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**GLOSSARY AND ABBREVIATIONS**

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<th>Definition</th>
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<tr>
<td>AS/NZS</td>
<td>Australian Standards and New Zealand Standards</td>
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<tr>
<td>BAU</td>
<td>Business-as-usual</td>
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<tr>
<td>CO₂-e</td>
<td>Carbon dioxide equivalent units</td>
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<tr>
<td>COP</td>
<td>Coefficient of Performance</td>
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<tr>
<td>DCCEE</td>
<td>Department of Climate Change and Energy Efficiency</td>
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<td>E3</td>
<td>Equipment Energy Efficiency Committee</td>
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<tr>
<td>ESWH</td>
<td>Electric storage water heaters</td>
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<tr>
<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
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<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
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<tr>
<td>GWA</td>
<td>George Wilkenfeld &amp; Associates</td>
</tr>
<tr>
<td>GWh</td>
<td>Giga Watt hour – 1 million kilo Watt hours</td>
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<tr>
<td>HPWH</td>
<td>Heat pump water heater</td>
</tr>
<tr>
<td>Kt</td>
<td>Kilo Tonnes – 1 thousand tonnes</td>
</tr>
<tr>
<td>kWh</td>
<td>Kilo Watt hour – 1 thousand watt hours</td>
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<tr>
<td>MCE</td>
<td>Ministerial Council for Energy</td>
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<td>MEPS</td>
<td>Minimum Energy Performance Standards</td>
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<tr>
<td>MRA</td>
<td>Mutual Recognition Act</td>
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<tr>
<td>Mt</td>
<td>Mega tonnes – 1 million tonnes</td>
</tr>
<tr>
<td>NFEE</td>
<td>National Framework on Energy Efficiency</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<tr>
<td>NZ</td>
<td>New Zealand</td>
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<tr>
<td>RECs</td>
<td>Renewable Energy Certificates</td>
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<tr>
<td>SCER</td>
<td>Standing Council on Energy and Resources</td>
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<td>SRES</td>
<td>Small-scale Renewable Energy Scheme</td>
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<tr>
<td>STC</td>
<td>Small-scale Technology Certificates</td>
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<tr>
<td>SWH</td>
<td>Solar water heater</td>
</tr>
<tr>
<td>TPR</td>
<td>Temperature pressure relief valve</td>
</tr>
<tr>
<td>TTMRA</td>
<td>Trans Tasman Mutual Recognition Arrangement</td>
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Electric Storage Water Heaters

The term electric storage water heaters (ESWHs) covers three main product types, conventional ESWHs, solar water heaters (SWHs) and heat pump water heaters (HPWHs). Conventional ESWHs, also known as electric resistive water heaters, heat water through one or more electric resistive elements and store the hot water for later use. ESWH can also be used as a key component of SWHs and HPWHs where the electric element typically provides limited heating (usually for ‘boosting’ low water temperature), with solar radiation (solar) or ambient air temperature (heat pump) providing the primary heat source. ESWHs are used in homes and businesses.

In Australian and New Zealand dwellings where ESWHs are used, water heaters are a major contributor to the consumption of electricity and to greenhouse gas emissions except when the electricity is from renewable sources.

The existing stock of ESWHs in the Australian and New Zealand market is around 6.5 million units (with approximately 5.2 million in Australia and 1.3 million in New Zealand). Around 430,000 ESWHs are sold each year of which around 12% are used with SWHs or HPWHs.

Conventional ESWHs have had to comply with Minimum Energy Performance Standards (MEPS) in the form of maximum tank heat loss limits since 1999 in Australia and from 2002 in New Zealand. However, the ESWHs included as part of SWHs and HPWHs are currently excluded from these MEPS limits provided that they meet certain energy performance criteria.

This report provides factual information and discussion to allow informed consideration of potential energy efficiency improvements for ESWHs in New Zealand and Australia. While this product profile explores a number of issues, it should be noted that no decision to alter any scope or stringency of current energy efficiency requirements would be taken without Ministerial approval and further consultation.

In examining the market for ESWHs, this product profile raises three policy options for consideration and comment which are discussed below. It is important to note that these options should not be considered in isolation of one another. As each option relates to a different aspect of the ESWH regulatory environment, adopting a combination of the outlined options or alternative options raised during consultation may be desirable.

Policy Option 1 - Harmonisation of Standards

There is a complex mix of test standards used for ESWHs across Australia and New Zealand (five standards covering three methods of heat loss tests). Further confusion is caused by the various MEPS requirements that apply depending on the test method used and country of sale – all of which reduces the clarity of MEPS standards for conventional ESWHs.

When the joint testing Standard (AS/NZS 4692.1:2005) was introduced in 2005 it was decided to allow testing to continue with the other standards already in existence. This was due to feedback at the time from manufacturers that there were difficulties in adapting to using the new testing Standard. The result is that manufacturers and importers in both countries continue to have the option of using alternative test methods instead of testing to AS/NZS 4692.1:2005.

The joint MEPS Standard (AS/NZS 4692.2:2005) therefore contains equations and tables that express the MEPS levels according to whichever Standard the heater has been tested to. This has complicated the registrations and the enforcement of regulations for water heaters. In addition there are some differences in the heat loss allowances permitted for products being registered in Australia and New Zealand.

A comparison of the MEPS between Australia and New Zealand revealed that for most sizes of water heaters the permitted heat loss under Australian MEPS was higher (i.e. less stringent) than that permitted by New Zealand MEPS. For all conventional ESWHs delivering less than 400 litres, the New Zealand heat loss requirements are consistently more stringent for any given size of water heater than the Australian requirements, with an average...
difference of around 20%. However, for ESWHs delivering more than 400 litres of hot water, the Australian heat loss requirements are more stringent than the New Zealand requirements. Details are included in Table 4.

Harmonising the MEPS of the two countries within AS/NZS 4692.2:2005 to their respective higher levels would produce significant energy savings in the Australian market, and reduce the compliance burden for New Zealand by ensuring that ESWHs installed meet all local, typically more stringent, requirements. It would then make sense to remove the transitional testing standards arrangements that allow standards other than the joint AS/NZS 4692.1:2005 to be used. A single testing standard would ensure that all products can be compared on a consistent basis which can help inform consumers and streamline compliance and registration activities.

Policy Option 2 – Removal of Solar and Heat Pump Exemptions

The storage tanks used for conventional ESWHs and for SWHs and HPWHs are fundamentally the same, which suggests that there is a case for ensuring maximum allowable tank heat loss limits for SWHs and HPWHs are on an identical or similar basis to that applied to conventional ESWHs.

Storage tanks used for SWHs and HPWHs are generally excluded from the existing ESWH MEPS requirements due to an exemption clause for systems that use electric resistive heating to provide less than 50% of overall heating. There is some anecdotal evidence to suggest that some products would not meet the ESWH MEPS requirements if applied. Many systems will not be optimally installed, located or orientated, and over time may operate less effectively, which will increase the impact of the heat losses of the storage tanks. If the storage tanks were made MEPS compliant this would decrease such heat losses.

TRNSYS\(^1\) modelling (under AS 4234:2008 conditions) has been undertaken on the impact of tightening the heat loss of storage water tanks for SWHs and HPWHs. A range of scenarios were modelled with different system performance and climate zones in both Australian and New Zealand conditions. The modelled impact of reducing the heat losses of typical sized tanks by approximately 20% led to savings in the order of 20-40 kWh p.a. for HPWHs and 35 – 75 kWh p.a. for SWHs. However, the modelling assumed that 50% of such storage tanks already meet the conventional ESWH tank heat loss limits, so the actual gains would vary by product. Factors such as the size, efficiency, climate zone, installation and water load profiles of the system, as well as the price of electricity would determine the actual ongoing savings to the household.

A recent key policy initiative in Australia is the phase-out of greenhouse gas intensive water heaters. The implementation of this policy would lead to increasing numbers of SWHs and HPWHs being sold due to restrictions on the installation of conventional ESWHs. As the estimated sales of SWHs and HPWHs rise, the importance of improving their energy performance will also increase.

Sales of conventional ESWHs are expected to steadily decline in Australia depending on the progress of the phase-out of greenhouse intensive water heaters and increasing take up of gas water heaters. In New Zealand, sales will also slowly decline as a result of expected increased gas water heater installations. The sales of SWHs and HPWHs are expected to grow quickly in Australia in response to the phase-out policy and other market drivers supporting the installation of lower emission water heaters and/or water heaters with lower running costs. The sales of HPWHs and SWHs are expected to grow more slowly in New Zealand as there is no regulatory pressure to change water heater types.

The result of these sales trends is that the energy consumption by the stock of conventional ESWHs is expected to decline over time while the energy consumption by SWHs and HPWHs will increase despite the lower energy consumption of these heaters compared to conventional ESWHs. It is therefore expected that there will be an overall decrease in the energy consumed by the total mix of ESWHs, despite an increase in the total stock of heaters. However, as the phase-out has yet to be fully implemented in Australia, this product profile includes sales projections for the three types of ESWHs (conventional, SWHs and HPWHs) under both a fully implemented phase-out scenario and for a scenario based on the current limited implementation of the phase-out. These two scenarios will provide insights into the possible upper and lower bounds for the costs and benefits of the policy options noted within this product profile.

\(^1\)TRaNsient SYstem Simulation (TRNSYS) is a public domain model originally developed by the University of Wisconsin. It is an algebraic and differential equation solver typically used to simulate performance of energy systems including water heaters, heating ventilation and cooling systems and renewable energy systems. Although other programs can be used, ‘TRNSYS’ will be used here to indicate all programs with the required capabilities.
This report does not contain detailed consideration of separate MEPS or labelling specifically for SWHs or HPWHs as these are likely to be covered by later product profiles. However, the ESWHs associated with these systems are currently excluded from the ESWH MEPS and this exclusion is now being reviewed.

**Policy Option 3 – Stronger Tank Heat Loss Limits**

While the analysis and discussion in this product profile generally focuses on the above two policy options, feedback is also sought on further strengthening of tank heat loss limits. MEPS for ESWHs have not been updated since 2005 and while some products have heat loss levels well under the maximum allowable levels, other products experience heat losses very close to the limits set in 2005.

As water heating is responsible for a substantial portion of household energy use, the market should drive consumer preferences towards purchasing the better performing models, thereby improving the heat loss characteristics of the whole market over time. Based on the results of laboratory testing and claimed tank heat loss levels by manufacturers it appears that consumer preferences have had only limited success in shifting the heat loss characteristics of the market. However, this product profile does not explore other drivers of consumer demand such as pricing and brand loyalty.

Water heaters tend to be purchased in ways which are not conducive to orderly research and comparison of products by consumers. The decisions for replacement water heaters tend to be made under time pressure after an existing water heater has broken down, and often by, or with the advice of, intermediaries such as plumbers, who are less concerned with operating cost. Water heater purchases for new homes are not subject to time pressure, but they are still subject to split incentives, in that the units are typically selected by builders or developers, who are usually motivated to minimise capital cost. A split incentive is also likely to also exist in the selection of water heaters for properties in the rental markets where the purchaser is not the end user and as a result has an incentive to reduce upfront costs and install the least expensive option.

A market failure may be occurring due to the lack of easily accessible information for consumers, the existence of split incentives and the lack of heat loss improvements in some products from 2005 limits. Strengthening the tank heat loss MEPS, above any changes that may occur though standard harmonisation activities, is likely to provide net benefits to Australia and New Zealand.

