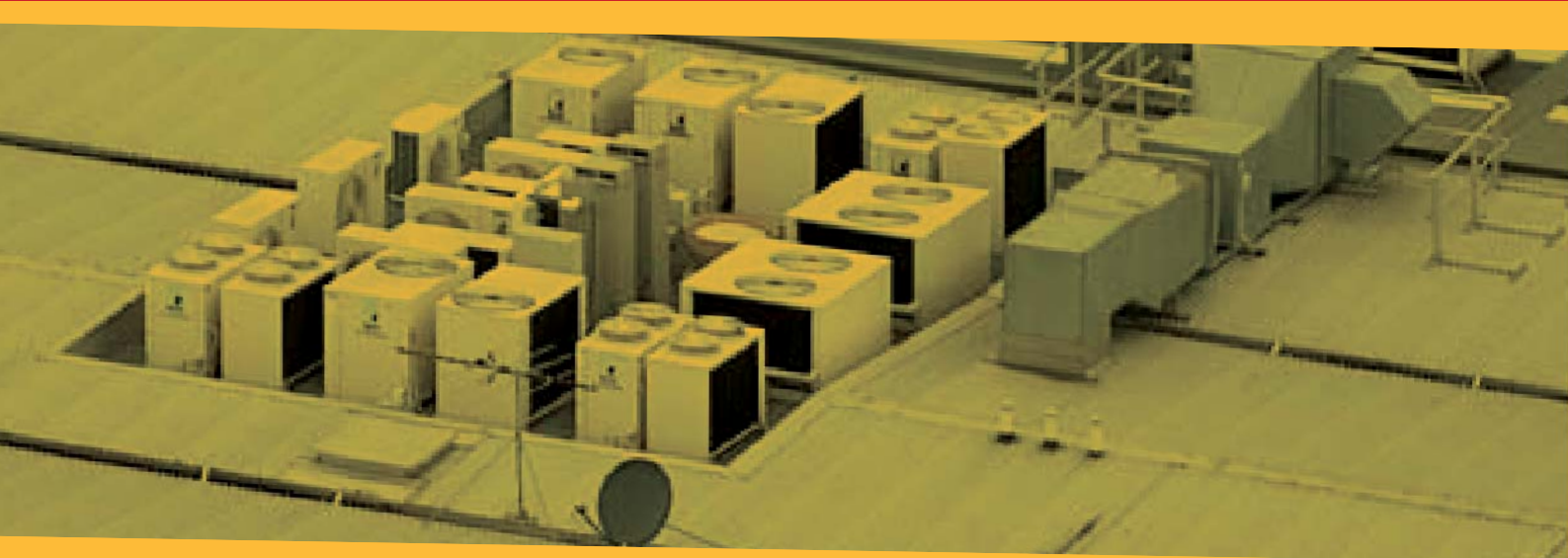




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**EQUIPMENT ENERGY EFFICIENCY**

## **Equipment Energy Efficiency Committee Decision Regulatory Impact Statement**

Air Conditioner MEPS and Energy Labelling



APRIL 2009

Prepared for the Department of the Environment, Water, Heritage and the Arts, Australia  
& the Energy Efficiency & Conservation Authority, New Zealand

Based on NAEEEEC Report 2008/09

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This Regulatory Impact Statement was prepared for the Department of the Environment, Water, Heritage and the Arts, representing the Equipment Energy Efficiency Committee (E3 Committee) under the Ministerial Council on Energy for the Australian federal, state and territory governments and the New Zealand Government.



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While this report was commissioned by government, any views expressed are those of the authors. While the authors have taken every care to accurately report and analyse the data, the authors are not responsible for the source data nor for any use or misuse of data or information provided in this report nor any loss arising from the use of this data.

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We have drawn on the following documents throughout this report:

- *Regulatory Impact Statement; Energy Labelling and Minimum Energy Performance Standards for Household Electrical Appliances in Australia (GWA, 1999a)*
- *Regulatory Impact Statement; Energy Labelling and Minimum Energy Performance Standards for Household Electrical Appliances in Australia – Supplementary Cost-Benefit Analysis on Transition to a Revised Energy Label (GWA, 1999b)*
- *Guide to Preparing Regulatory Impact Statements for the National Appliance and Equipment Energy Efficiency Program (NAEEEP) (GWA, 2005)*

## GLOSSARY

ABARE	Australian Bureau of Agricultural and Resource Economics
AGO	Australian Greenhouse Office (now DEWHA)
BAU	Business As Usual
COAG	Council of Australian Governments
COP	Coefficient of Performance for an air conditioner in heating mode (ratio of output to input in Watts/Watt)
CPI	Consumer Price Index (Australian Bureau of Statistics)
CPRS	Australian Carbon Pollution Reduction Scheme
DCC	Department of Climate Change
DEWHA	The Department of the Environment, Water, Heritage and the Arts
E2WG	Energy Efficiency Working Group
E3	Equipment Energy Efficiency Committee (federal-state-NZ)
EECA	Energy Efficiency and Conservation Authority of New Zealand
EER	Energy Efficiency Ratio for an air conditioner in cooling mode (ratio of output to input, also called cooling coefficient of performance)
EES	Energy Efficient Strategies (E3 consultants)
ETS	New Zealand Emissions Trading Scheme
GHG	Greenhouse gas(es), mass of CO <sub>2</sub> equivalent
GWA	George Wilkenfeld and Associates (E3 consultants)
GWh	GigaWatt hours (measure of energy = 10 <sup>9</sup> Wh)
IEA	International Energy Agency
kt	kilotonnes GHG (10 <sup>6</sup> tonnes) (equivalent of 10 <sup>12</sup> grams or 1 Gg)
kWh	Kilowatt hours (measure of energy = 10 <sup>3</sup> Wh = 3.6 MJ)
MCE	Ministerial Council on Energy (federal-state-NZ)
MEPS	Minimum Energy Performance Standards
MJ	Megajoule (measure of energy = 10 <sup>6</sup> Joules)
Mt	Megatonne GHG (10 <sup>6</sup> tonnes)
NAEEEC	National Appliance and Equipment Energy Efficiency Committee (now E3)
NAEEEP	National Appliance and Equipment Energy Efficiency Program (now E3 Program)
NFEE	National Framework on Energy Efficiency
NGS	National Greenhouse Strategy
NPV	Net Present Value of future values using specified discount rate
NZ	New Zealand
NZEECS	New Zealand Energy Efficiency Conservation Strategy
NZES	New Zealand Energy Strategy
OECD	Organisation for Economic Cooperation and Development
PJ	Petajoule (measure of energy = 10 <sup>15</sup> Joules, 1000 GWh = 3.6PJ)
RIS	Regulatory Impact Statement
SRI	Star Rating Index (decimal star rating value)
TTMRA	Trans Tasman Mutual Recognition Arrangement, part of the Closer Economic Relations (CER) agreement between Australia and NZ
UNFCCC	United Nations Framework Convention on Climate Change

## Executive Summary

This is a Decision Regulatory Impact Statement (RIS) which examines the impacts arising from a proposal to change the star rating algorithm for the energy labelling system and update the MEPS levels for air conditioners. It also proposes a number of new requirements as part of the regulatory scheme for these products. The proposed regulation is an element of the Equipment Energy Efficiency (E3) program, which is an initiative of the Ministerial Council on Energy (MCE). With increasing growth in the energy sector and associated greenhouse gas emissions, improvements in the energy efficiency of end uses of electricity is one very effective measure to ensure that energy consumption and emissions are stabilised or even reduced (Stern, 2006). Both Minimum Energy Performance Standards (MEPS) and Energy Labelling have been core to Australia's commitment to increasing appliance efficiency and reducing greenhouse gas emissions for over ten years.

Air conditioners are estimated to make up 6% of residential electricity consumption in Australia in 2005, which is set to increase to 9% in 2020 (for heating and cooling), as a result of increased ownership of these products, although this is tempered by growth in electricity consumption of other end uses. Similarly, the share of electricity consumption for air conditioners in NZ is estimated to be approximately 7% (primarily for heating) and this too is expected to increase in the future.

Energy labelling for air conditioners has been in place in Australia since 1987, with a revision of the energy label algorithm and label design undertaken in 2000. MEPS for air conditioners was implemented in 2001 for three phase units and 2004 for single phase units. These MEPS levels were made substantially more stringent in 2006 and 2007 through upgraded requirements. New Zealand made the MEPS scheme mandatory in 2002 for three phase units and 2004 for single phase units, and the energy labelling scheme mandatory in 2003.

While MEPS and labelling are not directly linked, any action regarding one will influence the other. Labelling has encouraged more efficient models onto the market and allows consumers to identify efficient models, while MEPS has removed the worst performing products. Increasingly stringent MEPS has resulted in a market whereby most products with lower star ratings under the 2000 algorithm have been eliminated, leaving star ratings bunched for air conditioners, predominately with a rating of between 3.5 and 5 stars. There are now a significant number of models that rate beyond the current maximum scale of 6 stars.

Studies have shown that more than 90% of consumers can recall the energy label unprompted, nearly 9 out of 10 consumers use the information on the energy label when buying an appliance and 75% say that the energy rating label is very important in the appliance purchasing process (Artcraft Research, 2006). The continuing impact of the energy rating label as a driver of increasing energy efficiency for the air conditioner market depends on several factors, including:

- A reasonable spread of star ratings on the market for all classes and capacities, so buyers are motivated to seek out more efficient options where available. With the rapid increase in average efficiency in 2004 and 2005 due to MEPS, most lower star rating products have been eliminated. The most common rating is now 4 stars. As consumers generally consider this a satisfactory rating, there is less motivation to seek out more efficient products. Paradoxically, the elimination of products with a lower star rating has also narrowed the range of technical efficiency for some product groups in the short term;
- Sufficient space at the top of the energy rating scale so that suppliers can exploit the commercial value of introducing more efficient products (allowing them to strive for higher star ratings which will remain available for a long period);
- A good match between energy consumption under test conditions and energy consumption under use conditions (at least in a comparative sense, if not absolutely in all cases); and
- That both suppliers and consumers have continued confidence in the integrity of the program.

One aim of this proposal is to implement an energy labelling proposal for air conditioners that is both technically sound and that will provide a solid basis for the rating of products in Australia and New Zealand over at least the next 5 years and more likely for as long as 10 or more years. Ultimately the proposal will have to be a compromise that maximises agreement between local manufacturers, importers, government and consumer groups as well as meeting the objectives of an algorithm revision with reasonable longevity that achieves the program objectives.

An equally important aim of this proposal is to introduce more stringent MEPS levels for a range of products, primarily affecting single phase air conditioners. MEPS has an impact on overall product efficiency by eliminating the lowest efficiency products from the market. MEPS is a very effective tool to drive the market and to address pockets of the market that may be unresponsive to the energy label message through market failures such as split incentives. Other aspects of energy consumption for air conditioners are also addressed such as power factor, demand response capability, standby power and crankcase heaters. MEPS for heating mode, which has not been previously regulated, is included in the proposal.

## The Proposal

The RIS considers a range of regulatory and other options to improve the energy efficiency and performance of air conditioners.

After consideration of the all the relevant factors, the recommended proposal is to undertake a revision to AS/NZS3823.2 to include the following elements:

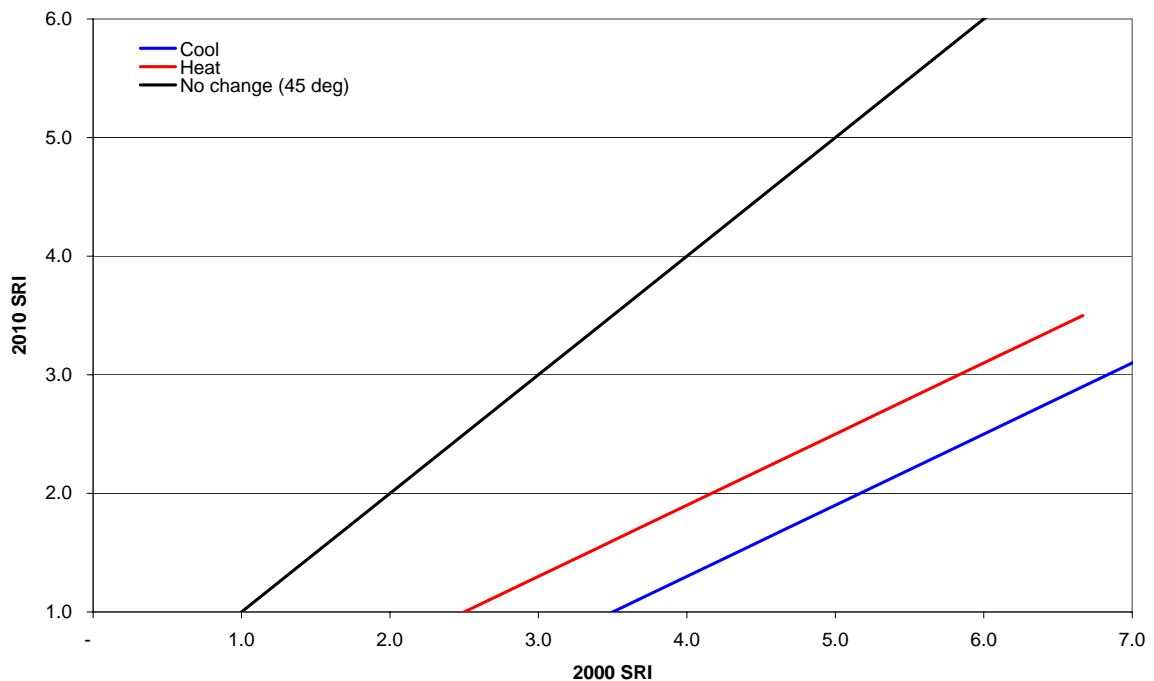
- more stringent MEPS levels for selected products for cooling mode;
- introducing MEPS levels for heating mode for the first time for all products with a heating function;

- measures that reduce standby power consumption and the energy used by crankcase heaters for air conditioners, by inclusion of this energy into the overall efficiency requirements of the products;
- a new energy labelling algorithm and energy label for air conditioners together with a refined energy label design; and
- new requirements for minimum power factor.

These are set out in more detail in the following sections.

The impact on the star rating of new products under the new energy labelling algorithm is set out below in Figure 1. For example, a product that current rates 2.5 stars for heating will rate 1 star under the new algorithm by 2010. Similarly, a product that rates 6 stars for cooling will rate 2.5 stars under the new algorithm by 2010.

**Figure 1: Air conditioners – Star Rating 2000 vs Star Rating 2010**



Also included is a section on incorporating demand response enabling devices (DREDs) into new air conditioners. Demand response will become an important means of reducing the impact of peak load on the electricity supply system created by the use of air conditioners on extreme weather days. While the inclusion of these devices in air conditioners is not a requirement under this proposal, the collection of Information on any demand response capability is proposed as part of the registration system for air conditioners. It is proposed that the revision of AS/NZS3823.2 include the following provision:

If an air conditioner complies with the requirements of AS4755.3.1, then:

- the absence or presence and level of demand response capability must be reported at the time of registration for energy labelling and MEPS;
- the level of capability *may* be indicated on the energy label by means of a marking regime; and
- if a level of capability is indicated on the energy label, an identical indication, in the same format, may be permanently stamped on the compliance plate.

### Analysis Options Considered

The current requirements for energy labelling and MEPS have been introduced progressively over the years. Each element of the current requirements has undergone a regulatory impact statement and has met the necessary requirements. Therefore, the option of removal of existing regulations has not been considered under this RIS. While such a proposal (removal of current regulations) has not been quantified, it is likely to result in a degradation in air conditioner efficiency.

A non regulatory rebate scheme was considered, although a detailed analysis was not conducted due to low overall cost effectiveness apparent in the initial analysis and the high capital cost.

A range of other program options to improve energy efficiency of air conditioners were considered. The analysis sets out detailed costs, energy and emissions for four main combinations of policies:

**Base Case:** MEPS 2007, label 2000 – this is the Business As Usual (BAU) case, with no changes for either the energy labelling algorithm or the current MEPS levels. This would see a slowing in efficiency gains for air conditioners as the effect of previous MEPS declines and products on the market become increasingly bunched towards the upper end of the star rating bands resulting in an increasing ineffectiveness of the energy label.

**Scenario A:** MEPS 2010 + label re-grade 2010 – in this scenario both energy labelling and MEPS levels get upgraded to new levels. This would see a strong increase in the efficiency of new air conditioners generated by both MEPS and labelling. It would promote higher base efficiency levels due to more stringent MEPS in the shorter term and also create a stronger pull for high efficiency product due to the re-grading of the star rating algorithm over the longer term.

**Scenario B:** MEPS 2010, label 2000 – in this scenario MEPS levels are being upgraded, while the labelling algorithm stays the same. This would see an increase in the efficiency of air conditioners due to the implementation of more stringent MEPS levels. However, the market pull from energy labelling in subsequent years would become very weak as the bunching of star ratings in the higher star bands becomes extreme.

**Scenario C:** MEPS 2007, label regrade 2010 – in this scenario the labelling algorithm is upgraded, while the MEPS levels stay the same (2007 levels). This would see an

increase in efficiency of air conditioners due to the increased market pull from the re-grade of the energy label algorithm. However, the overall effect increase in energy efficiency is relatively modest as there is no increase in MEPS levels.

**Transition**

They key regulatory dates in this proposal are 1 April 2010 and 1 April 2011 – by these dates all new products imported must comply with the relevant upgraded requirements. The follow stages have been identified in this transition process.

**Table 1: Transition Stages – Registration**<sup>1</sup>

		For obsolete registrations: none For models removed from sale during overlap period (1): none For models continuing on market after overlap period: MEPS/label re-registration and display transition costs (2)
		For models removed from sale during overlap period (1): none For models continuing on market after overlap period: MEPS/label re-registration and display transition costs (2)
		No additional costs
		No additional costs
		No additional costs

Notes:

<sup>1</sup> Refer to Section 2.6 for details of registration requirements for energy labelling and MEPS.

- 1) Overlap period (1 April 2009 – 30 September 2010): new registrations to old or new Part 2 accepted – new labels may show transition data. Registrations to new Part 2 must also meet all new requirements for MEPS, power factor, standby/crankcase heaters and demand response.
- 2) New label start date (1 October 2009): all new registrations must be to new Part 2 (AS/NZS3823.2-2009). Only products that carry an energy label will have display transition costs.
- 3) Display transition period (1 April 2009 – 1 April 2010): labels changed from ‘old’ to ‘new’ on showroom display models, or ‘new’ labelled models selected for display in preference to ‘old’ labelled models. Mixture of labels on display.
- 4) For models listed in New Zealand, there is no expiry date. Future requirements for 2012 may be considered in a subsequent RIS.

E3 has budgeted up to \$500,000 for retailer information and other targeted publicity for this ‘display transition’ program, the objective of which is that no labels should remain on showroom display after 1 April 2010. Clearly, suppliers and retailers will also bear some costs in printing, distributing and fixing over-sticking labels and in managing the showroom stock more carefully during the transition process.

**Costs and Benefits**

Supplier costs regarding registration and re-labelling are summarised in Table 2 below. All values reported for New Zealand are in Australian dollars in this RIS.

**Table 2: Total Costs per Element for Re-registering**


Note – New Zealand is part of the above analysis, as the figures come from total approved registrations.

The same supplier costs apply to all scenarios except the Business as Usual.

The supplier (including manufacturer, importer and retailer) costs are estimated at about \$0.5 million. Given the normal retail mark-ups, this implies a potential cost which could be passed on to appliance purchasers of over \$1.0 million. The total costs of the introduction of new labels would amount to about \$1.7 million, 60% of which would be passed onto consumers, the rest being government administration costs which are covered internally. This cost equates to about \$5.00 per appliance sold if spread over one year and \$0.50 per appliance sold if spread over 10 years (based on 2006 sales).

The analysis of benefits and costs has been completed from a consumer perspective. It has been assumed in the Business As Usual (BAU) analysis that there is slow improvement in energy efficiency after the introduction of MEPS 2006 and MEPS 2007, as these MEPS levels were stringent and there is now only a low incentive to further improve star ratings as many products already receive high star ratings. It has also been assumed for air conditioner types that there will be a 1% or greater improvement in efficiency per annum from 2007 to 2010, for Scenario A (algorithm change and MEPS level increase) over and above the Base Case. The improvement

in efficiency is reduced in the years 2010 to 2020 as only energy labelling is the only policy in force that continues to drive efficiency.

The following table outlines the BAU and Scenario A costs and benefits for Australian air conditioners.

The main Scenarios are defined as (noting that a wide range of other cases are also examined):

- BAU - Business as Usual case (no labelling algorithm change), using Base Case assumptions
- Scenario A – expected impacts of the proposal, using the Base Case assumptions. The Impact is the BAU Scenario minus Scenario A.

**Table 3: BAU vs Scenario A Costs and Benefits for Australian Air Conditioners by Year**

						\$0.0
						\$21.0
						\$23.3
						\$25.8

The below table outlines the cumulative costs and benefits for Australian air conditioners for the years 2005 to 2020.

**Table 4: Cumulative Costs and Benefits for Australian Air Conditioners – 2005 to 2020**

				NPV Purchase Cost (\$m)
				\$11,274
				\$11,406
				\$132

The table below summarises the cumulative costs and benefits for Australian air conditioners for the years 2005 to 2050. The analysis examines the impact on new appliances installed up to 2020. Appliances installed in 2020 will continue to have an impact on the stock energy consumption up to around 2048, hence the cumulative tables to 2050 give a more accurate overall program impact for the life of the products that are affected by the program.

**Table 5: Cumulative Costs and Benefits for Australian Air Conditioners – 2005 to 2050**

				NPV Purchase Cost (\$m)
				\$11,274
				\$11,406
				\$132

The following table outlines the BAU and Scenario A costs and benefits for New Zealand air conditioners. Note that most energy consumption for air conditioners in New Zealand is for heating. The New Zealand Government has stated that its preferred discount rate for assessment of program financial impacts is now 5.0%. The comparative discount rate is stated in the relevant tables.

**Table 6: BAU vs Scenario A Costs and Benefits for New Zealand Air Conditioners by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$1.8
						\$1.9
						\$2.1

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

The table below outlines the cumulative costs and benefits for New Zealand air conditioners for the years 2005 to 2020.

**Table 7: Cumulative Costs and Benefits for New Zealand Air Conditioners – 2005 to 2020**

				NPV Purchase Cost (\$m)
				\$1,188
				\$1,202
				\$14

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

The tables below outline the cumulative costs and benefits for New Zealand air conditioners for the years 2005 to 2050. The analysis examines the impact on new appliances installed up to 2020. Appliances installed in 2020 will continue to have an impact on the stock energy consumption up to around 2048, hence the cumulative tables to 2050 give a more accurate overall program impact.

