorporated.

range of electric models, from small to large, with a large number of element sizes and configurations. The other Australian manufacturers of electric MPSWHs have much smaller market shares and compete less on price than on attributes such as longevity, tolerance of higher storage temperatures and connectivity to solar collectors (all of which can be achieved using a stainless steel rather than a copper pressure vessel, for example).

Peter Sachs Industries of Brisbane (Saxon Brand), Aquamax (Melbourne) and Beasley (Adelaide) only make two or three electric MPSWH models each, all in the 160 to 315 litre delivery range, and none of the small models in the scope of this RIS. Edwards Energy Systems in Perth is the only other manufacturer to offer a 50 litre delivery model. A number of suppliers offer very small imported electric storage water heaters with deliveries in the range 5 to 10 litres. These are designed to serve a single outlet, like older style instantaneous "sink heaters", but with the advantage that they need only a single phase electricity supply rather than a three-phase supply, since sufficient hot water to fill a sink or basin is stored hot for use.

At present these very small delivery units are outside the scope of the heat loss levels in AS1056, which only covers units with a delivery of 25 litres or greater (see Table 6). It is recommended in this RIS that there be no lower capacity limit for the scope of MEPS. There is very little information on sales or heat loss characteristics of very small units, since they are not covered by the 1999 MEPS, but their heat loss may be significant and should be subject to the same limits as other small water heaters.

For purposes of cost-benefit analysis, the average service life of small water heaters is estimated at 9 years, allowing for both technical failures and early retirement of serviceable units due to building renovations. (The cost-benefit analysis in Chapter 4 includes a test of sensitivity to service life assumptions).

Rheem and Dux offer two quality grades in their larger water heaters - 5 and 10 years' warranty respectively - but only one quality grade, with 5 years' warranty, for the smaller models. Edwards uses a stainless steel tank (reflected by the higher price) and offers a 10 year warranty for all models. The main characteristics of the current small models, and the estimated weighted averages for sales in 2000, are summarised in Table 8.

Table 8 Characteristics of small electric water heaters on the market, 2001

Brand	Model	Delivery litres	Storage litres	Height mm	Diameter mm	Heat loss kWh/24hr(a)	Retail $
Rheem	111025	18	25	400	385	1.0	395
Rheem(b)	111050	51	53	670	393	1.7	410
Edwards	DES50	50	55	700	470	1.47	680
Dux	25 VI	25	30	418	405	1.4	385
Dux	50 VI	51	54	673	405	1.7	395
Weighted(c)		41	45	586	398	1.49	415

Source: Manufacturer catalogues and sales departments; (a) As declared on www.energyrating.gov.au
(b) Separate Vulcan brand 50 litre model is no longer manufactured. (c) Weighted averages from author's estimate of market share by company and product size, 2000.

Market Size

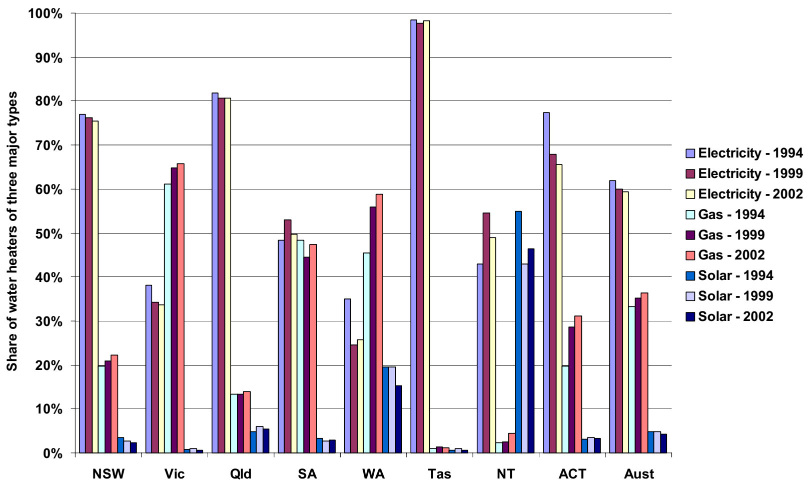
In 1999 there were about 7.14 million water heaters installed in Australian dwellings (an average of 1.01 per dwelling) and an unknown number of domestic-style units in commercial and institutional use. Figure 1 illustrates the share of household water heaters by type in 1994, 1999 and 2002. It indicates that:

∉# On a national basis, the electric share of total water heaters installed declined from 62.4% to 59.4% between 1994 and 2002, the gas share increased from 33.3% to 36.4% and the solar share declined from 4.9% to 4.2%;
∉# The shift from electric to gas was most marked in the ACT, WA and Victoria;
∉# The electric water heater share increased in the NT (where electricity took market share from solar), and remained fairly steady in SA and in Tasmania (where there is no natural gas supply).

Figure 2 illustrates the distribution of electric water heaters by jurisdiction. NSW and Queensland between them have nearly 70% of the national electric water heater stock

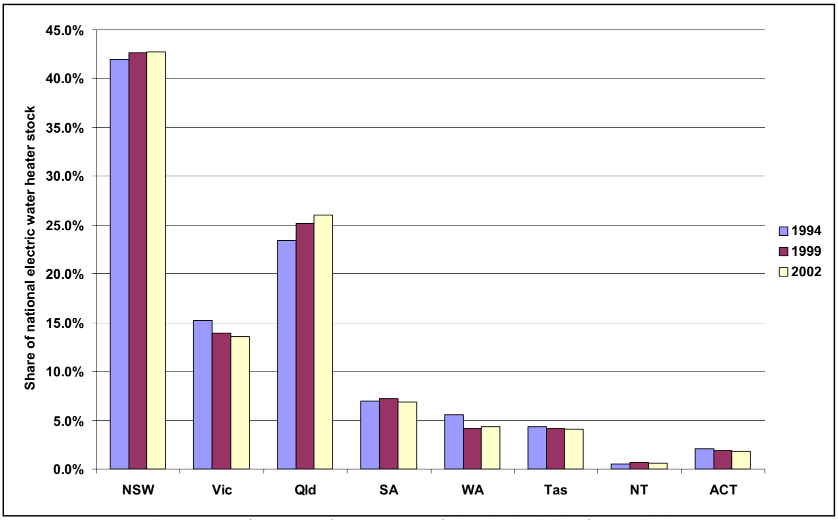
Figure 3 illustrates the historical trend in gas and electric water heater sales between 1998 and 2000, and a trend projection based on the regression line, which smooths out the year to year fluctuations caused by the variability of the housing market.
It is estimated that in 2000 the trend sales of gas and electric water heaters totalled about 700,000 units (62% electric, 38% gas). This covers units intended for non-household as well as household use. Total sales are projected to reach about 900,000 units per annum by 2020 (54% electric, 46% gas). It is estimated that small water heaters accounted for about 26% of electric water heaters sales in 2000, and that this will increase to 30% by 2020. Projected sales of small water heaters by jurisdiction are illustrated in Figure 4.

Figure 1 Share of household water heaters by energy type, 1994, 1999 and 2002



Source: Environmental Issues, March 2002, ABS Catalogue 4602.0

Figure 2 Share of household electric water heater stock by jurisdiction, 1994, 1999 and 2002



Source: Environmental Issues, March 2002, ABS Catalogue 4602.0

Figure 3 Historical and projected annual sales of electric and gas water heaters

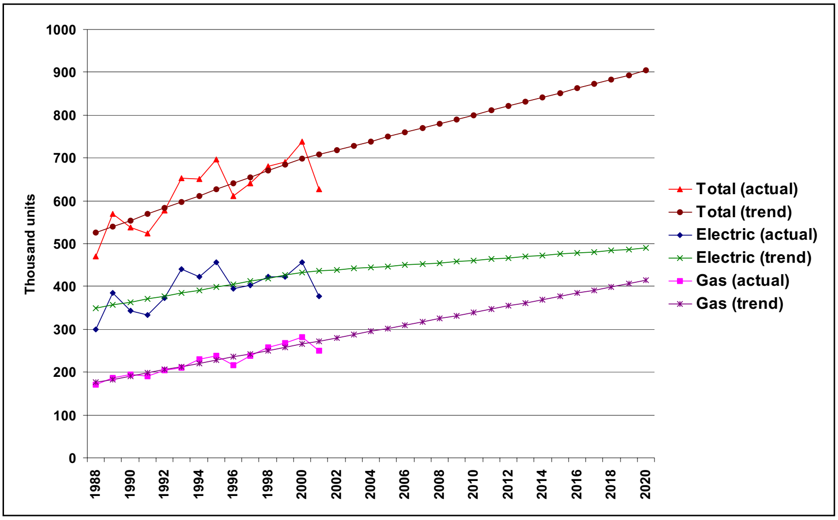
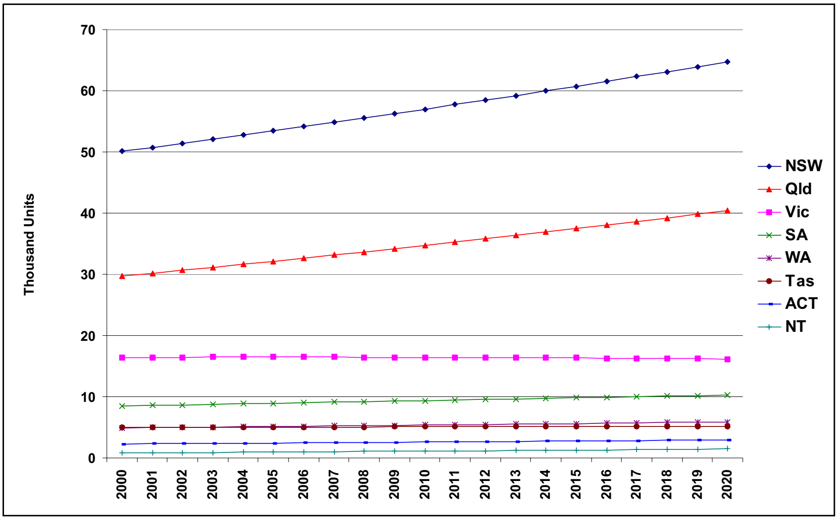


Figure 4 Projected annual sales of small electric water heaters by jurisdiction



Product selection

Life Cycle Costs

Small electric water heaters are the most expensive way to heat water. Although they are cheapest to purchase, they incur the highest running costs, both for useful energy and to cover heat losses. Table 9 summarises the life cycle costs of obtaining the same amount of daily hot water for 9 years from a small continuous tariff electric SWH and by four alternatives: a gas instantaneous water heater (a more likely direct competitor than gas storage for small electric water heaters), electric off-peak 1 (restricted hours), electric off-peak 2 (extended hours) and solar with off-peak 2 boost. The table indicates that, for the continuous electric water heater:

Table 9 Typical life cycle costs for alternative means of water heating

Water heater type and tariff	Purchase	Install-ation	Energy cost (a)	Total life cycle cost	Energy/ total cost	Heat loss cost (d)
Continuous (50 litre) – new/same location	$ 400	$ 150	$2,440	$ 2,990	82%	$ 425
Continuous – relocation (b)	$ 400	$ 500	$2,440	$ 3,340	73%	$ 425
Gas instantaneous – existing gas connection	$ 870	$ 300	$1,040	$ 2,210	47%	
Gas instantaneous - new gas connection	$ 870	$ 600	$1,040	$ 2,510	41%	
Off-peak 1 (250 litre)	$ 780	$ 250	$963	$ 1,993	48%	$ 203
Off-peak 2 (160 litre)	$ 670	$ 250	$1,562	$ 2,482	63%	$ 294
Solar/Off-peak 2 (subsidised) (c)	$ 1,500	$ 500	$642	$ 2,642	24%	
Solar/Off-peak 2 (no subsidy)	$ 2,000	$ 500	$642	$ 3,142	20%	

(a) Net present value of energy costs over 9 years, at 10% discount rate, for supplying 150 litres of hot water per day. (b) Where replacement cannot be installed in same location, and either the enclosure has to be altered or the unit relocated. (c) $500 minimum government subsidy available in NSW, Queensland and Victoria; higher subsidy available in some cases. (d) NPV of 9 years of standing heat losses from water heater (excluding fittings and pipework).

- the life cycle costs are the highest (apart from unsubsidised solar)
- energy costs represent about 82% of the life cycle cost
- the net present value of energy losses alone exceeds the capital cost of the water heater
- The least costly option (off-peak 1) costs about one-third less.

The costs and cost components are illustrated in Figure 5.

User concern with energy efficiency

Small electric SWH tend to be purchased in preference to other types when minimising capital cost is the main concern in the initial purchase decision, when access to space outside the dwelling is difficult and when the purchase price and the running costs are borne by different parties (ie there are "split incentives").

The most common applications for small electric SWH are:

- New townhouses and apartments, where the developer wishes to minimise costs;
- Rental accommodation, where the landlord wishes to minimise costs;
- Apartments where space is limited;
- Remote bathrooms in larger houses, where pipe runs from the main water heater are excessive;
- Those commercial and institutional kitchens and bathrooms where hot water requirements are modest and space is limited.

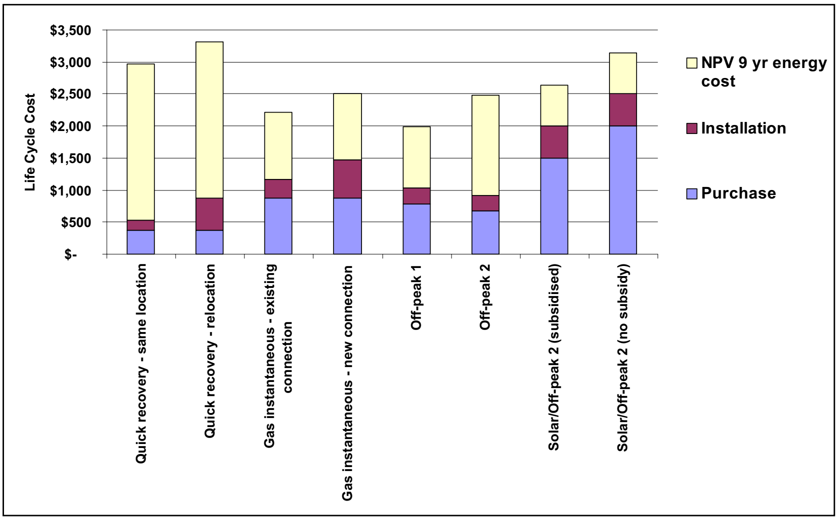


Figure 5 Typical life cycle costs for alternative means of water heating

There is a strong inverse correlation between dwelling size and tendency to rent. Table 10 indicates that in 1999 over 69% of flats were rented, compared with 18% of separate houses. There is also a correlation between household income and tendency to rent. The ABS reports that in 1999, the median weekly income of owning households was $ 823, compared with $ 612 for renting households *(Australian Housing Survey 1999*, ABS Catalogue 4182.0). Adjusted for differences in average size of owning and renting households, this was equivalent to $ 304 and $ 255 per capita respectively.

While these data are not conclusive, they suggest that small electric water heaters are likely to be installed in rental accommodation, where decisions about the choice of water heater are not made by the resident who pays the energy bills, and where the resident is likely to have a lower income. In other words, the mode of water heating with the highest energy and life cycle costs tends to be imposed on the lowest income groups.

Table 10 Dwelling type by tenure

Dwelling type	Owned(a)	Rented(b)	Other(c)	Total	% rented
Separate house	4535.8	1049.3	150.2	5735.3	18.3%
Semi-detached	275.6	347.4	18.5	641.5	54.2%
Flat	221.7	553.9	22.9	798.5	69.4%
Other	NA	NA	NA	41.6	NA
All types	5033.1	1950.6	191.6	7216.9	27.2%

Source: Australian Housing Survey 1999, ABS Catalogue 4182.0 All values thousands (a) Includes owner with mortgage. (b) Private landlord and housing authority. (c) Includes rent-free tenure.

The potential impact of labelling

Of course, many householders do purchase their own water heaters, if not at the time of first moving in (when the water heater is the one chosen by the builder, the landlord or the previous occupant), then at the time when the water heater fails and needs replacement. The selection of the replacement is often made under severe time pressure (nobody wants to go without hot water for any longer than necessary) and without visiting a showroom to inspect alternatives. For these reasons the most common replacement is another water heater of the same type, and in the same location (GWA et al 1993).

Where running costs do enter the decision process, it is usually in the form of technology type (eg gas vs conventional electric vs solar vs heat pump) and tariff selection (eg off-peak vs continuous tariff electricity). Only then does the comparative energy efficiency of alternative models of the same energy type become a factor. For gas water heaters, there are two distinct technology types (storage and instantaneous) and many efficiency levels within each type, so choice is both worthwhile and possible because of gas appliance labelling, which was introduced by the gas industry in the early 1980s.

Historically, MEPS has been the main driver of improvement in the energy efficiency of electric water heaters. In the mid 1980s more stringent MEPS levels were enforced by the energy utilities, mainly out of concern with off-peak water heater service quality (which affected competition with gas) and energy retention (which affected the economics of electricity supply). The further increase in MEPS levels in 1999 was prompted by ANZMEC. These changes are illustrated in Table 11.

Table 11 Reductions in water heater maximum heat loss levels since 1986

Date	AS1056.1 maximum standing heat loss, kWh/24 h		
	50 l delivery	160 l delivery	250 l delivery
Pre-June 1986	2.3	3.4	3.7
From June 1986	1.7	2.7	3.4
From October 1999 (MEPS)	1.7(a)	1.96	2.38

(a) No change, but compliance mandatory for first time

Given the historical weakness of buyer interest in greater energy efficiency, it is likely that any further increases in water heater energy efficiency will depend largely on further changes in MEPS levels, but the potential value of energy labelling as a supplementary policy option is now increasing.

Until fairly recently Australian electric SWHs were all built to conform to the maximum heat loss levels in AS1056.1, and labelling would have revealed no significant efficiency difference between models. This was one of the main reasons for ANZMEC's 1996 decision to proceed with MEPS for electric water heaters.

This is no longer the case. There is at least one model now on the Australian market with a substantially lower heat loss[11], and if suppliers took up the option of sales-weighted MEPS compliance then more models of different heat loss levels would become available. In addition, new models have now been introduced in New Zealand to meet the NZ MEPS, and if these were to be introduced in Australia they would constitute another heat loss class.

Other factors likely to increase the potential for both voluntary and mandatory labelling to impact on the electric water heater market are:

- The AGO has proposed to industry a voluntary "endorsement" labelling scheme that would identify "higher efficiency" models in all product classes (eg the water heaters with the lowest heat losses). While the use of the label would be voluntary, Trade Practices sanctions would apply for misleading label claims;

- The AGO plans to introduce a mandatory "disendorsement" labelling scheme to assist buyers to easily identify the least efficient models in all product classes. These could be applied to current (1999 MEPS level) water heaters in the event that these remain on the market due to the adoption of the sales-weighted compliance option; and

- AGO-sponsored programs such as "Green Plumbers" and local-government based environmental sustainability ratings for building approvals, which will increase the tendency of formerly resistant intermediaries (ie plumbers and builders) to prefer more energy-efficient water heaters, provided they can easily identify them.

[11] The Edwards 50 litre delivery model has thicker wall insulation thickness and a declared heat loss of about 14% less than the AS1056 level. However, the price premium is about $300, which is more than three times the NPV of the heat loss reduction, even over a longer than average service life.

The Dimensional Constraint Issue

Magnitude of the issue

In 1993, the major objection by water heater suppliers to increasing MEPS levels for small water heaters was the argument that increasing the external dimensions of new products would make it difficult to replace those existing water heaters installed in confined enclosures, when they reach the end of their service lives.

There are two broad approaches to reducing standing losses from electric storage water heaters:

a) Increasing the insulation thickness; and
b) Accumulation of measures which do not affect insulation thickness.

There is a finite technical scope for type (b) measures (see Table 7), but the potential for (a) is limited by economic considerations, not technical ones. The approach – or combination of the two approaches – which manufacturers will follow to achieve any given MEPS level is up to them. However, it is highly likely that if more stringent MEPS require a heat loss reduction of more than 10-20%, it will be achieved with some increase in insulation. The more stringent the MEPS requirement, and the greater the reduction in foam performance that accompanies the phaseout of HCFCs, the greater the likely insulation increase.

When the first round of MEPS was introduced in 1999, requiring a 30% reduction in the heat loss of larger water heaters, all suppliers increased the insulation thickness of the models affected. It is highly likely that a an increase in insulation would be part of the compliance strategy for smaller water heaters as well.

If all water heater models increase in external volume, then when some existing units reach the end of their service life, it may be impossible to install their replacements in the same location. The options would then be:

1. Rebuilding the enclosure;
2. Locating the replacement small electric water heater in a different place; and/or
3. Adopting a different energy form (eg gas or off-peak electric).

Each of these options would impose additional capital costs beyond the "direct replacement" option, ie installing a new small electric storage water heater in the same location. However, option 3 may actually be cost-effective for the user if the subsequent reduction in running costs were large enough.

In 1999 the AGO commissioned Taylor Nelson Soffres (TNS) to research the proportion of installations where a larger water heater would not fit, the options available in such cases and the costs (TNS 1999). This was followed up by a supplementary survey in August 2000 (TNS 2000).

Most of the MEPS options considered in this RIS could be achieved with increments of less than 80mm in the diameter and height of the water heater. Table 12 indicates that a 30% reduction in heat loss could be accommodated with a 50 mm increment, even assuming that only the technical approach used is thicker insulation. Only at 50% heat loss is the increment likely to exceed 80mm.

Table 12 Indicative size increases to accommodate thicker insulation

	Standing heat loss compared with AS1056.1-1991				
	100%	**80%**	**70%**	**60%**	**50%**
Thickness of wall insulation	25	44	50	58	70
Increase in wall thickness(a)	NA	19	25	33	45
Increase in cabinet diameter and height	NA	37	50	67	90

(a) Assuming that heat loss through insulated walls and ends accounts for about 70% of initial standing heat loss, and reduction in heat loss is achieved solely through increasing the insulation thickness.

Table 13 summarises the average clearances determined in the surveys, and Figure 6 illustrates the implications for water heater replacement outcomes. It indicates that for every 2120 instances where a small electric water heater was initially installed, only 26 (2%) would eventually face a situation where, if the owner wished to replace with another small electric, there would be difficulties if the replacement was more than 20mm larger. The proportion with difficulties at other specified increments is not known.

Table 13 Average clearances around existing water heaters

Dimension	Mean mm
Clearance above the water heater	401
Clearance below the water heater (including false bottom)	259
Clearance on the right of water heater	149
Clearance on the left of water heater	294
Clearance at the back of water heater	55
Clearance at the front of water heater	254
Height of water heater	653
Diameter of water heater	356

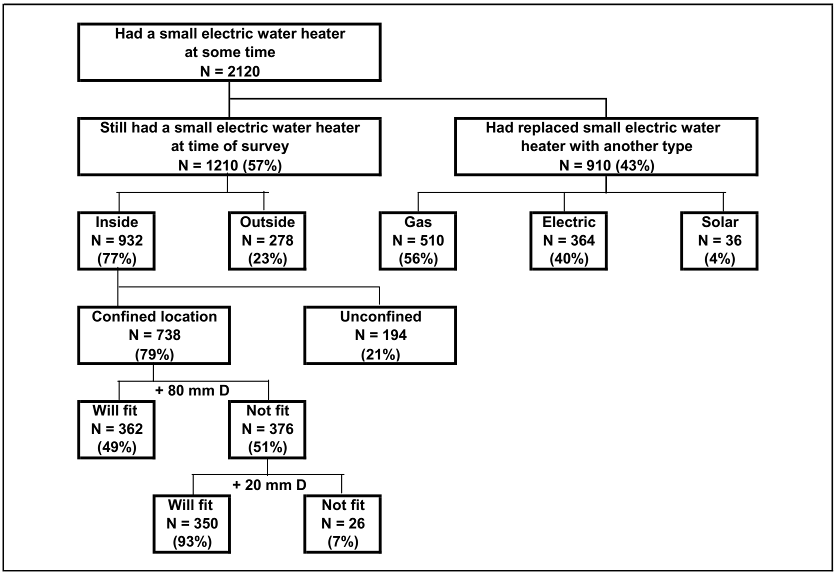
Source: TNS (2000)

However, it is likely that nearly all the small water heaters measured pre-date the 1999 MEPS, when manufacturers increased insulation to ensure that models which had not previously met the AS1056 heat loss levels now did so. The average water heater diameter reported in the survey was 356mm (Table 13). The smallest of the 50 litre delivery water heaters now available has a diameter of 393mm (see Table 8). Therefore in an unknown proportion of installations (perhaps 2-4%) there will be a problem accommodating even a current model, let alone a model meeting a higher MEPS level. This may increase the number of instances in which enclosure alteration will be required, but the increase in the average cost of enclosure change will be small. If relocation or alteration is required in any case to accommodate even a current water heater, then the marginal cost of accommodating a still larger water heater meeting a higher than current MEPS level is likely to be small.

If the existing enclosure cannot accommodate the smallest of the small electric water heaters available at the time of failure, then some owners would have the options of replacement with different type of water heater, in a different location. Because the life cycle costs of *all* alternatives are lower (see Table 9) a forced change would in fact make the owner better off.

Some owners will not be able to replace with a different type, because they do not have access to a natural gas supply, to a suitable location outside or on the wall of the dwelling, or – in the case of solar - access to a suitable roof. Many flats will be in this situation. In these cases the only options will be alteration to the enclosure or relocation within the dwelling. The costs of these actions are taken into account in the cost-benefit analysis.

Figure 6 Small electric water heater replacements and dimensional constraints



Source: Author estimates based on TNS (1999, 2000)

A possible flexibility mechanism

The water heater industry advises that a high proportion of likely problem installations is located in older apartment buildings in inner Sydney and the Gold Coast. The industry has indicated that even if MEPS levels for small water heaters were increased, it would prefer to be able to continue to manufacture a limited number of the current 50 litre models for a limited period – say 5 years – to alleviate the difficulties faced by water heater replacement buyers in these areas. The number of problem installations will decline over time, as individual apartments are renovated and, ultimately, the buildings are demolished. The manufacturers would have the flexibility to decide at what point within the 5 year period it was no longer economic to offer two 50 litre models (an "old" model at the 1999 MEPS heat loss level and a "new" model with lower heat loss) and could then drop the old model.

Without safeguards, however, such an arrangement could undermine the objective of MEPS. The manufacturing setup costs of the old model have already been incurred, and the material costs would be less than the more highly insulated new model, so the old model would in normal circumstances sell for less. Given that the market for small electric water heaters is driven by first cost, the great majority of buyers would then prefer the old model to the new, even though the life cycle cost of the new model would be lower. Therefore the national energy cost and greenhouse savings would be reduced, and the average life cycle costs to electric water heater buyers would be higher than if all units met the MEP level.

Therefore buyers must be given an incentive to prefer the 2005 MEPS model, and suppliers must be give the incentive to supply it. This would require a range of measures including

- mandatory "disendorsement labelling" to enable those buyers who are energy-sensitive to identify and avoid the 1999 MEPS models. Such a label would also assist the growing number of energy-sensitive intermediaries, such as plumbers accredited under the Green Plumbers scheme and local governments which apply sustainability criteria in their building approvals; and

- penalties for suppliers who exceed their sales-weighted target.

Suppliers could then rationally factor the value of avoiding the penalty into their pricing. If suppliers were to price the old models at a sufficient premium to the new models, the market would prefer the new models in all cases except where the water heater location is within a constrained enclosure, the costs of enclosure change are much higher than the survey average (about $350) and alternative fuel/technology combinations are not available. Alternatively, if the number of old units produced each year were limited, scarcity would drive up their price.