**Conclusions**

The research shows that there are a number of areas for reform relating to tank heat loss levels and to harmonisation of Standards to increase the overall performance of ESWHs and to streamline and increase the transparency of the associated regulatory arrangements. Three reform options have been proposed and any combination of these options could be pursued. However, as implementing one option will influence the marginal costs of other options, any preferred combination (or alternative policies nominated by stakeholders) would benefit from additional modelling and analysis. Any changes would be unlikely to take effect before late 2013.
Where to from here?

This consultation document is an investigation of the energy efficiency and the market for electric storage water heaters, the current standards and regulations in use, and possible opportunities for improving these.

Readers are asked to comment on a number of aspects in this document, particularly market data and modelling assumptions, to assist with the formulation of preferred future policy options. While we welcome comments on all aspects of the product profile, responses to the key questions provided below would be of particular assistance.

Readers also may wish to note that a separate product profile looking at the system performance of Heat Pump Water Heaters was released on 29 June 2012 for comment.

Written comments should be sent via e-mail, and should be received by 10 September 2012. Comments can be sent to:

   Email: energyrating@climatechange.gov.au   Subject: Electric storage heater product profile

What happens after consultation on the product profile?

The material in this product profile as well as written submissions and/or issues raised at stakeholder meetings will be considered in helping Governments’ to make decisions on whether to proceed with a proposal for ESWH (to improve their energy efficiency) and what the preferred options could be.

If the preferred options involve revising or changing the scope under the existing regulations (i.e. MEPS) a Regulation Impact Statement (RIS) will be prepared to analyse the costs, benefits, and other impacts of the proposal. Any options will be subject to the usual consultation process and the final decision on policy will be made by the Select Council on Climate Change in Australia and by the New Zealand Cabinet.

Electric storage water heater product profile – key questions

1. What do you think would be the best way for governments to facilitate an increase in the average energy efficiency of electric storage water heaters?

2. Do you agree with the market data presented for Australia and New Zealand? In particular, do you agree with the estimates of current stock and sales of water heaters? Please provide data if you have contrary views.

3. Do you agree with the breakdown of sales between the various product types? Are there any major trends or drivers that are not specified in the product profile for Australia and/or New Zealand? Please provide data.

4. Do you agree with the projected market trends? In particular, have the two scenarios modelled for Australia covered what you think the future water heater market will look like?

5. Do you think that there is a case for Trans-Tasman harmonisation of electric storage water heater Standards?

6. What impact do you think implementing harmonised Trans-Tasman MEPS would have on the industry in Australia and New Zealand?

7. What additional costs or savings do you think harmonised Standards would place on industry compared to the current situation?

8. What impact do you think harmonised Standards would have on competition and consumer choice?

9. What impact do you think there would be from removing the exemption for tank heat loss requirements for heat pump and solar water heating systems?

10. Do you believe that there are any significant technical barriers to removing the tank heat loss exemptions for solar and heat pump water heating systems? Are there any exemptions that are technically justified noting that products are currently available that meet the requirements? Explain in detail if you believe there are technical barriers.

11. Are there any additional measures which the E3 program could consider to increase the energy efficiency of electric storage water heaters?
1. Introduction

Improving the efficiency of hot water appliances contributes to both the objectives of the Equipment Energy Efficiency (E3) program and the Australian National Hot Water Strategic Framework (NHWSF). Both E3 and the NHWSF are identified under the Australian National Framework for Energy Efficiency (NFEE) and National Strategy on Energy Efficiency (NSEE). This project also meets the objectives of the New Zealand Energy Efficiency and Conservation Strategy (NZEECS).

In dwellings where conventional ESWHs are used, they are a substantial contributor to the consumption of electricity and to greenhouse gas emissions (unless the electricity is from renewable sources).

Conventional ESWHs have had to comply with MEPS in the form of maximum tank heat loss requirements since 1999 in Australia and since 2002 in New Zealand. A revision to the MEPS for ESWHs took place in 2005 but since then the requirements have remained unchanged. MEPS are typically revised every few years. No Mandatory Energy Performance Labelling (MEPL) requirements apply to ESWHs.

There is an E3 project concurrently reviewing the efficiency of HPWHs. The investigation of MEPS changes or other policy initiatives to specifically apply to HPWHs may be complementary to any reforms of the ESWH regulatory environment.

There is a complex mix of test standards used for conventional ESWHs in Australia and New Zealand which reduces the clarity of the MEPS standards. Due to the allowable usage of alternative test methods, the measured energy performances under the standards are not directly comparable with each other. In addition, some ESWH products such as SWHs and HPWHs have exclusions from MEPS if they met certain criteria.

The above arrangements can be confusing to both suppliers registering the products and the regulators reviewing and conducting compliance against these registrations. It also reduces the potential to provide consumers with clear information about the heat loss characteristics of different hot water heaters. There is also a less stringent MEPS level specified in Australia compared to New Zealand for tanks under 400 litres, which increases the compliance burden for New Zealand in ensuring that ESWHs installed meet all local, typically more stringent, requirements.

Conventional ESWHs are expected to continue to have a major share of the New Zealand market because there are no anticipated changes to government policy regarding hot water heaters. However, there is potential for an increase in the uptake of SWHs and HPWHs that are exempt from the current tank heat loss MEPS which may alter the New Zealand market.

In Australia, there is a policy initiative to phase-out greenhouse gas intensive hot water heaters for certain dwelling types. All Australian states and territories other than Tasmania and the Northern Territory have rules restricting the use of greenhouse-intensive water heaters in new Class 1 houses (defined as detached, row, terrace or townhouses in the National Construction Code), either through their own regulations or by reference to the relevant clauses in the National Construction Code. These rules have largely eliminated conventional ESWHs from the new home market in favour of HPWHs, SWHs, natural gas and liquefied petroleum gas (LPG) systems.

At the end of 2010, the Ministerial Council on Energy (MCE) agreed to adopt measures to phase out greenhouse gas intensive water heaters for existing houses in all jurisdictions, other than Tasmania\(^2\). South Australia and Queensland have had regulations (based on urban postcodes for SA and gas reticulated areas for Qld) restricting the installation of conventional ESWHs since 2009 and 2010 respectively. If the phase-out for existing Class 1 homes is completely implemented, the water heater replacement market for these dwellings will shift away from conventional ESWHs to other technology types.

Under the National Hot Water Strategic Framework a phase-out for Class 2 dwellings (multistorey flats or apartments) is also noted for examination.

If these phase-out policies are fully implemented, it is expected that the number of SWHs and HPWHs installed in Australia will substantially increase. These systems usually incorporate an ESWH, however the ESWH component of SWHs and HPWHs are currently excluded from the MEPS applied to conventional ESWHs, provided the systems meet certain criteria. As the phase-out is a significant driver of the future market for water heating systems, this product profile includes two sets of market projections for Australia, one scenario based on current implemented policy settings and the second based on a fully implemented phase-out.

Given all of the above, the objectives of this product profile are therefore to examine and consult upon the potential benefits and/or alternatives to:

- harmonisation of ESWH Standards (test methods and MEPS) between Australia and New Zealand;
- removal of the ESWH tank heat loss MEPS exemption provided to SWHs and HPWHs;
- stronger tank heat loss limits for ESWHs; or
- a combination of the above, or alternative, policy options.
2. Policy context

The Minimum Energy Performance Standards framework

MEPS set mandatory energy efficiency requirements that products must meet. MEPS proposals are developed by E3 and are currently regulated through state government legislation and regulations in Australia and national regulations in New Zealand. Technical requirements for MEPS are set out in the relevant appliance Standard, which is referenced in state, territory and New Zealand regulations.

Currently in Australia, state-based legislation is necessary because the Australian constitution gives Australian States responsibility for resource management issues, including energy (see www.energyrating.gov.au/programs/e3-program/meps/about/). Work is currently under way on a 2009 Council of Australian Governments' (COAG) commitment to introduce national legislation for MEPS and labelling requirements under the Greenhouse and Energy Minimum Standards (GEMS) Bill3.

MEPS that define the maximum allowable standing heat loss from the water storage tank under static conditions, have been applicable for mains pressure ESWHs sold in Australia since 1 October 1999. These MEPS requirements cover unvented (displacement) heaters and were originally set out in AS 1056.1 – Amendment 3. Storage tank heat loss MEPS were also introduced in New Zealand in 2002 but older Standards, such as NZS 4602:1988 and NZS 4606:1989, regarding other aspects of water heater performance, safety and manufacturing had previously been developed.

A joint ESWH MEPS Standard for Australia and New Zealand was introduced in 2005, AS/NZS 4692.2:2005. An additional ESWH test standard relevant to this MEPS regulation was also introduced as part of AS/NZS 4692.1:2005. It is worth noting that the MEPS levels themselves and scope of water heaters covered for Australia and New Zealand are different and this is discussed in more detail in the section Comparison of the Minimum Energy Performance Standard levels, page 34.

Australian policy context

In Australia, water heating is the largest single source of greenhouse gas emissions from most dwellings. On average, each ESWH produces around four tonnes of greenhouse gas emissions every year. Conventional ESWHs may produce up to three times the greenhouse gases produced by low emission technologies such as SWHs, HPWHs or gas hot water systems.

The NHWSF sets out a pathway to transition Australia to low emission hot water heaters while delivering lifetime cost savings to households. One of the measures identified in the NHWSF is the development of performance requirements for water heating in certain building types which will lead to the phase-out of conventional ESWHs in some situations.

All Australian states and territories other than Tasmania and the Northern Territory have rules restricting the use of greenhouse gas intensive water heaters in new Class 1 buildings. Additionally there is also a commitment through the MCE to phase out greenhouse gas intensive water heaters for existing Class 1 buildings in all jurisdictions, other than Tasmania. As well as reducing greenhouse gas emissions the phase-out would also result in benefits to consumers through lower running costs of alternative water heating technologies.

Since the 2010 MCE decision, no jurisdiction has implemented new regulations to implement the phase out for existing Class 1 buildings.

A fully implemented phase-out would have a number of implications regarding ESWHs, including:

- The number of sales of conventional ESWHs would dramatically decrease in Australia especially for the medium to large water heaters used in Class 1 buildings. The resulting decline in the sales of the conventional ESWHs would be around 50% from current levels.
- If the phase-out was extended to Class 2 buildings this would further decrease the number of small to medium sized conventional ESWHs sold. Any extension of the phase-out would be unlikely to affect the replacement of existing units for some time.
- The sales of SWHs and HPWHs would significantly increase.

Sales trends are further explored in the section *Estimated stock and sales by product category*, page 20. However due to significant potential of implemented phase out regulations, two future scenarios have been modelled for the Australian market – ‘current regulatory settings’ is based on current implemented policies and ‘phase-out’ is based on the future implementation a phase out in existing Class 1 building from 2013.

**Small-scale Technology Certificates and Rebates**

In Australia, SWHs and HPWHs are eligible to receive Small-scale Technology Certificates (STCs) under the Commonwealth Small-scale Renewable Energy Scheme (SRES). The number of STCs (previously renewable energy certificates or RECS) received depends on the amount of renewable electricity the system produces or displaces.