**Table 8: Cumulative Costs and Benefits for New Zealand Air Conditioners – 2005 to 2050**

				NPV Purchase Cost (\$m)
				\$1,188
				\$1,202
				\$14

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

An analysis of actual price paid and the registered energy consumption on the energy label was conducted on more than 1600 models sold in Australia in 2006. Almost no correlation was found between the energy efficiency of air conditioners models and their price. Therefore, it could be suggested, based on this extensive market data and analysis, that the proposal will not intrinsically impact on product price if it is implemented within the bounds of the small efficiency changes that are expected to occur as a result of the energy labelling algorithm change and MEPS proposals. However, for the purposes of this cost-benefit analysis, it has been assumed that increasing efficiency of products above the BAU case will in fact result in some increased costs of appliances (over and above the BAU case). These assumptions are considered to be conservative in that increased appliance purchase costs are likely to be significantly overestimated for the analysis in this study.

The following tables outline the Net Present Value (NPV) benefits and costs of the Program for Australia and New Zealand.

**Table 9: Australia and New Zealand NPV Benefits and Costs of Program – Cumulative to 2050**

					2.9
					6.5
					7.4

Figure 2 below shows the Scenario A energy savings in GWh by year for air conditioners for Australia and New Zealand. It can be seen that there are steep increases in savings up to the year 2020 as new appliances installed, and after which these savings taper off to nothing by 2050 as the appliances are retired from the stock. Only appliances installed up to 2020 are considered in the program modelling and analysis, so overall savings decline after this date. Figure 3 and Figure 4 below show energy savings in GWh by year for air conditioners for Australia and New Zealand for Scenario B and C respectively.

Figure 2: Energy Savings in GWh by Year for Scenario A for Australia and New Zealand.

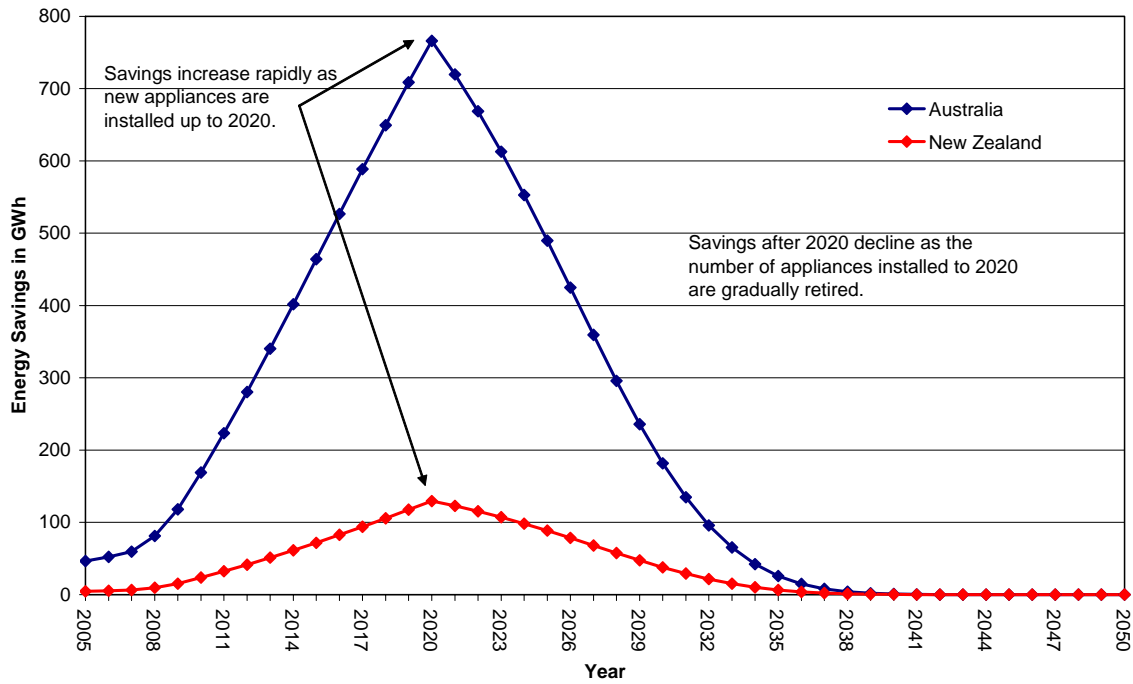
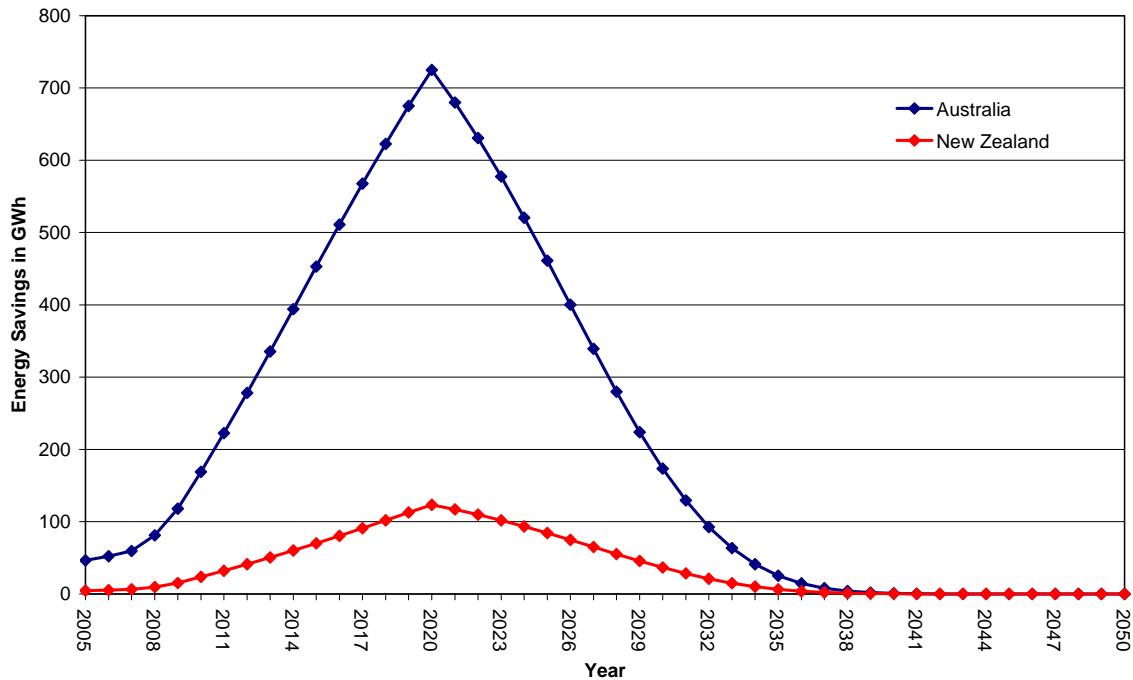


Figure 3: Energy Savings in GWh by Year for Scenario B for Australia and New Zealand



**Figure 4: Energy Savings in GWh by Year for Scenario C for Australia and New Zealand**

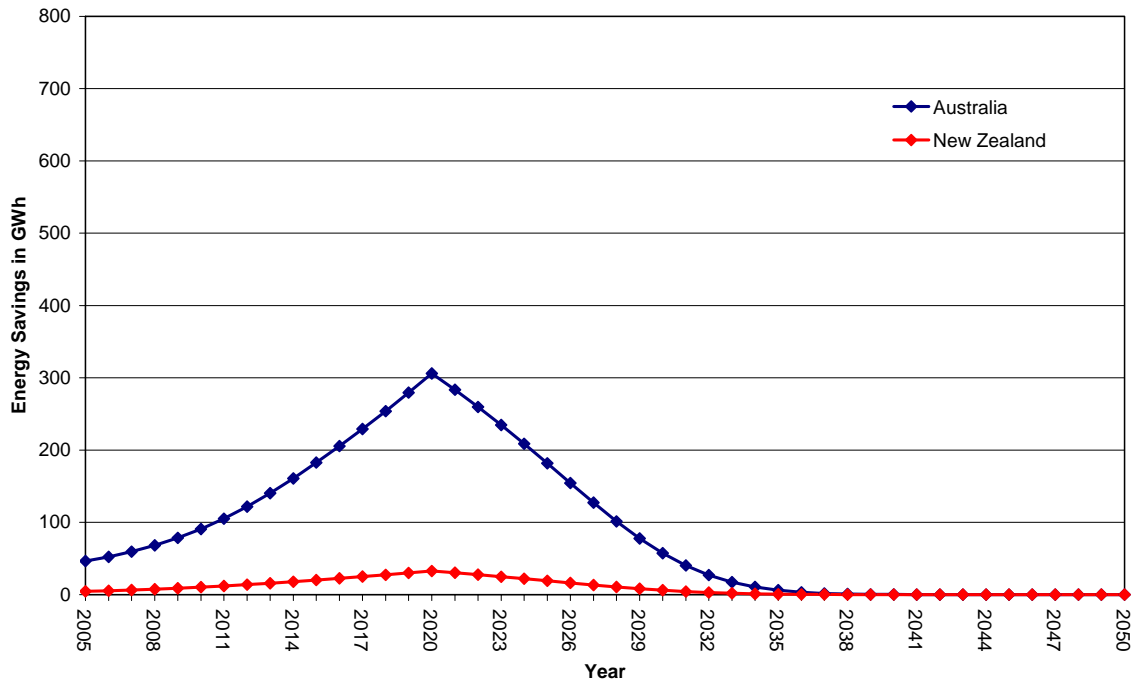


Table 10 below shows a summary of costs and benefits of the Scenario A, Scenario B and Scenario C.

**Table 10: Summary of NPV Benefits and Costs of Scenario A, Scenario B and Scenario C for Australia and New Zealand**

					B/C Ratio
					2.9
					3.0
					1.8
					7.4
					7.9
					3.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

While Scenario B has a slightly higher benefit cost ratio than Scenario A, Scenario A, which includes both energy labelling and MEPS, is recommended as it has a greater net benefit (but a lower benefit cost ratio) and also has other intangible and non-financial benefits associated with the integrity of the energy labelling program.

Under Scenario B, MEPS levels are being upgraded, while the labelling algorithm stays the same. This would see an increase in the efficiency of air conditioners mainly

due to the introduction of more stringent MEPS levels. In Scenario B the expected program impact is slightly reduced due to no label upgrade when compared to the Scenario A. Under Scenario B, the benefit cost ratio has increased slightly due to the lower program costs of avoiding a label change, but with very similar benefits. Scenario B does not solve the issue of bunching of the energy star ratings towards the more efficient end of the label, and therefore could not be said to increase or continue consumer purchase discretion. Scenario B effectively makes the energy labelling scheme ineffective and increasingly redundant over time and ultimately will mean that it is increasingly more difficult for consumers to use as a product selection tool. A consequence of Scenario B may eventually be a call to remove energy labelling because of its small ongoing impacts, which will remove consumer information and the ability to choose more efficient products. Therefore Scenario B could unintentionally undermining the effectiveness of labelling which may hasten its long term demise. Removal of energy labelling (consumer information to facilitate consumer choice) is not likely to have government or consumer support and could in fact have larger negative consequences in terms of energy consumption which have not been quantified in this RIS.

Under Scenario C, the labelling algorithm is upgraded, while the MEPS levels stay the same. This would see an increase in efficiency of air conditioners due to the evolution of market due to a re-grade of the energy label algorithm. The overall effect is small compared to the MEPS scenarios.

A wide range of parameters were examined to test the sensitivity and robustness of the proposed program measures. The tables below outline some of the most important results from the sensitivity analysis.

**Table 11: Scenario and Sensitivity Analysis**

	Purchase price impact of 60% greater than the Base Case
	Sliding scale shadow CO <sub>2</sub> cost 1
	Energy tariff increasing at 1% per annum in real terms

**Table 12: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 4 for Australia and New Zealand**

					2.9
					1.8
					7.4
					4.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

**Table 13: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 5 for Australia and New Zealand**

					2.9
					3.0
					7.4
					7.7

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

**Figure 5: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 7 for Australia and New Zealand**

					2.9
					3.3
					7.4
					8.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Under the expected possible range of sensitivities for each of the main input variables, the benefit cost ratio stays well above 1.0 for Australia and New Zealand, indicating that the program will result in overall benefits even under adverse market conditions and assumptions.

### Conclusions and Recommendations

A case for new MEPS levels and a change of algorithm for the energy star rating of air conditioners for the Australian and New Zealand market is set out in this regulatory impact statement. The need for these measures is widely acknowledged by stakeholders and supported by industry. MEPS levels and new performance requirements will drive increased energy efficiency and help resolve power factor, crankcase heater and demand response issues. With energy labelling, the market is tending towards a majority of products having star ratings that are bunched around the range of 4 to 6 stars. Market research demonstrates that consumers use the star rating labels in purchase decisions and that it also provides suppliers with a means to differentiate their product with a view to increasing market share. To enable the labelling program to continue to be an effective tool for all stakeholders, a change in the star rating algorithm is required.

Intensive modelling and analysis on the effects that these proposed changes would have on the air conditioner market and on product prices has been undertaken in this report. It was found there is only a weak correlation between product efficiency and price. Even with the worst case scenario of greatly increasing the consumer costs due to efficiency increases (above the levels derived from market analysis) (Sensitivity 4), the cost-benefit ratio for the proposal will still remain well above 1. This indicates that the analysis and modelling underpinning the MEPS levels and algorithm change and associated market effects is robust (in all likelihood only small price rises will result from the increases in energy efficiency that are expected as a result of this proposal as has occurred during the introduction of previous MEPS for air conditioners and other products). The cost-benefit ratio of the proposal is 2.9 for Australia and 7.4 for New Zealand under modelled Base Case conditions. In the current policy climate, scenarios with real increases in either energy tariffs or the introduction of some pricing structure for CO<sub>2</sub> are more likely; in both of these cases the cost-benefit ratio increases well above the Base Case. It should be noted that though Scenario B has a slightly higher cost-benefit ratio, this Scenario does not include a change to the star rating algorithm which could have a long term detrimental effect on the program.

The preferred proposal (Scenario A) would ensure that the energy labelling program continues to be an effective measure for both consumers and suppliers in the air conditioner market and that MEPS levels for Australian products continue to meet best practice. The introduction of the changes to the MEPS levels and other performance requirements have been bundled with the energy label change and star rating algorithm change into a single regulatory requirement in order to minimise costs to industry.

This report recommends:

- New energy labelling algorithms be implemented in AS/NZS3823.2-2009 for air conditioners as set out in this report. This will have associated with it a new label design, the details of which will be set out in a public comment version of AS/NZS3823.2;
- The introduction of more stringent MEPS levels for selected products for cooling mode;
- The introduction of MEPS levels for heating mode for all products with a heating function;
- Introduction of minimum requirements for power factor;
- Introduction of measures to reduce both standby power consumption and crankcase heater energy use by inclusion of this energy into the energy labelling and MEPS requirements into an annual efficiency requirement which will be used as the basis for both energy labelling and MEPS;
- Introduction of requirements to report the presence of DRED (demand response) capabilities in air conditioner units at the time of product registration with regulators and supplier have the option to indicate that products are demand response ready on the energy label;

- All products manufactured or imported after 1 April 2010 will be required to have a current approved registration/listing for this label (including compliance with new MEPS levels and the new energy label);
  - Transition arrangements over the period April 2009 to April 2010 as set out in this report be implemented;
  - All new registrations from October 2009 will required to meet all requirements of the revised Part 2 standard including the new energy label, MEPS and other performance requirements;
- A retailer communication package to be developed to ensure that new energy labels to appear on all new products on display as far as possible by April 2010.

### **Differences between Consultation RIS and Decision RIS.**

There are a number of differences between the Consultation RIS (E3 report 2008/09 on [www.energyrating.gov.au](http://www.energyrating.gov.au)) and this Decision RIS. These differences have been included as a result of intensive consultation with the air conditioner industry in order to provide more time for industry to adjust to these new technical requirements. The energy impacts of these changes are very small and have not been separately quantified. In summary, the main changes from the original Consultation RIS are:

- Inclusion of an interim MEPS level for 2010 based on operating EER/COP (which does not include non-operative energy);
- Delay in the introduction of MEPS based on annual EER/COP (which does include non-operative energy such as standby and crankcase heaters) from April 2010 to April 2011 (nominal levels are the same);
- A delay in the power factor requirements from April 2010 to April 2011 together with a technical clarification.

It should be noted that the energy labelling proposals are not affected.

# 1. Scope

## 1.1 General

This Decision Regulatory Impact Statement (RIS) has been prepared to help demonstrate the potential costs and benefits arising from revisions to energy labelling algorithms, and the introduction of more stringent Minimum Energy Performance Standards (MEPS) levels for air conditioners which are covered by existing regulations and within the scope of AS/NZS 3823.2. A number of new performance requirements for air conditioners are also proposed.

## 1.2 Australian and New Zealand Policy Responses to Global Warming

Australia's greenhouse abatement and climate change policies have evolved steadily since the release of the National Greenhouse Response Strategy in 1997. The paper received overall bipartisan support, including support for national energy efficiency measures. Appendix 6: Emissions Trading Schemes records some of the more important stages in that development.

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

In October 2008, the Council of Australian Governments (COAG) agreed to develop the National Strategy for Energy Efficiency, to accelerate energy efficiency efforts across all governments and to help households and businesses prepare for the introduction of the incoming Carbon Pollution Reduction Scheme (CPRS). Streamlined roles and responsibilities for energy efficiency policies and programs will be agreed in early 2009. The strategy will be implemented by June 2009, ensuring that programs assisting households and businesses to reduce their energy costs are in place before the CPRS is introduced.

Most recently, the CPRS White Paper, released in December 2008 stated on page 110 (Vol 2) that:

*"Energy efficiency is the final piece of the emissions reduction strategy. Energy use is the key driver of emissions growth in Australia. The Renewable Energy Target and Carbon Capture and Storage will reduce the emissions produced and released in generating energy, but there is also considerable scope to increase the efficiency of energy use. Using energy more efficiently can significantly reduce the cost of greenhouse gas abatement and ease the transition to a low-carbon economy"*

and

*“There are several impediments to the uptake of energy efficiency measures, including gaps in the information available to households and businesses to make informed decisions. By becoming more energy efficient, households can reduce the cost impacts of the Scheme. Prior to the commencement of the Scheme, the Government will deliver household energy efficiency initiatives building on existing programs to help households do their bit to tackle climate change and reduce energy bills”.*

### **1.2.1 New Zealand's Response to Climate Change**

New Zealand climate change policies have a similar history of long-term support by government. New Zealand ratified the Kyoto Protocol in 2002, and has committed to reducing its greenhouse gas emissions back to 1990 levels, on average, over the period 2008 to 2012 (or to take responsibility for any emissions above this level if it cannot meet this target).

Energy efficiency is one of a range of policy platforms designed to reduce greenhouse gas emissions, consistent with meeting New Zealand's commitments under the Kyoto Protocol. Furthermore, the implementation of an emissions trading scheme is a key feature of New Zealand's climate change policy response package. The consequent price to be put on greenhouse gas emissions is expected to make the purchase and use of energy efficient appliances and products more cost-effective, and helps justify governmental actions under the E3 programme.

In 2007 the New Zealand Energy Strategy (NZES) vision committed the country to implement “a reliable and resilient system delivering New Zealand sustainable, low emissions energy services”. To do so the government committed to a range of actions, including “maximizing the contribution of cost-effective energy efficiency and conservation of energy” and “promoting the early adoption of environmentally sustainable energy technologies”.

In October 2007 the New Zealand Minister of Energy released the New Zealand Energy Efficiency and Conservation Strategy (NZECS), an action plan to maximise energy efficiency, energy conservation and the use of renewable sources of energy. The NZECS is a key part of the government's response to meeting its energy, climate change, sustainability and economic transformation goals. It has been written as a companion document to, and will give effect to a number of the objectives set out in, the NZES. It includes measures to reduce electricity demand, address energy use in transport, buildings and industry, and promote greater consideration of sustainable energy in the development of land, settlements and energy production. The strategy is available at <http://www.eeca.govt.nz/eeca-library/eeca-reports/neecs/report/nzeecs-07.pdf>.

The New Zealand Energy Efficiency and Conservation Strategy includes a focus on better products as part of a range of initiatives to improve end-use energy efficiency in the residential, commercial and industrial sectors. Using energy more efficiently in products and appliances reduces greenhouse gas emissions and cuts energy costs,

including the need to provide more costly electricity generation capacity. It also reduces network congestion, makes the system more secure and makes it easier for New Zealand to increase the proportion of electricity supplied from renewable sources.

The introduction of MEPS and labelling for household appliances continues to form part of New Zealand's climate change strategy, as part of implementing the NZEECS.

### 1.2.2 *The MCE Moves Beyond 'No Regrets' Energy Efficiency Measures*

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

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

### 1.2.3 *IEA Sees Improving Energy Efficiency as Top Priority*

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

*"The IEA estimates that under current policies, global emissions will increase 50% by 2030 and more than double by 2050. However, if we act now, this unsustainable and dangerous pattern can be curbed. IEA findings show that emissions could be returned to current levels by 2050 and even reduced thereafter, while an ever growing demand for energy services, notably in developing countries, can be fully satisfied. Improving energy efficiency in the major consuming sector – buildings and appliances, transport and industry – must be top priority. While alleviating the threat of climate change, this would also improve energy security and have benefits for economic growth."* – Claude Mandil, Executive Director, International Energy Agency (IEA), Paris, February 2007.

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

#### 1.2.4 *Equipment Energy Efficiency Program*

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

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

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

The broad policy mandate of E3 has been regularly reviewed over the last decade and was most recently refreshed in 2004. Not only is any energy using equipment type potentially included in resulting work plans for possible regulation but air conditioners were specifically nominated for regulatory impact assessment.

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

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

## 2. The Problem

### 2.1 Energy and Greenhouse Gas Emissions

Climate change is a serious global challenge, requiring an effective global response (IPCC 2007). There are now strong community concerns regarding the threats posed by global warming, and governments are responding with a wide range of programs to reduce greenhouse emissions.

The United National Framework Convention on Climate Change (UNFCCC) was agreed in 1992 and came into force in 1994. It places much of the responsibility for taking action to limit greenhouse gas emissions on the developed countries which are collectively referred to as Annex 1 countries, including Australia and New Zealand. Annex 1 countries are required to report each year on the total quantity of their greenhouse gas emissions and on the actions they are taking to limit those emissions.

On 11 March 2008, Australia's ratification of the Kyoto Protocol was officially recognised by the UNFCCC. Under Kyoto, Australia is obliged to limit its greenhouse gas emissions in 2008-2012 to 108 percent of 1990 emission levels

Similarly, New Zealand ratified the Kyoto Protocol on 19 December 2002, and has committed to reducing its greenhouse gas emissions back to 1990 levels, over the same time period or to take responsibility for any emissions above this level if it cannot meet this target.