Government has no direct means of control over the pricing or production of water heaters. Even if the numbers of "old" models needed each year could be determined – and this would require considerable additional survey work – there would be no means for governments to ensure that production volumes were limited to those numbers, or that the units produced were in fact directed to the problem installations. However, the water heater industry could be given the incentive to manage the issue itself, without compromising the overall objectives of MEPS, in the following way.

Suppliers could agree to mix the sales of old and new 50 litre units each year to achieve a "target" sales-weighted average heat loss (or lower), rather than a MEPS level that would apply to every unit produced. For example, if the target heat loss level for 50 litre units were 1.19 kWh/24 hrs (30% lower than the "old" MEPS level of 1.70 kWh/24 hrs) and suppliers wished to be able to make up 10% of their sales from old units, they could do so provided that the heat loss of the other 90% sold were no higher than 1.134 kWh/24 hrs to compensate.

For example, if a supplier sold 50,000 units in a year, and old models accounted for 16% (8,000 units) instead of the intended 10% (5,000 units) the sales-weighted heat loss would be 1.224 kWh/24 hrs instead of the target 1.190. The total additional heat loss from that cohort would be (50,000 x 0.034 x 365) = 620,500 kWh per year, or 620.5 MWh per year for the life of that cohort.

Suppliers would need to report sales of each model to government (directly or through a reliable intermediary) and there would have to be some penalty in the event that the sales-weighted average heat loss exceeded the target level. One appropriate penalty might be the value of the additional electricity cost imposed on the purchasers of those 50,000 water heaters over their expected 9 year service life. At an average tariff of 11.43 c/kWh (Table 18) this would be $638,300. It would be administratively simpler to pay the full amount in the year the water heaters are installed: at a 10% discount rate, the NPV would be $ 408,400. This amounts to $136 for each of the *extra* 3,000 "old" water heater units sold. The proceeds from the fine could be applied to energy efficiency programs targeting hot water use.

Suppliers would have an incentive to avoid fines of this magnitude by physically limiting their production of "old" units, or price them to recover the value of the fines, so making them less attractive to the market. They would also have an incentive to carefully consider the actual demand for "old" units in the first place, since the higher the projected market share the lower the heat loss limits must be for the "new" units. Once "old" models are removed from the market, the sales-weighted heat loss would automatically become the heat loss of the "new" models. As this would be lower than the target heat loss, the total energy and greenhouse reductions thereafter would be greater than if the target heat loss had been adopted as a universal MEPS level.

The key elements for its success would be

1. legally binding agreements between government and participating suppliers
2. a market monitoring system; and
3. fines high enough to give the appropriate signals and incentives.

An alternative (and weaker) penalty would be for government to agree with the supplier that chooses the flexible compliance option an annual target for sales-weighted heat losses. The concession would be terminated in the event that the target was not met, thereby forcing the supplier to cease manufacture of the 1999 MEPS units within a short period (say 1 month) of notice. For this approach to be workable the criteria for monitoring and reporting and the magnitude of allowable deviations from the agreed trend would have to be clearly specified in the agreement.

An additional incentive for adhering to the agreement would be the risk that any subsequent MEPS revision would be set higher in order to recover the energy savings foregone as a result of any underperformance in the period 2005-10. However, it would be difficult to limit the impact of this to the underperforming supplier alone without also impacting on its complying competitors.

There should be no obligation to take up the flexible compliance option. One supplier might take advantage of the arrangement to supply the perceived problem market, while another might simply adopt the universal MEPS level and so avoid exposure to the risk of penalties, but give up a (declining) market niche to its competitors. If suppliers take up different compliance options it may lead to a wider range of models appearing on the market, and increase the scope for energy labelling and for price competition among suppliers.

2. Objectives of the Regulation

COAG Guidelines:

- ***Objective:*** *the objective which the regulation is intended to fulfil must be stated in relation to the problem. The objectives of a regulation are the outcomes, goals, standards or targets which governments seek to attain to correct the problem.*

2.1 Objective

The primary objective of the proposed regulation is to bring about reductions in Australia's greenhouse gas emissions from the use of small electric storage water heaters, below what they are otherwise projected to be (ie the "business as usual" case) in a manner that is in the community's best interests.

2.2 Assessment Criteria

The primary assessment criterion is the extent to which an option meets the primary objective.

The following secondary assessment criteria have been adopted:

1. Does the option address market failures, so that the average lifetime costs of obtaining hot water from small electric storage water heaters are reduced, when both capital and energy costs are taken into account?

2. Does the option minimise negative impacts on product quality and function?

3. Does the option minimise negative impacts on manufacturers and suppliers?

4. Is the option consistent with other national policy objectives, including in this case reduction in the emissions of ozone depleting substances and the objectives of the National Appliance and Equipment Energy Efficiency Program to match "world best practice" standards?

3. Proposed Regulation and Alternatives

COAG Guidelines:

- ***Statement of the proposed regulation and alternatives:*** *this should describe the proposed regulation and distinct alternatives in sufficient detail to allow comparative assessment and evaluation in the rest of the RIS.*

The following options for achieving the objectives were considered.

7. Status quo (termed business as usual, or BAU): maintaining the MEPS levels introduced in October 1999;

8. The proposed regulation: an increase in the stringency of the existing MEPS levels, effective October 2005);

9. Voluntary MEPS;

10. Product labelling;

11. A levy on less efficient equipment to fund greenhouse reduction programs;

12. A levy on electricity reflecting it greenhouse gas emissions.

The following sections describe the options in more detail, and assess the non-mandatory MEPS options (3, 4, 5 and 6). Option 2 has been subject to detailed cost-benefit analysis, which is reported in the next chapter.

3.1 Status quo (BAU)

Improvements in energy efficiency are not likely to take place in the absence of any market intervention, for the reasons set out in the preceding chapter.

A "BAU" water heater energy use projection has been developed for each State and Territory, taking into account the projected sales of electric water heaters and the market share of different sizes.

The Status Quo option would, by definition, fail to meet the objective of the regulation. There would be no reduction in Australia's greenhouse gas emissions below the BAU case, and there would be no correction of identified market failures. On the other hand, there would be no negative impact on product quality or function, or negative impacts on manufacturers and suppliers.

3.2 Mandatory MEPS

The proposal is to increase the stringency of the existing MEPS levels for small electric water heaters (delivery less than 80 litres). This would be put into effect by revising the maximum standing heat loss values in Clause 2.4 of Australian Standard

AS 1056.1-1991 *Storage water heaters Part 1: General Requirements*. This is the same mechanism as was used to implement the 1999 water heater MEPS levels.[12] Existing State and Territory energy labelling and MEPS regulations enforce compliance with this clause (see example, Appendix 1).

The revised MEPS levels have yet to be determined. The selection of MEPS levels will be informed by the cost-benefit analysis, risk analysis and other considerations in the present RIS.

COAG has agreed to include MEPS in its consideration measures to increase energy efficiency. The National Greenhouse Strategy states that "improvements in the energy efficiency of domestic appliances and commercial and industrial equipment will be promoted by extending and enhancing the effectiveness of existing energy labelling and minimum energy performance standards [MEPS] programs. This will be pursued by … developing minimum energy performance standards for a broader range of new appliances and equipment" (NGS 1998).

A high priority in the work program of the National Appliance and Equipment Energy Efficiency Committee is to "commence negotiation to increase MEPS levels for refrigerators, freezers and electric water heaters for implementation in 2004" (NAEEEC 1999).

When the water heater industry and ANZMEC agreed to the implementation of MEPS for these products in October 1999, it was understood that the levels would be reviewed regularly, but MEPS levels would not be changed before October 2004 at the earliest. It was also understood that there would be at least three years notice of the revised MEPS levels proposed for adoption.

3.3 Voluntary MEPS

Under a voluntary MEPS regime, water heater suppliers would be encouraged to meet more stringent MEPS voluntarily, ie in the absence of regulation. This would require them to incur the costs of changing at least part of their model range. Otherwise, "voluntary MEPS" is in effect "business as usual".

Suppliers would presumably only introduce lower heat loss models if there were commercial incentive for them to do so. Such incentive might perhaps come from an industry association. If membership of, or product approval by the association were a commercial necessity, and the association perceived adoption of more stringent heat loss standards to be in the collective interest of all its members, it may be feasible for the association to urge or require members to adopt such standards. These conditions have never been present in the electric water heater industry (which is covered by AEEMA). They were once but are no longer present in the electricity supply industry, which in the past was able to enforce technical standards on water heater suppliers (as the Australian Gas Association is still able to do, albeit to a lesser extent than formerly).

[12] In 1996 Standards Australia issued the new heat loss levels as Amendment No 3 to AS1056.1-1991, with a footnote that the levels would take effect from 1 October 1999. The date of the main Standard was not changed.

Another commercial incentive for voluntary action could be the aim to increase the average price of water heaters, manufacturer revenues and profitability. The average price of electric water heaters increased following the adoption of the 1999 MEPS levels. While it is not possible to assess whether this led to an increase in manufacturer profitability, there is no indication of any adverse effect.[13] Further price increases would be expected from the introduction of more stringent MEPS; this would in effect enable the water heater manufacturers to capture more of the value of the water heating energy service business from the electricity suppliers.

More stringent heat loss levels would most likely be in the longer term commercial interests of the water heater manufacturers, but only if they took concerted action. If only one moved, others would have a price advantage which could be readily exploited to gain market share, since consumers are more concerned with first cost than life cycle cost. Coordination of changes to standards by the manufacturers could be construed as collusive behaviour by the ACCC, even though – as the present RIS demonstrates - the public interest would be served.

To sum up, it appears that the chances of a successful voluntary implementation of more stringent MEPS appears remote. Furthermore, the outcome would be uncertain for several years, so the risk that the program would fail to contribute sufficiently to national greenhouse gas reduction objectives would be high.

3.4 Energy Labelling

Compliance with a higher voluntary MEPS level, or the introduction of models more energy-efficient than a mandatory MEPS level, would be more commercially advantageous for suppliers if buyers could be encouraged to consider lower heat loss as a desirable product attribute.

This is not the case at present, for the reasons given in Chapter 1 –the split incentives between many water heater buyers and users, and the low level of information about water heater heat loss.

The low level of information could be addressed if two conditions were satisfied:

1. There were credible and accessible indicator of the heat loss of different models; and

2. There was a significant difference in the heat loss levels of mass market models.

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[13] For example, when Southcorp still owned Rheem Australia and a number of US water heater manufacturers it reported revenues and Earnings Before Interest and Tax (EBIT) for the water heater division (as a whole, not on a country basis). Up to the 1999 financial year, the water heater division was part of the appliances division, but the other appliance operations were divested in early 1999. The division's ratio of EBIT to revenues was 4.0% in financial year 1997, 5.6% in 1998, 7.0% in 1999, 15.4% in 2000 (the financial year in which the current water heater MEPS took effect), and 11.2% in the first half of 2001. Although this reflected many market factors including some outside Australia, there was no evidence of financial penalty from the introduction of MEPS. Comparable financial information for Dux's parent company GWA International was not available.

Condition 1 does not apply at present, since there is energy labelling for electric water heaters. Condition 2 applies only to a limited extent: there is one small water heater model on the market with a significantly lower heat loss than the present MEPS level, but it is outside the mass market because of its higher price (Table 8).

The energy labelling of water heaters is certainly feasible, but is not likely to be introduced without government intervention. Otherwise suppliers would have to agree on an energy label with their competitors, and promote it heavily at their own expense before it reached a level of public awareness and acceptance anywhere near that of the current energy appliance labelling program.

Condition 2 would be satisfied if products of different levels of efficiency came on to the Australian market as a consequence of the takeup of the flexible MEPS compliance mechanism outlined in Chapter 3, or indeed as a consequence of the water heater MEPS levels recently introduced in New Zealand (Chapter 5).

If energy labelling for water heaters were introduced, the impact on the water heater market would take some years to build up. Point of sale labels would initially influence only a small proportion of buyers. Many intermediaries would continue to purchase products solely on first cost, even if the label indicated a lower level of energy efficiency. However if the label were subsequently retained on the product – as an indelible mark rather than just a peel-off label – it would over time reach the ultimate end users and raise awareness in a way that would feed back to the intermediaries. Customers would begin to ask questions of their plumber or builder if they noticed that their water heater carried an indelible label indicating its low energy efficiency.

The conditions for the success of water heater labelling are not likely to be present without a mandatory introduction of labelling, and the introduction of models of different levels of efficiency, which is not likely to occur without a change in the MEPS regime. Therefore labelling does not constitute a realistic *non-mandatory* option on its own, but could be effective in addressing information failure if:

- Labelling is mandatory;
- The label is permanent, so it cannot be removed by intermediaries; and
- The labels indicate some energy efficency differentiation in the market, as would occur if an increase in stringency of MEPS prompted the introduction of new models.

Therefore labelling is a possible complement to the proposed increase in the stringency of MEPS, but not an independent alternative to it.

3.5 Equipment Levy

Another option involves "a levy imposed upon inefficient appliances to fund programs to redress the greenhouse impact of equipment energy use." Two variations of this option have been considered:

a) the proceeds from the levy are diverted to greenhouse-reduction strategies unrelated to water heater efficiency (ie the levy is “revenue-positive”); or
b) the proceeds are used to subsidise the costs of more efficient water heaters – if and when these are introduced - so that any cost differentials between these and the standard efficiency water heaters are narrowed or eliminated (ie the levy is “revenue-neutral”).

The flexibility mechanism proposed in Chapter 3 as a means of addressing the dimensional constraint issue within an overall MEPS framework may lead to a voluntary form of (b) above. However, the issue considered here is the scope for a mandatory levy as a full alternative to MEPS.

A threshold question for both the “revenue-neutral” and “revenue-positive” options is whether the Commonwealth or State tax regimes could support the raising of the levy. The recent abolition of wholesale sales tax, which could be levied at different rates, in favour of a single-rate GST, removed the most likely vehicle for imposing a levy.

Once funds were raised, then under a “revenue-positive” option they would be applied to a greenhouse reduction activity determined by government – perhaps under competitive project bidding such as the AGO’s current Greenhouse Gas Abatement Program (GGAP). The “revenue-neutral” option would be more complex, in that it would require

- the presence on the market of electric storage water heaters of different efficiency levels; and
- a mechanism for applying the funds raised to the desired objective of narrowing the cost differential between more efficient and less efficient water heaters.

Possible approaches include:

- payments to manufacturers (or importers) according to a formula based on sales and efficiency;
- rebates direct to the purchasers of energy-efficient water heaters.

Where a supplier offered water heaters across a range of efficiencies, it may be largely unaffected by the levy (ie its required contribution to revenues may be close to it nominal receipt of benefits). Alternatively, where a supplier is a net recipient it may use the revenues to support product prices in ways that conflict with the objectives of the levy. The only way to ensure that the funds are actually applied to the purchase price of the more efficient water heaters would be to offer rebates direct to purchasers. However, this would create the following difficulties:

- high fixed costs to establish a publicity, verification and payment infrastructure;
- administrative and transaction costs would probably be high in relation to the value of each payment to buyers;
- “free riders”: a large number of buyers who would have bought the more efficient water heaters in any case will claim payments.

There are no readily apparent means for raising the proposed levy. While expert legal advise would need to be obtained, it is not likely that differential taxation rates can be implemented under existing Commonwealth or State taxation or licencing laws. A levy would only become feasible if general provisions were introduced to enable import duties and other tax rates to be linked to specific product characteristics, in this case energy efficiency.

The product registration, check testing and ongoing administrative costs to business and government would be no less than under mandatory MEPS.

In the "revenue-positive" case, where the funds raised by the levy were applied to greenhouse gas reduction programs outside the water heating sphere, there is no evidence that potential greenhouse gas reductions from other possible application of the funds would be more cost-effective, or even equally cost-effective, to water heater MEPS.

In the "revenue-neutral" case, where the funds raised were to be applied to reducing the cost differential between more- and less-efficient water heaters, it is first necessary that the more efficient models be introduced to the market, but it would still be difficult and/or administratively costly to ensure that payments to water heater suppliers and/or purchasers were targeted as intended.

If the framework could be established, a "revenue-neutral" levy would act as a form of MEPS in which regulations would enforce the payment of the levy rather than prescribe characteristics to be met for lawful sale. Suppliers would be free to sell water heaters less efficient than the reference level, but each sale would carry a financial cost. With a mandatory MEPS regime, suppliers who sell non-compliant products are subject to financial penalty under the regulations. The main difference is that the levy would provide an in-built mechanism for scaling the penalty to the extent by which MEPS is exceeded, whereas the existing regulations do not. However, if such a feature is considered desirable it may be more straightforward to incorporate it into the regulations than to establish a levy regime.

The proposed levy, even if legally feasible, appears to offer no cost savings, no greater greenhouse gas reductions (in fact, probably less greenhouse gas reductions) and probably higher lifetime appliance costs to purchasers, compared with mandatory MEPS. Some form of levy *in association with* MEPS may produce greater energy savings, but more information about the form and design of a levy proposal would be necessary in order to form a judgement.

3.6 Electricity Levy

At present, the electricity prices faced by consumers reflect – however imperfectly - the cost of the capital invested in the electricity generation and distribution system, operating and maintenance costs, and taxes (now including GST). They may also reflect the costs of controlling pollutants such as oxides of nitrogen and sulphur (NOx and SOx), for which emissions standards are currently in force in some areas. They do not reflect the value of greenhouse gas emissions, or rather they implicitly assign a value of zero to such emissions. In other words, greenhouse costs are not internalised in the electricity price.

It may be possible to introduce a levy on the price of electricity to reflect the cost of greenhouse gas emissions from the production and combustion of the fuels used to generate it – in effect, a carbon tax. Alternatively, if a cap and trade emissions permit scheme were implemented, electricity generators and other major emitters would have to obtain sufficient permits to cover their emissions. Some of these may be obtained free (ie by "grandfathering") and some may have to be purchased, but if there is an open market then all permits will ultimately have the same monetary value. The permit value would thus be reflected in the price of electricity and all greenhouse-intensive goods and services. The effect of a permit trading scheme would be similar to a carbon tax in its pervasiveness, but the magnitude of the electricity price impact would vary with the market price of permits.

The decision to introduce an electricity levy or an emissions trading scheme is a matter for the highest levels of Commonwealth, State and Territory Government. In that respect the options are not direct alternatives to the proposed mandatory MEPS regime.

However, the matter raises the following issues for consideration:

1. If an electricity levy were introduced, would market failures be corrected to the extent that higher MEPS levels were no longer necessary?

2. Alternatively, if the price of electricity reflected a value for emissions higher than zero, what would be the impact on the cost-effectiveness of higher MEPS levels?

3.7 Conclusions Regarding Alternatives

Increasing the stringency of the 1999 MEPS levels by mandatory means is the only option likely to be effective on its own in achieving the objectives of the regulation. The assessment of the other options is summarised in Table 14.

Table 14 Assessment of alternatives against objectives

Objective and assessment criteria	A. Status quo	B. Mandatory MEPS	C. Voluntary MEPS	D. energy efficiency labelling	E. Levy on Inefficient Appliances	F. Levy on electricity
Objective: Reduce emissions below BAU	No	Significant reduction projected	Extent of reduction uncertain – most likely zero	Labelling not likely to be introduced without intervention, nor effective as stand-alone option without MEPS	Extent of reduction uncertain – if funds raised go to other programs, they are not likely to be as effective as MEPS	Extent of any reduction uncertain
Address market failures	No	Yes – projected to reduce life cycle costs of water heating	Fails to address market failure; relies on raising consumer and supplier concern with energy	Yes, if conditions for effectiveness satisfied, but impact slow to build	May address market failure, but large price differentials would be necessary to affect purchase decisions	Large electricity price increase necessary to affect purchase decisions
Minimise negative impact on product quality or function	No effect	No effect on performance	No effect on performance	No effect on performance	No effect	No effect
Minimise negative impacts on suppliers	No effect	Most suppliers will have some non-complying models, so costs are fairly widely distributed. MEPS-complying products already available. Range of supplier responses possible. 2003 start may be less disruptive	Would minimise supplier costs, since suppliers not likely to opt in	Suppliers with only less-efficient models (ie 1999 MEPS level) would be disadvantaged, but proposed higher MEPS would force all suppliers to have at least one more efficient model.	Supplier costs no less than for mandatory MEPS. Administrative costs likely to be higher	Would minimise supplier costs
Other issues		Some existing water heaters are installed in confined enclosures, which will require modification to accommodate larger units	True voluntary MEPS has not been successfully introduced anywhere in the world	Labelling possible useful adjunct to MEPS proposal, especially if label is indelible rather than peel-off	No readily apparent legal means of raising the levy. At best, would be a form of non-mandatory MEPS with higher costs	Not a true alternative – decision does not rest with ANZMEC

Source: GWA (2001b)

4. Costs, Benefits and Other Impacts

COAG Guidelines:

∉# ***Costs and benefits:*** *there should be an outline of the costs and benefits of the proposal(s) being considered. This should include direct and indirect economic and social costs and benefits. There should also be analysis of distinct alternatives (including ' do nothing') to the proposed regulation.*

The major economic benefit of more stringent MEPS is the value of the electricity saved. The major economic cost is the increase in the average cost of water heaters, and the possible costs of accommodating larger water heaters. This chapter summarises the cost-benefit modelling carried out to estimate these benefits and costs.

A reduction in electricity consumption would also produce environmental benefits in the form of lower greenhouse gas emissions. These are quantified, but not given monetary value.

The economic costs and benefits are likely to be passed on to the household and business users of electric storage water heaters, but there will also be impacts on the manufacturers, importers and exporters of water heaters. These are also covered.

4.1 Benefits and Costs of Mandatory MEPS

Options

This revised RIS has considered the following options, the main characteristics of which are summarised in Table 15:

4. A revised MEPS level for small water heaters that would require a 30% reduction in the current maximum standing heat loss for all units sold, to take effect at the end of 2005 (the earliest practicable implementation date, given the lead times required for compliance). It has been established by technical analysis that this MEPS level is technically feasible (See *Scope for Energy Efficiency Increases* in Chapter 1)

5. A revised MEPS level for small water heaters that would require a 50% reduction in the current maximum standing heat loss for all units sold, to take effect at the end of 2005. This is roughly equivalent to the New Zealand MEPS levels, the most stringent currently in force for water heaters of this type (see *International Standards*); and

6. A flexible sales-weighted MEPS regime supplemented with energy labelling designed to inform buyers about different heat loss levels. A heat loss level of 50% lower than the 1999 MEPS level would be designated as 5 star or "High Efficiency" (HE), a heat loss level of 30% lower than the 1999 MEPS level would be designated as 3 star or "Moderate Efficiency" (ME) and the 1999 MEPS level

would be designated as 1 Star or "Low Efficiency" (LE). The flexible regime would terminate after 5 years and revert to Option 1.

Option 3 has been developed in consultation with the water heater industry. Under Options 1 and 2 all units produced meet the new MEPS level, but in Option 3 it is assumed that at least one supplier chooses flexible compliance, because the possibility of introducing and selling HE models significantly increases the chance of meeting sales-weighted targets and reduces the risk of non-compliance. In this scenario the overall energy benefit is projected to be higher than in Option 1, because once the 1999 MEPS models are excluded in 2010 all the remaining models have lower heat loss than lowest heat loss model in Option 1.

Table 15 Characteristics of MEPS options

MEPS option	Can current (1999) MEPS models stay on market?	Is there High Efficiency designation?	Do suppliers have compliance options?	Likely efficiency levels on market	Scope for labelling?
1. 30% reduction (as in last RIS)	No	No	No	2	Yes
2. 50% reduction (proxy for NZ MEPS)	No	No	No	1	No
3. 30% reduction with compliance flexibility & endorsement label	Yes	Yes (NZ MEPS level)	Yes	3	Yes

Modelling Approach

The costs and benefits of each option have been calculated from the perspective of the end users of water heaters, since they will bear the increases in purchase price of water heaters as well as benefit from the reductions in running costs.[14]

The business-as-usual (BAU) case is modelled as follows:

1. The number of small electric storage water heaters projected to be sold in each State in each year from 2001 to 2021 is projected (see Figure 4). Each year's sales is termed a "cohort";

[14] It may be argued that the appropriate perspective for the analysis is that of the economy as a whole. The cost to the economy of manufacturing more efficient hot water system is the resources diverted from other activities, valued at the marginal cost of those resources. As such, only the extra *costs* involved in the manufacturing and distibution processes — such as extra materials, handling and storage costs — should be counted for water heaters, and the benefit should be the marginal cost of electricity production, not the retail price. Price increases not related to costs, such as retail markups and taxes, are merely transfers from consumers to intermediaries, and should not be counted. This is examined further in Appendix 4. However, the main analysis is still based on prices, because (a) the available data on costs are less reliable than the data on prices (which are public), (b) the multipliers are roughly equal, so it is likely that either type of analysis would identify clearly cost-effective and clearly non cost-effective options and (c) if price-based analysis indicated that an option would likely leave consumers worse off, that option would be difficult to recommend even if net economic gains could be demonstrated, so price-based analysis will be required in any case. It is arguable that price-based analysis alone will yield all of the information necessary for decision-making, although cost-based analysis may be a useful supplement.

2. The projected total heat loss from water heaters sold between 2001 and 2021 is calculated, using the numbers sold, the weighted average heat loss with the existing (1999) MEPS levels (see Table 8) and the cohort survival rate. It is assumed that each year's cohort of new water heaters has a 100% survival rate up to the year before the average service life (ie to year 8 for an average service life of 9 years), then two thirds survive to the end of the ninth year, one third to the end of the tenth year and none to the end of the eleventh year;

3. The value of the energy lost by the water heaters in each year is calculated, using the marginal household day-rate electricity tariffs in each State and Territory (see Table 18);

4. The value of water heater sales in each year is calculated, using the average values in Table 8;

5. The net present value (NPV) at mid 2003 of the projected capital costs and energy costs is calculated, both undiscounted and at discount rates of 5% and 10%;

6. The greenhouse emissions from generating the electricity associated with the water heater heat losses is calculated, using the marginal greenhouse intensity coefficients in Appendix 3.

After the baseline is established, steps 2 to 6 are repeated for each of the three options. The energy consumption, energy costs, capital costs and greenhouse gas emissions under each option are then compared with the BAU baseline, to calculate the NPV of the energy cost savings (the benefit), the NPV of the capital cost increments (the costs), the benefit/cost ratios and the greenhouse gas reductions.

It is only necessary to model the energy use of the *new* water heaters entering service after the new MEPS levels implemented, not the energy consumption of the whole stock. The energy consumption of models installed prior to changes in the MEPS regime will not be affected by those changes, and so can be excluded from the analysis. However, if a 9 year service life is assumed, the stock will be composed entirely of compliant models by the 11th year after new MEPS levels are introduced.

Similarly, it is only necessary to model heat losses, not the total energy used by electric water heaters, since hot water consumption will not be affected by MEPS. Any energy savings from changes in water heater installation practice or reductions in hot water use would be additional to and independent of the heat loss savings achieved through changes in the design of the water heaters themselves.

It is assumed that the demand for water heaters is essentially inelastic. All new dwellings in Australia have a water heater, and the unit is replaced almost immediately whenever it fails. The demand for electric water heaters was not noticeably affected by introduction of MEPS for larger water heaters in 1999, and is not likely to change at the price increases likely to be associated by more stringent MEPS for smaller water heaters (see Table 17).

Costs of reducing heat loss

There are many technical options available to manufacturers for meeting any given reduction in standing heat loss (EP et al 2000). For simplicity, costs have been calculated as if only one technical approach is used - increasing the insulation thickness. This modelling approach was used in GWA et al (1993) to develop the 1999 MEPS levels, and is consistent with the actual response of suppliers following the introduction of MEPS for larger water heaters in 1999.