It is important to note that the focus of the STC framework on energy displacement/generation is very different to the focus of the E3 committee on energy efficiency. For example the potential for a solar water system to displace energy can be increased by increasing the volume of the storage tank. As this policy does not specifically promote electricity efficiency, it is not clear what effect this policy has had on efficiency levels. Indeed, in some cases the policy appears to have encouraged suppliers to market larger heat pumps and solar systems, in order to maximise rebates.

Typical residential HPWHs were considered to create around 20 to 30 STCs which reduced the up-front price consumers paid by around $800 to $1,000 dollars. SWHs also typically create around 20 to 30 STCs and so generally benefited from a decrease in the up-front cost to the consumer by similar amounts.

Rebates of $1,000 for solar systems and $600 for heat pumps where they replace existing conventional ESWHs were offered under the Australian Federal Government Renewable Energy Bonus Scheme, which closed for systems purchased/ordered after 28 February 2012. The provision of rebates under this scheme was linked to the STC framework. However, rebates were only offered for systems that were eligible for at least 20 STCs, which was difficult to achieve with small HPWHs and SWHs. Small systems produce less renewable energy / displace less electricity than larger products of equal efficiency.

Rebates are still offered by state governments on some installations of SWHs and HPWHs. These rebates range from $400 to $1,600 and are offered in Western Australia, Victoria and South Australia. The rebates are for eligible products which are generally determined by the technology type being acceptable under the state scheme. In South Australia the product must earn a minimum of 18 STCs while Victoria requires a minimum of 60% solar contribution in climate zone 4.

Other State based policies, such as white certificate schemes are also driving uptake of SWHs and HPWHs.

**New Zealand policy context**

Water heating uses about 5.5% of New Zealand’s total energy. In homes, conventional ESWH are the predominant form of water heating, and electric water heating makes up about one-third of residential electricity consumption.

Energy efficiency and conservation will play an important role in promoting economic growth and helping New Zealand meet the challenge of having enhanced security of energy supply while reducing greenhouse gas emissions. The New Zealand government’s strategic direction for the energy sector is set out in the New Zealand

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*It is noted that the value of STC’s can vary over time, and therefore, the value of rebates over the life of the program have varied and will continue to do so.*
Energy Strategy (NZES) 2011-2021. One of the four priorities in the NZES is “achieving efficient use of energy” which is a key part of “having better consumer information to inform energy choices”.

The New Zealand Energy Efficiency and Conservation Strategy 2011-2016 (NZEECS) is a companion document to the NZES and is a statutory document prepared under the Energy Efficiency and Conservation Act 2000. One of the objectives of the NZEECS is “greater business and consumer uptake of energy efficient products” with a target of “extending minimum energy performance standards, labelling and Energy Star® product coverage to remain in line with major trading partners”.

The NZEECS promotes the careful use of a mix of measures, such as information on consumer and business needs, along with codes and standards, to underpin confidence in energy efficient products and practices. It recognises that common standards and energy labelling information supports closer economic relationships with Australia and reduces compliance costs for product manufacturers and suppliers who are often trading in both countries.

New Zealand is committed to providing energy efficiency labelling and standards for products to better inform consumer choice in association with Australia.

Interaction of the Building Code and installations of electric storage water heaters

Under the Trans-Tasman Mutual Recognition Arrangement (TTMRA), products that are legally allowed to be sold in one country must be legally available in the other. The difference between New Zealand and Australian MEPS levels has had an impact on the products available for sale in New Zealand. It is estimated that 800 tanks were sold in New Zealand in 2011 that met Australian MEPS requirements, but not local requirements.

The Building Code of New Zealand (the Code) supports the use of water heaters compliant with New Zealand MEPS, but does not prohibit nor fully prevent lower efficiency, Australian registered, water heaters being installed. The Code is a performance based regulation that does not prescribe particular Standards or solutions. Compliance with the Code is most easily shown using “acceptable solutions”, which describe one way to meet the Code requirements. Acceptable solutions for ESWH reference the standards NZS 4305, NZS 4606 and AS 1056.1, which require equivalent performance to NZ MEPS. It does not explicitly require that water heaters meet MEPS requirements as alternative solutions to comply with the code are possible.

In practice, most installations will comply with the ‘acceptable solution’ as it is simple and easier to demonstrate compliance. However, this is not mandatory and it is up to building inspectors to decide if the installation is Code compliant. A complicating factor is that while all modifications to a building should meet the Code, a building inspection is not required for minor modifications such as replacing a water heater.

Summary policy context

In Australia, conventional ESWHs remain a significant portion of the hot water market - approximately 50% of Australia’s 8 million households use these water heaters.

In view of rising electricity prices, improvements to the efficiency of these products will assist in reducing the appliance running costs for households. In addition ESWHs are considered emission intensive, producing up to three times the greenhouse gases of low emission alternatives. Reducing the electricity consumption of ESWHs is a primary concern.

The proposed phase-out of conventional ESWHs in Class 1 dwellings has not been fully implemented. There are some exemptions to the phase-out, such as Tasmania not participating, that still provide reason to ensure any ESWHs on the market are more efficient. ESWHs are also key components of HPWHs and SWHs and so raising the efficiency of these ESWHs is also critically important. There are also differences in the MEPS levels and testing methods of Australia and New Zealand with the Australian MEPS and testing often allowing higher levels of tank heat losses to occur than the New Zealand MEPS and testing methods.

In New Zealand the current policy challenges mainly focus on the less stringent MEPS requirements in Australia and that TTMRA arrangements allow the importing of storage tanks that do not meet New Zealand specific MEPS requirements. The New Zealand Building Code appears to be only partially effective in restricting the installation of imported tanks that may fail New Zealand MEPS.

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6 Ibid
3. Scope of products

This product profile covers all water heaters with storage tanks and electric boost/heating elements. While it focuses on conventional ESWHs, SWHs and HPWHs are also included as these use hot water storage tanks and in some instances electric elements for boosting the water temperature. The effectiveness of storage tanks in minimising heat loss affects the overall performance of SWHs and HPWHs. This section describes each of these technologies in greater detail.

Conventional electric storage water heaters

A conventional ESWH consists of an insulated storage tank, usually cylindrical, where hot water is kept ready to be used. The water is stored at a pre-set temperature typically 60-80°C. The water is heated in the storage tank by one or more electric resistance elements. Over time, the water temperature decreases through heat losses from the storage tank and from hot water draw-offs (usage). This results in the tank being refilled with cold water which in turn lowers the overall temperature of water in the tank. For water heaters operating on a continuous electric tariff the electric elements are turned on when the water temperature drops below the thermostat set point. The thermostat will turn on the electric elements periodically throughout the day and night, to maintain the water in the storage tank at the required temperature. The number of times and the length of time the elements operate will vary with the size, location and number of elements as well as hot water draw-off behaviour and the heat loss characteristics of the storage tank.

Some conventional ESWHs are not operated on a continuous electric tariff but instead operate on some form of restricted tariff, such as off peak tariffs or ripple control tariffs. Often larger tanks are used to ensure that users on restricted tariffs do not run out of water before the system can reheat the water.

Restricted tariffs are used when an electricity supplier wishes to control the electricity demand of electric hot water systems on their network. Such tariffs are a type of load management system that allows the electricity supplier to switch off a set of appliances, in this case water heaters, during periods of peak electricity demand. This is often referred to as “ripple control” in New Zealand, where the majority of ESWHs are controlled. In Australia, approximately 25% of homes use a form of continuous tariff for electric water heating.

The choice for the household or business of which electricity tariff structure to use depends primarily on the level of hot water service required, the price difference of the types of tariff(s) being offered and the number of hours the tariff(s) cover.

Heat pump water heaters

Air-sourced HPWHs are a form of storage water heater that makes use of renewable energy via the ambient heat in the atmosphere. This type of water heater uses a refrigeration cycle to transfer heat energy from the air into the water which allows the water to be heated. Refrigerators and air conditioners are familiar examples of heat pumps which transfer heat from one space, e.g., the inside of the refrigerator, and move that heat to another space.

Typically HPWHs use an air-to-water system which involves a fan-coil evaporator and a water cooled condenser. The evaporator part of the system consists of the evaporator coil, a fan for blowing air over the evaporator and a compressor pump. The condenser unit is either an internally or externally located ‘refrigerant to water’ heat exchanger.

Air-sourced HPWHs can consist of integrated systems with the evaporator-fan unit physically part of the water heater, or stand-alone systems with the evaporator-fan and external condenser forming one unit physically separate from the water heater storage tank. Some types of stand-alone systems are popular in New Zealand, as they allow the heat pump component of the system to be purchased separately and retrofitted to an existing conventional ESWH. Stand-alone systems only appear to be used in limited numbers in Australia.

The ESWH component of HPWHs is currently provided an exemption to the ESWH MEPS requirements.
Solar water heaters – electric boost

Solar-electric, close-coupled thermosiphon

Close-coupled thermosiphon are the most common solar hot water system on the market. It consists of roof-mounted solar collectors combined with a horizontally-mounted storage tank located immediately above the collectors. In these solar systems a pump is not required. Heated fluid rises naturally through the solar collectors and enters the storage tank. When this happens, cooler water at the base of the storage tank is forced out and flows down to the bottom of the collectors to be heated.

Boosting can be provided by gas or electricity (typically on a restricted tariff to reduce running costs). The booster in the storage tank (tank boost) should be in the top half of the tank so that solar energy can be used to heat the bottom of the tank. Alternatively, boosting can be done after the solar storage tank by using a continuous flow gas heater (or other in-line boosting) designed to accept varying inlet temperatures.

The heating cycle illustrated in Figure 1 is continuously repeated while there is sufficient solar energy available. Many commercially available solar hot water systems employ this cycle commonly referred to as ‘thermosiphon flow’.

The ESWH component of SWHs are currently provided an exemption to the ESWH MEPS requirements.

Figure 1: Close-coupled thermosiphon (mains pressure)

Solar-electric, split-systems (or pumped systems)

With a pumped system the tank is located below the level of the collectors usually at ground level. Water must therefore be pumped from the tank to the collectors and back by a thermostatically controlled pump (see Figure 2).

The electric boosting elements are usually controlled by a combination of timers and thermostats but may also be manually operated.

Figure 2: Forced circulation system (mains pressure pumped)
4. Market characteristics

The market for water heaters is effectively segmented into two parts – purchases of new water heaters and the market for replacement hot water systems in existing dwellings. The volume of sales for new homes is tied to the market for new homes which can be quite variable. Regulation and policy initiatives may affect these two segments of the market differently. For example, recent Australian state initiatives requiring the building of more energy efficient housing, which must install low greenhouse gas intensive solar, heat pump or gas water heaters, have affected the mix of sales for the new home market segment.

There is also a market for water heaters which are either gas based or do not use a storage tank (instantaneous or continuous systems) which are outside the scope of this product profile.

Market and suppliers

Conventional electric storage water heaters

Australia

In Australia, conventional ESWHs constituted 52% of residential water heater stock in 2011, SWHs (both gas and electric) composing 9% and HPWHs responsible for around 2% (ABS 2011). Low pressure or gravity fed electric water heaters have historically been installed however mains pressure systems have been the most popular system for several decades.

Conventional ESWHs come in a variety of types and sizes. In Australia there is a mixture of continuous and restricted tariff water heaters. Restricted tariffs units tend to be larger in size and installed in the detached house and townhouse market. The ESWHs on a continuous tariff tend to be much smaller units and are often preferred for flats and apartments.