The introduction of minimum energy performance standards for inefficient energy consuming equipment continues to form part of Australia's and New Zealand's climate change strategies is described in Section 1.2.

Table 14 below shows the Australian greenhouse gas emissions by sector for 2005 from the *National Greenhouse Gas Inventory 2005*. It can be seen that although there are obvious changes in the sectors where emissions have increased or reduced, the net emissions for Australia in 2005 of 559.1 million tonnes of CO<sub>2</sub>-e has increased by 2.2% when compared to 1990 figures.

The generation of electricity makes the greatest contribution to Australia's emissions and has seen by far the largest increase in emissions (over a half increase in emissions for 2005 compared to 1990). Electricity generation accounted for 194.3 Mt CO<sub>2</sub>-e or 34.7% of national emissions and 69.5% of stationary energy emissions in 2005. Electricity generation emissions increased by 0.7 Mt CO<sub>2</sub>-e (0.4%) from 2004 to 2005, and by 64.8 Mt CO<sub>2</sub>-e (50.1%) from 1990 to 2005.

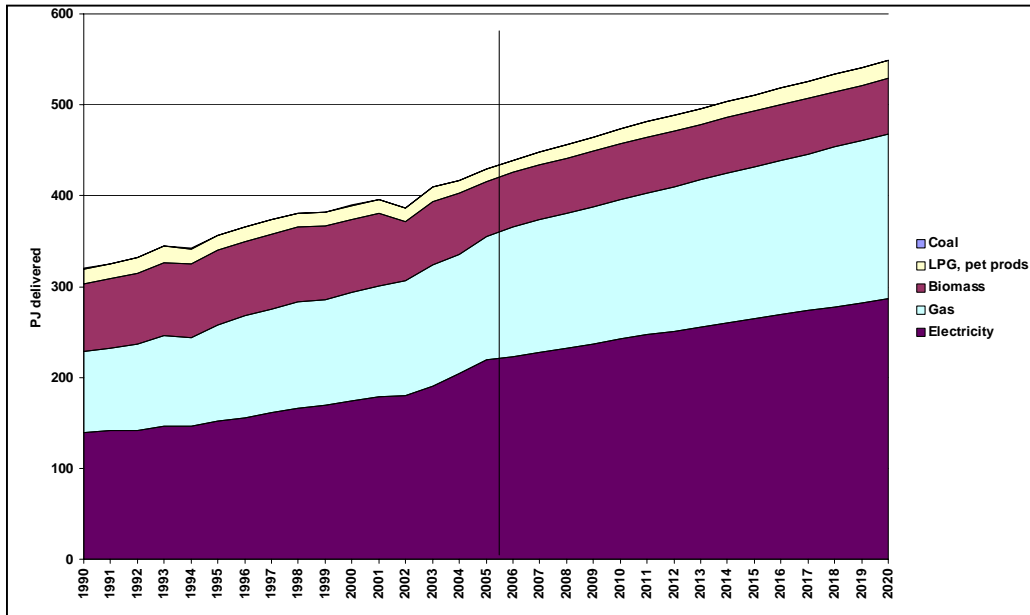
**Table 14: National Greenhouse Gas Inventory 2005**

					<b>90-05</b>
					<b>36.3%</b>
					<b>42.6%</b>
					<b>50.2%</b>
					<b>30.0%</b>
					<b>7.3%</b>
					<b>16.5%</b>
					<b>0.2%</b>
					<b>-5.8%</b>
					<b>18.4%</b>
					<b>-6.9%</b>
					<b>-73.9%</b>
					<b>-100.0%</b>
					<b>-58.7%</b>
					<b>2.2%</b>

(Australian Greenhouse Office, 2007)

Figure 6 shows the Australian Bureau of Agricultural Resources Economics (ABARE) projections for residential electricity consumption to 2020, which indicate an average growth rate of 1.8% per annum. This growth will result in increased greenhouse gas (GHG) emissions, although the amount of future emissions will depend on electricity generation sources. Electricity use in the residential sector is projected to account for around 23% of the increase in total electricity use over the period to 2030 (ABARE 2006). Slowing, and ultimately reversing, the growth in electricity related emissions is a high priority in Australia’s greenhouse gas reduction strategy.

Figure 6: ABARE Residential Electricity Consumption, Historical and Projected

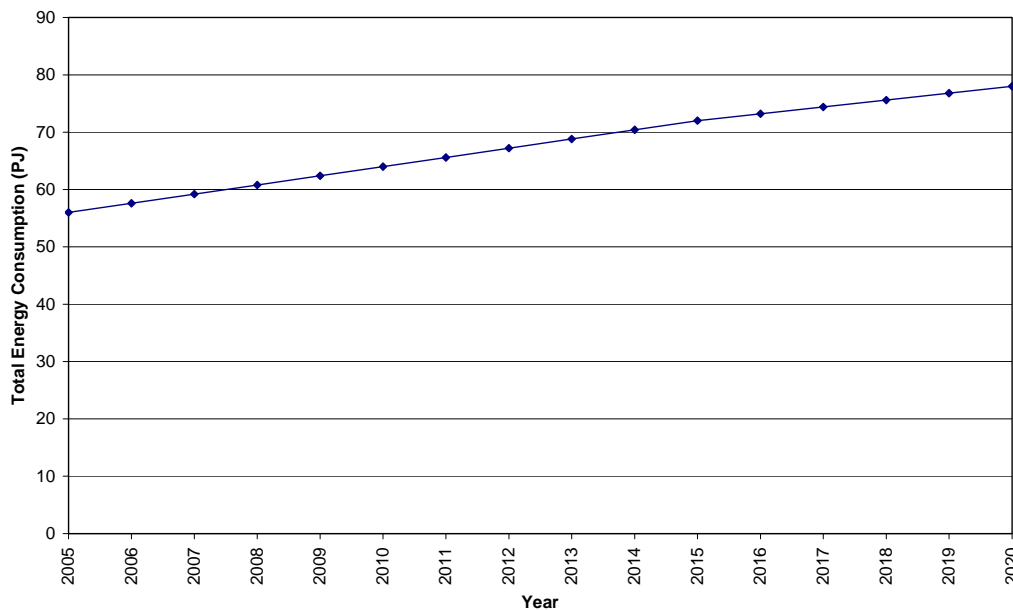


Source: ABARE 2006

In New Zealand, thermal electricity generation accounted for 24.5% of CO<sub>2</sub> emissions from the energy sector in 2005. In 2005, emissions from this source increased significantly by 35.2% compared with 2004 due to increased consumption of coal. In total, thermal electricity generation produced almost 8 Mt CO<sub>2</sub>-e in 2005. Total greenhouse gas emissions from the energy sector is projected to grow by about 30% between 2005 and 2030 (MED NZ 2006).

Projected total energy consumption for the residential sector from 2005 to 2020 has been provided by EECA. This is shown in Figure 7 below.

Figure 7: Projected Total Residential Energy Consumption for New Zealand



Increasing efficiency in each of the major end uses of electricity is one very effective measure to ensure that growth in energy consumption is stabilised or reduced and that any associated emissions are also kept in check. The Stern Report, prepared for the UK government, notes that technical potential for efficiency improvements to reduce emissions and costs is substantial (Stern, 2006). Studies by the International Energy Agency show that, by 2050, energy efficiency has the potential to be the biggest single source of emissions savings in the energy sector (IEA, 2006).

Australia’s main policy instrument for greater increasing the energy efficiency of appliances is the Commonwealth-State Equipment Energy Efficiency Program (E3), which continues and enhances Energy Labelling and Minimum Energy Performance Standards (MEPS) policies first implemented in 1986.

## 2.2 Contribution of Air Conditioners to National Energy Use and Emissions - Australia

Table 15 below shows the electricity consumption share of air conditioners in Australia. It can be seen that over the course of time, that the absolute electricity consumption of air conditioners is expected to increase rapidly as a result of rapidly increasing ownership and larger house sizes. While MEPS and energy labelling programs are having an impact in the reduction of energy compared to a scenario without these program measures, there is still a large net increase in total air conditioner energy consumption. The share of electricity consumption is also expected to increase. As electricity as an energy source generally has a high greenhouse emission intensity, the increased energy consumption of air conditioners translates in to a large increase in associated greenhouse gas emissions.

**Table 15: Projected Air Conditioner Share of Household Electricity Consumption – Australia**

			Air Conditioner Share (%)
			6%
			7%
			7%
			7%
			7%
			8%
			8%
			8%
			8%
			8%
			8%
			8%

			Air Conditioner Share (%)
			8%
			9%
			9%
			9%

Source: Air conditioner figures from EES stock model estimates for BAU case. Residential Electricity Consumption Projections from ABARE 2006. Electricity consumption includes both cooling and heating where applicable.

Table 16 below shows the estimated air conditioner emissions for Australia. It can be seen that like electricity consumption, emissions are estimated to be increasing over time despite the impacts of MEPS and energy labelling programs.

**Table 16: Air Conditioner Emission Estimates – Australia**

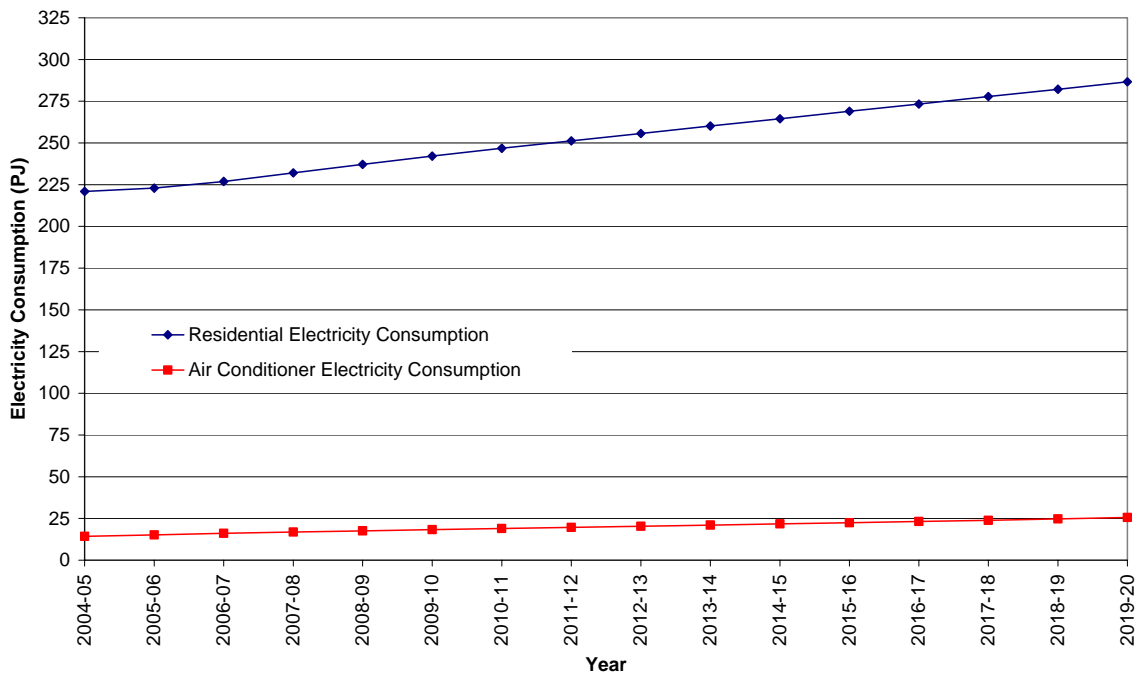
	Air Conditioner Emissions - kt
	3819
	4033
	4212
	4371
	4511
	4615
	4708
	4795
	4878
	4957
	5033
	5085
	5134
	5182
	5228
	5270

EES estimates using emission factors in Section 6.10, BAU case, residential sector only.

Figure 8 below shows the EES Baseline projections for residential electricity from 2004 to 2020 (EES 2008). It can be seen that residential electricity consumption is projected to steadily increase, from about 220 PJ in 2005 to 290 PJ in 2020. The stock model estimates for the BAU case for air conditioner electricity consumption are also shown. Air conditioner electricity use is projected to increase rapidly primarily due to rapid increases in ownership but also due to increases in average house size. An additional concern is that air conditioners contribute greatly to summer peak load issues, but this issue is not covered by this RIS. Therefore further (unquantified) benefits in addition to those included in this RIS are likely to arise from the energy saving measures proposed.

For New Zealand, electricity consumption of air conditioners amounted to about 3.0 PJ, which is about 7% of total electricity consumption for NZ. Data for New Zealand is sparse and estimates have some uncertainties attached to them. For the purposes of modelling in this RIS, it has been assumed that estimates for Tasmania provide a reasonable indication of energy trends in New Zealand as both have similar climatic factors, product ownership and household makeup.

**Figure 8: ABARE Projections for Residential Electricity Consumption - Australia**



Source: ABARE, 2006 and EES stock model estimates, BAU case

### 2.2.1 *Interaction of an Carbon Pollution Reduction Scheme and MEPS Regulations*

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

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

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

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

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

Further, there is strong evidence to suggest that householders in general are overly sensitive to capital costs and tend to ignore ongoing operating costs (effectively making decisions with a very high discount rate of 20% to 50% in some cases) (Goldstein & Hogarth 1997, Conner & Lucas 1994, Revelt & Train 1997). However, such behaviour does not explain the market behaviour of many air conditioner purchasers – in virtually all categories of products, sales data shows that very low cost products with high efficiency attributes are available. There is only a weak correlation between efficiency and price for most product types. However, given the high internal discount rates used by many consumers, electricity tariffs would have to increase by 100% or 200% to be effective in forcing the purchase of high efficiency air conditioners under these conditions. This is much higher than the possible tariff increases of 12% to 25% under the base case for the CPRS by 2020 (ACIL Tasman, 2008).

These factors, along with the market failures and information failure described in the following sections, outline why there are large potential energy efficiency savings in the market which are available at negative cost. The only effective way to deal with a substantial part of the market that continues to make sub-optimal economic decisions regarding the efficiency of air conditioner products is to introduce regulatory requirements (such as those set out in this proposal) which effectively minimises the ability of consumers to select a product with poor efficiency – Minimum Energy Performance Standards.

Complementary measures such as MEPS, which reduce energy consumption at negative cost, will in fact contribute to reducing the total economic cost of energy supply and will help to reduce the future price of carbon required to meet a specified cap under a CPRS. Therefore MEPS, and other regulatory programs that reduce energy consumption, will help minimise the future economic impact of a CPRS by reducing the market price of carbon at a lower rate than it would have otherwise been. Also, future damping of the cost of carbon can in fact help to reduce the cost associated with structural adjustments in the economy towards a low carbon future. In fact an increase in the diversity of complimentary measures to reduce energy consumption at least cost (whether regulatory or market based) will mean that the overall energy market is optimised as far as is possible.

Elimination of complimentary measures to reduce energy consumption, leaving reliance only on the CPRS to optimise market costs, will mean much higher (and possibly more volatile) future carbon and the associated damage to the economy.

### 2.3 Ownership and Stock

The ownership of air conditioners in Australia and New Zealand has been increasing rapidly. Between 1994 and 2005, the average number of air conditioners in Australia per household increased from 0.34 to 0.76, which is more than double in 11 years. This is equivalent to an annual growth of 8.3%. It is also worth noting that the number of households with multiple air conditioners has also been increasing steadily over the same period.

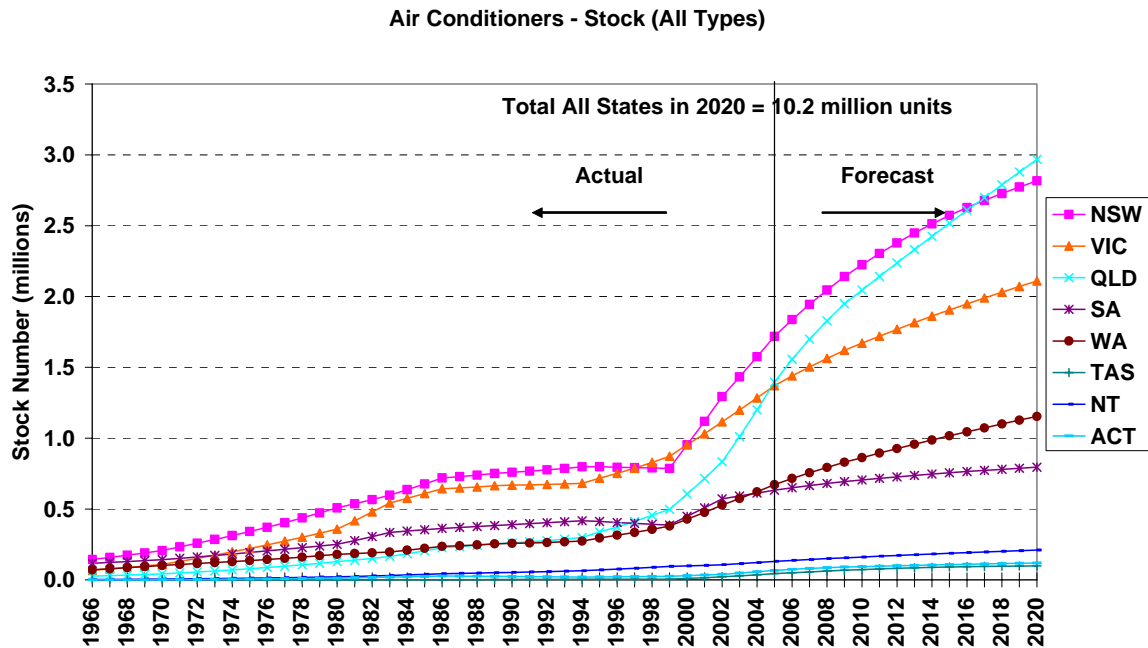
**Table 17: Ownership of Air Conditioners**

% of Households with Air Conditioners		
	1999	2005
1 Air Conditioner	81.8%	78.3%
2 Air Conditioners	13.6%	15.2%
3 or more Air Conditioners	4.6%	6.5%
Total	100%	100%
Ownership	0.43	0.76

Source: ABS 4602.0, March 2005: assumes '3 or more' = 3

The stock of air conditioners in Australia by state is illustrated in Figure 9 below.

Figure 9: Stock of Air Conditioners for Australia – All Types



Note that forecasts are based on a trend analysis of historical data to 2005 as well as market and sales trends over the past 10 years. They are based on the best available data and the same future trend in ownership has been used for all scenarios modelled in this RIS.

Ownership data for New Zealand is much less complete than for Australia. Although there appears to be low penetration and ownership at the moment, the sales data from New Zealand suggests that this is increasing at a rapid rate. Due to this lack of trend data available for NZ, it has been assumed that ownership trends and energy consumption for heating and cooling in NZ will be comparable to those in Tasmania for the analysis period. Both markets have comparable climate and market structure (dominated by sale of reverse cycle split systems) and the gas distribution system is limited in both markets. New Zealand energy estimates have been estimated using data on sales in both markets together with data on household numbers.

## 2.4 Technology and Energy Efficiency

### 2.4.1 Australian Data

For this Regulatory Impact Statement several sources of data have been used in order to estimate the total market structure, size and characteristics of air conditioners.

Since 2003, the Australian air conditioner market has been systematically monitored using sales data collected by GfK (a market research company). GfK air conditioner sales data for the calendar years 2003 to 2006 inclusive, obtained in April 2007, has been analysed and referenced throughout this report. The data provides brand and model information together with average price and state of sale for over 600,000 air conditioners in each calendar year. As the coverage of the GfK data tends to be poorer for specialist retailers and does not cover wholesale operations, their sales database is incomplete so GfK estimates are an understatement of total national air conditioner sales. Their coverage of non-ducted units is quite good (80%+) but the coverage for ducted systems is relatively low. GfK data has been used primarily to provide accurate sales weighted estimates of energy efficiency, capacity and average actual consumer price paid for air conditioners by type by year.

The Australian Bureau of Statistics (ABS) 4602 report – *Environmental Issues: People's Views and Practices*, is released every three years. This report outlines ownership data for Australia for major appliances, using a sample of several thousands households. It gives a good basis for historical ownership, although it gives no indication of sales and is somewhat ambiguous with the definitions of some types of units. Use of this data in a stock model can generate an implied sales stream which has been used as a confirmation input for this process.

BIS Shrapnel publish an overall market report for climate control appliances every two years and a long time series is available from previous editions. It documents customer responses to a series of detailed questions regarding their purchases in the year. Around 5,000 households are surveyed in this process for each report. BIS Shrapnel also compile total product and import data from the ABS to estimate the market size. BIS Shrapnel provide data on ownership, sales share by type and total market estimates. This report has been used as a benchmark to confirm other data sources.

Informark operates an internal industry subscription service which tracks market supplies by type from all major suppliers in Australia. It reports yearly sales for different types of air conditioners at a state level and provides good coverage of both the residential and commercial markets. This data has been used as a primary data source for total market sales for the few years where it has been available (1998 to 2006). However, it only covers those brands which subscribe to the service so market coverage is partly incomplete.

Because registration with government is mandatory for MEPS and energy labelling, detailed performance data for all models on the Australian market are supplied to regulators as they enter the market. The number of registrations entering the market in each year varies by appliance type (number of models on the market) and to some degree this is also affected regulatory changes that occur from time to time. Registration data contains model performance data and is used to cross match against GfK sales data to provide a more complete market picture on general trends for the performance and characteristics of air conditioners. Registration data is available since energy labelling commenced in 1987 so it provides an accurate long term data set for air conditioner performance trends. Using this data to estimate

performance trends needs to be done with care as the sales share of each model registered will vary from the market sales share.

In the case of New Zealand, the regulator (Energy Efficiency and Conservation Authority, EECA) mandates the collection of sales data for models listed in New Zealand. This data has been used determined sales weighted attributes for the New Zealand market. No price data has been made available within the New Zealand market, but given that all products are imported from comparable sources into both countries, the relative prices are expected to be comparable.

It should be noted that there are discrepancies between all of these data sources and none of them appear to be totally complete. The air conditioner market is large and complex and there are some 200 brands now present, so obtaining complete market data is fraught with difficulty for many reasons. For this RIS, the best available composite data has been prepared to undertake energy estimates.

The main types of air conditioners examined in this RIS are illustrated below.