The costs are calculated as follows:

1. The insulation foam volume and steel cabinet surface area of each of the water heater models in Table 8 is calculated, from the manufacturer's specifications (using the difference between external cabinet volume and water storage – not delivery – volume as the proxy for insulation volume);

2. The insulation thickness is increased by the dimensions in Table 12, to match the more stringent heat loss levels under each of the MEPS options;

3. For each MEPS option, the following values are calculated:

   - the additional cost of foam, calculated from the increase in foam volume and the unit cost of foam (see costs in Table 16)
   - the additional cost of steel, calculated from the increase in steel surface area and unit cost of steel (see Table 16)
   - the additional cost of packaging, calculated from the increase in carton surface area and the unit cost of packaging (see Table 16)
   - the additional cost of fittings, calculated from the increase in the fitting lengths and an assumed standard cost per total length of fittings (Table 16);
   - the additional costs of warehousing and transport, calculated from the increase in carton volume and the estimated unit costs in Table 16.

Table 16 Estimated material and other cost components

Element	Units	Unit cost
Insulation foam	\$/litre	\$ 0.75 (a)
Colourbond steel	\$/m^2	\$ 10.00 (a)
Carton packaging	\$/m^2	\$ 2.00 (b)
Fittings (length)	\$ for 25mm	\$ 5.00 (b)
Storage	\$/m^3	\$ 4.00 (b)
Transport	\$/m^3	\$ 6.00 (b)
Manufacturer markup		1.3 (b)
Retail markup		1.3 (b)

(a) From EP et al (2000). (b) Author estimates, based on GWA et al (1993)

For Option 1, about 70% of the cost increase is due to more insulation, 8% to more steel, 2% to packaging, 18% to longer fittings and less than 1% each to transport and storage.

4. The once-off capital costs of changing dies and machine settings are calculated as $500,000 per model affected, irrespective of the MEPS increment. As there are 5 separate models (Table 8), the total capital cost, incurred during 2005 for a late 2005 implementation date would be $2.5 M. It is assumed that this capital impost is recovered from the units sold in the 3 years after MEPS (equivalent to $7.94 per unit) and then dropped.

5. The additional material and capital costs incurred by manufacturers are marked up by a factor of 1.3 in the wholesale price, and by a further factor of 1.3 in the retail price (which includes GST, as do the energy tariffs used to estimate savings); ie a total markup factor of 1.7.

Table 17 summarises the projected price changes for successive MEPS levels as well as the benefits to buyers in terms of expected electricity savings, at the national weighted average tariff of 12.4 c/kWh. During the 3 years while the capital cost of the changeover is recovered, the benefit/cost ratio from the perspective of users is around 1.8 for all options. After the capital cost is recovered, the benefit/cost ratios increase, to between 2.4 and 3.0.

Table 17 Estimated price changes associated with reducing heat loss

	Current	Option 1 30% reduction	Option 2 50% reduction	Option 3 flexible compliance
Specified material and service costs (with wholesale and retail markup)	$ 67.3	$ 110.3	$ 155.0	$ 128.3
Capital impost (for 3 yrs after changeover)	$ -	$ 28.9	$ 28.9	$ 28.9
Total cost impact on retail price	$ 67.3	$ 139.2	$ 183.9	$ 157.2
Average retail price	$ 414.5	$ 486.5	$ 531.2	$ 504.4
Cost increase (including capital impost)		$ 72.0	$ 116.7	$ 89.9
		17%	28%	22%
NPV of savings over 9 years, 10% discount	0	$127.6	$212.6	$170.1
Benefit/cost ratio (with capital impost)		1.8	1.8	1.9
Cost increase (without capital impost)	0	$ 43.1	$ 87.8	$ 61.0
		10%	21%	15%
Benefit/cost ratio (without capital impost)		3.0	2.4	2.8

Cost of overcoming dimensional constraints

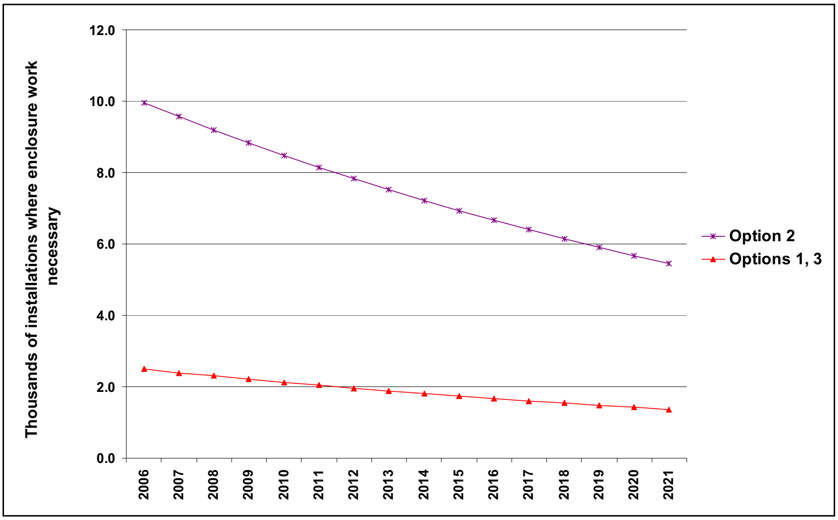
The number of installations where enclosure alterations or relocations will be necessary above the number that would be necessary in any case to accommodate water heaters meeting the 1999 MEPS levels are estimated as follows:

- For the 30% heat loss reduction level (Option 1): 2% of new water heaters in 2006, (0.95 x 2)% in the second year, (0.95 x 0.95 x 2)% in the third year and so on;
- For the 50% heat loss reduction level (Option 2): 8% of new water heaters in 2005, (0.95 x 8)% in the second year, (0.95 x 0.95 x 8)% in the third year and so on;

- For Option 3 it is assumed that the sales-weighted compliance option is taken up by at least one suppler, so that 1999 MEPS level units continue to be available until 2010, and that these are successfully targeted to dimensionally constrained installations. Therefore the number of alterations and relocations is no higher than in Option 1, even though the water heaters on average are somewhat larger because the sales-weighted heat loss is lower.

The projected number of units affected is illustrated in Figure 7. The estimated cost per enclosure change is $350 (TNS 1999). It is possible that the costs of overcoming dimensional constraints will deter some householders from replacing an existing new small electric water heater with a new one, and they will opt to change systems. In that case they will be better off financially, since benefits will exceed costs from an individual perspective (see Table 9), and the net economic benefit of the MEPS program as a whole would *increase*. The net greenhouse impact from water heaters changes would range from a large reduction - if the transfer was to gas, LPG, solar or heat pump - to a small increase, if the transfer was to off-peak, where heat losses are somewhat higher. These effects are expected to be marginal, and have not been explicitly modelled.

Figure 7 Projected number of installations where enclosure work is necessary



National Benefits and Costs

Electricity Prices

Table 18 summarises the electricity prices used in the cost-benefit analysis. The marginal tariffs (ie excluding any initial standing charges, high-cost or low-cost blocks) were taken from the sole or the largest electricity retailer in each State and Territory in mid 2003.[15]

The AGO projects that wholesale prices in the national electricity market will fall over the next 20 years (except in Victoria) (AGO personal communication, April 2000). However, wholesale prices (including transmission costs) account for only about 30% of the retail price – the other 70% represents distribution and retail costs. As the residential part the retail market is deregulated, remaining price controls will be removed, and retail margins are more likely to increase than to decrease. Given the range of upward and downward price pressures, it has been assumed that tariffs remain constant in real terms throughout the projection period. The price impact of reduction in demand for electricity as a result of higher MEPS levels for water heaters is considered negligible in the context of continued overall growth in electricity demand.

The projected cost-benefit calculations are much less sensitive to electricity price assumptions than to water heater capital cost assumptions, since capital costs are incurred at the time of installation whereas energy costs are incurred progressively over the service life, and subject to greater time discounting.

It is estimated about 90% of the energy loss from small electric water heaters occur in the residential sectors, and 10% in the commercial sector (Table 4). Therefore the electricity price is weighted 90% to the residential tariff and 10% to the business tariff. The nationally weighted average cost in 2003 was 12.4 c/kWh. This varies slightly over the projection period with changes in the share of the national water heater stock installed in each jurisdiction.

Table 18 Marginal electricity prices

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	**National**
Residential c/kWh	11.3	14.0	11.4	19.5	13.9	9.0	14.0	10.3	
Business c/kWh	11.7	15.0	12.6	17.3	14.6	12.6	16.3	15.2	
Weighted c/kWh	11.4	14.1	11.5	19.3	14.0	9.4	14.3	10.8	**12.4**

Projected Energy and Greenhouse Reductions

Figure 8 illustrates the projected electrical energy supplied to cover heat lost from the small electric water heaters installed new in Australia from 2001 to 2021, under business-as-usual (BAU) assumptions and under each of the five MEPS options. It is estimated that about 2.77 million units will be installed over that period (Figure 4). Note that this is energy represents heat losses only, not the total electricity consumed by small water heaters, since the electricity embodied in the useful hot water delivered from water heaters is not affected by MEPS. The first part of the projection curve rise steeply as additional and ever larger cohorts of new water heaters are added in each

[15] General business tariffs were used: there are so many business price structures available, including time of use and maximum demand, that is impossible to estimate marginal business electricity prices in any other way. Most data sources reporting "business" electricity prices (eg ESAA) report average rather than marginal prices, and amalgamate commercial and industrial sector prices.

successive year. After the eighth year (corresponding to the average service life of the water heaters) the energy saved each year by the retirement of previous cohorts largely offsets the energy added by new cohorts, and the growth in total consumption is much slower.

Figure 9 illustrates the energy savings under each MEPS option – in effect the difference between the BAU trend line and the trend line for that MEPS option in Figure 8. Savings commence in fiscal year 2006, the first full year in which water heaters affected by revised MEPS levels are sold. Figure 10 shows the BAU heat-loss related greenhouse gas emissions by State and Territory and Figure 11 shows the projected national savings in greenhouse gas emissions (calculated using the greenhouse coefficients in Appendix 3).

Table 19 summarises the projected energy and greenhouse savings over the entire projection period, and the average annual reduction in greenhouse gas emissions in the period 2008-2012, the First Commitment Period under the Kyoto Protocol. It is projected that the average emissions reduction during this period will range from 255 kt CO_2-e per year (16% below BAU) under Option 1 to 426 kt CO_2-e per year (27% below BAU) under the Option 3.[16]

Table 19 Projected energy and greenhouse savings, 2001-2021

MEPS option	Total GWh saved, 2001-2021	Total kt CO_2-e saved, 2001-2021	Avg kt CO_2-e saved/yr 2008-12	Avg reduction below BAU 2008-12
1. 30% reduction in heat loss	6589	5615	255	16%
2. 50% reduction in heat loss	10982	9358	426	27%
3. 30% reduction with flexible compliance & labelling	8786	7486	341	22%

Note: All energy and greenhouse estimates refer to heat loss only, and exclude the energy delivered as useful hot water.

[16] There would be some offsetting increases in the emissions associated with the production of the water heater materials, but these are negligible in comparison with the emissions savings.

Figure 8 Projected energy losses from small electric SWH installed 2001-2021

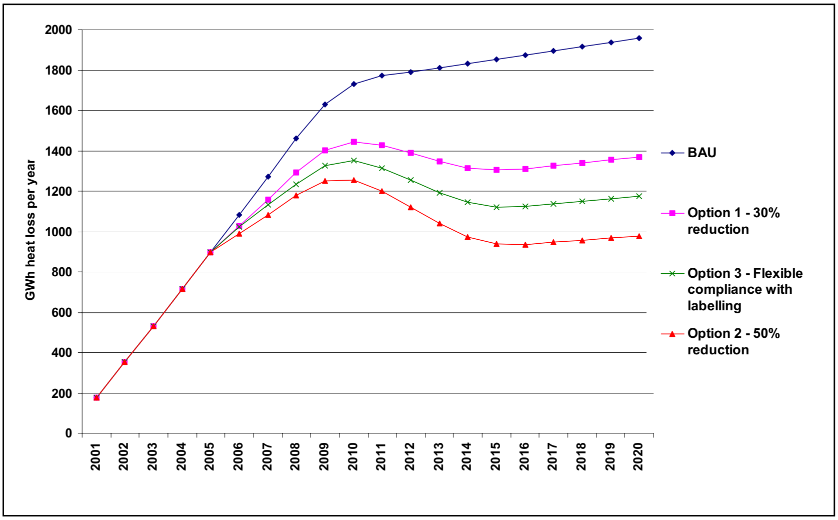


Figure 9 Projected energy savings from MEPS options, 2001-2021

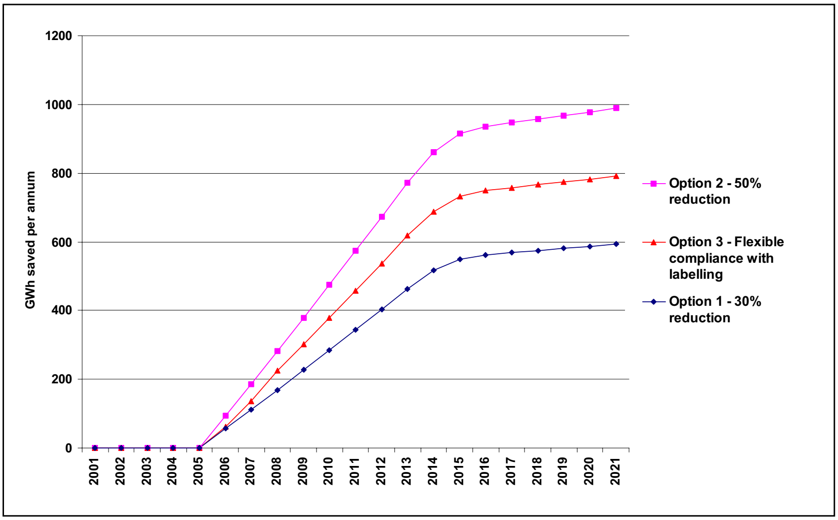
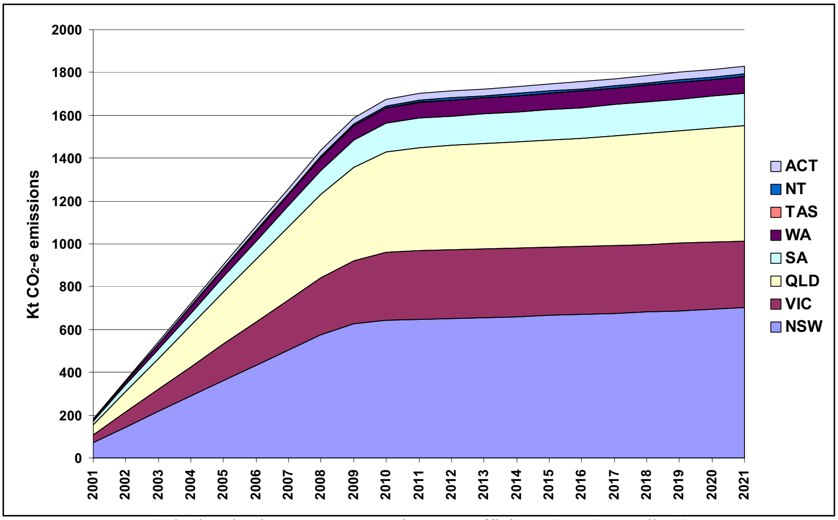
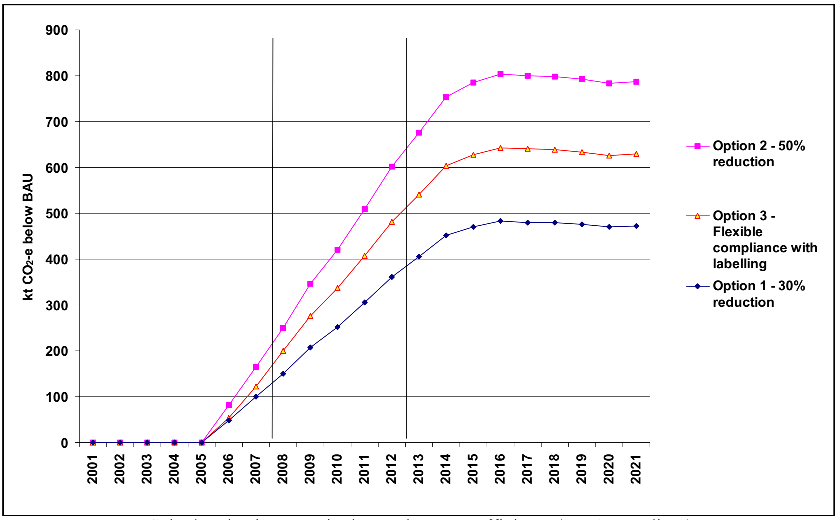


Figure 10 Projected BAU greenhouse gas emissions from heat loss of small electric SWH sold in 2001 and later, State and Territory



Calculated using average greenhouse coefficients (see Appendix 3)

Figure 11 Projected annual greenhouse savings from MEPS options, 2000-2020



Calculated using marginal greenhouse coefficients (see Appendix 3)

Costs and Benefits

The projected national costs and benefits of the MEPS options from the perspective of water heater users are summarised in Table 20. The benefits are the electricity price savings. No value has been given to greenhouse gas emission savings. The costs are the sum of increases in the purchase price of water heaters due to higher material costs, the capital costs of retooling, the costs of altering enclosures to accommodate larger water heaters and (for Option 3) labelling costs. There are no additional program costs, since the testing and administrative infrastructure already exists

The costs of enclosure modification could rise to nearly a fifth of the total national cost in Option 2. They are lower in Option 1, because the average increase in water heaters size is less. In Option 3, the average size increase is projected to be somewhat larger than for Option 1 but significantly less than Option 2. However, the likely retention of 1999 model water heaters should hold the number of problem enclosures to the same proportion as in Option 1.

The projected benefit/cost ratios are higher for Options 1 and 3 (4.8-5.1) than Option 2, but the net national benefit is highest in Option 2 ($356 million net present value at 10% discount rate). Table 20 illustrates the impact of discount rate assumptions on the benefit/cost ratios. The value of the future stream of electricity savings is more heavily discounted than the capital costs, which are incurred in one lump. Hence the higher the discount rate, the lower the benefit/cost ratio. At a 5% discount rate, the benefit/cost ratio of Option 2 is 5.1, whereas at 10% it is 4.1.

Given that benefits exceed costs in each scenario, the greenhouse gas reductions would be gained at a *negative* cost of about – 40 $/tonne CO_2-e saved over the period 2001-2021 for each option (Table 21).

Table 20 Projected national costs and benefits, MEPS options

Options	NPV purchase costs $M	% of enclos-ures changed	NPV enclosure costs $M	NPV total capital costs $M	NPV energy costs $M	Capital cost increase $M	Energy saving $M	Net benefit $M	Benefit/ cost (10% discount)	Benefit/ cost (5% discount)	Benefit/ cost (0% discount)
BAU	$449	NA	NA	NA	$1,534	NA	NA	NA	NA	NA	NA
Option 1	$505	1%	$3	$507	$1,254	$59	$281	$223	4.8	5.7	7.0
Option 2	$539	8%	$22	$562	$1,067	$113	$469	$356	4.1	5.1	6.4
Option 3	$520	1%	$3(a)	$523	$1,160	$74	$375	$301	5.1	6.1	7.4

All Net Present Values at mid 2003, at 10% discount rate. Projections have been tested for sensitivity to a range of assumptions regarding material costs, discount rates, water heater service life and enclosure alteration costs. (a) 1999 MEPS models may be retained for a period to minimise these costs.

Table 21 Projected cost per tonne greenhouse emissions saved

MEPS option	**Total kt CO_2-e saved, 2001-2021 (a)**	**Net benefit $M (b)**	**$ Cost (benefit) per tonne CO_2-e saved**
Option 1	5615	$223	(39.9)
Option 2	9358	$356	(40.3)
Option 3	7486	$301	(40.5)

(a) From Table 19 (b) From Table 20

4.2 Industry, Competition and Trade Issues

Industry issues

Supplier competition

At present there are two major manufacturers of small (50 litres and less) mains pressure electric water heaters in Australia and New Zealand: Rheem (manufacturing in Australia and New Zealand) and Dux (manufacturing in Australia only). The third Australian supplier, Edwards, has a relatively small market share. These manufacturers (and others) have successfully adjusted their water heater ranges to increased MEPS levels in the past, and the proposed changes in MEPS levels for smaller models are most unlikely to lead to the departure any of the present suppliers from the market, although it may impact on the pattern of water heater trade flow between Australia and New Zealand (see below).

The introduction of more stringent MEPS levels will require manufacturers to make a once-only change to the tooling and production lines for each model: $500,000 has been allowed in the cost-benefit analysis for each of the 5 models in the range 18 to 50 litres delivery currently on the market.[17] All else being equal, suppliers with a smaller number of annual sales per model may be at a disadvantage, since the capital cost impact per unit sold will be somewhat higher. However, the dimensional relationships between models is also a factor: where two models share the same diameter and end details, most of the cost of the changeover can be shared.

Under option 3, suppliers of water heaters in Australia would have the choice of:

- Adopting the 30% lower heat loss level for all their small water heaters models, and labelling them all as “medium efficiency”;

- Adopting a sales-weighted approach in which they retain their 1999 MEPS level model for some time (labelled as “low efficiency”), *and* introduce a model with a better than 30% reduction in heat loss (either a 4 star or a 5 star “high efficiency”), which would most likely also meet the New Zealand MEPS level).

Each supplier’s assessment of what it competitors are likely to do will impact on its own strategy. Option 3 is likely to increase the importance of product energy efficiency as a factor in supplier competition, more than Options 1 or 2. On balance, none of the Options is likely to increase or decrease the number of suppliers in Australia, or the extent of price competition between them.

Montreal Protocol issues

As required under the Commonwealth Ozone Protection Act 1989, which gave effect to Australia’s ratification of the Montreal Protocol on Substances that Deplete the Ozone Layer, the appliance industry phased out the use of CFCs as refrigerants and as

[17] This is probably an overestimate: the Edwards model already appears to have a substantially lower heat loss than 1999 MEPS level, so full retooling would not be necessary.

foaming agents by 1996, and some companies substituted HCFCs in the foam blowing process. The water heater industry is at present in another transitional period in which some HCFCs are still being used, albeit in smaller quantities and as part of blends, but a long term substitute foaming agent has not yet been determined. HCFCs have ODPs in the range 2–15% of that of CFC-11 and will have to be phased out. The import, export and manufacture of HCFCs has been controlled under the Ozone Protection Act and Customs (Prohibited Imports) Regulations since 1996.[18]

The current target date for HCFC phaseout in Australia is 2020.[19] However, this will almost certainly be brought forward, partly as a consequence of policy decisions in the USA, where the manufacture of HCFC-141b, the preferred HCFC foam blowing agent, will cease in 2003 (Table 22).

Table 22 Montreal Protocol and US Schedules for HCFC Phaseout

Montreal Protocol		**United States**	
Year by which Developed Countries Must Achieve % Reduction in Consumption	% Reduction in Consumption Using the Cap as a Baseline	Year to be Implemented	Implementation of HCFC Phaseout through Clean Air Act Regulations
2004	35.0%	2003	No production and no importing of HCFC-141b
2010	65.0%	2010	2010 No production and no importing of HCFC-142b and HCFC-22, except for use in equipment manufactured before 1/1/2010 (so no production or importing for NEW equipment that uses these refrigerants)
2015	90.0%	2015	No production and no importing of any HCFCs, except for use as refrigerants in equipment manufactured before 1/1/2020
2020	99.5%	2020	No production and no importing of HCFC-142b and HCFC-22
2030	100.0%	2030	No production and no importing of any HCFCs

Source: US Environmental Protection Agency, www.epa.gov/ozone/title6/phaseout/hcfc.html
The Agency intends to meet the limits set under the Protocol by accelerating the phaseout of HCFC-141b, HCFC-142b and HCFC-22. These are the most damaging of the HCFCs. By eliminating these chemicals by the specified dates, the Agency believes that it will meet the requirements set by the Parties to the Protocol.

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[18] HCFC suppliers and users must be licenced and licensees must not import or manufacture HCFCs unless they hold a quota allocated under the Act. The HCFC quota system sets a maximum annual limit on the quantity of HCFCs that may be imported under an individual licence. For 2000-01 the total annual limit on HCFCs to be imported is 220 ODP tonnes. In 2002-03 the annual limit will be reduced to 190 ODP tonnes. Quota allocations for 2002-03 will be based on a licensee's regulated activity in 2000. (Source: HCFC Environment Australia *Licence Application Form*, at http://www.environment.gov.au/epg/ozone/Drafting/downloads/hcfcapplicationdownload.htm)

[19] *Review of the National Ozone Protection Program*, Australian and New Zealand Environment and Conservation Council, January 2000.

The timing of the phaseout of HCFCs in Australia and New Zealand is still subject to considerable uncertainty. In fact the resolution of the issue may have been delayed because of the ability of water heater manufacturers (in both Australia and NZ) to take advantage of ODP tonne quotas released through technological changes or reductions in business activity by other foam users.

Australian water heater manufacturers will have to decide on a non-HCFC foam blowing agent within the next two to three years. There are no ideal substitutes – all have drawbacks. The hydrofluorocarbons, for example, have zero ODPs but very high Global Warming Potentials. For example, HFC-134a has a GWP that is 1300 times as great as CO_2 (mass for mass over a 100-year time scale), and HFC-245fa has an ODP of 790. Furthermore, some of the HFCs are toxic and their use would require the installation of new ventilation systems in the factory.

The most promising substitutes include hydrocarbons such as propane, butane, isobutane, n-pentane, isopentane, cyclopentane, and isomers of hexane. These are cheaper than the HFCs and have zero ODP and GWP. Cyclopentane is already in use as a foam blowing agent in the manufacture of refrigerators, but it has a lower insulating performance than HFC-134a and is flammable. There are workplace safety concerns in its use in water heater manufacture, where foam injection often takes place in close proximity to welding operations. Other possible substitutes include liquid carbon dioxide, or carbon dioxide with water.

It is important that each supplier be given the opportunity to integrate its planning for new blowing agents and for revised MEPS levels. An implementation date of late 2005 for revised MEPS levels would be consistent with the foaming agent changeover schedule that suppliers are likely to follow. Manufacturers have indicated that they could accommodate MEPS increments of up to 30% in a single step at the same time as switching foams. They have also indicated that on present information late 2005 should be an achievable timeframe, subject to review in case of major unforseen problems in the availability of the replacement foams or in the adaptation of their foam blowing equipment.

There is clearly significant risk in enforcing MEPS levels that require very large increments in foam thickness at the very time that the type, costs and properties of foams is subject to uncertainty. On the other hand, it is not clear when the uncertainty will be resolved – the situation is in many ways as fluid now as it was when the original RIS was prepared two years ago (GWA 2001a). Postponing any change in MEPS levels until the foam issue is resolved will impose costs on the community in terms of the value of energy savings foregone and higher greenhouse emissions. The optimum compromise appears to be the adoption of increased MEPS levels that can be met with a range of technical options, not just greater foam thickness and foam performance, and where the compliance regime has some flexibility.

Trade

GATT issues

One of the requirements of the RIS is to demonstrate that the proposed test standards are compatible with the relevant international or internationally accepted standards and are consistent with Australia's international obligations under the General Agreement on Tariffs and Trade (GATT) *Technical Barriers to Trade* (GTBT) Agreement. The relevant parts of the GTBT *TECHNICAL REGULATIONS AND STANDARDS Article 2: Preparation, Adoption and Application of Technical Regulations by Central Government Bodies* are addressed below.

The regulations would apply equally to imports and locally manufactured products, and so do not discriminate against imports.

It is a particular concern of the GTBT that where technical regulations are required and relevant international standards exist or their completion is imminent, Members should use them, or the relevant parts of them, as a basis for their technical regulations. Unlike products such as fluorescent lamps, air conditioners or electric motors, where there is considerable international trade and a degree of convergence on international standards, there are no accepted international test standards for electric water heater heat loss.