The share of water heaters sales for conventional ESWHs is estimated to be 29% of total sales so the proportion of conventional ESWHs in the installed water heater stock is slowly declining. The current estimated ESWH stock is around 4.2 million units.

Australian conventional ESWH sales in 2009/10 were estimated to be around 280,000 units (derived GWA 2010) and the annual sale number has been declining. The decline over the last few years is in response to factors such as restrictions on the installation of conventional ESWHs in new Class 1 buildings, the partial phase-out of electric water heaters for existing Class 1 buildings in two States, rebates and incentives encouraging the installation of lower emission water heaters, the increasing cost of electricity and consumer preference for other types of water heaters such instantaneous gas systems.

New Zealand

In New Zealand, conventional ESWHs have a much greater share of the installed water heater market than in Australia, estimated at 77% in 1996 by Statistics New Zealand (SNZ 1996). A more recent survey by BRANZ in 2005 (BRANZ 2005) found a penetration of 71% and though this was based on limited sample, it suggests the high penetration of conventional ESWHs has continued. Allowing for the trend over recent years towards the increasing use of gas water heaters, it is estimated that there are around 1,240,000 conventional ESWHs installed in New Zealand.

Historically, ESWH tanks have been manufactured from copper, have a service life of around 50 years, and are either 135 litres (30 gallon) or 180 litres (40 gallon) in capacity. These ESWHs were low pressure systems utilising a header tank in conjunction with the storage tank to supply the pressure. The majority of New Zealand houses still use low pressure (3.6 metre head) systems, but they are gradually being replaced by main pressure systems. The decision to upgrade from low pressure to mains pressure is usually taken when the existing storage tank fails or the house undergoes substantial renovations, or when an energy efficient water heating system is to be installed. The preferred water heater storage tanks being purchased are now mains pressure rated, and are typically 200-300 litres in size, tending towards the higher end of this range if using with SWH or HPWH systems.
Due to the prevalence of conventional ESWHs in New Zealand, there has been considerable focus on the heat loss of the tanks. Whilst most ESWHs are installed within the house (usually in the middle), the average ambient temperature of the house is generally cold, particularly during winter. As a result the thermal losses of the tanks are in the order of 30% of the electricity consumed by the heated water system. For water heaters installed externally the heat losses will be even greater, resulting in high ongoing costs to the consumer.

**Suppliers**

In both Australia and New Zealand ESWH sales are dominated by a few key suppliers. In Australia the majority of sales are by Rheem, Rinnai and Dux and consist principally of sales of conventional ESWHs i.e., not HPWHs or SWHs. In New Zealand, Rheem is also the dominant player with around two thirds of the market share.

**Solar and heat pump water heaters**

**Australia**

Australia has had a well-established SWH manufacturing base for many years. There are now over 50 SWH suppliers currently operating in Australia and a wide variety of product types are available. Likewise there has been considerable research conducted in Australia by local suppliers over the last few decades to develop commercially viable, air-sourced HPWHs. There has been development and refinement of these products internationally as well. There are now 18 different suppliers of HPWHs in Australia.

Despite the history of product development and the number of suppliers in Australia, sales of SWHs and HPWHs constitute a minority of total water heater sales in Australia. SWHs form around 9% and HPWHs are estimated to be approximately 2% of the installed water heater stock in 2011. Electric boosted solar systems form only part of the total number of SWH installations and data provided by DCCEE suggest around 65% of installations in recent years are electrically boosted solar systems – with the remaining solar systems using gas to supplement solar heat. This equates to around 4.5% of the total water heater sales in Australia being electrically boosted SWHs. Recent regulatory changes at the state and national level have increased the sales of SWHs and HPWHs to the new homes market and the phase-out of greenhouse gas intensive electric water heaters initiative, if fully implemented, would further increase the market share of SWHs and HPWHs in the replacement market.

The annual Australian market for HPWHs was under 5,000 units five years ago and has increased to around 65,000 in 2009. In 2010 the total number of HPWH installed decreased to approximately 20,000. Approximately 65,000 electrically boosted solar systems are estimated to have been installed in 2010 however 80,000 may have been installed in 2011.

Within the SWH segment of the Australian market there are a number of major suppliers including:

- Solahart (Rheem)
- Chromagen
- Dux (GWA Group Limited)
- Edwards (Rheem)
- Rinnai Sunmaster

For HPWHs the main suppliers are:

- Rheem
- Dux
- Quantum
- Siddons
- Stiebel Eltron

**New Zealand**

New Zealand also has a well-developed SWH market with a range of local manufacturers and importers competing in the market. The solar market has five major players selling a total of 3,000 systems annually nationwide. Nova is the dominant company and other major players include Solar City, Solar Group, Switch and Eco Solar. The remainder of the market is fragmented.

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7 Based on data supplied by DCCEE.
The HPWH market is smaller, with around 1,000 sales annually, and is less developed. There are three local manufacturers of heat pumps including Hot Water Heat Pumps, Econergy, and Eco Hot Water Heating Solutions. There are also twelve suppliers of imported products including New Zealand divisions of Rheem and Quantum.

While the SWH and HPWH industries are steadily growing, the relatively high proportion of electricity generation from renewable energy sources (largely hydro-electricity) means that there is little impetus for ESWHs to be phased out on greenhouse gas reduction basis.

Estimated stock and sales by product category

The estimated current stock of conventional ESWHs, HPWHs and SWHs in Australia and New Zealand is presented in the table below. The size of the New Zealand stock is approximately 20% of Australia’s stock. These estimates include commercial installations.

Table 1: Estimated current storage water heater stock

<table>
<thead>
<tr>
<th>Current Stock -2011</th>
<th>Australia</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar-Electric</td>
<td>595,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Heat Pump</td>
<td>139,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Electric</td>
<td>4,439,000</td>
<td>1,242,000</td>
</tr>
<tr>
<td>Total</td>
<td>5,173,000</td>
<td>1,274,000</td>
</tr>
</tbody>
</table>

The current sales of conventional ESWHs, SWHs and HPWHs in Australia and New Zealand have also been estimated.

Table 2: Estimated annual storage water heater sales

<table>
<thead>
<tr>
<th>Current Sales -2011</th>
<th>Australia</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar-Electric</td>
<td>80,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Heat Pump</td>
<td>20,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Electric</td>
<td>270,000</td>
<td>53,000</td>
</tr>
<tr>
<td>Total</td>
<td>370,000</td>
<td>57,000</td>
</tr>
</tbody>
</table>

Projected sales and stock levels by product category

Forecasts have been developed for the future sales of ESWHs, SWHs and HPWHs in Australia and New Zealand using historic sales and stock figures as well as sales trends over recent years. The sales and stock projections are important for examining the impact of any changes in regulatory arrangements and these projections are separately presented as any changes in sales behaviour may take some time to cause noticeable effects on the overall installed stock of water heaters.

Australia has two sets of projections presented due to the potential impact of the policy to phase-out conventional ESWHs. Of the two sets of projections for Australia, one is based on the current regulatory settings and one on the implementation of the phase-out in Class 1 buildings. Forecasts were also developed based on the expected operating life of ESWHs and the forecast sales from the 2010 Decision Regulatory Impact Statement on Phasing Out Greenhouse-Intensive Water Heaters in Australian Homes (GWA 2010).

Figure 3 shows the forecast sales under current regulatory settings and the phase out scenario. In the phase out scenario, the forecasted rapid decline in annual sales of conventional ESWHs is a result of the staged implementation of regulations by Australian state and territory governments to phase out greenhouse-intensive water heaters. From 2015 onwards, the sales of ESWHs slowly decline as they are typically used to replace existing ESWHs in the smaller commercial sector market and Class 2 buildings. The replacement of conventional ESWH in Class 1 buildings in Australia will decrease after 2021 as the operating lifespan of the current installed stock of
ESWHs comes to an end, and therefore sales of SWHs and HPWHs are forecast to fall at this point. The projected increase in sales of SWHs and HPWHs in Australia during the period 2018-2022 is due to householders replacing units to the end of their life which were purchased in the late 2000’s when government incentives created a surge in the installations of SWHs and HPWHs.
A median operating life of 12 years was used for Australian conventional ESWHs and a 25 year median operating life for New Zealand ESWHs. The majority of New Zealand ESWHs are low pressure systems that last much longer than high mains pressure systems which are commonly used in Australia.
Figure 4 shows the forecast stock under current regulatory settings and the phase out scenario. In the phase out scenario, there is a decline in the sales of electric storage water heaters in Australia but also an increase in SWHs and HPWHs sales. In New Zealand the decline in conventional ESWHs is less pronounced as is the increase in sales of SWHs and HPWHs.

**Figure 4: Forecast stock of storage water heaters in Australia and New Zealand**
Market trends

Australian market trends

Conventional electric storage water heater trends

In Australia, regulatory settings are a key driver of potential change in the conventional ESWH, SWH and HPWH markets. The requirement for low greenhouse gas emission water heaters to be installed in new homes has been driving an increase in the sales of SWHs and HPWHs for several years, assisted by the eligibility of these products for STCs/RECs, federal rebates and state rebates. If the policy to phase-out conventional ESWHs is implemented in existing Class 1 buildings and/or in Class 2 buildings, the trend towards SWHs and HPWHs will accelerate.

A trend in Australia which may increasingly affect the size of the conventional ESWHs sold is a reduction in the use of restricted (off-peak) tariffs for water heaters. At present approximately 75% of conventional ESWHs are on some form of restricted tariff, but the cost savings from using such tariffs is decreasing as the differential price between tariff types is decreasing.

Solar and heat pump water heater trends

There are a number of market drivers which have contributed to the increasing sales of SWHs and HPWHs. Some of these drivers are expected to continue into the future. The main drivers identified are:

- The Renewable Energy Target and Small-scale Renewable Energy Schemes;
- Rebates and white certificate schemes; and
- Water heater regulations.

These factors have previously been discussed (see Australian policy context, page 13) and have contributed to the current market trends which suggest that Australians are moving away from conventional ESWHs. In 2008, 53% of Australian dwellings used conventional ESWHs and about half of water heater sales were conventional ESWHs but by 2010 the share of sales for these products had dropped to 29% (GWA 2010). These factors have resulted in a significant increase in the sales of SWHs and HPWHs over the past few years and to varying degrees are likely to drive an increase in sales in the future, noting that some rebate programs have recently closed and others have either a fixed duration and/or a maximum amount of funding.

New Zealand market trends

Conventional electric storage water heater trends

Traditionally, the vast majority of water heating in New Zealand has been provided by conventional ESWHs and this continues to be the case today. However, in recent years increasing electricity prices, some expansion of the reticulated gas supply and the increasing popularity of gas water heating as well as concern about the environment have become factors which have put pressure on the market for conventional ESWHs. Gas water heater sales, in particular, have increased and now stand at approximately half the comparable number of conventional ESWH sales (EnergyConsult, 2011). As a result there is a slow decline in predicted conventional ESWH stock from 1,250,000 in 2011 to 1,000,000 in 2025 (forecast in Figure 4).

