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EQUIPMENT ENERGY EFFICIENCY

Equipment Energy Efficiency Gas Committee

Regulatory Impact Statement

Consultation Draft

Proposal to Introduce a
Minimum Energy Performance Standard for
Gas Water Heaters

Discussion draft for stakeholder comment issued under the auspices of the Ministerial Council on Energy

AUGUST 2008

Prepared by Syneca Consulting for DEWHA

This Regulatory Impact Statement was prepared by Syneca Consulting for the Equipment Energy Efficiency Committee. This Committee reports to the Ministerial Council on Energy, comprising the energy ministers of the Australian federal, state and territory governments, and of the New Zealand government. The Committee invites written comments on the proposal and will accept submissions until the close of business on Friday 3 October 2008.

Comment is invited on any relevant matter. But please refer to the section immediately following the Executive Summary for a consolidated list of the particular issues on which E3 requests stakeholder comment. Please be specific about any concerns that you have and, where appropriate, provide supporting argument and information.

Please address written submissions to:

Australia	New Zealand
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Melanie Slade
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Department of Environment, Water, Heritage and the Arts

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Glossary

AGA	Australian Gas Association
AGO	Australian Greenhouse Office
AS/NZS	Australian Standard/New Zealand Standard
BAU	business as usual
CfAF	Council for the Australian Federation
COAG	Council of Australian Governments
CO_2-e	carbon dioxide equivalent
CPRS	Carbon Pollution Reduction Scheme
DPMC	Department of the Prime Minister and Cabinet
EES	Energy Efficient Strategies Pty Ltd
E2WG	Energy Efficiency Working Group
E3	Equipment Energy Efficiency Program
GAMAA	Gas Appliance Manufacturers Association of Australia
GANZ	Gas Association of New Zealand
GHG	greenhouse gas
GiWH	gas instantaneous water heater
GJ	gigajoules – 10^9 joules
GsWH	gas storage water heater
GWA	George Wilkenfeld and Associates Pty Ltd
GWH	gas water heater
HWS	hot water system
IEA	International Energy Agency
kL	kilo-litre
kt	kilo-tonne
L	litres
MCE	Ministerial Council on Energy
MEA	Mark Ellis & Associates
MED	Ministry of Economic Development
MEPS	minimum energy performance standard
MMA	McLennan Magasanik Associates Pty Ltd
MoU	Memorandum of Understanding
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NETT	National Emissions Trading Taskforce
NGACs	NSW Greenhouse Abatement Certificates

NZEECS	New Zealand Energy Efficiency and Conservation Strategy
OBPR	Office of Best Practice Regulation
MJ	megajoules – 10^6 joules
Mt	megatonnes – 10^6 tonnes
NGS	National Greenhouse Strategy
PJ	petajoules - 10^{15} joules
REC	renewable energy certificate
SEAV	Sustainable Energy Authority Victoria (now Sustainability Victoria)
SEGWHAI	Super Efficient Gas Water Heating Appliance Initiative
SKM	Sinclair Knight Merz
TJ	terajoules – 10^{12} joules
TTMRA	Trans Tasman Mutual Recognition Agreement
USEPA	US Environmental Protection Agency
UNFCCC	United Nations Framework Convention on Climate Change
VHK	Van Holsteijn en Kemna – consultants to the European Commission for the Eco-Design for Water Heaters project
WPM	with proposed measures

Executive summary

This is a regulatory impact statement (RIS) proposing the introduction of common minimum energy performance standards (MEPS) in Australia and New Zealand for gas water heaters (GWH).

An initial Cost-Benefit Analysis (CBA) of the proposal was released in June 2007 (available at http://www.energyrating.gov.au/library/details200706-cba-gwh.html). It was prepared by the Equipment Energy Efficiency Committee (E3 Committee) under the Ministerial Council on Energy (MCE) of the Australian federal, state and territory governments and the New Zealand Government. Stakeholder submissions called for changes to that proposal. This RIS, taking account of those stakeholder submissions, provides an assessment of the revised proposal.

Proposal
The proposal is to adopt one of several options to significantly increase the MEPS, referred to hereafter as options 1A, 1B and 2. E3 does not express a preference for a particular option at this stage and will formulate its recommendation in the light of stakeholder responses to this consultation RIS.

The options are expressed in terms of energy rating stars. Each additional star denotes a 7% reduction in energy consumption relative to a baseline GWH on 1 star. This means that, for example, a 3-star GWH uses 14% less energy than a 1-star GWH, with 3 stars and 1 star corresponding to annual energy consumption of 24,854 MJ and 28,900 MJ respectively. The reductions for 5 stars and 7 stars are 28% and 42%, corresponding to 20,808 MJ/year and 16,762 MJ/year respectively. However, the scale is considerably out of date. For practical purposes the least efficient GWH on the market have 3 stars.

Option 1A is to impose MEPS with the practical effect of excluding GWH with energy ratings of less than 5 stars (20,808 MJ/year). It is proposed that the measure be implemented by prohibiting the import and manufacture of such appliances from October 2009, and that compliance be determined by a regulatory standard containing methods of test for energy efficiency to replace parts of Australian Standard AS 4552, *Gas fired water heaters for hot water supply and/or central heating.* Other key aspects of the proposal are:

- transitional arrangements that allow for the continued sale of GWH that have been rated at 5 stars under the existing standard;
- recalibration of the mandatory labelling requirements to better reflect the current and prospective range of GWH energy efficiency; and

Option 1B differs from option 1A in respect to timing and transitional arrangements. The measure would be deferred to December 2010 and the transitional arrangements for existing products would be discarded. The undertaking on future increases in MEPS would still cease at October 2013. Option 1B is a relatively minor variation on Option 1A and, for the purposes of this summary, Option 1 is equated with Option 1A.

Option 2 is quite different, imposing MEPS at 4 stars (22,831 MJ/year) from October 2009 and at 7 stars (16,762 MJ/year) not earlier than April 2013. This phrasing recognises that there is uncertainty about when 7-star MEPS will be economically feasible. E3 has included this option in the consultation RIS to test the proposition that further development of the 5-star market is a technological 'dead end' – in terms of both energy efficiency and greenhouse abatement – and that industry's product development resources are better directed at the next generation of gas water heating technology, which is at the 7-star level. Option 2 would be an acceptable to E3 if the rollout of 7 stars GWH can be achieved in an

acceptable timeframe and does not involve large sacrifices of energy efficiency over an extended intervening period.

The proposal applies only to a sub-set of products that are designed for residential and small commercial applications. Specifically excluded are products that fall outside the scope of the existing gas labelling requirements or are primarily designed for use in caravans, mobile homes and recreational vehicles. These products will be considered for later inclusion in the MEPS regime.

Gas storage water heaters that are installed internally have also been excluded, pending further consideration of the availability of affordable replacements that are significantly more energy efficient than existing products. These types of water heater will not be included in the MEPS program before October 2010.

The problem addressed by the regulation

The proposal is an element of the Equipment Energy Efficiency Program (known as E3), which is an element in the climate change strategies of both Australia and New Zealand. The program is jointly managed and funded by the Australian Commonwealth, state and territory governments and the New Zealand Government.

Based on the modelling undertaken for this RIS, Australia's greenhouse emissions from GWH will increase by 71% from 1990 to 2010, which is the mid-year of the first commitment period under the Kyoto protocol (2008-2012). Emissions will increase by a further 16% in the decade to 2020. The Australian Government is committed to meeting its Kyoto target for the nation as a whole, which is to limit emissions growth to 8% in the period 1990 to 2010.

Australia's total greenhouse emissions in 2010 are projected to be 603 Mt CO_2-e. Emissions from GWH will contribute 0.83% of that amount.

Under BAU conditions, New Zealand's greenhouse emissions from gas water heaters are expected to increase by 114% in the decade to 2010, and by a further 26% in the decade to 2020. Emissions are estimated to reach 0.42 Mt CO_2-e in 2010, which is 0.5% of the forecast for total New Zealand emissions in 2010. New Zealand has ratified the Kyoto Protocol and is committed to reducing its average net emissions of greenhouse gases over 2008-2012 to 1990 levels or to take responsibility for the difference.

There are significant information failures in the market for energy efficient GWH. Energy accounts for about 74%[1] of the life-cycle costs of heater operation, but households need to perform a reasonably sophisticated calculation to understand its significance and determine the value of higher efficiency, involving estimates of energy use, energy prices, asset lives and discount rates. There are also significant impediments to gathering the required information. Replacement heaters are often purchased in circumstances where the existing heater has failed and the household is without hot water; the heater may be purchased on the user's behalf by a builder or landlord who is concerned only to minimise the capital cost; and, unlike whitegoods, consumers can seldom inspect water heaters and their energy labels on the shop floor.

Market research commissioned by the E3 Program has reported that the gas labelling regime is ineffective, particularly in comparison with its counterpart for electrical goods, which is the widely recognised Energy Label.

The objective

The objective of the proposed MEPS is to contribute to cost-effective greenhouse abatement in Australia and New Zealand. Abatement measures that do not increase the life-cycle cost of appliances are considered to be cost-effective. This means that the value

[1] The details of this calculation are provided on page 15 of the RIS.

of the energy savings is not less than the incremental purchase price of a more efficient appliance.

MCE has determined that it will also consider greenhouse abatement measures that have a net financial cost to Australians and New Zealanders, provided the net cost (per tonne of CO_2-e) is not higher than the cost of abatement achieved by other programs. In the present case, however, the abatement is delivered at negative cost and the issue of willingness to pay positive costs does not arise.

The measures need to be efficiently designed, minimising adverse impacts on suppliers and on product quality and function. The measures also need to be clear and comprehensive, minimising potential for confusion or ambiguity for users and suppliers.

Policy alternatives

Alternative policy approaches have been assessed as follows:

- Information and education programs can complement MEPS but are not an effective substitute. Labelling is the strongest instrument but is largely invisible to consumers in the case of water heaters.
- A national greenhouse emissions trading scheme will be introduced during the life of the regulation, putting a price on greenhouse gas emissions. However, the Prime Ministerial Task Group on Emissions Trading argued the case for complementary measures, including efficiency regulations. The National Emissions Trading Taskforce, which reports to the Premiers and Chief Ministers of all Australian states and territories, had previously come to the same conclusion.
- There is no realistic prospect that other regulatory forms – such as self-regulation or regulation by industry bodies – will be effective. Experience teaches that suppliers engage most effectively with the E3 Program when there is the prospect of regulation by 'black letter' law.

Expected greenhouse abatement

Figure 1 provides scenarios for greenhouse emissions with and without the proposed measures. These indicate that, if Option 2 proved feasible, it would contribute much more to greenhouse abatement than Option 1, and deliver significant reductions in emissions growth in the period 2010 to 2020.

Regardless of figure 1, it should be noted that there is nothing in Option 1 that would prevent the introduction of more demanding MEPS in the future. The real difference between the options is that Option 2 includes a commitment to MEPS at 7 stars at the earliest possible date. Also note that:

- Option 1 makes a negligible contribution to greenhouse abatement in New Zealand, to the point where it cannot be distinguished on the scale used in figure 1. This is because the New Zealand market is dominated by the instantaneous type of GWH and almost all have energy ratings of at least 5 stars. In contrast, the storage type of GWH has a significant share of the Australian market, including units with less than 5 stars. Emissions will increase significantly despite the high levels of average efficiency, because GWH penetration of the New Zealand market is increasing.
- The analysis period was extended to 2025 for Option 2, allowing sufficient time for the second stage of the proposal to work its way through the stock of water heaters.

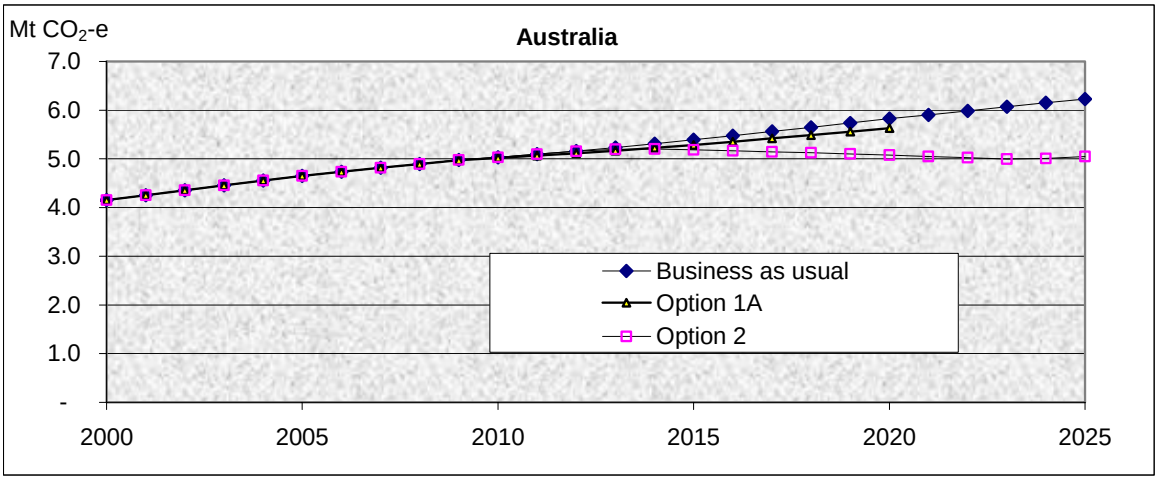
The key impact indicators are as follows:

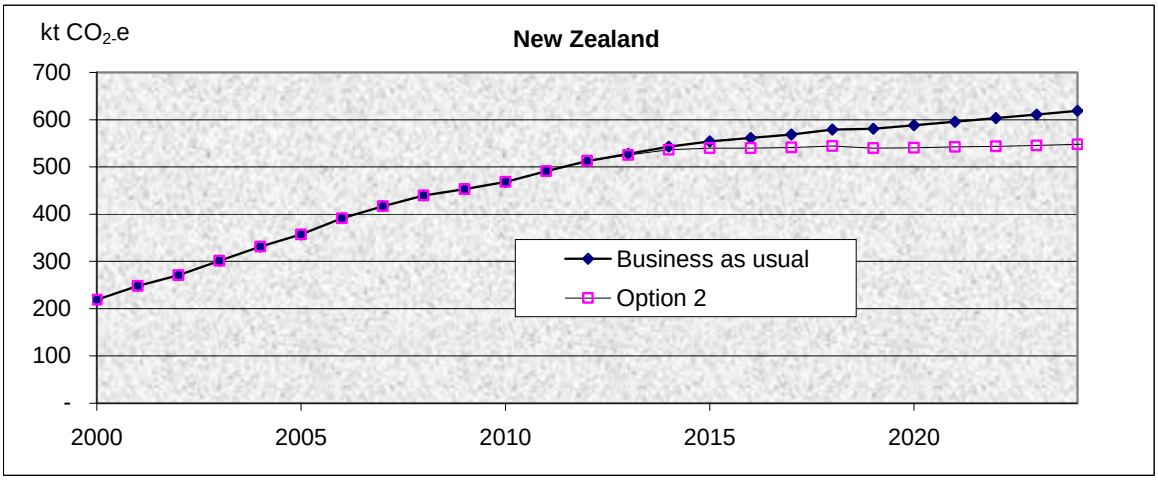
- Australia, Option 1: A total of 0. 83 million GWH would be upgraded to 5 stars in the period from 2009 to 2020. Emissions increase by 12.1%, compared with an increase of 15.7% under business as usual (BAU) conditions. The cumulative contribution to greenhouse abatement, over the life of the units that are affected by

the measures, is 2.3 Mt CO_2-e. This is equivalent to about 0.4% of Australia's total annual emissions at the present time.

- New Zealand, Option 1: A total of 1,400 GWH would be upgraded to 5 stars, contributing 3,115 tonnes of CO_2-e to greenhouse abatement over the life of the units that are affected by the measures.
- Australia, Option 2: A total of 4.4 million GWH would be upgraded if Option 2 proved feasible, including 3.8 million that would be upgraded to 7 stars. Emissions are held to zero growth over the period to 2025, compared with growth of 23.7% under BAU conditions. The cumulative contribution to greenhouse abatement is 13.7 Mt CO_2-e, equivalent to about 2.3% of annual emissions at the present time.
- New Zealand, Option 2: A total of 444,000 GWH would be upgraded if Option 2 proved feasible, mostly to 7 stars, contributing 1.0 Mt CO_2-e to greenhouse abatement over the life of the units that are affected by the measures.

FIGURE 1 GREENHOUSE EMISSIONS SCENARIOS





Expected financial impacts

Table 1 presents a summary statement of the financial impacts, with an analytical time frame to 2020 for Option 1 and to 2025 for Option 2. The analysis conservatively assumes that the unit value of gas remains constant, excluding the impact of emissions trading on the value of the gas that is saved.

It is important to understand that table 1 reports a substantive analysis for Option 1 but that the analysis of Option 2 is solely for the purposes of indicating the potential impact of Option 2 in the event that considerable uncertainties can be resolved favourably.

TABLE 1 SUMMARY STATEMENT OF COST BENEFIT ANALYSIS

	Australia			*New Zealand*		
	units	*Option 1 – to 2020*	*Option 2 – to 2025*	*units*	*Option 1 – to 2020*	*Option 2 – to 2025*
Number of upgraded GWH	million	0.83	4.44	number	1,400	444,246
Energy use	PJ	-34.3	-204	GJ	-51,914	-16,417,272
Greenhouse abatement	Mt CO_2-e	2.31	13.71	tonnes CO_2-e	3,115	985,036
Undiscounted dollar amounts						
cost to the taxpayer	$mA	0.41	0.61		50.0	50.0
business compliance costs	$mA	0.77	1.57	$kNZ	0.0	0.0
incremental cost of heaters	$mA	130.4	1,917	$kNZ	315.0	166,578
household expenditure on energy	$mA	-474.8	-2,827	$kNZ	-1,368.5	-432,778
Present values						
cost to the taxpayer	$mA	0.37	0.51		50.0	50.0
business compliance costs	$mA	0.65	1.40	$kNZ	0.0	0.0
incremental cost of heaters	$mA	80	897	$kNZ	263.2	58,962.0
household expenditure on energy	$mA	-204	-895	$kNZ	-826.4	-91,785.3
Investment criteria						
total benefits	$mA	204	895	$kNZ	826.4	91,785.3
total costs	$mA	81	899	$kNZ	313.2	59,012.0
Net present value	$mA	124	-4	$kNZ	513.1	32,773.3
benefit/cost ratio		2.5	1.0		2.6	1.6

Regarding Option 1, the key findings are that:

- Option 1 is beneficial for Australia, with net benefits of $A124 million and a benefit-cost ratio of 2.5. The cost benefit ratio exceeds 1.9 for reasonable variations in assumptions.
- The financial impact on New Zealand is small but positive. It is the sum of two small amounts associated with storage and instantaneous heaters that are installed externally, with a combined net present value about $NZ513,100. The exclusion of internally installed storage water heaters has altered the impact assessment for New Zealand, but it would still have been relatively small.

Regarding Option 2, the first stage is for MEPS at 4 stars and is essentially a weaker version of Option 1. It is confidently assessed as financially beneficial but, allowing for the difference in analytical time frames, the first stage delivers less than half the greenhouse abatement of Option 1. In contrast, the second stage of Option 2 (MEPS at 7 stars from 2013) presents a major analytical challenge. The main problem is that there is no such product now on the market, allowing the incremental installed costs of 7-star units to be estimated with reasonable certainty.

What is known about GWH with 7 stars can be briefly stated:

- The achievement of 7-star energy ratings seems to require the application of gas condensing technology, which is essentially a means of extracting much more energy from flue gases, including the latent heat of water vapour as it condenses to liquid form.
- Gas condensing technology has been applied to commercial applications and the smaller of these units are now being installed in some large homes throughout North America. These units are expensive but are currently produced on a small scale when compared to the potential domestic market.

- The SEGWHAI[2] project in the US has published a draft report with indicative estimates of the incremental installed costs of condensing and 'near-condensing' GWH of the storage type, but does not consider situations where there are likely to be significant costs associated with the increased size of the units or in obtaining access to electrical services and drainage. (Drainage is required to dispose of the condensate.) The SEGWHAI analysis appears not to have been endorsed by US manufacturers.
- The SEGWHAI analysis returns incremental benefit cost ratios of less than 1.0 – down to 0.6 for some segments – under plausible assumptions for Australian conditions, that is, using Australian prices for energy and the baseline installed cost of conventional GWH, and a discount rate of 7.5%.

Accordingly, table 1 provides an assessment that indicates the potential of Option 2 on the assumption that it is feasible, over the five years to April 2013, to reduce the incremental installed cost of GWH with 7 stars to the point where Option 2 'breaks even', that is, returns a benefit cost ratio of 1.0. To be explicit, the benefit cost ratio of 1.0 is assumed for the purposes of table 1.

E3 recognises the potential in Option 2 and is aware of concerns that further development of 5-star products, under Option 1, is a technological 'dead end'. However, the uncertainties are such that E3 can neither justify nor credibly undertake further analysis at this stage. E3 cannot make further progress without significant input from industry and, to justify that work, there would need to be broad agreement and convincing argument from industry that Option 2 can break even and it does not require inefficient products to remain on the market for an extended intervening period.

E3 is prepared to facilitate the consideration of complementary policy action in support of Option 2, addressing matters such as water efficiency and the sizing of water heaters. It is assumed that any reduction in the hot water load and the size of water heaters will mitigate the problems associated with replacing existing hot water heaters that are more efficient but also tend to be more bulky.

Response to earlier stakeholder feedback on the cost benefit analysis
The regulatory proposal that was assessed in the CBA was for a single stage of MEPS at 5 stars, very similar to the Option 1 proposal. Ten written submissions were received in response to the CBA. They raised a number of issues and this RIS provides a detailed summary, including the response by the E3 Program. The main elements of that response have been to:

- exclude internally installed gas storage water heaters from the proposal and give undertakings that (a) the inclusion of these units will be subject to further analysis of the appropriate MEPS, and (b) they will not be included before October 2010;
- relax the timing somewhat, allowing extended access to the certification procedures of the existing standards, but still at the 5-star level;
- abandon a proposed intermediate step at 4.5 stars and go directly to 5 stars;
- more clearly explain some elements of the impact assessment, particularly the estimates of future sales of gas water heaters with less than 5 stars; and
- adjust the sensitivity analysis to deal adequately with supplier criticism of baseline assumptions on which the assessment depends.

[2] The Super Efficient Gas Water Heating Appliance Initiative (SEGWHAI) aims to develop and implement the next generation of cost-effective, high-efficiency, replacement GsWH, for residential applications in the US. The early work done by SEGWHAI has been funded by the California Energy Commission's Public Interest Research Program. It seems that SEGWHAI's main output to date is a report on the market development activities that would be needed to extend high efficiency technologies into the residential market, including energy efficiency criteria (Valley Energy Efficiency Corporation 2007).

The major outstanding issue is an assertion by Rheem Australia that the measures will accelerate the transition from storage to instantaneous heaters, with adverse impacts for water efficiency, Australian manufacturing jobs and the further development of water heating technologies involving storage, including solar water heaters. E3 has put counter arguments, citing the opportunity to rationalise production of storage heaters around 5-star products and the additional costs of installing instantaneous GWH as replacements where the gas supply is not adequate. We note that other suppliers of GsWH have not expressed the same concerns and that concerns about job losses are significantly moderated by the very low levels of unemployment at the present time.

Rheem Australia maintained their position in subsequent meetings and correspondence with E3. Option 2 was subsequently formulated.

E3 emphasises that its primary concern is greenhouse abatement and that the relative merits of options 1 and 2 will first be decided in terms of cost effective reductions in greenhouse emission. If option 2 is found to be inferior from that perspective, issues of industry development and industry restructuring may then be considered. To inform possible further consideration along those lines, a request for more detailed information on industry structure will be dispatched to relevant suppliers at the same time as this consultation RIS.

The issue of water efficiency has been taken up by the Water Efficiency Labelling and Standards (WELS) Scheme. WELS found there was insufficient data to assess the issue and has commissioned laboratory tests on a selection of instantaneous GWH.

Suppliers should review E3's response to their comments on the CBA, for example, in relation to:

- the outlook for sales of GWH with less than 5 stars;
- the exclusion of internal gas storage water heaters from the proposal, at least until October 2010;
- reform of the labelling scheme and the extension of mandatory labelling to New Zealand;
- technical feasibility of the proposed measures;
- contribution to cost-effective greenhouse abatement;
- costs and benefits of the proposal.

Matters requiring further stakeholder comment
This consultation RIS will provide a further opportunity for stakeholders to provide feedback. See the section immediately following the Executive Summary for a consolidated list of the particular issues on which E3 requests stakeholder comment.

Draft recommendations
E3 recommends that further consideration of the options be restricted to Options 1 and 2, and will determine its final recommendation in the light of responses to this consultation RIS.

Regarding the choice between Options 1A and 1B, E3 will determine its final recommendation in the light of responses to this consultation RIS.

Request for stakeholder comment

Stakeholders are invited to comment on any aspect of the RIS. E3 specifically asks for feedback on the following matters.

Chapter 1 - the problem

1. The outlook for sales of gas water heaters with less than 5 stars – section 1.3 for Australia and section 1.4 for New Zealand
2. Impediments to energy efficiency in the market for gas water heaters – section 1.6
    a. Is this an accurate description of the impediments?
    b. Are these impediments sufficient grounds for government intervention?

Chapter 3 – the options

3. Description of the proposed regulation – section 3.2
4. Exclusion of certain types of gas water heater from the proposal, particularly internal gas storage water heaters – section 3.2.5
5. Shortlist of options for detailed analysis – section 3.4
    a. Should any of these options be deleted from the shortlist, for example, on grounds of technical or economic feasibility?
    b. Is the implementation schedule realistic?
    c. Should any other options be included in the shortlist? What are the advantages and disadvantages of:
        i. voluntary approaches to achieving the Government's objectives, eg. voluntary standards
        ii. a 'labelling only' scheme to achieving the objectives, involving reform of the labelling arrangements but no MEPS
        iii. alternative timing and level of MEPS
6. Usefulness and desirability of MEPS alongside an emissions trading scheme.

Chapters 4 & 6 – impact analysis for options 1A and 1B (Australia, chapter 4 – New Zealand, Chapter 6)

7. Estimates of the 'red tape' costs incurred by suppliers of gas hot water heaters – section 4.3, Australia – section 6.2, New Zealand
8. Impact on domestic production – section 4.4, Australia (domestic production in New Zealand is not affected by the proposal)
9. Consumer costs and benefits – section 5.4, Australia – section 6.2, New Zealand
    a. Are the estimates of energy saving reasonable?
    b. At the estimates of incremental equipment costs reasonable?
    c. Is the sensitivity analysis comprehensive?

Chapters 5 & 7 – impact analysis for option 2 (Australia, chapter 5 – New Zealand, Chapter 7)

The consultation RIS does not provide more than an indicative analysis of the costs and benefits of going to 7 stars in 2013, which is not a strong basis for regulation. For E3 to

take the analysis further there would need to be strong stakeholder support and a basis for making credible estimates of costs and benefits. You may wish to comment on:

10. Technical and economic feasibility of 7 star MEPS. We understand that gas condensing technology can achieve 7 stars and we know that broader use of gas condensing technology is being actively considered overseas. But we also recognise that there is uncertainty about when it will be economically feasible to introduce gas condensing technology to the broader domestic market. It has been indicated to us that 'five years' is a reasonable timeframe to develop 7-star products for the Australian market and that the industry's product development budget would be better spent if focused on gas condensing technology over the medium term, rather than on the development of the 5-6 star (near condensing) technology in the shorter term.
11. The reasonableness or otherwise of the five-year timeframe, to April 2013. Note that the proposal is for introduction of 7-star MEPS no earlier than April 2013. This anticipates the possibility of some slippage but in the expectation that the degree of slippage would be minor.
12. Markets where 7-star performance is not likely to be feasible
13. Risk of restricted supplier access to 7-star technology and reduced competition between suppliers
14. Policy options that would mitigate some of the cost issues that would be raised by MEPS at 7 stars.

1 The problem

This Consultation Regulatory Impact Statement (RIS) assesses the benefits of a proposal by the Equipment Energy Efficiency (E3) Committee to mandate minimum energy performance standards (MEPS) for gas water heaters (GWH). A RIS is required whenever new or more stringent mandatory measures are proposed by government. Under guidelines agreed by all Australian jurisdictions and New Zealand, product regulation is undertaken only where the benefits outweigh the costs to the community. In this case, the cost of improving the energy efficiency of GWH needs to be outweighed by the energy and greenhouse gas emissions savings over the life of these appliances.

This document includes E3's responses to stakeholder comment on the cost benefit analysis that E3 published on 25 June 2007.[3] The submissions and responses are summarised in section 8. See the section immediately following the Executive Summary for a consolidated list of the particular issues on which E3 requests stakeholder comment.

1.1 Energy efficiency policy in Australia and New Zealand

This regulatory proposal cannot be assessed in isolation; it forms part of a co-ordinated response by governments to undertaking regulatory measures for any energy-using product that are cost-effective and meet agreed environmental and energy goals.

Australia
Australia's greenhouse abatement and climate change policies have evolved consistently for more than 15 years, since the release of the National Greenhouse Response Strategy in 1992. The paper received overall bi-partisan support, including for national energy efficiency measures. Appendix A records some of the more important stages in that development.

In May 2007, the Prime Minister's Task Group released its report on the introduction of an Australian emissions trading scheme (ETS), which endorsed the support of complementary measures as a means to address market failures where an Emissions Trading Scheme was not effective:

> *Beyond information-based policies, energy efficiency policies could target areas where market barriers are likely to be more fundamental and enduring. This is likely to be in areas where consumers make infrequent decisions and where it is difficult to judge the energy and emissions implications. There is a good case for continuing the development of well-designed and consistent regulated minimum energy standards for buildings and households appliances. Purchase of energy-efficient products can have a large impact on aggregate emissions over time, and reduce the impact on household budgets of any rise in carbon prices.* (DPMC 2007 pp135)

Similarly in July 2007, the Prime Minister released *Australia's Climate Change Policy – our economy, our environment, our future*. The policy reasserted that energy efficiency regulation remains a key element of cost effective greenhouse abatement:

> *Energy efficiency is an important way to reduce greenhouse gas emissions cheaply. Demand for electricity in Australia is expected to more than double by 2050. Improvements in energy efficiency have the potential to lower that projected growth, and avoid greenhouse gas emissions. They can also deliver a net financial gain for firms and consumers. … The MEPS programme is one of the main success stories of the National Framework for Energy Efficiency (NFEE). The NFEE was developed*

[3] Available at http://www.energyrating.gov.au/library/details200706-cba-gwh.html

> *cooperatively across jurisdictions and covers a range of policy measures, designed to overcome market barriers to energy efficiency.* (pp 16-17)

Most recently, on 11 March 2008, Australia's ratification of the Kyoto Protocol was officially recognised by the United Nations Framework Convention on Climate Change (UNCCC). Under Kyoto, Australia is obliged to limit its greenhouse gas emissions in 2008-2012 to 108 per cent of 1990 emission levels. The Australian Government has also released a report demonstrating how Australia intends to measure the reductions in emissions required under Kyoto titled Australia's Initial Report under the Kyoto Protocol.

New Zealand's response to climate change

New Zealand energy efficiency policies have a similar history of long-term support by government. New Zealand ratified the Kyoto Protocol in 2002, and has committed to reducing its greenhouse gas emissions back to 1990 levels, on average, over the period 2008 to 2012 (or to take responsibility for any emissions above this level if it cannot meet this target). The introduction of minimum energy performance standards for household appliances continues to form part of New Zealand's climate change strategy, as part of implementing the New Zealand Energy Efficiency and Conservation Strategy (NZEECS).

The NZEECS was released in October 2007 (New Zealand Government 2007a) and proposes ways to promote energy efficiency, energy conservation and the use of renewable sources of energy. It includes measures to reduce electricity demand, deal with energy use in transport, buildings and industry, and promote greater consideration of sustainable energy in the development of land, settlements and energy production. The strategy is available at http://www.eeca.govt.nz/eeca-library/eeca-reports/neecs/report/nzeecs-07.pdf

The NZEECS has been developed within the framework of the New Zealand Energy Strategy (New Zealand Government 2007b). The NZEECS is a key part of the government's response to meeting its energy, climate change, sustainability and economic transformation goals.

The MCE moves beyond 'No Regrets' energy efficiency measures

In October 2006, the Ministerial Council on Energy (MCE) of Australian federal, state and territory and New Zealand energy ministers agreed to new criteria for assessing new energy efficiency measures. The MCE replaced its previous 'no regrets' test (that a measure have private benefits excluding environmental benefits which are greater than its costs) with the criteria that the MCE would consider …*new energy efficiency measures which deliver net public benefits, including low-cost greenhouse abatement measures that do not exceed the cost of alternate measures being undertaken across the economy*.

This policy means the MCE will consider new regulatory measures that may have net up-front costs but have greater private economic and greenhouse benefits over the long term. The policy is based on the principle that prudent investment now may avoid more costly intervention later. This bipartisan agreement demonstrates the continuing commitment of all participating jurisdictions to using regulatory measures that deliver effective, measurable abatement.

International Energy Agency (IEA) sees improving energy efficiency as top priority

Australian and New Zealand policy is in accord with international endeavours in this field.

> *The IEA estimates that under current policies, global emissions will increase 50% by 2030 and more than double by 2050. However, if we act now, this unsustainable and dangerous pattern can be curbed. IEA findings show that emissions could be returned to current levels by 2050 and even reduced thereafter, while an ever-growing demand for energy services, notably in developing countries, can be fully satisfied. Improving energy efficiency in the major consuming sectors – buildings and appliances, transport and industry – must be the top priority. While alleviating the threat of climate change this would also improve energy security and have*

> *benefits for economic growth.* – Claude Mandil, Executive Director, IEA, Paris, February 2007.

Australian and New Zealand policies are at the forefront of international work to improve the energy efficiency of globally traded equipment, which lower trading costs while still delivering environmental and economic benefits.

Equipment Energy Efficiency Program

In Australia, regulatory intervention in the market for energy-using products was first introduced with mandatory appliance energy labelling by the NSW and Victorian Governments in 1986. Between 1986 and 1999 most state and territory governments introduced legislation to make energy labelling mandatory, and agreed to co-ordinate labelling and minimum energy performance standards (MEPS) decision-making through the MCE. New Zealand has participated in monitoring the Australian program for more than a decade and has been a partner in decision-making for several years. Regulatory interventions have consistently met the requirements to demonstrate the actual benefit increasing energy efficiency standards, which deal with market failure relating to lifetime energy cost information for appliances and equipment.

The proposed regulation is an element of the Equipment Energy Efficiency Program (E3), formerly known as National Appliance and Equipment Energy Efficiency Program (NAEEEP). E3 embraces a wide range of measures aimed at increasing the energy efficiency of products used in the residential, commercial and manufacturing sectors in Australia and New Zealand. E3 is an initiative of the MCE, comprising ministers responsible for energy from all jurisdictions, and is an element of both Australia's National Framework for Energy Efficiency (NFEE) and New Zealand's National Energy Efficiency and Conservation Strategy. It is organised as follows:

- Implementation of the program is the direct responsibility of the Equipment Energy Efficiency Committee (referred to as the E3 Committee), which comprises officials from Australian federal, state and territory government agencies and representatives from New Zealand. These officials are responsible for implementing product energy efficiency initiatives in the various jurisdictions.
- The E3 Committee reports through the Energy Efficiency Working Group (E2WG) to the MCE and is ultimately responsible to the MCE.
- The MCE has charged E2WG to manage the overall policy and budget of the national program.
- The Australian and New Zealand members of the E3 Committee work to develop mutually acceptable labelling requirements and MEPS. New requirements are incorporated in Australian and New Zealand Standards and developed within the consultative machinery of Standards Australia.
- The program relies on state and territory legislation for legal effect in Australia, enforcing relevant Australian Standards for the specific product type. National legislation performs this task in New Zealand.

For many years the E3 Program and its predecessor[4] focused on electrical appliances and equipment. As a result of its 2004 review of the program, the Australian Government not only refreshed the broad policy mandate, but also expanded the program to include gas appliances and some commercial equipment – *Securing Australia's Energy Future* (DPMC 2004: page 111). Subsequently, MCE released its strategy for improving the energy efficiency of gas appliances – *Switch on Gas: 2005-2015* (AGO 2004a) – which signalled the intention of all ministers to bring gas appliances and equipment into the E3 Program.

[4] The E3 Program was previously called the National Appliance and Equipment Energy Efficiency Program (NAEEEP) and the committee was the National Appliance and Equipment Energy Efficiency Committee (NAEEEC). Its reconstitution as the E3 Program includes a formal partnership with New Zealand.

To be included in the program, appliances and equipment must satisfy certain criteria relating to the feasibility and cost effectiveness of intervention. These include potential for energy and greenhouse gas emissions savings, environmental impact of the fuel type, opportunity to influence purchase, the existence of market barriers, access to testing facilities, and considerations of administrative complexity. Policy measures are subject to a cost-benefit analysis and consideration of whether the measures are generally acceptable to the community.

E3 provides stakeholders with opportunities to comment on specific measures as they are developed by issuing reports (including fact sheets, technical reports, cost-benefit analyses and regulatory impact statements) and by holding meetings. Regulation of gas water heaters has been discussed with key industry leaders for many years.

1.2 Profile of gas water heaters

Current product technologies[5]
Two water-heating technologies fall within the scope of the proposed measures: storage heaters and instantaneous or continuous heaters.

Gas storage water heaters (GsWH) Gas storage water heaters consist of an insulated tank with typical storage capacities ranging from 90 to 260 litres, a gas burner at the base of the tank to heat the water, and a heat exchanger/flue that usually rises through the centre of the storage tank. When a hot water tap is turned on, cold water enters the bottom of the tank, displacing hot water through an outlet at the top of the tank. Re-heating of the water inside the tank is controlled by a thermostat.

Gas instantaneous water heaters (GiWH) Gas instantaneous water heaters do not have a tank to store heated water and so are more compact than storage systems. When a hot water tap is turned on, cold water flows into the unit and a high-powered gas burner is ignited, generally by means of a continuously burning pilot or some form of electronic ignition (either mains powered or powered independently). The units currently available have rated hot water deliveries of up to 32 litres/minute (based on a temperature rise of 25°C), depending on their intended application.

Two other technologies fall outside the scope of the measures. These are gas-boosted solar hot water heaters and boilers. Some households use such boilers to provide heating or a combination of heating and hot water, but their dominant use is heating.

Advanced gas water heating technologies
The US Environmental Protection Agency recently announced that it is considering gas condensing water heaters for inclusion in the ENERGY STAR® program, despite the fact that residential gas condensing water heaters are not widely available (USEPA 2007: page 7). The situation is that some commercial-scale appliances are being installed in larger US and Canadian dwellings, particularly where the unit is used for both water heating and space heating.

[5] Much of the technical, market and impact information that is presented in the remainder of this chapter is drawn from the following documents.

- *Energy labelling & minimum energy performance standards for domestic gas appliances*, Report to SEAV compiled by a team led by Mark Ellis and Associates, November 2002
- *Driving Energy Efficiency Improvements to Domestic Gas Appliances*, AGO Discussion Paper, July 2003
- *NFEE - Energy efficiency improvement potential case studies, residential water heating*, Report to SEAV by George Wilkenfeld and Associates, February 2004

The key difference between a conventional and condensing GsWH is that in the latter the flue gases are retained in a spiralling heat exchanger within the storage tank until they condense and drain away as slightly acidic water. USEPA says that, by capturing the heat of condensation, gas condensing water heaters reduce energy consumption by 30% relative to conventional GsWH that are available in the US.

USEPA also identifies an intermediate option that it calls the advanced non-condensing gas storage water heater, also not generally available.[6] These are similar to conventional GsWH but with a number of improvements to increase energy efficiency, such as a powered burner with a draft inducer plus advanced valves and heat traps. USEPA estimates that they provide energy savings of 18% relative to conventional GsWH that are available in the US.

Product standards and labelling - Australia

The AGA certifies gas water heaters and publishes selected details in its *Directory of AGA Certified Products*. (Two other certifiers, SAI Global and the Queensland Gas Association, have yet to certify GWH that fall within the scope of the proposed measures.) For certified GWH it lists the certification number, date certified, model name, annual energy consumption, star rating and the type of gas. Annual energy consumption is determined according to the test method defined in Australian Standard *AS 4552 – Gas fired water heaters for hot water supply and/or central heating.* This originated as AGA test procedure AG102 which was developed in the 1980s and was first published by Standards Australia as *AS 4552* in 2000. The most recent edition was published in December 2005 and this was expanded to cover safety requirements for boilers. The vast majority of products included in the AGA certified directory have been tested to the 2000 edition of the standard. The standard covers all aspects of these products including safety, performance, MEPS and energy labelling.