The GTBT urges GATT members to give positive consideration to accepting as equivalent the regulations of other Members, even if these regulations differ from their own, provided they are satisfied that these regulations adequately fulfil the objectives of their own regulations.

There would be scope for accepting the results of water heater tests conducted in other countries provided that AS1056 were used as the basis of testing. However, there is no scope for accepting a water heater that may comply with MEPS in its country of origin (eg in the EU) unless it also complies with Australian MEPS levels. The GATT does not prevent countries from setting MEPS levels according to their own requirements, costs and benefits.

In summary, water heater MEPS are not inconsistent with the GATT *Technical Barriers to Trade* Agreement.

International Standards

In 1999 ANZMEC agreed that Australia would "match the best MEPS levels of our trading partners after taking account of test method differences and other differences (eg climate, marketing and consumer preference variations)" and that this policy covered "any product regulated by mandatory labelling or MEPS programs in other developed countries" (NAEEEP 2001b). Therefore, when considering a revised MEPS level for small electric water heaters it is necessary to review the relevant standards for these products elsewhere.

New Zealand

During the public comment period for the RIS, the New Zealand Government decided (in July 2001) to introduce regulations for MEPS and mandatory energy labelling in New Zealand. The regulations were passed in February 2002 and MEPS for electric storage water heaters, took effect in February 2003. The MEPS are based on the heat loss test in New Zealand standard NZS4602, which differs somewhat from the test is AS1056. The New Zealand MEPS levels are more stringent than the new levels recommended for Australia in the previous RIS, but the extent of the difference is uncertain because the differences in the test methods and in laboratory testing practices make direct comparisons difficult.

The New Zealand MEPS regime makes mandatory the advisory efficiency standards in NZS4305:1996 *Energy Efficiency – Domestic Type Hot Water Systems.* It is not apparent from the public record whether the water heater MEPS levels proposed for Australia, or other MEPS levels, were also considered.[20] However, it should be noted that two of the risk factors identified for Australia – the costs of overcoming dimensional constraints and risk to exports – are likely to be much lower for New Zealand.

The New Zealand government has made Temporary Exemption Regulation under the Trans-Tasman Mutual Recognition Act applying to water heaters and lighting ballasts. This means that water heaters cannot be imported from Australia in the period 1 February 2003 to 31 January 2004 unless they meet the New Zealand MEPS requirements, or unless the importer purchased them under a contract entered into before 1 February 2003.[21] The Australian and New Zealand government positions on aligning standards for small water heaters is still being developed.

There are several links between the Australian and New Zealand water heater markets.[22] New Zealand has only one manufacturer of main pressure electric storage water heaters - Rheem NZ, a subsidiary of Rheem Australia, which commenced water heater manufacture in Wellington in 1969. Other New Zealand water heater manufacturers concentrate on low pressure units, which are outside the scope of this RIS.

Rheem NZ makes a different range of small MP water heaters from Rheem Australia. The two small NZ models (24 litres and 44 litres storage) are for indoor installation only (they are finished in galvanised steel, not weatherproof colourbond) and are not sold in Australia. Both Rheem and Dux exports some of their Australian MP models to NZ.

NZS4305:1996 *Energy Efficiency – Domestic Type Hot Water Systems* sets out efficiency standards for both gas and electric water heaters. For small electric water

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[20] A 6-page Regulatory Impact Statement covering all products subject to MEPS in New Zealand, prepared by the Ministry for the Environment in October 2001, is publicly available. Supporting analyses on water heaters have been requested from the MfE, but were not available when this draft was prepared.

[21] It is understood that importers did enter such contracts, so the exclusion intent of the exemption has limited effect.

[22] There is trade in the larger sizes, mostly exports from Australia to New Zealand.

heaters of 90 litres storage (not delivery) and less, the maximum permitted standing heat loss over 24 hrs is determined by the formula:

$$0.0084\ L + 0.40$$

Table 23 compares, for the same size water heaters, the maximum standing heat loss specified in NZS4305 and measured in accordance with NZS4602 with the maximum heat loss specified and measured in accordance with AS1056 (see Table 6). The NZ efficiency standard is equivalent to between 47% and 61% of the current Australian MEPS level. For the most popular sizes (25 and 50 litres delivery) this corresponds to MEPS Option 2 (a heat loss of 50% below current Australian MEPS).

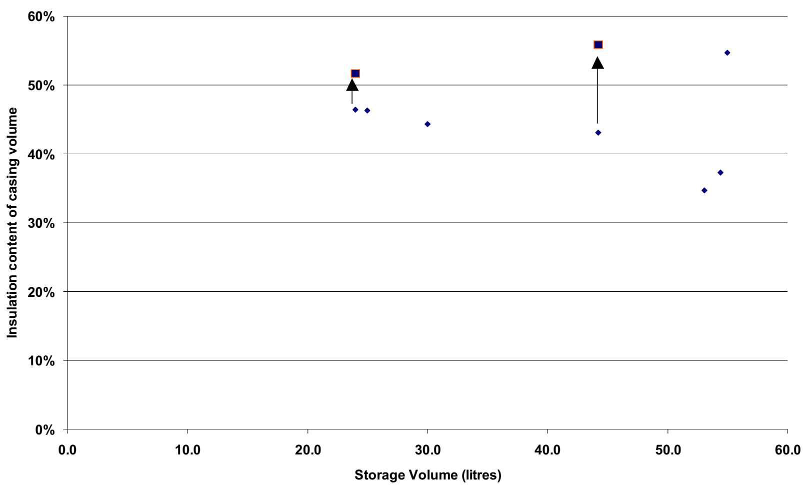
The recent introduction of two new Rheem NZ models meeting the 2003 MEPS levels gives another opportunity to compare the heat loss levels in Australia and New Zealand, and to assess the impact on water heater dimensions of more stringent heat loss requirements. Figure 12 illustrates the proportion of the casing volume that is occupied by foam insulation, for mains pressure electric water heater models in the range 24 to 54 litres storage volume (approximately 18 to 50 litres delivery). All else being equal, a unit with a higher proportion of insulation would have lower heat loss.

Table 23 Australian and New Zealand heat loss standards, small electric water heaters

Delivery litres(a)	Storage litres(b)	AS1056.1 heat loss kWh/24h(c)	NZS4602 heat loss kWh/24h	NZ/Aust heat loss
18	25	1.0	0.61	61%
25	30	1.4	0.65	47%
51	54	1.7	0.85	50%

(a) AS1056 relates heat loss to delivery volume. (b) NZS4602 and NZS4305 relate heat loss to storage volume. (c) Excludes 0.2 kWh/24h allowance for hot-side temperature and pressure relief valve.

Figure 12 Insulation content of casing volume, small water heaters



The two pairs of points linked by arrows indicate the changes in the Rheem NZ models prompted by the introduction of the NZ 2003 MEPS. In the case of the 24 litre model the diameter increased by a modest 20mm from 385mm to 405mm, and the foam content of the casing from 46% to 52%. In the case of the 44 litre model the diameter increased by 58mm, from 430mm to 488mm, and the foam content of the casing from 43% to 56%. However, manufacturers standardise end cap diameters across several models, and it is understood the next available size led to greater foam content than necessary solely to meet the MEPS level.

Figure 12 also indicates the foam content of the Australian-made water heaters listed in Table 8. While most have foam volume percentages roughly comparable to the pre-MEPS NZ models, the most highly insulated one has a foam volume comparable to the post-MEPS NZ models. This suggests that in practice the stringency of the NZ 2003 MEPS levels may not differ as much from the proposed 2005 Australian MEPS levels as might appear, and reinforces the need for a unified test and inter-laboratory calibrations.

TTMRA

The Trans-Tasman Mutual Recognition Agreement (TTMRA) states that any product that can be lawfully manufactured in or imported into either Australia or New Zealand may be lawfully sold in the other jurisdiction. If the two countries have different MEPS requirement for a given product, the less stringent requirement (which may be no MEPS at all) becomes the defacto level for both countries unless the one with the more stringent requirement obtains an exemption under TTMRA.

The impact on trans-Tasman product flows would vary with the MEPS option and according to whether there is an effective and permanent exemption under TTMRA which blocks exports from Australia which fall short of the New Zealand MEPS levels.

> *Option 1 (30% reduction in heat loss).* If there were no TTMRA exemption this would become the de-facto NZ MEPS level, and Rheem NZ's lower heat loss models may be at a price disadvantage against less insulated imports from Australia. This would increase the production volume of Australian manufacturers somewhat, and hence spread the capital costs of retooling to meet the Australian MEPS. If there were a permanent and effective TTMRA exemption these models could not be sold in New Zealand. Australian manufacturers are unlikely to introduce more highly insulated models solely for the New Zealand market, and would have the choice of either withdrawing from that market or retooling all models to the NZ MEPS level, which is unlikely since it would place suppliers at a potential price disadvantage in Australia and in non-NZ export markets. It follows that a TTMRA permanent exemption would most likely reduce the range of models and market competition in NZ.
>
> *Option 2 (50% reduction in heat loss).* This option would largely align the Australian MEPS level with the new NZ level, albeit not until the MEPS take effect (late 2005 is proposed). There would then be no need for TTMRA permanent exemption. Alignment may not however be complete, as there are

differences in interpretation of the results of the common heat loss test, and in the way in MEPS are applied (eg as an absolute level which every unit must meet - as in Australia - or as the target mean for all units produced - as in New Zealand).

Option 3 (30% reduction in heat loss, with options of sales-weighted compliance and "High Efficiency" endorsement for products meeting NZ MEPS level). This option could lead to the availability of at least two and perhaps three efficiency levels in the combined ANZ market:

- the existing 1999 Australian MEPS-compliant models (which would remain on the market if at least one supplier took the sales-weighted compliance option);
- the existing 2003 NZ MEPS-compliant models; and
- a model with at least 30% lower heat loss than the 1999 Australian MEPS (more than 30% lower for a supplier that takes the sales-weighted compliance option) that would have to be introduced by late 2005.

All three types may well be sold in Australia: the 1999 MEPS models in small numbers for constrained replacement applications (and possibly carrying a "disendorsement" label), NZ-sourced models for customers seeking HE units (and contributing to sale-weighted compliance by suppliers) and the 30%+ lower heat loss model providing the bulk of sales. If there were TTMRA exemption then neither the 1999 MEPS units nor the 30%+ lower heat loss unit could be sold in NZ. If there were no TTMRA exemption then all types could be sold in NZ, although the arrangement between the AGO and a supplier taking the sales-weighted compliance could include an agreement not to export the 1999 MEPS complying model to NZ.

Whether or not NZ secures a TTMRA permanent exemption for water heaters not meeting its MEPS level would have minimal impact on the pattern of public costs and benefits in Australia, and only limited impact on the costs and benefits for Australian suppliers exporting or intending to export to NZ, given that NZ is such a small proportion of the ANZ market for these products. The issue of exemption may have significant impact on NZ manufacturers of electric storage water heaters, and on prices and competition in the NZ water heater market, but this is outside the scope of the present RIS, which is limited to Australia alone.

Canada

The permitted heat loss in Canada is lower but is measured at a lower standard hot water temperature (Table 24). Canada is changing to the USA Energy Factor method to eliminate the implied trade barrier in having differing testing standards.

United States of America

The MEPS level adopted in the USA in 1980 is indicated in Table 24. In 1998, the US Department of Energy decided not to proceed with revised minimum performance standard for small water heaters (under 20 US gallons, or 75.7 litres) because of:

- Absence of data to determine the appropriate daily hot water consumption; and
- DOE's need to develop and evaluate the stand-by loss procedure.

Daily hot water consumption is significant because the US water heater standards are expressed in terms of an Energy Factor - a measure of water heater efficiency over a 24 hour period under standard service conditions of temperature, connection and draw off. By contrast. the Australian and New Zealand standards are expressed in terms of standing heat loss only, and so are independent of any assumptions about daily usage.

In 1999 the American Society of Heating, Refrigeration and Airconditioning Engineers, ASHRAE (1999) published an advisory minimum Energy Factor formula for electric water heaters not larger than 12 kW: 0.93 – 0.005V (V = volume in litres).

In 2001 the US government rejected the adoption of the ASHRAE value as a MEPS level because it would lead to increased energy consumption compared with the existing standard.[23]

European Union

The countries of the European Union have widely varying mandatory standards. The Swiss and German standards are significantly more stringent than current Australian MEPS for tanks sizes up to about 90 litres. French standards are slightly more stringent than Australian MEPS for tanks sizes up to about 70 litres. The British requirements are very low by world standards.

The EU is currently considering common MEPS levels, which would be close to the current German/Swiss levels (EES et al 2001). The heat loss test is similar to the AS1056 but is done with a temperature difference of only 45°C and the container volume rather than rated delivery defines tank size (Table 24).

The average heat loss for EU models of 50 L container capacity is about 0.880 kWh/24h. They have insulation thicknesses of between 64 and 93 mm. Several German manufacturers offer models with heat losses 33% lower than the standard (EP et al 2000).

Table 24 Indicative standard heat loss for selected countries

Country	Nominal Size (L)(a)	Temp. Diff. (°C)	Target Losses (kWh/24h)	Status
Australia	50 delivery	55	1.700	Mandatory; excludes allowance of 0.2 kWh/24h for the T&P valve
Canada	55	45	1.728	Mandatory in some provinces, moving to Energy Factor rating to conform with USA
Switzerland Germany	55	45	0.938	Mandatory; likely to become EU standard
New Zealand	55	55.6	0.862	Mandatory since February 2003
USA (1980) USA (ASHRAE)	55 55	44.4 38.9	1.032 1.085	ASHRAE recommendation is 5.9 + 5.3· V watts for units over 12 kW; smaller units target an Energy Factor of ≥ 0.93 – 0.005V (volume in litres)

Source: EP et al 2000. (a) Storage or recoverable storage volumes unless otherwise stated.

[23] 10CFR Pt 431 Part X, published in *Federal Register* 12 January 2001.

Comparison

Table 24 compares the heat loss standards under the various test regimes, for a small water heater roughly equivalent to an Australian 50 litre delivery model. Table 25 presents the data scaled to the Australian test temperature difference, for those countries where tests are based on standing heat loss alone, and so are independent of hot water usage. (It would be misleading to scale the US values without making additional assumptions about daily draw-off patterns).

For 50 litre water heaters:

- Swiss and German mandatory MEPS levels require are about 33% lower heat loss than current Australian levels. This is close to the MEPS level proposed for Australia in 2005;
- Canadian MEPS levels require about 24% higher heat loss than current Australian levels;
- The 2003 New Zealand MEPS levels require about 50% lower heat loss than current Australian levels.

The NAEEEP policy of "matching the best MEPS and mandatory labelling levels of our trading partners", would on the face of it indicate matching the NZ level (ie Option 2). However, the level of trade for the products in question is modest and essentially one-way (to NZ). It is of greater advantage to Australian industry and the Australian economy to align MEPS levels with the best regulatory practice among those trading partners from which there are significant imports, because this reduces the risk that less efficient models will be diverted to the Australian market, and – with more complex products – would also bring to the local market the benefits of the overseas research and development prompted by those more stringent energy standards. The case for matching MEPS levels for products that are less traded, which are relatively simple in technology (such as water heaters) and which differ in design from country to country is less clear.

Option 3 could create incentives to import NZ products to fill the HE niche. Option 2 would probably not create the same incentives, since if all models made in Australia were forced to the same heat loss level as in NZ, the higher production volumes would probably give them a substantial price advantage over imports.

Table 25 Mandatory maximum heat loss levels for selected countries adjusted to Australian test

	Temperature Difference in test (ºC)	Heat loss kWh/24 hrs (a)	Adjusted kWh/24 hrs (b)	% of Australian heat loss
Australia (1999)	55.0	1.700	1.700	100%
Australia (2005 proposed)	55.0	1.19	1.19	70%
Canada	45.0	1.728	2.112	124%
Switzerland and Germany	45.0	0.938	1.146	67%
New Zealand (2003)	55.6	0.862	0.853	50%

Based on Table 24. All units approximate 50 litres delivery. (a) As tested. (b) Scaled to temperature difference of 55ºC.

Conclusions with Regard to Competition

The revision of small mains pressure electric water heater MEPS, and the level adopted, would inevitably have some impact on individual suppliers, but is not likely to greatly effect the degree of competition between suppliers.

Because there are only three manufacturers of small mains pressure electric water heaters in Australia and New Zealand, and negligible trade in these products, it is difficult to speculate on the effects of MEPS on competition without analysing the likely commercial strategies of each supplier under different MEPS regimes.

The suppliers responded to the 1999 increase in MEPS levels without apparent commercial cost, and were able to pass the costs on to customers. Therefore the adoption of more stringent MEPS levels would be within the normal business environment and need not reduce competition.

5. Consultation

COAG Guidelines:

- ***Consultation:*** *a RIS must outline who has been or will be consulted, and who will be affected by the proposed action. On a case by case basis, this may involve consultation between departments, with interest groups, with other levels of government and with the community generally.*
- ***Review:*** *there should be consideration of how the regulation will be monitored for amendment or removal. Increasingly, sunset provisions are regarded as an appropriate way of ensuring regulatory action remains justified in changing circumstances.*

5.1 Consultations

The issues related to MEPS for electric storage water heaters have received considerable exposure over the last decade.

Chronology of Previous Reports and Consultations

July 1993	Electric storage water heaters identified as one of the product types suitable for MEPS, in GWA et al (1993)
1993-1995	Several meetings held between representatives of the water heater industry, Commonwealth and State governments and electricity suppliers, to discuss MEPS issues related to water heaters
1995	ANZMEC agrees to implement MEPS for electric storage water heaters, commencing October 1999 (more stringent for larger than for smaller) and to further consider smaller water heaters following discussions with industry and completion of any necessary research
February 1999	RIS on mandatory labelling and MEPS for household electrical appliances, including water heaters, completed .
July 1999	TNS (1999) report on dimensional constraint issues for smaller electric storage water heaters.
October 1999	Water heater MEPS come into force
March 2000	Initial discussions between representatives of AGO, NSW government and water heater industry re smaller electric storage water heater MEPS proposals
May 2000	EP et al (2000) report on technical options to increase efficiency of smaller electric storage water heaters
June 2000	Issues paper prepared (GWA 2000a)
August 2000	TNS (2000) further report on dimensional constraint issues for smaller electric storage water heaters
May 2001	Consultations with water heater manufacturers
June 2001	Draft Regulatory Impact Statement released for public comment (GWA 2001a)
July 2001	NZ Government decides to adopt separate MEPS for water heaters
September 2001	Meetings in Melbourne and Sydney, receipt of written submissions
October 2001	Final Regulatory Impact Statement released (GWA 2001b)
February 2002	NZ Government announces MEPS levels
Early 2002	MCOE decides against adopting recommended MEPS level, requests revision of RIS
February 2003	NZ MEPS and TTMRA temporary exemption take effect
August 2003	Draft revised RIS completed (ie this document)

Public consultations for original RIS

During the public consultation period on the original draft RIS (GWA 200a), the AGO sent out copies of the draft RIS to known interested parties, advertised its availability, and held public meetings in Sydney and Melbourne, at which the consultants made presentations.

Written responses were received from:

- Rheem (makers of Rheem and Vulcan water heaters);
- Dux Manufacturing Limited (makers of Dux water heaters);
- The Chair of Standards Australia Committee EL-20, which is responsible for AS 1056 (the standard for measuring standing heat losses from electric storage water heaters).

Proposed public consultations for revised RIS

The AGO proposes the following publicity and consultation process for this revised Draft RIS:

- Posting Draft RIS on AGO internet site;
- Advertising in national press re availability of Draft RIS and proposed public meetings (see below);
- Advising known interested parties (about 200 companies, organisations and individuals) of availability of Draft RIS on internet site;
- Holding one public meeting each in Sydney and Melbourne in early September (subject to public demand – in the past such meetings have on occasion had zero attendance);
- Holding meetings with water heater industry and NAEEEC representatives (scheduled for early September);
- Receiving written comments for a period of 3 weeks after the industry and public meetings (to late September).
- Incorporating comments received into Final RIS (early October).

5.2 Comments on previous draft RIS

The present Draft RIS is based on an original RIS completed in 2001, before the New Zealand MEPS levels were adopted. All respondents to the previous RIS supported the increase in stringency of MEPS for the products within the scope of the RIS, to 70% of the maximum heat losses allowed under the current (ie 1999) MEPS.

The industry respondents also supported the option of a "sales-weighted" compliance option, and:

- This should be available for 50 litre delivery units only (ie the MEPS levels for smaller units should be absolute);

- The reconciliation period for meeting the sales-weighted average for 50 litre units should be extended to 5 years, so that higher sales of less efficient (but still 1999 MEPS-compliant) units in the earlier years can be compensated by sales of units of better than 2005 MEPS in the later years;

- In order to give regulators assurance of progress towards compliance over the 5 year reconciliation period, water heater manufacturers taking the sales-weighted option would be prepared to have their sales audited by an appropriate third party, who would submit reports to regulators.

In addition, the following points were made:

- The standing heat loss test in AS1056 was being revised. It was anticipated that the new test would be finalised by the end of 2001;

- Given the understanding that there will be a full 3 years notice period from the announcement of revised MEPS levels (which must be related to a fixed method of test), 1 January 2005 was the earliest practical date of implementation rather than October 2004. A January introduction would also be preferable from the viewpoint of production scheduling;

- It would be highly desirable for Australia and New Zealand to harmonise both MEPS levels and methods of test. The most appropriate forum for the latter is via EL-20, which could produce a joint AS/NZS standard;

- As previously agreed by regulators, MEPS should urgently be implemented for immersed coil (ie heat exchange) and low-pressure storage water heaters, so that mains pressure water heaters are not disadvantaged in the market;

- Industry acceptance of the higher MEPS level is based on a presumption that no new requirements regarding ozone depletion (ie additional to any phaseout programs already in progress or announced) are implemented by government in the period leading up to the MEPS implementation or the 5 year stability period. If any such measures resulted in a reduction in the insulation properties of commercially available foams, manufacturers would not re-engineer products again to compensate for heat loss penalties;

- It was agreed that the scope of AS1056 needs clarification, with regard to the minimum size of the water heaters covered by the Standard, and the corresponding maximum heat loss, and that EL-20 would attend to this in the current round of revisions.

5.3 Responses to Comments

In relation to the above points:

- The Australian and NZ methods of test are indeed being harmonised and a joint test standard is being developed;

- The revised test was not completed by the end of 2001, as was intended at the time, and indeed this is not now likely to happen before late 2003;

- Suppliers have already had a clear indication of the likely MEPS levels, since these are essentially similar to the levels proposed in the final version of the original RIS in October 2001. Therefore implementation should not be significantly deferred beyond the date proposed in the previous RIS, notwithstanding the longer than expected period of development of the revised heat loss test;

- NAEEEP has agreed to the implementation of MEPS for immersed coil (ie heat exchange) and low-pressure storage water heaters (NAEEEP 2002);

- There has been no significant change with regard to the uncertainties surrounding insulation foam blowing agents – the level of risk is much the same as it was two years ago when the original RIS was drafted.

With regard to the clarification of the product capacities falling in the scope of AS1056, the MEPS formula should be described as a linear equation rather than as a set of discrete maximum heat loss levels applying to units of specified delivery volumes, as is the case at present (see Table 6). Figure 13 illustrates an equation which gives an exact heat loss match with AS1056 for units of 50 litres delivery and a close match at all other capacities:

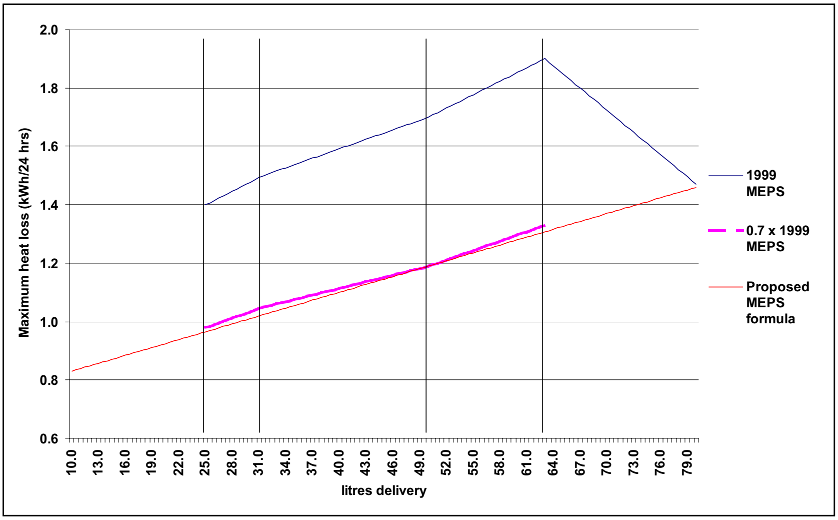
$$H = 0.009\,L + 0.74$$

Where

> H = maximum heat loss in kWh per 24 hrs (before any allowances for additional valves or fittings) and
> L = delivery volume in litres.

The adoption of such an equation would ensure that all small mains pressure storage water heaters are subject to MEPS irrespective of their capacity. Expressing the MEPS level as an equation would also be consistent with the way the NZ MEPS levels are set, and also with the proposed MEPS for miscellaneous electric water heaters (NAEEEP 2002).

Figure 13 Proposed linear equation for maximum heat loss



6. Evaluation and Recommendations

COAG Guidelines:

- ***Evaluation:*** *there should be an evaluation of the relative impacts of the proposal and any alternatives, to show that the desired policy objective cannot be achieved at a lower cost to business and the community at large.*

6.1 Assessment

In relation to the assessment criteria applied in this revised RIS:

Does the option address market failures, so that the average lifetime costs of water heating are reduced, when both capital and energy costs are taken into account? All three options are based on more stringent MEPS, and all are likely to be effective in meeting the objectives stated for the regulation: reductions in greenhouse gas emissions and reduced life cycle costs to users. Option 3 has the highest ratio of benefits to costs (narrowly followed by Option 1), whereas Option 2 has the greatest net monetary benefit (followed by Option 3).

Does the option minimise negative impacts on product quality and function? Option 3 rates best on this criterion, since it allows for the widest range of small electric water heater types on the Australian market, and hence increases the probability that buyers will be able to find a model that best meets their requirements.

Does the option minimise negative impacts on manufacturers and suppliers? Option 3 rates best on this criterion because it offers the widest range of compliance options.

Is the option consistent with other national policy objectives, including in this case reduction in the emissions of ozone depleting substances and the objectives of the National Appliance and Equipment Energy Efficiency Program to match "world best practice" standards? There is a conflict between these objectives. Option 3 offers the greatest chance that the MEPS levels can be met and will not need to be revisited, whatever foaming agents are eventually adopted. On the other hand, the NZ 2003 MEPS levels set regulatory standards at the equivalent of a "world best practice" standard that did not exist when the original RIS was prepared, and Option 2 would force Australian regulatory levels to match them.

NAEEEP has a policy of "matching the best MEPS and mandatory labelling levels of our trading partners", which on the face of it would indicate Option 2. However, the level of trade for the products in question is modest and essentially one-way (to NZ). It is of greater advantage to Australian industry and the Australian economy to align MEPS levels with the best regulatory practice among trading partners from which there are significant imports, because this reduces the risk that less efficient models will be diverted to the Australian market, and – with more complex products – would also bring to the local market the benefits of the overseas research and development prompted by those more stringent energy standards. The case for matching MEPS levels for products that are less traded, which are relatively simple in technology (such as water heaters) and which differ in design from country to country is less clear.

Options 3 could create incentives to import higher efficiency NZ products because they could fill the HE niche. Option 2 would probably not create the same incentives, since if all models made in Australia were forced to the same heat loss level as in NZ, the higher production volumes would probably give them a substantial price advantage over imports.