Another trend is that New Zealand households are increasingly converting from low pressure hot water systems to main-pressure systems. This is primarily to reduce the effect of multiple users of hot water reducing the delivery pressure. Correspondingly, existing houses converting to mains pressure often increase their hot water consumption as the tap-ware is suited to low pressure and allows greater water flows once on mains pressure. New houses on the other hand will have mains pressure tap-ware installed and will be less affected. The trend in new housing is likely to see more mains pressure systems being installed and as a result the conventional ESWH products in the New Zealand market may become increasingly similar to the Australian market.

At present, water is predominantly heated outside periods of peak transmission loads using a ‘restricted tariff’. There are two tariffs within the ‘restricted tariff’ band – ‘night-only’ and ‘ripple’ tariffs. Whilst there may be a price differential between cheaper ‘night-only’ tariff and the ‘ripple’ tariff, the former is not offered to customers in many regions, so the uptake is limited. Also, switching existing ESWHs to ‘night-only’ tariffs may not be suitable where the capacity of the tank is too small to meet one day of hot water demand. If the availability of cheaper ‘night-only’ tariffs increases, it may lead to New Zealand installing more conventional larger sized ESWH products which are similar to the size of products on the Australian market.
Solar and heat pump water heater trends

SWH sales have been increasing in New Zealand from a very low base, but have recently slowed. In 2011, sales of SWHs are still only equivalent to approximately 6% of sales of conventional ESWHs.

EECA’s ENERGYWISE™ program has provided SWH grants in various forms for eligible households since November 2006. Since 2008, the grants have been $500 or $1,000, depending on the related energy savings of the system installed. The program has recently ended, applying to eligible SWHs purchased up to 14 June 2012.

The same program also provided grants of $575 for eligible HPWHs purchased between 14 January 2011 and 14 June 2012.

While both grant schemes have recently ended, the information provision component of the ENERGYWISE™ program continues.

Promotion and government endorsement of SWHs and HPWHs through ENERGYWISE™ has contributed to creating a market for them in New Zealand.

Many new SWHs in New Zealand use storage tanks with a dual heating element design. The upper element in positioned in the top half or third of the tank and is continuously energised (thermostatically controlled). Generally, the supply of electricity to this element is based on a restricted tariff. The second element is positioned at the bottom of the tank and is recommended to be manually controlled for times of high hot water demand.
Energy consumption and greenhouse emissions characteristics

Energy consumption characteristics

The sources of energy consumption for ESWHs include electric resistive heating, operating a compressor and associated parts (HPWHs) and pumping (some SWHs and HPWHs). The energy consumption is in response to hot water demand and for reheating water from tank heat losses.

General

To reduce unnecessary energy consumption by ESWHs, the tank should typically have low thermal storage losses. At the current NZ-MEPS level, the thermal storage loss is generally about 20% of the average annual energy supplied by the water heater. Reduced energy consumption by SWHs may be achieved with improvements to insulation on these systems as they generally operate at higher temperatures than ESWHs. This is due to the water temperature in conventional ESWHs and HPWHs typically reaching 60-70°C while solar gain in SWHs may heat the water in excess of these temperatures. Reduced tank heat losses for SWHs would also allow increased retention of solar heated water over periods of insufficient solar gain.

Solar water heaters and heat pump water heaters

Currently a number of Australian manufactured storage tanks which are non-compliant with New Zealand MEPS are sold as part of packaged solar water heating systems in New Zealand. New Zealand data indicates that over 90% of imported tanks in the 180 to 400 litre range, the sizes that could be used for solar systems, currently meet New Zealand specific MEPS. Generally the industry has adopted the NZ manufactured tank once the modelled performance was known which suggests some appetite for improved energy consumption.

There has been considerable comment within the New Zealand solar water heating industry regarding the heat loss of thermosiphon tanks as these tanks are externally situated (on the roof) and therefore experience much lower ambient temperatures than split systems which generally have internally located storage tanks. At present thermosiphon tanks are not required to be MEPS compliant.

Tank heat losses affect HPWH operation disproportionately when the household has low hot water demand since the proportion of energy being lost through tank losses is relatively high. This results in previously heated hot water being reheated which decreases the overall efficiency of the heat pump performance while increasing ongoing costs to the consumer.

In order to determine the potential energy savings from introducing improvements in energy consumption of ESWHs it is necessary to quantify the current and forecast business as usual energy consumption. A model of the energy consumption of SWHs and HPWHs in Australia and New Zealand has been developed based on stock numbers and sales forecasts and the known energy consumption of products of the different types of technologies in the market.

Energy consumption

In order to develop estimates of current and future energy consumption by product and technology type several parameters were taken into account:

- the market share of different sizes of water heaters;
- the anticipated sales trends for different ESWH types;
- the impact on such trends of carbon pricing;
- the potential implementation of the policy to phase out of greenhouse intensive water heaters in Australia; and
- trends in the improvement of the energy efficiency of the different technologies.

The total energy consumption of conventional ESWHs of all types in Australia and New Zealand were also determined. The resulting forecasts of energy consumption are presented in Figure 5 and Figure 6.
The figures indicate a decline in energy consumption in Australia over the forecast period. The decline occurs more rapidly in the phase-out scenario due to the decrease in the proportion of stock that are conventional ESWHs and an increase in the proportion of stock of SWHs and HPWHs.

The decline in energy consumption also occurs in New Zealand but it not as pronounced. The lower decline in New Zealand is a reflection of the decline in the total numbers of conventional ESWHs of all types due to the uptake of gas products which are outside the scope of this product profile.
Figure 5: Total annual energy consumption of electric storage water heaters by technology

**Current regulatory settings**

**Phase Out**
Figure 6: Total annual energy consumption of electric storage water heaters

Current regulatory settings

Phase Out
Greenhouse gas emission characteristics

The greenhouse gas emission impacts of the water heaters was calculated from energy consumption data and the resulting emissions forecast for each technology type is illustrated in Figure 7. The chart shows a decline under current regulatory settings in the emissions associated with ESWH due to both the reduced installations of these types of water heaters and the change to less carbon-intensive electricity generation in Australia. Under the phase out scenario, there is a considerable decline in the emissions associated with ESWH from approximately 10,500 kt CO2-e p.a in 2011 to around 3,500 kt CO2-e p.a in 2025 and a more gradual increase in the emissions associated with SWHs and HPWHs from less than 1,000 kt CO2-e p.a in 2011 to approximately 3,000 kt CO2-e p.a in 2025 as more are installed. The difference between the greenhouse gas emissions of water heating in Australia and New Zealand is larger than the difference in energy consumption as New Zealand's electricity supply is less carbon-intensive due to a large proportion of renewable energy.
The total greenhouse emissions from both Australia and New Zealand from all forms of electric storage water heating are forecast to decline in both scenarios as shown in Figure 8. This trend largely reflects the decline in forecast energy consumption but expected changes in emission factors for electricity will have magnified the decline by around 20% by the year 2020.
Figure 8: Total annual greenhouse gas emissions of electric storage water heaters

Current regulatory settings

Phase Out

Legacy standards

The standards that are used in MEPS regulations usually consist of two parts, a test method, and a MEPS standard. These documents list the minimum energy efficiency requirements that products must meet to be sold in Australia and/or New Zealand.

When the joint AS/NZS 4692.1 testing Standard was introduced in 2005 it was decided to also continue to allow the use of the alternative test Standards then in use in Australia and New Zealand. This decision was made following manufacturers claims of difficulty in adapting to using the new testing standards in the time available and potential additional costs.

Currently to register conventional ESWHs in Australia, testing can be undertaken to the joint MEPS Standard, AS/NZS 4692.1:2005, or to the Australian 'legacy' Standards of AS 1056 or AS 1361. If registering products in New Zealand, the testing can be undertaken to AS/NZS 4692.1:2005, or the legacy Standards NZS 4602 or NZS 4606.1 as applicable. This means manufacturers and importers in both countries have had the option since 2005 of using alternative test methods instead of testing to one joint Standard AS/NZS 4692.1:2005.

The result is that the joint MEPS Standard AS/NZS 4692.2:2005 contains equations and tables that express the MEPS levels according to a variety of test standards. Consequently there are some differences in the heat loss allowances permitted for products being registered in Australia and New Zealand. The list of applicable standards is shown in Table 3.

Table 3: Australian and New Zealand electric storage water heater standards

<table>
<thead>
<tr>
<th>Test Standards</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1056.1</td>
<td>Storage Water Heaters- Part 1 General requirements</td>
</tr>
<tr>
<td>AS 1056.4</td>
<td>Storage Water Heaters- Part 4 Storage water heaters—Daily energy consumption calculations for electric types</td>
</tr>
<tr>
<td>AS 1361</td>
<td>Electric heat-exchange water heaters- For domestic applications</td>
</tr>
<tr>
<td>NZS 4606.1</td>
<td>Storage Water Heaters Part 1 – General Requirements</td>
</tr>
<tr>
<td>NZS 4602</td>
<td>Low pressure copper thermal storage electric water heaters</td>
</tr>
</tbody>
</table>

Other Key Standards

<table>
<thead>
<tr>
<th>Test Standards</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 4234</td>
<td>Solar water heaters—Domestic and heat pump—Calculation of energy consumption</td>
</tr>
<tr>
<td>AS/NZS 5125</td>
<td>Heat Pump Water Heaters</td>
</tr>
</tbody>
</table>
Comparison of the Minimum Energy Performance Standard levels

Minimum Energy Performance Standard exclusions

The joint Standard AS/NZS 4692.2 includes different MEPS requirements for Australia and New Zealand. Suppliers of conventional ESWHs are required to meet the relevant MEPS levels to register the heater in the different countries.

SWHs and HPWHs are provided an exclusion from the Australian and New Zealand MEPS standard (AS/NZS 4692.2) provided that they are able to meet specified hot water demand requirements. AS/NZS 4692.2 states that MEPS requirements do not apply to:

"Water heaters that use electric-resistive heating to provide less than 50% of the energy supplied in a typical year (e.g., heat pump and solar water heaters) when simulated to AS 4234 under Climate Zone 3 with an energy delivery of 22.5 MJ/day for an electric boosting heating unit and energization profile specified by the manufacturer."

This means that if an electric boosted SWH or HPWH can meet more than half of its energy contribution via a source other than electric resistance (shown through TRNSYS modelling), it is excluded from the requirements of MEPS. However, as TRNSYS modelling involves a number of physical tanks tests and key information to be provided by the manufacturer, which is difficult to verify, checking for compliance with this exemption is difficult and cannot be conducted in a completely independent manner.

Two other types of electric water heaters are also excluded from the MEPS requirements but are not being reviewed in this product profile. These are:

(1) Vented water heaters, with an attached feed tank that have a hot water delivery of less than 125 L; and

(2) Water heaters that are not intended for electric power grid connection (e.g., for use in vehicles and marine applications).

Hot water delivery and capacity

Comparing the Australian and New Zealand MEPS levels is complicated, in fact there are effectively three main different test methods which can be used to determine the thermal storage losses of most water heaters. These methods are discussed in Comparison of Minimum Energy Performance Standard test methods (page 39). These test methods are again the result of decisions made in 2005 to allow legacy test methods to remain. It should be noted that the joint test Standard AS/NZS 4692.1:2005 requires some refinement to create a fully harmonised requirement that would allow consistent and equitable comparison of MEPS.