The energy rating and labelling regime is organised as follows:

> … *Energy labelling is a mandatory part of appliance certification by the AGA. All states require AGA certification before any mass-produced domestic appliance can be made available for sale or installation, therefore energy labelling (and compliance with MEPS) of nominated gas appliances is mandatory. The Standards require the label to be affixed in a prominent position on the appliance, but this does not extend to point-of-sale display.*
>
> *The gas water heater label scales were revised in 1988, and the label underwent a minor review of star presentation in 1999 to allow display of part star ratings. A recent revision of the test methodology for instantaneous water heaters is effective from 21 March 2003.* (AGO 2003: page 17)

The Australian Standard AS 4552 does not apply to GWH with a gas consumption rate in excess of 500 MJ/hour (for example, extremely large instantaneous units). The effect is to eliminate water heating equipment that is designed for large commercial and industrial applications, many of which are likely to be specially configured or designed for specific applications and would not fall into the category of mass-produced products.

A total of 153 appliances are recorded in the April 2007 edition of the AGA directory, comprising 68 appliances of the storage type and 85 of the instantaneous type. However, the following were excluded from immediate consideration:

- GWH not subject to energy tests: The energy testing and labelling requirements of AS 4552 do not apply to GsWH with gas consumption in excess of 50 MJ/hour, or to GiWH models with gas consumption in excess of 250 MJ/hour. The effect is to confine the energy testing and labelling regime to GWH that are designed primarily

[6] Also referred to as near-condensing gas water heaters (ACEEE 2007)

for residential and small commercial applications, removing about 8% of the entries from the certified list of appliances.

- GWH for caravans and mobile homes: Five of the entries on the certified list are for small water heaters that are designed for use in caravans and mobile homes, comprising four of the storage type and one of the instantaneous type. These are excluded from immediate consideration because (a) it is unclear whether the existing energy testing procedures of AS 4552 can be confidently applied to the small storage units, (b) the options of improving efficiency at reasonable cost are severely constrained by the lack of space in recreational vehicles and (c) E3 regulations for other product types are normally for products used in stationary applications.
- Obsolete and duplicate certifications: We eliminated entries for appliances that are no longer sold, based on examination of product lists from supplier websites and follow-up calls to sales staff. We also took that opportunity to identify and remove duplicate entries where possible, that is, where the same model is rebadged for marketing reasons and appears two or more times in the certified list.

The revised list contains 32 entries for GsWH appliances and 31 entries for GiWH appliances. Figures 1.1 and 1.2 show the distribution of energy consumption and energy efficiencies for appliances on the revised list, separately identifying appliances that are designed for external and internal installation. The significance of this distinction is that (a) the fluing arrangements for internally installed GWH may constrain the ability to extract more heat from the combustion process flue gases and thereby limit options for increasing energy efficiency, and (b) there can be significant additional costs of replacing internally installed storage units where a like-for-like replacement is difficult.

Regarding the interpretation of figures 1.1 and 1.2, note that:

- The labelling requirements of AS 4552 refer to a heater that is assumed to consume 28,900 MJ/year to perform the standardised heating task (delivery of 37.7 MJ/day of hot water or 13,761 MJ/year). Any heater returning a test result of 28,900 MJ/year, or more, is assigned 1 star.
- The rating scale provides for up to 6 stars, in equal step reductions of 2,023 MJ/year, which is 7% of the reference level, so that the highest rating of 6 stars is achieved when the energy consumption is reduced by 35% relative to the reference heater (= 5 steps * 7%, reducing energy use to 18,785 MJ/year and raising overall task efficiency to 73.26%).
- The older certification dates can be misleading. Some suppliers retain the original certification numbers and dates when upgrading their models, possibly for administrative simplicity. There are certainly cases where models have been redesigned for greater efficiency but the original certification numbers and dates have been retained.

External appliances account for 80% of the entries in the (truncated) list of certified appliances, split about 50:50 between storage and instantaneous models. The simple average[7] of their star ratings is 4.4 stars, with GsWH and GiWH averaging 3.7 stars and 5.1 stars respectively. Eighty-one per cent of the GiWH are 5 stars or more, but only 24% of the GsWH – see figure 1.1. Most certifications since 2000 have been at 5 stars or better, with the recent exception of two storage models that were registered in 2006 with 4.1 and 4.2 stars.

[7] The simple average is potentially misleading because it is not sales weighted.

FIGURE 1.1 STANDARDISED ENERGY CONSUMPTION OF EXTERNALLY INSTALLED GWH, BY TYPE AND DATE OF CERTIFICATION

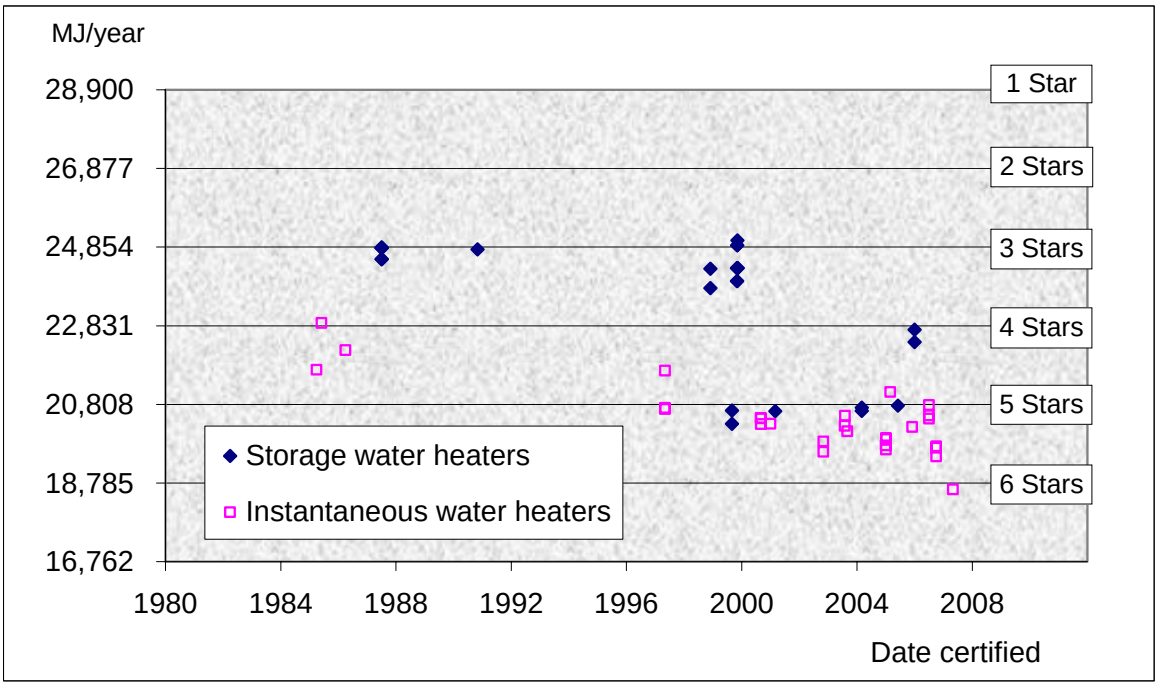
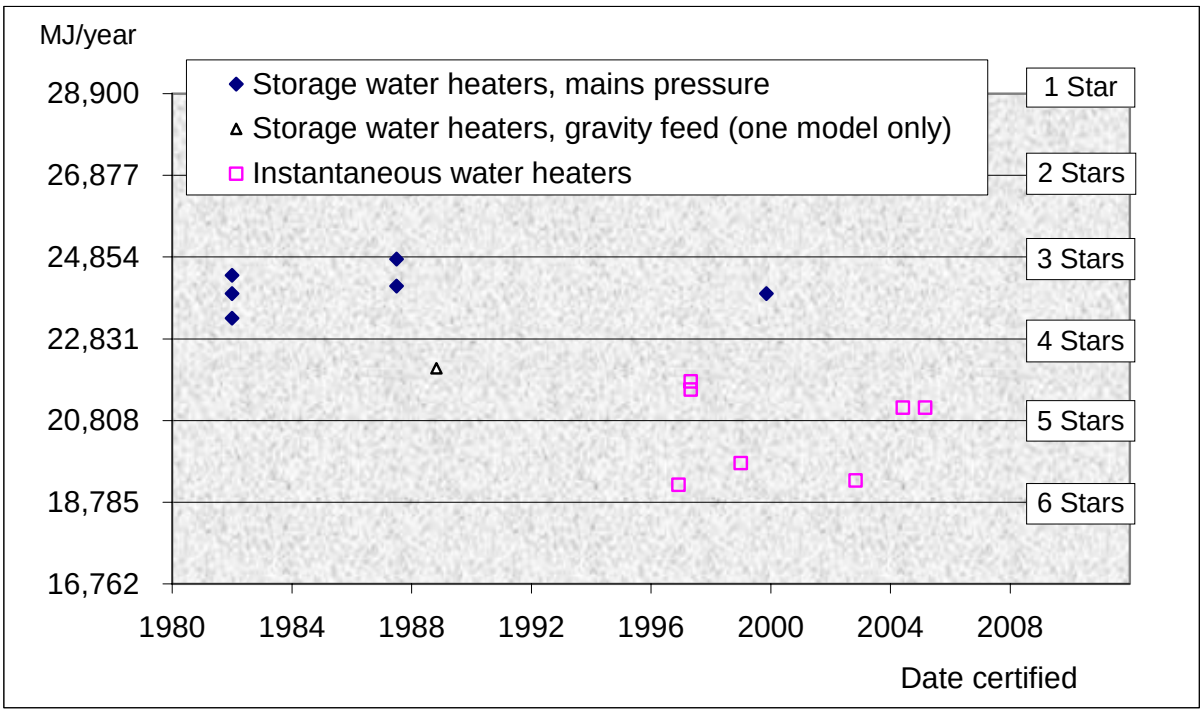


FIGURE 1.2 STANDARDISED ENERGY CONSUMPTION OF INTERNALLY INSTALLED GWH, BY TYPE AND DATE OF CERTIFICATION



Significant GiWH certifications date from the late 1990s and coincide with the application of computer technology to GiWH, with many providing precise temperature control to the user, modulating gas burners and therefore much lower minimum flow rates. These developments remedied two weaknesses of the first generation of GiWH – the early heaters did not ignite until a significant flow rate was achieved and, once ignited, the water temperature varied with the water flow.

There is a cluster of GiWH with certification dates from the mid-1980s and with energy ratings in the range of 4-4.5 stars. These seem to be the only remaining GiWH with permanent pilot ignition. The elimination of a permanent pilot light, which ignites the burner on demand but burns continuously itself, offers a significant energy saving. It can be replaced with electronic ignition or by a self-contained device for gas ignition, such as battery ignition or a device that uses the flow of water to generate a spark on demand.

Internal appliances account for 20% of the certifications, also split about 50:50 between storage and instantaneous models. The simple average of their star ratings is 4.3, with mains pressure GsWH and GiWH averaging 3.4 stars and 5.1 stars respectively. There is a single GsWH of the gravity feed type that is installed in the ceiling of a house, with a rating of 4.4 stars.

Three of the 14 internal appliances have 5 stars, all being GiWH. Another four internal appliances have 4-4.5 stars, all GiWH. All GsWH of the mains pressure type have less than 4 stars and 80% are less than 3.5 stars.

Product standards and labelling – New Zealand
The New Zealand Building Code requires that GWH installed in new dwellings meet the requirements of New Zealand Standard NZS4305:1996, which are:

- GWH with 200 litres of storage or more shall have a minimum conversion efficiency of 70% and a maximum gas consumption rate of 1.26 MJ/hour in standby mode.
- Smaller GWH shall have a minimum conversion efficiency of 75% and a maximum gas consumption rate of 0.97 MJ/hour in standby mode.
- Gas instantaneous water heaters shall have a minimum conversion efficiency of 75%.

NZS 4305:1996 refers to AGA102 for the method of measurement.

The energy efficiency of GWH is not otherwise regulated or publicly disclosed in New Zealand. However suppliers must declare that appliances comply with safety regulations and declared appliances are listed on the website of Safety New Zealand. Our assessment of energy efficiency was informed by matching New Zealand's declared products with the products listed in AGA's *Product Directory*, which provides the energy ratings. We also consulted with individual suppliers of unmatched products.

We conclude from this review that the range of GWH on the market is very similar in the two countries. However, there are major differences in market shares. This has implications for the average efficiency and emissions profile of GWH in New Zealand, documented in the sections 1.4 and 1.5.

Product suppliers
GsWH are manufactured in both Australia and New Zealand, and all but one of the GsWH certifications are from the three suppliers – Rheem, Dux and Aquamax. The remaining certification is for a small Perth-based company that seems not to be a going concern.

The bulky nature of GsWH means that transport costs are high and import competition is restricted. However, New Zealand imports a small number of GsWH, mainly from Australia.

In contrast, the vast majority of GiWH are imported, mainly from Japan. Bosch and Rinnai have the longest history in this market, particularly Bosch. Dux and Rheem have obtained certifications for a range of these products since the late 1990s. A major Japanese supplier, Tagaki, has certifications dating from 2006 and is now marketing products under several

brand names. Bosch, Rinnai and Rheem appear to be the major suppliers to both the New Zealand and Australian markets, and market the same range of products in both markets.

There are also smaller Australian suppliers of GiWH that assemble units from imported components. Two of these operate from Melbourne and Sydney – Douglas & Company and Servgas – and supply small markets for internal replacement units in flats. Primo-Tech is a new entrant to the GiWH market. It has manufacturing facilities in Perth and expects its first significant sales in 2007.

There are two small New Zealand importers. Abergas imports a small range of both GiWH and GsWH. What Power Crisis imports a small range of GiWH.

There are 11 suppliers to the Australian market, three supplying GsWH only, six supplying GiWH only, and two supplying both. There are six suppliers to the New Zealand market, two supplying GsWH only, three supplying GiWH only, and one supplying both. They range from large multinational companies to small and medium-sized businesses.

1.3 GWH stocks and sales – Australia

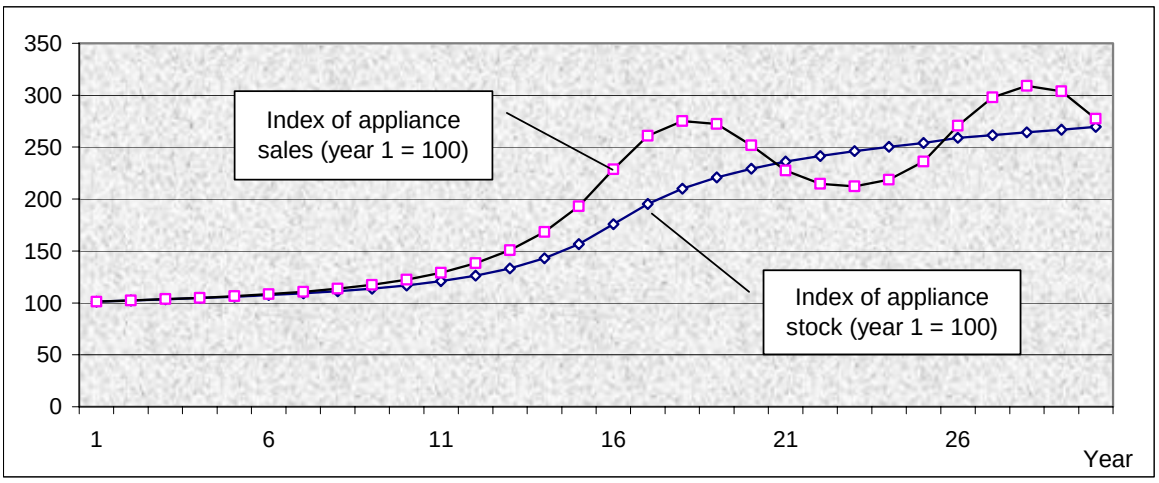
The impact assessment requires an estimate of the number of GWH with less than 5 stars that will be sold in the period to 2020. The main uncertainty affecting that calculation is the extent to which the market will continue to shift in favour of GiWH. This is important because the average GiWH is more efficient than the average GsWH and the shift has been significant. We estimate that the GiWH share of GWH sales increased from 5% in 1995 to 53% in 2005. Necessarily, GsWH sales have contracted sharply at the same time.

However, sales data must be interpreted carefully. Figure 1.3 illustrates the problem. It shows an appliance stock that grows moderately for a period but then achieves a higher level of household penetration before returning to sustainable growth at the higher level. Sales behave more erratically. They increase sharply to deliver higher rates of stock growth in the earlier stages of the transition but decline when the rate of growth of the stock falls in the later stages of the transition. The first surge in sales is echoed in a replacement cycle 10 years later.

The sales estimate has been developed in the following stages, aiming to ensure that the assessment is based on a coherent account of developments in stocks and sales:

1. Develop a scenario GWH 'penetration' – that is, the percentage of households with GWH.

FIGURE 1.3 ILLUSTRATION OF VARIABLE RELATIONSHIP BETWEEN STOCKS & SALES



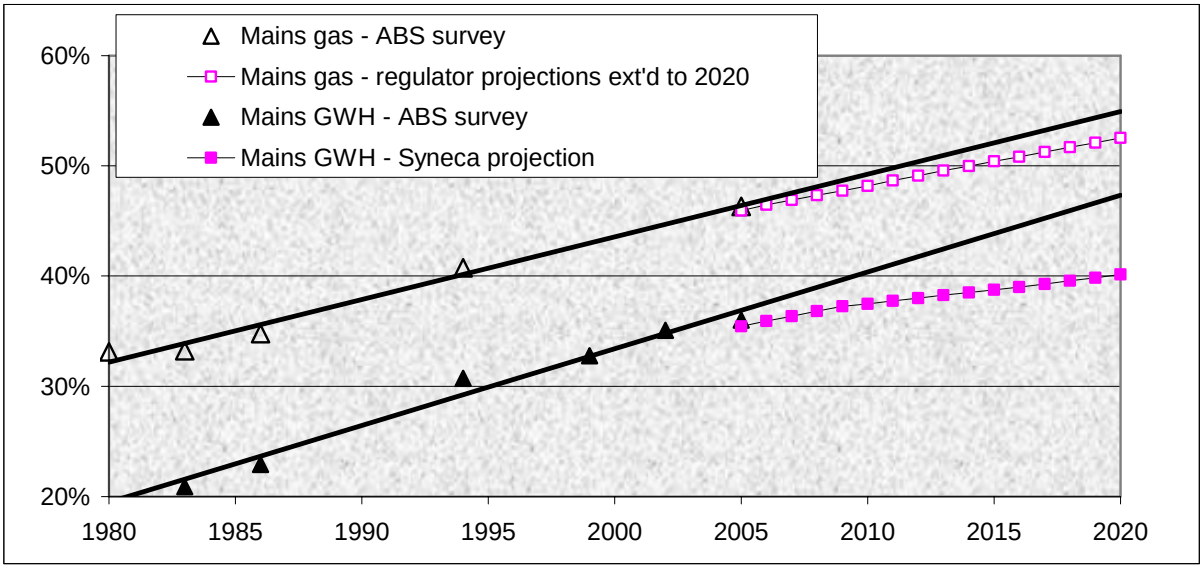
2. Develop scenario for relative penetration of GsWH and GiWH, which has a major impact on scope for sales of GWH with less than 5 stars.
3. Develop sales scenario for GiWH and for the share of GiWH sales with less than 5 stars.
4. Develop sales scenario for GsWH and for the share of GsWH sales with less than 5 stars.
5. Document uncertainties.
6. Document the mix of internal and external GWH.

(1) Penetration of gas water heaters

It is assumed that the number of GWH fuelled with bottled LPG remains constant at 185,000, which is now about 2.3% of Australian households, and declines to 2% in 2020. This is consistent with returns from ABS surveys of energy and appliance use over the past 10 years.[8]

It is assumed that the proportion of Australian households using GWH fuelled by mains gas ('mains GWH penetration' hereafter) will increase from 35.4% in 2005 to 40.1% in 2020. This is slower than the historical trend indicated by ABS surveys – see figure 1.4.

FIGURE 1.4 GAS AND GWH PENETRATION OF AUSTRALIAN HOUSEHOLDS, PROJECTED TO 2020 (MAINS GAS ONLY)



The increase in mains GWH penetration is due mainly to an increase in the proportion of households connected to mains gas, which is projected to rise from 46% to 52.5% over the period to 2020. This is consistent with regulator[9] projections for the growth in residential customers in the period to 2011, but assumes continued growth at that rate in the decade to 2020. This projection is also reported in figure 1.4.

Historically, the proportion of mains gas customers with GWH has also tended to rise, which has the effect of closing the gap between the two schedules in figure 1.4. Looking forward, however, further increases in most jurisdictions will be offset by Victoria's 5-star building regulations, which strongly favour the installation of gas-boosted solar systems

[8] ABS Cat 4602.0 *Environmental Issues*, 1994, 1999, 2002 & 2005.
[9] We refer here to the competition regulators in the various jurisdictions. They determine tariff structures for distribution networks and, in the process, publish projections for residential customer numbers and gas usage. See appendix B for further details.

where new dwellings have access to gas.[10] Over the period to 2020, therefore, the proportion of gas customers with non-solar or gas-only GWH is projected to remain constant at around 77%.

(2) Baseline scenario for GsWH and GiWH shares of water heater stock
Figure 1.5 reports the key result from the first stage, which is a scenario for GWH penetration, and shows a split between GsWH and GiWH. The main features are that:

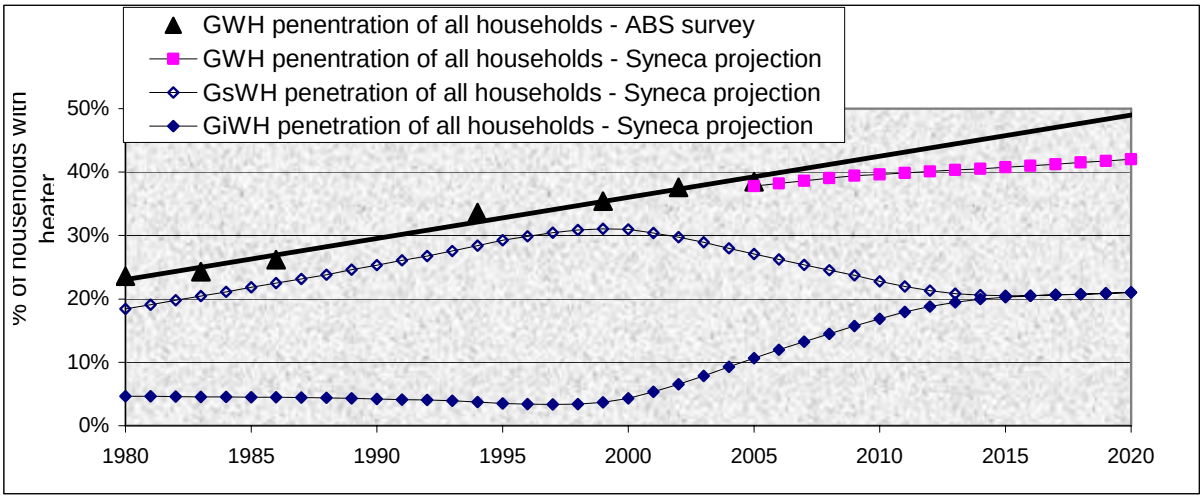
- GWH penetration (both bottled and mains) rises from 38% to 42% of households in the period from 2005 to 2020.
- GiWH accounts for 50% of the installed GWH stock by 2015 and maintains that share thereafter. This means that GiWH penetration reaches 20% of households in 2015 and then grows moderately to 21% in 2020 (=50% * 42%).
- The stock of GsWH mirrors the stock of GiWH. It falls to 20% of households in 2015 but then grows moderately to 21% in 2020 (=50% * 42%).

Does figure 1.5 give a plausible account of the future? It is certain that GiWH penetration has increased over recent years and continues to increase. But where does it stand and how much further will it rise? Our interpretation of the available data is as follows:

- BIS Shrapnel reports that its 2006 survey put GsWH and GiWH penetration at 25% and 20% respectively (BIS Shrapnel 2006). However, examination of import data suggests that GiWH penetration is only about 11%. (All GiWH are imported and, while imports have increased rapidly in recent years, they don't account for 20% of the installed stock.) Accordingly, figure 1.5 reports GsWH and GiWH penetration, in 2005, at 27% and 11% respectively.
- The growth of GiWH sales has moderated in recent years. In the four years to 2001 they increased by almost 50% a year. In the next four years, to 2005, they increased at 8% per year. This suggests a reduction in rate of growth of the stock of GiWH.
- It is relatively easy for GiWH to replace GsWH in the market for new gas water heaters but more difficult in the replacement market. This is because of the relative ease of replacing a failed GsWH with another GsWH, requiring no change to gas and water connections. The market for GsWH is increasingly a replacement market, particularly for appliances with less than 3 stars.

[10] Appendices A and B provide supporting material. Appendix A documents policy measures favouring gas connections and installation of gas appliances. Appendix B provides a review of regulator projections for distribution networks, including projections for the growth in residential connections to mains gas.

FIGURE 1.5 ESTIMATES OF GWH MARKET PENETRATION: AUSTRALIA, PROJECTED TO 2020 (TOTAL OF BOTTLED AND MAINS GAS)



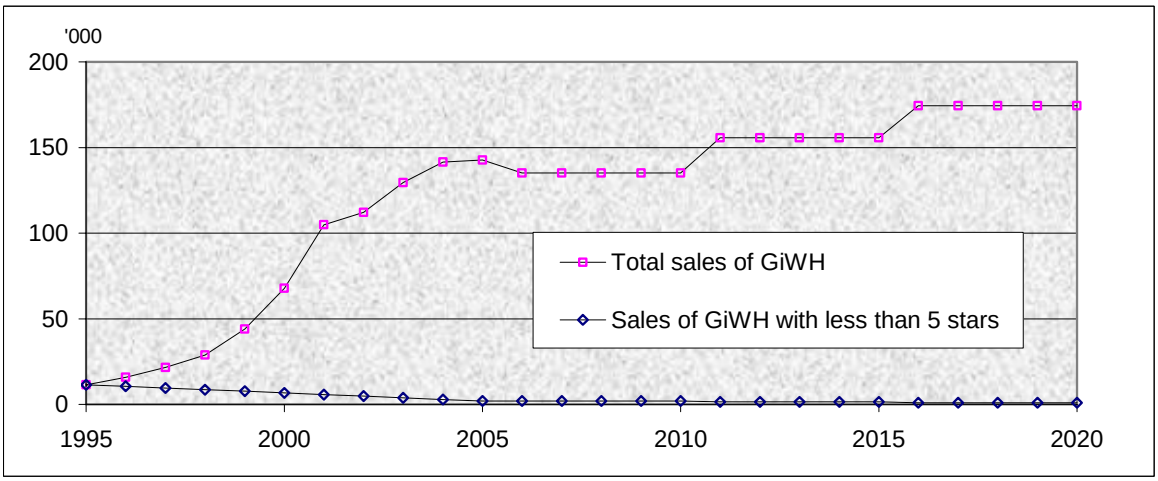
(3) Baseline scenario for sales of GiWH

Figure 1.6 presents a scenario for sales of GiWH that is consistent with the outlook for GiWH penetration that is presented in figure 1.5. The data to 2005 is the record of imports. The post-2005 projections are based on a simple stock-adjustment model[11] but with sales averaged over five-year periods, suppressing year-to-year variations.[12] Sales of GiWH with less than 5 stars are small and declining and it is assumed that they will be phased out over the projection period. The tally of sales in the period 2005 to 2020 is 22,500.

(4) Baseline scenario for sales of GsWH

Figure 1.7 presents a scenario for sales of GsWH that is consistent with the outlook for GsWH penetration that is presented in figure 1.5. The data for the three years to 2005 is based on industry-wide information that is collected in collaboration with the ABS. Earlier estimates are consistent with studies that have been published since the early 1990s and with periodic product reviews published by BIS Shrapnel. The post-2005 projections are based on a simple stock-adjustment model but with sales averaged over five-year periods.

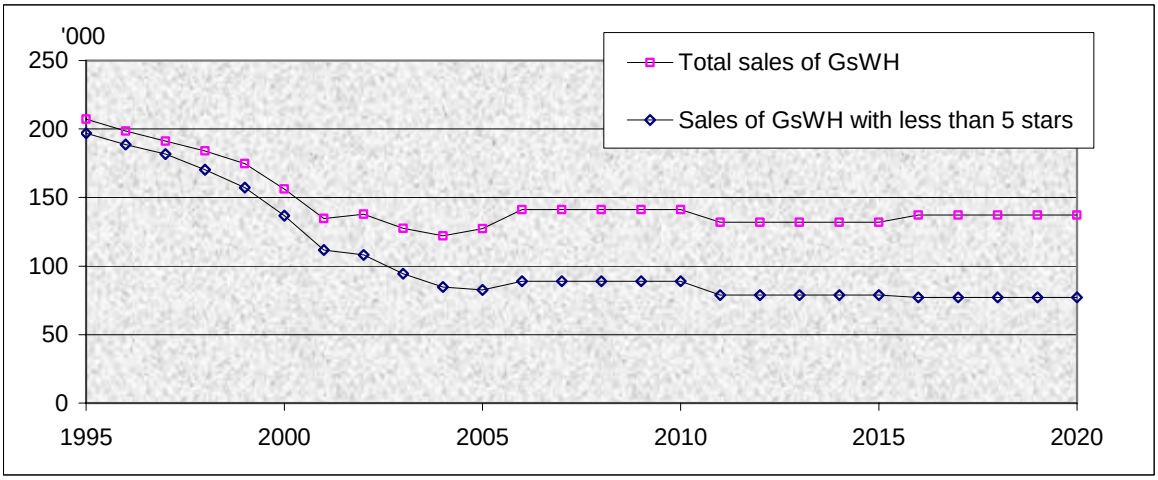
FIGURE 1.6 GIWH SALES: AUSTRALIA, 1995 TO 2020



[11] In a stock-adjustment model, annual sales are set equal to the increase in the stock of heaters over the relevant year plus an estimate of the number of heaters that need to be replaced. The increase in stock depends on population growth and changes in market penetration. Replacement demand is set to a constant fraction of stock.

[12] Historical fluctuations are repeated as replacement cycles over the projection period, imparting a sense of precise calculation that is unrealistic with simple stock adjustment models.

FIGURE 1.7 GSWH SALES: AUSTRALIA, 1995 TO 2020



Sales of GsWH with less than 5 stars decline steadily but remain significant in the period to 2020. The tally of sales in the period 2005 to 2020 is 1.2 million.

The projected sales of GsWH with less than 5 stars are about 60% of the sales that would be needed to maintain the stock of such units. Put another way, 40% of replacement sales are upgrades to 5 stars. The effect is to reduce the stock of GsWH with less than 5 stars by 44% in the period from 2005 to 2020 – from 1.51 million units to 0.85 million units.

(5) Uncertainties

There is unavoidable uncertainty about the outlook for GWH penetration and the mix of GsWH and GiWH. It is assumed that GWH are in a good competitive position relative to electric water heaters. Consider that:

- The greenhouse advantage of GWH over electric hot water systems (HWS) is set to become more important in the market, reflecting their superior greenhouse performance.
- GsWH have lower running costs in the three states with relatively cheap natural gas and relatively expensive electricity – Victoria,[13] SA and WA.
- GiWH extend this running cost advantage to other states.

The exploitation of this advantage is impeded by inertia in replacement decisions, with many consumers taking the simplest option of replacing like with like. Where conversions occur, however, gas is strongly favoured: very few people convert to an electric heater from some alternate system.[14] This suggests that market forces will continue to favour gas in replacement decisions, but working slowly through the minority of replacements where conversion is actively considered.

Another uncertainty is the impact of solar hot water systems on sales of GWH. The market for GWH would be further reduced if there were broader support for solar hot water systems.

That said, it should be remembered that the market for GsWH with less than 5 stars, which is the critical market for this assessment, is basically a replacement market. This sub-market may be relatively unaffected by alternative scenarios for overall growth of the GWH market and the outcome of competition between GsWH and GiWH for 5-star sales.

[13] GWA (2005a) documents the competitive advantages of natural gas in Victoria.
[14] This pattern of behaviour is consistently documented by the consumer surveys conducted by BIS Shrapnel (BIS 2004 & 2006)

The developments of direct relevance are the impact of a national emissions trading scheme, as announced in June 2007 by the Prime Minister, on the cost of running inefficient appliances, and growing household awareness of and attention to energy efficiency. It is appropriate to test for sensitivity to a wide range of sales of GsWH that will be affected by the regulation.

(6) Mix of external and internal GWH
The significance of the distinction between internally and externally installed GWH is that improving the efficiency of internal GWH presents additional challenges for manufacturers and installers, and additional costs for households.

We have spoken to all significant suppliers of internal GWH, of both the storage and instantaneous type, and understand that internal GWH are for niche markets that number in the several hundreds or several thousands a year. Total sales are about 8,000 a year, roughly comprised as follows:

- Internal GsWH of the mains pressure type, replacement only – 3,250/year.
- Internal GsWH of the gravity feed type (installed in ceilings, replacement only) – 250/year.
- Small internal GiWH of the 'under-sink' type, replacement only – 500/year.
- Other internal GiWH for replacement purposes – 2,000/year.
- Internal GiWH in new and refurbished dwellings (only where it is not feasible to install an external unit) – 2,000/year.

The sub-markets for the replacement of obsolete products are in decline. Total sales of all internal GWH may be of the order of 50,000 over the period 2010-20, which is 1.5% of the cumulative tally for GWH, 3.3 million.

Implicitly, the vast majority of GWH sales will be for externally installed units.

1.4 GWH stocks and sales – New Zealand

Key findings from the Household Energy End-Use Project (HEEP)
New Zealand's HEEP survey collected data on all aspects of domestic energy use, including for hot water. The data was collected from 1995 to 2005 and published in a series of reports by BRANZ.

HEEP's random sample of 400 dwellings contained a total of 443 HWS, with 9% of dwellings having two units and 1% having three. However, not all systems were operational and many of the multiple installations were combinations of wood-fired appliances plus electric or gas appliances. These data indicate that GWH penetration of New Zealand households is about 13%, with GsWH and GiWH at 8% and 5% respectively (BRANZ 2005: page 94). There would be a reasonable degree of statistical uncertainty, since the sample contains only 34 GsWH and 20 GiWH. Another source of uncertainty is that the data was collected over a decade and provides no information about trends over this period. The breakdown by type is doubtful, since there has been a major shift in favour of GiWH over this period.

The following research findings from the HEEP project are relevant in the present context:

- Of households with hot water cylinders, including both gas and electric, 91% were installed internally and 80% were in a cupboard inside the house. All the standing heat losses from internal cylinders contribute to house winter space heating and this was found to be considerable proportion in some cases: 66% of households used the space around the cylinder for linen or clothes storage.

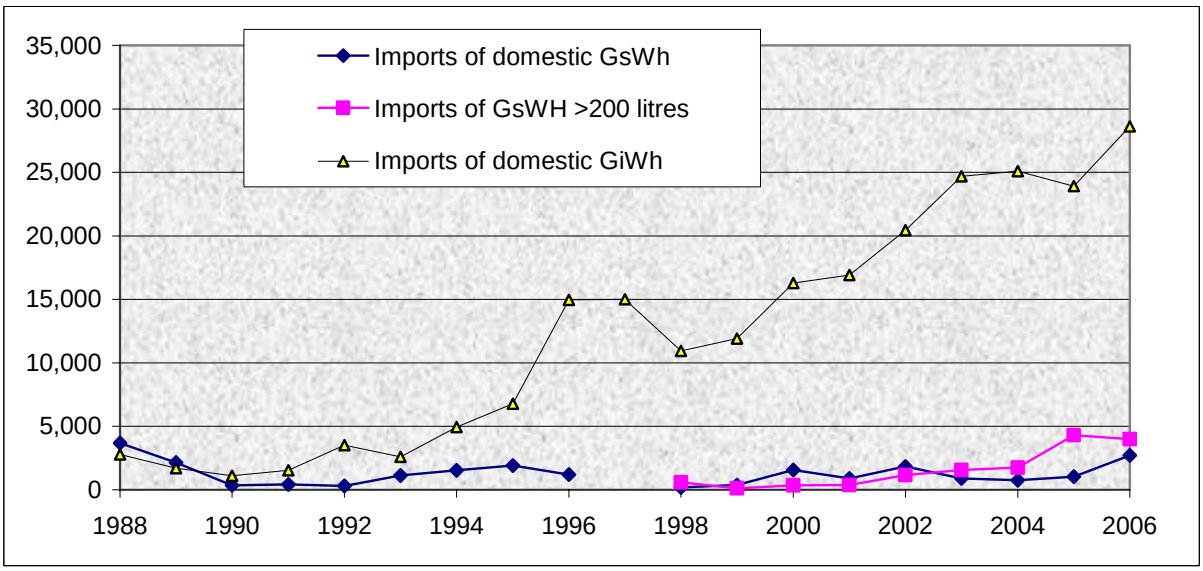
- 94% of the GsWH were in the size range that also dominates the Australian market, with 135 or 170 litres of storage. The sample includes only two units outside this range and two units where storage capacity could not be determined. The outliers comprised one unit with a 75 litres of storage and one of industrial size, with 350 litres of storage.
- The split between GsWH units with 135 or 170 litres of storage is 60:40 in favour of the smaller unit.
- 40% of the GsWH were low pressure units and these correlate with the use of bottled gas. The combination of low pressure and installation in a cupboard is achieved by installing a feeder tank in the ceiling space or a pressure-reduction valve on the mains connection. In contrast to the Australian situation, low pressure units are not generally installed above the ceiling.

Increasing penetration and sales of GWH

It is apparent that GWH penetration of New Zealand households is increasing. The number of households connected to mains gas increased by 5.2% a year from 2000 to 2005, raising mains gas penetration from 12.6% of households in 2000 to 15.3% in 2005. LPG is well established on the South Island, where mains gas is not available. In addition to bottled LPG there is increasing penetration of reticulated LPG in new housing estates. In a recent joint submission to government, the LPG and Gas Associations of New Zealand report that the LPG market has grown by 50% over the past five years and that almost 75% of new homes on the South Island use gas (GANZ 2007: page 12).

Almost all GWH are imported to New Zealand. The only exceptions are internal GsWH that are manufactured in New Zealand, numbering about 2,000 a year. This means that import data tell the story – see figure 1.8. Assuming that the entire stock of water heaters must turn over every 12 or 13 years, these data suggest that about 250,000 GWH are installed in New Zealand homes. This represents market penetration of about 17%, somewhat higher than the 13% that HEEP recorded for 1995-2005.

FIGURE 1.8 IMPORTS OF GWH TO NEW ZEALAND: 1988 TO 2006*



Note

* There is a break in series affecting the data for GsWH. The sub-categories were defined as 'domestic' and 'other' before 1997 and then redefined as 'less than 200 litres' and 'greater than 200 litres'. It has been assumed that the 'domestic' series, pre-1997, is the precursor of the 'less than 200 litres' series, post-1997.

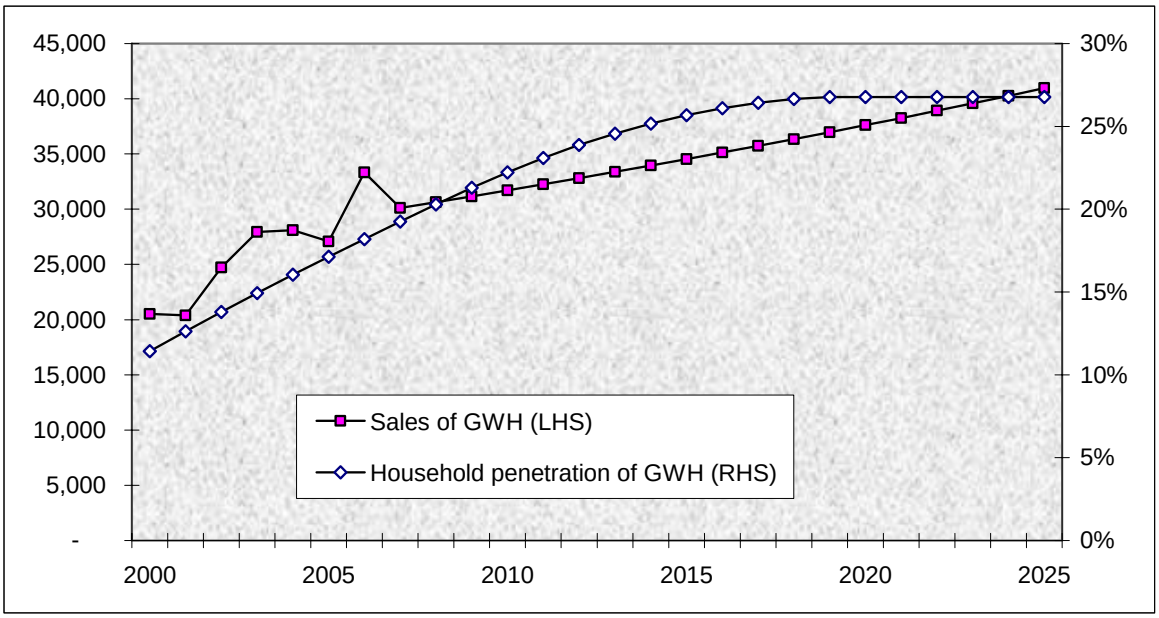
Projected penetration and sales of GWH

Figure 1.9 presents our baseline projection for GWH penetration and sales. It envisages that penetration will continue to grow but at a decreasing rate and that penetration will increase from about 17% now to about 27% in 2020. This is consistent with a further increase in sales, to about 40,000 a year. The continued growth is because, given the history of increasing penetration, replacement sales will continue to grow strongly.