6.2 Conclusions

On considering the three options for more stringent mandatory MEPS levels for electric mains pressure storage water heaters, it is concluded that:

8. More stringent MEPS is likely to be effective in meeting the objectives stated for the regulation: addressing market failure, reducing life cycle costs to users and reducing greenhouse gas emissions.

9. None of the alternatives examined appear as effective as MEPS in meeting all objectives, some would be ineffective with regard to some objectives, and some appear to be far more difficult or costly to implement.

10. Of the three MEPS options analysed, Option 3 (30% reduction heat loss, with the option of sales-weighted compliance and supported by indelible labelling of products with their energy efficiency) gives the highest ratio of benefits to costs.

11. The option with the highest net benefits and greenhouse savings is Option 2 (50% reduction in standing heat loss, which is roughly equivalent to the MEPS levels adopted in New Zealand in 2003). This also leads to the greatest increase in total water heater costs, with about four fifths of the increase coming from higher manufacturing costs and one fifth from the cost of changing enclosures to accommodate larger water heaters.

12. The greater the volume of insulation foam that will be required, the greater the exposure to uncertainties regarding foam availability, cost and characteristics and the costs of rebuilding enclosures or relocating water heaters. The higher MEPS level (Option 2) would require significantly greater increases in foam volume than Options 1 or 3 and so carries a significantly higher level of risk.

13. A “sales-weighted target” approach (in which some higher heat loss units could be sold provided that enough lower heat loss units were also sold) would give suppliers greater flexibility to address the dimensional constraint issue than a regime in which every unit sold would have to meet the nominated MEPS level.

14. Given that there is likely to be no more than 3 discrete levels of heat loss under Option 3, a simplified form of energy labelling which identifies High Efficiency, Medium Efficiency and Low Efficiency models of electric mains pressure storage water heater, may be as effective as a full comparative scale.

6.3 Recommendations

It is recommended that:

12. States and Territories implement more stringent mandatory MEPS for storage water heaters of less than 80 litres delivery (as defined in AS1056.1 *Storage Water Heaters Part 1: General requirements*).

13. The MEPS levels be set at a 30% reduction of the current maximum standing heat loss in AS1056.1-1991.

14. The scope of AS1056.1-1991 should be expanded to cover water heaters of delivery smaller than 25 litres delivery (the current lower limit).

15. The mode of implementation be through the existing regulations governing appliance energy labelling and MEPS in each State and Territory.

16. The revised MEPS levels take effect on 1 October 2005 and not be revised for at least 4 years.

17. The basis of MEPS should be the revised heat loss test recently developed for use in the proposed joint Australian and New Zealand standard for heat loss testing, and the recommended MEPS level should be adjusted should the joint test method result in different standing heat loss results from the current AS test (ie so that the objective of at least 30% reduction in maximum heat loss is maintained).

18. Governments allow the option of "sales-weighted" compliance, for water heaters of 50 litres delivery volume only. Suppliers who take this option could continue to sell water heaters which meet only the current (ie 1999) MEPS level for up to 5 years, so long as the sales-weighted average heat loss of all of that supplier's sales of 50 litre models over the 4 year period is no higher than the revised (ie 2005) MEPS level for 50 litre delivery water heaters.

19. Participation in the sales-weighted compliance option should be subject to the agreement of annual weighted heat loss targets and sales reporting arrangements. Failure to meet the annual targets should trigger the abandonment of the sales weighted scheme and the adoption of a more stringent universal MEPS level, so that the foregone energy savings are achieved.

20. Water heaters whose heat loss meets the New Zealand MEPS level (once the precise equivalence using the new test is determined) should be designated as "High Efficiency" and display a label to that effect, using the design currently being developed by the AGO.

21. In the event that companies opt for "sales-weighted" compliance, any 1999 MEPS models remaining on the market after the commencement of the new MEPS regime should be designated as "Low Efficiency" and display a label to that effect, using the design currently being developed by the AGO. This will assist label-aware buyers, specifiers and planning authorities to identify and avoid these models, thereby also assisting suppliers to meet their compliance targets.

22. The Ministerial Council on Energy should initiate a review of the optimum joint MEPS regime for Australia and New Zealand combined, no later than 2007 (to facilitate possible further revision of MEPS levels in 2010), or earlier in the event that a major exporting economy makes a significant change in its MEPS regime for electric storage water heaters.

7. Review

An increase in the stringency of water heater MEPS would be implemented under the same State and Territory regulations as existing MEPS, and so subject to the same sunset provisions, if any. Victoria and SA have general sunset provisions applying to their labelling/MEPS regulations as a whole, while NSW has sunset provisions applying to the inclusion of some (but not all) items scheduled.

Once the States and Territories agree to mandatory requirements, their removal in any one jurisdictions would undermine the effect in all other jurisdictions, because of the Mutual Recognition agreements between the States and Territories (GWA 1999a). Under the cooperative arrangements for the management of the National Appliance and Equipment Energy Efficiency Program, States advise and consult when the sunset of any of the provisions is impending. This gives the opportunity for fresh cost-benefit analyses to be undertaken.

The Australian Standards called up in State and Territory labelling and MEPS regulations are also subject to regular review. The arrangements between the Commonwealth, State and Territory governments and Standards Australia provide that the revision of any Standards called up in energy labelling and MEPS regulations are subject to the approval of the governments.

Therefore any proposal to make the MEPS in AS1056.1 *Storage Water Heaters Part 1: General requirements* either more or less stringent would need the cooperation of both the Standards bodies and of the regulators.

NAEEEC has adopted the principles that there should be a MEPS "stability period" of *at least* 4 years, and that a cost-benefit analysis would be undertaken before any revisions are proposed (NAEEEC 1999). The earliest possible timing of any change to the MEPS regulations discussed in this RIS would therefore depend on date of their implementation. If they are implemented October 2005, the earliest possible revision would be October 2009. However, if one or more suppliers take the sale-weighted compliance option for 50 litre models, and a reconciliation period of 5 years is allowed, it would be consistent for regulators to assure stability of MEPS levels to the end of the period, ie to April 2010. It would be necessary to carry out a study well in advance of any proposed revision, so that adequate notice could be given to industry in the event that a change were justified.

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Appendix 1 Extract from Typical State Regulations

NSW Electricity Safety Act (1945)
Electricity Safety (Equipment Efficiency) Regulation 1999

Part 2 Standards

5 Minimum standards

(1) An electrical article listed in Schedule 2 must comply with the performance criteria set out in Part 2 of the relevant standard when tested, in accordance with Part 1 of that standard, by an accredited laboratory.

(2) An electrical article listed in Schedule 3 must comply with the energy efficiency requirements set out in the relevant standard.

(3) In this clause, accredited laboratory means a laboratory:

(a) accredited by the National Association of Testing Authorities, or

(b) approved by the Corporation.

Part 4 Labelling of electrical articles

15 Electrical articles to be appropriately labelled when sold

(1) A person must not sell an electrical article listed in Schedule 2 unless an approved energy efficiency label is displayed on the article in accordance with Part 2 of the relevant standard. Maximum penalty: 20 penalty units.

(2) In the case of an air conditioner that is sold in a package, the approved energy efficiency label may instead be displayed on the package.

(3) This clause applies in respect of the sale of new articles, whether by wholesale or retail, but does not apply to the sale of second-hand articles.

SCHEDULE

(Clauses 7 and 19)

Item	Fee
For registration of an electrical article	$150
For transfer of registration of an electrical article	$50
For provision of an extract from the Register	$50

Schedule 2 Standards for electrical articles that require registration and labelling

Article: (Clause 5 (1))

Relevant standard:

Clothes washing machine Australian/New Zealand Standard, "Performance of household electrical appliances Clothes washing machines Part 1: Energy consumption and performance", AS/NZS 2040.1:1998, and Australian/New Zealand Standard, "Performance of household electrical appliances Clothes washing machines Part 2: Energy labelling requirements", AS/NZS 2040.2:1998.

Dishwasher Australian/New Zealand Standard, "Performance of household electrical appliances Dishwashers Part 1: Energy consumption and performance", AS/NZS 2007.1:1998, and Australian/New Zealand Standard, "Performance of household electrical appliances Dishwashers Part 2: Energy labelling requirements", AS/NZS 2007.2:1998.

Refrigerating appliance Australian/New Zealand Standard, "Performance of household electrical appliances Refrigerating appliances Part 1: Energy consumption and performance", AS/NZS 4474.1:1997, and Australian/New Zealand Standard, "Performance of household electrical appliances Refrigerating appliances Part 2: Energy labelling and minimum energy performance standard requirements", AS/NZS 4474.2:1997.

Room airconditioner Australian/New Zealand Standard, "Performance of household electrical appliances Room airconditioners Part 1.1: Non-ducted airconditioners and heat pumps Testing and rating for performance", AS/NZS 3823.1.1:1998, and Australian/New Zealand Standard, "Performance of household electrical appliances Room airconditioners Part 2: Energy labelling requirements", AS/NZS 3823.2:1998.

Rotary clothes dryers Australian/New Zealand Standard, "Performance of household electrical appliances Rotary clothes dryers Part 1: Energy consumption and performance", AS/NZS 2442.1:1996, and Australian/New Zealand Standard, "Performance of household electrical appliances Rotary clothes dryers Part 2: Energy labelling requirements", AS/NZS 2442.2:1996.

Schedule 3 Standards for electrical articles that require registration only

Article: (Clause 5 (2))

Relevant standard:

Storage water heater unvented without an attached feed tank Australian Standard, "Storage water heaters Part 1: General requirements", AS 1056.1:1991, Clause 2.4 "Thermal Insulation".

Appendix 2 Storage Water Heater Technology and Energy Tariffs

Pressure

The two pressure classes are "mains pressure" (MP) and "low pressure" (LP). (The "mains pressure" designation actually covers a range of design pressures, from about 850 to 1400 kPa, and in areas where supply pressure could exceed the design pressure, reducing valves have to be installed). MP tanks are generally installed at floor level, inside or outside the dwelling. Because the hot water is at or near mains pressure it can be used at several outlets simultaneously, and the mixing of hot and cold is easier. MP water heaters have no feed tank

In LP water heaters the pressure is reduced by a cistern-operated feed tank or a valve, and the hot water is stored in the main tank at atmospheric pressure. "Side-fed" LP tanks are generally installed in the roof space to give sufficient head for satisfactory water pressure at the outlets. Even so, the unit must be located near the main draw-off points. It is often difficult to serve more than one outlet at a time, and the balancing of LP hot supply and MP cold supply can be a problem. In the "cistern-fed" LP configuration, there is a cistern in the roof and the main tank is located at floor level.

LP tanks are relatively simple to fabricate, and used to be the most common type until about 30 years ago. As MP tanks came to be manufactured in large quantities, their quality became more consistent and their price declined. LP tanks now tend to be installed only in areas without reticulated water supply. However, their remaining advantage over MP tanks is their far longer service life: 30 years or more, compared with about 8-10 years for MP (even less in areas of poor water quality, such as Adelaide).

There are also non-storage water heating technologies, which rely on very high rates of energy input to bring cod water up to the required delivery temperature. This can be achieved by the high-capacity gas burners in instantaneous water heaters, with ratings of 18-27 MJ/hr (equivalent to 5-7.5 kW), high-power electric elements (eg sink heaters which have to be connected to three-phase supply, or by passing the cold water through a copper coil immersed in tank of water kept hot by solar energy or an electric element. This last type is called a “heat exchange” water heater, and is made by Peter Sachs Industries in Brisbane (Saxon Brand). It is claimed that the design combines the advantages of MP hot water delivery while achieving the longevity of a LP system, since the storage cylinder is not under pressure. Any possibility of contamination of the delivered water by the storage vessel materials is also removed.

Neither low pressure nor heat exchange water heaters are subject to MEPS at present. In early 2002 the NAEEEC published a plan to extend nationally consistent MEPS, commencing in or around July 2005, to low pressure storage, instantaneous, boosted solar, calorifiers, heat exchangers and boiling water units (NAEEEC 2002).

Energy Type

The different types of energy used in storage systems are natural gas, liquefied petroleum gas (LPG), continuous supply electricity, and restricted supply ("off-peak") electricity. Each of these types interacts with the water heater in different ways: in this respect, continuous electricity has more in common with gas than with restricted supply electricity. In storage heaters which are gas-fired or "continuous" electric (sometimes called "quick recovery"), reheat begins as soon as a draw-off commences.

In "off-peak" (OP) water heaters, reheat can take place only during the restricted periods when the utility make electricity supply available to the element. This may be for as little as 6-8 hours during the night ("restricted OP"), or for as long as 16-18 hours ("extended OP"): ie, supply may be available at all times except during the hours of peak demand on the electricity system. The more restricted the hours of electricity supply, the larger the water storage needed. For example, a four-person household which would be adequately supplied by a gas-fired or continuous electric water heater of about 125 litres storage capacity, might require a tank of 160 litres on extended OP, and 250 or even 315 litres on restricted OP.

The larger the tank, the higher the costs of manufacturing it , transporting it, and of accommodating it within or outside the dwelling. There are also additional costs associated with installing separate off-peak electricity meters and wiring circuits. Therefore the capital cost of an off-peak hot water system is higher than the cost of an equivalent continuous electric system.

The great advantage of OP water heaters is access to lower electricity tariffs. The marginal cost to produce and distribute an additional kWh of electricity is highest during peak demand periods and lowest during the night, when most of the demand can be met by the lowest cost base load power stations. The electricity utilities signal these costs in their tariff structures: the restricted hours OP tariff is typically about a third of the continuous tariff, and the extended hours OP tariff is about two thirds. However, the utilities also specify the minimum size of water heater that may be connected to these tariffs, for two related reasons:

- so the heat storage capacity of the water heater is adequate to maintain hot water supply during the periods when reheat is denied (the gas utilities exploited this risk in their advertising, by noting that gas hot water is “unlimited”); and

- so the water heater can absorb enough heat to function as a significant energy sink during periods when power supply prices are low, so the utility maximises the profit margin on the tariff.

The minimum size for connection to the restricted hours OP tariff is generally 250 litres, and the minimum for the extended hours OP tariff is generally 160 litres. Small electric water heaters (less than 80 litres) can only be connected to the continuous tariff.

Appendix 3 Greenhouse Gas Emissions

There are two ways of calculating the greenhouse gas intensity of electricity systems:

- average intensity: total annual emissions divided by total annaual electricity produced, sent out, or delivered; and
- marginal intensity: the additional emissions that would be created (or avoided) by adding or saving an additional kWh.

Both intensity measures vary over time, but the marginal intensity takes into account the merit order of generators. In Australia, the base electricity load is met by coal-fired power stations (which are the cheapest – so long as greenhouse emissions costs are externalised - and the most CO_2-intensive) while intermediate and peak loads are met by more expensive but less CO_2-intensive natural gas and zero-intensity hydro. Thus a measure that reduces overall electricity demand – such as MEPS - will trend to reduce the operation of power stations that are less CO_2-intensive than the average; ie the CO_2-intensity per kWh avoided should be calculated using the marginal coefficients.

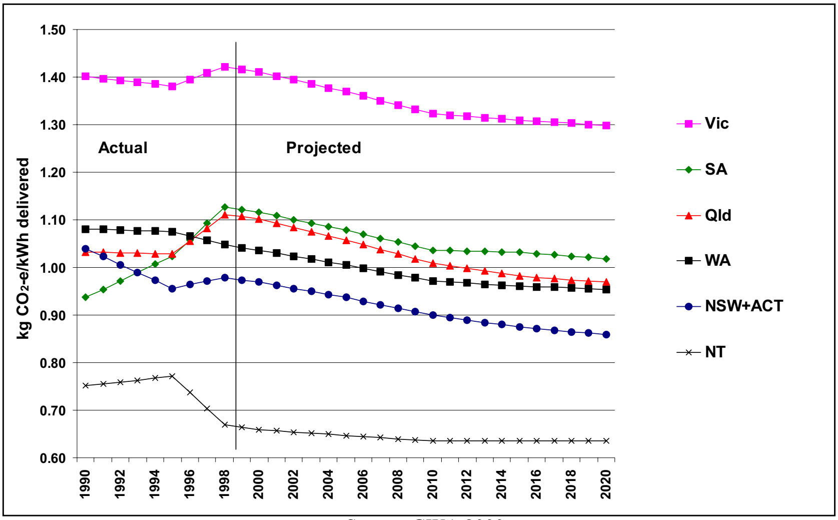
However, when estimating the emissions associated with existing electricity uses which are more or less continuous (as distinct from time-controlled loads such as off-peak water heating, or seasonal loads such as airconditioning) any ranking of loads in priority order would be arbitrary. Therefore, it is more appropriate to use average rather than marginal coefficients when estimating the share of national emissions associated with electric water heating in 2000.

The average electricity system CO_2–e intensities used in the RIS, illustrated in Figure 14, are taken from GWA (2000a). The intensities are projected to decline due to an eventual preference for natural gas, and the impacts of two Commonwealth initiatives, the "2% renewables" measure and power station efficiency standards.

The marginal electricity system CO_2–e intensities used in the RIS, illustrated in Figure 15 were supplied by the AGO (personal communication, April 2000). These embody specific assumptions about the scheduling of future generation and transmissions projects. For example, the projected completion of Basslink in 2005 would harmonise the marginal coefficient for Tasmania and Victoria, and both would converge to the intensity of natural gas generation.

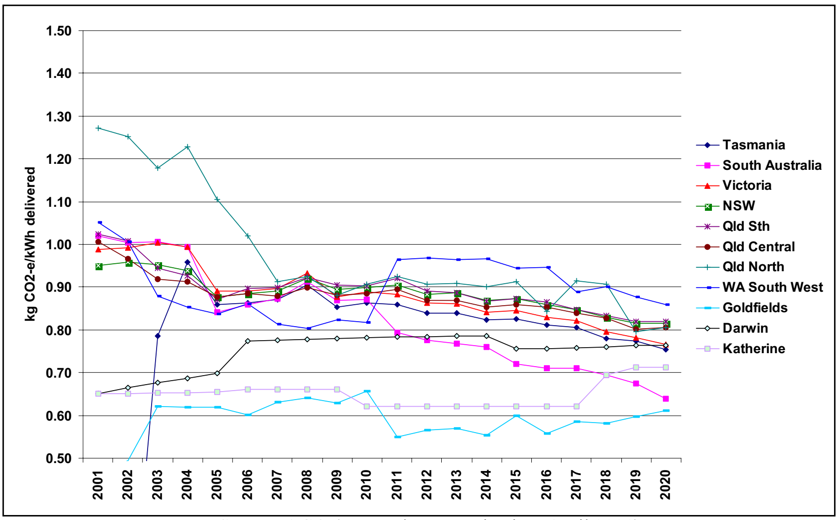
In order to derive a single marginal State coefficient for household electricity use, the three Queensland zone coefficients supplied by AGO were weighted on the basis of population in 2000 as follows: 80% south Queensland, 8% central Queensland, 12% north Queensland. The WA coefficient was weighted 98% southwest WA and 2% Goldfields. The NT coefficient was weighted 90% Darwin and 10% Katherine. The weighted coefficients are illustrated in Figure 16.

Figure 14 Projected average emissions-intensity of electricity supply by State, 1990-2020



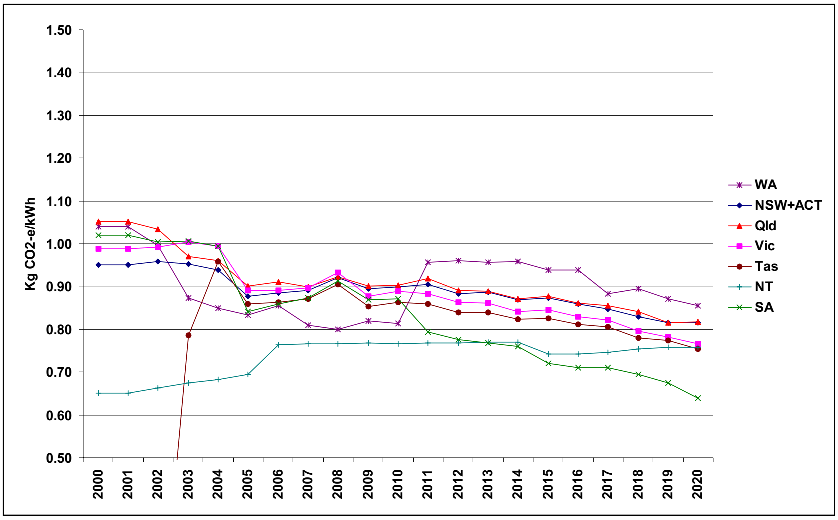
Source: GWA 2000a

Figure 15 Projected marginal emissions-intensity of electricity supply by State (sub zones), 2001-2020



Source: AGO (personal communication, April 2001)

Figure 16 Projected marginal emissions-intensity of electricity supply by State (weighted averages), 2000-2020



Appendix 4 Resource Costs and Benefits

This Appendix estimates the resource costs to the economy of the three proposed MEPS options which are analysed in the RIS from the perspective of end users of water heaters.

The cost to the economy of manufacturing more efficient hot water system is the resources diverted from other activities, valued at the marginal cost of those resources. As such, only the extra *costs* involved in the manufacturing and distribution processes — such as extra materials, handling and storage costs — should be counted for water heaters, and the benefit should be the marginal cost of electricity production, not the retail price. Price increases not related to costs, such as retail markups and taxes, are merely transfers from consumers to intermediaries, and should not be counted.

The resource analysis differs from the price analysis in the following respects:

1. Electricity costs rather than prices are used;

2. Water heater production costs are used, without intermediary markups;

3. All capital costs of tooling are accounted in the year they are likely to occur (ie the year preceding the implementation of MEPS;

4. Taxes are excluded.

The marginal electricity production costs are derived from a set of projections of marginal costs at regional reference nodes in the National Electricity Market (SA, Victoria, Tasmania, NSW, Snowy, Southeast Queensland, Central Queensland and Far North Queensland) developed in 2000 by the AGO for use in the evaluation of Greenhouse Gas Abatement Program (GGAP) proposals. The values have been adjusted as follows:

- The original costs projections were in constant 2000 dollars. They have been inflation-adjusted to constant 2003 dollars (increased by 9%)

- The three Queensland nodes have been adjusted to a single Queensland value on the basis of population in 2000 as follows: 80% Southeast Queensland, 8% Central Queensland, 12% Far North Queensland;

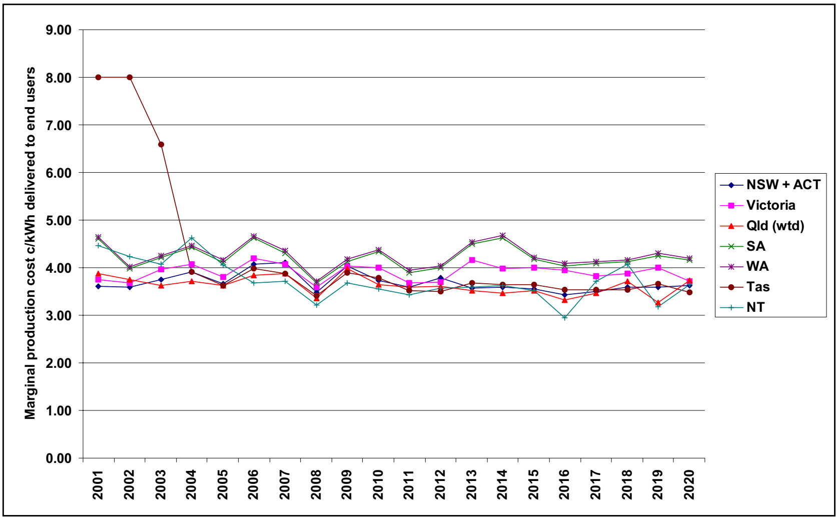
- WA costs have been set to equal SA, and NT costs to equal Far North Queensland

- The marginal costs of energy *delivered* to users has have been calculated by scaling up the cost at reference nodes by the average distribution loss factor for the State distribution systems (ranging from 5% to 7%) reported by the Electricity Supply Association of Australia.

The marginal production costs are illustrated in Figure 17. The high cost for Tasmania prior to 2005 is based on the assumption that hydro capacity is fully utilised, and marginal production used petroleum fuel at Bell Bay; the completion of Basslink in

2005 would harmonise the marginal price for Tasmania and Victoria, and both would be based on natural gas generation

Figure 17 Projected marginal electricity production costs, 2001-2020



The benefits and costs calculated used resource costs are summarised in Table 26 and Table 27. The corresponding values using price-based analysis are in Table 28 and Table 29. Both benefits and costs are lower using resource cost analysis. The value of energy savings is about 70% lower and the value of water heater cost increases is about 40% lower. Because the value of benefits falls more than the value of costs, the benefit/cist ratios are also lower in the range 2.2 to 2.4 at 10% discount rate, compared with 4.1 to 5.1 using price-based analysis. However, the ratios are all well above 1, so this analysis serves confirms that all of the proposed MEPS options are likely to be cost-effective.

The apparent saving per tonne of greenhouse emissions avoided also falls, from about \$40/tonne under price analysis (Table 29) to about \$8/tonne under resource analysis (Table 26). Nevertheless it is still a *saving* per tonne rather than a *cost* per tonne.

While this supplementary analysis is useful, the main analysis in this RIS is still based on prices, because (a) the available data on costs are less reliable than the data on prices (which are public), (b) the multipliers move in the same direction, so it is likely that either type of analysis would identify clearly cost-effective and clearly non cost-effective options and (c) if price-based analysis indicated that an option would leave consumers worse off, that option would be difficult to recommend even if net economic gains could be demonstrated, so price-based analysis will be required in any case. It is arguable that price-based analysis alone will yield all of the information necessary for decision-making, although cost-based analysis may be a useful supplement.

Table 26 Projected national costs and benefits, MEPS options – resource based

Options	NPV purchase costs $M	% of enclos-ures changed	NPV enclosure costs $M	NPV total capital costs $M	NPV energy costs $M	Capital cost increase $M	Energy saving $M	Net benefit $M	Benefit/ cost (10% discount)	Benefit/ cost (5% discount)	Benefit/ cost (0% discount)
BAU	$267	NA	NA	NA	$469	NA	NA	NA	NA	NA	NA
Option 1	$306	1%	$1	$307	$384	$39	$85	$46	2.2	2.6	3.2
Option 2	$327	8%	$11	$338	$328	$60	$141	$82	2.4	2.8	3.4
Option 3	$314	1%	$1	$315	$357	$47	$113	$65	2.4	2.8	3.5

All Net Present Values at mid 2003, at 10% discount rate.

Table 27 Projected cost per tonne greenhouse emissions saved – resource based

MEPS option	**Total kt CO_2-e saved, 2001-2021 (a)**	**Net benefit $M (b)**	**$ Cost (benefit) per tonne CO_2-e saved**
Option 1	5615	$46	(8.2)
Option 2	9358	$82	(8.7)
Option 3	7486	$65	(8.7)

(a) From Table 19 (b) From Table 26.

Table 28 Projected national costs and benefits, MEPS options – price based

Options	NPV purchase costs $M	% of enclos-ures changed	NPV enclosure costs $M	NPV total capital costs $M	NPV energy costs $M	Capital cost increase $M	Energy saving $M	Net benefit $M	Benefit/ cost (10% discount)	Benefit/ cost (5% discount)	Benefit/ cost (0% discount)
BAU	$449	NA	NA	NA	$1,534	NA	NA	NA	NA	NA	NA
Option 1	$505	1%	$3	$507	$1,254	$59	$281	$223	4.8	5.7	7.0
Option 2	$539	8%	$22	$562	$1,067	$113	$469	$356	4.1	5.1	6.4
Option 3	$520	1%	$3(a)	$523	$1,160	$74	$375	$301	5.1	6.1	7.4

Source: Table 20 in text. All Net Present Values at mid 2003, at 10% discount rate. Projections have been tested for sensitivity to a range of assumptions regarding material costs, discount rates, water heater service life and enclosure alteration costs. (a) 1999 MEPS models may be retained for a period to minimise these costs.