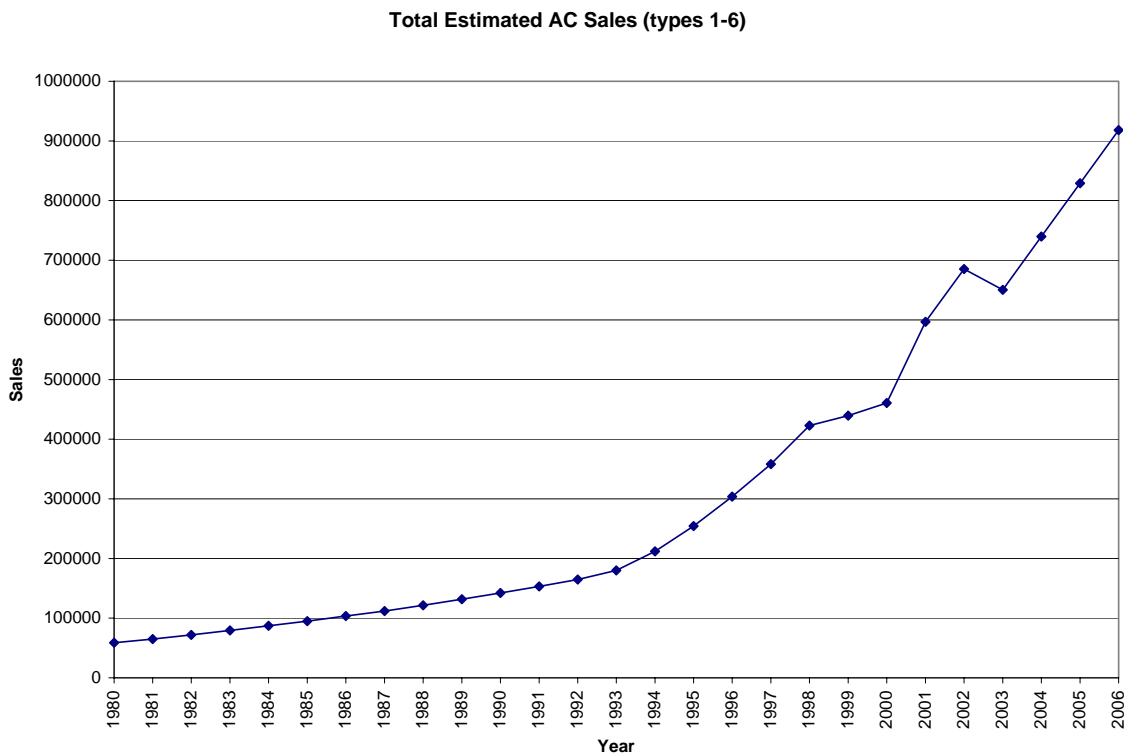
**Table 18: Air Conditioner Types**

		Other Criteria and Notes
		New energy label and new MEPS levels for heating and cooling
		New energy label and new MEPS levels for cooling
		New energy label and new MEPS levels for heating and cooling
		New energy label and new MEPS levels for cooling
		Energy label is voluntary so this element not covered by this RIS. New MEPS levels for heating and cooling
		Energy label is voluntary so this element not covered by this RIS. New MEPS levels for cooling

Note: Some other types are also common such as cassette and packed systems, but these tend to be larger systems.

*Air Conditioners – Sales Data*

Air conditioner sales have increased in a spectacular manner over the past 25 years from less than 100,000 units per year in 1980 to more than 900,000 units a year in 2006 (non-ducted types 1 to 4 and ducted types 5 & 6 only). Another 100,000 units are also supplied primarily to the commercial sector (cassette and packaged units, larger 3 phase systems, water cooled systems). Data compiled from all the major data sources cited above have been used to prepare the time series in Figure 10.

**Figure 10: Estimated Sales of Air Conditioners – Australia (Types 1 to 6)**

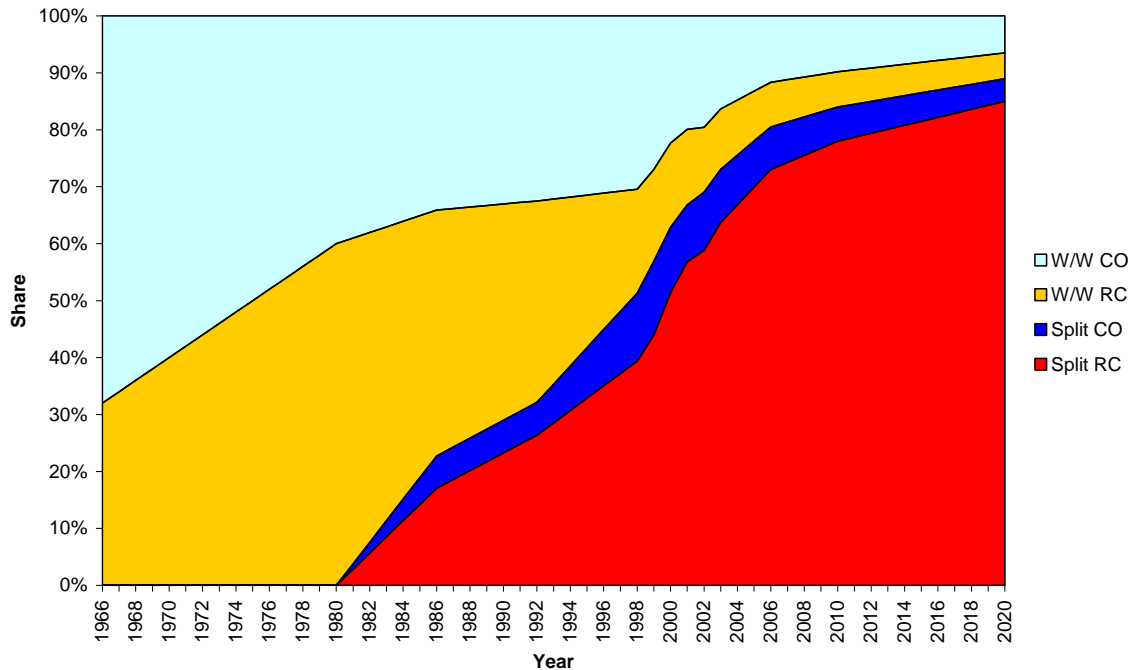
For this RIS, air conditioners have been classified into one of six possible types that will be directly affected by the proposal. These types are predominately made up of three defining unit configurations – whether the unit is ducted or non ducted, the internal configuration or construction (unitary = window wall or split system), and the functionality (reverse cycle or cooling only).

Salient points to note are:

- Total air conditioner sales have doubled since 2000 (an increase of over 12% per annum).
- The market share of split system reverse cycle units (Type 1) has increased steadily and now makes up over 60% of sales in Australia.
- The market share of split system cooling only units (Type 2) has been declining steadily and now makes up 6% of sales in Australia.
- The market share of window wall reverse cycle units (Type 3) has been declining steadily and now makes up 7% of sales in Australia.
- The market share of window wall cooling only units (Type 4) has been declining slowly and now makes up 10% of sales in Australia.
- The market share of ducted reverse cycle units (Type 5) has been steady at about 10% of sales. The sales of ducted cooling only units (Type 6) is very small in Australia.

Since their introduction in about 1980, split system reverse cycle units have grown in market share rapidly as illustrated in Figure 11 below. It is important to note that over the period depicted that the market has also increase in size by a factor 10 as well, so the increased sales volume of split system reserve cycle models is even more pronounced than depicted.

**Figure 11: Changes in Market Share for Non-Ducted by Air Conditioners in Australia**



**Key Characteristics – Air Conditioners**

The changes in the capacity of air conditioners over the study period is complex. The following figures show trends in air conditioner capacity – these have been compiled from a wide range of available data sources. The capacity of split systems has been increasing for many years but this has now peaked and is expected to decline in the future, based on trends in recent years. The capacity of window wall systems was steady for many years but started to decline in the mid 1990’s (as larger systems were replaced by split systems). The capacity of window wall cooling only systems is significantly smaller than for window wall reverse cycle models. In contrast, the capacity of ducted systems has increased gradually for many years and is expected to increase in the future. These trends are depicted in Figure 12 and Figure 13.

It is important to note that future capacity trends for air conditioners are expected to remain unaffected by the MEPS and energy labelling proposals in this RIS as these program measures target efficiency and not capacity.

Figure 12: Trends in Non-Ducted Air Conditioner Capacity

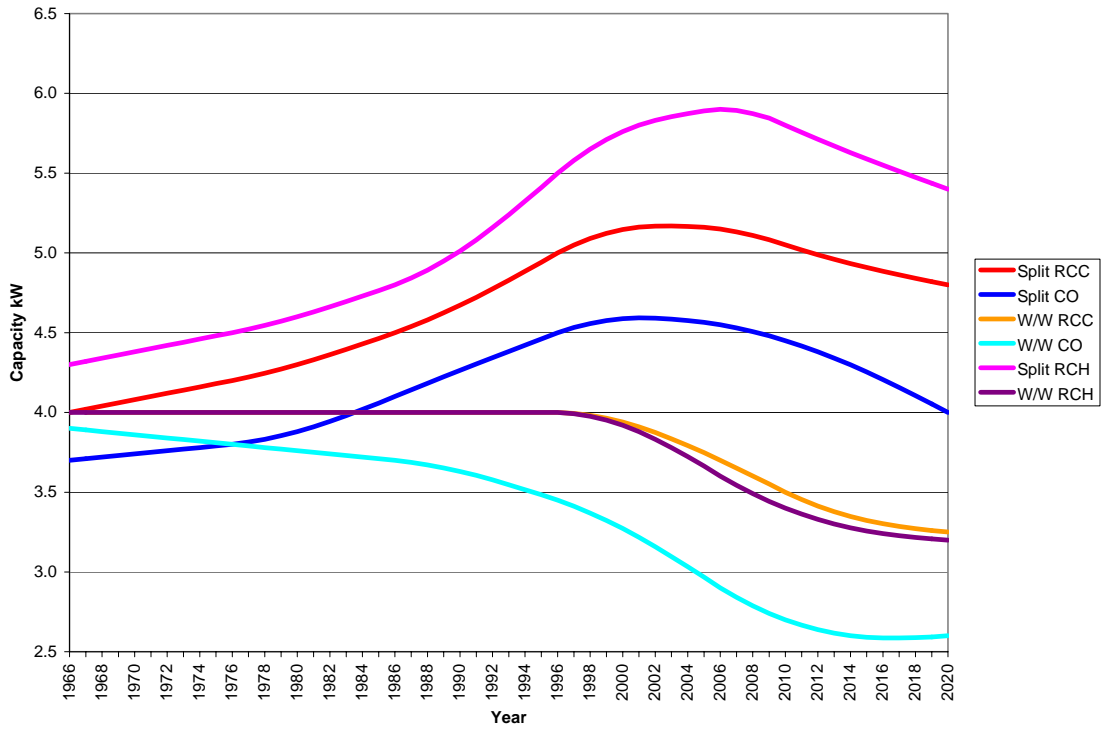
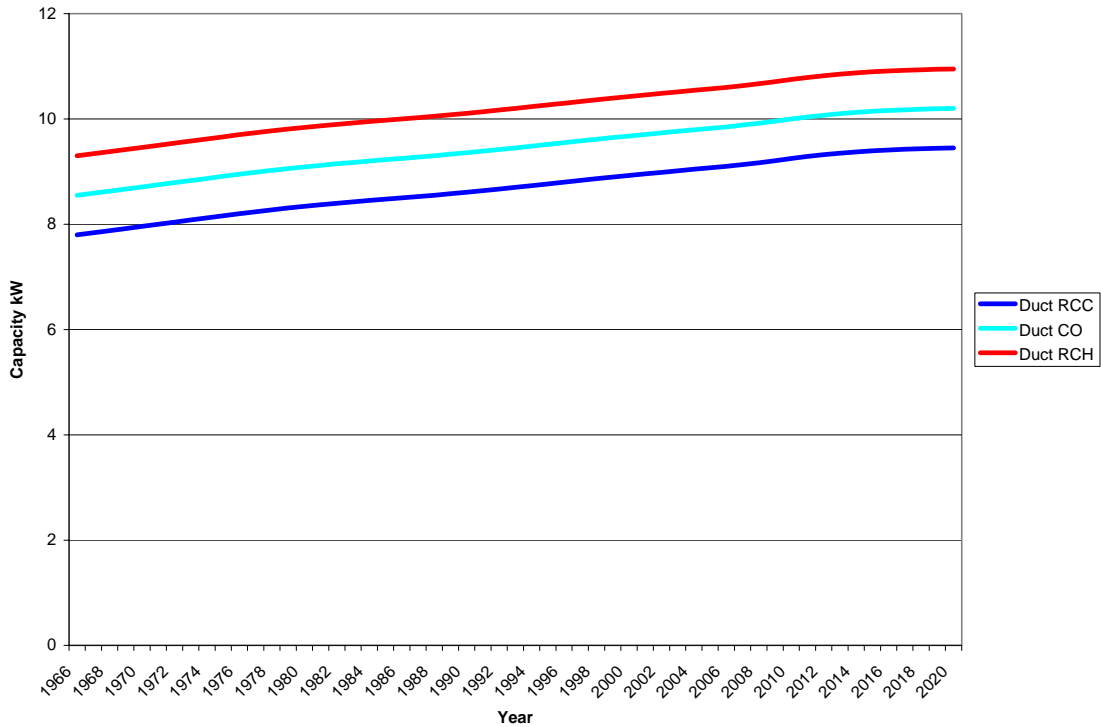


Figure 13: Trends in Ducted Air Conditioner Capacity



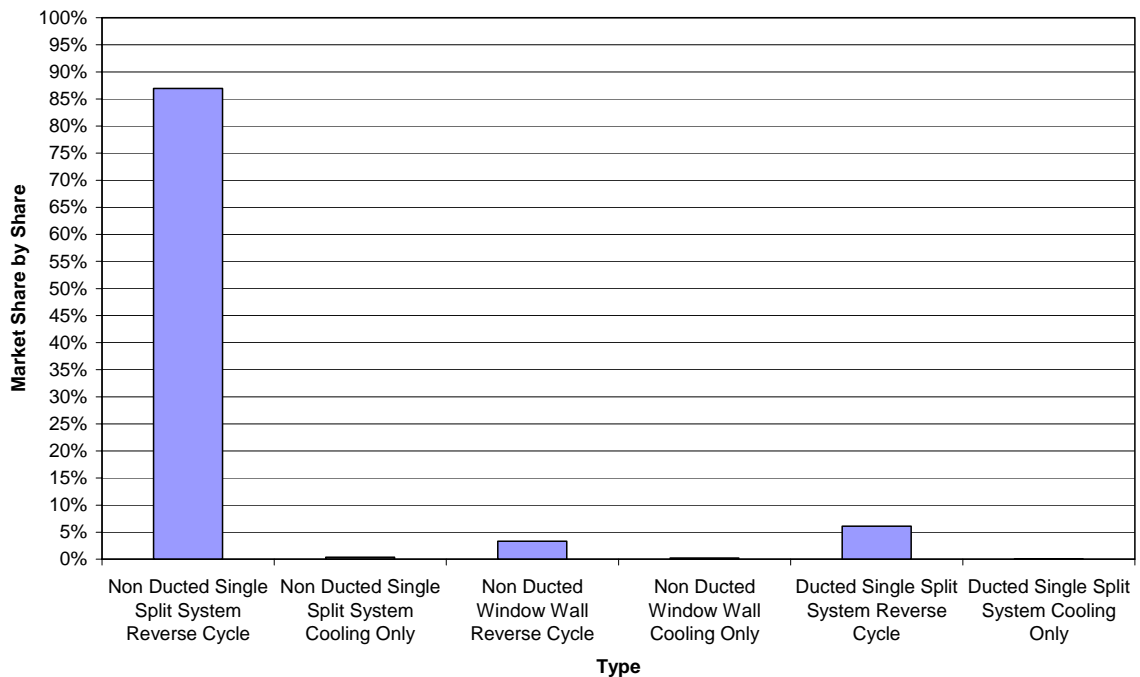
Note: RCC = reverse cycle cooling, RCH = reverse cycle heating, CO = cooling only

The historical and future trends in air conditioner efficiency are examined as part of the impacts of the proposal.

**2.4.2 New Zealand Data**

The monitoring of sales in New Zealand started in 2002 by the Energy Efficiency and Conservation Authority (EECA) as part of their regulatory powers with the introduction of mandatory energy labelling. For this project, sales data for the year from April 2005 to March 2006 (referred to as 2006 sales in this report) was analysed in detail. Figure 14 below shows the market share by type for 2006 air conditioner sales in New Zealand. The non ducted single split system reverse cycle type comprises quite easily the greatest market share with just over 85%; all other types individually make up close to or less than 5% of the market.

**Figure 14: Market Share by Type for New Zealand 2006 Air Conditioner Sales**



No data on product prices or efficiency trends over time are available for New Zealand for this study. However, trends are assumed to be comparable to those in Australia in general and in Tasmania in particular as the mix of products sold in both jurisdictions and the sales per household appear to be very similar. There is also a large overlap of models registered for sale in both markets. As all products are imported into both countries from the same sources and by the same suppliers, it is expected that prices in Australia and New Zealand will be comparable.

Table 19 below shows the number of annual sales of air conditioners for New Zealand. The annual sales of air conditioners appear to be increasing each year from 2004 to 2006. It can be seen that the overall market for air conditioners in New Zealand is about 8% of the Australian market.

**Table 19: Number of Annual Sales of Air Conditioners for New Zealand**

			<b>2006 - Units</b>
			72,981

Source: EECA

**2.4.3 Comparison between NZ and Australian Key Data Attributes for 2006**

Table 20 below shows the air conditioner types sales share comparison between Australian and New Zealand sales for 2006. It is quite apparent that the main difference between the Australian and New Zealand is for reverse cycle split systems (Type 1). This Type comprises almost all of the market share for New Zealand and over two thirds of the share for Australia (although this is growing). However, as noted above, the market share by type in New Zealand is highly comparable to that in Tasmania.

**Table 20: Air Conditioner Type Share: Australian and New Zealand 2006 Sales**

						<b>6</b>
						0.0%
						0.0%

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

Table 21 below shows a comparison of key characteristics for air conditioners for 2006 sales for Australia and New Zealand. The average heating and cooling characteristics for split system reverse cycle (Type 1) air conditioners for (sales weighted) are almost the same, although the efficiency of New Zealand models appears to be slightly higher on average. This is notable as this type comprises the largest market share for both Australia and New Zealand. The average characteristics for other types (Types 2-6) are comparable for the most part. There are some small differences, although the small sample size in New Zealand for these needs to be taken into account. The overall averages for both Australia and New Zealand are comparable, mostly due to the closeness of the characteristics of Type 1 (and its large sample size).

The comparison of ducted systems needs to be treated with caution as the sample size in both jurisdictions is small.

**Table 21: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 1**

						<b>SRI Heat</b>
						3.8
						4.5

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

**Table 22: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 2**

			SRI Cool
			3.6
			3.5

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

**Table 23: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 3**

						SRI Heat
						3.0
						2.6

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

**Table 24: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 4**

			SRI Cool
			3.3
			3.8

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

**Table 25: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 5**

						SRI Heat
						4.3
						4.2

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published).

**Table 26: Air Conditioner Characteristics Comparison Between Australian and New Zealand 2006 Sales – Type 6**

			SRI Cool
			2.8
			2.9

2006 GfK data for Australia and EECA sales data for New Zealand (note: the New Zealand data is not published). There are few of these products in either market, so caution is required.

For the purposes of data analysis in this report, the relative energy characteristics of air conditioners between Australia and New Zealand in 2006 are assumed to remain constant over the modelling period.

## 2.5 The Product Market

### 2.5.1 Suppliers

The air conditioner market for both Australia and New Zealand is one of many suppliers and brands, with a range of prices. The picture is complicated by a number of differing unit types, and the range of retailers. Retailers vary from small specialised outlets stocking a handful of brands to large chain stores stocking a multitude of brands and types. There are a very large number of registrations in the online registration system, held by a large number of suppliers. This complexity in the market for air conditioners means that obtaining an accurate and overall picture of the market can be difficult.

Figure 15 below outlines the slowing in the trend of decreasing price. The prices shown are in real 2005 dollars. The overall price decrease from 1995 to 2005 was on average 7.6% per annum. However, trend data suggest that falls in prices are slowing dramatically. Based on sales data from GfK it is estimated that current and future prices trends will fall at a much slower rate into the future. Hence a real price decline of 2% per annum has been assumed as the base case for future price modelling. Reasons for this average price decrease may include the influence of an increasing share of low cost imports from China and South Asia into the Australian market and increased competition amongst retailers. The decrease in average price seems to be slowing due to the increasing trend towards air conditioner types that contain inverter functions and the saturation of the market by low cost suppliers from China and other parts of Asia. It is also interesting to note that inverter models tend to be offered by 'named' brands and therefore may have a price premium associated with higher quality products, further increasing their price above low end products.

Figure 15: Real Purchase Price for Air Conditioner Types 1-4 by Year

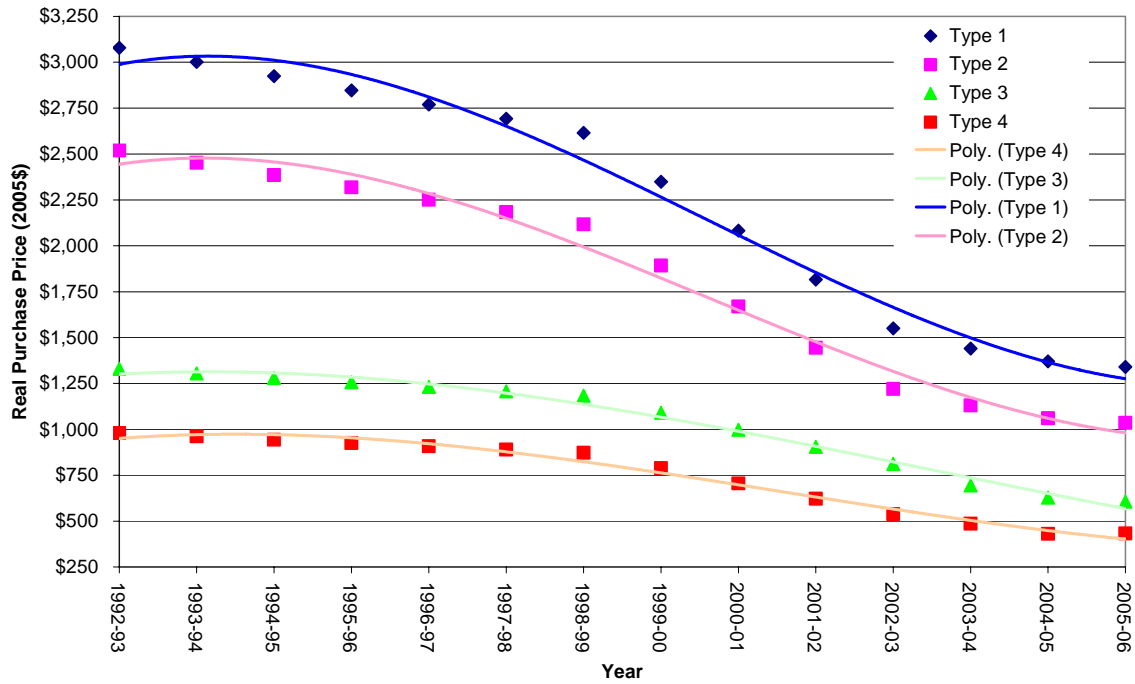


Table 27 below shows the country of origin of sales for air conditioners for Australia in 2006. Over a third of the market is supplied by China, with Thailand making up 25% and Korea and Malaysia 18% and 11% respectively. Three countries contribute between 2% and 4% of the market, with a multitude of countries supplying less than 1% (these have been aggregated into Other).