This projection may be conservative. New Zealand gas interests say there is considerable scope to further increase mains gas take-up by households that already have access to gas, and that the residential market for LPG will grow at 10% a year (GANZ 2007: page 12). In a report on alternatives to augmentation of electricity supplies, SKM (2004: page 24) say that mains gas take-up by households with access to gas is 40% in Auckland and 70% in Wellington.

The strong switch in favour of GiWH seems permanent. Based on discussions with suppliers, GsWH have become niche markets and will not recover. We assume they will decline linearly to zero over the period to 2020. This means that, of the approximately 500,000 GWH that will be sold in the period to 2020, only 25,000 (5%) will be GsWH – 15,000 internal GsWH and 10,000 external GsWH.

FIGURE 1.9 BASELINE PROJECTION FOR GWH PENETRATION AND SALES: NEW ZEALAND



This is in sharp contrast to projections for the Australian market, where GsWH are projected to retain 50% of the market in 2020. An important difference between the two markets is that GsWH are made in Australia on a much larger scale. GsWH are bulky items and suffer a significant cost disadvantage as imported goods. The GsWH that are manufactured in New Zealand – about 2,000 internal GsWH a year – remain strongly competitive in their niche market. It appears that only 10-20 internal GsWH are imported to New Zealand each year.

Small and declining sales of GWH with less than 5 stars

With respect to the energy efficiency profile of the New Zealand market, we understand the situation as follows:

- External GsWH: There are several suppliers of GsWH to this small market – Rheem, CJ Energy Services (agent for Dux) and Abergas (agent for Ruud). Import data indicate that sales have averaged 1,400/year over the past five years and suppliers have indicated that less than 100 of these would have less than 5 stars.

The baseline scenario is for the sale of 10,000 external GsWH in the period to 2020, 700 of which will be at less than 5 stars.

- Internal GsWH: The relatively few appliances that are imported from Australia – no more than 10-20 a year – have ratings of about 3 stars. The remainder are made in New Zealand and have not been energy tested. But the supplier believes that they would also be rated at about 3 stars. Current sales are 2,000/year but declining, and the baseline scenario is for 15,000 of these units to be sold in the period to 2020.
- External GiWH: The major suppliers are the same for New Zealand and Australia, as is the product range. One product uses a pilot light and the proposed measures would require it to be removed ahead of its normal replacement schedule. One other small importer (What Power Crisis) has annual sales of about 200 units that are imported from China. They have not been energy tested. The baseline scenario is that 0.5% of total GiWH sales are of the external type with less than 5 stars, which is the same proportion as for Australia. This is about 700 units over the period to 2020.
- Internal GiWH: The major suppliers are the same for New Zealand and Australia, as is the product range. There is only one product with less than 5 stars and we understand that it is scheduled to be replaced with a 5 star product under normal process of product renewal, independently of regulation.

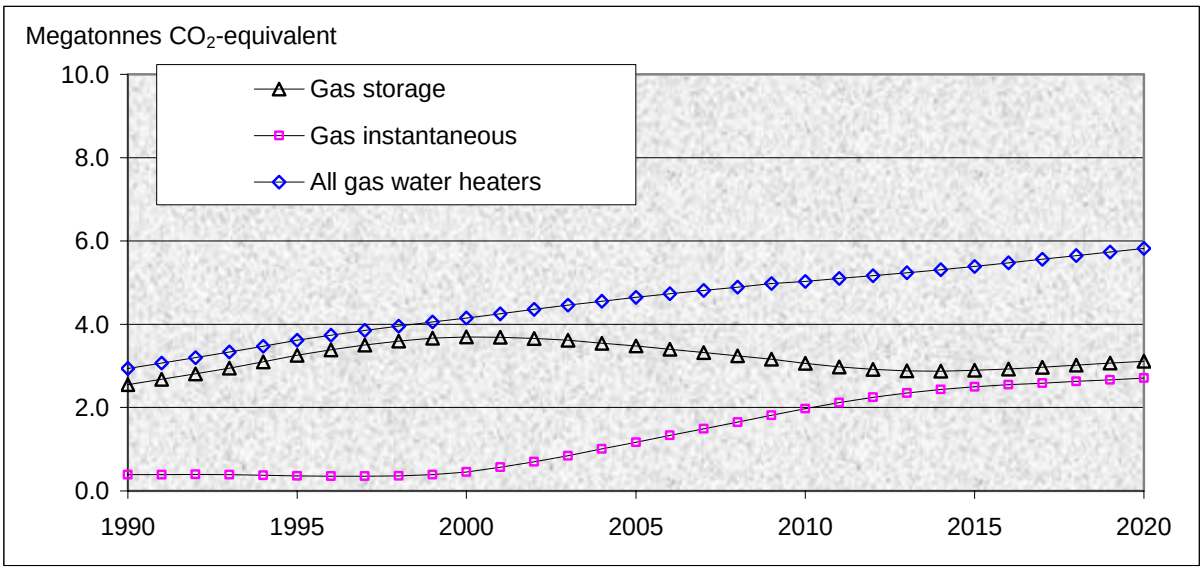
In summary, the BAU scenario is that 16,400 GWH with less than 5 stars would be sold in the period to 2020, comprising 15,000 internal GsWH, 700 external GsWH and 700 external GiWH.

1.5 Contribution to growth of greenhouse emissions

Australia

Figure 1.10 reports historical estimates and BAU (business as usual) projections of greenhouse gas emissions from the installed stock of GWH. This modelling indicates that emissions increased by 41% in the decade to 2000, will increase by 21% in the decade to 2010, and will increase by a further 16% in the decade to 2020.

FIGURE 1.10 GREENHOUSE GAS EMISSIONS FROM INSTALLED GWH: AUSTRALIA, 1990 TO 2020



In the first commitment period of the Kyoto Protocol (2008-12), this modelling indicates that:

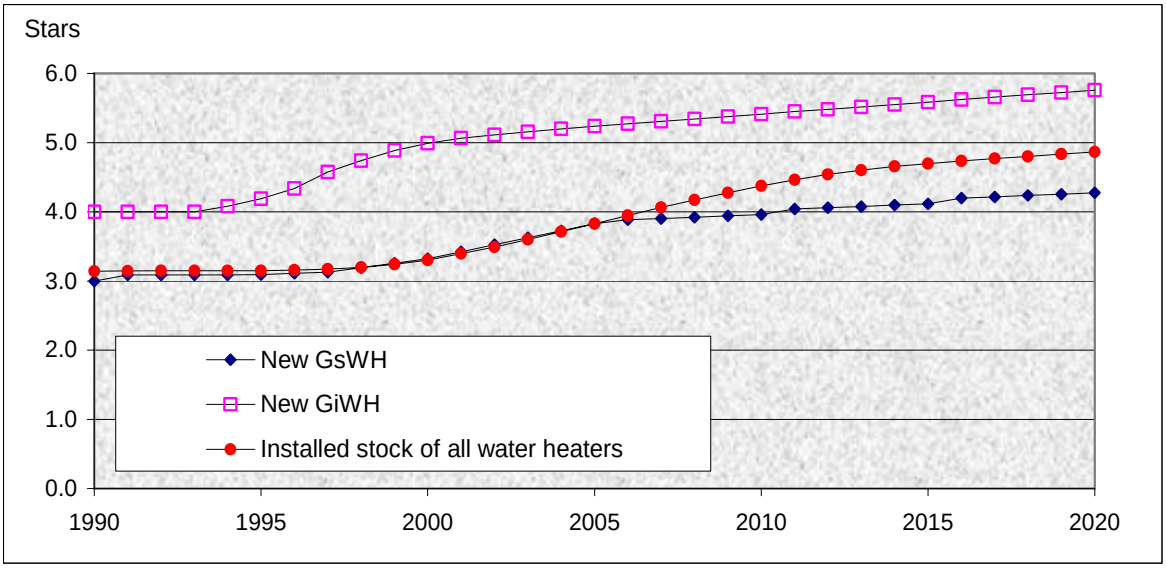
- Emissions will grow to 5.0 Mt CO_2-e/year.
- GWH will account for 0.83% of Australia's total emissions, which are projected to reach 603 Mt CO_2-e/year in 2010.
- GWH emissions will grow to 171% of their 1990 level, compared with a projected increase in total emissions to 109% of their 1990 level. The Australian Government is committed to meeting a 108% Kyoto target for the nation as a whole, that is, across all sectors and all emissions sources.

The drivers of emissions growth are population growth[15] and growing penetration, but offset by increases in the efficiency of new heaters. This is largely the result of declining sales of GWH with less than 5 stars, as indicated in figures 1.6 and 1.7. However, the baseline scenario also includes a lesser contribution from increased average efficiency within each of the market segments, including increased average efficiency of appliances with less than 5 stars. These assumptions are based on examination of trends in the efficiency of newly-certified units, as follows:

- New GsWH with less than 5 stars: The average efficiency of new units rises from 3.0 stars in 1995 to 3.23 stars in 2007 and continues to improve at that rate, reaching 3.48 stars in 2020.
- New GsWH with at least 5 stars: New units are set at 5.05 stars in 2007 then improve at the same rate as units with less than 5 stars, reaching 5.3 stars in 2020.
- New GiWH with less than 5 stars: The average efficiency of new units rises from 4.0 stars in 1995 to 4.41 stars in 2007 and continues to improve at that rate, reaching 4.85 stars in 2020.
- New GiWH with at least 5 stars: New units are set at 5.32 stars in 2007 then improve at the same rate as units with less than 5 stars, reaching 5.76 stars in 2020.

Figure 1.11 reports the implied efficiency outcomes for new GWH and for the installed stock of GWH.

FIGURE 1.11 AVERAGE ENERGY STAR RATINGS FOR NEW AND INSTALLED GWH: BAU SCENARIO FOR 1990 TO 2020 (AVERAGE STAR RATINGS)



New Zealand

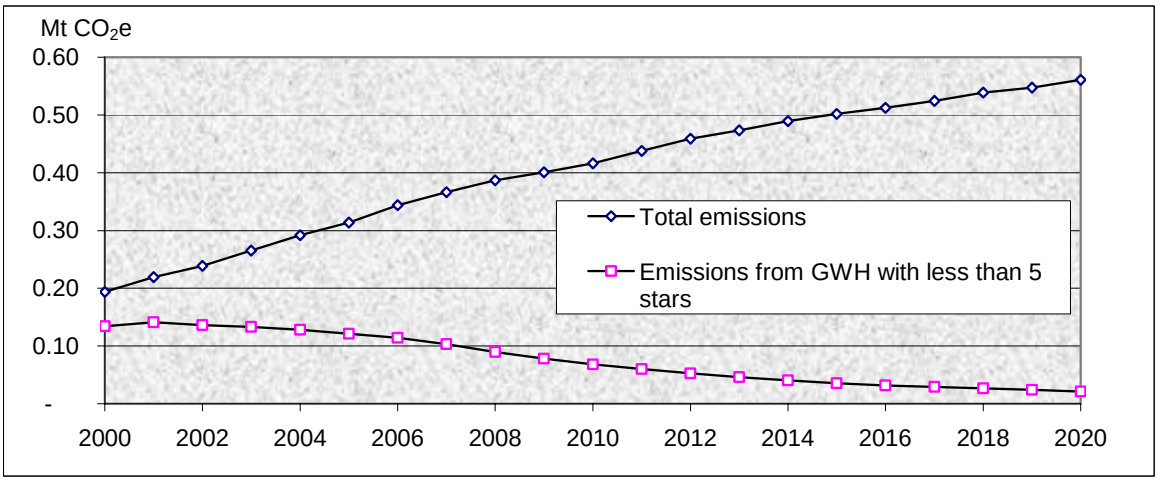
[15] In 2010, the number of households is projected to be 142% of its 1990 level.

Figure 1.12 reports estimates of the expected increase in greenhouse emissions under BAU conditions. They increase by 114% in the decade to 2010 and by a further 26% in the decade to 2020. This is somewhat slower than the corresponding increases in the installed stock of GsWH – at 134% and 32% respectively. The projection incorporates the same BAU improvements in energy efficiency, for individual products, that are assumed for Australia.

Emissions are estimated to reach 0.42 Mt CO_2-e in 2010, which is the mid-point of the first commitment period under the Kyoto Protocol. This is 0.5% of the forecast for total New Zealand emissions in 2010, which is 83.9 Mt (Ministry for the Environment 2006: page 91).

The greenhouse contribution from GWH with less than 5 stars is declining, reflecting the declining prospects for GsWH described in section 1.4.

FIGURE 1.12 BAU SCENARIO FOR GREENHOUSE EMISSIONS – NEW ZEALAND



1.6 Impediments to energy efficiency in the GWH market

Despite the recent history of increasing efficiency and the prospect of further improvements, the market for gas water heaters may still be regarded as failing to minimise the lifecycle costs of providing domestic hot water. We deal here with issues of imperfect information and split incentives. Section 1.7 deals separately with the question of whether an the ETS that are proposed for Australia and New Zealand will overcome these impediments.

Imperfect information
Consumers are self-motivated to minimise the cost of hot water services, including the energy costs, but cannot do so without good information. However, fairly demanding calculations are required to make a fully informed assessment of alternative water heaters. It requires information about future heated water loads, the efficiency of alternative water heaters, the relationship between heated water loads and efficiency, energy prices, asset lives and discount rates, a good basis for trusting the sources of such information, and the ability to do the arithmetic. The question is the extent to which households are able to 'do the sums' in this way. We have considered the following matters.

Infrequent purchases and aggregated energy bills
Lack of prior information is not critical where consumers have opportunities to learn quickly and cheaply from experience and experimentation. For example, consumers can get rapid feedback on their choice of coffee: each purchase is relatively cheap and feedback on the product, via tasting, is immediate. In contrast, water heaters have

relatively long lives of about 10-15 years and are purchased infrequently, and feedback on energy performance is impeded by the fact that (a) consumers are not billed separately for the energy used by each appliance, (b) the energy bill is also periodic, at intervals of 2 or 3 months, and (c) the interpretation of energy bills is complicated by seasonal variation in energy consumption and the payment of varying marginal tariffs under block tariff arrangements. Water heaters are therefore at the more difficult end of the spectrum of purchasing decisions. Specifically, a water heater is more a 'credence good' or an 'experience good', as opposed to a 'search good'[16].

- The attributes of a search good can be determined prior to use, for example, a greeting card.
- The attributes of an experience good can be determined only with use, for example, motor vehicles and other durables that consumers value for their whole-of-life performance, including ongoing reliability and costs of operation and maintenance.
- The attributes of credence goods may never be discovered – for example, a medical procedure – or may be determined only after a very long delay.

The intrinsic characteristics if water heaters are such that much depends on the quality of the pre-purchase assessment of options. Consider that, for typical GWH that will be affected by the regulation, the lifetime energy costs comprise about 74% of the total lifetime costs of the heater.[17] The remaining 26% is the capital cost of the heater. Energy costs should therefore be a significant consideration in the purchase decision, given almost three times more weight than the capital cost.

Sizeable minority without the required pre-purchase assessment skills
With respect to the pre-purchase assessment of water heaters, it is reasonable to expect that some proportion of the population does not have the required skills in gathering and analysing information. While E3 has not directly tested these specific skills in the general population, results of the ABS survey of adult literacy and life skills (ABS Cat 4428.0) indicate that a significant minority would find it difficult to gather the required information and make the required calculations. Specifically, on tests of literacy and numeracy, the ABS estimated that the following proportions of the adult population in private dwellings are at Level 1 or Level 2, on a scale from Level 1 to Level 5 where Level 1 is the least skilled and Level 5 is the most skilled.

- prose literacy – 46.4%
- document literacy – 46.8%
- numeracy – 52.5%

To have a sense of what these numbers mean it is necessary to review the Level 3 tasks: these are the 'next most difficult' tasks that could <u>not</u> be performed by survey respondents on Levels 1 and 2. Examples of the Level 3 tasks are provided in a report jointly published by Statistics Canada and the OECD – *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*[18] – and the interested reader should refer to that publication

[16] This distinction originated with an article by Philip Nelson (Nelson 1970).
[17] The details of this calculation for a typical heater are as follows:
- The average new heater costs about $909, including GST.
- Annually, a 3.4-star heater uses 24,000 MJ of gas under standard test conditions. At the Australian average price of 1.38 cents/MJ, the annual cost is $324, including GST.
- Over a life of 13 years, and discounting future costs at 7.5% a year, the present value of the annual gas expense is $2,633.
- The total lifetime cost is therefore $3,542, split 74%:26% between energy and capital costs.

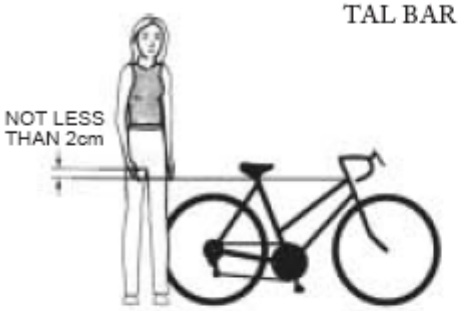
[18] http://www.oecd.org/LongAbstract/0,3425,en_2649_37455_34867439_1_1_1_37455,00.html
The International Adult Literacy Survey (IALS) was a large-scale co-operative effort by governments, national statistical agencies, research institutions and the Organisation for Economic Co-operation and Development (OECD). The development and management of the survey were co-ordinated by Statistics Canada and the Educational Testing Service of Princeton, New Jersey.

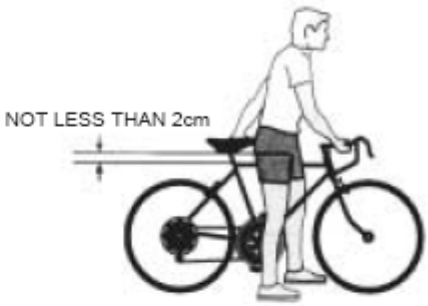
for a detailed explanation. For the purposes of this RIS, however, the following indicate the difficulty of Level 3 tasks.

- Prose literacy: One of the prose literacy tasks at the lower end of Level 3 refers the reader to the following page from a bicycle's owner's manual to determine how to ensure the seat of a bicycle is in the proper position. The respondent needs to identify, in writing, that the seat is in the proper position when the sole of rider's foot is on the pedal in its lowest position and the rider's knee is slightly bent.

PROPER FRAME FIT

RIDER MUST BE ABLE TO STRADDLE BICYCLE WITH AT LEAST 2 cm CLEARANCE ABOVE THE HORIZONTAL BAR WHEN STANDING.





NOTE: Measurement for a female should be determined using a men's model as a basis.

PROPER SIZE OF BICYCLE

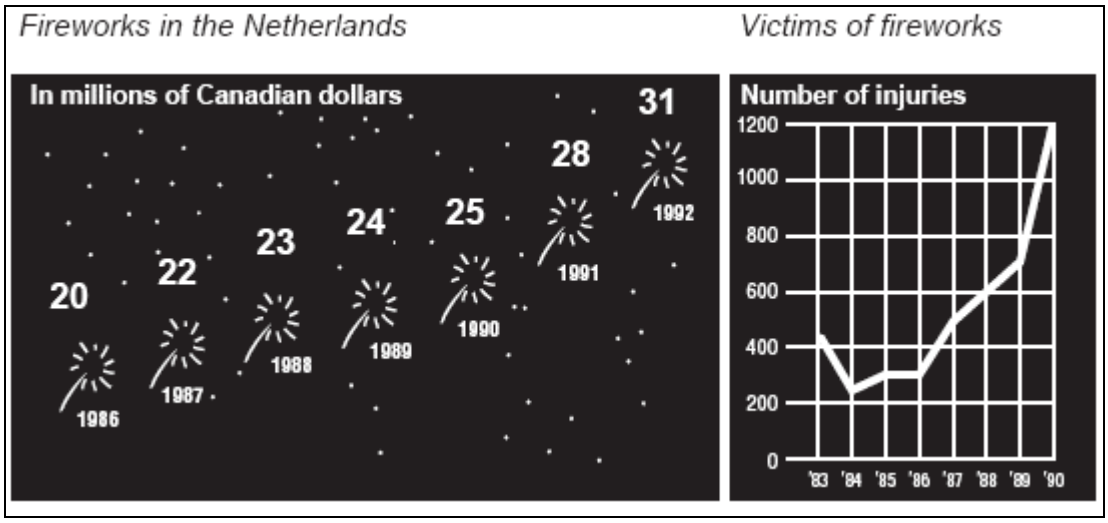
FRAME SIZE	LEG LENGTH OF RIDER
430mm	660mm-760mm
460mm	690mm-790mm
480mm	710mm-790mm
530mm	760mm-840mm
560mm	790mm-860mm
580mm	810mm-890mm
635mm	860mm-940mm

OWNER'S RESPONSIBILITY

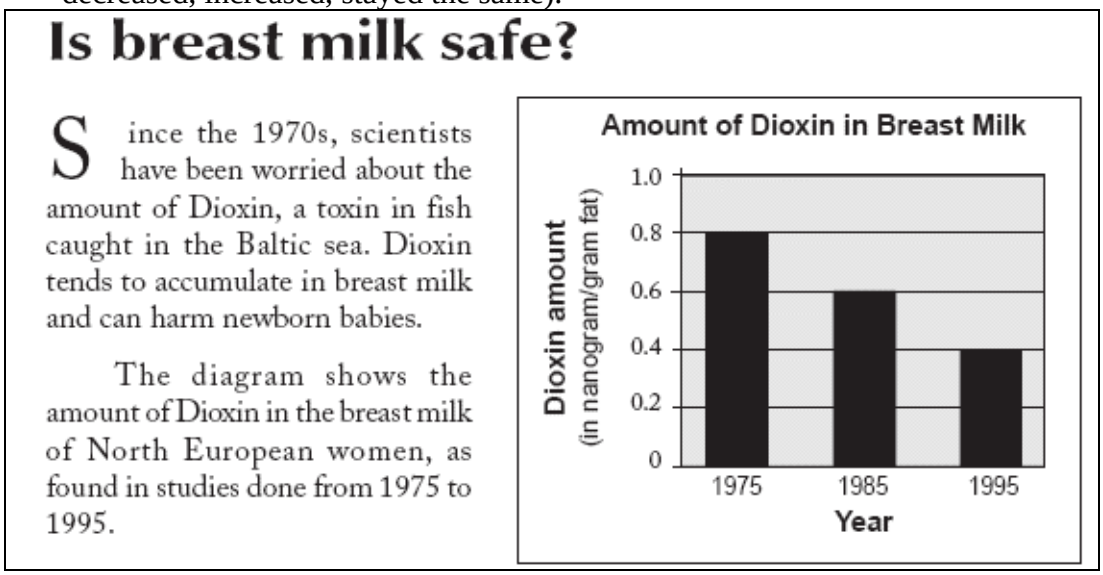
1. **Bicycle Selection and Purchase:** Make sure this bicycle fits the intended rider. Bicycles come in a variety of sizes. Personal adjustment of seat and handlebars is necessary to assure maximum safety and comfort. Bicycles come with a wide variety of equipment and accessories . . . make sure the rider can operate them.
2. **Assembly:** Carefully follow all assembly instructions. Make sure that all nuts, bolts and screws are securely tightened.
3. **Fitting the Bicycle:** To ride safely and comfortably, the bicycle must fit the rider. Check the seat position, adjusting it up or down so that with the sole of rider's foot on the pedal in its lowest position the rider's knee is slightly bent. Note: Specific charts illustrated at left detail the proper method of deter-mining the correct frame size.

The manufacturer is not responsible for failure, injury, or damage caused by improper completion of assembly or improper maintenance after shipment.

- Document literacy: A document literacy task from the middle of Level 3 required the reader to look at the following charts involving fireworks from the Netherlands and to write a brief description of the relationship between sales and injuries based on the information shown.



- Numeracy: One of the numeracy tasks at the lower end of Level 3 referred to the following graph and accompanying text on the levels of dioxin in breast milk. Respondents were not required to calculate the amount of change over each of the periods, just describe in their own words the change in the levels of dioxin (e.g., decreased, increased, stayed the same).



These Level 3 tasks in literacy and numeracy seem relatively easy in comparison to the tasks that are required to make an informed assessment of alternative water heaters, indicating that a significant minority of the population would not be confident about making such assessments.

We also note that a numeracy task involving compound interest was assigned to Level 5.

The ABS survey also tested problem solving ability but, unfortunately, the source documentation (Statistics Canada *et al*: 2005) does not report the degree of problem solving that characterises Level 1 and Level 2. However, one of the scenarios used to assess problem solving was the planning of a family reunion, which involved the completion of a set of tasks that seems no more demanding than making an informed assessment of water heaters. The specific tasks for the respondent were to:

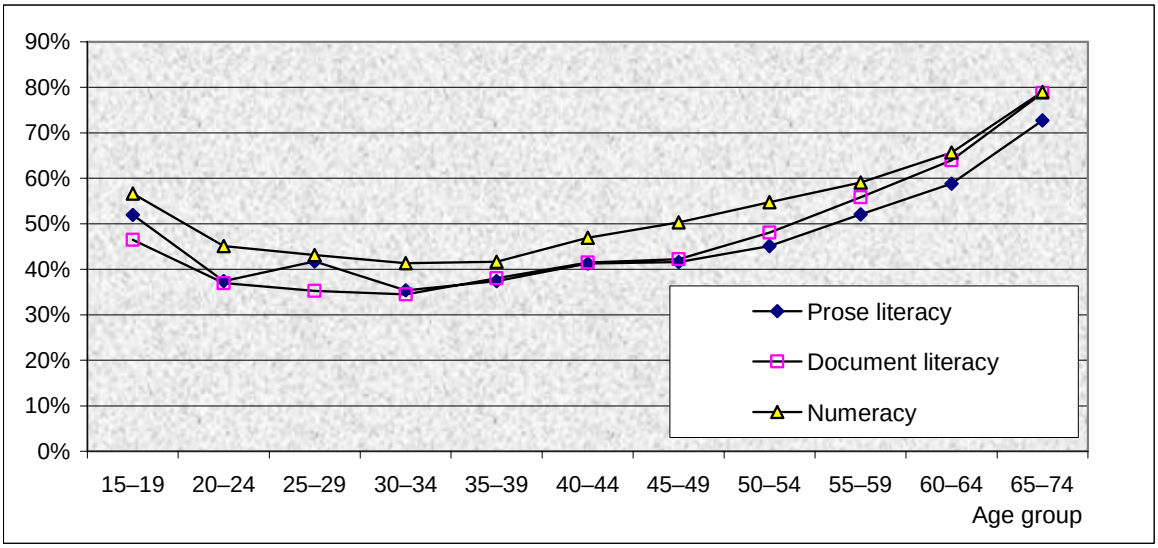
- set the date for the reunion allowing for the prior commitments of six relatives
- consider relatives' suggestions for a specific outing (a hike) and decide on a convenient location for the outing

- plan what needs to be done before booking your flight
- answer relative's questions about travelling by plane
- book your flight
- make sure your ticket is correct
- plan your own trip to the airport

The ABS found many could not complete all of these planning tasks – 34.9% of Australians were at Level 1 on problem solving and 70.1% were at Level 1 or Level 2, but now on a scale of Level 1 to Level 4. This suggests that at many Australians cannot confidently assess energy efficiency issues that seem to be of at least commensurate difficulty, such as the assessment of water heaters.

Other general findings are that skill levels are positively related to education and labour force participation, and negatively related to age beyond 30 years. Figure 1.13 reports the latter finding.

FIGURE 1.13 PROPORTION OF AUSTRALIANS AT SKILL LEVELS 1 OR 2*, BY AGE



Source: ABS Cat 4882.0 *Adult skill and life skills survey*
Note:
* For each literacy domain, proficiency is measured on a scale ranging from 0 to 500 points. To facilitate analysis, these continuous scores have been grouped into 5 skill levels with Level 1 being the lowest measured level of literacy.

Urgency of heater replacements
Water heaters generally fail without warning and, because heated water is a basic need, replacement becomes an urgent matter. This is reflected in the prominence of advertisements for 'same day' replacement services. This suggests that it is often difficult for consumers to assess energy efficiency to the degree that they may otherwise prefer.

Importantly, the market for GWH with less than 5 stars is primarily a replacement market.

Split incentives
There are circumstances where water heater selections are delegated to people who do not pay the energy bills and may avoid the consequences of a poor decision, creating a problem of split incentives. In a recent report on 'principal-agent' problems in energy efficiency decisions, the International Energy Agency (IEA 2007) explained the problem as follows.

> *Split incentives occur when participants in an economic exchange have different goals or incentives. This can lead to less investments in energy efficiency than could be achieved if the participants had the same goals. A classical example in energy efficiency literature is the 'landlord-tenant problem', where the landlord provides the tenant with appliances, but the tenant is responsible for paying the energy bills. In this case, landlords and tenants face different goals: the landlord typically wants to minimise the capital cost of the appliance (with little regard to energy efficiency), and the tenant wants to maximise the energy efficiency of the appliance to save on energy costs.*
>
> *Split incentives occur in the property ownership market, where many homeowners and businesses have limited incentive to invest in efficiency measures because they do not expect to stay in their building long enough to realise the payback from investments in energy efficiency. Split incentives also occur in the hotel industry, where the occupant seeks to maximise comfort and does not directly pay for the room's energy use. The hotel owner, on the other hand, does face the energy costs – which is why many hotels typically install compact fluorescent lamps and keys that deactivate a room's energy use when removed from their slots.* (IEA 2007: page 25)

The IEA report is an innovative attempt to quantify the split incentive problem in energy efficiency and includes a case study of residential water heaters in the US (IEA 2007: chapter 8). IEA found that there was little information on the selection of water heaters and it is fair to say that the resulting IEA estimates are little more than an educated guess. IEA assumed that there is a split incentive problem in the following circumstances.

- water heaters installed in a rental dwellings;
- water heaters installed in a new owner-occupied dwellings; and
- emergency replacement of water heaters in owner-occupied dwellings

On this figuring, 87.5% of the installed stock of water heaters is subject to some form of the split incentive problem. IEA takes for granted that there will be no serious consideration of energy efficiency options for emergency replacements, which are assumed to account for 60% of replacement decisions.

IEA may have overstated the problem but too little is known about the selection water heaters to make a more definitive estimate. Split incentives remain a significant problem even if confined to rental properties. Based on a special tabulation from the 2005 ABS survey of environmental issues (ABS Cat 4602.0), 26% of dwellings with GWH are rental properties.

It may be argued that renters can penalise poor decisions by seeking out more energy efficient properties for rent or purchase, but it requires them to be informed and vigilant and to incur extra search costs. However, while we are not aware of any systematic study of renter behaviour in this respect, it seems reasonable to assume that renters who have difficulty in assessing the financial case for energy efficiency have even more difficulty in converting that assessment into a rental premium for energy efficient properties. IEA also pointed out that landlords can simply remove energy labels or unscrupulously make false claims that appliances are efficient (IEA 2007: page 33). It is subsequently difficult for renters to verify performance and enforce their rights in respect of such claims.

Market failure and the BAU scenario

Market failures are factored into our account of outlook under BAU conditions, as expressed in sections 1.3 and 1.4. In the Australian market for example:

- We have allowed for only a modest continuation of the recent shift in the market towards 5-star GWH. The market share of GWH with less than 5 stars is 25% in 2020, down from about 35% in 2005.

- The average efficiency of new GsWH is only 4.3 stars in 2020.
- There will be almost a complete renewal of the installed stock of GWH in the period to 2020, but its average efficiency is still less than 5 stars.

Suppliers should examine this analysis of probable developments under BAU conditions, and argue the case for any alternative assessment of the probable future.

1.7 Role of energy efficiency programs after CPRS is introduced

In 2007, the Australian Government formally announced its intention to introduce a Carbon Pollution Reduction Scheme (CPRS, previously known as the Emissions Trading Scheme) by 2010. Economic literature suggests such a scheme can be used as an effective policy tool for internalising the costs associated with greenhouse gas emissions. However, even under a CPRS, there may still be a role for complementary policies.

Energy efficiency measures have been proven in some circumstances as a cost-effective method for households and businesses to reduce energy consumption while delivering greenhouse gas abatement. All other things being equal, the increase in costs of energy resulting from a CPRS should encourage households and businesses to improve the efficiency of their energy use. However, in some instances, market failures and/or other factors may act to mitigate some of the impacts of a CPRS, and therefore complementary energy efficiency measures may be appropriate.

For example, the presence of split incentives (such as between building owners and tenants) may lessen the effectiveness of a CPRS in delivering an 'optimal' investment in energy efficiency in tenanted dwellings.

In other instances, the transactions costs of investing in energy efficiency may outweigh the marginal benefits of such investments, even in a CPRS environment. For example, the potential energy savings to consumers may be small, relative to the time and effort required to calculate the associated life cycle costs when purchasing a product. In this circumstance, it is possible that a CPRS will not deliver an optimal investment in energy efficiency. A similar situation can arise if there is imperfect information, such as a lack of comparative energy consumption data on energy bills.

Taking into account the above factors, in some situations it is possible that the increase in electricity prices induced by a CPRS may result in a relatively small rise in demand for energy efficient products. Therefore it is possible that the carbon abatement costs induced by complementary energy efficiency measures may be lower than those induced solely under a CPRS. In such cases, it may be beneficial to consider energy efficiency policies, including MEPS and energy labelling, in conjunction with a CPRS.

CPRS and the market for gas water heaters
CPRS will not adequately address failures in the market for gas water heaters. This is because there is nothing in CPRS that deals directly with the underlying market failures. Specifically, CPRS does not:

- reform energy metering and billing practices in a way that provides users with prompt feedback on amount and cost of the gas that is used but their water heater;
- improve the literacy and numeracy skills of users to the point where they can calculate the costs and benefits of more efficient water heaters;
- motivate landlords to provide more efficient water heaters that will reduce the energy bills paid by tenants; or
- provide users with more time to consider their options when faced with an urgent need to replace a water heater that has failed.

It follows that measures such as MEPS and energy labelling may continue to assist users in their efforts to manage energy costs pressures, including the additional pressures that that a CPRS will impose.

2 Objectives of government action

2.1 Objective

The objective of the proposed MEPS is to contribute to cost-effective greenhouse abatement in Australia and New Zealand.

2.2 Assessment criteria

Abatement measures that do not increase the life-cycle cost of appliances are considered to be cost-effective. This means that the value of the energy savings to the user is not less than the incremental purchase price of a more efficient appliance and the 'no regrets' criterion is satisfied. The contribution to abatement is implicitly valued at zero.

MCE has determined that it will also consider greenhouse abatement measures that have a net financial cost to Australians and New Zealanders, provided the net cost (per tonne of CO_2-e) is not higher than the cost of abatement achieved by other programs. This recognises that regulatory proposals can deliver a net benefit to the community despite an increase in financial costs, and implicitly puts a positive value on the contribution to abatement.

While MCE has not defined the maximum price that it is willing to pay for greenhouse abatement, this RIS provides some supplementary figuring that assumes a value of $10-20/tonne – see appendix F.

Several secondary assessment criteria are also applied:

1. Does the option address market failures?
2. Does the option minimise negative impacts on product quality and function?
3. Does the option minimise negative impacts on manufacturers and suppliers? For example, the measures need to be clear and comprehensive, minimising the potential for confusion or ambiguity for users and suppliers.

3 Options that may achieve the objectives

This chapter explains the need to revise the method of testing that is used to determine the energy ratings of GWH (section 3.1), explains the proposed regulation (section 3.2), examines possible alternatives (3.3), and shortlists the options that are considered feasible (3.4). The shortlisted options 'go forward' to impact assessment in chapters 4 and 5 for Australia, and chapters 6 and 7 for New Zealand.

3.1 Revision of the energy rating test

The GWH addressed in this proposal must comply with Australian Standard *AS 4552 – Gas fired water heaters for hot water supply and/or central heating* for safety, performance and energy requirements. Standards Australia committee AG-001 is preparing a new energy test procedure for gas water heaters which will form the basis of future government regulation for energy efficiency. That work, including a new energy test method and an associated regulatory standard (to be published as a separate standard number) will be finalised in late-2008, including all consultation procedures.

A major focus for this work is the revision of the energy test method. Particular concerns about the existing energy test, which dates from the early 1980s, are that:

- It is unnecessarily cumbersome and costly.
- There is unacceptable variation in the results reported by different laboratories.
- Several errors and ambiguities of a technical nature have been identified which result in larger than expected uncertainty for some key parameters.
- An accurate result for the start-up phase of instantaneous water heaters is difficult. This is critical to the comparative rating of GsWH and GiWH, since they differ significantly in their start-up configuration and behaviour.

The E3 Program is providing significant financial, technical and administrative support for the work, including funding for laboratory tests and analysis. E3 intends that the new standard, particularly the energy test method, will provide a sound basis for the implementation of mandatory government regulated minimum energy performance standards.

3.2 Proposed regulation

The existing Australian Standard AS 4552 imposes certain minimum requirements on the efficiency of gas burners and on the rate of gas consumption needed to maintain the temperature of stored hot water. In effect, these requirements impose MEPS of almost 2 stars under AS 4552-2005.[19] The proposal addressed in this consultation RIS is to adopt one of two main options to significantly increase the MEPS, referred to hereafter as Option 1 and Option 2. The first option has two sub-options related to timing and transition arrangements – Options 1A and 1B. E3 does not express a preference for a particular option at this stage but will formulate its recommendation in the light of stakeholder responses to this consultation RIS.

[19] Under AS 4552-2000, the base MEPS requirement was 1 star for a standard storage unit. The maximum start-up energy for instantaneous systems is not specified in the standard, so there was no real minimum star rating. An increase of the minimum permitted burner efficiency from 70% to 75% was introduced in the 2005 edition. The vast majority of products certified by AGA to date will be to the 2000 edition of the standard and hence the nominal 1-star minimum efficiency.

3.2.1 Option 1A – 5 stars from October 2009

The first option is to raise the MEPS to a level that is equivalent to 5 stars under AS 4552-2005 from October 2009. Under standard test conditions, a 5-star GWH uses 20,808 MJ/year of gas. The precise details cannot be known until the new standard is finalised, which means that the option is expressed as the intention to impose an MEPS that employs the new test method and standard for compliance purposes, and that the new MEPS will be broadly equivalent to 5 stars under the existing test and standard.

Transitional arrangements
Transitional arrangements are proposed for GWH that are certified to the existing standard before October 2009. This means that there are two categories of product for regulatory purposes:

- Category 1: These are GWH that are certified to the existing standard before October 2009. They can be imported or manufactured to October 2010 if they have energy ratings of at least 5 stars under the existing standard, and can continue to be imported or manufactured thereafter if they achieve the corresponding energy rating under the new standard.
- Category 2: All other GWH must be certified to the new standard, including MEPS at the equivalent of 5 stars.

The new standard will be available for certification purposes as soon as it is finalised in 2008 and the intention is that it will become the sole standard for new certifications after October 2009.

In giving the undertaking that the new MEPS will be broadly equivalent to 5 stars under the existing standard, the intention of the E3 Program is to minimise uncertainty caused by the fact that the new standard is not yet available. Suppliers can confidently plan on the assumption that 5-star products that are certified to the existing standard will, at most, need only minor adjustments to be certified to the new standard.

3.2.2 Option 1B – 5 stars from December 2010

This option is essentially to delay Option 1A by 15 months, to December 2010, but there would be no transitional arrangements allowing extended use of the existing test method. All GWH that are imported or manufactured after December 2010 would have energy ratings that are '5-star equivalent' under the new standard.

The effect of Option 1B is to give suppliers more notice and adjustment time in the first instance, but to accelerate the phase-out of the existing test method.

3.2.3 Option 2 – 4 stars from October 2009 & 7 stars from April 2013

The second option is to significantly reduce the MEPS that will be required in the short term, to '4-star equivalent' (22,831 MJ/year), but to commit to the introduction of MEPS at '7-star equivalent' (16,762 MJ/year) as soon as is practicable after April 2013. Again, we refer to star ratings that would be determined under the existing labelling scheme, even though a 7-star rating is beyond the maximum of 6 stars that is now assumed for the purposes of the existing labelling scheme.