To illustrate, Australian MEPS are referenced to rated hot water delivery, but New Zealand MEPS are referenced to nominal tank capacity. The nominal tank capacity is the volume of water that the tank holds, while the rated hot water delivery is the quantity of hot water that can be drawn off continuously at a specified flow rate without exceeding a specified temperature drop (12°C in AS/NZS 4692.1:2005).

In order to compare the MEPS requirements of the two nations, the New Zealand nominal capacity MEPS were converted to an estimated rated hot water delivery basis to allow comparison with the Australian MEPS. To do this, an investigation into the relationship of nominal tank capacity versus measured delivered hot water was undertaken for Australian and New Zealand tanks by the E3 Committee.

From this analysis, the average ratio of delivered hot water to nominal tank capacity was 85% for New Zealand tanks. This ratio was used to undertake the comparison of the MEPS levels in Tables 4 and 5. This process enabled the Australian and New Zealand MEPS requirements contained with levels under testing method AS/NZS 4692.1:2005 to be compared on a similar basis. The MEPS levels for vented and unvented conventional ESWHs are shown in Table 4 and Table 5. For the Australian unvented values an allowance for one temperature/pressure relief value has been made.

The comparison of the MEPS levels reveals that for most sizes of ESWHs the heat loss allowed by Australian MEPS was higher than that permitted by New Zealand MEPS. For all conventional ESWH delivering less than 400 litres, the New Zealand heat loss requirements are consistently more stringent than the Australian requirements. However, for ESWHs delivering 400 litres and above, the Australian heat loss requirements are more stringent than the New Zealand requirements.
Table 4: Comparison of Australian and New Zealand Minimum Energy Performance Standards: unvented water heaters

<table>
<thead>
<tr>
<th>Nominal capacity in NZ Table (litres)</th>
<th>Equivalent hot water delivery (litres)</th>
<th>Relevant Rated hot water delivery in Australian Table (litres)</th>
<th>Australia: Max Heat Loss (kWh/24h)</th>
<th>New Zealand: Max Heat Loss (kWh/24h)</th>
<th>NZ MEPS as a percent of Aust MEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS/NZS 4692.2, (Table A5)</td>
<td>Based on 0.85 ratio of HWD: Capacity</td>
<td>AS/NZS 4692.2, (Table A1)</td>
<td>AS/NZS 4692.2, (Table A1) + TPR</td>
<td>AS/NZS 4692.2, (Table A5) with TPR</td>
<td></td>
</tr>
<tr>
<td>23.8</td>
<td>20.2</td>
<td>&lt;=25</td>
<td>1.24</td>
<td>0.77</td>
<td>62%</td>
</tr>
<tr>
<td>47.6</td>
<td>40.5</td>
<td>40</td>
<td>1.38</td>
<td>0.97</td>
<td>70%</td>
</tr>
<tr>
<td>47.6</td>
<td>40.5</td>
<td>40</td>
<td>1.38</td>
<td>0.97</td>
<td>70%</td>
</tr>
<tr>
<td>59.5</td>
<td>50.6</td>
<td>50</td>
<td>1.45</td>
<td>1.07</td>
<td>74%</td>
</tr>
<tr>
<td>83.3</td>
<td>70.8</td>
<td>63</td>
<td>1.59</td>
<td>1.27</td>
<td>80%</td>
</tr>
<tr>
<td>100.0</td>
<td>85.0</td>
<td>80</td>
<td>1.73</td>
<td>1.37</td>
<td>79%</td>
</tr>
<tr>
<td>120.8</td>
<td>102.7</td>
<td>100</td>
<td>1.87</td>
<td>1.47</td>
<td>79%</td>
</tr>
<tr>
<td>162.5</td>
<td>138.1</td>
<td>125</td>
<td>2.01</td>
<td>1.66</td>
<td>83%</td>
</tr>
<tr>
<td>204.2</td>
<td>173.6</td>
<td>160</td>
<td>2.22</td>
<td>1.86</td>
<td>84%</td>
</tr>
<tr>
<td>245.8</td>
<td>208.9</td>
<td>200</td>
<td>2.43</td>
<td>2.06</td>
<td>85%</td>
</tr>
<tr>
<td>308.3</td>
<td>262.1</td>
<td>250</td>
<td>2.64</td>
<td>2.36</td>
<td>89%</td>
</tr>
<tr>
<td>370.8</td>
<td>315.2</td>
<td>315</td>
<td>2.92</td>
<td>2.65</td>
<td>91%</td>
</tr>
<tr>
<td>475.0</td>
<td>403.8</td>
<td>400</td>
<td>3.13</td>
<td>3.15</td>
<td>101%</td>
</tr>
<tr>
<td>600.0</td>
<td>510.0</td>
<td>500</td>
<td>3.41</td>
<td>3.74</td>
<td>110%</td>
</tr>
<tr>
<td>704.2</td>
<td>598.6</td>
<td>500</td>
<td>3.41</td>
<td>4.24</td>
<td>124%</td>
</tr>
</tbody>
</table>
Table 5: Comparison of Australian and New Zealand Minimum Energy Performance Standards: vented water heaters

<table>
<thead>
<tr>
<th>Nominal capacity in NZ Table (litres)</th>
<th>Equivalent hot water delivery (litres)</th>
<th>Relevant Rated hot water delivery in Australian Table (litres)</th>
<th>Australia: Max Heat Loss (kWh/24h)</th>
<th>New Zealand: Max Heat Loss (kWh/24h)</th>
<th>NZ MEPS as a percent of Aust MEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS/NZS 4692.2, (Table A5)</td>
<td>Based on 0.85 ratio of HWD: Capacity</td>
<td>AS/NZS 4692.2, (Table A1)</td>
<td>AS/NZS 4692.2, (Equation A1)</td>
<td>AS/NZS 4692.2, (Table A5) without TPR</td>
<td></td>
</tr>
<tr>
<td>23.8</td>
<td>20.2</td>
<td>&lt;=25</td>
<td>0.91</td>
<td>0.65</td>
<td>71%</td>
</tr>
<tr>
<td>47.6</td>
<td>40.5</td>
<td>40</td>
<td>1.19</td>
<td>0.85</td>
<td>71%</td>
</tr>
<tr>
<td>47.6</td>
<td>40.5</td>
<td>40</td>
<td>1.19</td>
<td>0.85</td>
<td>71%</td>
</tr>
<tr>
<td>59.5</td>
<td>50.6</td>
<td>50</td>
<td>1.30</td>
<td>0.95</td>
<td>73%</td>
</tr>
<tr>
<td>83.3</td>
<td>70.8</td>
<td>63</td>
<td>1.48</td>
<td>1.15</td>
<td>78%</td>
</tr>
<tr>
<td>100.0</td>
<td>85.0</td>
<td>80</td>
<td>1.59</td>
<td>1.25</td>
<td>78%</td>
</tr>
<tr>
<td>120.8</td>
<td>102.7</td>
<td>100</td>
<td>1.72</td>
<td>1.35</td>
<td>79%</td>
</tr>
<tr>
<td>162.5</td>
<td>138.1</td>
<td>125</td>
<td>1.93</td>
<td>1.54</td>
<td>80%</td>
</tr>
<tr>
<td>204.2</td>
<td>173.6</td>
<td>160</td>
<td>2.10</td>
<td>1.74</td>
<td>83%</td>
</tr>
<tr>
<td>245.8</td>
<td>208.9</td>
<td>200</td>
<td>2.26</td>
<td>1.94</td>
<td>86%</td>
</tr>
<tr>
<td>308.3</td>
<td>262.1</td>
<td>250</td>
<td>2.47</td>
<td>2.24</td>
<td>91%</td>
</tr>
<tr>
<td>370.8</td>
<td>315.2</td>
<td>315</td>
<td>2.66</td>
<td>2.53</td>
<td>95%</td>
</tr>
<tr>
<td>475.0</td>
<td>403.8</td>
<td>400</td>
<td>2.92</td>
<td>3.03</td>
<td>104%</td>
</tr>
<tr>
<td>600.0</td>
<td>510.0</td>
<td>500</td>
<td>3.20</td>
<td>3.62</td>
<td>113%</td>
</tr>
<tr>
<td>704.2</td>
<td>598.6</td>
<td>500</td>
<td>3.41</td>
<td>4.12</td>
<td>121%</td>
</tr>
</tbody>
</table>

Figure 9 and Figure 10 show the relationship of the MEPS levels of Australia and New Zealand plus the heat losses of a range of water heaters of different sizes registered for MEPS in the Australian and New Zealand market. The New Zealand MEPS and the nominal storage capacity of the New Zealand ESWHs were converted to equivalent hot water delivery based on a ratio of 0.85 hot water delivery to nominal capacity. The result is the heat losses of ESWH and their MEPS are plotted against their equivalent rated hot water delivery.
Figure 9: Australian & New Zealand Minimum Energy Performance Standards levels and registered water heaters heat losses: unvented water heaters

Note: models above the green line do not meet the NZ MEPS levels
The differences in MEPS levels for the Australian and New Zealand tanks in part reflects the thermal insulation typically used, the greater emphasis on restricted tariff heaters in Australia and the differences in determining tank capacity. In New Zealand conventional ESWHs generally have approximately 50 mm of polyurethane foam insulation. Australia typically uses 25 – 30 mm of polyurethane foam but this foam may not be distributed uniformly.

The emphasis of some Australian manufacturers is on selling products designed to operate on restricted tariffs, i.e., ESWHs only heated for a limited period at night. This may help explain why some manufacturers provide increased insulation thickness on the top of the tank at the expense of insulation at the bottom of the tank. This insulation spread allows good heat retention at the top of the tank which is likely to still contain hot water as the day progresses. The lower part of the tank is likely to be cold throughout the day due to reduced heating times.

Note that the MEPS requirements do not specify insulation types, thicknesses or location but rather focus on the overall heat losses.

An analysis of the claimed heat loss efficiency of the unvented Australian registered water heaters showed that 40% of the models would likely fail the New Zealand MEPS requirements. There are no vented Australian registered water heaters on the market.
Comparison of Minimum Energy Performance Standard test methods

There are now a number of testing standards used for the thermal loss of electrically heated water storage tanks including the joint Standard AS/NZS 4692.1:2005, and the legacy standards from both New Zealand and Australia. A comparison of the main features and requirements of the three main testing standards are shown in Table 6.