Table 27: Country of Origin of 2006 Sales for Air Conditioners for Australia

	Share of Market for 2006 (% of total market)
	35%
	25%
	18%
	11%
	4%
	3%
	2%
	3%

Table 28 below the country of origin of sales for air conditioners for New Zealand in 2006. Over a third of the market is made up of units supplied from Thailand, with China contributing almost 20% and Japan 16%. Five countries supply between 2% and 10% of the market, with a number of countries contributing less than 1% (aggregated into Other).

**Table 28: Country of Origin of 2006 Sales for Air Conditioners for New Zealand**

	Share of Market for 2006 (% of total market)
	39%
	19%
	16%
	9%
	5%
	5%
	4%
	2%
	2%

### 2.5.2 Purchasers

Consumer research indicates that appliance purchasers divide into four broad segments; the hip-pocket orientated who tend to look for models that cost the least to buy, the efficiency orientated who tend to look for models that are the most energy efficient, the environment orientated who tend to look for models that will do least harm to the environment, and those that don't look at any of the three aforementioned reasons. Those customers who are efficiency orientated are more likely to be aware of the energy label and to believe that it was important in the appliance purchase decisions than either the environmentally or hip-pocket orientated consumers (Artcraft, 2006).

Nearly 9 in 10 (88%) of the Australian consumers surveyed, state that they use the information on the energy label when buying an appliance (around 50% for New Zealand), and 75% say that the energy label is very important in the appliance purchasing process, although these numbers are for appliances generally (mainly whitegoods) and are likely to be somewhat lower for air conditioners. Consumers engage in a two stage buying process for appliances. In the first stage they assess a number of aspects of an appliance such as the capacity, features, type (cooling only, reverse cycle) design, configuration (non-ducted, ducted) etc. Having then identified the suitable options among possibly two or three appliances, then consumers tend to begin comparing value, performance, running costs etc. It was found that 44% of consumers refer to the energy label in the first stage of this two stage appliance buying process and 75% of consumers refer to the energy rating label during the second stage of that process as well (Artcraft, 2006).

## 2.6 Operation of Energy Labelling and MEPS

### 2.6.1 Existing Labelling and MEPS Regime

The mandatory star rating energy label was first introduced for air conditioners in 1987 in NSW and Victoria and was progressively adopted by other states through the 1990's. In 2002 New Zealand introduced a mandatory energy labelling scheme that aligned with the existing program. Energy labelling is now accepted by consumers as an authoritative method of communicating the comparative energy efficiency of air conditioners, as well as the other products to which labelling applies (refrigerators, freezers, dishwashers, clothes washers and clothes dryers).

Mandatory energy labelling of appliances is widely seen as a necessary element in a properly informed and functioning market. It requires suppliers to declare, on a standardised basis, their products' energy consumption (shown as kW input on the air conditioner label) and efficiency (on a 6 star scale) so that consumers are able to compare them. The cost of energy is the major ongoing cost of operation for a air conditioner and the energy cost over the product's life can be more than the purchase cost. The energy consumption of a product is not visible by inspection, so a mandatory declaration is essential to enable consumers to consider total life cycle cost during their purchasing deliberations, if they are so motivated. The presence of the label itself alerts consumers to running cost and energy efficiency, and increases the probability that they will take these factors into account.

The 'algorithm' is the formula or equation which relates the electricity consumed by a particular model under standard test conditions to the number of stars to be displayed on the label. The original star rating algorithm, which was in use from 1986 to 2000, had a single equation to determine star ratings for all types and groups. This algorithm was made more stringent in 2000, although it still followed the same structure.

MEPS were first introduced for three phase air conditioning products in 2001 and single phase products in 2004, with the aim of taking the less efficient products off the marketplace. More stringent MEPS levels were introduced in April 2006 for most single phase products and October 2007 for all remaining product types (including three phase products). In 2003 New Zealand introduced a mandatory MEPS scheme that aligned with the existing program in Australia.

Although the MEPS levels are not formally related to the number of stars on the energy label, the introduction of more stringent MEPS level has removed many products with a lower star ratings from the market. This has narrowed the range of ratings that buyers encounter during their search and has thus made the label less effective.

State regulations for energy labelling and MEPS include the requirement that test results, energy label ratings and declarations of compliance with MEPS must be registered with one of the four regulatory authorities empowered to register products in Australia or they must be listed with the New Zealand regulator. The four Australian regulatory bodies are:

- New South Wales
- Queensland
- South Australia
- Victoria

A registration for energy labelling or MEPS in any of these states, or a listing in New Zealand, are accepted and valid in all Australian states and territories and New Zealand. There are special rules regarding listing with the New Zealand regulator and supply of products to the Australian market under the Trans-Tasman Mutual Recognition Arrangement (TTMRA) (essentially products that rely on a NZ listing and which are sold in Australia must be supplied through NZ).

Applications for registration may be made on paper or electronically on the website [www.energyrating.gov.au](http://www.energyrating.gov.au). These applications need to include:

- The reports of product characteristics, energy consumption and any other performance tests carried out in accordance with the relevant standard;
- A declaration that the product meets all relevant performance requirements;
- A sample label (if applicable);
- A declaration that the product meets MEPS requirements (if applicable); and
- The prescribed fee.

Regulatory authorities are empowered to take a range of actions in the event of false labelling, non-labelling or breaches of label display requirements, including the following:

- If a person is found to supply (ie sell) a 'specified' article which is not registered for energy labelling or MEPS (where applicable) or where the registration has been cancelled;
- If the energy label is found to be obscured (where the product is on display for sale);
- If other information is found displayed near the label that conflicts with the data on the energy label; or
- If the supplier is found to have made a false or misleading declaration.

Other obligations for registration holders include:

- Notifying the regulatory authority of any changes in contact details;
- Supplying product for testing if requested by the regulatory authority; and
- Liability for costs of check testing by the regulatory authority if tests show that the product does not comply with requirements.

(E3 Administrative Guidelines, 2005)

The ultimate sanction for proven breaches of labelling or MEPS requirements is deregistration of a product and/or prohibition of its supply.

The Equipment Energy Efficiency Committee (E3) manages both the energy labelling and MEPS programs for Australia. It works in concert with the Energy Efficiency and Conservation Authority (EECA) of New Zealand which is responsible for program implementation in NZ. The two countries have a policy of harmonisation of labelling and MEPS requirements and regulations. Formerly known as the National Appliance Equipment Energy Efficiency Committee (NAEEEC), E3 is ultimately responsible to the Ministerial Council on Energy (MCE) which includes the energy ministers of the Commonwealth, the States and Territories and New Zealand.

### *2.6.2 Regulatory Instrument AS/NZS 3823 – Its Parts and their History*

In the mid 1990s, government and industry agreed on a common format for all standards which covered products to be regulated for energy efficiency. The so called 2 part standard structure was devised as follows:

- "Part 1" covers the test procedure and ambient conditions such as the test method, performance measures and test materials;
- "Part 2" contains the detailed technical requirements for energy labelling and MEPS (where applicable).

In the case of air conditioners, several Part 1 standards (test methods) have been adopted, based on ISO test procedures, for these products as follows:

- AS/NZS3823.1.1 – Non-ducted air conditioners (ISO5151)
- AS/NZS3823.1.2 – Ducted air conditioners (ISO13253)
- AS/NZS3823.1.3 – Water sourced heat pumps (ISO13256-1)

These test methods are compatible with ISO test methods apart from some small adjustments to tolerances permitted for some test conditions and local voltage specifications.

The regulatory Part 2 standard originally contained the energy labelling algorithm (which was first adopted in 1987 in state regulations) was first published in 1998. The 2000 edition contained the revised energy labelling algorithm introduced in that year. The 2001 edition contained MEPS levels for three phase products which were introduced in 2001. The 2003 edition contained MEPS levels for single phase products were that were introduced in 2004 as well as revised MEPS levels for single and three phase products in 2007. The 2005 edition contained accelerated levels for non-ducted single phase products less than 7.5kW output) forward to April 2006 and also contained notice of MEPS levels for 2008 as well as the new energy labelling algorithm. The 2008 MEPS levels were withdrawn in Amendment 3 (29 February 2008) with the intention of delaying these for up too two years (the subject of this Regulatory Impact Statement). Amendment 3 also introduced new more stringent part load MEPS requirements for models with variable output compressors for products that do not meet MEPS at rated capacity.

There is also a Part 3 standard which specifies simulation requirements for larger products and provides an alternative to physical testing for the purposes of

registration. This standard is only applicable to selected products which do not carry an energy label (either on a mandatory or voluntary basis, in which case the rating must be based on physical tests rather than simulation).

All parts of AS/NZS3823 go through the normal public consultation process within Standards Australia. In addition, E3 hold stakeholder forums from time to time to discuss regulatory and related issues. There is a close and ongoing dialogue between industry and government on air conditioner efficiency issues.

A revision of Part 2 containing the revised energy labelling algorithm, label design changes, new MEPS levels and transition arrangements will be prepared and released for public comment in early to mid 2009, subject to the satisfactory completion of this RIS process. Publication is expected in mid 2009.

### *2.6.3 Membership of EL15/16*

Standard AS/NZS 3823 comes under the jurisdiction of Standards Australia committee; EL 15/16. As with all standards committee constituted under Standards Australia, EL15/16 has a broad representation from a wide range of industry including importers, manufacturers and other suppliers, the Retail Traders Association, consumer groups such as the Australia Consumers' Association as well as a number of government representatives, primarily representing energy regulators and E3.

EL15/16 originated as committee ME-016 in the 1980's (reflecting the mechanical origin of early air conditioning products) and this was placed under the coordination of EL-015 (household appliances) in the mid 1990's as EL15/16 as part of the committee restructure for government regulation. EL15/16 is a constituted sub-committee of EL-015 – this means that it is made up of representatives of specified national organisations (such as peak industry associations and governments) and it has the ability to prepare and vote to approve standards without reference to a parent committee (however, EL-015 receive copies of all EL15/16 documents and are permitted a courtesy vote on any ballot).

As required under Standards Australia rules, all proposed standards, revisions and amendments are issued for public comment for a period of 9 weeks (this time can be reduced only in special cases). The committee is required to consider all public comments on standards and to make any changes that are warranted prior to publication.

Committees are expected to operate on a consensus basis wherever possible. A positive ballot of members on the final text for publication is required before a standard can be published. A majority of members is required for a successful ballot but if there are negative votes from any significant stakeholder group, Standards Australia would normally only allow a standard to proceed to publication once a submission had been made to and approved by the Electrotechnology Standards Sector Board (E-000). A special Memorandum of Understanding between Standards Australia and the Department of Environment, Water, Heritage and the Arts (DEWHA) (on behalf of E3) requires E3 approval prior to the publication of any specified "Part 2" regulatory standard, including AS/NZS3823.2.

## 2.7 Market Failure

Despite the presence of energy labelling for air conditioners, it appears that a substantial minority of purchasers appear to be uninterested in the efficiency of the products they purchase. These are either owners who do not care about energy costs (or the associated environmental impact – see next section on information failure) or where the products purchased are subject to one of a number of possible market failures.

Common market failures in the air conditioner market, where there is a disconnect between the capital cost and the operating cost, all relate to the case of split incentives. For example:

- landlord/tenant problem - where owners are interested in the lowest capital cost and do not have to pay ongoing energy bills – this is especially prevalent in commercial establishments but also some residential properties,
- the supply of air conditioners by builders in new homes - where minimal capital cost is the primary consideration but owners or occupiers pay the ongoing energy bills; and
- selection and installation of an air conditioner by a specialist supplier (in this case they tend to recommend the product with the highest sales margin and lowest warranty call-out rate) where the purchaser does not actively engage in the product selection.

All of these factors can work against the selection of high efficiency products.

It is important to note that all split systems and other large air conditioning units must be installed by a licensed refrigerant handler. Purchasers often leave it to these specialists to select and install a suitable unit for their application. Unless the consumer specifically requests an energy efficient unit and actively specifies this through the installer or supplier, the most convenient model for the supplier is likely to be selected (products in stock and models that they know). In addition, sizing of products is very complex and most purchasers will defer to the expertise of specialists (who have a vested interest in over-sizing products to ensure performance and to increase profit margins), which essentially results in a further distancing between the owner (who pays the ongoing energy costs) and the purchasing decision.

The detailed analysis in Section 6.12 and Appendix 4 show that for many air conditioner types there is only a weak correlation between price and energy efficiency. For some types of air conditioners, there is no apparent correlation. However, even in the case of a weak correlation between price and efficiency, the tendency will be to install the lowest capital cost option and hence the efficiency will be lower on average (irrespective of the cost effectiveness of more efficient products).

In the case where there is no apparent correlation, the problem is less severe, but in theory the lowest cost options should be of a random efficiency, meaning that these types of installations should be of average efficiency (rather than low efficiency). Therefore, both cases still constitute a market failure because both result in an overall sub-optimal economic outcome when capital and operating costs are considered together.

Air conditioners are subject to several possible market failures, and together with the information failure outlined in the next section, makes the energy label ineffective in many cases (where it is present, noting that many air conditioners are not required to carry an energy label). An effective way to overcome these failures is through the introduction of MEPS, which eliminates low efficiency products, removing them from consumer choice. More stringent MEPS levels is therefore a core component of the proposal to improve the efficiency of air conditioners and to overcome these market failures.

## 2.8 Information Failure

This section outlines the limitations in providing information to consumers to help them optimise their purchasing decision with respect to minimising long term operating costs. There is no suggestion that information is not important or that energy labelling should be withdrawn or modified. A large proportion of consumers use this information in a range of ways and programs like energy labelling and the associated Energy Rating website are heavily used by consumers (especially for air conditioners). However, there are limitations on the effectiveness of information awareness (outlined below) which suggest that complementary program measures may be required to ensure that cost effective energy savings are implemented.

As outlined in the previous section, there are a number of market failures associated with air conditioner purchase and ownership, including cases where there are several types of split incentives (where the purchasers does not directly pay the ongoing energy bills). Also, although not necessarily a market failure in the strict sense, there also appears to be many cases where information or voluntary measures are likely to be ineffective in the air conditioner market.

Research has shown that as many as 30% of air conditioner purchases are impulse buys where no research or information is sought before purchasing (typically during hot weather), which indicates that voluntary or information type programs will be ineffective for a substantial part of the market.

This RIS shows in the section on market analysis, that even where good information is available on air conditioner energy consumption and efficiency, processing this data to determine an optimal life cycle cost is complex and is possibly beyond the capability of many customers. The overall result is that many air conditioner purchasers do not consider the efficiency of the product when making a purchase, even where information is available. This is despite the fact that some air conditioners of comparable price use half the energy and have half the ongoing operating costs for the same service. Unfortunately for such consumers, the provision of information appears to be ineffective.

In the case of ducted systems (around 12% of the market) or larger three phase systems (about 25% of the market), products are not required to carry an energy label. As these types of products are almost exclusively selected and installed by specialist suppliers, and these products are rarely on display in retail outlets, government regulations have not required these products to be labelled – only MEPS

is mandatory and effective for these products. While some information is available in product literature and on the Energy Rating website, this is less accessible than the information on the energy label.

Analysis later in this RIS details the efficiency of products within each of the main product categories. In a functioning market, (where long term operating costs were carefully considered) consumers would take the energy efficiency of products into careful consideration when making a purchase and select high efficiency and low cost products. Detailed market analysis suggests that this is not always the case, although there are always other purchase-deciding factors which are also considered such as brand and features.

It is instructive to consider the market research conducted on recent non ducted air conditioner purchasers by BIS Shrapnel (2006). While they found that 50% to 60% of purchasers across all states considered energy efficiency to be very important or critical in their purchasing decision. they also reported the following data:

- 28% of all purchasers did not consider the energy label at all – for some brands (noticeably low end brands) nearly 50% of purchasers did not consider the energy label at all;
- 31% of air conditioner purchases were an impulse buy (no lead time);
- 30% of purchasers did no research at all and nearly half of the remaining purchasers spoke only with the retailer or supplier;
- 69% of first time air conditioner purchasers were in existing households (associated with neither a new household or a renovation);
- A significant minority of purchasers were responding to short term weather events.

All of these factors tend to suggest that many consumers do not consider the energy efficiency of the products they purchase, suggesting that energy labelling and associated information has limited or no impact in some cases. This quantitative data fits well with anecdotal evidence from retailers – if a summer is hot, retailers are unable to meet consumer demand for air conditioners and they are able to sell everything in stock. As most air conditioners are imported, the lag time for supply can be many months. Under these market conditions, consumers use no discretion in their purchasing approach – they buy whatever is immediately available.

An associated issue is that taking the energy efficiency of a product into account in the purchasing decision is complex. Once a product is correctly sized for a particular application, estimating the annual heating and cooling requirement is a non trivial task and this varies substantially around Australia and New Zealand. Despite tools being available to assist consumers in the sizing of products (eg [www.fairair.com.au](http://www.fairair.com.au)) and to calculate annual operating costs (eg cost calculator on [www.energyrating.gov.au](http://www.energyrating.gov.au)), few tools to estimate annual energy used by an air conditioner by climate zone are available. This may partly explain why some consumers find taking the energy label for air conditioners into account more difficult than for other products.

The energy label for air conditioners undoubtedly has a strong impact in some segments of the market as is demonstrated by detailed market research of consumer purchasing patterns by BIS Shrapnel. However, in the case of air conditioners, around 35% of products are not required to carry an energy label as they are not on display in retail outlets. A substantial minority of consumers who do buy a labelled air conditioners do not consider the energy label and fall into the category of being energy label insensitive or resistant. Their purchasing decisions are either impulse buys or they do not consider any information such as an energy label or product efficiency. In the case of weather driven purchases, consumers tend to buy whatever product is available.

## 2.9 Bunching in the Higher Star Rating Bands

One reason for the continued market impact of energy labelling over such a long period was the adjustment of the energy labelling algorithm in 2000 so that product suppliers retained a commercial incentive to supply more efficient products, and buyers were still able to identify the most efficient models against a background of general efficiency improvements.

MEPS have also had a significant impact on the energy consumption of air conditioners, through the mechanism of removing the least efficient models, rather than increasing customer demand for the more efficient models, as is the case with energy labelling.

Because they affect the market in different ways, the impacts of changes in energy labelling take longer to become evident compared with the introduction of MEPS, which are tied to specific compliance dates and efficiency levels for all products. The label-related energy savings accrue gradually over a longer period as consumer preference for more efficient products grows, and as suppliers and manufacturers undertake a range of evolutionary changes to their products in order to achieve higher star ratings. In general terms, the energy impacts from energy labelling also tend to be smaller overall, especially when compared to stringent MEPS levels, but persist over a longer period.

Evidence shows that when the intention to introduce or change labelling or MEPS regulations are communicated to industry in advance, suppliers generally respond by introducing changes to their products well before the actual date of the regulatory change. This is generally desirable to ensure that products meet compliance criteria by the time of introduction of the actual regulation (EnergyConsult, 2006). While this lead time will affect the characteristics of some products prior to the introduction of the program measure, the bulk of the program impacts (either energy or cost savings, changes in emissions or changes in product characteristics) usually occur after the changes in regulation have been implemented and the new products which are affected by the changes have been installed for some time.

While labelling and MEPS operate on a product market in different ways, they are obviously interrelated. At the technical level, they generally rely on the same legislative instruments, administrative structures, and energy and performance tests.

At the market level, an introduction of MEPS (or more stringent MEPS) can reduce the impacts of energy labelling, because it will remove labelled products with lower star ratings from the market and decrease the range of product efficiency on display. This will reduce the range of star ratings which the buyer sees in the showroom, and so reduce the apparent energy value of seeking out a higher-rated product.

The continuing impact of the energy label as a driver of increasing energy efficiency for the air conditioner market depends on several factors.

- A reasonable spread of star ratings on the market for all classes and capacities, so buyers are motivated to seek out more efficient options;
- Sufficient space at the top of the energy rating scale so that suppliers can exploit the commercial value of introducing more efficient products over time;
- A good match between energy consumption under test conditions and energy consumption under use conditions, at least in a comparative sense;
- That both suppliers and consumers have continued confidence in the integrity of the program.

Government indicated its desire to review the energy labelling algorithm for air conditioners as early as 2004 in anticipation of revised 2006 and 2007 MEPS levels. A new algorithm was discussed and agreed with industry in 2005 and this was included as Appendix F of AS/NZS 3823.2-2005. It was originally scheduled for implementation in 2008. During 2006 E3 agreed that the introduction of the new energy label algorithm should be delayed until 2009 or 2010 following discussions with industry.

Many of the lower efficiency products have been eliminated with the introduction of these new stringent MEPS levels. There are now a limited number of products with less than 3 stars on the market in any type for either cooling or heating and for some product types and sizes the minimum efficiency permitted under MEPS is 4.5 stars. With the revised MEPS proposal included in this RIS, the minimum permitted star rating will be almost 5.5 stars (out of a maximum total of 6 stars) for some product types.

Table 29 below shows the current MEPS levels and the equivalent star ratings for air conditioners. The bulk of registrations are for small (greater than 4kW) split system air conditioners, although sales of the smaller split systems is also large.

**Table 29: Current MEPS Levels and Equivalent Star Ratings for Air Conditioners**

			Number of Registrations *
			180
			550
			950
			660

Note: \* Number of approved registrations as of April 2008, rounded. # Rated cooling output in kW.

Figure 16 below shows the current star ratings for approved single phase non ducted split system air conditioners. This particular grouping (types 1 and 2) are of greatest interest as they combined comprise by far the greatest market share for air conditioners for Australia and New Zealand. It can be seen that the majority of approved units under the current algorithm achieve four stars or greater, this is due to the current MEPS levels. A number of products rate well in excess of 6 stars under the 2000 star labelling algorithm. Although it is not defined on the below figure, the effect of these MEPS levels can be seen through the ‘steps’ in approved models plots in the figure (the steps go down as the cooling capacity increases). Figure 17 better demonstrates this trend.