Note that the timing of the second stage MEPS is formally put as 'not earlier than' April 2013. This recognises the uncertainty about when a '7-star equivalent' MEPS will be economically feasible. E3 puts the proposal on the understanding that this is a reasonable timeframe for the required product development and that any delay beyond 2013 will be minimal.

Transitional arrangements are proposed for the first stage of Option 2, applying to GWH that are certified to the existing standard before October 2009. This means that there are two categories of product for regulatory purposes:

- Category 1: These are GWH that are certified to the existing standard before October 2009. They can be imported or manufactured to April 2010 if they have energy ratings of at least 4 stars under the existing standard, and can continue to be imported or manufactured thereafter if they achieve the corresponding energy rating under the new standard.
- Category 2: All other GWH must be certified to the new standard, including MEPS at the equivalent of 4 stars.

3.2.4 Labelling

The information provided on energy labels can help consumers to make better decisions and, for GWH, labelling commenced in Victoria in 1981. By 1995 the labelling scheme had evolved into its current form as a national mandatory program that is administered by the AGA. The label has a 6 star design that is visually consistent with the electrical label that is used for electrical appliances but has a different colour.

E3 has noted that, in feedback on the CBA, a number of suppliers supported the continuation of the mandatory labelling scheme in Australia and for its extension to New Zealand. None expressed a contrary view.

E3 agrees that labelling should continue but considers that the labelling scheme needs to be reformed. E3 does not have a specific proposal at this stage but invites comment on the general approach outlined here. Specifically, it is proposed that the energy star ratings be recalibrated to better reflect the range of feasible efficiencies. E3 considers that water heaters with borderline compliance should be assigned no more than 1.5 or 2 stars, which means that heaters that are now labelled as 5-star would be reassigned to this lower level. E3 also considers that there should be a meaningful gap between heaters with borderline compliance and those that achieve the higher levels of efficiency that can be achieved with gas condensing technology. There would need to be a gap of 2 or 2.5 stars between the lower and higher levels of efficiency.

In the event that Option 2 is selected, E3 considers that GWH with borderline compliance at ‘4-star equivalent’ should be assigned no more than 1 star.

It is recognised that recalibration of the energy rating scale can disrupt marketing arrangements and strategies, particularly where there are perceptions that products and suppliers have been downgraded. E3 undertakes to work with suppliers to facilitate the introduction of a recalibrated rating scale and to minimise the potential for misunderstanding. Energy labelling will be incorporated in the standards that the Australian and New Zealand jurisdictions use to regulate for MEPS.

3.2.5 Exclusions

The following types of GWH are excluded from the proposal:

1. GsWH with a gas consumption rate in excess of 50 MJ/hour.
2. GiWH with a gas consumption rate in excess of 250 MJ/hour.
3. GsWH with a storage capacity of less than 30 litres.
4. GiWH with a nominal delivery rate of less than 7.5 litres per minute.
5. Internal GsWH.

The first two exclusions govern the labelling requirements of the existing standard and, as yet, no consideration has been given to the testing requirements that may be appropriate for GWH that are outside these limits.

The second two exclusions have the effect of excluding GWH that are designed primarily for caravans, mobile homes and recreational vehicles generally.

The final exclusion is in recognition of unresolved challenges in the manufacture and installation of internal GsWH that are significantly more energy efficient than existing products, and doubts about whether the small volume of sales justifies the effort. E3 welcomes the undertaking by Rheem New Zealand to examine its energy efficiency options and recognises that Rheem New Zealand has only asked for an exemption to 2010. However, the appropriate MEPS are unknown and, at this stage, E3 intends to exclude internal GsWH from this MEPS proposal.

All the exclusions are provisional. The E3 Program will review the first four later, with a view to broadening the MEPS to include larger commercial and industrial appliances, central heating boilers, boilers that are used to provide both central heating and a hot water service, and appliances for mobile applications.

Regarding the exclusion for internal GsWH, E3 will ask Standards Australia committee AG-001 for advice on the suitability of existing test methods and the appropriate level of MEPS in order to meet the E3 Program criteria of feasibility and cost effectiveness. MEPS will not be applied to internal GsWH before October 2010.

3.3 Alternative policy options

The BAU or 'do nothing' alternative is implicitly short-listed. It provides the base case against which all feasible options are compared. The remaining options are to vary the level or timing of the MEPS, adopt alternative regulatory forms, use market-based instruments such as taxes or subsidies to either penalise the selection of less efficient heaters or reward the selection of more efficient heaters, or use information and education campaigns to influence consumer behaviour.

3.3.1 Level of the MEPS

This review of issues relating to the level of the MEPS is organised to explain overseas MEPS, review overseas initiatives relating to the next generation of GWH, and explain how E3 has assessed the alternatives.

Overseas MEPS
The only other IEA countries to have mandatory MEPS for gas water heaters are Canada, the US and the European Union (IEA 2003: table 2.1). This discussion is confined to the most recent of these, which are the US MEPS adopted in January 2004, and since adopted by Canada.

Differences in testing methods means that it is difficult to make comparisons but, based on a 2002 report to Sustainability Victoria (MEA *et al* 2002), the US MEPS are in the range 3-4 stars. (The differences in the testing regime are such that it is not possible to be more precise.) The MEA report recommended MEPS at about the same level for Australia. However, it should be noted that:

- The MEA report said that only a couple of models would meet the 2004 US MEPS (MEA *et al* 2002: page 26). The situation has now changed. There is a considerable range of products with 5-star ratings – see figures 1.1 and 1.2.
- The MEA report said that a large number of models in both Canada and the US already complied with the 2004 US MEPS, demonstrating that they were clearly feasible (MEA *et al* 2002: page 26).

- In November 2006 the US EPA commenced another round of rule-making for residential water heaters, intending to further increase the US MEPS.
- We approached US government and industry sources for information about the impact of the 2004 MEPS and were told that no price or other effects were observable. This suggests that the 2004 US MEPS had minimal effect on the efficiency of water heaters.

It seems likely that the US and Canadian MEPS have had minimal impact, requiring that the issue be reopened.

Overseas initiatives addressing the next generation of GWH

SEGWHAI targets - USA

The Super Efficient Gas Water Heating Appliance Initiative[20] (SEGWHAI) aims to develop and implement the next generation of cost-effective, high-efficiency, replacement GsWH, for residential applications in the US. The early work done by SEGWHAI has been funded by the California Energy Commission's Public Interest Research Program (PIER). The project steering committee includes representatives from the three major water heater manufacturers in the US, industry organisations, state regulators, gas utilities and industry experts. It seems that SEGWHAI's main output so far is a report on the market development activities that would be needed to extend high efficiency technologies into the residential market, including the specification of Tier 1 and Tier 2 energy efficiency criteria (Valley Energy Efficiency Corporation 2007).

The proposed market development activities are not regulatory, at least at this stage. They seem to comprise:

- efficiency criteria that provide a focus for product development;
- ENERGY STAR® specifications for gas storage water heaters;
- funding support for product development;
- financial incentives for product purchase, mainly utility customer rebates and government tax credits; and
- institutional and stakeholder networking.

Table 3.1 reports the proposed energy efficiency criteria. The Tier 1 criterion (Energy factor[21] (EF) = 0.70) is at the low end of the range of efficiencies that SEGWHAI says could be achieved by non-condensing gas storage water heaters. The feasible upper limit for such technologies is considered to be EFs in the range 0.72-0.77. A GsWH achieves Tier 1 by replacing standing pilot with spark ignition; dampered flue (takes to EF of 0.72); better/more tank insulation; low leakage flue dampers or induced draft blowers (takes EF to 0.76). Another approach is to marry a tankless unit with a standard storage unit, and add heat traps. This is called the 'side arm' option. (See Valley Energy Efficiency Corporation 2007: pages 89-90.)

The Tier 2 SEGWHAI scenarios involve a helical internal flue, maximum insulation or a 'side arm'[22], taking EF to 0.82, 0.85 and 0.89 respectively.[23]

[20] http://www.segwhai.org/

[21] The energy factor is the ratio of 'output energy' to 'input energy' under the test conditions employed in the US and Canada.

[22] We have not found anything in the SEGWHAI report explaining how the side arm differs between the Tier 1 and Tier 2 scenarios. See Valley Energy Efficiency Corporation 2007: page 90.

[23] Actually, SEGWHAI report is somewhat confusing. In other places it says the maximum EF for a non-condensing heater is 0.7 and that a medium efficiency condensing heater has an EF of 0.82. See page 19. Hopefully, these matters will be sorted out when the report is finalised. We have the April 2007 version and the 'final final' has not been released.

TABLE 3.1 US ENERGY EFFICIENCY CRITERIA

	Rated volume	
US gallons	40	50
litres (equivalent)	151	189
	US energy efficiency criteria (Energy Factor)	
1991 US MEPS	0.54	0.53
2004 US MEPS	0.59	0.58
SEGWHAI Tier 1	0.70	0.70
ENERGY STAR®	0.80	0.80
SEGWHAI Tier 2	0.82	0.82
	% energy savings relative to 2004 US MEPS	
SEGWHAI Tier 1	15.1%	17.9%
ENERGY STAR® & Federal tax credits	25.8%	28.1%
SEGWHAI Tier 2	27.6%	29.9%

US ENERGY STAR®

In a recent draft analysis of the ENERGY STAR® criteria for gas water heaters, USEPA has proposed a minimum EF of 0.80 (USEPA 2007). This applies exclusively to GiWH and to condensing GsWH. ENERGY STAR® is allowed to 'pick winners'.

This is also the Energy Factor that triggers a $US300 tax credit from the US Federal Government. At present the only qualifying models are GiWH. All the available condensing GsWH exceed the size limit for residential appliances.

Eco-Design for Water Heaters - Europe

Eco-Design for Water Heaters (EDfWH) is a study commissioned by the European Commission and undertaken by a Netherlands-based consultancy, Van Holsteijn en Kemna (VHK). EDfWH is a comprehensive study with reports now in their draft final form, and dated July 2007 – see http://www.ecohotwater.org/. The latest reports of consultation meetings, available from the website, suggest that there is significant further work to do and that final recommendations will be published in 2008.

The study has defined a basecase (task 5) and identified short-term target design options (part of task 6), pinpointing solutions with the least life cycle cost (LLCC) and the Best Available Technology (BAT). VHK also identified the NBAT (= Best Not yet Available Technology). In policy terms, these are described as follows (VHK 2007: task 6, page 1):

- LLCC technology – plausible target for MEPS
- BAT – medium target more suited to promotion measures than regulation
- NBAT – long-term possibilities that help define scope and nature of possible measures

EDfWH finds that condensing technology does not yet qualify as LLCC and is not suitable for MEPS. The technology has reached the European market for GsWH, but all models mentioned seem to have at least 200 litres of storage capacity. The 'Cyclone' model, manufactured by AO Smith, has storage capacity of 227 litres (60 US gallons) and may be the smallest. Condensing technology has also been applied to GiWH in Europe. But the examples given are even bigger and seem unsuitable for domestic use.

Rest of the world

The task 1 report in the EDfWH series includes a comprehensive review of regulatory arrangements around the world, including Asia and North America. Key findings are:

- The Japanese Top Runner program set the 2006 energy efficiency target for GiWH at 'close to condensing' – 83%. Importantly, this is a sales-weighted average and would require a proportion of sales to exceed the target.
- Japanese utilities are pushing for sales of 3.5 million condensing water heaters by 2010. The volume of sales suggests they are domestic units.
- China is reportedly contemplating MEPS for GiWH, at 88% in 2008 and 95% in 2015. Average efficiency is currently 86.9%.

There is uncertainty about how these metrics relate to US and Australian measures.

How E3 has assessed alternative MEPS for Option 1

The only practical alternatives for Option 1 are 4 stars and 5 stars. Consider that:

- It makes no sense to go lower than 4 stars because almost all products with less than 5 stars are in the range of 3 to 4 stars. They average 3.23 stars and it would be trivial to raise them to, say, 3.5 stars.
- It is not generally feasible to examine alternative MEPS at increments of less than 1 star, for example, introducing an option of 4.5 stars. E3 does not have access to the detailed cost information that would be needed to assess incremental costs and benefits at intervals of 0.5 stars.

To this point E3 has expressed a strong preference for MEPS of 5 stars, based on the following considerations:

- A 4-star MEPS would deliver minimal greenhouse abatement. In fact, several suppliers criticised the 5 stars proposal as delivering too little greenhouse abatement to justify the policy effort. It is reasonable to expect that they would have little patience with analysis designed to test the case for a lesser intervention.
- There is already a considerable range of 5-star products on the market.
- The 4-star market has been all but vacated[24] and it seems more sensible to build on the available 5-star products than to repopulate the 4-star market.
- Only niche products would need to be excluded from a 5-star MEPS. It makes no sense to sacrifice about 50% of the gains to increase product coverage by less than 5%.
- E3 had offered a concession for products certified to the existing standard, allowing those with at least 4.5 stars to remain in the market for a limited period beyond October 2008. However, two suppliers who could take advantage of this concession – Dux and Rheem – said they preferred to go directly to 5 stars, but to have more time to make the adjustment. The proposal was modified accordingly.[25]
- Given recent and prospective development of gas water heating technology, it would be necessary to revisit the issue within a relatively short period.

How E3 has assessed alternative MEPS for the second stage of Option 2

[24] The sole exception is Dux, which recently introduced two GsWH models with ratings of 4 stars.

[25] The details are as follows:

- The concession that was put in the CBA was that (a) 4.5-star products certified to the existing standard before July 2007 could be manufactured or imported until October 2010, and (b) 4.5-star products certified to the existing standard in the remaining period to October 2008 could be manufactured or imported for only one further year, until October 2009.
- The revised proposal in this RIS dispenses with the July 2007 cut-off but raises the threshold. All products certified to the existing standard before October 2008 can be manufactured or imported until October 2010, but would need to be 5 stars.

It is reasonable to interpret the supplier response as signalling that they see little point in reopening the 4-star segment of the market on a temporary basis and would prefer to devote resources to preparations for the 'main game' in the medium term, which is to compete for the 5-star market.

In response to industry feedback on the CBA, E3 is now willing to consider a first round of MEPS at 4 stars provided there is a strong commitment to go to 7 stars at the earliest practical time. The overriding consideration for E3 is the proposition that (a) the development of a full range of 5-star products will absorb significant product development resources and competitive energy, and (b) these resources would be better directed at the next stage of product development, which is GWH in the vicinity of 7 stars. In effect, it is argued to E3 that 5 stars is a technological 'dead end' in terms of both energy efficiency and greenhouse abatement. E3 needs to understand this proposition more fully and strongly encourages suppliers to provide convincing evidence for both parts of the proposition.

E3 emphasises that its primary concern is greenhouse abatement and that the relative merits of options 1 and 2 will first be decided in terms of their contributions to timely and cost effective greenhouse abatement. If option 2 is found to be inferior from that perspective, issues of industry development and industry restructuring may then be considered. To inform any further consideration of industry issues that may be needed, a request for more detailed information on industry structure will be dispatched to relevant suppliers with this consultation RIS.

At this stage it is unclear whether gas condensing technology is generally required to achieve 7-star performance under the test conditions used in Australia. Suppliers are strongly encouraged to comment on the technological requirements.

3.3.2 Timing of the MEPS

The E3 Program intends to implement the proposals as soon as possible, given the constraints of program development, consultation processes and the need to give reasonable notice.

Option 1
October 2009 is the earliest feasible date for implementation but requires transition arrangements for products that have been registered under the existing standard. E3 recognises that there will be some uncertainty until the new standard has been finalised but considers that this is substantially mitigated by E3's undertaking to (a) make the new MEPS broadly equivalent to 5 stars under the existing standard, and (b) provide transition arrangements allowing 5 star products that are certified to the existing standard before October 2009 to be manufactured or imported to October 2010.

E3 anticipates that some suppliers will say that October 2009 is still too early, arguing that E3 has underestimated the uncertainties created by the changes to the energy rating test. E3 has therefore devised Option 1B, which provides a further delay of 15 months, and will formulate its final recommendation in the light of comments on the consultation RIS.

Option 2
Minimal changes to existing products will be required by the first stage MEPS, at 4 stars. E3 therefore considers that it is reasonable to reduce the transition period to six months for products that have been certified under the old standard. E3 invites comment but, based on discussions with suppliers, expects that there would be few objections to this arrangement.

The second stage MEPS, at 7 stars, has been expressed as 'no earlier than' April 2013. E3 considers that the case for Option 2 is severely undermined if the earliest timing for MEPS of 7 stars must be deferred significantly beyond 2013.

3.3.3 Information and education

GWH are subject to a mandatory labelling scheme that provides ratings from 1 to 6 stars. It is little known and understood by the public, but it could be reformed to better reflect the range of product efficiencies that are now available, and it could be better promoted for increased effectiveness. E3 has not given that work priority to this point but has responded

to supplier comments on the CBA by proposing a general approach to labelling reform, explained in section 3.1. Suppliers are invited specifically to comment on that approach.

In general, E3 uses energy labelling to complement MEPS, not as a substitute for MEPS. Labelling and MEPS have different roles, one being to encourage development of high efficiency options, the other being to put a floor under low efficiency. Also, E3-commissioned labelling reviews indicate that the gas labelling scheme has been considerably less effective than the labelling scheme for electrical appliances.

2006 Artcraft review

The most recent study (Artcraft 2006) found that only 15% of people were able to recall the gas label unprompted, rising to 20% when prompted. Even in Victoria, with the highest rate of gas connection (92%), prompted awareness is only 26%. Artcraft described the research methodology as follows.

> *With gas and water about to join electricity as resources covered by mandatory efficiency labelling, a series of quantitative studies were commissioned investigating awareness and use of the labels among the general public, recent buyers of appliances, retailers, and installers of appliances.*
>
> *A series of six surveys were designed and conducted, mainly by telephone using a structured questionnaire format. The overall study involved 3,460 members of the general public, (1,730 electrical appliance buyers, 1,730 gas appliance buyers in Australia and New Zealand) and 500 retailers and installers in Australia. Random sub-samples were drawn in each city using an electronic phone book with an inbuilt sampling function. At the analysis stage, data was weighted to realign the samples with population proportions. A sub-sample of 200 general public was interviewed face-to-face to validate questions on prompted recall of the labels, producing results within 1% of the main samples. The interviews were conducted in September and October 2005.* (Artcraft 2006: page 1)

These findings contrast with almost universal recognition of the energy label for electrical appliances. 94% of Australian consumers recall the electrical label unaided, rising to 96% when prompted, on a par with leading market brands and high profile celebrities. 88% of consumers say that they use the labelling information at some point in appliance selection processes.

Failure to recall the gas label would not be a problem if the replacement transaction occurred in a way that brought the label to the consumer's attention. However, it is unusual for consumers to see the gas label before purchase. Water heaters are not 'shop floor' items and do not have the same consumer exposure as other types of household appliance. And, as noted, the urgent need for a replacement limits the opportunity to absorb and assess labelling information.

Much then depends on whether the installers who are invited to quote are motivated to educate consumers about the range of products that are available, inviting them to stop and think about the possible advantages of buying a more expensive unit that is more energy efficient. We are sceptical about that prospect, mainly because of the urgency of most replacements, the lack of repeat business (at least for 10-15 years), and because the customer does not see the label. This suggests that there may be little opportunity or incentive for installers to establish their credentials to the level needed to promote energy efficiency or, indeed, any aspect of their product other than that it is an established brand at a good price and available for quick installation. But we have not examined the marketing behaviour of installers and invite suppliers to comment on the (a) strength of installer incentives to promote energy efficiency in the context of a replacement transaction, and (b) whether anything is to be learned by researching installer behaviour.

2000 GWA review

George Wilkenfeld & Associates assessed the effectiveness of the gas labelling scheme as it applied to GWH in the period to 1999 (GWA 2000). The following findings are relevant for this RIS.

- The model-weighted average efficiency of external GsWH was virtually unchanged over the period 1987-1999, at about 3.4 stars. The trend line is flat (GWA 2000: page 20). Importantly, external GsWH are the main focus of the proposed regulation.
- In contrast, the average for external GiWH improved steadily, increasing by 0.7 stars to 4.2 stars.
- It is apparent that suppliers often took the minimum step of raising the efficiency of products to the next 'whole star' level – for example, to 2.0 stars, 3.0 stars or 4.0 stars. This is indicated by the clustering of energy ratings at or slightly above the whole star ratings.
- The effect of labelling on buyer behaviour and average efficiency could not be established. Consumer response to the gas label had not been monitored to the same degree as for the electrical label.

Developments since 1999
The record of product registrations shows that the average efficiency of GiWH improved sharply after 1999, to the point where almost all GiWH now have energy ratings of 5-6 stars. The model-weighted average efficiency of external GsWH also improved modestly, to 3.7 stars, largely because GsWH suppliers expanded their range of 5 star products.

Our view is that exogenous technological improvement in the efficiency of GiWH has been the main driver, not labelling. The use of electronics has greatly improved the performance of GiWH, not just in terms of energy efficiency but also in terms of temperature and flow control. GiWH are not manufactured in Australia and these developments occurred overseas, independently of developments in the Australian market. The observed expansion in the range of GsWH with 5 stars appears to have been a supplier response to sharper competition from GiWH and it is likely that the existence of the labelling scheme has sharpened the need for a competitive response. This interpretation of recent developments has been put directly to a meeting of suppliers and was not contradicted.

It should also be noted that E3 has been discussing regulatory options with suppliers for several years and that may have prompted suppliers to expand the range of GsWH with 5 stars.

Overseas labelling programs
Compared with other types of appliances, labelling of water heaters is not a policy option that is used extensively in other countries. Of 30 countries that were reviewed by E3 in an earlier study of labelling and standards program (Harrington and Damnics 2001), only nine (30%) had labelling programs for water heaters. To the extent that labelling effectiveness is revealed by the implementation of labelling programs, the hierarchy is as follows:

1. Refrigerators – 30 countries (100%)[26]
2. Freezers, lamps – 21 countries (70%)
3. Clothes washers – 19 countries (63%)
4. Room air conditioners – 16 countries (53%)
5. Clothes dryers, dishwashers – 14 countries (47%)
6. Integrated clothes washer dryers, computers – 12 countries (40%)

[26] The study reported only on countries with labelling and standards programs. Labelling for refrigerators was the common element in all programs.

7. Copiers, fax machines, monitors – 10 countries (33%)
8. Ballasts, televisions, water heaters – 9 countries (30%)

Water heaters use much more energy than many other appliances that are much more likely to be subject to labelling. This suggests an adverse assessment of the effectiveness of labelling, confirmed by the Australian experience.

Conclusion
The bi-modal nature of the GWH market seems to have become entrenched, with the large majority of models and sales being at either 3 stars or 5 stars. Based on the above considerations, E3 considers that there is no reasonable prospect that a revived labelling scheme would have an impact on the sales of 3 star products that is comparable with the impact of MEPS, and several years would be lost in testing a doubtful proposition.

3.3.4 Appliance subsidies and levies

Another means of increasing the uptake of energy efficient products is to increase the life-cycle cost (purchase plus operating costs) of inefficient products, relative to their more efficient counterparts. One broad option is to impose a levy on energy purchases. Another is to impose a levy on the purchase of inefficient appliances or to subsidise the purchase of efficient appliances.

Three of the state governments – Queensland, Victoria and Western Australia – have subsidy programs that variously favour 5-star GWH or solar water heaters. (See appendix C for details). These are targeted programs that are aimed at replacing electric water heaters or encouraging take-up of solar water heaters. Requirements that replacement GWH be 5 stars are incidental to the main purpose of these interventions, which is to replace electric water heaters. The Queensland intervention is restricted to a limited number of households on a first-come-first-served basis. None of the programs aim to replace existing GWH with more efficient units.

In a review of policies for energy efficient homes, IEA says most of its members use a variety of policies but that the most widely adopted policies are information and awareness, labelling and MEPS, with the latter defined to include voluntary agreements. It says that other procurement programs and financial incentives are used much less frequently and for limited durations (IEA 2003: page 55). Financial incentives are mostly implemented by state and local authorities and by utilities, and take the form of rebates. This accurately describes Australia. The IEA report contains no examples of financial penalties (levies) on the purchase of inefficient household appliances.

Levies and subsidies have 'in principle' attractions relative to MEPS. In particular they would allow households with a particular preference for an inefficient appliance – on grounds of low use or costs of changeover – to obtain the preferred appliance by paying the levy or refusing the subsidy. Nevertheless, E3 has not examined the feasibility of deploying financial measures to influence consumer decisions for long periods in mass markets. The main reason to doubt that such work would be productive is the administrative complexity and rigour of an ongoing program that requires large amounts of money to change hands. Labelling and standards programs use existing regulatory mechanisms and are much less demanding on taxpayer funds

E3 believes that there would be no support for policy work of this kind and can only provide a more detailed analysis of such options if and when that situation changes.

Conclusion
E3 is unable to shortlist plausible options for market-based interventions, or provide detailed analysis of any such options. That would require extensive consultation at the highest levels of government and ultimately, like emissions trading, would require a change of policy at the national level.

3.3.5 Alternative regulatory forms

Regulatory forms with a substantial voluntary component

The proposed arrangement, relying on black-letter law, is standard operating procedure for the E3 Program. It uses the administrative and legislative machinery that is familiar to Australian and New Zealand industry, being Australian/New Zealand Standards and the legislative instruments that the Australian states and territories and New Zealand use to reference these standards and give them legal effect.

It has been the general experience of the E3 Program that suppliers do not respond to regulatory proposals with a substantial voluntary component – such as self-regulation, quasi-regulation or co-regulation. There is no tradition of government/industry co-operation on the matters under consideration, and no history of industry associations that exercise significant persuasive or disciplinary power to ensure compliance with commitments that are entered into voluntarily.

A related consideration is that, according to the local staff of foreign-owned companies, it is extremely difficult to induce head office to address such matters unless there is an explicit regulatory requirement in prospect.

This general lesson has been reinforced in the present case. When it became apparent in 2006 that there would be significant delays in revising the standard, the E3 Program proposed that suppliers devise a voluntary program of retiring the least efficient water heaters, and offered assistance to work through the issues. The supplier response was such that the E3 Program formed a view that there would be no significant voluntary change.

Voluntary agreements are used extensively in the European Union but not as a matter of preference. IEA has explained that:

> *Unlike for labels, there is currently no framework regulation for MEPS in the EU and thus each additional MEPS requirement has to be introduced as a separate piece of primary regulation. …*
>
> *Because of the arduous and time-consuming process of developing MEPS legislation for individual products, the Commission has often sought instead to negotiate voluntary agreements with industry. These implore the majority of manufacturers supplying the product to the EU market to either cease manufacture of less efficient equipment or raise the fleet average of their product lines or both. Thus far, negotiated agreements on seven products have been concluded. (IEA 2003: page 65).*

Water heaters are one product where the EU adopted the time-consuming process of developing MEPS legislation.

E3 has tried and failed to make progress on the basis of a voluntary agreement. It does not have a workable proposition to put forward for detailed analysis.

Building regulations

The Australian Building Codes Board is examining options for including hot water systems in the energy efficiency requirements of the Building Code of Australia. The New Zealand Department of Building and Housing is proposing that the existing provisions in the New Zealand Building Code be replaced with a requirement for overall system efficiency, covering both the performance of the water heater and the water delivery system. Such changes would include all electric, solar and heat pump technologies, not just gas. This creates an issue of how building codes are integrated with all manner of policies and programs, not just MEPS, for hot water systems.

E3 considers that the unresolved issue of integration should not delay a decision on the proposed measures. It is sensible for building regulators and product regulators to separately consider these issues. This is because new construction presents low cost 'greenfields' options for emissions abatement, unconstrained by the additional cost factors that often apply to the upgrading of existing buildings. Whatever the decisions taken by product regulators, building regulators should separately consider the standards that are appropriate for new buildings.

3.4 Shortlist of feasible options

Based on the above discussion, the only feasible options are to (a) maintain the *status quo* or (b) adopt one of the several options that have been put in section 5.2. These are:

- Option 1A: This option is to raise the MEPS for GWH to a level that is equivalent to 5 stars under AS 4552-2005 from October 2009, but using a revised test method and regulatory standard, with transitional arrangements for GWH that are certified to the existing standard before October 2009.
- Option 1B: This is the same as Option 1A except that implementation would be delayed by 15 months to December 2010 and the transitional arrangements would be abandoned.
- Option 2: The second option is to implement MEPS from October 2009 but to and significantly reduce the initial MEPS to '4-star equivalent' (22,831 MJ/year), reduce the transition period to 6 months, and commit to the introduction of MEPS at '7-star equivalent' (16,762 MJ/year) as soon as is practicable after April 2013.

4 Impact analysis: Option 1 - Australia

This chapter reports an assessment of the impact of imposing a 5-star MEPS on gas water heaters. It first deals with the expected contribution to greenhouse abatement (section 4.1). It then deals with each step in the process by which abatement is achieved, starting with the taxpayer-funded investment in program development (4.2), the compliance (red tape) costs incurred by business to responding to the program (4.3), the impacts on competition and trade (4.4), and the impacts on consumers (4.4). The chapter concludes with a summary statement of the net national impact and sensitivity analysis (4.6 and 4.7). Appendix G provides a breakdown of impacts by jurisdiction.

Most of the discussion is in terms of Option 1A. Option 1B, which is a relatively minor timing variation, is assessed in the context of the sensitivity analysis.

4.1 Contribution to greenhouse abatement

4.1.1 Timeframe for the analysis

The measures are assumed to apply fully from 2011 to 2020, but with the first effects becoming apparent in 2009 and building through 2010. Our market projections for this period have been reported in Chapters 1 and 2 and can be summarised in three propositions: (a) Australian households will purchase 10.0 million new HWS over the period 2009 to 2020; (b) 3.6 million of these will be GWH; and (c) 0.98 million will be GWH with less than 5 stars. Allowing for the exclusions and the phase-in period from 2009 to 2011, we estimate that 0.83 million GWH with less than 5 stars will be affected by the measures.

The estimate for total purchases is well-founded but the breakdown by type and efficiency is uncertain. We consider that the estimate of 0.83 million is a plausible inference from historical trends, existing market pressures, and known impediments to household take-up of energy efficient technologies.

Most GWH purchased in the period to 2020 will continue in use through the 2020s and some will survive into the late 2030s. On average, units that are bought in 2020 with a 5-year warranty are assumed to retire in 2031 (11-year life) and units with a 10-year warranty are assumed to retire in 2035 (15-year life). Impact estimates are for the whole of the life of all units purchased in the period to 2020.

4.1.2 Greenhouse abatement

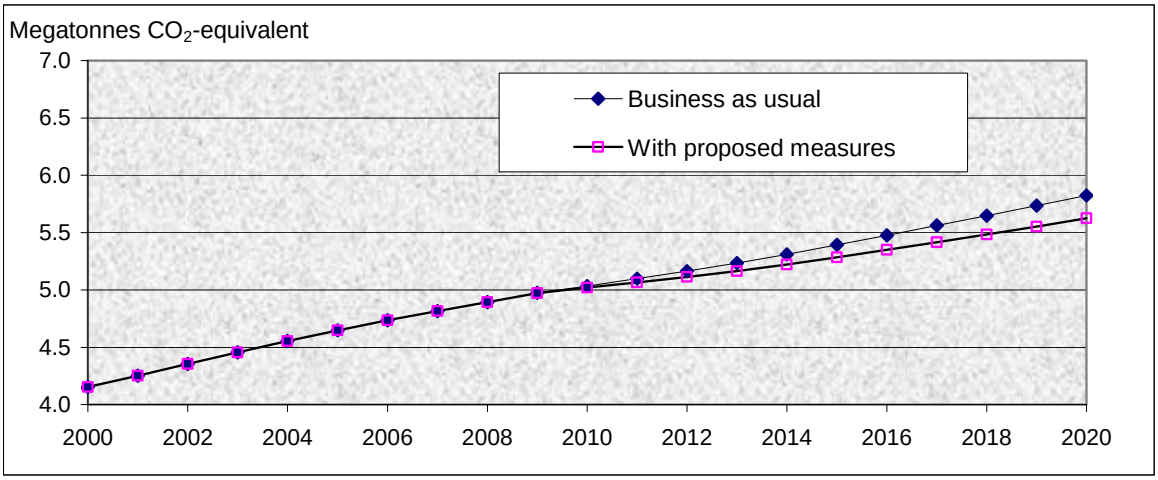
As discussed in Chapter 1, the problem being addressed is that the greenhouse emissions associated with the use of GWH will grow to 5.0 Mt CO_2-e/year (0.83% of Australia's emissions) in the first commitment period of the Kyoto Protocol (2008-12). They will increase by a further 15.7% in the period 2010 to 2020, to 5.8 Mt CO_2-e/year.

The proposed measures would be introduced during the first commitment period and have negligible impact on compliance with the Kyoto target. But the effects are cumulative, increasing as the stock of GWH is renewed over time and more of the installed stock comes within the scope of the measures – see figure 4.1. The impact of the measures is to:

- Reduce emissions growth for the period 2010-20 from 15.7% to 12.1%.
- Reduce 2020 emissions by 0.2 Mt CO_2-e. This is a 3.4% reduction in 2020 emissions, or 25% of the emissions abatement that would be needed to stabilise GWH emissions at the 2010 level.

- Deliver a 15% reduction in the emissions from the 0.83 million GWH that would otherwise have been sold with energy ratings of less than 5 stars.
- Contribute 2.3 Mt CO_2-e to emissions abatement over the life of the more efficient units that are purchased in the period to 2020.

FIGURE 4.1 IMPACT ON EMISSIONS GROWTH: 2000 TO 2020



4.2 Cost to the taxpayer

Table 4.1 provides estimates for the incremental cost of including GWH in the E3 Program, which is taxpayer funded. The E3 Program estimates that, in the period to 2008, it will spend $290,000 to develop the proposals and facilitate the revision of AS 4552, with a major component being the program of laboratory testing to evaluate the existing test procedures and inform the development of new test procedures.

The continuing costs are for check-testing, maintenance of the product register, and the maintenance of stakeholder relationships. All incremental costs to taxpayers will be incurred at the Commonwealth level. The registration and enforcement tasks at the state and territory level are not materially altered.

We have high confidence in these estimates.

TABLE 4.1 COST TO THE TAXPAYER OF INCLUDING GWH IN THE E3 PROGRAM

	Cumulative total to 2008 ($)	*Annually, 2009-2020 ($/year)*
Laboratory tests (store surveys to 2006 and combination of store surveys and compliance testing after 2006)	$150,000	$12,500
Industry consultation (to formulate testing procedures, standards and agree on timetables)	$50,000	$1,000
Analysis and publications (strategy documents, impact statements)	$50,000	$1,000
Program administration	$40,000	$5,500
Total	**$290,000**	**$20,000**

4.3 Business compliance costs

The Council of Australian Governments (COAG) requires each RIS to provide estimates of the administrative and paperwork costs incurred by a business in meeting regulatory requirements, defined as follows:

- *Notification:* costs of reporting transactions before or after the event
- *Education:* maintaining awareness of regulations and regulatory changes
- *Permission:* applying for and obtaining permission
- *Purchases:* materials and equipment required for compliance
- *Record keeping:* keeping statutory documents up to date
- *Enforcement:* facilitation of audits and inspections
- *Publication and documentation:* displays and labels
- *Procedural:* required compliance activities such as fire drills and safety inspections

Regulators throughout Australia approve appliances for sale by recognising the certification processes operated by AGA and others,[27] which means that suppliers already incur costs under most of these headings. It is assumed that these procedures will not be affected. But there will be incremental cost increases of both a once-only and continuing nature. All these will be incremental costs of obtaining permissions – to test and certify continuing products against the new standard, to test and certify new products that will be introduced in the transition period, and to test and certify products that will be introduced in the subsequent period to 2020. There will be ongoing costs for the latter because the new energy test will be more exhaustive and costly than the existing test.

There are two reasons for uncertainty about the incremental permission costs. First, there is uncertainty about how suppliers will respond. This will be a mix of product rationalisation, the partial redesign or 'tweaking' of existing products (for example, to marginally increase efficiency or to alter existing 5-star products to provide a range of 5-star products with 5-year warranties), and full product redesign. The incremental compliance cost is different in each case.

Second, there is uncertainty relating to the structure of fees for testing and certification. For example, the testing of a group of products may require a full test for only one member of the group, costing about $15,000, plus incremental costs of about $5,000 per additional member of the group, depending on design commonalities. It may cost $3,000 to $5,000 to retest a model or family of models that has been 'tweaked', and a similar amount where the test is solely to determine the energy rating of a product. Certifier charges are also structured around a base charge of about $3,000 for a related family of products, which means that the charge per product depends on the number of products in the family group. Importers sometimes engage a consultant to co-ordinate the application for certification and would pay fees of $4,000 for a family of products, but with as 25% discount for single products, and charges of $500-$1,000 for product modifications. We include these in the cost of certification and use the consultant's fee as a proxy for the paperwork costs incurred by suppliers who make applications directly.

Table 4.2 summarises the unit cost assumptions that we adopted.

[27] The function of the certifier is to assess whether the product meets the requirements of a certification scheme, including relevant standards. The supplier engages the certification process by submitting an application in the approved form, complete with drawings, test results and other technical information.

TABLE 4.2 BUSINESS COST CALCULATION INPUTS

Category	*Task*	*Cost input ($/product)*	*Sources*
Permission	Once-only energy re-test for complying product	$3,000-$6,000	Test lab
Permission	Once-only re-certification of complying product	$1,500-$3,000	AGA and certification consultant
Permission	Once-only energy test for 'tweaked' product	$1,500	Test lab
Permission	Once-only certification of 'tweaked' product	$1,500	AGA and certification consultant
Permission	Once-only energy test for redesigned product	$10,000	Test lab
Permission	Once-only certification of re-designed product	$3,000	AGA and certification consultant
Permission	On-going energy test for new products	$1,500-$3,000	Test lab
Permission	On-going certification for new products	$750-$1,500	AGA and certification consultant

Table 4.3 presents our findings and is organised around four broad types of products – existing products that will comply with the 5-star MEPS but need to be retested (panel 2), products that will be partially redesigned or fully redesigned (panels 3 & 4), and new products that are introduced after 2010 but will be require a more costly energy test (panel 5). The total compliance cost for each category of product is obtained by multiplying the number of products by the average incremental permission cost.

The following broad judgments are incorporated in table 4.3:

- For GsWH, it is assumed that one third of non-complying products are replaced by new products that would, under BAU conditions, have been introduced in the relevant timeframe. (The underlying assumption is that average product life is nine years and that one third of products will be replaced in the three years to October 2010.) Of the remaining two thirds, one half is by partial redesign of existing 5-star products and one half is by full redesign.
- We understand there will be some rationalisation of the GiWH range of product but no significant impact on the rate at which new products are introduced.
- Average testing and certification costs are commensurate with the available price information, but assuming that discounts apply to product groups.
- Intermediate and small suppliers pay higher unit prices for testing and certification (per product) because they have fewer products per certification.

Total additional expenditure is $770,100 over the period to 2020. These outlays have a present value of $648,500. Our confidence in this estimate is medium to high, since it has attracted no adverse comment from suppliers when presented in the CBA.

Note that table 4.3 reports separately for three broad categories of supplier – major, intermediate and small – that have been defined according to the number of products registered in April 2007.

It should also be noted that COAG's concern is to monitor the administrative and paperwork burden imposed by the particular form of regulatory transaction between government and business. These compliance costs are defined to exclude the costs of developing and testing new products, except for the cost of the final certification test. The costs of product development are assumed to be recovered from consumers and are

counted as part of the price premium that is paid for more energy efficient products. These are included in the assessment of impacts on consumers (section 4.4) and would be counted twice if included here.