Table 29 Projected cost per tonne greenhouse emissions saved – price based

MEPS option	**Total kt CO_2-e saved, 2001-2021 (a)**	**Net benefit $M (b)**	**$ Cost (benefit) per tonne CO_2-e saved**
Option 1	5615	$223	(39.9)
Option 2	9358	$356	(40.3)
Option 3	7486	$301	(40.5)

Source: Table 21 in text.

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Report 2004/03

Minimum Energy Performance Standards for Miscellaneous Electric Water Heaters

Regulatory Impact Statement

Draft Report – 29 June 2004

Prepared for

Australian Greenhouse Office

Prepared by

Syneca Consulting

Contents

Figures

Abbreviations

AGO	Australian Greenhouse Office
ANZMEC	Australian and New Zealand Minerals and Energy Council (forerunner to MCE)
AS	Australian Standard
AS/NZS	Joint Australian Standard/New Zealand Standard
BAU	business as usual
E2WG	Energy Efficiency Working Group
EP	Energy Partners
GWA	George Wilkenfeld and Associates
GWh	Giga watt hours
kt	kilo tonnes, usually of carbon dioxide equivalent (CO_2-e)
LBNL	Lawrence Berkeley National Laboratories
MCE	Ministerial Council on Energy
MEA	Mark Ellis and Associates
MEPS	minimum energy performance standards
NATA	National Association of Testing Authorities, Australia
MEPS	Minimum Energy Performance Standards
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NAEEEP	National Appliance and Equipment Energy Efficiency Program
NGS	National Greenhouse Strategy
NPV	net present value
RIS	regulatory impact statement
TESAW	Top Energy Saver Award Winner
TNS	Taylor Nelson Soffres
USDoE	US Department of Energy

Executive summary

This is a regulatory impact statement for a proposal to introduce mandatory minimum energy efficiency requirements for certain types of electric water heaters supplied in Australia. These are the low pressure and heat exchanger types of water heater, jointly referred to here as 'miscellaneous electric heaters'. They account for a small (6%) and declining share of total sales of electric water heaters.

The problem
The proposal is an element of the National Appliance and Equipment Energy Efficiency Program (NAEEEP), which is jointly managed and funded by the Commonwealth, State and Territory governments. NAEEEP is part of the National Greenhouse Strategy and targets the energy efficiency of consumer appliances, industrial and commercial equipment.

The energy used by miscellaneous water heaters accounted for only a small fraction of Australia's greenhouse emissions in 2000 – less than 0.3%. Moreover, the proposed efficiency measures can only reduce the 'standing losses' from the water heater's storage tank, having no effect on losses from pipes or the energy content of hot water delivered to the user. These standing losses would account for less than 0.1% of total emissions.

Market failure
For there to be scope for regulations to achieve cost-effective reductions in standing losses, markets must be regarded as having failed to minimise the lifecycle costs of using water heaters. (The energy lost directly to the atmosphere from a storage tank is called the standing loss, and can be reduced by better insulation of the tank.)

An important consideration in this context is that the lifetime value of standing losses is typically greater than the installed cost of the heater, and may be up to 20% larger. Ideally, therefore, the rate of heat loss should be at least as significant a consideration as the purchase price. However manufacturers agree that this is not the case, and that users undervalue the long term impact of additional insulation on their electricity consumption. One obvious reason is that there is usually some urgency about replacing water heaters that have failed, leaving little time for a market search. And new home buyers generally leave heater selection to the builder, whose main concern is to minimise the installed cost.

The objective
The proposal would bring the MEPS arrangements for miscellaneous water heaters into line with the arrangements currently applying to the rest of the market for electric water heaters, comprising mains pressure units. The various types of electric heater would be treated uniformly thereafter, there being no significant technical differences in respect of heat losses and measures to reduce them.

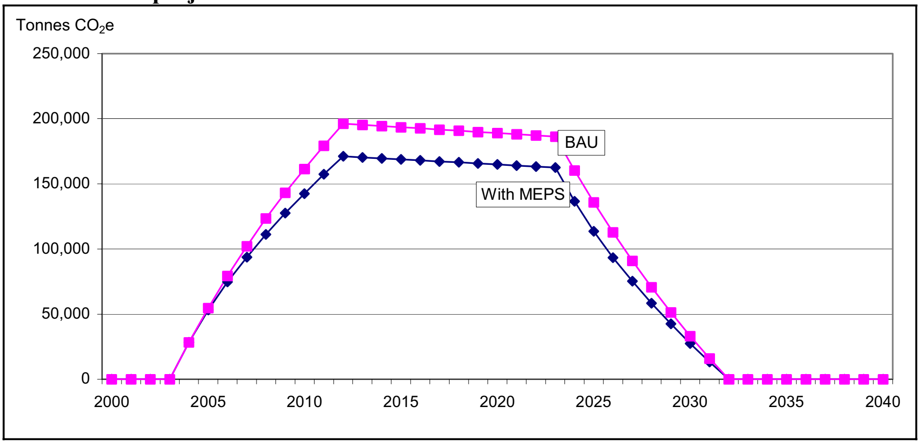
NAEEEP will apply its policy of 'world's best regulatory practice' to water heaters over the longer term. This involves setting MEPS at levels broadly comparable with the most demanding MEPS adopted by Australia's trading partners, but following that lead with a lag of several years, and after taking into account domestic market circumstances and policy settings.

The proposal
The proposed measures will replace the current recommended or voluntary MEPS with mandatory MEPS, and reduce the maximum permitted heat loss by 30%. This will require the replacement of models that account for at least 90% of existing sales. Some manufactures have already introduced more efficient models that comply with the proposed standard or will do so after further relatively minor adjustment.

Figure 1 reports estimates of greenhouse emissions from miscellaneous electric water heaters that are supplied to the market in the period to 2012, which is the final year of the first commitment period under international arrangements to reduce greenhouse emissions. Over the life of units supplied in this period, total reductions in greenhouse emissions are estimated at 487 kt of CO_2 equivalent. Coincidentally, total energy use is reduced by 487 GWh over the period.

At their peak in 2012, energy use and greenhouse emissions would be reduced by 15% relative to the BAU projections for the standing losses from miscellaneous heaters *supplied in the period 2004-2012*. However, the transition to more efficient water heaters would be incomplete at this stage, since currently supplied water heaters may not be fully retired until 2030 or later. The savings would continue to increase to about 25% of the projected levels if the regulation is maintained indefinitely.

Figure 1: Greenhouse emissions: business-as-usual (BAU) and 'With MEPS' projections: units installed 2004 to 2012



Assessment
From a regulatory perspective, the proposal will restore that level playing field that applied to electric water heaters before the 30% reduction in heat loss requirements was implemented for larger mains pressure units in 1999. Those changes have since been extended to smaller mains pressure units, with effect from October 2005. This proposal will complete the transition, also taking effect from October 2005.

Given that the remaining market segment is quite small, at 6%, the only practical options are to maintain the *status quo* or to implement the proposal. There is no significant technological or market distinction to justify an intermediate solution.

From a user perspective, the proposal will deliver net benefits of $10.1 million and a benefit/cost ratio of 2.1. The initial investment by users has a present value of $9.3 million. The assessment remains positive for reasonable variations in the underlying assumptions.

The proposal is somewhat less attractive from a national perspective. The main difference between the user and national perspective is that, allowing for the large fixed costs of electricity networks and the impact of peak demands, the tariffs paid by consumers exceed the avoidable costs of supplying electricity. Based on a conservative assessment of the avoidable costs of electricity, the net present value of the proposal is reduced to $3.2 million, and the benefit /cost ratio to 1.3.

The additional cost to government is virtually zero, since the administrative and program structures are already in place.

About 90% of the market for miscellaneous water heaters is supplied by manufacturers who are already quite comfortable with the proposed MEPS. They have developed energy efficient product and believe that it substantially complies. The remaining 10% of the market is supplied by smaller manufacturers, some of whom were not aware of the proposals. Generally, they considered that they would be able to make the appropriate adjustments, but questioned whether the effort was justified for a market that is already very small and is projected to decline further. Collectively, the upfront costs to suppliers – for redesign, testing, registration and retooling – would not be greater than $150,000.

Recommendations (draft)

It is recommended that:

1 States and Territories implement the proposed mandatory minimum energy performance standards.

2 Existing State and Territory regulations governing appliance energy labelling and MEPS be amended to implement the proposed standards.

1 The context for regulation

This regulatory impact statement (RIS) addresses a proposal to introduce mandatory minimum energy efficiency requirements of certain types of electric water heaters supplied in Australia. These are vented storage heaters (also called 'low pressure' or 'gravity fed' heaters) and the heat exchanger types of water heater. They account for a small (6%) and declining share of total sales of electric heater. They are more significant in stock terms, reflecting much higher sales in the past.

The proposal is to bring the MEPS arrangements for this minority into line with the MEPS arrangements that already apply to the mains pressure type of electric water heater, levelling the regulatory playing field for electric storage water heaters. The proposal is part of the National Appliance and Equipment Energy Efficiency Program (NAEEEP), which is an element of the National Greenhouse Strategy (NGS). This section explains the policy context.

The water heaters under consideration will sometime be referred to simply as 'miscellaneous electric water heaters'. See appendix 1 for the technical background and a description of the heaters under consideration and the proposed MEPS levels.

1.1 National Greenhouse Strategy

The Australian Government's response to concerns about the environmental, economic and social impacts of global warming was enunciated in the Prime Minister's statement of November 20, 1997, *Safeguarding the Future: Australia's Response to Climate Change.* In the statement the Prime Minister announced a package of measures to reduce Australia's greenhouse gas emissions designed to ensure Australia plays its part in the global effort to reduce greenhouse gas emissions while protecting the Australian economy.

The Prime Minister noted that the Government was seeking . . . *realistic, cost-effective reductions in key sectors where emissions are high or growing strongly, while also fairly spreading the burden of action across the economy.* He also stated that the Government is . . . *prepared to ask industry to do more than they would otherwise be prepared to do, that is, go beyond a "no regrets", minimum cost approach where this is sensible in order to achieve effective and meaningful outcomes.*

The NGS was subsequently endorsed by the Commonwealth, States and Territories as a commitment by governments to an effective national greenhouse response.

> *The Strategy maintains a comprehensive approach to tackling greenhouse issues. The range of actions it encompasses reflects the wide-ranging causes of the enhanced greenhouse effect and the pervasive nature of its potential impacts on all aspects of Australian life and the economy. (NGS 1998)*

The NGS is also the mechanism through which Australia will meet its international commitments as a party to the *United Nations Framework Convention on Climate Change*. The Australian government has announced its intention to meet an overall target by 2008-2012 of 108% of its 1990 emissions which is, in effect, a 30% reduction on the projected business-as-usual scenario that would occur in the absence of interventions.

1.2 Nationally Consistent Energy Efficiency Program

The proposed regulation is an element of the National Appliance and Equipment Energy Efficiency Program (NAEEEP). NAEEEP is part of the National Greenhouse Strategy and targets the energy efficiency of consumer appliances, industrial and commercial equipment. The main tools of the Program are mandatory energy efficiency labelling, minimum energy performance standards, and voluntary measures including endorsement labelling, training and support to promote the best available products.

NAEEEP's governance structure is as follows:

- The Program is the direct responsibility of the National Appliance and Equipment Energy Efficiency Committee (NAEEEC), which comprises officials from the Commonwealth, State and Territory government agencies, together with representatives from New Zealand, responsible for implementing product energy efficiency initiatives in those jurisdictions.
- NAEEEC reports through the Working Group for Energy Efficiency and Greenhouse Gas (E2WG) to the Ministerial Council on Energy (MCE), which is made up of the Ministers with portfolio responsibility for implementation of the National Greenhouse Strategy in this field.
- MCE has charged E2WG to manage the overall policy and budget of the national program.

NAEEEP relies on State and Territory legislation to give legal effect. In turn, this legislation invokes the relevant Australian Standards for the specific product type. In the present case, State and Territory legislation will invoke the forthcoming AS/NZS 1056 series for water heaters[1]. These arrangements are further explained in chapter 7, dealing with implementation of the proposals.

1.3 NAEEEP's policy framework

The broad policy directions of NAEEEP were reviewed in 1998-99 and again in 2000-01, with recommendations brought together in two 'Future Directions' documents (NAEEEC 1999 & 2001). The MCE subsequently endorsed certain changes, with the result that NAEEEP operates with the authority of the MCE with respect to broad policy objectives. These relate to product coverage, communication, and procedures and timetable.

Product coverage
Any type of consumer appliance, industrial or commercial equipment is eligible for inclusion in NAEEEP, provided it is identified as a likely contributor to growth in energy demand or greenhouse gas emissions. The selection criteria include potential for greenhouse or energy savings, environmental impact of the fuel type, opportunity to influence purchase, market barriers, access to testing facilities, and administrative complexity. The measures adopted by NAEEEP are subject to a community cost benefit analysis and consideration of whether the measures are generally acceptable to the community.

Communication
NAEEEP develops its product strategies through a transparent planning process, including by providing stakeholders with formal opportunities for providing comment and feedback.

Procedures and timetable
In respect of any proposal to implement MEPS, a significant initiative in recent years has been the decision by MCE to match the best MEPS level of Australia's trading partners, after taking account of differences in test methods and other relevant differences such as climate or consumer preferences. The explicit adoption of 'world's best regulatory practice' focuses attention on specific options, provides stakeholders with confidence that proposed MEPS are

[1] Part 5 of this standard, dealing with MEPS for water heaters, is currently in draft form. It is intended that the new standard will define the MEPS for all water heaters addressed in the RIS. The standard series covering electric water heaters has been substantially revised and is being published as a joint standard for the first time and may be published as a different standard number after the public consultation process.

technically feasible, and thereby avoids the long and many-sided debates that have characterised the development process in the past.

Related to that, NAEEEP uses the standards machinery that is familiar to industry. Labelling and standards requirements are implemented in Australian and New Zealand Standards, and developed in consultation with, and using the consultative machinery of, Standards Australia.

NAEEEP has also adopted a legislative timetable, designed to implement any proposed MEPS within 3 to 5 years, giving industry adequate notice of new MEPS and some certainty about the process.

1.4 Contribution of water heaters to energy use and greenhouse emissions

Water heaters account for about 30% of the energy used in the residential sector and greenhouse emissions due to water heaters at estimated at about 19 Mt CO_2-e. Electric water heaters account for about 81% of the total. However, the water heaters under consideration here contribute a small and declining share of this total.

Table 1.1 presents a very rough accounting for the energy consumption and greenhouse emissions that may be attributed to miscellaneous water heaters. Basically, it has been assumed that the existing stock of heaters is about 20 times larger than current sales and that the total number in service is contracting by a third in each decade. On these assumptions, energy use in 2010 will stand at 43.6% of its 1990 level, and the corresponding ratio for greenhouse emissions is 36.5%.

The energy used by water heaters has three components. In addition to the energy content of the hot water delivered to consumers, heat energy is lost from the pipes and from the storage tank of the heater itself. The latter 'standby' or 'standing' losses account for about 30% of total energy consumption.

TABLE 1.1 ENERGY CONSUMPTION AND GREENHOUSE EMISSIONS: 1990-2010

	Energy use		*Greenhouse emissions*		
	GWh	*% of 1990 level*	*Mt CO_2-e*	*% of total emissions*	*% of 1990 level*
	Total - standing losses, pipe losses plus delivered hot water				
1990	2,055	100.0%	2.5	0.49%	100.0%
2000	1,356	66.0%	1.5	0.28%	60.7%
2010	895	43.6%	0.9	0.16%	36.5%
	Standing losses only				
1990	617	100.0%	0.8	0.15%	100.0%
2000	407	66.0%	0.5	0.08%	60.7%
2010	269	43.6%	0.3	0.05%	36.5%

1.5 Market failure

For there to be scope for regulations to achieve cost-effective reductions in standing losses, markets must be regarded as having failed to minimise the lifecycle costs of using water heaters.

An important consideration in this context is that the lifetime value of standing losses from miscellaneous water heaters is typically greater than the installed cost of the heater, and may be up to 20% larger. Ideally, therefore, the rate of heat loss should be at least as significant a consideration as the purchase price. However, it is apparent that is not the case. There is little enquiry after lower loss water heaters, and less demand. An obvious reason is the circumstances under water heaters are replaced. There is usually some urgency about the transaction since a replacement is needed for a unit that has suddenly failed. The plumber who breaks the bad news is often the only source of advice about a suitable replacement.

Similarly, builders usually choose the water heaters that are installed in new dwellings, and they have no on-going interest in the heat losses of the unit.

Manufacturers agree that heat losses are often not a primary or even a significant consideration in the purchase of a water heater. Moreover, the cost effectiveness of regulatory measures to promote energy efficiency has been demonstrated across a range of appliances and equipment in many countries.

2 The objective

This section explains the objectives of the regulations, firstly in terms of NAEEEC's strategy for water heaters, and secondly in terms of the formal objectives against which the proposal is assessed in this RIS.

2.1 NAEEEP's strategy for water heaters

Existing measures
Mandatory MEPS currently apply to mains pressure types of water heater, for sizes up to 630 litres of 'rated delivery'. The Australian and New Zealand Minerals and Energy Council (ANZMEC) decided on these measures in 1996, and they took effect in October 1999. The MEPS levels are expressed as maximum standing heat losses in Australian Standard AS1056.1 *Storage Water Heaters: General Requirements* - Amendment 3 (5 August 1996). MEPS are given effect in each State and Territory by the same regulations that govern appliance energy labelling. The prospect of revising the MEPS levels for electric storage water heaters was first formally discussed between government and the industry in 1996, when the 1999 MEPS levels were adopted. It was agreed that the 1999 MEPS levels would not be revised before October 2004 at the earliest.

The possible inclusion of various type of miscellaneous water heaters within the MEPS program in Australia was flagged in the MEPS profile which was released for public discussion in October 2001.

It has since been decided that a further changes will take effect from 1 October 2005, but only for the smaller mains pressure units (<80 litres). This will bring the smaller units into line with the stringency that has applied to the larger units since 1999. This change is the subject of a separate RIS (GWA 2003)

Australia and New Zealand currently operate different MEPS regimes for water heaters. (New Zealand has the more stringent requirements and has obtained a temporary exemption under the Trans-Tasman Mutual Recognition Act preventing non-complying imports from Australia.) However a common water heater standing heat loss test method has been developed which, if adopted by both Standards Australia and Standards New Zealand, would enable the one test to be used to determine a model's compliance with MEPS in both Australia and New Zealand.

Proposed measures
As noted already, the measures addressed by this RIS would bring the MEPS arrangements for miscellaneous heaters into line with the measures already applying to mains pressure units. Mains pressure and miscellaneous units present much the same issues of standing heat loss, and the same solutions will be adopted. At a technical level, therefore, there is nothing to justify different requirements. The proposed change will also align more closely the type of products covered for MEPS in Australia and New Zealand (noting that New Zealand have covered low pressure units from their introduction).

Looking further into the future, the MEPS for mains pressure types of electric water heaters are currently the subject of further discussions with industry, with a view to further tightening and alignment with world best practice. Currently there are significant gaps between Australian MEPS and corresponding MEPS in New Zealand and North America. Most likely, this will further raise the bar for the miscellaneous types.

In view of the substantial and increasing greenhouse emissions due to electric boiling water heaters, NAEEEC is also working with the industry to develop a package of measures to address this issue. This includes monitoring overseas developments of MEPS levels and testing methodologies. At this stage, however, NAEEEC does not intend to introduce MEPS for electric instantaneous water heaters, heat pump water heaters and solar water heaters (noting that the latter two are mostly covered by the national scheme on renewable energy credits or RECS).

Another development has been the reconsideration of the role of energy labelling for water heaters. Mandatory energy labelling was originally rejected in favour of a MEPS-only strategy because there was little variation in energy efficiency that the labels could describe. This situation is now changing and NAEEEC considers that there is a role for industry to provide more systematic information to customers on running costs and greenhouse emissions.

NAEEEC is also looking to work with stakeholders to develop best practice information programs aimed at the plumbers who install hot water heaters, and the development of modules in existing training courses for the building trades.

2.2 Specific objectives of the proposal

The objective of the proposed regulation is to reduce Australia's greenhouse gas emissions from the use of water heaters, subject to the following constraints:

- The measures need to be cost-effective for the broad community of users.
- The measures need to be efficiently designed, minimising adverse impacts on manufacturers and suppliers, and minimising adverse impacts on product quality and function.
- The measures need to be clear and comprehensive, minimising potential for confusion or ambiguity for users and suppliers.

3 Options

NAEEEC's options for promoting the efficiency of miscellaneous water heaters are explained here, generating a shortlist of options for more detailed consideration in chapter 4.

3.1 The proposed regulation

Scope of the regulation
The proposed regulation applies to vented storage water heaters and heat exchanger water heaters *that are heated solely by electricity*, and currently falling within the scope of the following standards (as amended):

- AS1056.1-1991: *Storage water heaters - General requirements*
- AS1361-1995: *Electric heat-exchange water heaters - For domestic applications*

The relevant standards committee is developing a new regulatory standard covering both types of electric water heater. It is proposed that the new MEPS will be contained in Part 5 of the new standard – AS/NZS 1056.5: *Water Heaters – Minimum Energy Performance Standards Requirements*.[2]

The existing standards apply to unvented storage water heaters with a rated delivery in the range 25-630 litres, and to heat exchanger types with storage capacity in the range 45-710 litres. (See appendix 1 for an explanation of these measures of capacity.) The proposal is to reduce the lower bound to zero in both cases, which means that smaller heaters will not escape regulation.

The effect of restricting the proposal to units heated solely by electricity is to exclude units that are partially or wholly energised by solar panels or by combustion stoves.

Taken together, the vented and heat exchanger types account for about 6% of total sales of electric heaters. That small share is expected to decline even further. The common characteristic of the two basic types is that the stored water is not kept under pressure. This allows the storage tank to be made of copper rather than steel, and using a simpler design, making them somewhat cheaper and much more durable than mains pressure units.

The heat exchanger type nevertheless deliver hot water at mains pressure, since the cold water passes through the storage tank in a copper coil, exchanging heat with the stored water as it does so. On the other hand the heat exchange arrangement effectively reduces the amount of usable heat, which means that to deliver a certain amount of usable hot water these units need to be somewhat larger. For the same reason, heat exchanger types require more frequent reheating and cannot take full advantage of off-peak tariffs.

The heat exchanger types are more suited to warmer climates where the heat exchange requirement is reduced by the higher temperature of the cold water supply. Accordingly, Queensland is the main market for heat exchanger types. But there are also some sales into Victoria and Tasmania.

The market for the vented or low pressure type is very small, put here are 2,000 units per year, compared with annuals sales of 18,000 for heat exchanger types. Suppliers describe the market as one being for replacement units only, sold mainly into Victoria and South Australia but with some sales into Tasmania and NSW. The low cost of manufacture is more than negated by the following considerations:

[2] As noted previously, this revised series of joint standards may have a new standard number.

- More households have a pressurised water supply, either from a reticulated supply or by pump attached to the domestic water storage. Increasingly, there is less reason to make do with the low pressures obtained by gravity from storage tanks installed in the ceiling.
- Water quality is also improving in regional areas, reducing the non-corrosive advantage of copper over steel.
- The cost advantages are offset by the additional cost of installing units in the ceiling. Some roofing may have to be removed; battens and rafters may have to be cut.
- Industry contacts also blamed plumbers' advice and government policy. Plumbers are now much more familiar with the mains pressure units and are reluctant to work in the ceiling when the alternative is to install a mains pressure unit on the floor level or outdoors. Regarding policy direction, gas-fired and solar water heaters are strongly favoured by building codes and other elements of greenhouse and energy efficiency policy.

Timing of the regulation
The proposal is to implement the proposal from October 2005, coinciding with the introduction of more demanding MEPS for mains pressure units with rated delivery of less than less 80 litres. The effect will be to restore the level playing field that was initially disturbed when more stringent standards for mains pressure units took effect in 1999.

Stringency of the regulation
The proposed MEPS are tabulated in appendix 1, differentiated according to the type and size of the water heater. Relevant technical explanations are also provided there. These requirements are also summarised in figures 3.1 and 3.2. Note that, whereas the MEPS for vented storage types are defined for discrete sizes, the MEPS for heater exchange types are defined by continuous functions. (AS1361 actually defines MEPS levels for discrete sizes but the use of these discrete sizes is not required in the standard, so an equivalent continuous function was developed.)

FIGURE 3.1 MEPS FOR VENTED STORAGE (LOW PRESSURE) UNITS

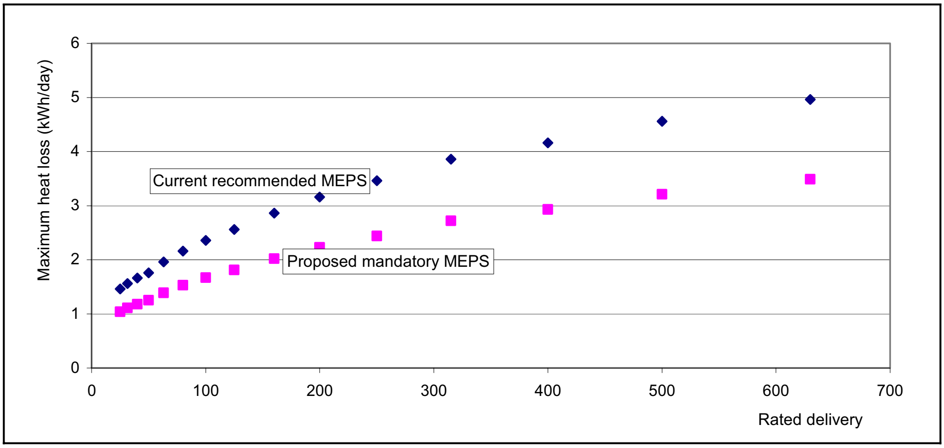
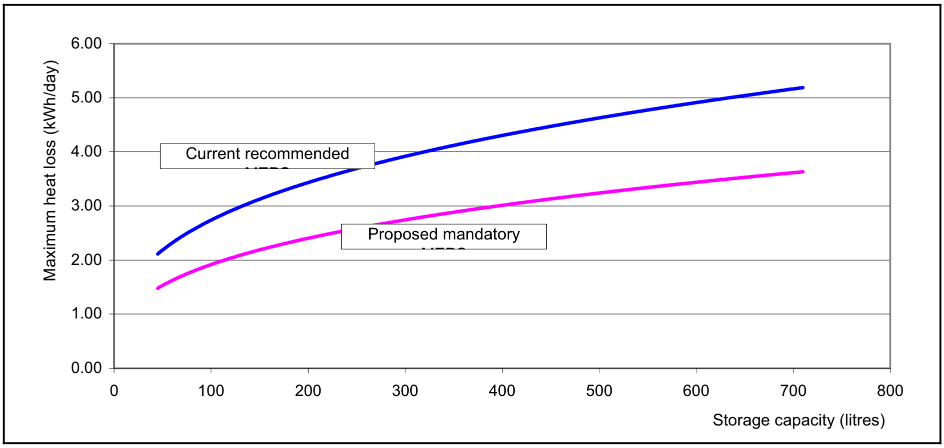


FIGURE 3.2 MEPS FOR HEAT EXCHANGER UNITS



The MEPS allow larger heat losses for larger units, but with maximum heat losses increasing less than proportionally with size. This is because the exposed external area of a heater increases less than proportionately with its volume, and it is the exposed external area that largely determines the rate of heat loss.

In both cases, the proposed mandatory requirement is to reduce the maximum standing heat loss to 30% less than the current recommended maximum.