**Figure 16: Current Star Ratings (2000) for Approved Single Phase Non Ducted Split System Air Conditioners – Cooling EER**

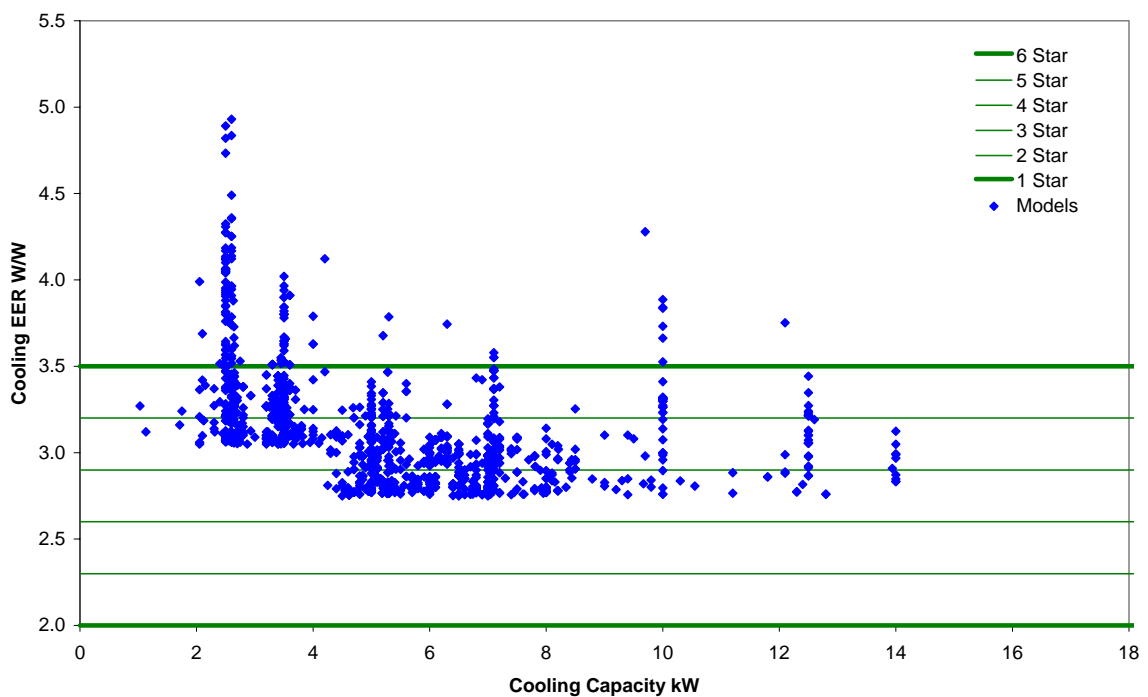


Figure 17 below shows the current MEPS levels for approved single phase non ducted split system air conditioners for Cooling EER. Like Figure 16 above, the models displayed are of types 1 and 2. The red line indicates the MEPS level for 2004, the pink line the MEPS level for 2007 and the green line the MEPS level for 2010, which is covered by this proposal. The ‘steps’ that can be seen in Figure 16 are all the more apparent and the reasons for these are clear, as the MEPS level decreases due to capacity reasons, the lowest cooling EER for registered models meet the line.

**Figure 17: Current Star Ratings for Approved Single Phase Non Ducted Split System Air Conditioners**

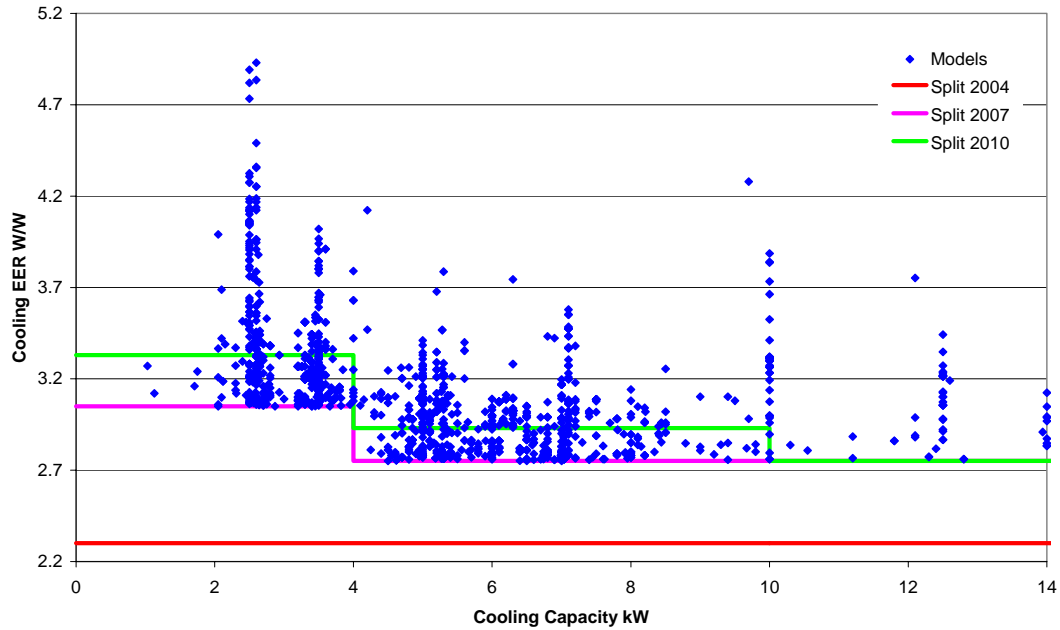
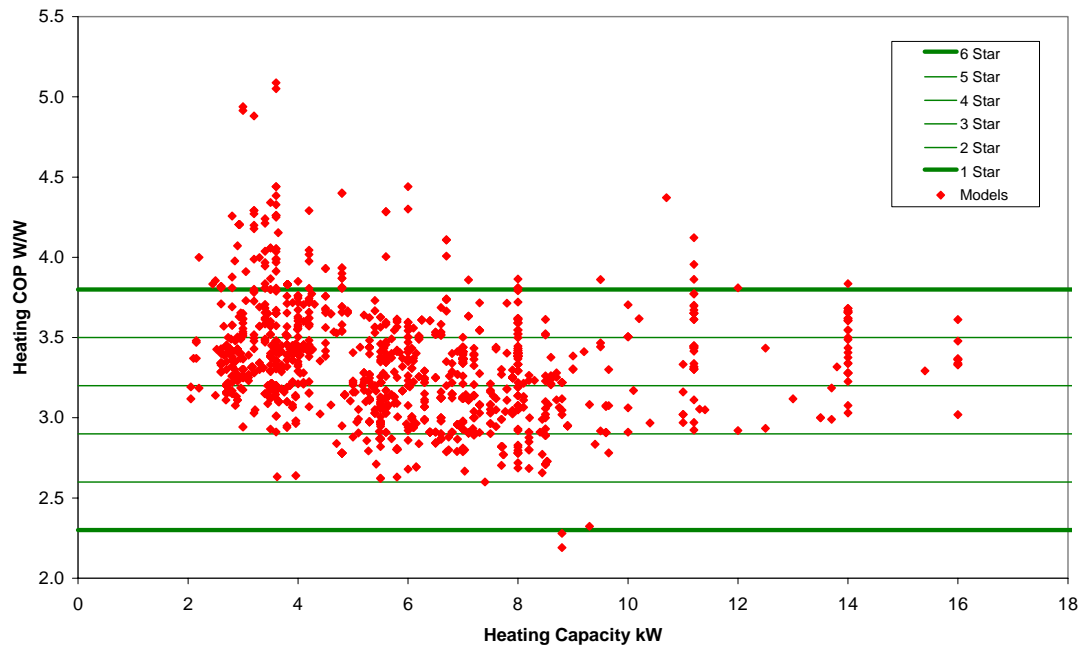


Figure 18 below shows the current star rating bands for approved single phase non ducted split system air conditioners for Heating COP. As for cooling, a number of products currently on the market exceed 6 stars under the 2000 star rating algorithm. It is worth noting the lack of ‘steps’ for heating mode as there is currently no MEPS requirement for heating.

**Figure 18: Current Star Ratings (2000) for Approved Single Phase Non Ducted Split System Air Conditioners – Heating COP**



The main project aim is to show the case for an introduction of new MEPS levels together with a revised energy labelling algorithm for air conditioners, that is both technically sound and will provide a solid basis for the rating of products in Australia and New Zealand over the next 5 to 10 years. Ultimately the solution will have to be a compromise that maximises energy savings within the bounds of technical feasibility while forging agreements between local manufacturers, importers, government and consumer groups.

The issue of clustering of stars at top of the energy rating label scale and hence declining impact of labelling on suppliers and buyers, was noted as early as 1991 for refrigerators and freezers (GWA, 1991). Air conditioners have followed the same trend as that found in refrigerators and freezers; as MEPS levels have been made more stringent, the star ratings of available products have clustered at the higher levels with the lower star rating bins empty.

Even without MEPS through the 1990's, a general re-scaling for all labelled appliances was necessary by 1998 and this was implemented in 2000. When energy labelling was first introduced, there was one algorithm for all types. This has continued through all algorithm changes. When MEPS for single phase products was first introduced in 2004, it eliminated the least efficient and lowest rated air conditioning products from the market. This caused some clustering of stars towards the top of the energy rating scale. More stringent levels in 2006 and 2007 have made this effect even more pronounced.

Energy labelling and MEPS programs are complementary. If there were only MEPS, suppliers would have no incentive to increase the efficiency of their products past the minimum performance levels required by law. This means that efficiency improvements would rely primarily on a continuous series of revised MEPS levels. Conversely, if there were only energy labelling, there would be nothing to stop the ongoing supply of low star rating and low efficiency products to those segments of the market that are not sensitive to lifetime operating costs or energy efficiency concerns (so called label resistant segments and those with market failures).

Together, the two programs not only exclude the least efficient products, but also motivate suppliers to gain market share by increasing the star ratings of their products.

The spread of star ratings on the market has narrowed over the past 4 years as seen in the below figures. Figure 19 shows the national sales distribution of air conditioners by star rating for cooling. It can be seen that the majority of the market for 2006, around 45%, was for 4 star models. It is important to note that sales data can lag behind the introduction of new MEPS levels – some models that were approved and imported prior to the 2006 MEPS levels and can still be sold after their introduction.

Figure 20 shows the national sales distribution of air conditioners for heating. It can be seen that the majority of the market for 2006, around 40%, was for 3.5 star models (in previous years it was 4 stars, the change can be put down to the prevalence of 'Private Label' models in the preceding years). Although these figures are only for 4 years, it can be seen that there is a clustering of star ratings towards the higher end, this will only be accentuated in the future with the introduction of more stringent MEPS levels.

Figure 19: Australian Sales Distribution by Star Rating – Air Conditioners - Cooling

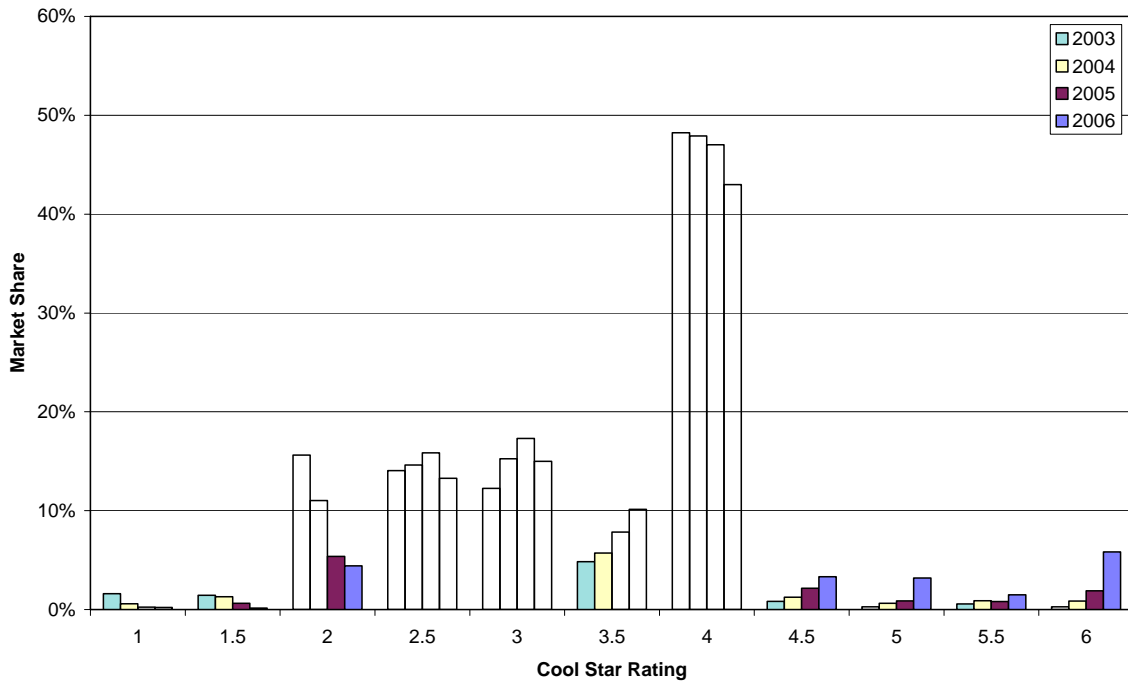


Figure 20: Australian Sales Distribution by Star Rating – Air Conditioners – Heating

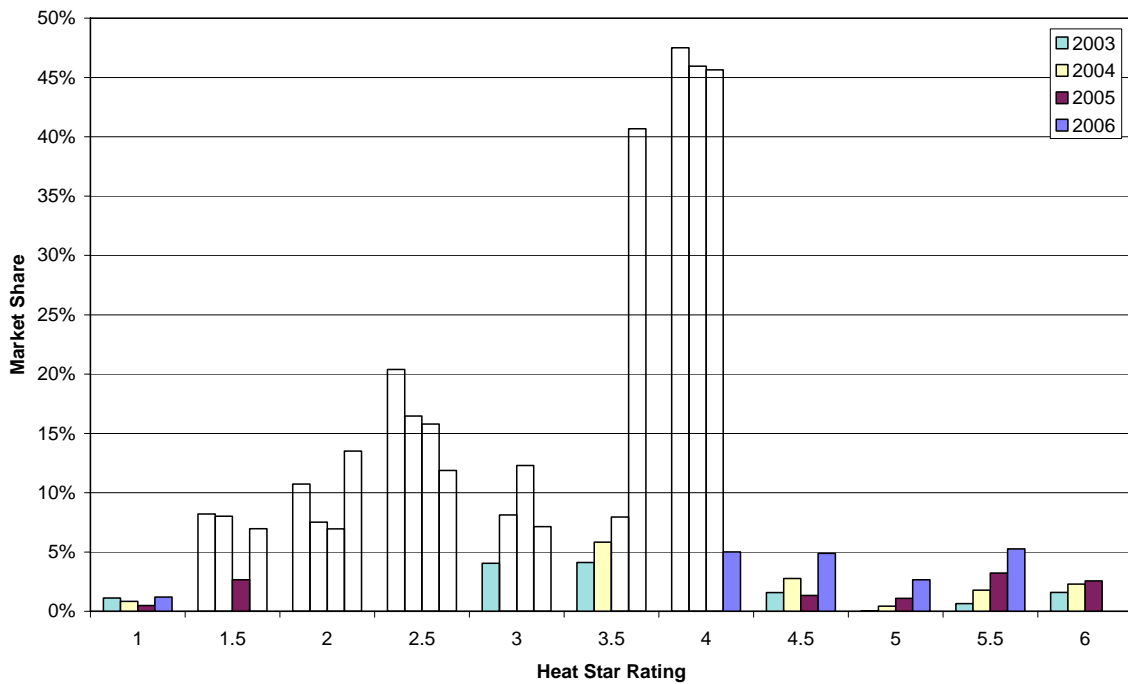
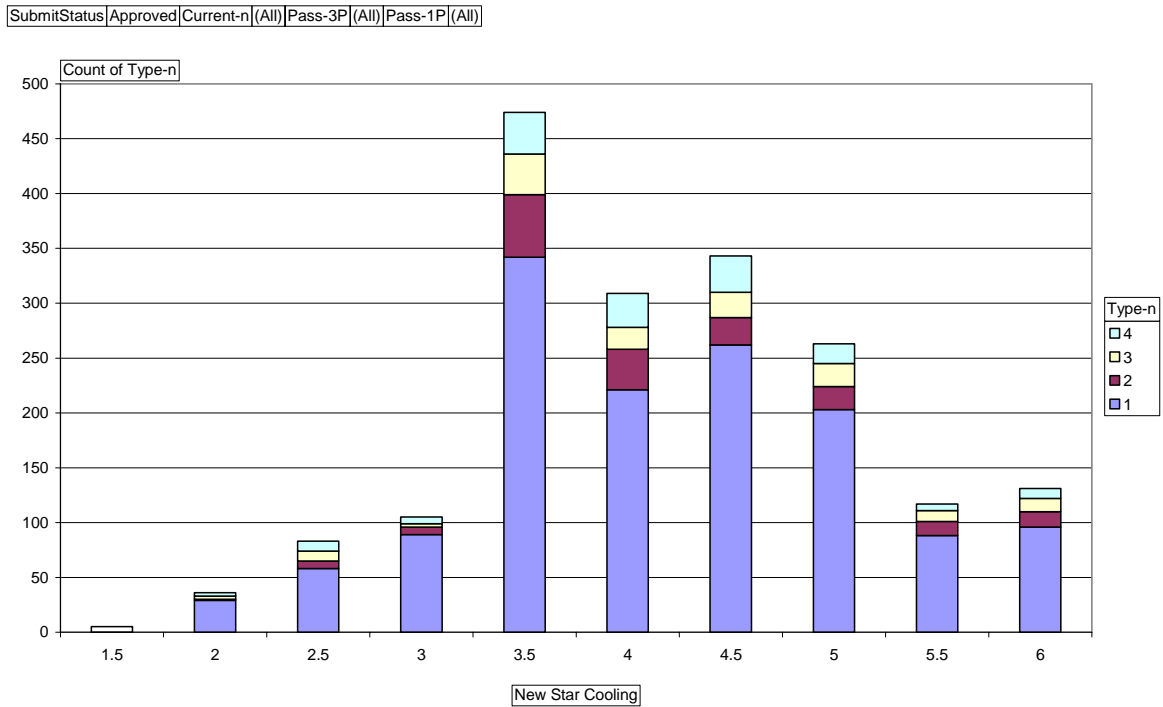
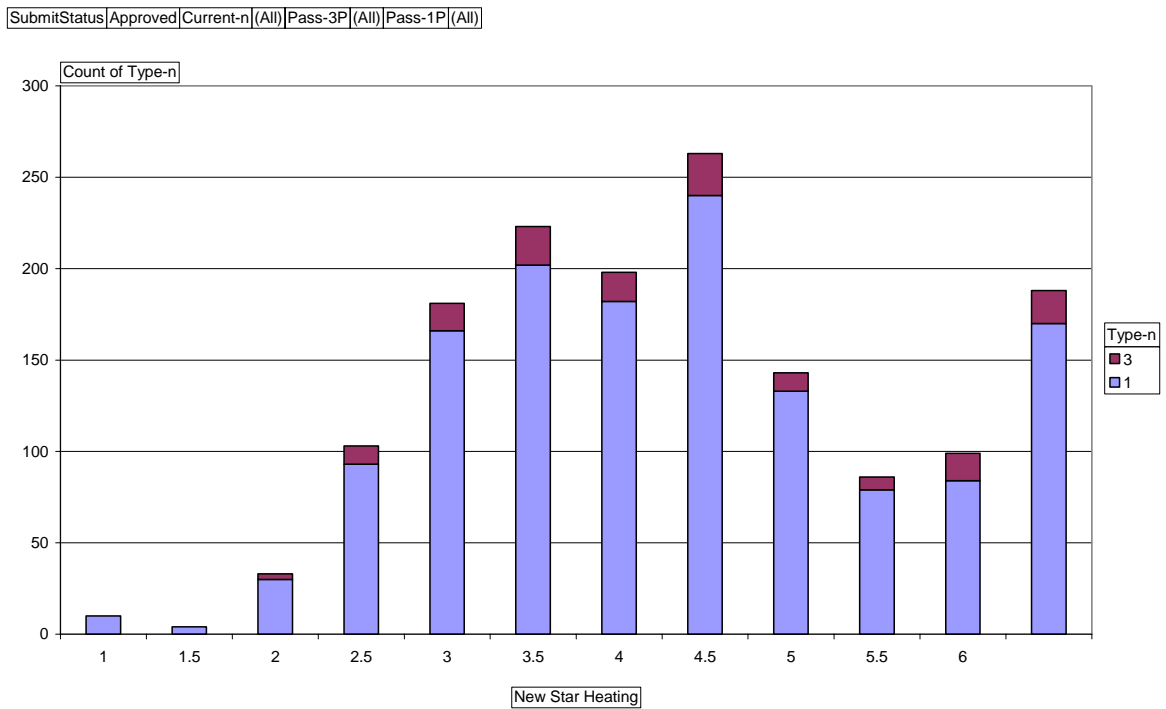


Figure 21 shows the distribution of the current star rating algorithm for cooling mode (2000) for approved registrations as at April 2007, which includes listings in New Zealand. It can be seen that although the distribution varies according to type, the majority of approved registrations are for 3.5 to 4.5 star models. These figures exclude all models that have been grandfathered as a result of 2006 and 2007 MEPS levels and reflect current products now on the market. Figure 22 shows the distribution of the current star rating algorithm for heating mode (2000) for approved registrations as at April 2007, which includes listings in New Zealand. It can be seen that the distribution varies according to type, the majority of approved registrations are for 3.5 to 4.5 star models.

**Figure 21: New Zealand Sales Distribution 2007 by Star Rating – Air Conditioners - Cooling**



**Figure 22: New Zealand Sales Distribution 2007 by Star Rating – Air Conditioners - Heating**



With the rapid increase in average air conditioner efficiency over the period 2004 to 2006 due to MEPS, the number of lower star-rated products on the market has declined, and the most common rating facing customers is now between 3.5 and 4.5 stars for both cooling and heating products, mostly due to the introduction of stringent MEPS levels. Even energy-aware customers generally consider 4 stars a satisfactory rating, so the motivation to seek out more efficient products is diminished. This effect will continue as sales-weighted star ratings gradually creep up in the coming years. It is also worth noting that there are currently some units on the market that have a current Star Rating Index of well over 6 (some are as high as 10), which is also a strong indicator that the star rating algorithm requires re-grading.

As was found in 2000, re-scaling may again be necessary to maintain the effectiveness of labelling. Given the lead time for any change star rating algorithm, customers will not see any new labels until 2010, so this would be about nine years from the last re-grading. This is about the optimum interval between algorithm updates, allowing the market to mature in terms of star rating distribution, and giving a better picture of whether any changes to the algorithm are required.