TABLE 4.3 ESTIMATE OF BUSINESS COMPLIANCE COSTS – AUSTRALIA, OPTION 1

	Category of supplier			*Total*
	Large	*Intermediate*	*Small*	
1. Supplier characteristics				
Number of suppliers	3	3	4	10
Average products per supplier	16.0	4.3	1.0	
Total products	48	13	4	65
2. Re-testing & certification of 5 star complying products (once-only)				
Averages				
products per supplier	5.0	4.3	0.6	
energy tests ($, permission cost)	3,000	4,000	6,000	
certification ($, permission cost)	1,500	2,000	3,000	
Totals				
products	15	13	2.4	30.4
energy tests ($, permission cost)	45,000	52,000	14,400	111,400
certification ($, permission cost)	22,500	26,000	7,200	55,700
3. Testing & certification of partially redesigned products (once-only)				
Averages				
products per supplier	2.3	-	-	
energy tests ($, permission cost)	1,500			
certification ($, permission cost)	1,500			
Totals				
products	7			7
energy tests ($, permission cost)	22,500			22,500
certification ($, permission cost)	22,500			22,500
4. Testing & certification of fully redesigned products (once-only)				
Averages				
products per supplier	2.7	-	-	
energy tests ($, permission cost)	10,000			
certification ($, permission cost)	3,000			
Totals				
products	8			8
energy tests ($, permission cost)	150,000			150,000
certification ($, permission cost)	45,000			45,000
5. Incremental ongoing costs (per year to 2020)				
Averages				
new products per supplier	3.2	0.9	0.2	
energy tests ($, permission cost)	1,500	2,000	3,000	
certification ($, permission cost)	750	1000	1500	
Totals				
new products per year	9.6	2.6	0.8	13
energy tests ($, permission cost)	14,400	5,200	2,400	22,000
certification ($, permission cost)	7,200	2,600	1,200	11,000
Present value				
energy tests ($, permission cost)	105,342	38,040	17,557	160,939
certification ($, permission cost)	52,671	19,020	8,779	80,470
6. Present value of all costs ($)				
Energy tests ($, permission cost)	322,842	90,040	31,957	444,839
Certification ($, permission cost)	142,671	45,020	15,979	203,670
Total	**465,513**	**135,060**	**47,936**	**648,509**

4.4 Impacts on competition and trade

Competition
There are three broad ways in which regulations can adversely affect the quality of market competition to meet consumer demand for hot water systems. Regulations can reduce competition by:

1. eliminating product options that cannot be replaced with 'like-for-like' products that are more energy efficient but otherwise have the same features as the prohibited products;
2. favouring products or suppliers in ways that are unrelated to the intention of the regulation, which is to increase energy efficiency; or
3. reducing the number of suppliers that effectively compete in the market, increasing the market power of the remaining suppliers.

Regarding the first matter, our baseline assessment of costs and benefits assumes that like-for-like replacements will not always be available for GsWH with 90 litres of storage capacity. (See section 4.4 for the impact analysis for these consumers. They account for about 2.5% of sales.) This judgment may be pessimistic. Suppliers are understandably reluctant to disclose their assessment of product options and say how they will respond competitively when the regulation is introduced, making it difficult to assess these effects before implementation.

There are lesser risks affecting the replacement of two other types of water heater:

- Three-star GsWH are generally available with 5-year warranties, whereas with the exception of one Aquamax appliance, 5-star GsWH have 10-year warranties. However, we understand that there are minimal material and manufacturing differences between products with shorter and longer warranties, and no significant impediment to the production of 5-star GsWH with 5-year warranties.
- One supplier produces a range of internal GiWH with ratings of 4.5-4.9 stars for a small replacement market of several thousand units a year, but for which there is no like-for-like substitute at 5 stars. However, the supplier considers that complying products will become available before the transition period expires.

Our baseline assumption is that, for these two sub-markets, like-for-like replacements will be developed at reasonable cost.

Regarding the second matter, Rheem and Rheem NZ say that the proposal has unintended adverse consequences for water efficiency. They say that the measure will accelerate the transition to GiWH and that GiWH are less water efficient. This is because, unlike the storage heater which has hot water 'ready to go', the instantaneous type 'ramps up' to its operating temperature and cold water is dumped in the meantime. A more detailed explanation is provided in section 8.3, which summarises supplier comments on the CBA and provides the E3 response. Briefly, however, E3's view is that:

- The water losses associated with GiWH can be minimised through regulation but that this will be addressed separately through the WELS (Water Efficiency Labelling and Standards) program, not E3.
- The cost of such losses is adequately covered by the sensitivity analysis and would not materially affect E3's positive assessment of the proposal.

Otherwise, it is important that the proposed regulation is performance-based. It sets a threshold for minimum energy performance and does not constrain the manner in which the minimum level of performance is achieved. It follows that the regulation does not discriminate between suppliers, other than in respect of the energy efficiency of their products. A related consideration is that the new energy rating test will provide for more

accurate comparison of storage and instantaneous appliances, which levels the playing field and enhances competition.

Regarding the third matter, several companies have expressed concerns about effects on their viability and competitiveness.

Envestra is a gas distributor and is concerned that the proposal will discourage the further roll-out of the gas network and the take-up of gas by households with access to gas. Again, a more detailed explanation is provided in section 8.3. Briefly, however, E3 considers that any adverse effect is overstated because GsWH with less than 5 stars are largely confined to the replacement market, which means that they have minimal impact on the economics of extensions to gas networks and the rate of gas take-up on new housing estates.

Morcraft is a small Perth-based company with a single certification for a 3-star GsWH and expressed concerns about continued viability when contacted by phone to elicit supplier responses to the proposal. However, it is not clear that the company is a going concern. E3 specifically solicited their response to the CBA but received no reply. There will be a further direct request for a response to this consultation RIS.

Rheem and Rheem NZ say that, because the major impact of MEPS at 5 stars is to increase the efficiency and cost of GsWH, they will be less competitive relative to GiWH and their market share will decline relative to GiWH. This will inhibit the development and production of storage-based water heating technologies, including solar hot water systems, and it will accelerate a trend that threatens its manufacturing operation, which employs nearly 1,000 people.

E3 recognises that GiWH have significant advantages. They tend to more energy efficient. They are relatively compact and have low transportation costs.[28] The user never runs out of hot water if the unit is properly sized to the water heating task. But it does not follow that the proposed measures impose a significant competitive handicap for GsWH. Relevant considerations are that:

- In the replacement market, which is the dominant market for GsWH with 3 stars, conversion from GsWH to GiWH is discouraged by the additional costs of installing a higher capacity gas line, power lines and new mountings. Plumber contacts suggest the additional cost is over $500 for standard conversions and higher in more difficult situations.
- GsWH with 5 stars are already available from all major suppliers, providing a large majority of households with the option of like-for-like replacement of storage units.
- 5-star storage units tend to be a little cheaper than 5-star instantaneous units, which may limit the uptake of GiWH by users who are more price-conscious.
- The price of GsWH with 5 stars may fall or at least stabilise relative to GiWH, reflecting economies of scale in the production of such units and reduced scope for premium pricing in the absence of less efficient baseline products. Scope exists for 'regular' or 'basic' versions of 5-star GsWH to be developed, with fewer features and shorter warranties that are now only generally available at the 3-star level.

We note that other suppliers of GsWH have not expressed the same concerns and that concerns about job losses are significantly moderated by the very low levels of unemployment at the present time.

[28] Reflecting their relative transport costs, most GsWH are manufactured locally and GiWH are imported. The exceptions are all minor GiWH suppliers at the present time, specifically: two suppliers that assemble GiWH from imported components, and a recent entrant to the GiWH market with manufacturing facilities in Perth.

Rheem maintained its position in subsequent meetings and correspondence with E3. Option 2 was subsequently formulated. However, we emphasise that E3's main concern is the proposition that further development of 5-star products is a technological 'dead end' and that product development resources would be better employed in developing 7-star products. E3 seeks stakeholder comment on whether an additional five years, to April 2013, is a reasonable timeframe.

Regarding the associated issues of industry restructuring and industry development, we have explained (section 3.3.1) that a request for detailed information on industry structure will be dispatched to relevant suppliers with this consultation RIS.

Impacts on small producers
With the exception of Morcraft, the smaller producers that are listed in the profile of GWH products (section 1.2) appear not to have concerns about their continued viability. Three are suppliers of GiWH that sell 5-star products. The only remaining small supplier – HWS Australia – produces internal GsWH that have been excluded from the proposal.

GATT issues
The proposal needs to be consistent with Australia's international obligations under the Technical Barriers to Trade (GTBT) Agreement, which is part of the General Agreement on Tariffs and Trade (GATT). Article 2 of the GTBT Agreement relates to the preparation, adoption and application of technical regulations by central governments and provides for matters like the even-handed treatment of imports and domestically produced products, the avoidance of unnecessary obstacles to international trade, the development and use of international standards where possible, acceptance of the regulations of other countries where possible, and the adoption of performance-based regulation where possible.

Based on the following considerations, the proposed regulations are fully consistent with the GTBT Agreement:

- The E3 Program reviewed the standards that are applied in Europe, North America and Japan and found that none have been developed to the point where they provide an acceptable basis for MEPS regulation in Australia.[29] Either they are specific to local definitions of the heating task[30] (Europe) or they have yet to provide adequately for instantaneous designs (North America). It seems likely that Japan will adopt the revised Australian standards.
- Australia's approach to the reform of the energy test may provide the basis for an international standard. The intention is to develop a test that measures the underlying determinants of the overall energy efficiency of a GWH, allowing performance to be simulated and measured for any heating task, and dispensing with local definitions of the heating task.
- The proposed regulation is performance-based. As such, it does not discriminate between importers and domestic manufacturers.

Trans-Tasman Mutual Recognition Arrangement (TTMRA)
The only further issue is that Australia and New Zealand have different arrangements for the regulation of gas appliance safety, to the point where gas appliances have an exemption under the TTMRA. For gas water heaters, the practical effect is that all products that Australian safety regulators allow to be sold in Australia can also be sold in New Zealand, but all not all products that New Zealand safety regulators allow to be sold in New Zealand can also be sold in Australia.

[29] These findings have yet to be published. The account given here is based on personal communications with E3's technical consultants, Lloyd Harrington (Energy Efficient Strategies) and Peter King (Enertech).
[30] The heating task refers to the operational circumstances under which the test is performed, for example, relating to the number and amount of hot water draw-offs, and allowed recovery times.

The proposed energy efficiency regulations will not alter this situation, nor will they be affected by it. The proposed MEPS will be mandated using stand-alone Standards, under the various energy efficiency regulations of the States, Territories and New Zealand. Lloyd Harrington[31] has explained that the revised energy rating tests will require simple safety checks for the purposes of the rating test - for electrical connections, gas leaks and carbon monoxide. This means that the adoption of the proposed regulations by both New Zealand and Australia, as intended, is not a *de facto* imposition of Australian safety standards on products sold in New Zealand.

New Zealand and Australian officials are working towards resolution of the differences with respect to safety regulation and the removal of the exemption that now applies to gas appliances under the TTMRA. The proposed regulation does not make that task any more difficult or less difficult. They are separate issues.

4.5 Impact on consumers

This section deals separately with the impact on consumers in five market segments. Appendix D contains a separate statement of impacts on owners of the internal GsWH that, depending on the further analysis to determine the appropriate level of MEPS, may be subjected to MEPS sometime after October 2010.

4.5.1 External GsWH with 135 or 170 litres of storage capacity

Incremental cost of water heater

External GsWH with 135 or 170 litres of storage capacity will account for about 97% of sales that will be affected by the measures, a total of 0.8 million units. The additional cost of these units has been estimated as follows:

- *Market segments:* Four market segments were distinguished, taking the two capacities (135L and 170L) and further splitting each type according to the warranty period – five years or 10 years.
- *Price of units with 5-year warranties under BAU conditions:* These prices were equated with prices reported in late 2006 editions of *Reed Construction Data*. The weighted average prices across the jurisdictions are $770 and $880/unit for 135L and 170L respectively.
- *Price of units with 10-year warranties under BAU conditions:* Based on examination of catalogue prices and price information provided by major plumbing supplier (Reece), the incremental cost of the extra five years of warranty was put at $110 and $120/unit for 135L and 170L respectively. For these units, therefore, the weighed average prices across the jurisdictions are $880 and $1,010/unit for 135L and 170L respectively.
- *Price increment for upgrading each market segment from 3.4 stars to 5.2 stars:* The energy efficiency of these units would need to increase by 15%. Based on a conservative interpretation of the available price information, we put the price increase also at 15% of the price of 3-star units with 10-year warranties. After adding GST, the baseline estimates of the incremental costs are as reported in table 4.4.
- *Weighted average price increment:* Market shares were assigned on the basis of information from suppliers, indicating that the warranty split is 90%:10% in favour of 5-year warranties, and that the capacity split is 60%:40% in favour of 135L. This provides the basis for calculating a weighted average increase, which is the $157 that is also reported in table 4.4.

[31] Lloyd Harrington is a technical advisor to the AGO represents the AGO one the relevant committees of Standards Australia.

TABLE 4.4 ESTIMATES OF APPLIANCE PRICE INCREASES

Storage capacity (litres)	*135*		*170*		*Weighted average*
Warranty period (years)	*5*	*10*	*5*	*10*	
Unit price ($)					
BAU price (3 stars)	770	890	880	1,010	826
WPM price (5 stars)	906	1,026	1,034	1,164	970
Incremental cost, ex GST	136	136	154	154	143
Incremental cost, inc GST	150	150	170	170	158
Weights	54%	6%	36%	4%	100%
Aggregate expense					
Total sales, 2009-2020 (million)	0.48	0.05	0.32	0.04	0.88
Incremental expense, inc GST ($million)					
Undiscounted value	71.5	7.9	54.1	6.0	139.5
Present value	45.8	5.1	34.6	3.8	89.3

Over the period to 2020, households would outlay an additional $139.5 million for 0.88 million units with an incremental price of $158/unit. This is the undiscounted value, with a dollar spent in 2020 given the same weight as a dollar spent in 2008. The present value, after discounting at 7.5% per year, is $89.3 million.

The estimates reported in table 4.4 are based on evidence from Australian and US sources.

Australian price comparisons

Catalogues and price lists were collected from appliance manufacturers, plumbing suppliers, energy retailers and online retailers, including outlets of a major plumbing supplier (Reece). Certain price differences can be reasonably attributed to a single appliance attribute, for example, differences in the price of models with the same capacity, same efficiency and from the same family of models, but with different warranty periods, or differences in the price of models with the same capacity, same warranty and from the same family of models, but with different efficiency. The price increments reported in table 4.4 – $149 to $169 for upgrading to 5 stars – are high relative to the average difference of $116 that was obtained from such price comparisons. (These are tabulated in appendix E.) The conservative bias is for two reasons.

First, the underlying comparisons returned highly variable results. In one instance, for example, a 5-star model was temporarily priced at only $1 more than its 3-star equivalent as part of a product promotion. Another source returned a difference $203 for the same comparison. There were other oddities, such as the cost of upgrading from a 5 to 10-year warranty being greater for 135L models than for 170L models.

A second limitation is that, whereas models with 5-year warranties are generally available in both 3 and 5-star versions, allowing price comparisons, models with 5-year warranties are generally only available in 3-star versions. The only exception is one of the smaller suppliers who introduced a '5-year/5-star' model in 2005. It has been assumed that:

- suppliers will develop a range of '5-year/5-star' versions in response to higher MEPS; and
- the incremental price will be the same as for the corresponding models with 10-year warranties.

Impact of energy conservation standards in the US

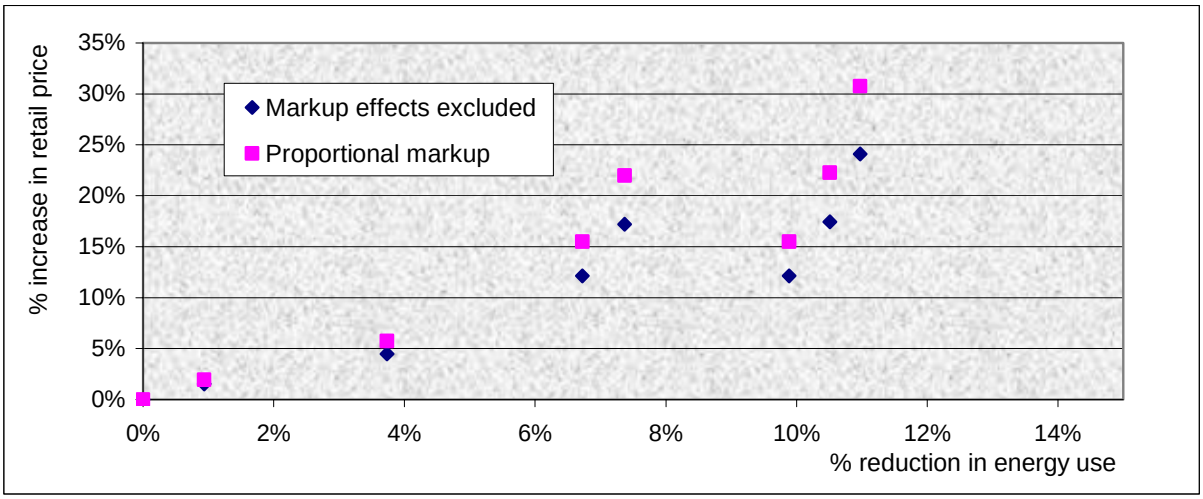
Figure 4.2 presents the results of analysis that the US Department of Energy published (DoE 1998) to inform the rule-making processes that led ultimately to an increase in the efficiency requirements of GsWH in the US, taking effect from January 2004. Depending

on how mark-ups[32] are treated, the analysis indicates that an 11% reduction in energy use would be at the expense of a 24-31% increase in retail price. This suggests that the ratio of percentage price increase (24-31%) to the percentage reduction in energy use (11%) is in the range 2.2 to 2.8. This is much higher than the ratio of 1.0 used to generate the baseline estimates reported in table 4.1, that is, a 15% reduction in energy use at the expense of a 15% increase in price, and reflects our view that the US estimates are unreliable.

We are concerned that the US cost analysis is from 10 years ago (pre-1998) and does not incorporate technical progress and economies that have been achieved in the meantime. There is also a long history of US regulatory authorities overestimating the cost impact of regulatory proposals. A review of the impacts of US MEPS noted that … *Looking at the trends, it is difficult to see an impact on price from DOE standards in most cases* (Meyers *et al* 2002: page 21).

We followed up with DoE and the US office of *Reed Construction Data*, seeking evidence of what actually happened to the price of GsWH after the new standards were introduced in the US. The informal advice from the DoE is that, while they have no hard data, the anecdotal evidence is that the observed increase in prices has been small, if any. The informal advice from *Reed Construction Data* is the same. We were told that, while there have been significant price changes in response to steel shortages and high copper prices, there was no noticeable effect from the increase in energy conservations standards. But we note the possibility that most manufacturers had few changes to make because their products already complied with the MEPS. In fact, a 2002 report to Sustainability Victoria noted that a large number of models in both Canada and the US already complied with the 2004 US MEPS (MEA *et al* 2002: page 26)

FIGURE 4.2 PROJECTED COST-EFFICIENCY RELATIONSHIP FOR THE US, FOR STANDARD 40 GALLON (150L) GAS STORAGE WATER HEATER



Source: DoE (1998) *Technical Support Document for Water Heaters*, Chapter 8, tables 8.4.25 and 8.4.26

Findings on incremental costs

The one supplier who commented on the cost estimates (Dux) agreed that the estimates of incremental appliance costs were reasonable. In a follow-up phone interview, Dux explained their comment related to a small number of situations where the larger 5-star heater may not be easily accommodated in the available space and there would be additional installation costs.

[32] Markups are the additional cost of wholesale, retail and transport function that are often set as percentage mark-up on the base price. There is uncertainty about how the markups will be adjusted. At the extremes, the increase in the mark-up can be set proportional to the increase in the base price or excluded from consideration.

We have medium confidence in the cost estimate reported in table 4.4 and consider that remaining uncertainties should be addressed in sensitivity analysis.

Value of energy savings

Methods

We have estimated the energy savings that will be obtained by requiring these 0.8 million GsWH to be upgraded to 5 stars, based on the following assumptions:

- They are upgraded by 1.8 stars (from 3.4 to 5.2 stars on average), this being the expected difference between the average efficiencies of 3-star and 5-star appliances under BAU conditions. (Section 1.4 explains the BAU scenarios for average energy ratings.)
- The energy savings that are observed under test conditions are good estimates of the energy savings that accrue, on average, to households under actual operating conditions. Note the reference to the average household: the proposition is obviously not true for all households.

Energy savings has been valued at the marginal residential gas tariff, which varies considerably across the country. A weighted average has been calculated, taking account of variations between jurisdictions, between metropolitan and regional consumers, and between small and large consumers. (Smaller consumers usually pay a higher marginal tariff than larger consumers.) There is also a small weight for LPG-fuelled heaters: LPG is about three times more expensive than mains gas. We estimated the national weighted average price at 1.38 cents/MJ in late 2006, including GST.

Future energy savings have been valued at a fixed price of 1.38 cents/MJ and discounted to the present at 7.5% a year. 'The present' is taken to be 2008, which is the proposed date of implementation. Note the conservative assumption that the unit value of gas remains constant, excluding the impact of emissions trading on the value of the gas that is saved.

Findings on value of energy savings

The installed stock of heaters affected by the measures will grow over the period to 2020, reaching 0.8 million in 2020. The full impact on energy use is therefore realised in 2020, and amounts to energy savings of 2.9 PJ a year, or 3.4% of the total energy consumed by GWH in 2020.

Annual savings grow in proportion to the number of GsWH affected by the measures until the maximum annual impact is realised in 2020, about $40 million a year. Over the entire period to the mid-2030s, when the last of the units purchased before 2020 is assumed to retire, the owners of the 0.8 million external GsWH will accrue financial savings of $464.7 million.

Financial gains become progressively less valuable as they are deferred further into the future. The E3 Program has adopted the general practice of discounting future values by 7.5% a year. On this basis, the present value of the savings is $200.4 million.

Net benefits for external GsWH with 135L and 170L storage capacity

The baseline assessment for households in this market segment is highly favourable.

- The incremental cost and benefits are $77.4 million and $200.4 respectively, in present value terms.
- The net benefits are $123 million and the benefit-cost ratio is 2.6.

4.5.2 External GsWH with 90 litres of storage capacity

The market for externally installed 90L GsWH is a niche market for replacement units and confined to smaller households and households in mild and warm climates, such as parts of

Queensland. Sales are about 3,250/year and our baseline assumes that the proposed regulation would affect sales of 13,200 units in the period 2020. It is assumed that the market is declining and that suppliers will sell existing models up to October 2011, taking full advantage of the transition arrangements.

The subsequent difficulty for customers is that these appliances are now available only in 3-star versions and suppliers may not invest in the design and production of 5-star versions, leaving them without a like-for-like replacement. Our baseline assessment assumes that they will upgrade to GsWH with storage capacity of 135L, with two consequences. First, existing price information (*Reed Construction Data* 2006) suggests that there would be an increase in the incremental cost of up to $100. Second, the 90L customer would not achieve all the energy savings that may accrue to the average user of a 135L unit. This is because the replacement unit would be oversized relative to the user requirement, which means that excess water is kept hot in standby mode.

Our findings for this market segment have been obtained by making two adjustments to the analysis for GsWH with 135L and 170L storage: (a) adding $100 to the incremental cost of the appliance, taking it to $257/unit, and (b) reducing the energy savings by 33%. Using the energy rating formulas from the existing standard, the latter is commensurate with a 50% reduction in water use and seems a reasonable allowance for the smaller user. The impact on this market segment can then be stated as follows:

Impact on average customer

- Incremental cost of heater – $257
- Energy savings – 2,440 MJ/year
- Value of energy savings – $36.70/year
- Present value of energy savings – $298 (asset life of 13 years, discount rate of 7.5%)
- Net financial benefit – $41
- Benefit cost ratio – 1.2

Aggregate impact

- Additional sales of 5-star units to 2020 – 13,200
- Present value of incremental cost – $1,880,000
- Present value of energy savings – $2,155,000
- Net financial benefit – $276,000
- Benefit cost ratio – 1.2

On this figuring, there seems to be sufficient ‘fat’ in the benefit-cost analysis to protect this class of customer from significantly negative outcomes.

4.5.3 External GiWH

We have discussed the impact of the proposed regulation with all suppliers of external GiWH who are concerned that some of their products may not comply with the 5-star MEPS. We understand that the main issue is with two products that employ a continuously burning pilot light for ignition and have energy ratings of 3.9 and 4.2 stars. They will be replaced with 5-star products with equivalent performance but hydro ignition. The incremental cost is expected to be about $60 a unit. The impact on this market can then be stated as follows:

Impact on average customer

- Incremental cost of heater – $60
- Energy savings – 1,012 MJ/year (transition), 2,023 MJ/year (full)
- Value of energy savings – $15.22/year (transition), $30.44/year (full)
- Present value of energy savings – $133/year (transition), $265/year (full)
- Net financial benefit – $73/year (transition), $205/year (full)
- Benefit cost ratio – 2.2 (transition), 4.4 (full)

Aggregate impact

- Additional sales of 5-star units to 2020 – 11,800 (assumes a declining market)
- Present value of incremental cost – $426,000
- Present value of energy savings – $1,709,000
- Net financial cost – $1,283,000
- Benefit cost ratio – 4.0

4.5.4 Internal GiWH

We have discussed the impact of the proposed regulation with all suppliers of internal GiWH with less than 5 stars. We understand that there is only one group of products on the market that may need to be upgraded and that upgrades are expected to be complete before the end of the transition period. There will be no significant impact on this market.

4.6 Baseline estimates of nationwide impacts

Table 4.5 summarises the findings that are reported in sections 4.2 to 4.5. The net present value is $123.6 million and the benefit-cost ratio is 2.5.

The cost-benefit ratio is best understood in terms of the shares of running cost and capital cost in the whole of life cost of a water heater. As discussed in section 1.5, a typical split is 74%: 26%, with energy costs having the larger share. This means that a 15% reduction in energy use will reduce the whole of life cost by about 11.1% (= 15% * 74%), and a 15%

TABLE 4.5 SUMMARY STATEMENT OF NATIONWIDE IMPACTS – AUSTRALIA, OPTION 1

Number of GWH upgraded to 5 stars (million)	0.83
Energy use – PJ	-34.3
Greenhouse abatement (Mt CO_2-e)	2.31
Undiscounted dollar amounts ($M)	
cost to the taxpayer	+0.41
business compliance costs	+0.77
incremental cost of heaters	+130.4
household expenditure on energy	-474.8
Present values ($M), discount rate = 7.5%	
cost to the taxpayer	+0.37
business compliance costs	+0.65
incremental cost of heaters	+79.7
household expenditure on energy	-204.3
Investment analysis	
total benefits ($M)	204.3
total costs ($M)	80.7
net present value ($M)	123.6
benefit-cost ratio	2.5

increase in the purchase price will increase the whole of life cost by about 3.9% (= 15% * 26%). This is the essence of the baseline estimate and suggests that the whole of life cost is reduced by 7.2% (= 11.1% - 3.9%) and that the benefit-cost ratio is about 2.8 (= 11.1% / 3.9%). This ratio is reduced to 2.5 as a result of various fixed costs of program development and higher costs of increasing efficiency in niche markets.

Given the assumptions underlying the baseline estimates, the proposals easily meet the criteria that measures should contribute significantly to greenhouse abatement without imposing a significant financial cost on the community.

4.7 Sensitivity analysis

The sensitivity analysis is organised under two headings, dealing separately with factors that alter the nationwide impacts and with factors that determine the impact on individual households. A particular outcome for the average household, at the national level, can hide considerable variation between households.

4.7.1 Sensitivity analysis of nationwide estimates

Table 4.6 reports the sensitivity analysis. It reflects our assessment that the most significant uncertainties relate to developments in the market share of GsWH with less than 3 stars, and the cost of upgrading these units to 5 stars.

Sensitivity analysis of the nationwide estimates indicates that the findings are robust. The benefit-cost ratio remains above 1.9 under reasonable alternative settings of the key variables.

Table 4.6 includes explanatory notes and these are sufficient for all sensitivity tests except those for energy savings and delayed implementation.

Impact of hot water usage on the estimated value of energy savings
The third panel of the table includes a reference to the worst case scenario for average household usage of hot water. This is in response to supplier criticism that the average household uses less hot water than the 200 litres/day that is assumed for the purposes of the energy rating test. As discussed in section 8.3, Rinnai says that 140 litres/day is a more reasonable figure.

The effect is to reduce the energy consumption and the estimate of energy savings. However the impact on energy savings is less than proportionate because there are losses from stored water even when no water is drawn off. Using the relevant formula from AS 4552, the effect of reducing water consumption by 30% (from 200 to140 litres/day) is to reduce the estimate of energy savings by 19.6%. Accordingly, the down-side test for sensitivity to variation in the estimate of energy savings is set at -20%.

Delayed implementation – Option 1B
Table 4.6 also provides information about the impact of delaying implementation by one year, which is Option 1B. E3 recognises that there will be some uncertainty until the new standard has been finalised but considers that this is substantially mitigated by E3's undertaking that (a) the new MEPS will be broadly equivalent to 5 stars under the standard, and (b) to allow 5-star products that have certified to the existing standard before October 2009 to be manufactured or imported to October 2010. E3 invites further comment on this issue.

Dollar value of greenhouse abatement
E3's current assessment methodology does not assign a dollar value to the expected greenhouse abatement. However, appendix F provides indicative estimates of the additional benefits that would be recorded if that were case, assuming prices in the range of $10-$20 a tonne of carbon dioxide under an emissions trading scheme.

TABLE 4.6 SENSITIVITY ANALYSIS OF THE NATIONWIDE IMPACTS – AUSTRALIA, OPTION 1

	Upgraded GWH (million)	*Energy use - PJ*	*Greenhouse abatement (Mt CO_2-e)*	*Total financial benefits ($M)*	*Total financial costs ($M)*	*Net present value ($M)*	*Benefit-cost ratio*
Baseline	0.83	-34.3	2.31	204.3	80.7	123.6	2.53
Market share of GsWH with less than 5 stars The baseline assumption is that, at the end of the period under consideration, 0.83 million GWH with less than 5 stars will be affected by the measures, comprising 23% of GWH sold in the period 2008 to 2020. The alternative scenarios are that the measures affect 10% or 30% of GWH sales in the period to 2020, corresponding to 'low' and 'high' expectations for sales of GsWH with less than 5 stars.							
10% of GWH	0.36	-14.5	0.98	79.3	32.5	46.8	2.44
30% of GWH	1.07	-44.3	2.98	267.2	104.9	162.3	2.55
Value of energy savings The baseline assumes an average energy price is 1.38 cents/MJ and we have high confidence in that figure. There is less confidence in the estimate of the energy savings, reflecting uncertainty about average water consumption and other factors. The down-side test of -20% covers the worst case scenario for household use of hot water.							
minus 20%	0.83	-27.46	1.85	163.4	80.7	82.7	2.03
plus 10%	0.83	-37.76	2.54	224.7	80.7	144.0	2.79
Incremental cost of 5 star GsWH The baseline assumption is that the percentage price increase is equal to the % increase in energy efficiency (15%) and is $157 for typical 135L and 170L units. We have medium confidence in this estimate and have tested in the range +/- 33%.							
plus 33%	0.83	-34.3	2.31	204.3	106.2	98.1	1.92
minus 33%	0.83	-34.3	2.31	204.3	55.2	149.1	3.70
Divergent trends in energy and capital costs The baseline assumptions are that the real prices of both energy and water heaters remain constant. An alternative scenario is that real energy costs increase as global warming is addressed, and that real manufacturing costs continue to decline.							
Energy costs up 1%/yr, heater costs down by 0.5%/yr.	0.83	-34.3	2.31	226.4	78.3	148.1	2.89
One year delay – Option 1B The baseline assumption is that the measures will be implemented from October 2008.							
Implementation in Oct 2009	0.74	-30.9	2.08	176.2	69.7	106.5	2.53
Discount rate The baseline discount rate is 7.5%							
0%	0.83	-34.3	2.31	474.8	131.6	343.2	3.61
5%	0.83	-34.3	2.31	265.6	94.1	171.5	2.82
10%	0.83	-34.3	2.31	159.8	69.8	90.0	2.29

4.7.2 Variable impact on individual households

Whatever the uncertainty about nationwide impacts, the impacts on individual households are certainly variable. Table 4.7 reports variations for the dominant market segment, which is external GsWH with 135L or 170L of storage. Impacts in individual households are shown to depend on water consumption, the heating task and the price of energy. (Note that table 4.7 includes a restatement of the nationwide average, but with a benefit-cost ratio of 2.6. This is the outcome for a typical user in this market segment, ignoring the fixed costs of the program and the less favourable outcomes for minority market segments.)

Water consumption

As noted for the national sensitivity analysis, energy savings increase and decrease with the amount of hot water that is used. For example, a plausible outcome is that a 50% reduction relative to the test assumption, to 100L/day, would reduce energy savings by 33%. Conversely, a 50% increase in water use, to 300L/day, would increase energy savings by 33%. The impact is sensitive to this parameter but the assessment remains positive – see the third panel of table 4.7

Heating task

The heating task is the increase in temperature – from 'cold water' to 'hot water' – that the heater is required to deliver. It is set at 45^{o}C in the calculation of annual energy use that is employed for labelling purposes. For example, the heating task may be to raise the water temperature from 15^{o}C to 60^{o}C, or from 20^{o}C to 65^{o}C. However, the typical task varies with the climate, and some types of appliance allow users to vary the heating task by resetting the target temperature to a higher or lower level.[33]

TABLE 4.7 SENSITIVE ANALYSIS OF IMPACTS ON HOUSEHOLDS – AUST, OPTION 1

	Capital cost ($)	*Whole of life energy cost ($)*	*Net effect ($)*	*Benefit cost ratio*
Nationwide average household, using externally installed 135L or 170L GsWH	+157	-406	-249	2.6
Water consumption				
water consumption reduced by 50%	+157	-272	-115	1.7
water consumption increased by 50%	+157	-540	-383	3.4
Heating task				
minus 10%	+157	-380	-223	2.4
plus 10%	+157	-432	-275	2.8
Price of energy				
LPG – 2.5 cents/MJ	+157	-734	-577	4.7
Natural gas				
NSW - 1.48 cents/MJ	+157	-435	-278	2.8
VIC – 1.0 cents/MJ	+157	-293	-136	1.9
QLD - 2.02 cents/MJ	+157	-592	-435	3.8
SA - 1.43 cents/MJ	+157	-420	-263	2.7
WA - 1.41 cents/MJ	+157	-413	-256	2.6
TAS - 1.53 cents/MJ	+157	-450	-293	2.9
NT - 1.43 cents/MJ	+157	-419	-262	2.7
ACT - 1.43 cents/MJ	+157	-420	-263	2.7

[33] The effect is to squeeze more hot water from a heater that is too small for the household's needs, or to reduce wastage from a heater that is too large.

The base temperature of cold water is a further source of variation in the heating task. Based on data provided in the Australian standard for solar water heaters,[34] there is a 10^{o}C difference in the average cold water temperatures of zone 1 (North and North East Australia) and zone 4 (Southern Victoria and Tasmania). Other sources of variation in the heating task are not well understood.

On this evidence, it is sensible to test in the range +/- 5^{o}C around the assumed figure of 45^{o}C. This has a less than proportional impact on energy savings and causes little variation in the benefit-cost ratio.

Regional variation in the price of energy
Marginal gas tariffs vary between states, resulting in considerable interstate variation in the value of energy savings. Only in Victoria is the benefit-cost ratio lower than the Australian average. It has the cheapest gas and the least to gain.

The returns are positive for the average householder in all jurisdictions – see the last panel in table 4.7.

Niche markets
Finally, section 4.5 reported the less favourable outcomes for owners of 90 L GsWH, where the net financial benefit is only $41 and the benefit cost ratio is 1.2.

[34] AS 3424-1994 *Solar water heaters – Domestic and heat pump – Calculation of energy consumption*

5 Impact analysis: Option 2 - Australia

This chapter reports an assessment of Option 2, which is to impose MEPS at 4 stars from October 2009 and MEPS at 7 stars from April 2013. It is organised in the same manner as chapter 4.

5.1 Contribution to greenhouse abatement

5.1.1 Timeframe for the analysis

The timeframe for the analysis is extended to 2025, allowing for an almost complete turnover of the GWH stock to 7-star units. However the impact estimates are for the life of all units bought in the period to 2025, which will extend into the late 2030s. It is assumed that all units have a life of 13 years, suppressing the distinction between units with shorter and longer warranty periods that was employed in the analysis of Option 1.

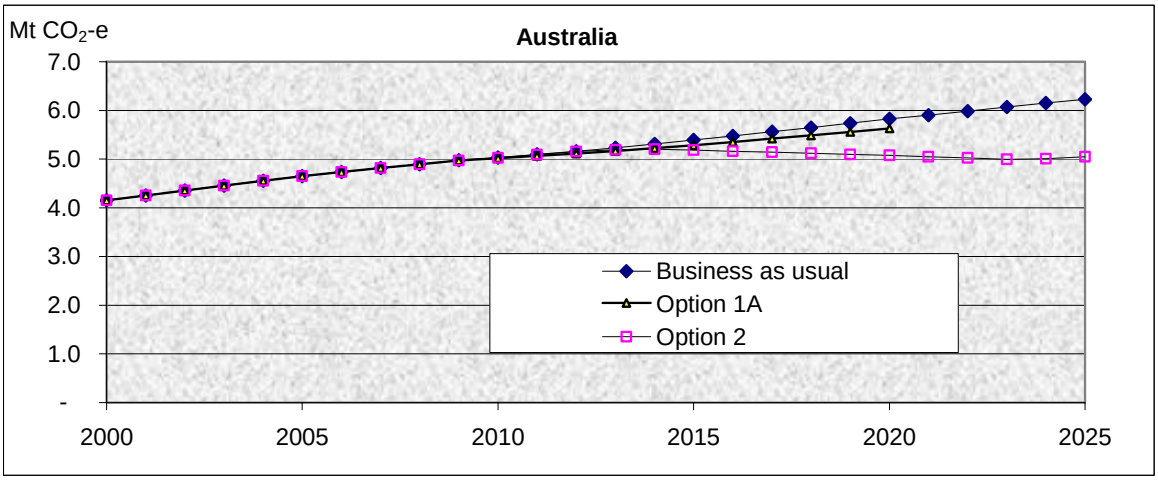
5.1.2 Greenhouse abatement

Figure 5.1 reports the impact on greenhouse emissions in the period to 2025, including a comparison with Option 1A for the period to 2020. Assuming that the second stage of Option 2 is introduced on schedule, at April 2013, the impact of the measures is to:

- reduce emissions growth for the period 2010-25 from 23.8% to 0.4%;
- reduce emissions by 0.75 Mt CO_2-e in 2020 and by 1.18 Mt CO_2-e in 2025; and
- contribute 13.7 Mt CO_2-e to emissions abatement over the life of the more efficient units that are purchased in the period to 2025.

Compared with Option 1, in either the 1A or 1B versions, Option 2 makes a smaller contribution to abatement in the early years but an increasingly larger contribution after 2015. That comparison is somewhat misleading however. Option 1 does not preclude further increases in MEPS in the future. The real difference is that Option 2 provides for a slower start in exchange for an explicit commitment to 7 stars at the earliest practical time.

FIGURE 5.1 IMPACT ON EMISSIONS GROWTH: 2000 TO 2025 – AUSTRALIA



5.2 Cost to the taxpayer

The assessment of Option 2 takes account of additional costs to the taxpayer of introducing stage 2 of the MEPS, but remembering that some such costs would be incurred under Option 1 but are not brought to account in the conventional figuring.

The additional taxpayer funded activities are to:

- monitor the development and rollout of 7-star GWH products over the period to 2013;
- periodically confer with suppliers on prospects for a full range of products to comply with 7-star MEPS from April 2013;
- revise impact assessments; and
- modify the implementation schedule as appropriate.

Table 5.1 presents a revised estimate of the cost to the taxpayer. Relative to Option 1, the additional expenses are $150,000 for implementation of the second stage and the extension of the annual expenses to 2025.

TABLE 5.1 COST TO THE TAXPAYER – AUSTRALIA, OPTION 2

	Stage 1 implementation to 2009 ($)	*Stage 2 implementation to 2013 ($)*	*Annually, 2009-2025 ($/year)*
Laboratory tests (store surveys to 2006 and combination of store surveys and compliance testing after 2006)	$150,000		$2,500
Industry consultation (to formulate testing procedures, standards and agree on timetables)	$50,000	$50,000	$1,000
Analysis and publications (strategy documents, impact statements)	$50,000	$50,000	$1,000
Program administration	$40,000	$50,000	$5,500
Total	**$290,000**	**$150,000**	**$10,000**

5.3 Business compliance costs

The assessment of Option 2 also takes account of additional business compliance costs associated with the second-stage MEPS. These are significant additional costs, estimated by assuming that (a) 80% of products will need to be completely retested and recertified and (b) the unit costs of testing and certification will be 50% higher than prices now quoted by laboratories and certification consultants. It is implicit in the former assumption that 7-star products will need to have a significant presence in the market, put at 20%, before MEPS are reset to 7 stars. The latter adjustment is to allow for the fact that 7-star GWH are technologically more complex.

These increases are partially offset by savings associated with the first stage MEPS, arising because it is easier to achieve compliance with 4-star MEPS and the retesting and re-certification tasks are correspondingly reduced. It is assumed that the unit costs are reduced by 33%.

Table 5.2 reports the resulting estimates. The total expense is $1.4 million, compared with $.65 million for Option 1.