<table>
<thead>
<tr>
<th></th>
<th>AS 1056</th>
<th>NZ 4606</th>
<th>AS/NZS 4692</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temp – ambient air</strong></td>
<td>20°C</td>
<td>21°C – 32°C</td>
<td>20°C</td>
</tr>
<tr>
<td><strong>Variation in T ambient</strong></td>
<td>+/- 3°C</td>
<td>+/- 3°C, Tmax-Tmin &lt;3°C</td>
<td>+/- 3°C, Tmax-Tmin &lt;3°C</td>
</tr>
<tr>
<td><strong>Temp tank</strong></td>
<td>Max thermostat setting, or 75°C (whichever is greater).</td>
<td>55.6°C above Tamb</td>
<td>Max thermostat setting, or 75°C (whichever is greater).</td>
</tr>
<tr>
<td><strong>Variation in Temp tank</strong></td>
<td>+/- 3°C</td>
<td>Internal thermostat: &lt;100 L, +/- 4°C &gt;100 L, +/- 2.4°C Other controls; +/- 1.4°C</td>
<td>+/- 2°C</td>
</tr>
<tr>
<td><strong>Temp sensor position</strong></td>
<td>Single sensor located at centre of gravity of water heater.</td>
<td>2/3 of distance between element and top of tank, in tank centre.</td>
<td>6 sensors positioned in centre of tank, spread vertically at specified locations.</td>
</tr>
<tr>
<td><strong>Electric element</strong></td>
<td>Element supplied with tank.</td>
<td>&lt;100 L, 60W &gt;100 L, 300W</td>
<td>Element supplied with tank.</td>
</tr>
<tr>
<td><strong>Fittings required</strong></td>
<td>TPR, CWE valves to be installed and not lagged. Other ports plugged and lagged with 12.5 mm of felt.</td>
<td>All ports plugged with 25mm fibreglass blanket.</td>
<td>All fittings to be installed and hot / cold in/outlets and test equipment insulated.</td>
</tr>
<tr>
<td><strong>Data collection</strong></td>
<td>At least 24hrs to reach steady-state. kWh consumed taken at first thermostat cut-out after next 24 hours.</td>
<td>At least 24hrs to reach steady-state. 4 readings taken at approx. 24hr intervals, when thermostat temp is reached.</td>
<td>At least 24hrs to reach steady-state. kWh consumed taken at first thermostat cut-out after next 24 hours.</td>
</tr>
<tr>
<td><strong>Thermal stratification modifiers</strong></td>
<td>None</td>
<td>Allow for tank averaging where a raised element is used.</td>
<td>Modified element to be used for raised element tanks.</td>
</tr>
<tr>
<td><strong>Draw-off test</strong></td>
<td>Required. Volume delivered before Tout (5L) – Tout &gt;12°C.</td>
<td>Not required.</td>
<td>Required. Volume delivered before Tout (5L) – Tout &gt;12°C.</td>
</tr>
<tr>
<td><strong>Basis of maximum allowable heat-loss.</strong></td>
<td>kWh / 24hours for the rated hot water delivery of tank.</td>
<td>kWh/24 hours at the nominal volumetric capacity of the tank.</td>
<td>Aust: kWh / 24hours for the rated hot water delivery of tank. NZ: kWh/24 hours at the nominal volumetric capacity of the tank.</td>
</tr>
</tbody>
</table>

The methodology between the three test methods is similar with the greatest difference concerning the inclusion of valve/test apparatus components in the heat-loss test methodology. It is worth noting that the differences in the legacy testing approaches were considered when developing the joint Standard and the continued use of the legacy testing standards was not intended when the joint Standard was introduced.

To date industry stakeholder consultation has not indicated any significant problem with suppliers moving to solely using the testing method defined in the joint standard AS/NZS 4692. One New Zealand industry stakeholder considered that the AS/NZS 4692 testing procedure is more difficult to undertake than the NZ 4606 procedure but other New Zealand industry stakeholders expressed a willingness and interest in moving to the AS/NZS 4692 testing procedure. Australian stakeholders did not raise this issue.
**Thermal stratification and tank capacity measurement**

The joint testing Standard AS/NZS 4692 includes a difference between Australian and New Zealand methods for determining the capacity of the tank and these differences are incorporated in the Standards. The differences in the approach to capacity measurement encourage Australian designed tanks to effectively use thermal stratification. Thermal stratification refers to the development of relatively stable layers of water of different temperatures in the tanks with the hottest water layer at the top of the tank.

Australian water heaters are usually main pressure systems and many water heaters are only heated at night using significantly cheaper restricted electricity tariffs. For Australian water heaters, maintaining thermal stratification is important to ensure sufficiently hot water during the day and evening before reheating occurs.

Thermal stratification has been less of a concern for New Zealand tank designs. Historically New Zealand households have predominantly had low pressure hot water systems, with either a header tank or a pressure reducing valve. These systems inherently tend to provide good thermal stratification reducing the need for the delivery test to be incorporated into the Standard. In addition, the New Zealand tariff structure allows the use of smaller tanks that are reheated shortly after moderate hot water demand and so do not need to store hot water for long periods of time without reheating. However, with the trend in New Zealand towards mains pressure ESWHs and increased sales of SWHs which all typically use larger tanks, a hot water delivery test will become increasingly important.

**Summary**

The comparison of the Australian and New Zealand MEPS levels contained in the Joint Standard AS/NZS 4692.2 showed that the New Zealand MEPS for conventional ESWHs require a significantly lower level of heat loss (i.e., a more efficient tank) for heaters, up to and including 400 litres delivered hot water capacity. Only for tanks beyond 400 litres are the Australian MEPS levels lower (i.e., more stringent) than New Zealand. Consequently moving the MEPS levels for Australia for tanks up to 400 litres, so they matched the MEPS levels of New Zealand would raise the efficiency levels of the Australian heaters. After such changes were implemented, around 60% of the Australian models registered at present would be unaffected. Likewise requiring New Zealand tanks of above 400 litres capacity to match the Australian MEPS levels would raise the performance of these larger tanks.

There is a joint testing Standard, AS/NZS 4692.1:2005 that meets both Australian and New Zealand requirements but at the same time there are legacy Australian and New Zealand testing standards which the current standard AS/NZS 4692.2 permits to be used for testing. The use of these alternatives complicates the application of the current standard and is a barrier to the establishment of harmonised MEPS levels. There appears to be no significant barriers to moving all water heater testing to the joint testing Standard AS/NZS 4692.1:2005. This would simplify heater testing, and allow more accurate comparison of the tank heat loss characteristic of ESWHs.
Assessment of market barriers to improving efficiency

The following section summarises the range of issues that have been identified by stakeholder interviews and expert advice. These issues have been grouped as follows:

- Size of water heaters and impact of better insulation
- Split incentives
- Use of restricted tariff electricity
- Perceived efficiency of SWHs and HPWHs

These are discussed below.

Size of water heaters and impact of better insulation

Requiring better insulation around the hot water storage tanks will decrease their heat losses. There are various opportunities to reduce tank heat loss ranging from a basic increase in the thickness of existing insulation through to using insulation with better thermal qualities, changing the distribution of the insulation, reviewing the number of fittings to the tank and the insulation requirements for fittings as well as looking at the thermal qualities of the external tank covers or a combination of the above.

It is recognised that if manufacturers chose to achieve improved thermal qualities by increasing the thickness of the current insulation it would either increase the external dimensions of the water heater or reduce the volume of delivered hot water. Increasing the size significantly of small hot water heaters may affect some manufacturers that make such water heaters for ‘under-bench’ use in flats and apartments, however, initial investigation show that a range of sizes and dimensions are currently available on the market.

There are various consequences to the above options to reduce heat loss but as the range of heat loss identified in physical testing has shown (refer Figures 9 and 10) the thermal properties, especially of the poorer performing models, can be improved.

Reducing the heat losses of the ESWHs would save energy, result in lower ongoing costs to the consumer and reduce greenhouse gas emissions.

Analysis shows that it would be possible to increase the MEPS levels for Australia to those of New Zealand and this would only impact on around 40% of the registered models currently on the market. As the majority of heaters would be unaffected by this MEPS change, and the change will not lead to any particular size of heater not being available on the market, it seems likely that replacement units could still be sourced without the need to install water heaters that supplied less hot water.

In Australia the barriers to increasing the insulation of the tanks in SWHs or HPWHs will be low as these heaters are generally installed externally so size constraints are less of an issue. Therefore, sizing should not be a constraint to improving the efficiency of the tanks of these water heater types, noting again that reducing tank heat losses will reduce the ongoing cost of the heater for the consumer.

In New Zealand, the majority of conventional ESWHs are installed inside the home so adding more insulation to the water heaters may create problems in the replacement market if the size of ESWHs increased. Many solar systems are installed as retrofits, so again most of the tanks can be assumed to be internal and space constraints could be a restriction on increasing the insulation of the these systems. However, from stakeholder feedback it appears that the majority of SWHs use MEPS compliant water tanks, so introducing MEPS levels to match those of conventional ESWHs for SWHs would not be expected to affect the market significantly. HPWHs are generally installed externally so space constraints will be less of an issue.

Split incentives

The issue of “split incentive” occurs where the end-user of the product is not directly involved in the purchase of the water heater but they are likely to pay the ongoing energy costs. This occurs in the rental market (both
residential and commercial), where the building owner purchases the hot water heater and the tenant pays for the ongoing energy costs. This is also a characteristic of parts of the new home market where the building developer will choose the hot water heater and the house purchaser is not involved in the decision. The motivation of the builder can be to minimise the upfront building or water heater installation costs, rather than choosing a more energy efficient heater.

The result is that many buyers of ESWHs purchase the lowest cost heater they can, regardless of the ongoing operating costs of the ESWH. This creates a barrier to raising the efficiency of water heaters. This split incentives barrier applies to both the Australian and New Zealand markets.

**Use of restricted (off-peak) tariff electricity**

Restricted tariffs have provided low cost water heating for several decades in many states in Australia and New Zealand. The resulting impact is that there is less cost incentive for purchasers to install more efficient ESWHs. This reduces the market pressure to improve the energy efficiency of systems designed to run on cheaper, restricted tariffs.

**Perceived efficiency of solar and heat pump water heaters**

SWHs and HPWHs are presented to the market as low emission technologies that operate much more efficiently than conventional ESWHs. The supplying of government rebates and incentives to support the installation of these technologies also reinforces this image in the market. Consequently, consumer pressure to further improve the efficiency of SWHs and HPWHs could be low, creating a barrier to improving the efficiency of these products.

**Options to reduce market barriers**

**Minimum Energy Performance Standards**

MEPS are designed to remove poorly performing products, in terms of energy efficiency, from the market. By preventing the worst performing products from entering the market, MEPS creates a level playing field for suppliers and protects consumers from low efficiency products with higher running costs. MEPS have the effect of increasing the overall sales weighted average energy efficiency of products installed and hence decrease energy use compared to a business as usual scenario. MEPS regulations are a proven and highly effective method of improving the efficiency of products, assuming the market can supply the products which meet the MEPS and provide some certainty for suppliers regarding market requirements.

MEPS already exist for conventional ESWHs, but MEPS requirements are higher in New Zealand than Australia for heaters up to 400 litres of delivered hot water capacity, and higher in Australia than in New Zealand for ESWHs delivering over 400 litres of hot water. This suggests there is an opportunity for MEPS levels to be harmonised between the two countries at the highest relevant current MEPS levels. This would raise the MEPS levels in Australia to New Zealand levels for most conventional ESWHs and raise the MEPS levels in New Zealand to those of Australia for larger heaters. These changes would also prevent the importing of non-compliant ESWHs effectively streamlining compliance and allowing consumers to access comparable heat loss information.

**Public information campaign**

The impact of some of the identified market barriers could be minimised through an information campaign designed to educate consumers about the likely running costs of various hot water technologies and what consumers can do to minimise these costs.

The running costs for hot water systems are very dependent upon the hot water usage of households. Factual and accessible information on how to reduce hot water use (e.g., through the installation of low-flow shower heads) and the associated expected savings from these actions may help influence consumer behaviour. Additionally, if a household can be informed of their likely hot water demand, it will help ensure that they purchase an appropriately sized hot water system.