Based on discussions with suppliers, there already exist a number of products that either comply with the proposed mandatory MEPS, or come close to doing so. However, the proportion of sales would be certainly less than 10%.

3.2 Other options

Scope of the regulation
Inclusion of partially electric heaters?
The proposal could be extended to include miscellaneous units that are only partially heated by electricity. However such a move may be counter-productive from the perspective of greenhouse policy. Solar water heaters provide the clearest example. Consider that electric boosted solar heaters typically use less than 25%[3] of the electricity used by fully electric heaters, and therefore deliver at least a 75% reduction in greenhouse emissions relative to the conventional units. However solar heaters are also quite expensive, with a market share of no more than 5%. Conceivably, the increased cost of yet more efficient solar heaters would inhibit their market penetration and put at risk the benefits already delivered.

A related argument is that solar water heaters (and some heat pump water heaters) are eligible for Renewable Energy Credits (RECS) from the Office of the Renewable Energy Regulator. RECS are assessed on the basis of the solar water heater's total performance profile and the existence of this scheme is driving manufacturers to optimise the total system performance, which include heat losses from the system, in the most cost effective fashion. Under such a regime there is only a weak argument to regulate one part of such a system (eg heat loss)

[3] The figure of 25% is implicit in a study commissioned by Environment ACT (EP 2002); actual solar contributions will vary by state and region.

separately and in addition to the total system performance under RECS. Some tanks that perform well within a solar system have higher heat losses in lower parts of the tank and appear poor under a standard heat loss test.

The financial returns to decreased heat losses are also unattractive in a solar system, a point that becomes apparent when the value of energy savings from fully electric heaters is put against the increased cost of those heaters. As reported in chapter 4, improvements in the heat loss of fully electric heaters are expected to return a benefit/cost ratio of 2.1. This ratio is reduced to 0.5 if the energy savings are reduced by 75% in the case of solar water heaters.

Similar concerns would arise if the regulation applied to storage units linked to combustion stoves and only partially heated by electricity. Based on estimates in a recent report commissioned by the AGO (Paul 2003), the burning of firewood can actually be positive for greenhouse emissions and, even at its worst, may generate emissions at 10% of the rate of equivalent electric units. To the extent that the arrangement captures waste heat that would otherwise have escaped up the flue, the energy is also free.

It may be argued that the exclusion of partially electric heaters means that the playing field is not completely level. However it needs to be understood that the regulatory objective is to deal cost-effectively with the policy issue, which is greenhouse emissions in this case. Lighter regulation is appropriate for products that present fewer opportunities to cost-effectively reduce emissions. As it happens, the case for requiring lower heat losses from partially electric heaters is weak at best. It may actually be counterproductive[4]. Accordingly, no further consideration is given to this option.

Exemptions on account of relatively few or declining sales
Suppliers have also argued the case for excluding certain products that are produced in relatively small numbers. One option is to exclude vented storage heaters, total sales of which have been put at 2,000 units/year, or about 0.3% of the total market, leaving the regulation to apply only to the heat exchanger types (18,000 units/year). Another proposition is to exclude the smallest and largest heaters, for both vented storage and heat exchanger types, leaving the regulation to apply to the mid range of heaters that dominate sales. Sales of the smallest and largest heaters might tally to several hundreds, but no more, and are spread across a number of suppliers.

Again, the key issue is cost effectiveness. On the one hand, it would generally be more difficult to recover the upfront costs of design, testing and tooling for products with small production runs and declining sales. On the other hand, there has already been a significant investment in the efficiency of 94% of the electric heaters on the market, in response to earlier regulations, and it is only the marginal cost of adapting those solutions to the remaining 6% that needs to be considered. Given that these smaller markets have the benefit of a 6 year lag behind the initial implementation of MEPS for mains pressure systems in 1999, it is reasonable to suppose there is a ready supply of exemplars and widespread industry knowledge about how best to proceed. If follows that cost effectiveness does not necessarily suffer as the remaining small markets are brought within the scope of the regulation.

A further consideration is that the ‘few sales’ criterion cannot be directly implemented. Rather, it must be approximated by excluding certain types of water heaters or certain size ranges. It is unavoidable that some small producers will find themselves on the wrong side of that dividing line, and will be treated inequitably relative to other small producers with the favoured products.

Accordingly, we consider that exclusions cannot be justified by appeals to the small size of particular markets or product lines. No further consideration is given to this option.

[4] That said, it is likely that there will be some spillover from energy standards for fully electric heaters to other heaters. Suppliers often use the same basic designs for a range of different heaters and it may prove economic to standardise the design of storage units around the new heat loss requirements

Timing of the regulation
There may be a lag of only one year between implementation of the regulation and its taking effect in October 2005. Arguably, industry should be given more time to adapt. However, it is apparent that suppliers accounting for more than 90% of the market have anticipated the proposal and are well-placed to make the adjustment. The levels for future MEPS of these products were originally flagged in a MEPS profile published in October 2001, so clearly much of industry has reacted to these initial proposals. For the most part, the industry will be catching up with MEPS that were imposed on mains pressure units in 1999, having been originally announced in 1996. No further consideration is given to this option.

Type and stringency of the regulation
A number of other options were canvassed in the earlier RIS for the smaller mains pressure types of water heater (GAW 2003). These included non-regulatory approaches – specifically, voluntary MEPS of the kind already in place, labelling, and levies on inefficient equipment and/or the consumption of electricity. Different levels of stringency were considered, ranging from a 20% reduction to a 50% reduction relative to the (then) recommended MEPS. Staged MEPS were also considered, with heat losses being reduced in a number of steps.

However, regardless of the merits or otherwise of the options considered for mains pressure types, the only practical alternative to the *status quo* for miscellaneous heaters is to align with the MEPS that have been implemented for mains pressure types. There is no significant technological or market distinction that could justify an intermediate solution.

The inclusion of low pressure units into the MEPS regime also aligns more closely – at least in terms of product type, if not MEPS level – the regulations of Australia and New Zealand, which is important under TTMRA.

Having created a level playing field in regulatory terms, it will be preserved in future by uniformly applying regulatory changes to the entire sector.

Labelling of 'high efficiency' units and the option of sales weighted compliance
Suppliers of miscellaneous water heaters have rejected AGO's offer to be included in a sales-weighted compliance scheme that is being made available to suppliers of mains pressure units. To explain, the proposed scheme for mains pressure units has the following elements:

- The Standard will contain a provision allowing suppliers to designate certain models as 'low loss' water heaters. The proposed 'low loss' level is about 20% lower than the heat loss specified under 2005 MEPS. This level is broadly equivalent to New Zealand MEPS requirements for tanks up to about 200 litres.
- Manufacturers of the 'low loss' heaters will be acknowledged as part of the Top Energy Saver Award Winner (TESAW) program. TESAW is a new award system that created by NAEEEC to recognise the most efficient products on the market and to help consumers to identify those products. It complements rather than replaces the star rating scheme, an important difference being that the minimum efficiency criteria for the awards are reviewed each year. In the case of electric water heaters, however, the criteria are likely to remain unchanged for some time as there is no comparative energy label for these products and large changes in heat loss are not expected from year to year after the implementation of MEPS.
- The emergence of a range of lower heat loss water heaters provides the context for the regulatory option of sales-weighted compliance that is being implemented only for mains pressure units with a rated delivery of 50 litres. The effect of this provision is to allow manufacturers to continue providing some non-complying (higher heat loss products that comply with 1999 MEPS levels) product for a period of 5 years after the introduction of the 2005 MEPS, provided those sales are offset by equivalent sales of 'low loss' product. The proposed requirement is that such a 'low loss' product will have to meet or exceed the TESAW criteria to be part of the sales weighted arrangement.

This provision recognises that a minority of customers would otherwise face substantial additional costs when replacing small heaters in confined spaces that were not designed to accommodate the thicker insulation and increased bulk of low loss units. It is restricted to units with rated delivery of 50 litres because that is particular size most affected by space restrictions.

That said, suppliers of miscellaneous water heaters have indicated to AGO that they are not interested in having access to this option. Based on industry advice, none of the vented storage products fall in the relevant size range (50 litres of rated hot water delivery), and only a small proportion of the heat exchanger product would do so. In the latter case, the continuous nature of the volume specifications also creates the opportunity of overcoming dimensional constraints by slightly reducing the storage volume. Given the small number of units involved, this option is more attractive than the option of engaging the TESAW program.

Given the lack of supplier interest in this option, no further consideration is given to the option of sales-weighted compliance.

3.3 Shortlist of alternative options

Accordingly, the shortlist of options contains only two items. One is to preserve the *status quo*. The other is to adopt the proposal. None of the other options is given further consideration.

4 Impacts analysis

This chapter is organised in 5 sections. The first four examine the difference between the proposed regulation and the BAU scenarios from a number of perspectives, as follows:

- Impact on energy use and greenhouse emissions – section 4.1
- Impact on users – section 4.2
- Impact on government – section 4.3
- Impact on suppliers – section 4.4

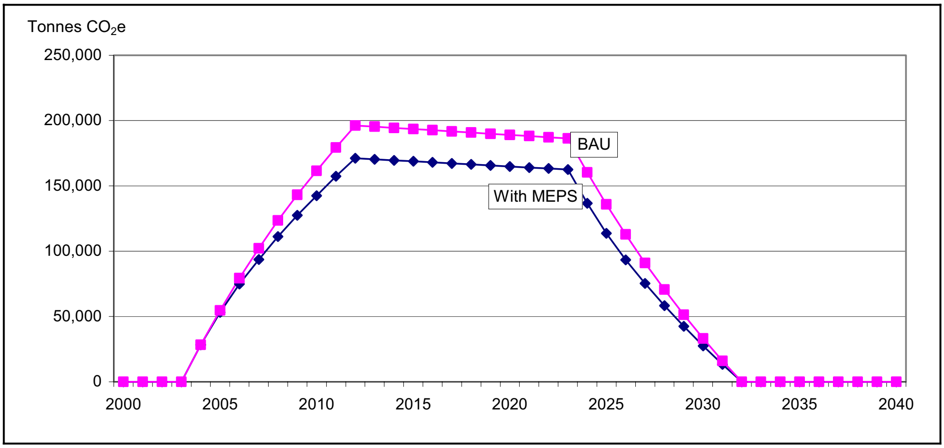
A national perspective is adopted in the final section, incorporating the results of the first four sections in a single statement.

4.1 Impact on energy use and greenhouse emissions

Figure 4.1 reports estimates of greenhouse emissions from miscellaneous water heaters that will be supplied to the domestic market in the period to 2012. The greenhouse reductions are represented by the gap between the BAU (business as usual) projection and the 'With MEPS' projection. The profile reflects the following considerations:

- 2012 is a convenient end point for examining the impact of the regulation. It is not only the final year of the first commitment period under the Kyoto Protocol, it is also reasonable to expect that MEPS for water heaters will be given fresh consideration by 2012. It is unreasonable to assume that decisions taken know would have impacts on water heaters purchased after 2012.
- It is assumed that the regulation is fully effective in 2007, but that sales of more efficient units are growing through 2005 and 2006.
- Annual savings start to fall away after 2024 as the water heaters acquired in the period to 2012 are retired and replaced.

FIGURE 4.1 PROFILES OF GREENHOUSE EMISSIONS, WITH AND WITHOUT THE MEPS: UNITS INSTALLED 2004-2012



- Figure A2.1 in appendix 2 presents the corresponding profile for energy consumption for both scenarios. The two profiles are very similar, only difference being that greenhouse emissions grow more slowly. This reflects the expectation that the greenhouse intensity of electricity generation will decline over time, mainly due to fuel switching from coal to gas and an increasing share of renewables.

The total savings of electricity and greenhouse gas are about 487 GWh and 487 ktCO_2-e respectively. At their peak in 2012, energy use and greenhouse emissions would be reduced by 15% relative to the BAU projections for the standing losses from miscellaneous heaters *supplied in the period 2004-2012*. However, the transition to more efficient water heaters would be incomplete at this stage, since currently supplied water heaters may not be finally retired until 2030 or later. The savings would continue to increase to about 25% of the projected levels if the regulation is maintained indefinitely. In the longer term, however, it is increasingly difficult to know how the regulation would differ from the normal processes of technological change and efficiency improvement.

The TESAW labelling provisions are assumed to contribute relatively little to the total energy savings, only 2%. Certainly, a minority of users buy "high efficiency" products as a matter of principle. However, a conservative estimate is appropriate in view of uncertainty about the take-up of this marketing option by suppliers to the relatively small markets that are under consideration.

4.2 Impact on users

Table 4.1 presents estimates of benefits and costs from the perspective of users. The main assumptions are as follows.

- The impact on miscellaneous heaters has been modelled in terms of 9 basic models listed in the table, comprising 4 sizes of the vented type and 5 sizes of the heater exchanger type.
- The installed cost has been estimated from industry sources.

TABLE 4.1 BENEFIT COST ANALYSIS – USER PERSPECTIVE

Size (litres)*	*Baseline sales (2003)*	*Installed cost ($)*	*Increase in installed cost ($)*	*Value of annual energy savings ($/year)*	*Lifetime value of energy savings ($)*	*Benefit/cost ratio*
			Vented type			
160	400	800	120	17	217	1.8
250	600	920	138	21	264	1.9
315	600	990	149	24	295	2.0
400	400	1,050	158	26	318	2.0
			Heat exchanger type			
70	750	630	95	23	285	3.0
140	7500	765	115	19	241	2.1
180	4500	805	121	21	262	2.2
280	4500	935	140	24	293	2.1
400	750	1,180	177	19	232	1.3
			Aggregate costs and benefits			
All	20,000		$9.3 million		$19.4 million	2.1

Note:
* The size of vented types is measured by the 'rated delivery' of the unit, whereas the size of heat exchanger types is measured by the capacity of the storage unit.

- The increase in the installed cost has been put at 15% for all units. This covers the cost of additional foam insulation, more metal for the outside case, larger cartons, increased costs of transport and storage, and increases in installation cost where the new unit does not fit easily in to the space occupied by the unit that it replaces.
- The energy savings have been estimated as the reduction in the heat losses required by the MEPS. However, the reductions that would be observed under test conditions have been discounted by 25% to allow for certain differences between test conditions and in-use conditions.
- The value of energy savings have been estimated on the assumptions that mid-sized heaters are on extended off-peak tariffs, smaller heaters are on standard tariffs, and larger heaters are on full off-peak tariffs. For heater exchanger units, the difference in tariffs largely accounts for the relatively high returns to small units and relatively low returns to the largest units.

On these assumptions, the aggregate benefits and costs are $19.4 million and $9.3 million, yielding a net present value of $10.1 million and a benefit/cost ratio of 2.1. Appendix 2 provides a more detailed explanation of the assumptions. There is one exception; the 15% estimate for the increase in installed cost is discussed here.

Increase in the installed cost of water heaters
To estimate the increase in the installed cost of lower loss water heaters, we rely on two previous studies of regulatory impacts.

Australian study
The cost issue has been addressed in a previous RIS (GWA 2001) dealing with the regulation of small (<80 litres rated delivery) water heaters of the mains pressure type. The same analysis was presented in a subsequent revision to that document (GWA 2003). The analysis is in two stages, first dealing with impacts on the retail price, then dealing with additional costs of overcoming dimensional constraints.

The findings with respect to the retail price are summarised in table 4.2, extracted from appendix 5 of the earlier document. Note the following:

- The estimates are based on analysis of a sample of 5 small heaters with rated delivery in the range 18-50 litres. The estimates in table 4.2 are averages across the five units.
- It is assumed that heat losses are reduced to the required level by increasing the thickness of foam insulation, adding to both the diameter and the height of the unit.
- The estimates allow for increased materials (more foam, more metal for the outside casing, longer fittings and larger carton), the increased cost of storage and transport, plus the capital cost retooling production lines.
- A separate estimate is provided for the increase in retail price that can be sustained after the cost of retooling has been recovered, which is assumed to happen after the first several years. These (smaller) increases are shown in the final column of table 4.2.
- A mark-up factor of 1.7 has been applied to allow for the mark-ups that would be applied at the wholesale and retail stages.
- The estimates of interest to this RIS are presented in bold, corresponding top a 30% reduction in heat losses. The estimated increase in retail prices is 12-15%. It would be somewhat less relative to the installed cost of the unit.

Additionally, installation costs are further increased where the new (larger) heater cannot be accommodated in the existing space. Either the space is enlarged or the heater is relocated. Drawing on an earlier dimensional study (NTS 1999) GWA find that that this is a significant additional cost, but affecting only a minority of heaters – specifically, and extra $350 for 2% of sales. The overall effect is to add about $7 to the average cost of installation and to add about 2% to the average retail price of a water heater.

TABLE 4.2 AUSTRALIAN ESTIMATES OF REGULATORY IMPACT ON THE RETAIL PRICE OF SMALL WATER HEATERS

% reduction in heat loss, relative to BAU	*Including retooling costs*		*% increase on BAU price, excluding retooling costs*
	Retail price ($/unit)	*% increase, relative to BAU retail price*	
20%	420.17	11.9%	9.1%
30%	**432.60**	**15.2%**	**12.5%**
40%	449.96	19.8%	17.1%
50%	475.81	26.7%	24.0%
Memo:			
BAU retail price	375.50	-	-

US study

The estimates reported in table 4.3 have been extracted from the Technical Support Document published by the USDoE (Department of Energy), which provides regulatory impact analysis of options for the regulation of residential water heaters. To quote from the document, the table shows …

> *…, for all standard sizes, the difference in total installed cost for each design option compared to the 2003 baseline for electric water heaters. Variations in total installed cost include variations in manufacturing cost, mark-up, and installed cost. An additional installation cost is added for water heaters with 3" insulation for a fraction of housing units to account for the removal and re-installation of doorjambs. This is shown in the figure for design options that include 3" insulation.* (USDoE 2000: page 9-89).

A 190 litre water heater would be regarded as average in the US.

The estimates of interest to this RIS are presented in bold. Based on discussions with industry, the general expectation is that foam insulation will need to be increased to 50-60 mm, which approximates 2-2.5 inches. In broad terms, therefore, these estimates indicate that the installed cost would increase by about 20%.

TABLE 4.3 US ESTIMATES OF REGULATORY IMPACT ON AVERAGE INSTALLED COST OF RESIDENTIAL WATER HEATERS ($US)

Design option	*Average manufacturing costs*	*Average retail price*	*Average total installed cost*	*% increase relative to baseline*
2003 baseline	114	220	385	-
Heat traps	117	227	392	1.8%
Tank bottom insulation	121	235	400	3.9%
2" insulation	**143**	**278**	**446**	**15.8%**
2.5" insulation	**155**	**300**	**486**	**26.2%**
Plastic tank	179	347	535	39.0%
3" insulation	193	375	615	59.7%

Reasons for the 15% estimate adopted here
It is important to note that both previous Australian and US studies have factored in a significant mark-up factor of about 1.7. This means that an additional manufacturing cost of $1.00 is converted into a $1.70 increase in the retail price, but without any explicit accounting for the additional resource costs that would actually be incurred by wholesalers and retailers. Certainly, there would be some additional costs of storage and transport. However, these are only part of the costs of wholesale and retail operations and, based on the explicit estimates of additional transport and storage costs incurred by the manufacturer, the mechanical application of mark-up factors yields very generous allowances for the additional costs actually incurred by wholesalers and retailers.

Also, analysis of pricing information published by Energex indicates that the difference between ‘low loss’ and standard units is approximately 10%.

For the purposes of the draft RIS, therefore, the increase in installed cost is put at 15%, which is about 25% less the figure indicated by the US study.

Sensitivity analysis
Table 4.4 presents the results of sensitivity analysis for reasonable variations in key parameters. The cost/benefit ratio remains comfortably above 1 in all cases.

With respect to the discount rate, it is worth noting that investments in low loss water heaters are extremely low risk. Hot water is a basic service and it is reasonable to expect that better insulated heaters will continue to deliver reductions in heat losses regardless of what is happening in the rest of the economy. These appliances are almost never turned off in any household. A discount rate of 5% is very reasonable in those circumstances, and rate of 10% is quite unreasonable.

TABLE 4.4 SENSITIVITY ANALYSIS – USER PERSPECTIVE

Parameter	*Variation*	*Present values ($ million)*	*Benefit/cost*

		Costs	Benefits	Net benefit	ratio
Base case		9.3	19.4	10.1	2.1
Market growth					
	-10%/year	7.0	14.5	7.5	2.1
Ratio of in-use heat losses to losses observed under test conditions					
	65%	9.3	16.8	7.5	1.8
	85%	9.3	22.0	12.6	2.4
Electricity prices					
	10% higher	9.3	21.3	12.0	2.3
	10% lower	9.3	17.4	8.1	1.9
Increase in installed cost					
	20%	12.4	19.4	7.0	1.6
	10%	6.2	16.8	10.6	2.7
Discount rate					
	0%	11.1	37.1	26.0	3.3
	10%	7.9	11.3	3.3	1.4
Asset life					
	15 years	9.3	17.0	7.7	1.8

4.3 Impact on government

The impact of the proposals on the taxpayer will be minimal. Not only is NAEEEP a relatively inexpensive program from the viewpoint of taxpayers, but the majority of these costs would be incurred under BAU conditions. Once the proposed measures have been developed and implemented, there are no additional costs that can be attributed to the proposal.

On the first point the ongoing costs of administering the MEPS initiative are of the order of $2M per year at most. This allows for the equivalent of two full-time staff members in each of the regulatory authorities of the larger states, a somewhat smaller resource commitment from the smaller states, and ongoing work by AGO staff at the national level.

On the second point, the ongoing program of registration, monitoring and check testing would be required for the purposes the existing MEPS for water heaters. The additional cost of extend the program to include the remaining 6% of the market would be less than $5,000 and can be safely ignored for the purposes of the RIS.

4.4 Impact on suppliers

A number of manufacturers were surveyed informally to identify impacts. There seem to be two broad groups.

Two manufacturers, one each from Queensland and Victoria, comprise the first group and supply about 90% of the market for miscellaneous water heaters. They are already quite comfortable with the proposed MEPS, having developed energy efficient product that they believe to be substantially compliant. They expect to make some further adjustments when subjected to laboratory tests, but there is no anxiety on that score.

The remaining 10% of the market is supplied by a number of smaller manufacturers. There are four operations in Victoria and South Australia, each making 250 – 750 units per year. In addition, industry contacts mentioned a number of even smaller suppliers that appear to be little more than backyard operations and operate from regional centres. While most of the smaller manufacturers were not aware of the proposals at the time they were interviewed for the purposes of this RIS, they considered that they would be able to make the appropriate adjustments. However they questioned whether the effort was justified for a market that is already very small and is projected to decline further.

Manufacturers are not totally reliant on the market for water heaters falling within the scope of the proposal. Some make commercial and industrial heaters to a variety of specifications, with the Victorian dairy industry being a large market. Others have developed niche markets in non-electric storage systems, for connection to solar panels and combustion stoves.

Regarding trade issues, all of the suppliers identified in the original scoping study (MEA 2001) are domestic manufacturers; none are importers. In our discussions with suppliers regarding the commercial impact of the proposal, none expressed concern about import competition or competitiveness of exports. The general impression that trade issues are not significant is reinforced by the findings the AGO's initial investigation of the market for miscellaneous heaters (MEA 2001). MEA found that … *There is little available information on the trade in electric water heater types under review, however it is estimated that the great majority are manufactured in Australia* (MEA 2001: page 24).

In discussions with manufacturers we also raised the issue of upfront costs, such as the costs of design, testing, registration and retooling. As already indicated, the larger manufacturers indicated that they had already worked through the issues and that further costs would be relatively small. Smaller manufacturers considered that their costs would be in the range $10,000 to $20,000. Given the progress that has already been made, it appears that the further upfront costs by the industry as a whole would not be greater than $150,000.

4.5 National benefits and costs

Table 4.5 presents the results of benefit/cost analysis from a national perspective, which differs from the user perspective on two matters. First the upfront cost to suppliers is included as separate costs that are not passed onto users. The second matter is more significant and relates to the avoidable cost of electricity.

To explain, the cost of electricity consists of the cost of electricity generation (including the energy lost as heat in transmission and distribution), the cost of network services (poles, wires and substations for transmission and distribution of electricity) and the market costs associated with functions such as metering, billing and advertising. These costs are recovered in the tariffs charged to users and users rightly look to the tariff schedules to determine the value of energy savings. From the perspective of the broader community, however, some of these costs are not avoidable. That is, they cannot be reduced by energy saving measures. Market costs are the obvious but relatively minor example, since market costs generally account for less than 5% of average costs.

Less obviously, the large fixed costs of providing network services means that the marginal cost of providing additional network capacity is considerably less than the average costs. Based on a recent report to the Australian Building Codes Board[5] (ABCB), the marginal network cost of a general increase in energy use might be reasonably put at about 30% of average network costs, although considerable uncertainty attaches to any such estimate. This proportion should be further reduced for appliances that contribute relatively little to peak loads. Water heaters fall into this category. By definition, any heater on an off-peak tariff contributes nothing to peak loads on electricity networks.

To a degree, these considerations are already factored into off-peak tariffs, which are up to 50% less than standard tariffs. However, a further discount may reasonably be applied. Accordingly, the estimates in table 4.5 assume that the avoidable cost of electricity used by

[5] Atech (2003), *A Financial Analysis Procedure for Energy Efficiency in Buildings*, Report to the Australian Building Codes Board

TABLE 4.5 COSTS, BENEFITS & SENSITIVITY ANALYSIS FROM A NATIONAL PERSPECTIVE

Parameter	*Variation*	*Present values ($ million)*			*Benefit/cost ratio*
		Costs	*Benefits*	*Net benefit*	
Base case		9.5	12.7	3.2	1.3
Market growth					
	-10%/year	7.1	9.5	2.4	1.3
Ratio of in-use heat losses to losses observed under test conditions					
	65%	9.5	11.0	1.5	1.2
	85%	9.5	14.4	4.9	1.5
Electricity prices					
	10% higher	9.5	14.0	4.5	1.5
	10% lower	9.5	11.4	2.0	1.2
Increase in installed cost					
	20%	12.6	12.7	0.1	1.0
	10%	6.4	11.0	4.6	1.7
Discount rate					
	0%	11.3	24.3	13.1	2.2
	10%	8.1	7.4	-0.7	0.9
Asset life					
	15 years	9.5	11.1	1.7	1.2

water heaters is only 5 cents/kWh. The net present value of the proposal is reduced to $3.2 million, and the benefit /cost ratio to 1.3.

As reported in table 4.5, the proposal becomes marginal for a discount rate of 10%. Otherwise the returns are positive for reasonable variations in key parameters.

5 Consultation

GWA (2003) provides an exhaustive chronology of previous reports and consultations, giving considerable exposure to water heaters MEPS over the last decade. The earliest reports and consultations date back to 1993. However most this work was in relation to mains pressure units. Detailed work on miscellaneous heaters has a shorter history, starting with an AGO-commissioned technical study undertaken by Energy Partners in association with Sustainable Solutions Pty Ltd and the University of New South Wales (EP et al 2000). The consultative activities undertaken since then are as follows:

May 2000	AGO publishes *Technical Study on Improving on Electric Water Heater Efficiency* (EP et al 2000), dealing with electric water heaters generally but including specific aspects of the design of low pressure and heat exchange types.
March 2001	AGO publishes *Analysis of Potential for Minimum Energy Performance Standards for Miscellaneous Water Heaters* (MEA 2001), profiling the market and identifying issues and stakeholders.
October 2001	AGO publishes *Consideration of Miscellaneous Electric Water Heaters For Minimum Energy Performance Standards* (NAEEEP 2001), outlining plans for improving the efficiency of electric water heaters not covered by existing MEPS.
2001 - 2004	Development of consolidated standards for mains pressure, vented and heat exchange water heaters, due to be finalised before the end of 2004.
March 2004	Informal industry discussions for the purposes of this RIS.
23 June 2004	Discussion and final resolution of outstanding issues with affected manufacturers and standards committee members, Melbourne.