TABLE 5.2 ESTIMATES OF BUSINESS COMPLIANCE COSTS – AUSTRALIA, OPTION 2

	Category of supplier			*Total*
	Large	*Intermediate*	*Small*	
1. Supplier characteristics				
Number of suppliers	3	3	4	10
Average products per supplier	16.0	4.3	1.0	
Total products	48	13	4	65
2. Re-testing & certification of 4 star complying products (once-only)				
Averages				
products per supplier	5.0	4.3	1.0	
energy tests ($, permission cost)	3,000	4,000	6,000	
certification ($, permission cost)	1,500	2,000	3,000	
Totals				
products	15	13	4	32
energy tests ($, permission cost)	45,000	52,000	24,000	121,000
certification ($, permission cost)	22,500	26,000	12,000	60,500
3. Testing & certification of 4 star products (once-only)				
Averages				
products per supplier	5.0	0.0	0.0	
energy tests ($, permission cost)	4,000			
certification ($, permission cost)	2,000			
Totals				
products	15			15
energy tests ($, permission cost)	60,000			60,000
certification ($, permission cost)	30,000			30,000
4. Testing & certification of 7 star products (once-only)				
Averages				
products per supplier	12.8	3.5	0.8	
energy tests ($, permission cost)	15,000	15,000	15,000	
certification ($, permission cost)	3,000	3,000	3,000	
Totals				
products	38	10	3	52
energy tests ($, permission cost)	576,000	156,000	48,000	780,000
certification ($, permission cost)	115,200	31,200	9,600	156,000
Present value				
energy tests ($, permission cost)	463,657	125,574	38,638	627,869
certification ($, permission cost)	92,731	25,115	7,728	125,574
5. Incremental ongoing costs (per year to 2020)				
Averages				
new products per supplier	3.2	0.9	0.2	
energy tests ($, permission cost)	1,500	2,000	3,000	
certification ($, permission cost)	750	1000	1500	
Totals				
new products per year	9.6	2.6	0.8	13
energy tests ($, permission cost)	14,400	5,200	2,400	22,000
certification ($, permission cost)	7,200	2,600	1,200	11,000
Present value				
energy tests ($, permission cost)	131,638	47,536	21,940	201,113
certification ($, permission cost)	65,819	23,768	10,970	100,557
6. Present value of all business compliance costs ($)				
Energy tests ($, permission cost)	700,295	255,536	93,940	1,049,770
Certification ($, permission cost)	233,519	80,968	32,570	347,057
Total	**933,814**	**336,504**	**126,509**	**1,396,827**

5.4 Impacts on competition and trade

As discussed in section 4.4, regulations can reduce competition by (a) eliminating product options that cannot be replaced with 'like-for-like' products, (b) favouring products or suppliers in ways that are unrelated to the intention of the regulation, or (c) reducing the number of suppliers that effectively compete in the market.

Competitive impacts in stage 1
Compared with Option 1, the first stage of Option 2 will reduce each of these concerns to the point where we expect there to be no significant competitive impacts. Compared to Option 1, we are more confident that:

- 4-star GsWH with 90 litres of storage capacity will be available.
- A full range of GsWH products with 5-year warranties will be available.
- A full range of GiWH with at least 4 stars will be available.
- GsWH do not suffer any significant loss of competitiveness relative to GiWH, reducing associated concerns about wastage of water and the loss of competitiveness.

Competitive impacts in stage 2
However the second stage of Option 2 introduces new concerns that are not fully understood. E3 seeks stakeholder comment on:

- the technologies that would be needed to achieve 7-star performance;
- the feasibility of applying these technologies to domestic hot water heaters;
- the reasonableness or otherwise of the 5-year timeframe, to April 2013;
- replacement markets where it will be more difficult to achieve 7-star performance at reasonable cost;
- supplier access to the intellectual property associated with the technologies required to achieve 7-star technology;
- how 7-star MEPS will affect the relative price of GiWH and GsWH;
- risks to competition if there is restricted access to the required technologies; and
- whether small producers can compete in the market for 7-star GWH.

GATT issues
Based on the same considerations as outlined in the assessment of Option 1, the proposed regulations are fully consistent with the General Agreement on Tariffs and Trade.

Trans-Tasman Mutual Recognition Agreement (TTMRA)
Based on the same considerations as outlined in the assessment of Option 1, the proposed regulations are not impeded by TTMRA.

5.5 Impact on consumers

This section is organised to separately report the impact of the first and second stages of Option 2. We have reported the impact by distinguishing the following three broad types of effect:

- The first effect is to increase the efficiency of 3-star units to 4 stars and is confined to GsWH, since there are no GiWH with less than 4 stars. While stage 1 notionally ceases in April 2013, it is assumed that the effect of stage 1 is to raise all units to at least 4 stars for the entire period of the analysis, which is to 2025.

- The second effect is to increase the efficiency of units with 4 stars to 7 stars. This mainly affects GsWH that would otherwise be at 4 stars, but there are some GiWH at 4 stars that would also be affected.
- The third effect is to increase the efficiency of units with 5 or 6 stars to 7 stars. This mainly affects GiWH but there are some GsWH that are already at 5 stars.

5.5.1 Stage 1 - 4 star MEPS from October 2009

Stage 1 will affect external GsWH with 90, 135 or 170 litres of storage capacity. We have modified the impact model used to assess the impact of 5-star MEPS on external GsWH with 135 or 170 litres of storage capacity (section 4.5.1), making the following changes:

- The timeframe has been extended to 2025.
- External GsWH with 90 litres storage have been included, on the assumption that they can be more easily upgraded to 4 stars than to 5 stars and will be retained in the product range.
- The energy gains have been scaled back. It is assumed that MEPS at 4 stars has the effect of raising the average star rating by 0.7-0.8 stars,[35] compared with increases of 1.8 stars under MEPS of 5 stars. The 4-star MEPS deliver 42% of the energy gains delivered by 5-star MEPS.
- The incremental cost of GsWH has been scaled back more than in proportion to the reduction in energy savings, on the assumption that there are diminishing returns to investments in energy efficiency and the initial increases are provided more cost-effectively. Specifically, the incremental cost is put at 33% of the cost increases that were estimated for the 5-star MEPS.

On these assumptions, MEPS at 4 stars are beneficial. The impact can then be stated as follows:

Impact on average customer

- Incremental cost of heater – $52.72
- Energy savings – 1,517 MJ/year
- Value of energy savings – $22.83/year
- Present value of energy savings – $185.48 (asset life of 13 years, discount rate of 7.5%)
- Net financial benefit – $132.76
- Benefit cost ratio – 3.5

Aggregate impact

- Additional sales of 5-star units to 2025 – 1,210,000
- Present value of incremental cost – $33.4 million
- Present value of energy savings – $118.5 million
- Net financial benefit – $85.1 million
- Benefit cost ratio – 3.5

5.5.2 7-star MEPS from April 2013

GWH with 7-star energy ratings are not yet available on the market and, as far as we are aware, no supplier has endorsed a particular estimate of their cost. It is therefore not

[35] Allowing for trend increases in efficiency, the gap between 3-star and 4-star units varies from 0.8 stars at the start of the period to 0.7 stars at the end of the period.

possible to provide other than indicative figuring for the second stage of Option 2. We first emphasise that E3 seeks stakeholder comment on a range of issues affecting the economic feasibility of stage 2.

Stakeholder comment requested on specific issues affecting the economic feasibility and impact of 7-star GsWH

High efficiency GWH products are likely to have special requirements of the following kind:

- connection to electrical power for electronic ignition and a combustion air blower
- higher capacity gas lines where a 7-star GiWH is used to replace a GsWH
- connection to drainage systems for the disposal of condensate
- more space to accommodate more bulky units, creating additional costs of replacement.

Is this a full list of special requirements and how significant are these matters in terms of the incremental costs of installation?

One of the difficulties in assessing the incremental cost of 7-star GWH is that, while comparable commercial units are very expensive, they are not produced on the mass scale that is comparable to domestic production. Are there significant scale economies in producing for domestic markets? How would mass production, raising market share from 10-20% to close to 100%, affect the incremental cost of 7-star GWH for domestic applications?

Very demanding MEPS for GWH may significantly alter the relative price and performance of GiWH and GsWH

- Is there any reason to believe that it is easier for GiWH to achieve 7 stars than GsWH? Or the reverse?
- Is it true that increased energy efficiency will reduce the recovery time of GsWH and reduce one of its main competitive disadvantages relative to GiWH, which is that the hot water runs out when loads are exceptionally high?
- Does an increase in recovery time mean that, to provide the same performance in terms of first-hour delivery capacity, GsWH will actually need somewhat less storage? Will they become less bulky when compared on a like-for-like basis?
- Looking ahead to the relative price and performance of GsWH and GiWH, is it possible to say which products are better suited to particular applications? For example, is it the case that GsWH may be better suited to larger applications and GiWH better suited to smaller applications? Or the reverse?
- Is it reasonable to anticipate the emergence of a hybrid technology, combining the best features of storage and instantaneous technology, with somewhat smaller storage tanks than are now used, but high efficiency/high capacity burners that significantly reduce the recovery time? Put another way, is it better to think in terms of a spectrum of technologies between storage and instantaneous, rather than in terms of the extreme forms of the technology?

Very demanding MEPS for GWH may alter the relative price of gas and non-gas water heaters.

- A particular concern is that more expensive GWH will discourage the phase-out of electric resistance water heaters, and perhaps reverse the process in some situations. Making allowance for a trend towards mandatory replacement with non-electric options where they are available, is this a threat and how should it be managed?

- Conversely, more expensive GWH may encourage the adoption of solar hot water, depending on the application of gas condensing technology gas boosted solar units. How will more demanding MEPS for GWH affect the market for solar hot water?

Indicative cost benefit analysis based on SEGWHAI report
Table 5.3 reports a cost benefit analysis that has been adapted from work that was recently published in draft final form by SEGWHAI (Valley Energy Efficiency Corporation 2007). We adapted the assessment to Australian conditions by applying Australian prices to the baseline equipment and energy costs. The installed costs of non-baseline units were adjusted in proportion. The discount rate was reset to 7.5%.

There is uncertainty about how the US measure of energy efficiency (Energy Factor) translates into Australian star ratings. Table 5.3 therefore uses the US measure. Despite that lack of precision, it is considered that the range of technologies presented in table 5.3 is broadly commensurate with the technologies that characterise Australian GsWH of 3 to 7 stars.

The SEGWHAI work relates to GsWH only and has been summarised in section 3.3 of this RIS.

The key findings are:

- The next generation of GsWH has the potential to reduce gas usage by about 30% relative to the conventional technologies now used in the US, but at the expense of some increase in electricity use for electronic ignition and combustion blowers.
- Next generation GsWH are expected to be considerably more expensive, adding $550-$650 to the cost, which is a 45-55% increase.
- The incremental installed cost for the 'more efficient' conventional units is minimal – $28. In fact, SEGWHAI could not detect a positive relationship between the price and energy efficiency of conventional units in the US. Price differences seem to be fully explained by differences in warranty periods.
- More efficient conventional technology has the lowest LCC (life cycle cost).
- There are modest net financial costs associated with the introduction of next-generation technologies. The incremental net present value for high efficiency condensing is a negative amount, -$42, and the corresponding estimates for medium and high efficiency condensing technologies are -$107 and -$55 respectively. This means that the transition from conventional to high efficiency condensing technology $204 (= $42 + $107 + $55).
- Next-generation technology provides greenhouse abatement at the relatively high marginal cost of $40-$200/tonne.
- The final panel is a memo item showing an alternative presentation of the financial estimates. These 'annualised' amounts are the annual payments that would be payable if installed costs are paid off over the life of the heater. The variation in annual cost across all technologies is quite modest – from $411/year to $436/year. The cost of the best prospective GsWH technology is $25/year or 50 cents/week.

This figuring is subject to important caveats. First, the SEGWHAI report is still in its draft form and has yet to be released publicly. Second, the major US manufacturers of GsWH are represented on the SEGWHAI steering committee but have not been asked provide confidential cost estimates or to otherwise endorse the estimates that have been provided. Third, SEGWHAI says the early rollout will be limited to situations where there are no significant costs associated with installing replacement heaters in the available space or obtaining access to electrical services and drainage.

TABLE 5.3 SEGWHAI'S COST BENEFIT ANALYSIS OF NEXT GENERATION GSWH

Technology	Conventional		Next generation		
type	Borderline compliance with 2004 US MEPS	More efficient conventional units promoted by US utilities	High efficiency non-condensing	Medium efficiency condensing	High efficiency condensing
Energy factor*	0.59	0.62	0.70	0.82	0.86
Energy usage under US test conditions					
gas (MJ/year)	19,505	18,557	16,237	13,812	13,074
electricity (kWh/year)	0	0	40	150	150
Incremental impact on energy use and greenhouse emissions					
gas (MJ/year)		-949	-2,320	-2,425	-738
electricity (kWh/year)		0	40	110	0
emissions (kg/year)		-64	-120	-64	-49
Life cycle cost (LCC, $, present value)					
installed cost	$1,273	$1,302	$1,570	$1,839	$1,981
gas cost	$2,274	$2,163	$1,893	$1,610	$1,524
electricity cost	$0	$0	$44	$164	$164
total	$3,547	$3,465	$3,507	$3,614	$3,669
Incremental costs and benefits (change in LCC)					
costs ($)		$28	$269	$269	$141
benefits ($)		$111	$227	$162	$86
net present value ($)		$82	-$42	-$107	-$55
B/C ratio		3.9	0.8	0.6	0.6
Incremental cost of greenhouse abatement					
$/kg		-$0.15	$0.04	$0.20	$0.13
$/tonne		-$153.40	$42.22	$199.43	$133.27
Memo item: annualised LCC ($/year)					
installed cost	$233	$232	$256	$283	$297
gas cost	$188	$179	$156	$133	$126
electricity cost	$0	$0	$3	$12	$12
total	$421	$411	$416	$429	$436

Note:
* US measure of energy efficiency under US test conditions, denoting the ratio of output energy to input energy.

These are significant limitations and the additional costs have not been factored into table 5.3. When addressing the various issues of economic feasibility that have been raised in this section, stakeholders are invited to extend their review to the figuring that is presented in table 5.3.

While these can be significant additional expenses in providing access to electricity, gas and drainage, these services are long-lived asserts that will outlast at least one water heater and possibly three or four replacements. The additional cost of these services can be amortised over a long time.

No cost benefit analysis available for 7-star GiWH

As far as we are aware, there is no published figuring for GiWH that is comparable with table 5.3. But there are indications, already noted in section 3.3, that the development of next-generation GiWH is further advanced than the development of next-generation GsWH. To repeat the material from section 3.3:

- The Japanese Top Runner program set the 2006 energy efficiency target for GiWH at 'close to condensing' – 83%. This is a sales-weighted average and would require a proportion of sales to exceed the target.
- Japanese utilities are pushing for sales of 3.5 million condensing water heaters by 2010. The volume of sales suggests they are domestic units.
- China is reportedly contemplating MEPS for GiWH, at 88% in 2008 and 95% in 2015. Average efficiency is currently 86.9% but it not clear how this figure relates to the efficiency measures used in Australia and New Zealand.

This is encouraging because GiWH may solve some of the problems associated with the replacement of GsWH, particularly where there are significant space constraints. But they still require access to electrical power and drainage and may also require new gas lines to provide gas at the higher rates required by GiWH.

However, that raises the question of whether GiWH can achieve 7 stars without introducing gas condensing technology. Possibly they can, since they do not incur the losses associated with hot water storage. It is noted that (a) the certified GiWH have higher star ratings than GsWH in Australia, even if the comparison is confined to models with a minimum of 5 stars,[36] and (b) Rinnai recently registered a new GiWH product with 6 stars. If so, the drainage problem is eliminated and the key remaining cost is the cost of providing electrical services and an adequate gas supply.

At this stage we are unable to assess the contribution of GiWH to compliance with MEPS at 7 stars. E3 is aware that there are unresolved issues about storage and start-up losses. The two issues in this debate are:

- Storage losses and average daily water use: Storage technologies are at a disadvantage at low loads, since there are relatively fixed losses from stored hot water.
- Start-up losses and water wastage: Instantaneous technologies avoid the storage losses but use energy and water during start-up, since this involves the discharge and dumping of partially heated water.

This debate is arbitrated by the energy test and depends critically on the tapping pattern that is assumed for the energy test – that is, the size distribution of the individual amounts of hot water that are drawn off or 'tapped', how individual tappings are distributed through the day, and the total amount of hot water that is drawn off. These issues have not been fully resolved.

When addressing the various issues of economic feasibility that have been raised in this section, stakeholders are invited to give particular attention to whether GiWH can achieve 7-star efficiency without taking the more expensive step of introducing gas condensing technology, and how GiWH might then contribute to the implementation MEPS at 7 stars.

5.6 Potential nationwide impact

Table 5.4 provides a statement of the potential nationwide impact of Option 2, including a comparison with Option 1A and a breakdown of the possible impacts by type of upgrade. The result for Option 1A has been copied from table 4.4 in section 4.

[36] See figures 1.1 and 1.2 in section 1.2.

TABLE 5.4 SUMMARY STATEMENT OF POTENTIAL NATIONWIDE IMPACT – AUSTRALIA, OPTION 2

	Option 1A	*Option 2*	*Type of upgrade under Option 2*				
			GsWH			*GiWH*	
			3 to 4 stars	*4 to 7 stars*	*5 to 7 stars*	*4 to 7 stars*	*5 to 7 stars*
Number of upgraded GWH (million)	0.83	4.44	1.21	0.92	0.89	0.01	1.94
Energy use – PJ	-34.3	-204	-24.16	-67.07	-45.21	-0.48	-67.53
Greenhouse abatement (Mt CO_2-e)	2.31	13.71	1.62	4.50	3.03	0.03	4.53
Undiscounted dollar amounts ($M)							
cost to the taxpayer	0.41	0.61					
business compliance costs	0.77	1.57					
incremental cost of heaters	130.4	1,917	63.8	671.4	554.2	3.1	624.8
household expenditure on energy	-474.8	-2,827	-334.1	-927.6	-625.2	-6.6	-933.9
Present values ($M)							
cost to the taxpayer	0.37	0.51					
business compliance costs	0.65	1.40					
incremental cost of heaters	80	897	33.4	300.8	281.0	1.7	280.6
household expenditure on energy	-204	-895	-118.5	-280.6	-213.0	-2.4	-280.6
Investment criteria							
total benefits ($M)	204	895	118.5	280.6	213.0	2.4	280.6
total costs ($M)	81	899	33.4	300.8	281.0	1.7	280.6
net present value ($M)	124	-4	85.1	-20.2	-67.9	0.7	0
benefit/cost ratio	2.5	1.0	3.5	0.93	0.76	1.43	1.0

Note

* This total is less than the sum of the individual upgrade categories. It excludes the double counting associated with upgrading certain GWH in two stages, first to 4 stars and subsequently to 7 stars.

It is important to understand that it has simply been assumed that Option 2 can break even, that is, generate a benefit cost ratio of 1.0. The break-even result is purely indicative and for the purposes of the consultation RIS only. It poses the question of whether this outcome can be achieved. It has been obtained as follows:

- The estimated impacts of the first stage of Option 2, raising GsWH from 3 stars to 4 stars, have been imported from section 5.5.1.
- It has been assumed that raising GiWH from 5 stars to 7 stars is also an intervention that breaks even, that is, returns a benefit cost ratio of 1.0. Table 5.4 also reports a small number of GiWH that are raised from 4 stars to 7 stars and return a benefit cost ratio of 1.46. This improvement is because the step from 4 to 5 stars is highly beneficial – see section 4.5.3.
- Finally, we adjusted the remaining incremental cost estimates, for GiWH that are raised from 5 to 7 stars, in a manner calculated to reduce the overall cost benefit ratio to 1.0. The practical effect was to impose an assumption that incremental installed cost of raising GsWH efficiency from 5 stars to 7 stars is about four times the incremental cost of raising GsWH efficiency from 3 stars to 5 stars. While the effect is to reduce the benefit cost ratio for these products below 1.0, they remain above the estimates derived from the SEGWHAI analysis.

E3 recognises that the analysis presented in table 5.4 does not provide a strong basis for regulation. The specific concerns are that:

- There is currently no basis for hoping that the proposal can do more than break even and, even then, there are net costs for significant categories of product.
- The SEGWHAI analysis indicates that the analysis presented in table 5.4 is optimistic.
- The SEGWHAI analysis itself excludes significant costs associated with replacing heaters in dwellings that do not have adequate space or connections to services.
- The effect of more marginal regulatory proposals is to sharpen concerns about the use of energy test results to estimate actual energy savings.

E3 can neither justify nor credibly undertake analysis further at this stage. E3 cannot make significant further progress without significant input from industry and, to justify that work, there would need to be broad agreement from industry that Option 2 is feasible and preferred.

E3 is prepared to facilitate the consideration of complementary policy action in support of Option 2, addressing matters such as the following:

- Water efficiency: Significant reductions in the hot water load and the size of water heaters may relieve space limitations on the replacement of existing hot water heaters with more efficient products.
- Tapping patterns: Smaller water heaters can also be accommodated by changing the tapping pattern, for example, by using automatic timers to schedule washing tasks for times when the dwelling is unoccupied.
- Water heater sizing: It would be important for reductions in hot water demand to be translated into smaller heaters and this may be impeded by poor information and metrics about the delivery capacity of hot water heaters, and the cost of larger heaters. It is significant in this context that 24% of Australian households (1.7 million) have one person and another 34% have two persons (2.4 million), and that average household size is falling.

6 Impact analysis: Option 1 – New Zealand

This chapter reports the impact analysis for Option 1 in New Zealand. The impact is so minor that it serves no practical purpose to distinguish between the impact of Options 1A and 1B. The discussion is mostly in terms of Option 1, but noting certain differences that may have significant consequences for some suppliers.

The New Zealand market for GWH is profiled in chapter 1. A key point from that review is that the difference between the New Zealand and Australian impacts is not just a matter of the size of the two populations. Other significant differences are that.

- A smaller proportion of New Zealand households have GWH. Even allowing for expected growth – 27% by 2020 – penetration will remain lower than in Australia.
- 5-star GiWH dominate the New Zealand market, which means that the average level of efficiency is high compared to Australia.
- Most of the storage units with less than 5 stars are installed internally and are provisionally excluded from the proposed MEPS. E3 proposes that (a) the inclusion of these units will be subject to further analysis of the appropriate MEPS, and (b) they will not be included before October 2010.

Another point of difference is that GWH in New Zealand are not subject to energy standards and labelling requirements. This raises the issue of new compliance costs in New Zealand and the impact of labelling in New Zealand.

The following assumes that the reader is familiar with the background on the New Zealand market that is provided in chapter 1.

6.1 Contribution to greenhouse abatement

Section 1.4 provides a projection for GWH stocks and sales under BAU conditions. In summary, the BAU scenario is that 16,400 GWH with less than 5 stars would be sold in the period to 2020, comprising 15,000 internal GsWH, 700 external GsWH and 700 external GiWH. With the internal GsWH provisionally excluded from the proposal, the proposed measure would affect sales of only 1,400 units.

Using the prescribed emissions factor for gas in New Zealand (60 kg CO_2-e/GJ), we estimate that the replacement of these 1,400 GWH with 5-star appliances would reduce total emissions over the period to 2020 by 2,100 tonnes CO_2-e. Over the period to 2020 total emissions from GWH would be little changed, at 6.24 Mt CO_2-e.

6.2 Financial impact of the proposal

This section is gives an account of what is known about the financial impact of the proposed measures, then draw conclusions.

Cost to the taxpayer
The incremental cost to the New Zealand taxpayer will be small and relates mainly to program development and the sharing of the costs of check-testing and product registration.

Subject to further consideration by EECA, we have assigned a notional figure of $NZ50,000 to the New Zealand taxpayer.

Business compliance costs

New Zealand does not require compliance with AS 4552 at present. However, inspection of the declared appliances list (Safety New Zealand website) indicates that the vast majority of new products comply with AS 4552 or one of its precursors, including Australian Gas Standard AG102. This is because major suppliers provide the same products to Australia and New Zealand but certify them in Australia. It appears that the only exceptions are the internal GsWH that are manufactured in New Zealand by Rheem NZ, and which are now provisionally excluded from the proposal, and a range of external GsWH that Abergas imports from the United States. Neither of these products is sold or certified in Australia.

We spoke to two of the major suppliers about the impact of the labelling requirements. Both said that the impact would be trivial. Rheem NZ said that, because labels are applied in the Australian factory and there is no separate production run for products exported to New Zealand, the Australian-sourced product is already distributed with labels. Rinnai NZ said that they favoured labelling and that it would be a trivial matter to have New Zealand product labelled in the same production runs as the product destined for the Australian market. The costs would be measured in cents/GWH and it may be cheaper not to have a separate production run for New Zealand. Rinnai NZ does not expect any change in the cost of imported products. We assume the other major suppliers, Bosch and Dux, are in the same situation.

Abergas is a small supplier that seems certain to incur significant additional compliance costs, for a small number (10-20 a year) of GsWH with a US brand (Ruud). The additional costs may be prohibitive for Abergas. The energy rating tests would probably need to be conducted in an Australian laboratory and, allowing for transport costs, would cost at least $NZ20,000. It seems unlikely that these costs can be recovered from sales of 10-20 a year. Abergas did not respond to the CBA and, to better understand their situation, E3 will specifically seek feedback from Abergas in response to this consultation RIS.

E3 will also specifically seek feedback from What Power Crisis, which imports smaller GiWH for caravans and for dwellings in remote and off-grid locations. Sales are about 200 per year and have been certified against the relevant Australian Standard, AS 4552. What Power Crisis is not sure of their energy rating and it has been assumed that these are either 5-star appliances or can be readily replaced with 5-star appliances. E3 intends to confirm that with What Power Crisis.

Abergas and What Power Crisis seem to be the only two suppliers that may not be able to take advantage of the transition arrangements under Option 1A. That is, they may not have 5 star products under the existing standard but plan to stay in business with 5 star products in the longer term, and must therefore obtain supplies of 5 star products before October 2008. While these can be certified to the existing or the new standard, the difficulty will be to organise supplies before the transition period starts in October 2009. On this issue, E3 will specifically seek feedback from Abergas and What Power Crisis in response to this consultation RIS.

The only further issue is that Australia and New Zealand have different arrangements for the regulation of gas appliance safety, to the point where gas appliances have an exemption under the TTMRA. But this is not a significant impediment to trade in GWH between the two countries, since most products are jointly marketed in both countries and are necessarily certified to Australian standards. The only products that are sold in New Zealand and not certified to Australian standards are either provisionally excluded from the proposal (internal GsWH made in New Zealand) or imported in very small numbers (10-20 GsWH/year imported by Abergas). Most importantly, the implementation of the proposed MEPS does not require New Zealand to abandon its arrangements for the regulation of gas

appliance safety. Lloyd Harrington[37] has explained the revised energy rating tests will require simple safety checks – for electrical connections, gas leaks and carbon monoxide. These do not override New Zealand's arrangements for the regulation of gas appliance safety and there are no 'compliance cost' complications.

In summary, the incremental compliance costs are trivial in most cases. This is because most of the GWH that will be affected by the proposal are marketed jointly in both New Zealand and Australia. All significant costs of energy testing and labelling will be incurred for the Australian market. There may be non-trivial impacts on smaller suppliers and E3 will seek further information during the consultation phase.

Impact of mandatory labelling
Based on the preceding discussion, and subject to further consultations with Abergas and What Power Crisis, we consider that the incremental cost of energy labelling will be insignificant.

It is reasonable to assume that there will be positive benefits that outweigh the costs but the amount is uncertain and cannot be estimated at this stage. This is because the labelling scheme will be reformed and it not feasible to estimate the impact until E3 has completed that work.

E3's has not given priority to energy labelling for GWH and, in the absence of supplier interest, would consider allowing the scheme to lapse. As discussed in section 3.3.3, the labelling of water heaters is not a policy option that is used extensively in other countries. This is because water heaters do not have the 'shop floor' exposure that we associate with whitegoods and other household appliances, restricting the consumer's ability to use energy labels to make efficiency comparisons.

Impact of MEPS on external GsWH imported from Australia
External GsWH with 5-star ratings are already sold in New Zealand and the effect of the proposal would be to shift 700 sales from the 3-star segment to the 5-star segment. This is financially attractive. The impact on this market segment can then be stated as follows:

Impact on average customer

- Incremental cost of appliance – $NZ350
- Energy savings – 3,680 MJ/year
- Value of energy savings – $NZ97/year (valued at marginal gas tariff of 2.64 cents/MJ)
- Present value of energy savings – $NZ922 (asset life of 13 years, discount rate of 5%)
- Net financial benefit – $NZ562
- Benefit cost ratio – 2.6

Aggregate impact

- Additional sales of 5-star units to 2020 – 700 units
- Incremental compliance costs - nil
- Present value of incremental appliance cost – $NZ204,746
- Present value of energy savings – $NZ533,346
- Net financial benefit – $NZ328,600

[37] Personal communication. Lloyd Harrington is a technical consultant to the E3 program and E3's representative on the relevant standards committees.

- Benefit cost ratio – 2.6

This is essentially the calculation provided for the corresponding Australian case but adjusted for New Zealand prices. The incremental cost is that nominated by the major supplier of these products, which is Rheem NZ. The marginal gas tariff is that charged by Vector, which has prices that are comparable to the estimate of average NZ prices published by the Ministry of Economic Development.[38] The discount rate is that prescribed by New Zealand Treasury, 5%.

Impact of MEPS on external GiWH
External GiWH with 5-star ratings are already sold in New Zealand and the effect of the proposal would be to shift 700 sales from the 3-star segment to the 5-star segment. This is financially attractive. The impact on this market segment can then be stated as follows:

Impact on average customer

- Incremental cost of appliance – $NZ100
- Energy savings – 2,023 MJ/year
- Value of energy savings – $NZ53/year
- Present value of energy savings – $NZ501/year
- Net financial benefit – $NZ466/year
- Benefit cost ratio – 5.0

Aggregate impact

- Additional sales of 5-star units to 2020 – 700 units
- Incremental compliance costs - nil
- Present value of incremental appliance cost – $58,499
- Present value of energy savings – $293,047
- Net financial benefit – $234,548
- Benefit cost ratio – 5.0

Again, this is essentially the calculation provided for the corresponding Australian case but adjusted for New Zealand prices.

6.3 Potential nationwide impact

Table 6.1 summarises the findings that are reported in sections 6.1 to 6.2. The net present value is $513,100 and the benefit-cost ratio is 2.6. Appendix D reports a preliminary impact assessment for the internal GsWH. MEPS may be extended to internal GsWH, but no earlier than October 2010, and depending on further work to determine the appropriate MEPS for such units.

[38] http://www.med.govt.nz/upload/35306/20060301.pdf

TABLE 6.1 SUMMARY STATEMENT OF NATIONWIDE IMPACTS – NEW ZEALAND, OPTION 1

Number of GWH upgraded to 5 stars	1,400
Energy use – GJ	-51,914
Greenhouse abatement over the life of the appliances (tonnes CO_2-e)	+3,113
Undiscounted dollar amounts ($k)	
cost to the taxpayer	+50
business compliance costs	0
incremental cost of heaters	+315
household expenditure on energy	-1,369
Present values ($k), discount rate = 5%	
cost to the taxpayer	+50
business compliance costs	0
incremental cost of heaters	+263.2
household expenditure on energy	-826.4
Investment analysis (NPV$k)	
total benefits ($k)	+826.4
total costs ($k)	+313.2
net present value ($k)	+513.1
benefit-cost ratio	2.6

7 Impact analysis: Option 2 – New Zealand

This chapter reports an assessment of Option 2 in New Zealand, which is to impose MEPS at 4 stars from October 2009 and MEPS at 7 stars from April 2013.

7.1 Impact on greenhouse emissions

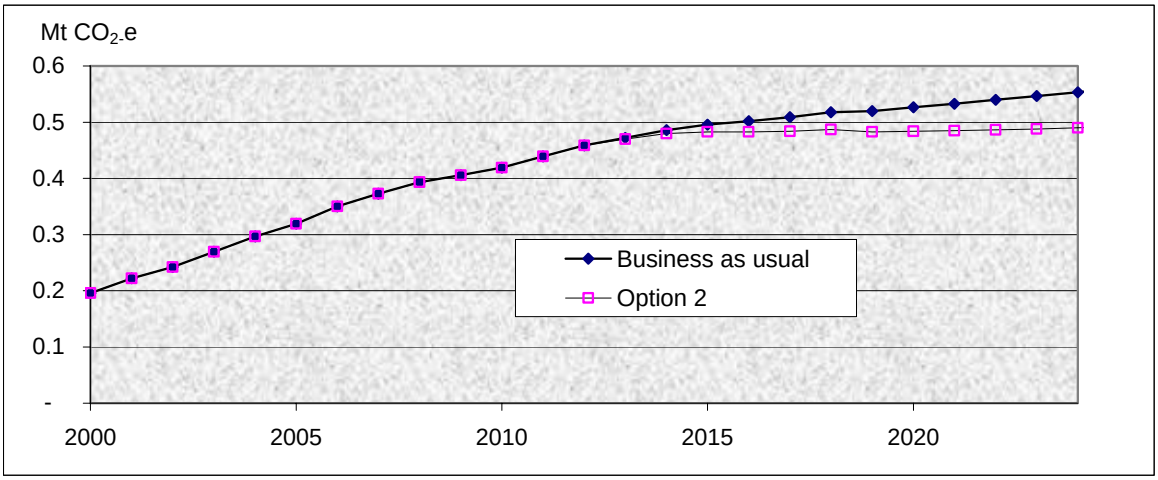
Figure 7.1 reports the impact on greenhouse emissions in the period to 2025. A comparison with Option 1 for the period to 2020 is not shown because the abatement contribution of Option 1 is not detectable on this scale. Assuming that the second stage of Option 2 is introduced on schedule, at April 2013, the impact of the measures is to:

- reduce emissions growth for the period 2010-25 from 33% to 17%;
- reduce annual emissions by 42,500 t CO_2-e in 2020 and by 68,300 t CO_2-e in 2025; and
- contribute 0.9 Mt CO_2-e to emissions abatement over the life of the more efficient units that are bought in the period to 2025.

The first stage of Option 2 makes a trivial contribution to this outcome. It is essentially a weaker version of Option 1 and would contribute 1,000 tonnes CO_2-e in the period to 2020. For practical purposes, the upgrading of virtually all GiWH from 5 to 7 stars delivers all the emissions abatement.

However, this comparison between Options 1 and 2 is somewhat misleading. Option 1 does not preclude further increases in MEPS at some future time. The real difference is that Option 2 provides for an explicit commitment to 7 stars at the earliest practical time.

FIGURE 7.1 IMPACT ON EMISSIONS GROWTH: 2000 TO 2025 – NEW ZEALAND



7.2 Financial impact of the proposal

Business compliance costs

It is reasonable to assume that smaller importers of GWH could not compete effectively in a market for 7-star appliances. For the major suppliers, however, it is assumed that the incremental costs of regulatory compliance are minimal and can be ignored. This is because major suppliers provide the same products to Australia and New Zealand but certify them in Australia.

7.3 Potential nationwide impact

Table 7.1 provides a statement of the potential nationwide impact of Option 2, including a comparison with Option 1 and a breakdown of the possible impacts by type of heater upgrade. The result for Option 1 has been copied and consolidated from section 6.

The estimates have been obtained by adapting the Australian analysis that is reported in section 5.6. It is important to read section 5.6 in full. E3 recognises that the analysis presented in section 5.6 is not a strong basis for regulation. The corresponding Australian analysis achieves a break-even outcome (benefit cost ratio of 1.0) by assumption and serves the purpose, purely for the consultation RIS, of posing the question of whether this outcome can be achieved.

The corresponding New Zealand estimates, reported in table 7.1, were obtained by using the prevailing exchange rate to convert the Australian estimate of incremental installed costs into New Zealand dollars. The energy savings are valued at the average marginal tariff that New Zealand households pay for gas.

Given those assumptions, the New Zealand analysis is more favourable than the Australian. This is because (a) gas is relatively more expensive in New Zealand, and (b) the New Zealand market is dominated by GiWH that we have assumed can achieve 7 stars efficiency more cost-effectively.

For the benefit of New Zealand readers, and to emphasise that E3 has a range of significant concerns about Option 2, the following are the specific issues raised in the corresponding Australian chapter, inviting stakeholder comment:

Regarding the competitive effects of setting MEPS at 7 stars, E3 seeks comment on:

- the technologies that would be needed to achieve 7-star performance;
- the feasibility of applying these technologies to domestic hot water heaters;
- the reasonableness or otherwise of the 5-year timeframe, to April 2013;
- replacement markets where it will be more difficult to achieve 7-star performance at reasonable cost;
- supplier access to the intellectual property associated with the technologies required to achieve 7-star technology;
- how 7-star MEPS will affect the relative price of GiWH and GsWH;
- risks to competition if there is restricted access to the required technologies; and
- whether small producers can compete in the market for 7-star GWH.

Regarding the economic feasibility of MEPS at 7 stars, E3 has specific concerns that:

- There is currently no basis for hoping that the proposal can do more than break even in Australia and, even then, there are net costs for significant categories of product.
- The analysis does not take account of significant costs associated with replacing heaters in dwellings that do not have adequate space or connections to services.
- The effect of more marginal regulatory proposals is to sharpen concerns about the use of energy test results to estimate actual energy savings.

E3 can neither justify nor credibly undertake further analysis at this stage. E3 cannot make significant further progress without significant input from industry and, to justify that work, there would need to be broad agreement from industry that Option 2 is feasible and preferred.

TABLE 7.1 SUMMARY STATEMENT OF POTENTIAL NATIONWIDE IMPACT – NEW ZEALAND, OPTION 2

	Option 1	*Option 2*	*Type of upgrade under Option 2*				
			GsWH			*GiWH*	
			3 to 4 stars	*4 to 7 stars*	*5 to 7 stars*	*4 to 7 stars*	*5 to 7 stars*
Number of upgraded GWH	1,400	444,246*	700	132	2,582	132	440,833
Energy use – PJ	-51,914	-16,417,272	-14,062	-9,777	-130,170	-7,843	-16,255,421
Greenhouse abatement (Mt CO_2-e)	3,115	985,036	844	587	7,810	471	975,325
Undiscounted dollar amounts ($k)							
cost to the taxpayer	50.0	50.0					
business compliance costs	0.0	0.0					
incremental cost of heaters	315.0	166,578	80.9	111.7	1,869.5	59.2	164,457.1
household expenditure on energy	-1,368.5	-432,778	-370.7	-257.7	-3,431.4	-206.7	-428,511.0
Present values ($k)							
cost to the taxpayer	50.0	50.0					
business compliance costs	0.0	0.0					
incremental cost of heaters	263.2	58,962.0	67.6	39.3	828.2	26.6	58,000.4
household expenditure on energy	-826.4	-91,785.3	-223.8	-54.8	-914.4	-56.2	-90,536.1
Investment criteria							
total benefits ($k)	826.4	91,785.3	223.8	54.8	914.4	56.2	90,536.1
total costs ($k)	313.2	59,012.0	67.6	39.3	828.2	26.6	58,000.4
net present value ($k)	513.1	32,773.3	156.3	15.6	86.1	29.6	32,535.8
benefit/cost ratio	2.6	1.6	3.3	1.40	1.10	2.11	1.56

Note

* This total is less than the sum of the individual upgrade categories. It excludes the double counting associated with upgrading certain GWH in two stages, first to 4 stars and subsequently to 7 stars.

8 Consultation

This chapter explains the industry consultations relating to the broad strategies for improving the efficiency of gas appliances (section 8.1), and explains the subsequent consultations relating specifically to MEPS for GWH (8.2). It also summarises stakeholder comments and criticisms on the cost-benefit analysis that E3 published on 25 June 2007, and E3's responses to those comments and criticisms (8.3).