While consumers (and renters) may be aware that SWHs and HPWHs are designed to provide lower running costs, it is difficult to estimate the ‘lifetime savings’ or the ‘payback period’ for purchasing these systems when compared to a typically cheaper conventional ESWH. Some manufacturers may present this type of information but consumers might be more willing to accept the results if they came from an independent third party. Independent information on appropriate manual boosting for SWHs and the likely noise levels associated with HPWHs may
also help consumers who have not purchased these types of ESWHs previously feel more comfortable to choose these technologies.

**Energy rating label – voluntary or mandatory**

The use of an energy rating label as an information provision tool can assist with consumer education and decision making. In Australia, an industry designed label is applied to gas hot water systems but an energy ratings label under a government framework does not exist for ESWHs, SWHs and HPWHs in either Australia or New Zealand.

The suppliers of SWHs and HPWHs often quote different measures of performance in their literature to illustrate the savings or performance of their systems. Some suppliers use their coefficient of performance (a measurement of energy used compared to useful energy provided) at a particular temperature, STC eligibility or modelled energy savings to describe the performance of their models. An energy rating label could assist with the provision of standardised information on this critical performance measure, either by stating this information on the label and/or the E3 energy rating website (www.energyrating.gov.au).

Mandatory energy rating labels generally help create a consistent and comparative measure of the performance of certain appliance types. There could be several benefits to the use of an energy rating label for ESWHs, however the main issue that would need to be addressed is the comparison between different types of water heaters – particularly the large variation in energy performance between SWHs, HPWHs and conventional ESWHs. An energy rating label based solely on tank heat loss levels may be misleading for consumers who may interpret such ratings as being indicative of overall system performance. Additionally, as conducting annual energy consumption modelling using TRNSYS under AS 4234 cannot be conducted in a completely independent manner, there are no current tools upon which to base a clear and independent energy rating label.

If an energy ratings label was considered for ESWHs, the usefulness of the label for product marketing and consumer choice would need to be investigated, as traditionally the consumer does not view the hot water units in a retail store like other energy labelled electrical products. Energy rating labels are not highly effective at addressing the “split incentive” issue as consumers do not always participate in the purchase decision. However, the mandatory registration and use of comparative information on websites and product literature may assist with consumer decision making where they are involved in the purchase decision.

There are other potential benefits of an energy rating label for the ESWH, including the validity checking by the E3 check testing program, the provision of standardised information and increasing consumer awareness from the use of the established label.

In summary, the option of introducing mandatory labelling is not considered a priority as it is very difficult to have a consistent and comparative measure for different types of water heater, and there are no current tools upon which to base a clear and independent energy rating label. An energy rating label based solely on tank heat loss levels may be misleading for consumers.
Assessment of potential policy changes

Conventional ESWHs are a significant source of energy consumption and greenhouse gas emissions for households. Additionally, the expected market share of SWHs and HPWHs is projected to grow for both Australia and New Zealand. There are a number of areas where the energy efficiency of water heaters could be improved and three policy changes have been identified as potential priorities:

- Harmonisation of ESWH Standards (test methods and MEPS) between Australia and New Zealand;
- Removal of the ESWH tank heat loss MEPS exemption provided to SWHs and HPWHs; and
- Stronger tank heat loss limits for ESWHs.

Harmonisation of electric storage water heater Standards between Australia and New Zealand

Test methods

The joint MEPS Standard AS/NZS 4992.2 has an associated test Standard AS/NZS 4692.1:2005 but it also permits legacy Australian and New Zealand testing standards to be used. The existence and permitted use of these alternative legacy standards complicates the documentation of the current arrangements and is a barrier to the movement to joint MEPS levels between Australia and New Zealand. Further complicating the issue is the fact that the joint MEPS Standard AS/NZS 4692.2 has separate requirements for Australian and New Zealand ESWHs.

The original justification for the continued use of the two legacy standards was that testing facilities were not in a position to undertake the AS/NZS 4692.1 testing and manufacturers needed time to move to the joint Standard. However, seven years later this justification for the use of the legacy standards no longer applies. There appears to be no significant reason why all water heater testing should not move to the joint testing Standard, AS/NZS 4692.1:2005 and this would simplify testing and compliance through more transparent joint MEPS levels.

If harmonised MEPS levels were applied in Australia and New Zealand the choice of measure for applying the MEPS level (hot water delivery or nominal capacity) would need to be investigated. Moving to hot water delivery as the measure would be relatively straightforward as this measurement is a requirement of AS/NZS 4692.1 testing. However, if the nominal capacity was chosen as the appropriate measure for MEPS, then a minimum hot water delivery per capacity of tank may be required to ensure that adequate service levels are maintained. This issue would require greater investigation to determine the impacts in each country and the application for SWHs and HPWHs.

Minimum Energy Performance Standards

Australia is operating with MEPS levels for conventional ESWHs that are less stringent than New Zealand for heaters up to 400 litres delivered hot water capacity. Improving efficiency for these water heaters could assist to meet or exceed the New Zealand MEPS levels. At present, around 60% of conventional ESWHs registered in Australia would meet the more stringent heat loss requirements of the New Zealand MEPS levels. Data suggests that all sizes of conventional ESWHs which would meet the New Zealand MEPS can be produced. Purchase costs may rise slightly if more insulation and other changes are required to increase efficiency to New Zealand levels, but the increase would not be significant provided enough time is available to introduce these changes to manufacturing processes. Lower running costs to the consumers would also be a result of any increased MEPS requirements.

For heaters of 400 litres or more delivered hot water capacity, New Zealand is operating with MEPS levels for conventional ESWHs that are less stringent than Australia and so improving efficiency for these heaters could involve raising efficiency to meet or exceed the Australian MEPS levels. Currently, there are only eight models of conventional ESWHs of above 400 litres storage capacity registered in New Zealand and the efficiency of all these...
models exceed Australian MEPS levels. There would be no market impact from raising the New Zealand MEPS levels for the larger heaters to Australian MEPS levels.

**Removal of the tank heat loss Minimum Energy Performance Standard exemption provided to solar and heat pump water heaters**

Storage water tanks of SWHs and HPWHs are exempt from MEPS requirements as previously mentioned. Compliance testing undertaken as part of the E3 program suggest some Australian and New Zealand SWHs and HPWHs would not meet the heat loss requirements of the current MEPS, suggesting there is scope for improvement.

The New Zealand market example provides evidence that the efficiency of SWHs and HPWHs can be raised to the MEPS levels of conventional ESWHs. The majority of SWHs and HPWHs in New Zealand are sold with storage tanks that meet the more stringent New Zealand ESWH MEPS requirements. This suggests that neither technical nor financial barriers are likely to present significant additional barriers to raising the efficiency of SWHs and HPWHs in Australia.

There are additional inlets and outlets in the tanks of SWHs and HPWHs which can increase their heat losses, but these could be provided additional allowances similar to those already provided under the current MEPS framework (described in AS/NZS 4692.2).

TRNSYS modelling (under AS 4234:2008 conditions) of the impact of tightening the heat losses of storage water tanks in SWHs and HPWHs over the course of a year has been undertaken as part of this report. A range of scenarios were modelled with different system performance and climate zones in both Australian and New Zealand conditions. The impact of reducing the heat losses of a typical sized tank by approximately 20% increases the annual, ongoing energy savings by 0.5% to 1.5% p.a. depending on the system type and climate zone. This equates to possible savings in the order of 20 – 40 kWh p.a. for HPWHs and 35 – 75 kWh p.a. for SWHs. However, the modelling assumed that 50% of such storage tanks already meet the conventional ESWH tank heat loss limits, so the actual gains would vary by product. Factors such as the size, efficiency, climate zone, installation and water load profiles of the system, as well as the price of electricity would determine the actual ongoing savings to the household.

Additionally, New Zealand has a market for installing ‘solar-ready’ conventional ESWHs, where the heater is installed with the intention of adding the solar collectors later. However, there is a risk in this market from excluding the heating tanks of SWHs from MEPS as the excluded tanks could be installed and operated solely as conventional ESWHs. Suppliers of conventional ESWHs can be expected to support the introduction of MEPS for HPWHs and SWHs to avoid unfair competition from the ‘excluded’ tanks.

One of the original arguments for the exclusion of SWHs and HPWHs from the existing MEPS requirements was because the total system performance levels of these technologies were understood to be generally much more efficient than comparable conventional ESWHs. However, this conclusion was based on the performance of new systems, assumed to be properly installed and operating correctly. In practice, many systems are unlikely to be optimally installed, located, or orientated, and a poorly insulated tank would mean that the SWH or HPWH may need to operate more frequently to maintain tank water temperatures. Likewise, over time the solar and heat pump components of systems will operate less effectively which will increase the impact of the heat losses of the storage tanks. If the storage tanks were made MEPS compliant, then at least the minimum energy efficiency of the total systems should not fall below a MEPS compliant conventional electric ESWH of a similar age, even if the solar or heat pump components of the system are not operating optimally.

Additionally many consumers purchase these more expensive water heating technologies to minimise their energy use and electricity bills or to minimise their greenhouse gas emissions. As such, allowing these systems to use storage tanks with high levels of heat loss which require more energy to re-heat previously heated water is not in these consumers’ best interests.

**Stronger tank heat loss limits for electric storage water heaters**

The MEPS levels of Australian conventional ESWHs could be raised to above the requirements of the New Zealand MEPS levels, and stakeholder comment is sought as to the technical feasibility and costs of this option. As heat loss requirements are made more stringent, there is also a greater likelihood that the physical dimensions of future heaters would increase, which could be a problem where replacement heaters are concerned.
As in Australia, there may be diminishing returns for New Zealand from further raising MEPS levels, as the costs of obtaining marginal efficiency benefits could rise as the efficiency requirements are raised. Also, as a disconnect often exists between the end-user, the purchaser/installer and the supplier, it can be difficult for energy efficiency to be promoted. Some suppliers commented that there is poor enforcement of the existing regulations which should become an area of focus, rather than on tightening the current requirements.

More generally, many products that are subject to MEPS have these limits reviewed periodically to see if there is a potential to tighten the MEPS requirements. A key reason for this is to ensure that consumers are provided with efficient products and that the efficiency of products is increased over time as technology advancements or consumer preferences allow. While there may be some impacts to the upfront cost or size of ESWHs, it may still be in consumers’ interest to increase the stringency of MEPS in order to reduce the running costs of these appliances. Current and future increases in the cost of electricity are also likely to strengthen the case for more stringent ESWH MEPS.

Conclusions

ESWHs can be significant sources of energy consumption for consumers. Improving the efficiency of hot water appliances contributes to the objectives of the E3 program, the Australian National Hot Water Strategic Framework and the NZEECS. While conventional ESWHs have had to comply with MEPS in the form of maximum tank heat loss requirements since 1999 in Australia and 2002 in New Zealand, no changes have occurred since a revision in 2005.

The investigation undertaken as part of this product profile has found that there is a strong case for strengthening and harmonising the MEPS requirements for ESWHs.

Stakeholders are now asked to comment on a number of aspects in this document, particularly the market data and modelling assumptions, to assist with the formulation of preferred future policy options. As any proposed policy would benefit from additional modelling and analysis, it is unlikely that any change would take effect until late 2013.
9. References


BRANZ 2005, SR 141-Energy Use in New Zealand Households: Year 9 Analysis of HEEPS, 2005


NZS 1996, Statistics New Zealand - Housing (Census 96) - Table 27- 1996.

Product Profile:
Electric Storage Water Heaters
www.energyrating.gov.au