Proposed consultations

The following further consultations are planned for 2004.

- The AGO will send out copies the draft RIS to known interested parties, advertise its availability, and hold public meetings if there is demand.
- Written comments will be received until <<…>>
- NAEEEC will determine its response to the comments and revise the final RIS as appropriate.

6 Conclusion and recommended option

Table 6.1 provides a summary statement of the two options considered in this RIS against the objectives of the proposed regulation. It is recommended that:

1. States and Territories implement the proposed mandatory minimum energy performance standards for miscellaneous electric water heaters.
2. Existing State and Territory regulations governing appliance energy labelling and MEPS be amended to implement the proposed standards for miscellaneous electric water heaters.

TABLE 6.1 ASSESSMENT SUMMARY

Objective	*BAU option*	*Proposed MEPS*
Reduction in greenhouse emissions	The outlook is for declining emissions of greenhouse gasses, reflecting the contracting market for miscellaneous types of water heaters.	Greenhouse emissions from the targeted water heaters will be reduced by about 2% in 2012, rising to 7.5% over the longer term.
Cost effective for users	Most users continue to minimise capital costs, but largely ignore the potential to reduce 'whole of life' costs by improving energy efficiency.	Total benefits exceed total costs by a significant margin. The benefit/cost ratio for most users would be in the range 2.0 – 2.4. There would be few losers because even those who use hot water sparingly cannot avoid standing losses. Only those with very low energy costs would be financially worse off.
Minimise adverse effects on manufacturers and suppliers	The business as usual scenario is for continued decline of this relatively small market.	Manufacturers accounting for at least 90% of the market seem to be well prepared for the proposed MEPS. They have already developed some energy efficient product, although they have more work to do. The remaining manufacturers say they can make the appropriate changes, but question the value of imposing these requirements on a small and declining market.
Minimise potential for confusion or ambiguity	No confusion or ambiguity	Although some suppliers were still unaware of the proposals when interviewed for this RIS, they readily understood the nature of the proposals and the required response in terms of product redesign.

7 Implementation and review

State and Territory legislation is required to give legal effect to the national scheme for mandatory energy labeling and performance standards. This creates potential for additional costs and inconvenience to industry for inconsistencies in the operations of the various regulatory agencies to create. NAEEEC published a set of administrative guidelines to minimize those risks (NAEEEC 2000). The Guidelines are not legally binding but they are intended to guide State and Territory regulatory agencies to facilitate uniform and consistent practice across the individual jurisdictions, delivering consistent outcomes for all affected products irrespective of the product or jurisdiction.

Key elements of the scheme are as follows:

- The technical details of the MEPS are contained in Australian Standards that are incorporated by reference into the State and Territory legislation. The Standards do not vary between States. The format and content of Australian Standards are also familiar to industry, as are the operations of Standards Australia.
- Changes to the technical detail in Standards are subject to transition periods that are negotiated between industry and government.
- To minimize trade barriers, State and Territory regulatory agencies support a policy of adopting international standards wherever appropriate.
- Grandfathering arrangements are adopted, allowing reasonable time for the phase out of non-complying stock.
- All States and Territories accept the registration of an appliance or equipment undertaken in another State.
- State and Territory regulatory agencies have set target time periods within which they aim to process applications.
- Proposed changes in administrative and operating practice are subject to consultation between states.
- Compliance monitoring takes the form of a program of check testing by accredited laboratories.
- Equipment is selected for check testing on the basis of risk factors rather than randomly. The risk factors are as follows:
    - history of success and failure in check tests;
    - age of models, with newer models given greater attention, reflecting the prospect of longer life in the market;
    - high volume sales;
    - claims of high efficiency;
    - complaints from third parties.
- There are several sanctions. There is a shaming option involving publication of failed brands or models in the AGO annual report. The second option is deregistration by the state authorities, subject to show cause procedures. Subsequent sale of deregistered appliances would be a criminal offence. Re-registration of models that are subject to MEPS is subject to new registration tests. The third option involves legal action by the Australian Consumer and Competition Commission but is highly unlikely.
- Standard statistical criteria are applied to deal with normal variation in the performance of equipment selected for check testing. (A sample of only one is selected initially, with a further sample of three selected if the first fails.)

- Laboratories that produce misleading test results may also be denied further registration business.
- In due course the introduction of more stringent MEPS will also be handled nationally. That is likely to be in 2012. Further increases in the stringency level at that time will be subject to the same processes of industry consultation and a RIS.
- NAEEEC holds a consultation forum each year, providing an opportunity for stakeholders to raise concerns about the operation of the Standards or the Guidelines.

The check-testing and sanctions regime is obviously critical. Currently, check-testing expenditure (on all products) is running at about $350,000 per year, and accounts for about 25% of NAEEEC's budget. The 2002 program included 160 laboratory tests, 126 tests as part of the standards development program and 34 as part of the enforcement program. There were 12 instances where the claimed energy efficiency was not supported by testing conducted at NATA accredited laboratories. State regulators subsequently deregistered six products, and negotiated acceptable outcomes including re-labelling of another four products.

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APPENDIX 1: PROPOSED MINIMUM ENERGY PERFORMANCE REQUIREMENTS

Technical background

Heat losses

The energy in a hot water storage tank can be lost in three ways. First, there is energy of the water drawn-off by the user in the form of hot water – in the shower, laundry or kitchen. Second, some energy is lost as the heated water moves along the pipe from heater to user. Third, energy also is lost through the shell and external fittings of the heater itself. The proposed measure addresses only the third form of energy loss, called standing heat loses. The heater needs to be insulated and otherwise designed to ensure that the standing heat loss that is observed over 24 hours under standard test conditions does not exceed the required maximum allowable level.

For compliance purposes, heat losses are measured under the test conditions prescribed by Australian Standard AS1056.1 *Storage Water Heaters: General Requirements*. Briefly, these test conditions are that:

- The water is the storage tank is maintained at a constant temperature of 75^{O}C over a 24 hour period.
- The temperature of the surrounding air is kept at 20^{O}C.
- The test is conducted in a space that is protected from draughts.
- The unit is isolated from the usual pipes, requiring that the inlet and outlet pipes be disconnected, plugged and lagged.

The water heater heat loss test methods for Australia and New Zealand have historically been separate, but work over several years has resulted in a joint test method which is due to be published in late 2004 or early 2005. The basic parameters are simular to the previous AS1056 requirements, but considerable work has been undertaken to improve the reproducibility of the test method through use of continuous measurements, corrections and analytical techniques.

However, the heat losses that are observed under test conditions in a laboratory are somewhat different to that that would actually occur in use. Consider that:

- The average temperature of the water in the storage tank will often be less than its maximum. This reduces the rate of heat loss, since the rate of loss varies directly with the temperature difference between storage water and surrounding air. This difference is narrowed as cold water is added after each draw-off, and endures for extended periods in heaters operating on off-peak tariffs. Since hot water rises, this means that insulation on the bottom and lower sides of the tank would be less effective in use than under test conditions.
- The temperature of the surrounding air may vary significantly from 20^{O}C. On the upside, for example, heat losses from units installed in ceiling space would be reduced by the higher temperatures in the ceiling during summer.
- Heat losses are accelerated by exposure to wind and weather, affecting units that are stalled outside the house.
- The rate of heat loss at inlets and outlets is higher in use than under test conditions, due to the high conductivity of the connecting pipe and cycling of hot water into the pipe caused by convection in some cases.

Storage configurations

Existing MEPS arrangements currently vary somewhat according to the storage configuration. The types are as follows:

- *Displacement storage units:* These are designed to hold a useful quantity of hot water that is directly heated. Cold water replaces the hot water as it is drawn off and reheating continues after the flow has ceased. There are two sub-types for regulatory purposes:

  - *Unvented displacement storage units:* These heaters are closed to the atmosphere and operate at mains pressure. These units are already subject to mandatory MEPS and are not addressed in this RIS.
  - *Vented displacement storage water heaters:* The water in these units is not at mains pressure, generally requiring that the unit be placed in ceiling and gravity-fed to the user. Otherwise a remote header tank may be installed at a high point, creating adequate pressure in a unit installed at floor level. These 'low-pressure' units are currently subject to non-mandatory or recommended MEPS and the proposal is to bring them into line with the MEPS applying to unvented units, and to make them mandatory.

- *Heat exchanger water heaters, sometimes referred to as indirect storage units:* The tank in this type of unit contains static heated water (or other fluid) and a heat exchanger, the latter usually being a coil of copper tubing. Cold water passes through the heat exchanger at mains pressure and takes heat from the stored water. The stored water is then reheated. These units are currently subject to non-mandatory or recommended MEPS and the proposal is to reduce these MEPS levels to a level that is equivalent to the MEPS applied to unvented units, and to make these MEPS mandatory.

Heating configurations
Most water heaters are both a heating device and a storage device. They are electric or gas fired, with the heat applied directly to the stored water. There are two other broad options however. The water may be heated externally, in a solar panel or combustion stove, and transferred to the tank for storage prior to use. Or a heat transfer medium may be heated externally and passed through a heater exchanger to transfer heat to the stored water. The latter are sometimes called calorifiers.

Heating methods can be used in various combinations. For example the vast majority of solar units have supplementary electric or gas heating, since solar radiation is not always adequate. Similarly, most units hooked up to a combustion stove would have supplementary (or complementary) electric, gas or solar heating.

Finally, heat pumps may be used to collect ambient energy from the latent and sensible heat of the atmosphere for transfer to the storage tank. These units can also be solar boosted, by exposing the evaporator to direct solar radiation.

Capacity of water heaters
MEPS allow larger heat losses for larger units, but with maximum heat losses increasing less than proportionally with size. This is because the exposed area of a heater increases less than proportionately with its volume, and it is the exposed area that largely determines the rate of heat loss.

The further complication is that the capacity of a storage water heater can be measured in two ways. The first is simply the storage or volumetric capacity of the tank, and is used to measure the capacity of the 'indirect storage' or 'heat exchanger' types. The second measure is the unit's 'rated hot water delivery' and is used to measure the capacity of direct storage types. This is the amount of water the heater can deliver on standby mode, before a significant (12-14°C) drop in temperature. This may be as little as two-thirds of the storage capacity for poorly designed units, rising to 95% for well designed units in the case of displacement water heaters.

The ratio of rated delivery to storage capacity would be somewhat less for heat exchanger types, reflecting the need for higher temperatures throughout the storage tank to achieve an acceptable level of heat transfer through the heat exchanger. The hot water output capacity of a heat exchanger type is very different to a displacement water heater and these types cannot be easily compared directly.

Development of Standards

Electric water heaters

The energy efficiency of electric water heaters is currently addressed by two Australian Standards, as amended since initial publication - AS1056.1-1991: *Storage water heaters - General requirements* and AS1361-1995: *Electric heat-exchange water heaters - For domestic applications.* These relate to the direct storage and indirect storage (heat exchanger) types respectively. Currently, the relevant standards committee is to working to develop a new regulatory standard for both types of electric water heater. The MEPS requirements will be contained in AS/NZS 1056.5: *Water Heaters – Minimum Energy Performance Standards Requirements*.

The values presented in the proposed revision have been increased to take account of the changed conditions in the forthcoming AS/NZS1056.1 for testing for loss of heat, primarily the addition of quick connects on the inlet and outlet. The change in the test does not constitute a technical change to the MEPS level.

Gas-fired water heaters

The design and construction of gas-fired water heaters is addressed by AS 4552-2000: *Gas water heaters.* The rate of heat loss from the storage tank is effectively governed by maximum requirements imposed on the rate of gas consumption needed to maintain the average temperature of the water at 45°C above ambient. This requirement is unchanged in current drafts of proposed revisions to this standard – see DR 04156: *Gas fired water heaters for hot water supply and or central heating.*

Solar and heat pump water heaters

The design and construction of solar and heat pump water heaters is addressed by AS/NZS 2712:2002: *Solar and heat pump water heaters - Design and construction.* It imposes no heat loss requirements on the storage tanks of such units provided there is no integral supplementary heating, that is, electric or gas booster. In the presence of integral supplementary heating, however, the requirements for maximum allowable heat loss are those contained in AS 1056.1 and AS 4552, that is, the corresponding standards for electric and gas-fired water heaters.

Combustion stove

None of the existing standards apply specifically to storage units connected to combustion stoves.

Scope of the proposed MEPS

The proposed regulation applies to unvented storage water heaters and heat exchanger water heaters *that are heated solely by electricity*, and currently falling within the scope of the following standards:

- AS1056.1-1991: *Storage water heaters - General requirements*
- AS1361-1995: *Electric heat-exchange water heaters - For domestic applications*

Existing and proposed MEPS

Vented storage water heaters.

Table A1.1 presents the MEPS schedules for vented water heaters. These values apply to water heaters with a single heating unit and may be increased by 0.2 kWh/24 hours for each additional heating unit (element). The values may also be increased by 0.3 kWh/24 hours for an attached feed tank, and by 0.2 kWh/24 hours for each temperature or temperature/pressure relief valve mounted on a hot part of the tank, but not for any valve mounted on a cold water fitting.

Heat exchanger types

The MEPS for heat exchanger types are calculated by the following equations, where V is the storage volume in litres:

Existing recommended maximum heat loss (kWh/day)	=	$.6099 \times V^{0.3261}$
Proposed mandatory maximum heat loss (kWh/day)	=	$.4269 \times V^{0.3261}$

The values from these equations apply to water heaters with a single heating unit and may be increased by 0.2 kWh/24 hours for each additional heating unit, by 0.3 kWh/24 hours for an attached feed tank, by 0.2 kWh/24 hours for an expansion relief valve and by 0.1 kWh/24 hours for each other water fitting (excluding a drain fitting). For purposes of comparison, table A1.2 shows the results of these formulas applied to the size categories that are used in the existing standard for heat exchanger types.

Table A1.1 MEPS for vented type water heaters

Rated hot water delivery (L)	*Existing recommended maximum heat loss (kWh/day)*	*Proposed mandatory maximum heat loss, from 1 October 2005 (kWh/day)*
25	1.46	1.04
31.5	1.56	1.11
40	1.66	1.18
50	1.76	1.25
63	1.96	1.39
80	2.16	1.53
100	2.36	1.67
125	2.56	1.81
160	2.86	2.02
200	3.16	2.23
250	3.46	2.44
315	3.86	2.72
400	4.16	2.93
500	4.56	3.21
630	4.96	3.49

Table A1.2 MEPS for heat exchanger type water heaters

Heat-storage volume (L)	*Existing recommended maximum heat loss (kWh/day)*	*Proposed mandatory maximum heat loss, from 1 October 2005 (kWh/day)*
45	2.11	1.48
56	2.27	1.59
71	2.45	1.71
90	2.65	1.85
112	2.84	1.99
140	3.06	2.14
180	3.32	2.32
224	3.56	2.49
280	3.83	2.68
355	4.14	2.90
450	4.47	3.13
560	4.80	3.36
710	5.19	3.63

New Zealand standards
The New Zealand MEPS levels are already more stringent than the proposals outlined in tables A1.1 and A1.2. Whereas the Australian proposal is to reduce the maximum heat loss by 30% relative to the current level, the New Zealand requirement is 40-50% lower.

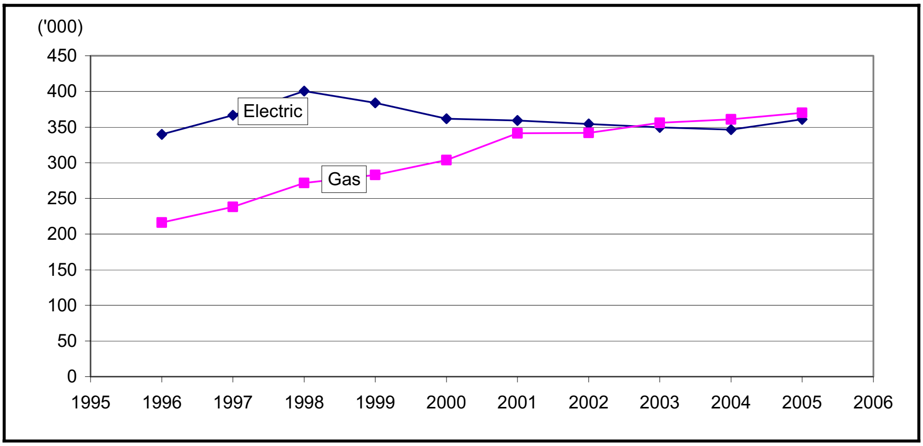
On 1 February 2003 the New Zealand government introduced a temporary exemption to the TTMRA with respect to MEPS requirements for electric storage water heaters. It intends to continue those exemption arrangements until 1 February 2005. After that date it is expected that the normal provisions of Trans Tasman Mutual Recognition Arrangement will apply (i.e. products lawfully sold in either country will be able to be sold in both countries).

APPENDIX 2: BENEFIT/COST ASSUMPTIONS

Market analysis

Figure A2.1 presents estimates of 'domestic supplies' of electric and gas water heaters, defined as domestic production plus imports minus exports. On these estimates, about 705,000 hot water heaters are sold into the residential market each year, including instantaneous heaters and solar water heaters with electric or gas boost. The long run rate of growth is about 2% per year and the general trend is for an increasing market share to gas heaters.

Figure A2.1 Household appliance market for hot water heaters



Source: BIS-Shrapnel 2003

The water heaters that are the subject of this RIS account for only a small percentage of those sales – about 3.1%. And 90% of those are of the heat exchanger type. Table A2.1 presents our baseline estimate of sales in 2003. Note the following:

- The estimates for total sales are somewhat less than those presented in a 2001 report to the AGO (MEA 2001). The main difference is for sales of vented storage heaters. These were previously put at 9,000/yr (in 1999/2000), compared with the estimate of 2,000/yr in table A2.1. Discussions with the main suppliers indicate that 2,000/yr is a maximum figure.
- The estimates of market share by size are based on discussions with the main suppliers and counts of the number of models in each size range.
- A steady sales decline has been forecast, at 5% per year. This would reduce sales to 63% of their current level in 10 years, and to 38% of their current level in 20 years. Industry contacts have cited a number of reasons for the poor outlook for sales of these heaters:
    - The market is restricted entirely to replacement sales. Virtually all new houses have access to pressurised water, if necessary by attaching a pump to the water supply, which severely restricts the market for the vented or low pressure types.
    - Plumbers receive much of the blame for the decline of sales, particularly gravity-fed units. They are familiar with the mains pressure units and tend to recommend them as a replacement. They are reluctant to work in the ceiling when the alternative is to install a mains pressure unit on the floor level or outdoors.
    - Gas-fired and solar water heaters are strongly favoured by building codes and other elements of greenhouse and energy efficiency policy.

- Some suppliers have developed high efficiency models, sales of which have been put at 10% of the total. Several forces are at work. It is partly anticipation of regulatory changes, partly a response to market demands, and partly a spillover from other markets that are more demanding, the market for solar heaters in particular. Other suppliers are still operating to old standards required by the (then) State Electricity Commissions.
- The estimates of unit costs have been obtained from industry price lists and include GST and the cost of installation. At these prices total annual expenditure is estimated at $16.8 million, $14.9 million of which is for units of the heat exchanger type. This includes installation and GST.

Table A2.2 Baseline assumptions about market size & composition - 2003

	Vented storage	*Heat exchanger*	*Total*	*Installed cost ($/unit)*
Total domestic sales - 2003	2,000	18,000	20,000	
By sector				
Residential	2,000	16,000	18,000	
Commercial	0	2,000	2,000	
By rated delivery (litres)				
160	400			800
250	600			920
315	600			990
400	400			1,050
By storage capacity (litres)				
70		750		630
140		7500		765
180		4500		805
280		4500		935
400		750		1,180
Other parameters				
Sales growth (%/year)	-5%	-5%	-5%	
Non-complying units (%)	85%	85%	85%	
Installed in the ceiling (%)	67%	0%		
Annual expenditure ($M)	1.9	14.9	16.8	

Other relevant aspects of the market are as follows:

- Queensland is the main market for heat exchanger types, but with some sales into Victoria and Tasmania. This reflects the higher temperature of the cold water supply, which reduces the demand for transfer of heat from the heated storage. They are most commonly installed outside, or under houses on high blocks, and it is generally easy to accommodate the increased bulk of more efficient heaters.
- The vented types are sold mainly into Victoria and South Australia, with some sales into Tasmania and NSW. These are usually installed in ceilings or, less commonly, outside. Very few are installed in cupboards within the house. The increased bulk of more efficient heaters can be problematic for ceiling installation, requiring some customers to make do with smaller capacity units.
- Both vented and heat exchange types tend to be somewhat cheaper than mains pressure units. They also last longer – up to 20-30 years. This is essentially because they don't have to withstand mains pressure, allowing the tank to be made of copper rather than steel and a more straightforward design.
- However, the costs of installation can be higher, at least when installed in the ceiling. Some roofing may have to be removed; battens and rafters may have to be cut.

- Heat exchanger types cannot take full advantage of off-peak tariffs, since efficient heat transfer requires relatively high temperatures to be maintained through the tank.

Energy savings and greenhouse reductions

Reduction in energy use

It is assumed that the required energy efficiencies will be achieved by adding extra insulation to the sides and top of each unit. Adding the following further assumptions, it is a simple matter to calculate the energy savings:

- Non-complying units are borderline compliant with the existing recommended MEPS.
- The non-complying units will achieve borderline compliance with the proposed mandatory MEPS.
- The test conditions approximate the actual operating conditions.

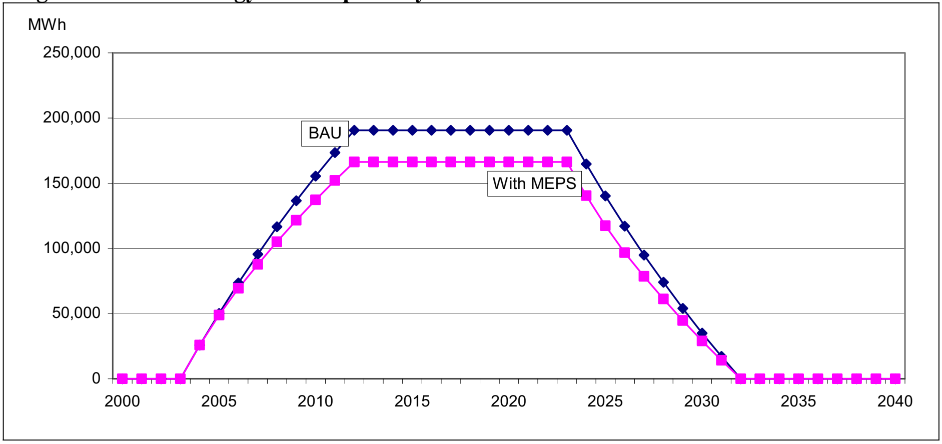
The first two of these assumptions are probably reasonable. The third assumption is problematic, however, for the reasons given in appendix 1. In particular, heat losses will be reduced for significant re-heat periods after water is drawn off, particularly in off-peak systems. This is because heat losses vary directly with the difference in temperature. Some guidance on this issue is provided by AS/NZS 1056.4:1997 *Storage water heaters - Daily energy consumption calculations for electric types.* The indicative figuring reported in Appendix A of that standard suggests that, for off-peak systems that provide heating between 11pm and 7am, in-use savings are 50-95% of the savings observed under test conditions, depending on the size of the unit, the amount of water drawn off, and the draw-off profile. For example, in-use savings are higher for the evening draw-off than for the morning draw-off. For the purposes of this RIS, in-use energy savings have therefore been put at 75% of the savings that would be observed under test conditions. This is a conservative assumption since most units are actually on extended off-peak tariff, which means that there will be some reheating during the day.

It is also recognised that some heaters operate in favourable heat loss environments - in ceiling spaces in particular. However, other heaters operate in less favourable conditions – such as exposure to wind and rain, and in cooler environments. Also, the set-point temperature of the stored water may be set higher or lower than the 75^{o}C assumed for the test, with consequent increases and decreases in the rate of heat loss. (According to industry sources, manufacturers set heat exchanger units to 80^{o}C, which would significantly increase the rate of heat loss.) For the purposes of this RIS it is assumed that these variations average out and that the test conditions are a reasonable approximation of the average conditions experienced in use.

Figure A2.1 presents the resulting profile of energy consumption by miscellaneous water heaters in the period to 2040. The energy savings are represented by the gap between the BAU (business as usual) and 'With MEPS' schedules. Note that:

- *Life of the regulation:* The figure refers the energy consumption by units purchased in the period to 2012. 2012 is a convenient end point. It is not only the final year of the first commitment period under the Kyoto Protocol, it is also reasonable to suppose that MEPS for water heaters would be given fresh consideration by 2012. It is unreasonable to assume that decisions taken know would have impacts beyond 2012.
- *Life of the water heaters:* A uniform asset life of 20 years has been assumed for all miscellaneous water heaters. This errs on the conservative side, since the industry view is that unpressurised units have a life of 25-30 years. However it is recognized that assets lives tend to be shortened by premature replacement with mains pressure units.
- *Ramp-up period:* Suppliers are assumed to achieve full compliance in 2007, with a ramp-up to full compliance in the years 2005 and 2006.

Figure A2.1 Energy consumption by miscellaneous water heaters installed 2004-2012



Dollar value of energy savings

The annual dollar value of the energy savings grows to about $1.8 million, reaching its maximum level in 2012 and maintained at that level till 2024 before tailing off. (Obviously, these savings follow the profile mapped out by the gap between the BAU and 'With MEPS' schedules in figure A2.1.) The present value of these savings, discounted at 5%/year, is $19.4 million.

Table A2.2 reports estimates of marginal tariffs that have been used in this calculation. They have been calculated with reference to the energy tariffs in the key markets (Victoria and South Australia for vented storage heaters, and Queensland for heat exchanger type), and with reference to industry estimates of the mix of standard, off-peak and extended off-peak tariffs.

Table A2.2: Marginal electricity tariffs

Retailer	*Standard domestic*	*Extended off peak*	*Off-peak*	
	Marginal tariffs(cents/kWh)			
Energex (Queensland)	11.41	7.72	5.26	
TXU (Eastern Victoria)	13.03	8.03	6.96	
Powercor (Western Victoria)	15.06	7.69	6.76	
ETSA Utilities (South Australia)	15.09	7.04		
Unit type and capacity	*Weights (%)*			*Weighted average tariff (cents/kWh)*
Vented storage units - averaged with reference to South Australian and Victorian country tariffs				
160		100%		7.59
250		100%		7.59
315		100%		7.59
400		100%		7.59
Heat exchanger units – with reference to Queensland tariffs				
70	100%	0%	0%	11.41
140	0%	100%	0%	7.72
180	0%	100%	0%	7.72
280	0%	90%	10%	7.47
400	0%	0%	100%	5.26

Greenhouse emissions
The profile of greenhouse emissions has a shape that is similar to that shown in figure A2.1for energy savings. And the units are approximately the same, since each MWh of electricity generates about 1 tonne of greenhouse gas emissions. The coefficient adopted in this RIS is a weighted average of the emissions coefficients reported by GWA in an earlier RIS for water heaters (GWA 2001: appendix 3). The emissions coefficient for Queensland has a weight of 90%, with weights of 6% and 4% assigned to Victoria and South Australia respectively.

The emissions intensity of electricity is assumed to decline at an average rate of 0.5% per year over the period of the projection, reflecting favourable changes in the mix of fuel used to generate electricity.

Increase in the installed cost of water heaters

The cost estimates are explained in section 4.2 of the report.

ENDNOTES

1 Laid before the Legislative Assembly on . . .

2 The administering agency is the Department of Mines and Energy.