### 2.10 Pushing Towards Higher Energy Efficiency for Cooling Mode

The wide range of efficiencies still on the market, despite the introduction of several MEPS levels over the period 2001 to 2007, show that there is still a lot of room for further improvements in energy efficiency in the air conditioner market. It is important to maximise this impact from an energy and greenhouse policy perspective. One of the most effective ways of achieving this is through more stringent MEPS levels.

MEPS results in substantial energy savings through removal of the least efficient products on the market.

Part of the proposal in this RIS is to also introduce more stringent MEPS levels for a range of air conditioners in 2010. This will push the average efficiency of available products to even higher levels and will ensure further savings are made. It will also make the proposed energy label re-grade even more urgent. Despite the higher MEPS levels proposed, there are still a large number of products on the market that meet the new requirements.

The aim of MEPS levels in Australia and New Zealand is to meet world's best practice. Australia and New Zealand cannot drive the efficiency of the world air conditioner market to levels that are higher than products that are commercially available as we are a relatively small importer of products. However, governments still have a responsibility to regulate products and to promote high levels of energy efficiency. In the case of air conditioners, setting higher MEPS levels is highly feasible as there is a very wide range of product energy efficiency already on the market. Setting new more stringent MEPS levels will mean that there will still be a wide range of product choice available to consumers. With sufficient notice, importers can alter the specification of minimum efficiency for products they import at minimal cost. Increasing appliance efficiency has substantial benefits in terms of reduced energy and greenhouse emission reductions that generally outweigh program and purchase costs.

New MEPS levels proposed in this RIS were set out in 2005 in AS/NZS3823.2-2005, originally for implementation in 2008. They were originally proposed in the consultation RIS released in mid 2005 (Syneca 2005). The proposed date for implementation has been delayed after consultation with industry to ensure that they have enough lead time. However, analysis of the market data suggests that a wide range of products already meet the proposed new MEPS requirements so the technical feasibility is no longer in doubt.

One important element in this proposal is to lift the MEPS level (minimum EER) to a uniform minimum of 2.75 for all smaller ducted systems. Ducted systems are a particular problem and may warrant even more stringent MEPS levels in the future as their energy use is generally larger than non ducted systems (their capacity is larger and they tend to be installed to condition the whole home) and losses from the ducting system can typically be of the order of 30%, which means that the overall system efficiency during normal use is 30% lower than the nominal tested system efficiency used for regulatory purposes such as labelling and MEPS.

## **2.11 Energy Efficiency for Heating Mode**

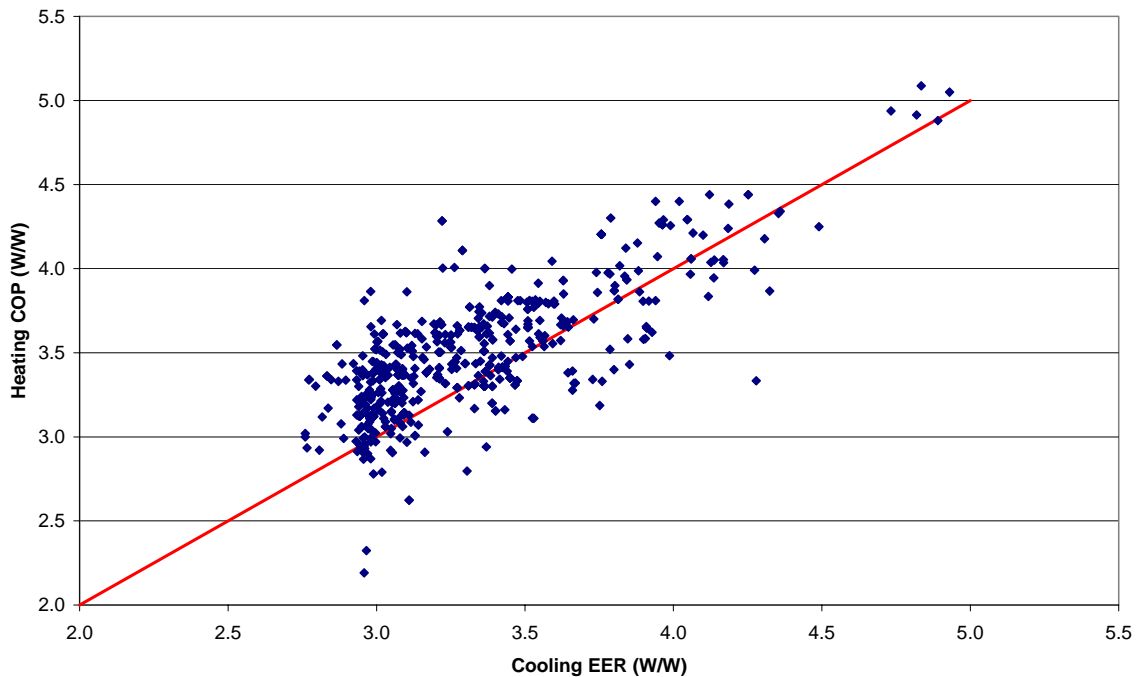
Since MEPS was first introduced for three phase air conditioners in 2001, there has been no minimum requirement for heating mode efficiency for reverse cycle or heating only products. In a well designed air conditioner which is optimised for both heating and cooling operation, the technical efficiency under heating mode is usually slightly higher in heating mode as the energy from the compressor operation (the heat

resulting from the compression of the refrigerant) can contribute to the overall heat load going into the conditioned space, which in turn increases the overall COP of the system. For a given air conditioner compressor, the relative performance of heating and cooling modes can be altered by changing the relative size of the indoor and outdoor evaporator/condenser units and also to some degree by the configuration of the refrigeration values and other controls.

It would appear that the introduction of stringent MEPS levels for cooling mode has resulted in an overall substantial improvement in heating mode efficiency of most products on the market, which is expected. However, of concern is the performance of a small minority of products where it appears that the heating mode performance has been downgraded substantially in order to meet the MEPS levels for cooling mode.

Figure 23 below shows the cooling EER versus the heating COP for approved single phase non ducted split system air conditioners. The vast majority of products lie above the red line which means that their heating performance is better than their cooling performance (expressed as Watts/Watt). However, it can be seen that there are a number of products that fall well below the red line, which means that their heating performance is poor and in all likelihood has been compromised in some way to meet the minimum efficiency (MEPS) requirements for cooling. If consumers are relying on MEPS to guarantee minimum cooling efficiency, or where MEPS is introduced to address market failures, it is reasonable that some equivalent guaranteed efficiency for heating performance is also applied as part of the MEPS regime. Given that such a requirement would only affect a small number of products which appear to have compromised heating performance in any case, the market impact of such a requirement is likely to be small. However it will offer a safety net of consumer protection for heating performance.

**Figure 23: Cooling EER versus Heating COP for Approved Single Phase Non Ducted Split System Air Conditioners**



Given that heating mode for air conditioners in many of the larger states accounts for a substantial part of the total energy consumption, and the majority of energy consumption in the ACT, Tasmania and New Zealand, it would appear that minimum efficiency requirements (MEPS) on heating mode is warranted, even if only at a level that offers some degree of consumer protection on heating efficiency (as opposed to driving the efficiency of the market).

## 2.12 Demand Response Capability

Air conditioners play a large role in peak load issues experienced during times of high electricity demand. Number studies have shown that air conditioners can account for 30% to 50% of total state demand on days of extreme weather (EES 2005a). In order to reduce the capital costs of providing distribution infrastructure that will only be utilised at peak times, electricity suppliers throughout Australia are exploring programs to encourage users to manage their electricity loads at those times. The essential elements of these programs are:

- Electricity pricing structures or other means to encourage customer to take action at the time of high loads on the supply system (often called 'critical peak' periods)
- Convenient ways for customers to respond

Signalling changing prices to consumers, eg via 'in-home displays' has been found to have a limited impact, in the absence of means for consumers to pre-select automated 'demand responses' or to voluntarily enter direct load control agreements with their electricity suppliers (NERA, 2008).

Demand Response is the automated alteration of an electrical product's normal mode of operation in response to an initiating signal originating from or defined by a remote agent<sup>2</sup>. At present, some air conditioners have a latent demand response capability in their control software, but low-cost means to realise this capability have not so far been available. A forthcoming standard will define the physical connections and communications protocols necessary to realise the demand response modes set out in Table 30.<sup>3</sup>

**Table 30: Proposed Demand Response Modes, AS4755.3.1**

	Description of Operation in this Mode
	Compressor off
	The air conditioner continues to cool or heat during the demand response event, but the energy consumed by the air conditioner in a half hour period is not more than 50% of the total energy that would be consumed if operating at the rated capacity in a half hour period
	The air conditioner continues to cool or heat during the demand response event, but the energy consumed by the air conditioner in a half hour period is not more than 75% of the total energy that would be consumed if operating at the rated capacity in a half hour period

The potential net benefit of introducing demand response capability into between 7.5% and 15% of the air conditioner stock, in the context of a national rollout of smart meters, has recently been estimated at between \$250 million and \$756 million NPV (MCE, 2008). However, the standard demand response capabilities envisaged in the above table could also be introduced without the presence of smart meters, or in advance of later installation of such meters.

As not all models of air conditioner will have demand response capability, or the same level of demand response capability, it is necessary to provide a convenient way for buyers to identify such products prior to and at the time of purchase.

Just as energy labelling enables buyers of products to respond to expected energy prices over the lifetime of the product, rather than (or in addition to) responding to dynamic prices by altering their use of the product, labelling can also assist buyers to select appliances with demand response capability. Their motivation to do so will depend on the perceived benefit. This is likely to come from financial incentives from

<sup>2</sup> The signal may be an instruction such as 'operate at 50% of maximum rated output for the next 30 minutes'. It may be originated by a remote agent, or by the software in the customer's own equipment, for example, if it receives an indication that pre-selected 'critical peak price' electricity levels have been reached. Possible ways to signal, respond to and over-ride demand response are set out in AS4755-2007 *Framework for demand response capabilities and supporting technologies for electrical products*.

<sup>3</sup> The provisional title for the Standard, which is being developed by committee EL-054, is AS4755.3.3-*Interaction of Demand Response Enabling Devices and Electrical Products: Operational Instructions and Connections for Air Conditioners*. It is due to be released for public comment in May 2008.

electricity suppliers (network operators, retailers or both) for participation in demand response programs. The utilities which have trailed or are currently trailing such programs include ETSA, Western Power, Ergon, Energex and Integral Energy.

Different utilities are likely to offer different levels of incentive according to their preferred level of demand response capability. All products claiming demand response capability under AS4755 must meet DRM 1 at least. However, the presence of DRM 2 and/or DRM 3 may make the product more attractive to some utilities (eg because it makes the air conditioner more likely to remain in a Demand Response program because the original buyer or subsequent occupants of the house will have a wider range of participation options) and less attractive to others (eg because total shut-off in emergencies is not an option). Also, some utilities will have simple communication systems that can only access DRM 1, while others will be able to access DRM 2 and DRM 3 as well:

*Communications networks will inevitably differ in different parts of the country and may involve different and proprietary communications protocols, which would therefore need to be inherent in the devices. This represents a significant issue that would need to be addressed. It also represents a potential barrier to customer take-up of DLC (direct load control) products, given that a customer would need to ensure that the appliance they purchased was suitable for the DLC system operated in their distribution region (NERA, 2008a, pp 166).*

### 2.13 Standby and Crankcase Heaters

Since March 2006, it has been mandatory for new registrations for MEPS and energy labelling to report data on the power consumption in standby and off modes as well as information on the power consumption of crank case heaters (where applicable). There are about 1850 approved records that contain this data to date (about two thirds of current approved registrations). Some approved registrations entered before March 2006 do not have this data and still remain current. Around 20% of records with the data entered have a crankcase heater, around 85% consume energy in standby, and 55% consume energy in off mode. It needs to be noted that there appears to be discrepancies in the registration data for a few models, but this does not detract from the general analysis and conclusions in this report.

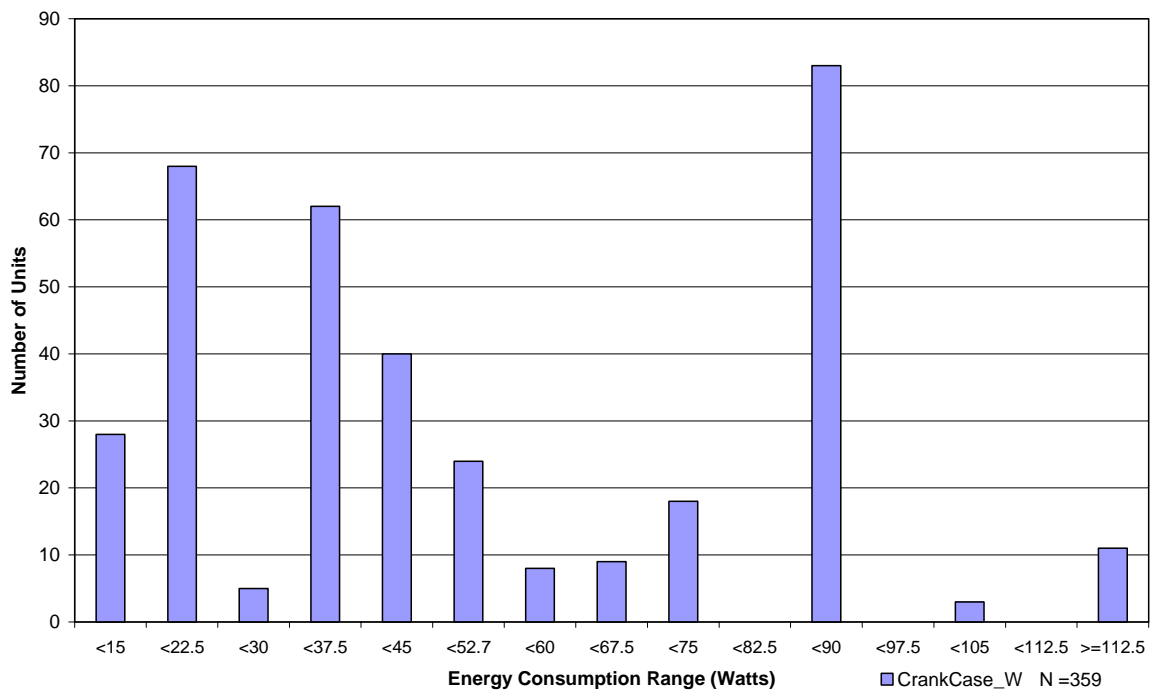
**Table 31: Air Conditioner Energy Consumption Values for Standby and Crankcase Heaters**

			Sample Size N =
			359
			355
			1205
			313
			710

For products with a crankcase heater, only standby mode or off mode will be the predominant power consumption when not in use. Similarly, for products without a crankcase heater, only standby mode or off mode will be the predominant power consumption when not in use.

Figure 24 below show the distribution of crankcase heater power for approved air conditioners (only those 359 models with crankcase heaters). It can be seen that there is a range of power levels (which will be present whenever the product is not operating), although of concern is the number of units that use between 90 and 97.5 Watts; which also contains the highest share of units with a crankcase heater.

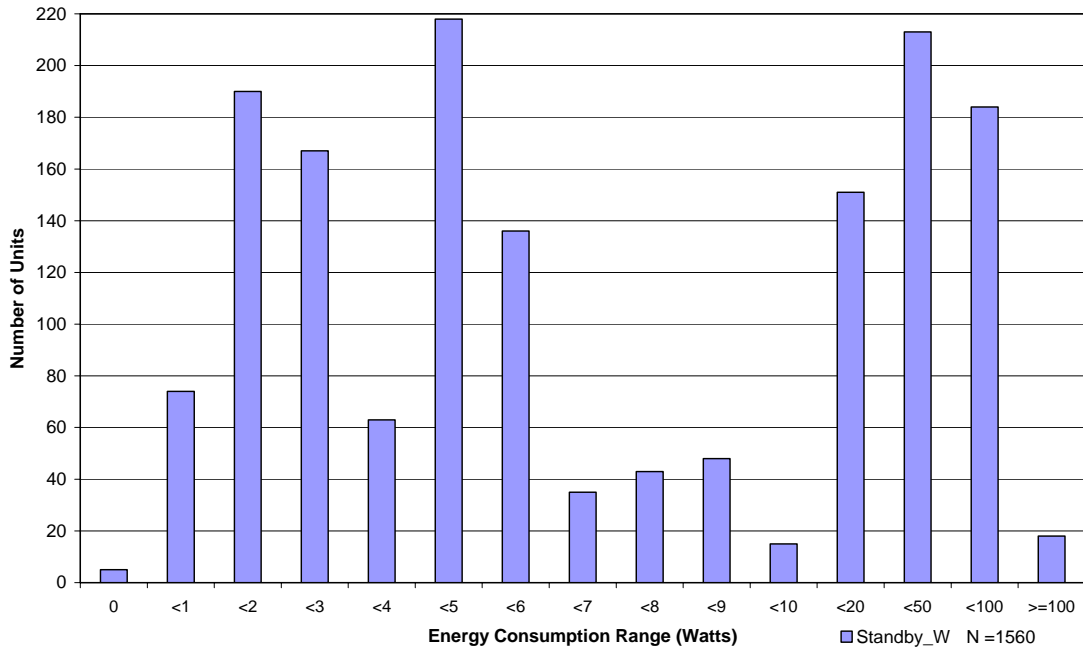
**Figure 24: Heater Power in Watts for Approved Air Conditioners with Crankcase Heaters**



Note: bin sizes are non-linear

Figure 25 below shows the power consumption in standby mode for approved air conditioners (for those 1560 models with a standby mode – includes some units with crankcase heaters). It can be seen that there is a range of power consumption, although of concern is the number of units that use more than 20 Watts, some of which do not claim to have crankcase heaters.

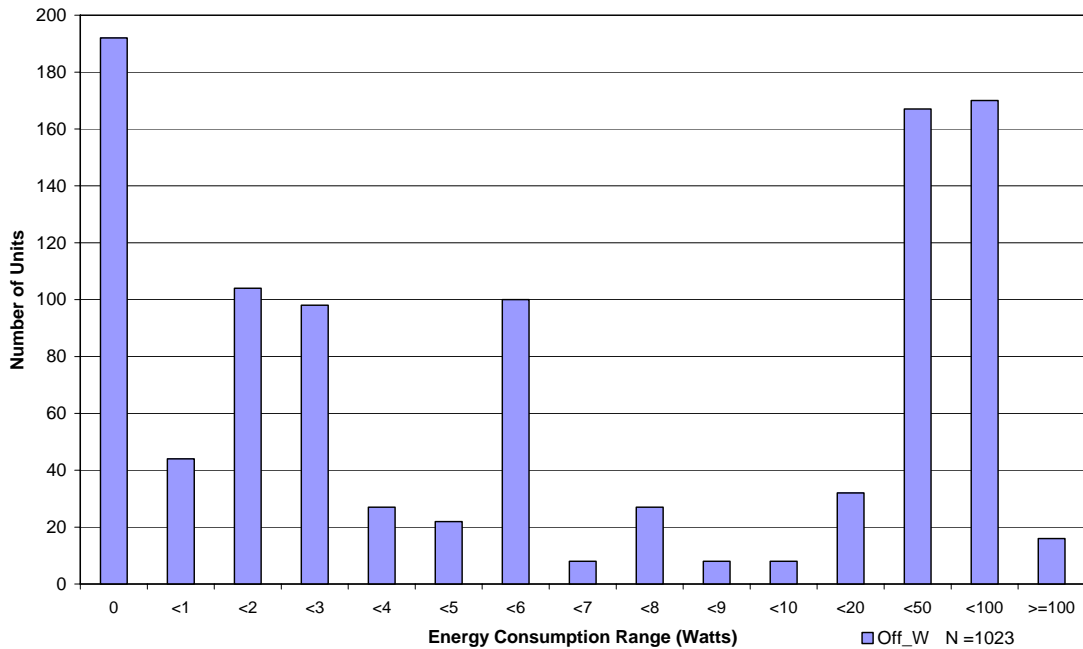
**Figure 25: Energy Consumption in Watts for Registered Air Conditioners in Standby Mode**



Note: bin sizes are non-linear

Figure 26 below shows the power consumption in off mode (for those 1023 models with an off mode – includes some units with crankcase heaters). It can be seen that there is a range of power consumption, although of concern is the number of units that use more than 50 Watts.

**Figure 26: Energy Consumption in Watts for Registered Air Conditioners in Off Mode**



Note: bin sizes are non-linear

Many products (but not all models) have both off mode and standby mode present.

This data shows that the power levels in off mode, standby mode and for crankcase heaters is substantial in some cases. At a power consumption of 50 Watts, the annual energy consumption would be 388 kWh per year (assuming 1000 hours usage, or 7760 hours not operating), which is the equivalent energy consumption a large new household refrigerator. At this stage, even though off mode, standby mode and crankcase heater data has been collected since early 2006, there are no requirements regarding this energy consumption in terms of an impact on energy labelling or MEPS (which only use operational efficiency and at this stage ignore any power consumption when not in use).

Figure 27 and Figure 28 below show the impact of crankcase heaters and standby consumption on annual overall EER for 500 hours of operation per year and 1500 hours of operation per year respectively. The current regulatory system does not take any non operational power consumption (so this is 0 Watts on the figures). It can be seen the impact of crankcase and/or standby consumption on EER increases markedly as the input size of the unit decreases. This decrease is accentuated as the hours of use decrease and the on mode energy consumption also decreases. For example, in the case of a 0.5 kW split system air conditioner with a crankcase heater of 50 Watts, the annual EER falls from 3.5 down to 1.3 for 500 hours use a year at rated capacity and in the case of a 75W crankcase heater the annual EER is 1.0, which is the same as a resistive heater. This level of use would be typical for many of these units. This example demonstrates the importance of including non operational energy consumption in the overall annual efficiency for air conditioners to enable consumers to make informed purchase decisions and to take this power consumption into account for MEPS.