8.1 Consultations relating to gas program strategy

For historical reasons, energy efficiency programs for gas appliances have always been administered by the industry body, AGA. Since 2002, however, the Australian Greenhouse Office has worked with Sustainability Victoria and Energy Safe Victoria to review the labelling and MEPS scheme for gas appliances and explore how to make it a more effective driver of energy efficiency. The milestones in this process were as follows:

1. *Mid-2002:* Mark Ellis and Associates (MEA *et al* 2002) reported on the potential for more efficient domestic gas appliances and the effectiveness of existing arrangements in promoting efficiency. MEA recommended more stringent MEPS for GWH, noting that the existing MEPS dated from 1983, that there had been significant technical developments since 1983, and most models on the Australian market did not comply with MEPS that the US introduced in January 2004. MEA also recommended that the labelling arrangements be revitalised, for example, with re-rating to reflect the actual spread of water heater efficiencies.
2. *November 2002:* The MEA report provided a focus for industry consultations. A government-industry working group formed as a result, aiming to make the gas program more effective. The group comprised AGO, Sustainability Victoria, VOGS and the two industry bodies, AGA and GAMAA.
3. *November 2003:* The working group released a discussion paper in July 2003 (AGO 2003). The group reported that …*Both key government agencies and gas industry organisations agree on the need for action, and on the general measures which are required to establish a national gas appliance efficiency scheme. Further consultation with stakeholders is necessary to refine current proposals, to determine priorities and timetables for action, and to ensure that the transition to a new regulatory regime is appropriately managed.* (AGO 2003: page 29) It also proposed a timetable for the development of a strategic plan and elements of a forward work plan. The consultation period extending to November 2003 and included stakeholder workshops in Sydney, Melbourne and Adelaide.
4. *December 2004:* MCE released its strategy for improving the energy efficiency of gas appliances – *Switch on Gas: 2005-2015* (AGO 2004a). Its highest priorities included agreement on *...test methods and MEPS and labelling requirements for domestic gas water heaters, room and ducted heaters.*…and agreement on the implementation date (AGO 2004a: page 7).
5. *April 2005:* The E3 Committee released a draft work program for public comment (AGO 2005) and workshopped the document at a Melbourne forum in April 2005. Regarding specific products, it assigned priority to the development of a test method for new water heaters, then moving quickly to develop new MEPS and labelling proposals for water heaters. These tasks were scheduled for completion by March 2006.
6. *October 2006:* The E3 Committee released a revised draft work program for public comment (AGO 2006) at a gas industry forum in Melbourne. Representatives from the Australian Greenhouse Office directly engaged with lead industry groups, the Gas Appliance Manufacturers Association of Australia and the Australian Gas

Association in the process of revising the document. The revised document contains revised program elements for the final 18 months of the original 3-year work plan as a consequence of the administrative and regulatory basis of the program, new information about gas appliance technology and testing, and gas consumer response to energy labels.

8.2 Consultations relating to MEPS for GWH

The E3 work program provided for development of a new GWH test method by November 2005, development of new labelling and MEPS proposals by January 2006, completion of the associated RIS process by July 2006, and commencement of a check-testing program in September 2006. However, progress on the new test methods has been slower than expected and it now appears that the new standard will be not be finalised before late 2008. This reassessment is in the light of a round-robin of tests that revealed unacceptable differences in the results from different laboratories. The standards committee had reviewed the issues by June 2007 and was awaiting the results of further laboratory investigations and new proposals that will be developed in the light of those results.

It was in this context that, at a GAMAA conference in Melbourne on 30 August 2006, the E3 Program proposed to suppliers that they voluntarily retire the least efficient water heaters from the market. The E3 Program subsequently commissioned a preliminary cost-benefit analysis of feasible measures to retire the least efficient units (Syneca 2006), and offered to provide funding for further investigations that suppliers considered useful. That document examined options for voluntarily setting MEPS at either 4 stars or 5 stars with introduction in either 2008 or 2009. It was made available to suppliers in October 2006. Suppliers made minor comments on the preliminary cost-benefit analysis, correcting assumptions about the product range, but did not ask for any additional work.

8.3 Stakeholder feedback on cost-benefit analysis

The E3 Program subsequently formulated the 5-star MEPS proposal and provided stakeholders with an analysis of costs and benefits. Preliminary results were presented to an industry meeting on 14 May 2007 in the Melbourne offices of Standards Australia. There was further work to assess impacts on a number of niche markets and the cost-benefit analysis was published on 25 June 2007. Six weeks were allowed for comment. This section summarises those comments and explains our response to those comments.

Importantly, Option 2 was not included in the cost-benefit analysis. Suppliers were responding to a core proposal of 5-star MEPS from October 2008 and transition arrangements that allowed products with 4.5 stars to be manufactured or imported until October 2010.

8.3.1 Technical feasibility of the proposed measure

Several respondents questioned the technical feasibility of aspects of the proposed measure.

- Dux said the market for internal mains pressure water heaters – both storage and instantaneous – was small and declining, and the development of more energy efficient product was not commercially justified.
- HWS Australia said the same for the small number of low-pressure ceiling-mounted heaters that it produces for the South Australian market. These units tend to have been installed snugly between roof trusses and some have since been surrounded by air-conditioning ducts, greatly reducing the scope to add additional insulation.
- Rheem and Rheem NZ also said that the extension of MEPS to internal water heaters was not warranted.

E3 recognises that technical feasibility is an issue for internal GsWH. The cost-benefit analysis noted the additional costs and the possibility that some gas heaters will be replaced with electric heaters, which would be perverse.

E3 considers that it is not cost-effective to provide a more detailed analysis of these issues in the regulatory impact statement and has simply excluded internal GsWH from the proposal. E3 proposes that these matters be further considered by Standards Australia committee AG-001 (Gas Appliances). AG-001 should have regard for the following matters:

- Whether test methods need to take account of hidden benefits of internal water heaters, such as contributions to the space heating task and the reduction in heat and water losses from pipes when the heater is closer to hot water outlets.
- Whether test methods should take account of differences in the ambient conditions of external and internal installations. (HWS Australia claims that ceiling installations are inherently more efficient because of the higher temperatures in ceiling spaces.)
- Whether there are practical and affordable means of improving energy efficiency, taking account of the cost of modifying the internal space that contains the heater.
- Whether there are likely to be perverse effects, such as replacement with electric heaters.

Regardless of how these matters may be assessed, AG-001 should also have regard for the small and declining sales of these heaters, and the cost-effectiveness of efforts to resolve these matters in a manner that provides a rigorous basis for government intervention. As discussed in chapter 1, the appliances and equipment included in the E3 Program must satisfy certain criteria relating to the feasibility and cost-effectiveness of intervention. These include the potential for energy and greenhouse savings, environmental impact of the fuel type, opportunity to influence purchase, the existence of market barriers, access to testing facilities, and considerations of administrative complexity.

8.3.2 Effectiveness of greenhouse abatement

Some respondents said that the proposed measures were poorly targeted or would have perverse effects on greenhouse abatement.

- Envestra is a gas distributor and is concerned about the impact of lower gas sales (per customer) and higher prices for gas appliances on the economics of existing networks and of network extensions to new subdivisions. Envestra is concerned that the measures may discourage the take-up of gas and inhibit the roll-out of the gas network. This has the perverse effect of discouraging the switch from electric to gas appliances.
- Envestra also says that measures to positively encourage the switch from electric to gas appliances would be more effective, such as a ban on electric water heaters where reticulated gas is available.
- Rheem and Rheem NZ say the measures will inhibit the development and production of solar water heaters. There seem to be two logical steps in this argument:
    - First, the measure must significantly reduce the production of storage units, which requires that a significant number of 3-star GsWH are replaced, not with 5-star GsWH but with 5-star GiWH.
    - Second, the reduction in the production of storage units would lead to the loss of economies of scale, increasing the cost of solar water heaters, or it would lead to loss of expertise and resources for the development of solar water heaters, or both.

- Rinnai calculated the potential for larger gains to be had by replacing electric water heaters with gas water heaters, claiming that a program of financial incentives aimed at households that are already connected to gas would reduce greenhouse emissions by 13 times more than the proposed measure. Envestra raised the same issue.

Regarding the existence of alternative greenhouse abatement options, our response is that the proposed measures should not be regarded as a substitute for alternative programs and policies. There is obviously scope for more to be done using instruments other than MEPS and labelling, but that does not diminish the contribution of MEPS and labelling. On the contrary, as the switch is made from electricity to gas it becomes progressively more important to use those fuels efficiently. Efficiency choices that are made now cannot be reversed for many years.

Regarding the proposition that more efficient gas appliances discourage the rollout of the gas network, our response is that:

- 3-star GsWH are mainly sold into the replacement market, which means that few would be installed in homes that are newly connected to gas or where a gas water heater is newly installed. It seems unlikely, therefore, that there will be significant adverse effects on the economics of network extensions.
- It is the role of the competition regulators in each of the jurisdictions to determine network prices that provide an economic return to network operators, and to adjust those prices in response to changing circumstances, such as changes in gas throughput.
- The E3 Program applies also to electrical appliances, reducing electricity throughput, and has similar effects on the economics of operating electricity networks.

Regarding the issue of perverse effects on the development and production of solar water heaters, a plausible alternative scenario is that the rationalisation of production around 5-star models will reduce the cost of GsWH and help to sustain the market share of GsWH and storage-based units generally, including solar water heaters. It is also noted that (a) GiWH appliances tend to be more expensive than GsWH, and (b) additional installation costs are incurred when GsWH are replaced with GiWH, which will help to protect the replacement market for storage units.

Rheem maintained their position in subsequent meetings and correspondence with E3, but without providing detailed market assessments and cost analysis in support of their case. Option 2 was subsequently formulated. As discussed in chapter 3, E3 is aware of concerns that further development of 5-star products is a technological ‘dead end’ and that product development resources would be better employed in developing 7-star products. E3 seeks stakeholder comment on whether an additional five years, to April 2013, is a reasonable timeframe.

8.3.3 Timing and transition arrangements

There are three matters.

- Suppliers criticised the schedule of transition arrangements that were proposed in the cost-benefit analysis, particularly given that the new testing arrangements have not been finalised and that there will be limited time to understand and respond to the changes.
- Dux and Rheem questioned the value for a transition arrangement that would allow products that have been certified under the existing test method to be manufactured or imported until October 2010, provided that have at least 4.5 stars. Their preference is for more time to make the adjustment, extended use of the existing

certifications, but going directly to 5 stars and dispensing with the intermediate step at 4.5 stars.

- There were also questions about the integration of the proposed measures with possible changes to both New Zealand and Australian building code requirements for water heaters. New Zealand has made more progress on the building proposals, and NZ entities posed the questions – Rinnai NZ, the New Zealand Department of Building and Housing, GANZ, and a consulting engineer who responded as a private individual.

E3 has revised Option 1 in response to the concerns about timing and the intermediate step at 4.5 stars. Specifically, Option 1A allows for any product that is certified to the existing standard before October 2009 to be manufactured or imported until October 2010, whereas the previous proposal required such products to be certified to the existing standard before July 2007. And the threshold has been reset to 5 stars. E3 also invites supplier comment on a timing variation that has been included as Option 1B, which is to defer implementation to December 2010 but dispense with the transitional arrangements for products that are certified to the existing standard before October 2009.

On the issue of integration with the building code, E3 considers that the unresolved issue of integration should not delay a decision on the proposed measures. Building regulators in New Zealand and Australia are dealing with the issue and have about the same timeframe as the Australian Standards committee that is revising the relevant standard.

8.3.4 Benefits of the measure

Several respondents commented on the estimate of benefits that was provided in the cost benefit analysis.

- Dux asked that there be a reconsideration of the factors that have driven demand for gas water heaters in the past, being investment in gas networks, industry promotion and a resurgence of interest created by innovative GiWH and 5-star GsWH, all of which have started to wane.
- Dux also noted the assumption that the figure for average daily draw-off of hot water that is used for testing purposes (200 litres a day) is a reasonable measure of actual usage. This has been accepted in the past only because there are no estimates that are generally regarded as providing a fair and accurate measure of domestic hot water use.
- Dux says that some households ignore longer term benefits and that effects on such households can be estimated by ignoring benefits that accrue after the first five years in the life of a more efficient heater. Implicitly, this is an issue of the appropriate rate of discount applied to future benefits.
- Rheem questioned the sales projections for 3-star GsWH, noting the declining market share of GsWH generally.
- Rinnai says that it is well understood in the industry that the average daily draw-off of hot water that is used for testing purposes (200 litres a day) is not a reasonable measure of actual usage, and that actual usage '… is in fact 140 litres'.

Regarding the issue of sales projections for 3-star GsWH, our response is that trends in market shares and sales need to be interpreted with considerable care. Uncritical extrapolation of recent history can lead to implausible results. It is necessary to examine both sales trends and underlying stock trends, recognising that a product can enjoy high sales growth while its share of the installed stock is increasing but that sales growth returns to normal levels when the stock adjustment process is complete and new market equilibrium is established. This document contains a more detailed discussion of these issues than was provided in the cost-benefit analysis (section 1.3). Sensitivity analysis is the appropriate way to deal with the remaining uncertainty.

Regarding the issue of hot water usage, our response is that there is uncertainty but no broadly agreed empirical basis for departing from the test condition of 200 litres a day. A sensitivity test for lower average hot water use, at 140 litres a day, is included in this RIS.[39]

Regarding the issue of discounting, our response is that the RIS tests for sensitivity to the standard range of discount rates.

8.3.5 Costs of the measure

One respondent commented on aspects of the cost estimates.

- Dux said that the estimates of additional appliance costs seemed reasonable but that there may be additional costs of installation where exact replacements are not available.
- Dux said there was a need to provide for more check testing for continuing compliance purposes, which is a cost to the taxpayer.

Our response to the first point is that, on all the evidence, the baseline estimate of incremental compliance costs is conservatively high. On the second point, E3 has checked its estimates and consider they are reasonable. The initial check-test is a cost to the taxpayer but follow-up testing is at the expense of the supplier.

8.3.6 Impact on water usage

Rheem and Rheem NZ say that increased take-up of GiWH will increase the water losses that are associated with their use. This relates to Rheem's claim that the measure will accelerate the transition to GiWH, first listed here in the section dealing with the effectiveness of greenhouse abatement policy (section 8.3.2). There are additional water losses because, unlike the storage heater which has hot water 'ready to go', the instantaneous type 'ramps up' to its operating temperature and cold water is dumped in the meantime. There are evaporation losses from GsWH but Rheem estimates that, a GiWH uses an additional 20.7 litres of water per day under standard test conditions, and that this is a conservative estimate of actual losses. Rheem further estimates that the aggregate loss is 1.7 billion litres a year, or 5% of domestic internal usage, if 75% of GWH are converted to GiWH.

Our assessment of this issue is as follows:

- There is no published research that independently assesses the water efficiency of GsWH and GiWH and investigates all aspects of the issue. Plausibly, for example, the 'dial a water temperature' feature of GiWH reduces the losses incurred as the user juggles the hot and cold to get and maintain the right temperature from GsWH.
- The marginal tariffs charged by the major water utilities vary from about 70 cents/kL to 130 cents/kL and have an unweighted average of 94 cents/kL. Taking a round number estimate of $1/kL, the annual cost of 20.7 litres/day is $7.55, that is, 7.55 kL valued at $1/kL. This is small relative to the expected energy savings under standard test conditions, which we estimate at $61/year, and would not alter our positive assessment of the proposal.
- As discussed in section 8.3.2, we question the assumption that the effect of the measures will be to significantly increase the sales of GiWH and accelerate the phasing-out of GsWH. This seems to ignore (a) economies from the rationalisation of GsWH production around 5-star units, (b) the fact that GiWH tend to be more expensive than GsWH, and (c) the additional installation costs that are incurred when a GsWH is replaced with a GiWH.

[39] It should be noted that the estimate of energy savings varies less than proportionally with hot water usage, since standing losses from stored water are relatively insensitive to the amount of water that is drawn off.

Our response is:

- Given doubts about the impact on market shares and the extent of the additional losses, we have not included a dollar estimate of the excess water losses in the baseline assessment of the proposal. The additional uncertainty is addressed in the sensitivity analysis.
- The water losses associated with GiWH can be minimised through regulation, but that this will be dealt with separately through the WELS (Water Efficiency Labelling and Standards) program, not E3.

The Water Efficiency Labelling and Standards (WELS) Scheme has been investigating the prospect of including instantaneous gas hot water systems under the Scheme. Initial consultancy work has been conducted in order to define the technology, map the industry and identify the different approaches taken to managing water wastage. This work identified a lack of data on the volume of water discharged by these appliances before they reach set temperature. WELS is currently conducting laboratory testing of a selection of instantaneous gas hot water systems, at a variety of water pressures and test conditions, to collect this baseline data on water wastage. That data will inform subsequent cost benefit analysis of water efficiency labelling for these products.

8.3.7 Impact on Australian manufacturing jobs

Rheem says that increased take-up of GiWH will reduce employment in the manufacture of GsWH. This also relates to Rheem's claim that the measure will accelerate the transition to GiWH, first listed here in the section dealing with the effectiveness of greenhouse abatement policy (section 8.3.2).

As explained in 8.3.2, our response is to invite Rheem to provide quantitative analysis in support of their argument that the measure threatens the production of storage-based heaters. In particular, Rheem need to substantiate the claim that the proposed measure may result in the loss of all Australian jobs in the manufacture of storage-based water heaters.

This RIS addresses the issue in the section dealing with impacts on competition and trade (section 4.4).

8.3.8 Product labelling

Two suppliers – Bosch and Rinnai NZ – said that energy labels provided useful information to customers and should be retained. E3 agrees but has not given the issue priority.

As discussed in section 3, E3 does not have a specific proposal at this stage but invites comment on the general approach outlined here. It is now proposed that the mandatory labelling requirements be retained but recalibrated to better reflect the current range of feasible efficiencies. E3 considers that water heaters with borderline compliance should be assigned no more than 1.5 or 2 stars, which means that heaters that are now labelled as 5-star would be reassigned to this lower level. E3 also considers that there should be a meaningful gap between heaters with borderline compliance and those that achieve the higher levels of efficiency that can be achieved with gas condensing technology. There would need to be a gap of 2 or 2.5 stars between the lower and higher levels of efficiency.

It is recognised that recalibration of the energy rating scale can disrupt marketing arrangements and strategies, particularly where there are perceptions that product and suppliers have been downgraded. E3 undertakes to work with suppliers to facilitate the introduction of a recalibrated rating scale and to minimise the potential for misunderstanding.

E3 does not have a specific proposal to put forward at this stage, but invites comment on the proposed approach. E3 will consult with Standards Australia committee AG-001, industry and community groups on the labelling options before making a recommendation.

8.3.9 Breach of contractual commitments

One supplier asked about the effect of MEPS on its commitment to replace heaters on a like-for-like basis during warranty periods. MEPS apply only to the manufacture and import of products. Manufacturers may, at their discretion, retain stock of pre-MEPS products for the purpose of fulfilling warranties and, so long as no sales transaction occurs, the MEPS will not impede the fulfilment of warranties. Replacement units are treated as spare parts, not as a new purchase.

9 Conclusion and recommendations

The primary assessment criteria are that the measures deliver the maximum reduction in energy use and greenhouse emissions, subject to the constraint that the measures are not less cost-affective than other abatement measures.

For Option 1, tables 9.1 and 9.2 report our assessment against these and various secondary criteria. Assuming that Option 2 is not viable, we conclude that the proposed measures will meet the assessment criteria and that the E3 Program can proceed to develop the measures with a high degree of confidence that the objectives will be achieved. In that case, it is recommended that the measures be developed expeditiously, aiming to publish revised methods of test in a new energy efficiency standard as soon as possible.

Regarding the choice between Options 1A and 1B, E3 will determine its final recommendation in the light of responses to this consultation RIS.

It is not possible at this stage to finalise the assessment of Option 2. E3 has taken the analysis as far as it can in the absence of further supporting argument from industry. E3 will determine its final recommendation in the light of responses to this consultation RIS.

There should be further consideration of options to improve the efficiency of the internal GsWH that have been excluded from the proposal.

TABLE 9.1 ASSESSMENT SUMMARY – AUSTRALIA, OPTION 1

Objective	*Assessment*
Do the measures reduce greenhouse emissions?	It is expected that the measures will reduce greenhouse emissions by 2.3 Mt CO_2-e. This is the result of a 15% reduction in the energy consumed by 0. 83 million GWH. These are the projected sales of the least efficient (3 & 4 star) of the current range of GWH, in the period 2009 to 2020.
Do the measures reduce the lifecycle cost of appliances?	The measures will deliver a significant reduction in the average lifecycle cost of these GWH. In present value terms, the lifecycle cost will be reduced by $123.6 million, comprising $204.3 million in energy savings, offset by equipment and program costs of $80.7 million. The benefit-cost ratio is 2.5.
Do the measures address market and regulatory failures?	The measures address significant failures in the market for GWH. Households need to perform a reasonably sophisticated calculation to understand the significance of energy costs, involving estimates of energy use, energy prices, asset lives and discount rates. There are significant impediments to making a fully informed decision, for example: replacement heaters are often purchased in circumstances where the existing heater has failed and the household is without hot water; the heater may be purchased by a builder or landlord who is concerned only to minimise the capital cost; and, unlike whitegoods, consumers can seldom inspect water heaters and their energy labels on the shop floor.
Does the option minimise negative impacts on product quality and function?	There are several issues of product quality and function. First, GsWH heaters with 5-year warranties are generally available at the 3-star level (90% of sales) but not at the 5-star level, where 10 years is the norm. However, it is assumed that a full range of models with 5-year warranties will be made available at the 5-star level, preserving the current range of product choice. Second, 5-star replacements may not be generally available for a minority of users with the smallest (90L) GsWH. The combined sales are currently about 2.5% of the market and declining. Certain internally installed GsWH have been excluded from the proposal in response to concerns about the availability of affordable replacements.
Do the measures minimise adverse effects on suppliers?	This proposal is the first initiative arising from the program of reform that industry and government embarked on in 2002, with extensive consultation throughout. It engages the machinery of Standards Australia that is familiar to industry, and the technical details are being developed in close consultation with industry, aiming to finalise in late 2008. Timing is always an issue and the schedule has been relaxed in response to supplier concerns. The E3 Program remains open to further supplier submissions on timing.

TABLE 9.2 ASSESSMENT SUMMARY – NEW ZEALAND, OPTION 1

Objective	*Assessment*
Do the measures reduce greenhouse emissions?	It is expected that the measures would reduce greenhouse emissions by 3,115 kt CO_2-e in the period to 2020. It is the result of a 15% reduction in the energy consumed by 1,400 GWH of less than 5 stars that will be sold in the period to 2020. The impact on emissions in the period to 2020 is small, a reduction of only 0.03%. The background is that the New Zealand market for GWH is dominated by GiWH, which tend to be more energy efficient than GsWH and generally comply with the proposed measures.
Do the measures reduce the lifecycle cost of appliances?	The financial impact on New Zealand is small but positive. It is the sum of two small positive amounts associated with external GsWH and external GiWH that are sold in the period to 2020, with a combined net present value about $NZ513,000.
Do the measures address market and regulatory failures?	The measures address failures in the market for GWH but applying to very few sales. Households need to perform a reasonably sophisticated calculation to understand the significance of energy costs, involving estimates of energy use, energy prices, asset lives and discount rates. There are significant impediments to making a fully informed decision, for example: replacement heaters are often purchased in circumstances where the existing heater has failed and the household is without hot water; the heater may be purchased by a builder or landlord who is concerned only to minimise the capital cost; and, unlike whitegoods, consumers can seldom inspect water heaters and their energy labels on the shop floor.
Does the option minimise negative impacts on product quality and function?	There are no significant issues of product quality or function.
Do the measures minimise adverse effects on suppliers?	The exclusion of internal GsWH from the proposal has eliminated immediate concerns about the adverse impacts on the sole New Zealand manufacturer of GWH. However, the measures may adversely affect the operations of two small importers. E3 will specifically seek feedback from these two businesses during the consultation period. Timing is always an issue and the schedule has been relaxed in response to supplier concerns. The E3 Program remains open to further supplier submissions on timing.

10 Implementation and review

General administrative arrangements
Australia's national scheme for mandatory energy labelling and minimum energy performance standards relies on state and territory legislation for legal effect. The jurisdictions have also agreed to a set of administrative guidelines. While not legally binding, they aim to promote a uniform approach, consistent outcomes and to minimise compliance costs. The E3 Program released the latest guidelines in May 2005 (NAEEEC 2005). The key administrative arrangements are:

1. The technical details of the MEPS are contained in Australian and New Zealand Standards that are incorporated by reference into the state and territory legislation. These standards do not vary between states. The format and content of the standards are also familiar to industry, as are the operations of Standards Australia.
2. Changes to the technical detail in Standards are subject to transition periods that are negotiated between industry and government.
3. To minimise trade barriers, state and territory regulatory agencies support a policy of adopting international standards wherever appropriate.
4. Grandfathering arrangements are adopted, allowing reasonable time for the phasing out of non-complying stock and changing over of labels.
5. All states and territories accept the registration of an appliance undertaken in another state.
6. State and territory regulatory agencies have set target periods within which they aim to process applications.
7. Proposed changes in administrative and operating practice are subject to consultation between states.

Product-specific compliance and enforcement activities
The E3 Program organises its compliance and enforcement activities as follows:

1. Compliance monitoring takes the form of a program of check testing by accredited laboratories.
2. 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.
3. 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 ACCC.
4. 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.)

5. Laboratories that produce misleading tests results may also be denied further registration business.

General monitoring and benchmarking of impacts and effectiveness
In the past the E3 Program has periodically commissioned an omnibus evaluation of overall effectiveness. The last of these was published in June 2003 (NAEEEC 2003), titled W*hen you can measure it, you know something about it: Projected impacts 2000-2020.* The general aims of such an exercise are to document expected impacts, estimate costs and benefits, and compare outcomes with earlier projections. It commits the E3 Program to examination of the appliance register and store survey data, and comparative review of trends in appliance efficiency.

The program has since advised industry that the 2003 exercise was the last of the omnibus reviews and will be replaced by piecemeal reviews. The first of these will address air-conditioners and fridges. A review of arrangements for HWS has yet to be scheduled.

Annually, the E3 Program holds a consultation forum and invites stakeholders to raise concerns about its operation and impacts.

Less frequently, the E3 Program reviews program fundamentals. The most recent exercise of this kind was a major research-based review and scoping of future directions for a wide range of appliance efficiency labels in Australia and NZ.

The program also takes occasional opportunities to benchmark its activities with programs in other countries.

Regulatory review
Review functions are not centralised: each state and territory has its own arrangements for review. The 'subordinate legislation' Acts in several states provide for the automatic revoking of regulations after 10 years. These states are Victoria, SA, Queensland and Tasmania. NSW requires that all regulations contain sunset clauses. The remaining jurisdictions have no general requirement but may include sunset clauses case by case.

All jurisdictions have some parliamentary machinery for the systematic review of regulations, such as a 'Legislation Review Committee'. Arrangements for agency or inter-agency review are more variable. Only Victoria has a specific body charged with regulatory oversight, which is the Victorian Competition and Efficiency Commission. This work is undertaken by an inter-departmental committee in the NT. Otherwise, however, the review process uses a parliamentary secretariat to raise issues and solicit public comment.

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APPENDIX A: DEVELOPMENT OF AUSTRALIAN ENERGY EFFICIENCY POLICY

The Australian Government's initial response to concerns about the environmental, economic and social impacts of global warming was set out in the Prime Minister's statement of 20 November 1997, *Safeguarding the Future: Australia's Response to Climate Change.* 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'*[40]*, minimum cost approach where this is sensible in order to achieve effective and meaningful outcomes."* This "no regrets" test was a key part of the guidelines adopted by the Council of Australian Governments (COAG) in 1997 that any initiative proposed by the MCE, including standards and labelling measures under the Equipment Energy Efficiency Program, must meet.

In 1998 the Australian Government released *The National Greenhouse Strategy* (NGS) that was endorsed by the Australian Government and state and territory governments and committed them to an effective national greenhouse response. Progress under the NGS was reported to the Council of Australian Governments (CoAG). Many key elements of the NGS were implemented successfully, but, over time, the Australian Government identified a range of emerging climate change priorities that required attention at the federal government level. Similarly, there was acknowledgment that state and territory jurisdictional boundaries necessitated state/territory level climate change action plans and these were developed.

In 2004, the Australian Government released a new climate change strategy as articulated through its Energy White Paper, *Securing Australia's Future*, and the 2004-05 Environment Portfolio Budget. Some elements of the earlier NGS were included in the new strategy. As a critical element of the Australian Government's climate change strategy, the new energy policy represented the refinement of strategic themes pursued in relation to energy under the NGS, including energy market reform, the development of low-emissions and renewable technologies, and improvements to end-use energy efficiency.

Since that time, CoAG has remained the primary forum for progressing Australian, state and territory government collaboration on climate change issues requiring inter-jurisdictional attention. Significant progress has been made under the CoAG climate change agenda since CoAG's agreement in June 2005 to establish a new Senior Officials Group to consider ways to further improve investment certainty for business, encourage renewable energy and enhance cooperation in areas such as technology development, energy efficiency and adaptation. This work culminated in the January 2006 CoAG climate change action plan. In addition, climate change issues requiring national coordination have been managed through a number of inter-governmental ministerial councils including the Ministerial Council on Energy.

The Australian Government's climate change strategy is the mechanism through which Australia will meet its international commitments as a party to the United Nations Framework Convention on Climate Change (UNFCCC). The Government has an overall target of limiting Australia's emissions in 2008-2012 to 108% of its 1990 emissions. This is a 30% reduction on the projected "business as usual" (BAU) outcomes in the absence of interventions.

[40] The Productivity Commission has defined "No regrets" policy options as measures that … *have net benefits (or at least no net cost) in addition to addressing the enhanced greenhouse effect. A more intuitive interpretation of 'no regrets' measures could be that they are actions which would still be considered worthwhile even in the absence of concerns about the potential adverse impact of global warming.* (PC 1997: page vii). This may involve imposing additional business costs on suppliers if the resulting more efficient products deliver a net benefit to the wider community.

Over 2006, the national policy debate over introducing a carbon price in Australia continued with the state and territory governments proposing an emission trading scheme, and the Australian Government holding a nuclear energy enquiry and announcing its own emissions trading inquiry by the *Task Group on Emissions Trading*.

In 2007, emissions trading became a major new plank in the Australian Government's response to climate change. The then Government announced in that Australia will introduce a world-class domestic emissions trading system by 2012. The new Government, elected in December, has brought the implementation date forward to 2010. Emissions trading will be the primary mechanism for achieving the long term emissions reduction goal.

Emissions trading will complement existing Government actions to reduce greenhouse gases. These include:

- improving end-use energy efficiency;
- investing in the new low emissions technologies Australia and the world will need in the future, including renewable energy technologies and clean coal;
- supporting world-class scientific research to continue to build our understanding of climate change and its potential impacts, particularly on our region; and
- assisting regions and industries to adapt to the impacts of climate change.

An emissions trading scheme will build on the success of past and ongoing measures. These measures include the *2004 Energy White Paper*, *2004-05 Climate Change Strategy*, earlier measures such as *Measures for a Better Environment* and *Safeguarding the Future*, as well as new programs announced in 2006-07.

APPENDIX B: REVIEW OF HISTORICAL TRENDS AND PROJECTIONS FOR GAS AND GWH PENETRATION

This review is based on the analysis of three sets of publications:

- Demand analyses that have been published by the competition regulators[41] in the various states. McLennan Magasanik Associates (MMA) undertook the analyses for Queensland, NSW, SA and ACT. That work is fairly current, having been completed in 2005 or 2006, and covers the period to 2010 or 2011.
- ABS Cat 4602.0 *Environmental issues*, 1994, 1999, 2002 and 2005. These provide survey-based estimates of household energy sources and types of water heater. The collections are not entirely consistent and we focused mainly on the 1994 and 2005 results.
- BIS Shrapnel's biennial review of the appliance market, *The Household Appliances Market in Australia*, 2004 and 2006.

There is considerable potential for statistical confusion. The following concepts have been employed where possible.

1. Network coverage – proportion of households with access to mains gas
2. Mains gas take-up – proportion of households with gas access that are gas customers
3. Mains gas penetration – proportion of households that are mains gas customers (= 1*2)
4. GWH penetration of mains gas customers – proportion of mains gas customers with GWH
5. Mains GWH penetration of all households – proportion of households with mains GWH (= 1*2*4)

Queensland

Penetration of mains gas and mains-fuelled GWH

There are four gas distribution networks in Queensland:

- Envestra reticulates Ipswich and the Brisbane suburbs north of the Brisbane River (Brisbane Region), plus Rockhampton and Gladstone (Northern Region). 90% of the network is in metropolitan Brisbane. Total residential connections in 2005 were 69,913.
- Australian Pipeline Trust reticulates the southern part of Brisbane, Gold Coast, Toowoomba and Oakey. Some NSW towns near the Queensland border, such as Tweed Heads, are also served by the network. Under cross-vesting arrangements between the jurisdictions, the Queensland regulator determines the access arrangements for the entire network. Total residential connections in 2005 were 61,517.
- The Dalby Town Council operates a network that serves about 2,500 natural and LPG consumers.
- The Roma Town Council operates a network the serves a total of 295 customers.

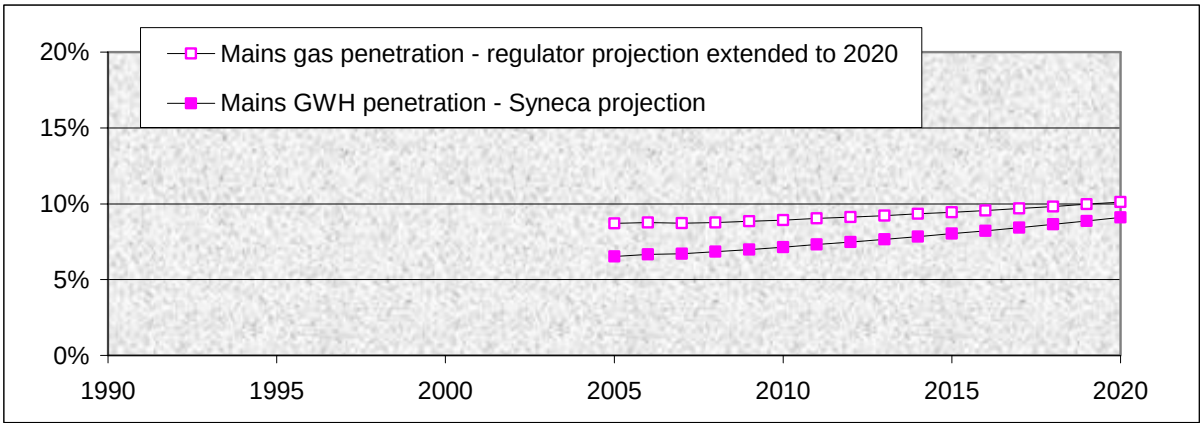
In 2005 these network companies reported a total of about 135,000 residential connections to Queensland's competition regulator, which is significantly lower than the ABS estimate of 189,400. We consider it is best to assume that there are significant errors in the ABS survey and to rely on the demand analyses published by the regulator, supplemented with

[41] Competition regulators determine network charges in the light of demand forecasts: higher demand improves the scale economies of network operations and reduces charges.

informal advice from the Queensland Department of Mines and Energy. These sources indicate that, in 2005, mains gas penetration was 9% and GWH penetration of mains gas customers was 75%.[42] This means that mains GWH penetration of Queensland households is only about 6.5%.

Figure B.1 reports our baseline projection to 2020. There is a modest increase in mains gas penetration, to 10%, assuming that the rates of customer growth envisaged by the regulator in the period to 2011 are maintained to 2020. There is more rapid growth of mains GWH penetration, from 6.5% to 9%, assuming a significant increase in GWH penetration of mains gas customers.

Figure B.1 Gas and GWH penetration of Queensland households, projected to 2020 (mains gas only)



Mains gas take-up seems to be in the range 40%-50%, indicating that there is potential for gas penetration to increase at a faster rate, carrying mains GWH penetration with it. In new housing estates, MMA (2005a: page 15) reports that Envestra achieves 45% take-up; Allgas requires that the great majority of houses have gas cookers and water heaters. As noted in appendix A, take-up on new housing estates has been boosted by Queensland's new sustainable housing measures, and there is obviously an intention to increase take-up by established dwellings as electric HWS fall due for replacement. The 1994 ABS survey also asked questions about access to mains gas and take-up of mains gas, and the responses suggest that there is take-up by 30%-60% of households with access to mains gas. (The uncertainty is because a significant minority of respondents did not know whether they had access to gas.)

The projected increase in GWH penetration of mains gas customers, closing the gap between mains gas penetration and mains GWH penetration as projected in figure B.1, is based on the economics of gas connection in warm climates with no significant demand for gas-fuelled space heating. As explained in recent reports to the Queensland regulator (MMA 2005a & 2005b), the remaining uses are cooking and water heating, using 2 GJ/year and 9-15 GJ/year respectively, and it is difficult to justify connection for cooking only. MMA reports that:

> *Both Allgas and Envestra have stated that they try to restrict new residential customer connections to those where customers connect, at a minimum, both hot water and cooking gas appliances. Without connection to a hot water system the required returns for new connections are unlikely to be met.* (MMA 2005a: page 16)

[42] Informal advice from the Queensland Department of Mines and Energy is that there are **<<xxx>>** mains gas customers that use it only for cooking, out of a total of 135,000.

The Department of Mines and Energy has identified cooking-only customers as prime targets for installation of GWH, taking advantage of their low marginal cost of incremental gas usage.

Bottled LPG in Queensland
ABS surveys indicate that, while there is moderate growth in the use of LPG, the number of LPG-fuelled GWH is static at about 60,000. This is about 4% of households and, when combined with our estimate of mains GWH penetration, takes total GWH penetration to about 10.5% of Queensland households. This figure is considerably lower than the BIS Shrapnel estimate of 14% for total GWH penetration. This raises the possibility that the ABS has significantly underestimated the number of LPG-fuelled GWH. We have adopted the ABS estimate nevertheless and assume that the number of LPG-fuelled GWH remains static at 60,000.

Market segments
BIS Shrapnel estimate that market penetration is split 50:50 between GsWH and GiWH.

NSW and ACT
Penetration of mains gas and mains-fuelled GWH
Excluding networks that have been cross-vested to the Queensland or Victorian regulators, there are four distribution networks in NSW and the ACT

- AGL Gas Network (AGLGN) – Sydney, Wollongong, Newcastle and a number of regional centres in the Central West. Total residential connections in 2005 were 930,758.
- ActewAGL – Queanbeyan and the Shoalhaven. Total residential connections in 2005 were 98,551.
- Country Energy Gas – Wagga Wagga and surrounding areas, and South West Slopes. Total residential connections in 2005 were about 17,500.
- Central Ranges Pipeline Gas Network – This network is under construction and is eventually intended to cover the towns of Tamworth, Gunnedah, Mudgee, Dunedoo, Coolah, Gulgong, Quirindi, Werris Creek, Coonabarabran and Gilgandra. The Tamworth system (250km of reticulation pipeline) will be complete by the end of 2007 but there are, as yet, no firm plans for the rest of the network. It is anticipated residential connections in Tamworth will eventually reach 7,500.

In 2005 these network companies reported a total of about 1,047,000 residential connections to the NSW and ACT regulators, which is somewhat higher than the ABS estimate of 996,500, and would be higher still if the cross-vested gas customers were included.

ABS surveys indicate that, in 1994, gas and GWH penetration in NSW and the ACT could be described as follows: network coverage was 50-55%: mains gas take-up was 50-55%; and GWH penetration of mains gas customers was 65%. The result was that 19% of all households had installed GWH. The latter figure increased to 25% in the period to 2005 and, while there is some uncertainty about the underlying drivers,[43] the results of an IPART-commissioned survey (IPART 2004) suggest that the main factor has been an increase in gas take-up. Regarding the other two factors:

- There seems to have been little change in GWH penetration of mains gas customers. An IPART-commissioned survey (IPART 2004) found that 70% of NSW mains gas customers had installed GWH in 2003, compared with the ABS estimate of 67% in 1994.

[43] There is uncertainty because information about access to mains gas was not collected in the post-1994 ABS surveys.

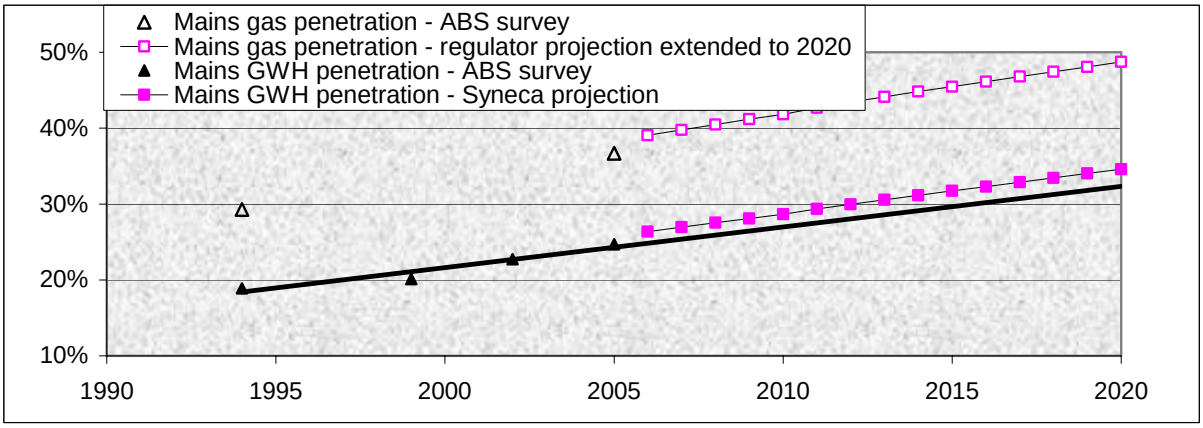
- While the gas network has been extended, it seems that network coverage did not change significantly. An obvious consideration is the amount of construction in coastal areas, outside the major urban areas with access to gas.

These averages hide considerable geographical variation within NSW and ACT. The 'Queensland model' is likely to apply in temperate coastal areas, that is, where the demand for gas-fired space heating is minimal and connection to gas makes little sense if GWH is not installed. Mains gas penetration tends to be relatively low in such circumstances but GWH penetration of mains gas customers can approach 100%. The growth of GWH penetration is then largely dictated by the growth of mains gas penetration.

Locations like Canberra and the Blue Mountains, with cold winters, present a different picture. They can have relatively high gas take-up, but relatively low GWH penetration of mains gas customers. In the ACT for example, network coverage was 90-95% in 2005; gas take-up was about 75%; and GWH penetration of mains gas customers was 60%. The result is that gas penetration of all households was only 42%, suggesting that there is considerable scope for increased GWH penetration in areas where gas is well established.

Figure B.2 reports our baseline projection to 2020. It assumes that mains gas penetration continues to grow strongly, carrying mains GWH penetration with it. There is also a small contribution from increasing GWH penetration of mains gas customers, rising from 67% in 2005 to 71% in 2020. The combined effect is to lift mains GWH penetration of all households from 26% to 35%. These projections are a continuation of the historical trends revealed by ABS surveys, but adjusted for the difference in the number of mains gas customers.

Figure B.2 Gas and GWH penetration of NSW and ACT households, projected to 2020 (mains gas only)



Bottled LPG in NSW and ACT

ABS surveys indicate that, while there is moderate growth in the use of LPG as a residential fuel, the number of LPG-fuelled GWH has been reasonably static, and now stands at about 1% of households. Our baseline assumption is that the number of LPG-fuelled GWH remains constant at 27,500, which is the average of the ABS survey estimates for 1994 and 2005.

The inclusion of LPG-fuelled GWH takes our estimate of total GWH penetration to about 27% of NSW and ACT households. The BIS Shrapnel estimate is a little higher, at 31%.

Market segments

BIS Shrapnel estimate that market penetration is split 55:45 between GsWH and GiWH.

Victoria

Penetration of mains gas and mains-fuelled GWH

Including networks that have been cross-vested to Victoria by the NSW regulator, there are three network operators in Victoria – Envestra, Multinet and SPI. Each has a share of the major metropolitan markets, Melbourne and Geelong. Envestra also reticulates the Eastern Rural and Central Rural. SPI also reticulates the Ballarat, Bendigo and Western Rural areas.

Total residential connections in 2005 were: Envestra, 494,025; Multinet, 618,000; SPI, 489,936. This is a total of about 1,582,000 residential connections, which is close to the ABS estimate of 1,552,300, and may be closer still if cross-vested gas customers are excluded.

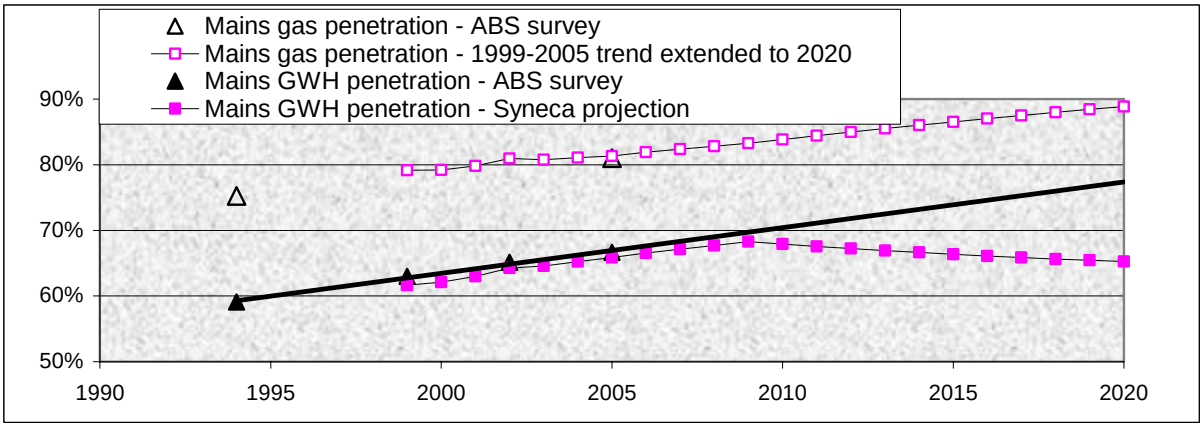
ABS survey estimates indicate that, in 1994, mains GWH penetration in Victoria could be described as follows: network coverage was 82%; mains gas take-up was 92%; and GWH penetration of mains gas customers was 79%. The result was that 59% of all households had installed mains GWH. The latter figure increased to 67% in the period to 2005 and seems to be the result of incremental gains on all margins. That is, there have been incremental increases in (a) network coverage, (b) mains gas take-up, and (c) GWH penetration of mains gas customers. Looking forward, relevant considerations are that:

- The existing projections for mains gas penetration are out of date, having been commissioned in 2002 for the regulatory period ending in 2007.
- A new review for 2008-2012 has been initiated but is not complete. However, we have historical data for 1999-2005 and rely on informal advice from the regulator that current trends should continue. Specifically, virtually all new dwellings are constructed in areas with gas access; virtually all of those dwellings are being connected to gas; and the Natural Gas Extension Program will continue to subsidise 'uneconomic' extensions to regional towns. This means that gas penetration will continue to grow, tending to carry mains GWH penetration with it.
- Victoria's 5-star building regulations require that new houses install either a rainwater tank or a gas-boosted solar hot water system. These regulations may be changed to require both a rainwater tank and a gas-boosted solar hot water system. The effect would be to significantly moderate the growth of mains GWH penetration, shifting incremental demand to gas-boosted solar.

Our approach to modelling the Victorian market is to first put aside the additional households that are expected to form in Victoria after 2009, which has the effect of assigning about 290,000 households to gas-boosted solar products and to alternative heating technologies where gas is not available. For the remainder, it is assumed that there is incremental growth of mains gas penetration (from 81% in 2005 to 88% in 2020) and incremental growth in GWH penetration of mains gas customers (from 81% in 2005 to 85% in 2020). This leaves GWH penetration of mains gas customers equal to the maximum figure that is now observed in Australian jurisdictions (for South Australia).

The result is that mains GWH penetration of total Victorian households is little changed from 2005 to 2020, at about 66%, as shown in figure B.3.

Figure B.3 Gas and GWH penetration of Victorian households, projected to 2020 (mains gas only)



Bottled LPG in Victoria

ABS surveys indicate that, while there is moderate growth in the use of LPG as a residential fuel, the number of LPG-fuelled GWH has been reasonably static, and now stands at about 1.5% of households. Our baseline assumption is that the number of LPG-fuelled GWH remains constant at 28,500, which is the average of the ABS survey estimates for 1994 and 2005. The inclusion of LPG-fuelled GWH takes our estimate of total GWH penetration to about 68% of Victorian households. The BIS Shrapnel estimate is a little higher, at 71%.

Market segments

BIS Shrapnel estimate that market penetration is split 63:37 between GsWH and GiWH.

Tasmania

Penetration of mains gas and mains-fuelled GWH

Figure B.4 reports our baseline projection for mains gas and mains GWH penetration in Tasmania. The background to the mains gas projection is that:

- Powerco has a Development Agreement with the Government of Tasmania to construct a gas distribution network in the state.
- A gas transmission pipeline is already in place from Victoria, across Bass Strait into Tasmania and down through the main population centres of the state to Hobart. Powerco's gas backbone network tees-off this transmission pipeline.
- The agreement with the state provides Powerco with the approval to distribute natural gas to Tasmania's major industrial, commercial and residential customers.
- The rollout to small business and residential customers commenced in 2006 and, at April 2007, 38,500 residential customers will have access to mains gas.
- Powerco recently signed its 2,000th customer, which is 1% of Tasmanian households.
- Powerco have a MoU with the Tasmanian Government to make gas available to 100,000 dwellings and hope for take-up of 60%, or 60,000 customers.
- The baseline projection is that about half of this target is achieved by 2020. It is assumed that Tasmanian households connect to mains gas at the rate of 1% a year for 15 years.

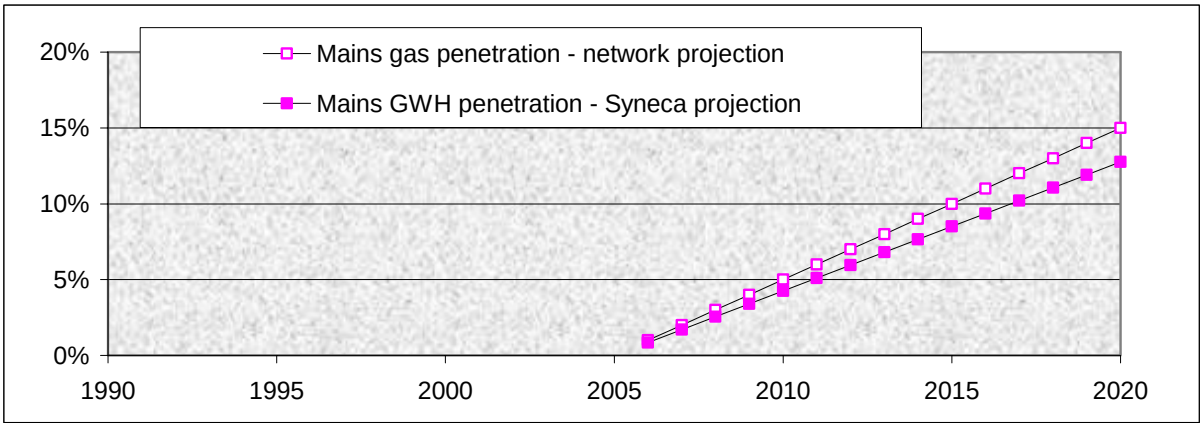
It has been assumed that mains GWH penetration of gas customers is 85%, equal to the maximum figure that is now observed in Australian jurisdictions (South Australia). Importantly, the rollout strategy includes a cash incentive payment for new connections and even the minimum payment requires that the customer has a permanently connected

water heating unit with a minimum rating of 40 MJ/hr. Overall, Powerco will need to be satisfied the customer's annual usage will exceed 20 GJ.

Bottled LPG in Tasmania
Our baseline assumption is that the number of LPG-fuelled GWH remains constant at 1,900, which is the average of the ABS survey estimates for 1994 and 2005.

Market segments
The network company has advised that almost 100% of the installations mains GWH are GiWH. This may reflect the profile of early adopters, who probably tend to be the more wealthy members of the community.

Figure B.4 Gas and GWH penetration of Tasmanian households, projected to 2020 (mains gas only)



South Australia
Penetration of mains gas and mains-fuelled GWH
Envestra is the only network operator in SA, serving Adelaide, Barossa Valley, Peterborough, Port Pirie, Mount Gambier and Murray Bridge. Total residential connections in 2005 were 348,844. The ABS survey estimate was 365,500.

ABS survey estimates indicate that, in 1994, mains GWH penetration in SA could be described as follows: network coverage was about 69%; mains gas take-up was 77%; and GWH penetration of mains gas customers was 86%. The result was that 46% of all households had installed mains GWH. The latter figure increased to 57% in the period to 2005 and seems to be the result of an uncertain mix of gains in network coverage and mains gas take-up. There was no increase in GWH penetration of mains gas customers. The latter figure was 86% in 1994 and 85% in 2005.

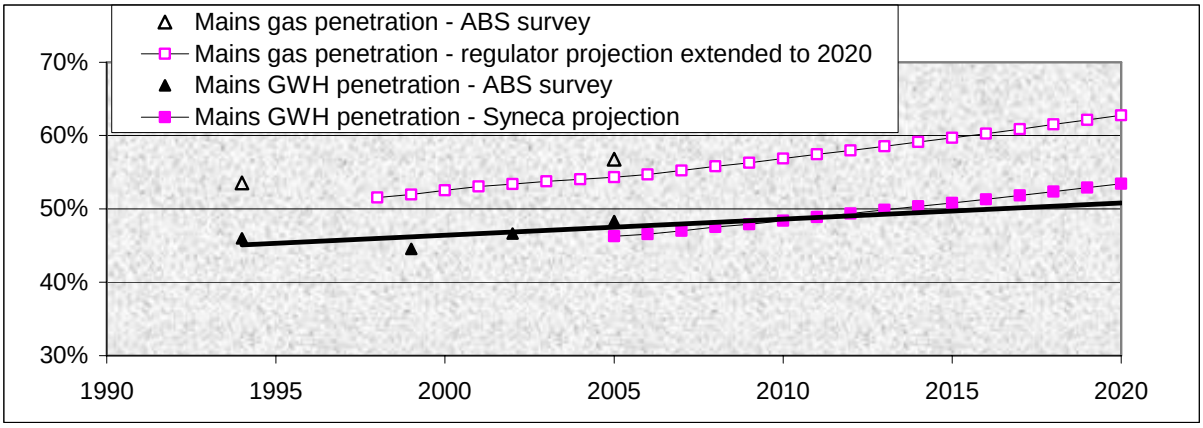
Figure B.5 reports our baseline projection to 2020. We assume that, for mains gas penetration, the projected growth to 2011 continues at the same rate to 2020. This delivers continuing gains in mains gas penetration, carrying mains GWH penetration with it. But there is no increase in GWH penetration of mains gas customers: SA already has Australia's highest GWH penetration of mains gas customers – 85%. The effect is to lift GWH penetration of all households from 46% to 53%, which is slightly faster growth than the historical trend suggested by ABS surveys.

Bottled LPG in SA
ABS surveys indicate that, while there is significant growth in the use of LPG as a residential fuel, the number of LPG-fuelled GWH has been static, and now stands at about 2.5% of households. Our baseline assumption is that the number of LPG-fuelled GWH remains constant at 15,500, which is the average of the ABS survey estimates for 1994 and 2005.

The inclusion of LPG-fuelled GWH takes our estimate of total GWH penetration to about 49% of SA households. The BIS Shrapnel estimate is much higher, at 63%.

Market segments
BIS Shrapnel estimate that market penetration is split 44:56 between GsWH and GiWH.

Figure B.5 Gas and GWH penetration of SA households, projected to 2020 (mains gas only)



Western Australia
Penetration of mains gas and mains-fuelled GWH
Alinta operates the major network in WA, serving Geraldton, Perth, Mundurah, Bunbury and Busselton. Total residential connections in 2005 were 517,005. There are several smaller networks with a total of about 10,000 residential customers, taking total mains customers to about 527,000. The ABS survey estimate was 530,500.

ABS survey estimates indicate that, in 1994, mains GWH penetration in WA could be described as follows: network coverage was about 70%; mains gas take-up was 73%; and GWH penetration of mains gas customers was 79%. The result was that 41% of all households had installed mains GWH. The latter figure increased to 54% in the period to 2005 and seems to be the result of an uncertain mix of gains in network coverage and mains gas take-up. The ABS survey records no increase in GWH penetration of mains gas customers. It was 79% in 1994 and 80% in 2005.

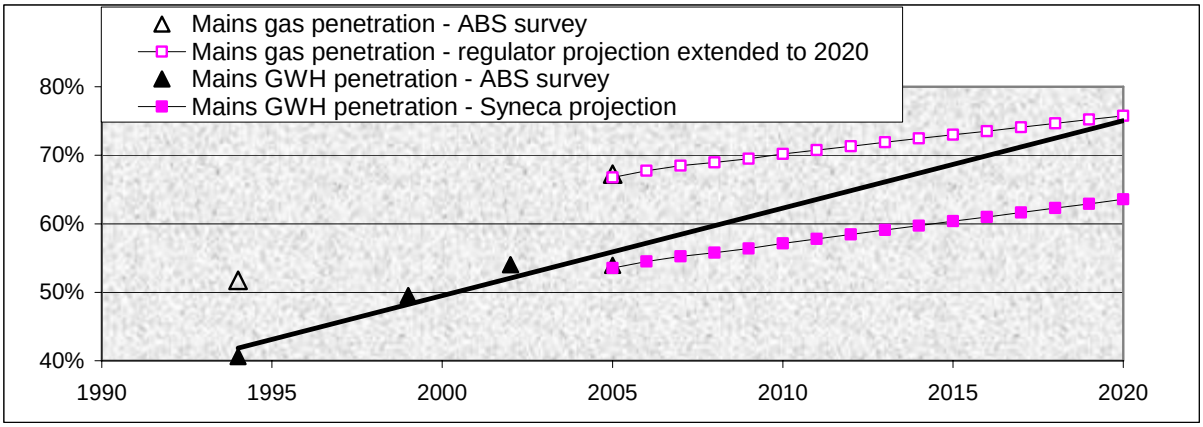
Figure B.6 reports our baseline projection to 2020. We assume that, for mains gas penetration, the projected growth to 2009 continues at the same rate to 2020. This delivers continuing gains in mains gas penetration, carrying mains GWH penetration with it. There is also a significant increase in GWH penetration of mains gas customers, from 80% to 85%, equal to SA. The effect is to lift GWH penetration of all households from 54% to 64%, which is considerably slower than the historical trend suggested by ABS surveys.

Bottled LPG in WA
ABS surveys indicate that there was little growth in the use of LPG as a residential fuel. The number of LPG-fuelled GWH has been static, and now stands at about 6.2% of households. Our baseline assumption is that the number of LPG-fuelled GWH remains constant at 48,700, which is the average of the ABS survey estimates for 1994 and 2005.

The inclusion of LPG-fuelled GWH takes our estimate of total GWH penetration to about 60% of SA households. The BIS Shrapnel estimate is somewhat higher, at 70%.

Market segments
BIS Shrapnel estimate that market penetration is split 50:50 between GsWH and GiWH.

Figure B.6 Gas and GWH penetration of WA households, projected to 2020 (mains gas only)



Northern Territory

The ABS surveys have returned estimates of 1,000-3,000 GWH in the Northern Territory. Our baseline assumption is that there will be a fixed stock of 2,000 GWH throughout the projection period.

APPENDIX C: GOVERNMENT PROGRAMS AFFECTING CHOICE OF HWS

	Selection of HWS in new dwellings	*Selection of replacement HWS*
C'wealth	Renewable Energy Certificates: available for installing a solar hot water, including heat pump HWS, in a new home. Value depends on the market for RECs but may be about $500.	Renewable Energy Certificates: for installing a solar hot water, including heat pump HWS. (From 11 September 2006, RECs are not restricted to replacement of electric HWS.)
NSW	BASIX: sets targets for thermal comfort, energy and water use of new houses. Typical single dwelling meets energy target if it: (a) includes efficient HWS - solar or 5-star gas; and (b) uses natural heating, cooling and lighting.	NGACs: This scheme requires NSW electricity retailers and others to meet mandatory targets for reducing or offsetting emissions from the electricity they supply or use. Retailers can earn abatement certificates by running programs that replace electric HWS with gas HWS or gas-boosted solar HWS.
Victoria	5-star housing: requires a 5-star energy rating for the building fabric of a new house, plus water savings measures and the installation of either a rain water tank or a solar hot water service.	High efficiency gas hot water rebate: for rural, regional and outer suburban areas, to replace electric day rate or wood-fuelled HWS with a 5-star GWH. Provides $700 to concession card holders and $400 to non-concession card holders. Solar hot water rebate: for replacing existing gas or solid fuel HWS, or converting an existing HWS to solar. Provides up to $1500 depending on the size and performance.
QLD	Sustainable housing measures: require low-emission HWS, either: (a) 5-star GWH (b) heat pump or solar HWS achieving at least 22 RECs for 3+ bedrooms or 14 RECs for 1 or 2 bedrooms	Gas Installation Rebate: $500 to be paid to 7,500 customers in existing houses, for replacement of electric HWS and/or cooking appliances with efficient gas appliances. Probably, GWH will need to be 5 stars. Phase out of electric HWS from 2010: This is a recently announced element of Queensland's Climate Change Strategy. Replacement HWS will need to be greenhouse-friendly. Switching will initially be voluntary in areas without mains gas.
SA	Greenhouse gas performance requirements for water heaters: From July 2008, the majority of domestic water heater installations need to meet greenhouse gas and flow rate performance standards. Most new or replacement water heaters need to be 5-star gas, solar or electric heat pump systems. In some cases, conventional electric and low efficiency gas water heaters are permitted.	Greenhouse gas performance requirements: These requirements apply to both new and replacement water heaters. Solar Hot Water Rebate Scheme: $500 rebate on the cost of a new solar or electric heat pump water heater system. The scheme targets low income households, defined as households with certain concession cards.
WA	5-Star Plus requirements for new homes From 1 September 2007, a house must meet the BCA's 5-star energy efficiency standards and have a low greenhouse HWS such as: (a) a solar hot water system; (b) a 5-star rated gas hot water system; or (c) a high energy-efficient electric heat pump. Solar hot water heater subsidy: Existing arrangement is same as for replacement HWS. Given the 5-Star Plus regulation, the future of this program is under consideration.	Solar hot water heater subsidy: $500 for gas-boosted solar water heaters, and $700 for bottled LP gas-boosted solar water heaters used in areas without reticulated gas.

APPENDIX D IMPACT ASSESSMENTS FOR INTERNAL GSWH THAT HAVE BEEN EXCLUDED FROM THE PROPOSAL

This appendix contains the impact assessment for internal gas water heaters that were included in the CBA but have now been excluded from the proposal.

Virtually all new GsWH are now installed outside the dwelling and many that were originally installed in the ceiling or laundry have been relocated outside. But there remains a declining market for internal replacement units. This is the cheapest replacement option, since it requires no changes to the gas and water lines. The issue is whether suppliers can upgrade these small volumes at reasonable cost. Options for venting the combustion gases are more limited when the heater is indoors, making it more difficult to reduce the amount of waste heat that escapes with the combustion gases.

We deal separately with the gravity feed type and the mains pressure type. The former are installed in the ceiling. We also deal separately with Australia and New Zealand

Australia

Internal GsWH, gravity feed type

HWS Australia Pty Ltd is the sole supplier of these units and produces about 250 a year for the replacement market, mainly in South Australia. One appliance is certified, with a certification date of 1988 and an energy rating of 4.4 stars.

We have had a single brief discussion with the manager of HWS, Bill Riach. He considers that it may be possible to achieve a 5-star rating – for example, by increasing the insulation – but emphasised there were severe dimensional constraints. The incremental cost may also be greater for small production runs than for units that are produced in tens of thousands.

For the baseline assessment we have assumed that this appliance is upgraded by 0.6 stars (from 4.4 stars to exactly 5 stars), that the upgrade occurs at the end of the transition period (October 2010), and that the incremental cost of these units equals the value of the energy savings. The impact on this market segment can then be stated as follows:

Impact on average customer

- Incremental cost of heater - $160
- Energy savings – 1,214 MJ/year
- Value of energy savings – $18.26/year (SA marginal tariff of 1.5 cents/MJ)
- Present value of energy savings – $160 (asset life of 13 years, discount rate of 7.5%)
- Net financial cost/benefit – $0
- Benefit cost ratio – 1.0

Aggregate impact

- Additional sales of 5-star units to 2020 – 1,250 (assumes a declining market)
- Present value of incremental cost – $142,000
- Present value of energy savings – $142,000
- Net financial cost/benefit – $0
- Benefit cost ratio – 1.0

Internal GsWH, mains pressure type

Suppliers of the mains pressure type of internal GsWH have indicated that, given the low volume of these sales (about 3,250/year, for replacement only) and that the market is declining, it may not be commercially feasible to produce a 5-star version of this product.

To test this proposition it is necessary to consider the options that are available to customers if they are unable obtain a 5-star replacement when their existing internal GsWH fails. There seem to be four options.

- The GsWH can be relocated outdoors, incurring the additional cost of changes to gas and water lines.
- The internal GsWH may be replaced with an external GiWH, also incurring costs of changes to gas and water lines. These may need to be rerouted and upgraded to supply gas and water at the higher rates required by GiWH. While some of these appliances also need to be connected to electricity, the cheapest product seems to be the 'hydro' range of heaters, which use the flow of water to generate a spark for igniting the burner.
- The internal GsWH may be replaced with an internal GiWH. Internal GiWH are more expensive than the external GiWH and may require the gas and water supply to be upgraded. There may also be changes to the fluing arrangements. Again, the cost of adding a power supply is avoided by selecting from the 'hydro' range of heaters.
- The customer can convert to an electric hot water system.

To better understand this problem, we conducted informal phone interviews with plumbers in Sydney and Melbourne. They emphasise that the additional costs are highly specific to the particular situation and that they always inspect the site before quoting. While reluctant to provide general indications, they say that external relocation of the GsWH generally costs about $500. One suggested a range of $200-$600 and another said the cost could go to $1,000 in particularly difficult circumstances.

It is not always feasible to install an external GsWH, for reasons of space or height above ground (for multiple-storey dwellings). Some corporate bodies also limit the customer's options for aesthetic reasons. The customer may then install a GiWH, either internal or external. Again, plumbers emphasise the site-specific nature of these costs, but the general feedback is that the additional costs are $1,500-$2,000 for external GiWH and $2,000-$2,500 for internal GiWH.

Regarding the electric option, price data (*Reed Construction Data* 2006) suggest that the installed cost of an electric appliance is $200-$300 lower than an equivalent gas appliance. For replacement units, however, this saving is substantially offset by the cost of running power to the electric heater. More importantly, the energy costs of electric units are much higher and may add $100 to the annual energy bill.[44] The present value of these additional amounts over the life of a heater is about $750.

These options are not attractive. However, if sufficiently unattractive, consumers must be willing to pay a significant premium for an internal replacement with a 5-star rating. The commercial question for suppliers is:

- Will a 5-star version of the internal GsWH cost 'thousands more', which means that it cannot compete with the options canvassed above?
- Or will a 5-star version cost somewhat more – say, $200 – and therefore be assessed by suppliers as commercially viable and likely to strongly preferred to options canvassed above?

[44] GWA (2005a) provides a detailed assessment of the running costs of alternative water heating technologies.

There is some evidence that GWH can be produced on a small scale and still sell at prices that are not radically different to the prices charged for units that are produced on a large scale. For example, the gravity feed model produced by HWS Australia Pty Ltd sells for about $900, which is similar to the price charged for mass-produced appliances. While the HWS design is simpler than comparable mains pressure units, the difference in underlying costs seems to be hundreds per unit, not thousands per unit.

Given the uncertainties, our baseline assessment is that the net financial impact on customers in this sub-market is zero. Given the possibility that there may be some increase in the use of electric hot water systems, the impact on greenhouse emissions is also put at zero.

New Zealand

Internal GsWH manufactured in New Zealand

While there has been no systematic review of options for increasing the energy efficiency of these installations at reasonable cost, the manufacturer considers that there are no promising options. He says that:

- Replacement with an external appliance, either GsWH or GiWH, is at the cost of new pipework for water and gas that can add $NZ1,500-$NZ2,500 to the cost of conversion, and may also require electric power.
- These units cannot be easily replaced with internal GsWH imported from Australia, even supposing that the Australian products are upgraded to 5 stars. The locally manufactured units are designed in the US fashion, with fittings on the top of the unit, whereas Australian appliances have fittings on the side and cannot be easily fitted into existing cupboard spaces. Importation of these bulky items would also add at least $NZ200 to the cost.
- The incremental cost of upgrading the local product would be high. Price differentials in the market for external GsWH suggest that the increase would be $NZ300-400, without allowing for either the need to recover the development costs from a small production run or the constraints imposed by the restrictions on appliance size and fluing arrangements for internal units.

A further uncertainty is the HEEP finding that internal GsWH contribute to the space-heating task during winter.[45] This means that space-heating appliances must at least partially compensate for reductions in cylinder energy losses, particularly where the cylinder is relocated outdoors.

The additional testing costs, for compliance purposes, have already been noted and put at $NZ20,000.

It should be noted that the potential for lower energy bills is non-trivial. They would be comparable with the estimate for external GsWH, which is $690 over the life of the heater. This suggests there is some scope for cost-effective increases in energy efficiency.

Internal GsWH imported from Australia

There are very few sales to New Zealand, 10-20/year. The baseline estimate for this market segment is for a net financial impact of zero and a benefit cost ratio of 1.0, as for Australia.

[45] BRANZ reports this finding in relation to the combination of gas and electric cylinders. The New Zealand manufacturer of internal GsWH has advised that these findings would apply equally well to the sub-set of these cylinders that are gas-fired.

APPENDIX E PRICE COMPARISONS OF 3 AND 5-STAR GAS STORAGE WATER HEATERS

We approached several installers, gas utilities and plumbing wholesalers for price information. This table reports the usable information, that is, where comparisons could be made like for like.

Two of our respondents referred to the Reece catalogue, but at different times, and reported somewhat different prices – hence the references to 'Reece 1' and 'Reece 2'.

Brand	*Product upgrade*	*3-star price ($)*	*5-star price (4)*	*Price difference ($)*	*Source*
		135 litre			
Rheem	Optima 811 TO Stellar	1,165.2	1166.0	0.7	Reece 1
Rheem	Optima 811 TO Stellar	1,078	1,177	99	Reece 2
Rheem	Optima 811 TO Stellar	947	1,150	203	Hot water on-line
Rheem	Optima 811 TO Stellar	900	1,050	150	Energy Australia
Dux	Proflo 111 Marathon TO Prodigy Storage	1,017	1,184	167	Reece 1
Dux	Proflo 111 Marathon TO Prodigy Storage	1,074	1,179	105	Reece 2
Dux	Proflo 111 Marathon TO Prodigy Storage	931	1,120	189	HW specialist
		170 litre			
Rheem	Optima 811 TO Stellar	1,232	1,365	132	Reece 1
Rheem	Optima 811 TO Stellar	1,080	1,200	120	Hot water on-line
Rheem	Optima 811 TO Stellar	1,025	1,115	90	Energy Australia
Dux	Proflo 111 Marathon TO Prodigy Storage	1,147	1,184	37	Reece 1
Dux	Proflo 111 Marathon TO Prodigy Storage	1,186	1,260	74	Reece 2
Dux	Proflo 111 Marathon TO Prodigy Storage	1,054	1,194	140	HW specialist
		Unweighted averages			
135 litre				131	
170 litre				99	
All				116	

APPENDIX F TRIAL STATEMENT OF ABATEMENT VALUATIONS THAT WILL BE INCLUDED IN FUTURE IMPACT ASSESSMENTS

The potential impact of an Australian emissions trading scheme (ETS) on the benefit-cost ratio is assessed in this appendix. On 3 June 2007, the Prime Minister announced that Australia would implement a domestic emissions trading system beginning no later than 2012, and that the Government would set a national emissions target in 2008. The ETS has the potential to increase the national benefits as a cost is imposed on greenhouse gas (GHG) emissions. Hence the RIS should take into account the increased benefits due to the avoided cost of carbon permits for electricity generators, which will result from the proposed MEPS reducing the consumption and generation of electricity at the margin.

These valuations were trialled in an earlier CBA (EnergyConsult 2007) dealing with proposed MEPS for chillers. The same methodology is applied here, with the results reported in table F.1.

Table F.1 applies to Option 1 only. Option 2 has not been developed to the point where credible calculations can be reported.

Table F.1 Abatement valuations for Australia, Option 1

Discount rate	0%	5%	7.5%	10%
Carbon permit price = $0/t CO_2-e				
Total Costs ($M)	$131.6	$94.1	$80.7	$69.8
Total Benefits ($M)	$474.8	$265.6	$204.3	$159.8
Net Benefits ($M)	$343.2	$171.5	$123.6	$90.0
Benefit-Cost Ratio	3.6	2.8	2.5	2.3
Cumulative Mt CO_2-e Abatement (2012 -2020)		2.26		
Carbon permit price = $10/t CO_2-e				
Value of greenhouse abatement ($M)	$22.6	$11.9	$8.9	$6.7
B/C ratio with greenhouse abatement included	$45.2	$23.8	$17.8	$13.5
Carbon permit price = $20/t CO_2-e				
Value of greenhouse abatement ($M)	3.8	2.9	2.6	2.4
B/C ratio with greenhouse abatement included	4.0	3.1	2.8	2.5

APPENDIX G BREAKDOWN OF IMPACTS BY JURISDICTION: OPTION 1

Impacts have been allocated to jurisdictions in proportion to their share of the GWH stock in 2005. The estimates of energy use are for GsWH only. Given differences in the rate of growth of GWH penetration between jurisdictions, there is no sound basis for allocating their energy use across jurisdictions.

This appendix applies to Option 1 only. Option 2 has not been developed to the point where credible calculations can be reported.

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUST
BAU energy use (PJ, GsWH only)									
2000	11.902	23.801	3.690	5.961	8.761	0.049	0.025	0.960	55.149
2001	11.861	23.720	3.678	5.941	8.731	0.049	0.025	0.957	54.961
2002	11.780	23.558	3.653	5.900	8.671	0.049	0.024	0.950	54.584
2003	11.629	23.257	3.606	5.825	8.560	0.048	0.024	0.938	53.888
2004	11.406	22.811	3.537	5.713	8.396	0.047	0.024	0.920	52.853
2005	11.192	22.382	3.470	5.605	8.238	0.046	0.023	0.903	51.861
2006	10.954	21.906	3.397	5.486	8.063	0.045	0.023	0.884	50.758
2007	10.690	21.379	3.315	5.354	7.869	0.044	0.022	0.862	49.535
2008	10.430	20.858	3.234	5.224	7.677	0.043	0.022	0.841	48.329
2009	10.178	20.354	3.156	5.097	7.492	0.042	0.021	0.821	47.161
2010	9.849	19.697	3.054	4.933	7.250	0.041	0.020	0.794	45.639
2011	9.584	19.166	2.972	4.800	7.054	0.040	0.020	0.773	44.407
2012	9.390	18.778	2.911	4.703	6.912	0.039	0.019	0.757	43.509
2013	9.277	18.552	2.876	4.646	6.828	0.038	0.019	0.748	42.985
2014	9.249	18.497	2.868	4.632	6.808	0.038	0.019	0.746	42.859
2015	9.309	18.617	2.887	4.663	6.852	0.039	0.019	0.751	43.137
2016	9.411	18.820	2.918	4.713	6.927	0.039	0.019	0.759	43.607
2017	9.563	19.124	2.965	4.790	7.039	0.040	0.020	0.771	44.312
2018	9.716	19.430	3.013	4.866	7.151	0.040	0.020	0.784	45.019
2019	9.869	19.736	3.060	4.943	7.264	0.041	0.020	0.796	45.729
2020	10.022	20.043	3.108	5.020	7.377	0.041	0.021	0.808	46.441
WPM energy use (PJ, GsWH only)									
2000	11.902	23.801	3.690	5.961	8.761	0.049	0.025	0.960	55.149
2001	11.861	23.720	3.678	5.941	8.731	0.049	0.025	0.957	54.961
2002	11.780	23.558	3.653	5.900	8.671	0.049	0.024	0.950	54.584
2003	11.629	23.257	3.606	5.825	8.560	0.048	0.024	0.938	53.888
2004	11.406	22.811	3.537	5.713	8.396	0.047	0.024	0.920	52.853
2005	11.192	22.382	3.470	5.605	8.238	0.046	0.023	0.903	51.861
2006	10.954	21.906	3.397	5.486	8.063	0.045	0.023	0.884	50.758
2007	10.690	21.379	3.315	5.354	7.869	0.044	0.022	0.862	49.535
2008	10.430	20.858	3.234	5.224	7.677	0.043	0.022	0.841	48.329
2009	10.170	20.338	3.153	5.093	7.486	0.042	0.021	0.820	47.123
2010	9.808	19.614	3.041	4.912	7.219	0.041	0.020	0.791	45.447
2011	9.483	18.964	2.940	4.749	6.980	0.039	0.020	0.765	43.940
2012	9.229	18.457	2.862	4.622	6.794	0.038	0.019	0.744	42.766
2013	9.057	18.112	2.808	4.536	6.667	0.037	0.019	0.731	41.966
2014	8.970	17.939	2.781	4.493	6.603	0.037	0.019	0.724	41.565
2015	8.971	17.940	2.782	4.493	6.603	0.037	0.019	0.724	41.568
2016	9.013	18.024	2.795	4.514	6.634	0.037	0.019	0.727	41.762
2017	9.105	18.209	2.823	4.560	6.702	0.038	0.019	0.734	42.191
2018	9.198	18.395	2.852	4.607	6.771	0.038	0.019	0.742	42.623
2019	9.292	18.583	2.881	4.654	6.840	0.038	0.019	0.750	43.057
2020	9.394	18.786	2.913	4.705	6.914	0.039	0.019	0.758	43.527
Energy savings (GJ)									
2000-08	0	0	0	0	0	0	0	0	0
2009	8,284	16,567	2,569	4,149	6,098	34	17	668	38,387
2010	41,422	82,837	12,844	20,746	30,490	172	86	3,341	191,936

2011	100,878	201,740	31,280	50,524	74,255	418	209	8,137	467,440
2012	160,334	320,644	49,716	80,302	118,019	664	332	12,933	742,944
2013	219,790	439,547	68,152	110,081	161,784	910	455	17,729	1,018,448
2014	279,247	558,450	86,587	139,859	205,549	1,156	578	22,525	1,293,951
2015	338,703	677,354	105,023	169,637	249,314	1,402	701	27,321	1,569,455
2016	398,198	796,334	123,471	199,435	293,107	1,649	824	32,120	1,845,137
2017	457,692	915,315	141,919	229,232	336,900	1,895	948	36,919	2,120,820
2018	517,187	1,034,295	160,367	259,030	380,693	2,141	1,071	41,718	2,396,502
2019	576,682	1,153,276	178,815	288,827	424,486	2,388	1,194	46,517	2,672,184
2020	628,721	1,257,345	194,951	314,891	462,791	2,603	1,302	50,714	2,913,318
Emissions abatement (t CO_2-e)									
2000-08	0	0	0	0	0	0	0	0	0
2009	591	1,054	177	306	370	2	1	48	2,574
2010	2,953	5,268	884	1,531	1,851	10	5	238	12,872
2011	7,193	12,831	2,152	3,729	4,507	25	11	580	31,349
2012	11,432	20,393	3,420	5,926	7,164	40	18	922	49,825
2013	15,671	27,955	4,689	8,124	9,820	55	24	1,264	68,302
2014	19,910	35,517	5,957	10,322	12,477	69	31	1,606	86,779
2015	24,150	43,080	7,226	12,519	15,133	84	38	1,948	105,255
2016	28,391	50,647	8,495	14,718	17,792	99	44	2,290	123,744
2017	32,633	58,214	9,764	16,917	20,450	114	51	2,632	142,232
2018	36,875	65,781	11,033	19,116	23,108	128	57	2,974	160,721
2019	41,117	73,348	12,302	21,315	25,766	143	64	3,317	179,210
2020	44,828	79,967	13,413	23,239	28,091	156	70	3,616	195,381
Value of energy savings ($'000)									
2000-08	0	0	0	0	0	0	0	0	0
2009	129	172	60	62	97	1	0	10	531
2010	646	862	298	312	484	3	1	48	2,654
2011	1,574	2,100	725	760	1,179	7	3	117	6,464
2012	2,502	3,337	1,152	1,208	1,873	11	5	186	10,274
2013	3,430	4,575	1,579	1,656	2,568	15	8	255	14,084
2014	4,358	5,812	2,006	2,104	3,262	19	10	323	17,894
2015	5,286	7,050	2,433	2,552	3,957	23	12	392	21,704
2016	6,214	8,288	2,860	3,000	4,652	27	14	461	25,517
2017	7,143	9,526	3,288	3,449	5,347	31	16	530	29,329
2018	8,071	10,764	3,715	3,897	6,042	35	18	599	33,142
2019	9,000	12,003	4,142	4,345	6,737	39	20	668	36,954
2020	9,812	13,086	4,516	4,737	7,345	43	21	728	40,289
Additional appliance cost ($'000)									
2000-08	0	0	0	0	0	0	0	0	0
2009	355	710	110	178	261	1	1	29	1,645
2010	1,420	2,839	440	711	1,045	6	3	115	6,579
2011	2,547	5,095	790	1,276	1,875	11	5	205	11,804
2012	2,547	5,095	790	1,276	1,875	11	5	205	11,804
2013	2,547	5,095	790	1,276	1,875	11	5	205	11,804
2014	2,547	5,095	790	1,276	1,875	11	5	205	11,804
2015	2,547	5,095	790	1,276	1,875	11	5	205	11,804
2016	2,549	5,098	790	1,277	1,876	11	5	206	11,812
2017	2,549	5,098	790	1,277	1,876	11	5	206	11,812
2018	2,549	5,098	790	1,277	1,876	11	5	206	11,812
2019	2,549	5,098	790	1,277	1,876	11	5	206	11,812
2020	2,549	5,098	790	1,277	1,876	11	5	206	11,812