Figure 27: Impact of Crankcase and Standby on Annual EER for 500 Hours of Operation per Year

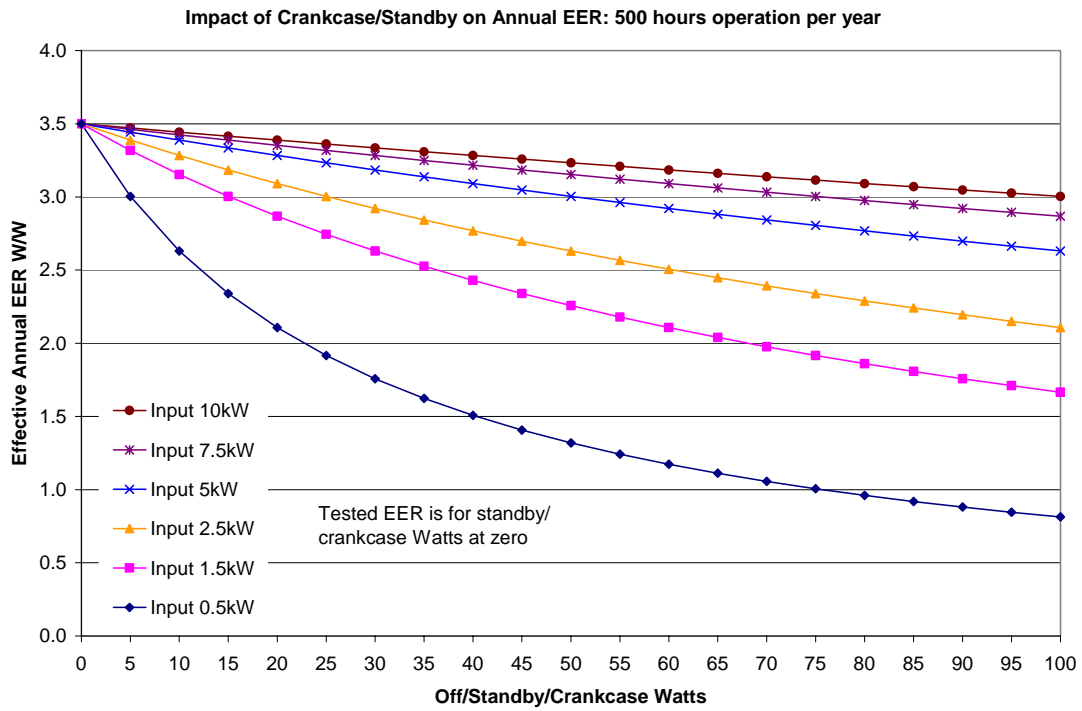
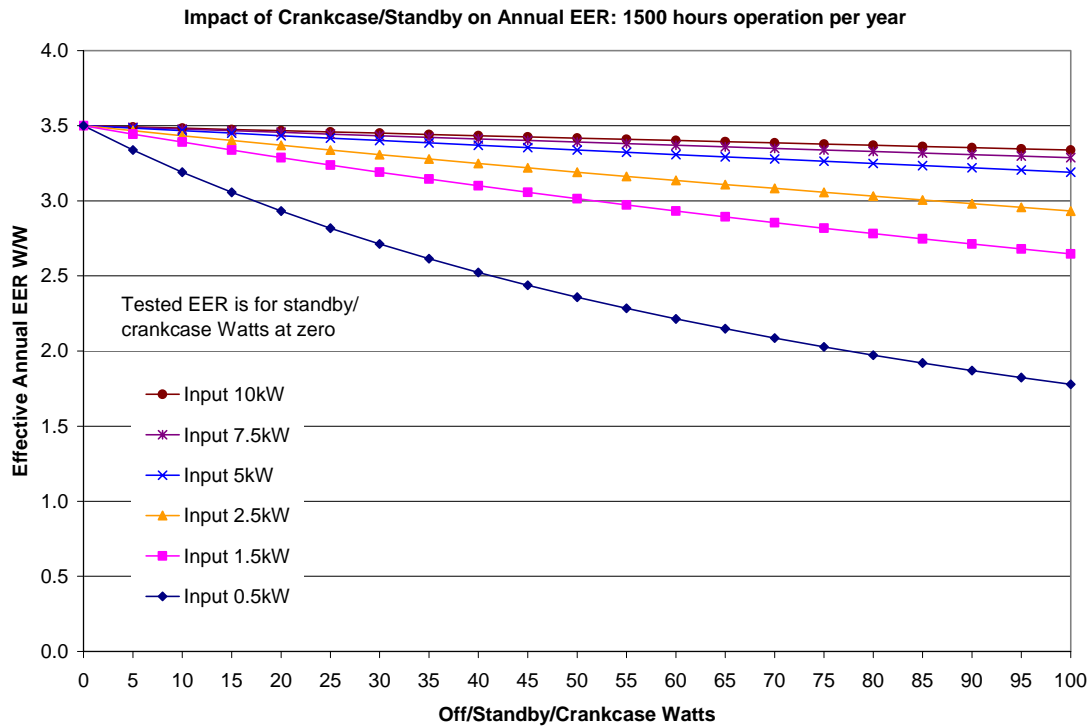


Figure 28: Impact of Crankcase and Standby on Annual EER for 1500 Hours of Operation per Year



### 2.14 Power Factor

Since March 2006, it has been mandatory for new registrations for MEPS and energy labelling to report data on the power factor during operation. The issue of power factor is often raised in the context of peak load and utility distribution issues – a poor power factor increases the current required (for a given input power) which can affect the sizing of distribution transformers and other elements of the distribution system. Given that many states now have summer peak loads and this is driven by air conditioning loads, some consideration of power factor is a potentially important issue, mostly from a peak load perspective.

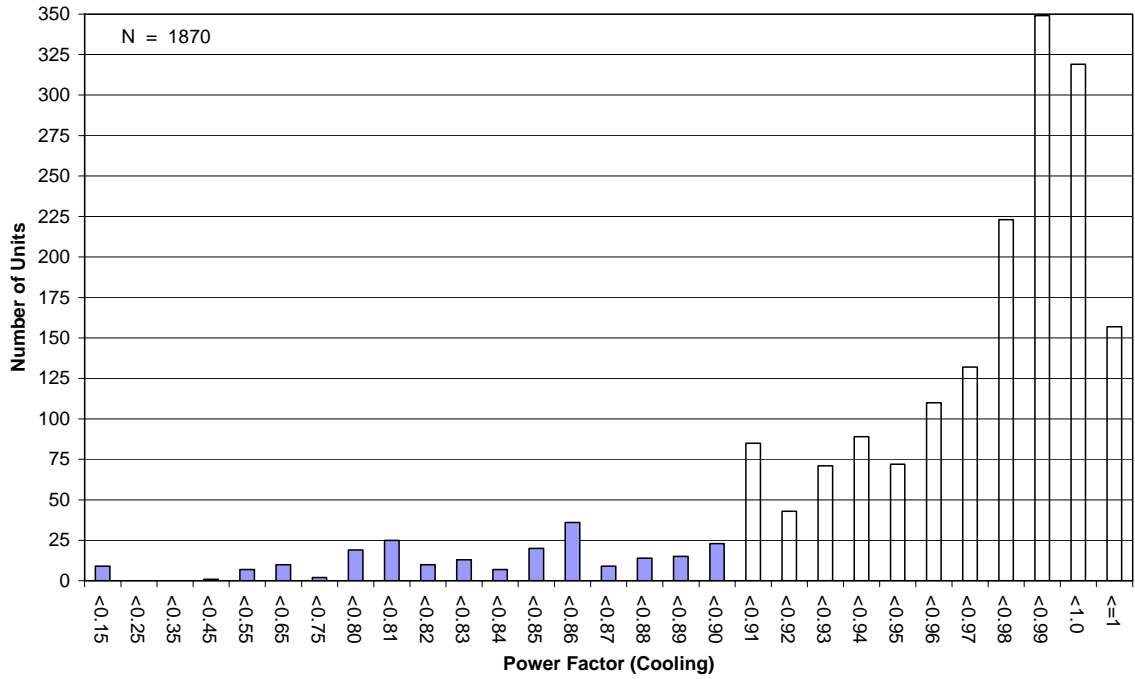
The power factor of an AC electric power system is defined as the ratio of the real or active power (the energy over a particular time) to the apparent power (the product of the current and voltage of the circuit); the lower the ratio, the lower the power factor. Currently there is no specific requirement for the allowable power factor for air conditioners. Figure 29 and Figure 30 below show the power factors for approved air conditioners for cooling and heating modes respectively. It can be seen that the vast majority of units have a power factor greater than 0.9, but units that claim a power factor of exactly 1 are perhaps suspect. Units claiming less than 0.85 are of some concern for the reasons listed above. The few models with a reported power factor of less than 0.5 may be spurious data.

There are about 1900 approved records that contain data on power factor to date.

**Table 32: Air Conditioner Power Factor Values for Cooling and Heating**

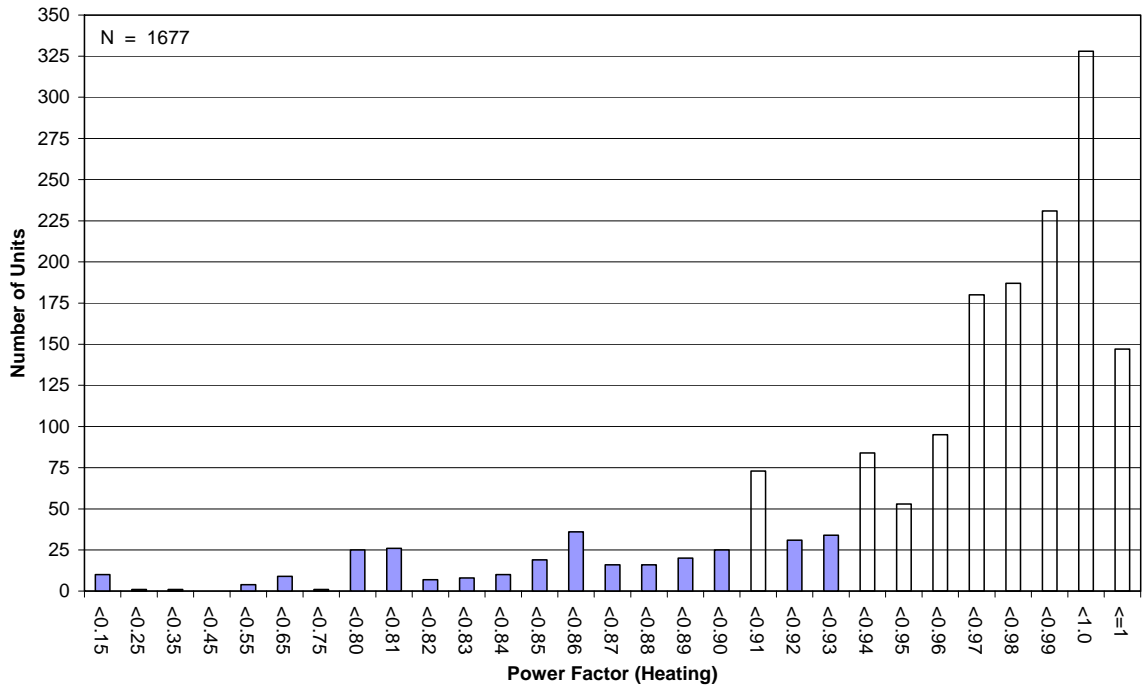
		Sample Size N =
		1870
		1677

Figure 29: Power Factor (Cooling) for Approved Air Conditioners



Note: bin sizes are non-linear

Figure 30: Power Factor (Heating) for Approved Air Conditioners



Note: bin sizes are non-linear

Given that most units appear to have a satisfactory power factor already, it would seem to be desirable, expedient and of low market impact to set a mandatory lower limit on power factor as part of the new MEPS and labelling proposal to eliminate the few models that have very poor power factor attributes. Such a proposal is expected to have wide industry support as well as support from electricity supply utilities.

## 3. Regulation Objectives

### 3.1 Objectives

The primary objectives of this proposal are to minimise the social costs (economic and environmental) associated with the supply and use of air conditioning services and to bring about reductions in Australia's greenhouse gas emissions below what they are otherwise projected to be (ie the "business as usual" case), in a manner that is in the community's best interests.

In addition to meeting the primary objective, any option for addressing the problems identified in the previous chapter should also meet appropriate assessment criteria.

#### 3.1.1 Assessment Criteria

The primary assessment criteria are the comparison of the projected costs and the projected benefits of the proposal compared to the base case of the program continuing unchanged.

Secondary assessment criteria are:

1. Does the option minimise negative impacts on product quality and function?
2. Does the option minimise negative impacts on manufacturers and suppliers?
3. Is the option consistent with other national policy objectives, such as reduction in the emissions of ozone depleting substances?

## 4. The Proposed Regulation and Options

The options considered to achieve this objective are to continue driving energy efficiency of the air conditioner market by the possible introduction of:

- non-regulatory approaches to achieve improved efficiency measures;
- more stringent MEPS levels for selected products in cooling mode;
- MEPS levels for heat mode for the first time for all products;
- measures that reduce standby power consumption and the energy used by crankcase heaters for air conditioners or where compensating increases in operating efficiency are required to counterbalance these elements;
- a new energy labelling algorithm and energy label for air conditioners; and/or
- a combination of some of these measures.

Other technical requirements are included to improve the performance and function of air conditioners but which do not necessarily result in any significant reduction in energy consumption.

The specific objectives of the energy label algorithm re-grade would be to:

- Maintain a reasonable spread of star ratings on the market for all classes and capacities, so buyers are motivated to seek out more efficient options;
- Provide sufficient space at the top of the energy rating scale so that suppliers can exploit the commercial value of introducing more efficient products;
- Ensure a good match between energy consumption under test conditions and energy consumption under use conditions, at least in a comparative sense;
- Assure that both suppliers and consumers have continued confidence in the integrity of the program.

Air conditioners are different to other products considered for regulation as many air conditioner types have been subjected to regulatory requirements since 1987. All products within the scope of this RIS are now subjected to mandatory Minimum Energy Performance Standards and almost all single phase non ducted units are subjected to mandatory energy labelling. Other air conditioning products carry an energy label on a voluntary basis as long as they meet the same requirements (testing requirements, registration etc).

The different appliance types covered by this RIS have differing programs concerning them. Single phase non ducted products<sup>4</sup> have been all been subject to mandatory energy labelling since 1987 and MEPS since 2004. Single phase ducted products may now carry an energy label on a voluntary basis and they have also been subjected to MEPS since 2004. All three phase products may carry an energy label on a voluntary basis and they have also been subjected to MEPS since 2001.

Normally a RIS would require consideration of non regulatory options in order to achieve the objectives stated by COAG. However, previous RISs have justified the current regulatory regime and have all passed the required regulatory review process in previous years as follows (refer to references for details – all reports are available from [www.energyrating.gov.au](http://www.energyrating.gov.au) in the electronic library):

- Labelling algorithm change in 2000: GWA 1999a and GWA 1999b
- Introduction of MEPS for three phase air conditioners in 2001: GWA 2000
- Introduction of MEPS for single phase air conditioners in 2004: Syneca 2003
- Upgrading of MEPS levels for single and three phase air conditioners in 2006/2007; Syneca 2005

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<sup>4</sup> At the time of its introduction in 1987, all systems to 7.5kW had to carry an energy label. The scope of energy labelling was changed from 7.5kW to single phase in 2000 while the requirement to mandate energy labelling only for single phase non-ducted systems was introduced in 2003.

Governments have indicated a strong desire to increase the energy efficiency of products on the market and the active dismantling of the current regulatory regime of energy labelling and MEPS, which has been very effective in reducing energy consumption to date, is not being actively considered as part of this RIS. The consequences of this option, which would be considerable in terms of a degradation in energy efficiency, have not been quantified for this regulatory impact statement.

Two possible non-regulatory options are considered feasible to operate in parallel with the existing regulations and these are outlined in the following section. Regulatory options are outlined in the subsequent sections.

## 4.1 Non Regulatory Options

### 4.1.1 *Voluntary Labelling Algorithm Change*

The first option is that the labelling algorithm change proposed be made voluntary rather than mandatory as is proposed. While conceptually this may be attractive, there are a number of serious ramifications from such an approach. The energy labelling regrade reduces the number of stars allocated to a particular product. Therefore suppliers will actively resist moving to the new energy labelling algorithm as they will receive a lower number of stars under the new algorithm compared to the existing algorithm and their product will appear less efficient to consumers. Without an enforced timetable for change to the new algorithm, it is likely that few, if any suppliers would adopt the new star rating algorithm for their products. The other serious issue is that without an enforced timetable for transition, there is likely to be a mix of old and new labels on display on the market for a considerable time, which will increase consumer confusion and may undermine the effectiveness of the energy labelling scheme overall. So a voluntary transition to the new energy labelling algorithm can be ruled out as an alternative proposal in this RIS – the only labelling options considered are to maintain the current algorithm for an indefinite period or to upgrade to a new labelling algorithm within a defined timeframe. It is important to note that the transition arrangements proposed have been developed in close consultation with industry and provide the maximum flexibility during the changeover.

### 4.1.2 *Rebate Option*

The second non-regulatory proposal considered is a subsidy or rebate for consumers to purchase more efficient air conditioners. A rebate could be an effective non regulatory measure to change consumer purchasing patterns. This is examined and quantified in more detail in the following section.

A rebate to purchase a more efficient air conditioner is a possible non regulatory option which could be implemented as an alternative to regulatory labelling and/or MEPS options, which are also considered in this RIS. The approach would be to offer a rebate of a specified amount to purchasers of an air conditioner that achieved a minimum specified efficiency level. The intent would be to increase the share of high efficiency air conditioner sales in order to achieve a comparable overall increase in average efficiency for new air conditioners sold under a regulatory option.

Given the analysis of price and efficiency for air conditioners sold in 2006, there appears to be only a weak correlation between price and efficiency for products of a similar type, features and size. However, a large step in the efficiency could result in a small increase in purchase price. This would be similar in overall effect for a MEPS option of a rebate option. For the proposed increase in EER (efficiency) of about 1.0 for products eligible for a rebate, consumers could be expected to pay of the order of \$50 to \$130 more in terms of purchase price (not considering the benefits from reduced energy costs which would offset these costs). An evaluation of a number of programs such as the water efficiency program and the impact of rebates offered to purchasers of clothes washers indicates that a rebate of the order of \$150 per product would be required to attract the attention of consumers and alter their purchasing behaviour (ISF 2008). A rebate of this size would appear to be the minimum to overcome the possible increase in purchase prices resulting from the increased efficiency and to make it worthwhile for consumers to seek the rebate.

The sales weighted efficiency of products currently on the market and offered for sale in 2008 is in the range of EER 2.9 to 3.1 (W/W), depending on the product type. The energy impact of the MEPS proposal is to increase the overall sales weighted EER by about 0.2. So a rebate approach should aim to have a comparable market impact in terms of energy efficiency, if it is to be considered a viable option.

The EER MEPS requirement for most products is now 2.5 or 2.75 for ducted systems, 2.75 for window wall and 3.05 for split systems (depending on size, noting that split systems dominate sales). To have a significant impact, a rebate should only be available for products that exceed the MEPS level by a considerable margin – eg by an EER of 1.0 (ie an EER of 3.8 on average, depending on the product type). Many products on the market are already well above the MEPS level, so the sales weighted average EER is already 0.2 above the average MEPS level – a total average of around 3.0. There are also a considerable number of models on the market that fall into the eligible category (1.0 above the MEPS level), but their current sales share is small, at around 5%.

When offering a rebate to achieve a minimum efficiency level, models that already meet the requirement will be eligible immediately. The change in the market average efficiency depends on which models reduce their sales in order to purchase products that are eligible for the rebate. The energy impact would be less than predicted if purchasers of higher than average efficiency products (ie already at 0.5 above the MEPS level) were moving to eligible products, whereas the impact could be larger than expected if purchasers of lower than average efficiency products (say only at the MEPS level) were moving to eligible products. For this analysis, an optimistic assumption of an average case (currently 0.2 above the MEPS level) moving to eligible products is assumed.

Total sales of air conditioners within the scope of a possible rebate are about 700,000 per year (assuming only single phase models are eligible – such a small rebate would have no impact on commercial products due to their much higher purchase price). If 5% of sales are already eligible for a rebate, this would have to increase to 26% to achieve an increase of EER of 0.2 (assuming purchasers were moving from average

market products to eligible products). This would need to be 30% or more if purchasers of above average products were the main consumers attracted to the rebates.

Assuming an administrative cost about \$50 per rebate (which based on data from other programs, is low), the funding for this program would be  $0.26 \times 200 \times 700,000$  which is \$36.4 million per year. This could be of the order of \$42 million per year if consumers that were otherwise selecting higher efficiency products were opting for a rebate. Funding for this program element would need to be maintained for an indefinite period to maintain its effect in subsequent years.

To put this in perspective, this funding is about 10 times the current total annual national government budget for energy efficiency within the energy efficiency committee of the government (E3).

This option can safely be ruled out of detailed consideration in this RIS as the NPV of just 3 years of rebate at this level would be more than the total net benefit arising from the MEPS proposal (Scenario A) over the period to 2020, assuming the effect would continue after the rebate has ceased in 3 years (unlikely). Obtaining a commitment for external funding of around \$110 million is not a trivial exercise. The benefit cost ratio would fall from around 3 under Scenario A (no rebate) to about 1 (no new regulation, rebate only).

There are a number of issues with a rebate approach which weight against its use. Firstly, to achieve an equivalent energy saving, the total value of rebates as indicated above would have to be considerable as indicated above. It is unclear where a funding stream for rebates would be obtained for this program. This could be funded by government or by electricity utilities. Given that air conditioner owners are already considerably more expensive for electricity utilities to supply compared to non air conditioner households (mostly associated with peak load issues which are not considered in this RIS) (GWA 2004), a further subsidy by electricity utilities for any air conditioner purchase would seem to exacerbate this situation further, which is undesirable.

The second issue is that the market response to the program is somewhat uncertain. At the proposed rebate level, the market response could be small (in which case their total value of rebates would be small but the associated energy savings would also be small) or the market response could be large. In the latter case, the total budget allocation could be used up very quickly, which could cause the program to be terminated. Starting and stopping of programs has the potential to confuse consumers and send mixed messages in terms of priorities.

Thirdly, the expected price increase for an increase in EER of 1.0 would take up a significant part of the rebate value. This has a large overall negative effect on the benefit cost ratio as the rebate appears as a program cost and the increase in purchase price of products also appears as a program cost.

A serious issue in any such rebate scheme is free riders – these are consumers that avail themselves of the rebate but who would have purchased the eligible product in any case. Free riders increase the total cost of the rebates but should not be counted

as part of the market impact or response. A survey of whitegood purchasers shows that as many as 50% of purchasers of front loading washers that received a rebate would have purchased the appliance even without the rebate (BIS Shrapnel 2006). While the number of free rider may not be quite as high for air conditioners, it could be considerable. This effect has not been explicitly included in the above calculations – the presence of any free rider reduces the savings arising from the program. The other associated free rider effect is the product efficiency eligible purchasers would otherwise have purchased. It is likely that many will be consumers that would have chosen higher efficiency products in any case, which means the energy impacts are somewhat overestimated while the costs remain the same. All of these factors go to substantially reducing the overall energy savings attributable to the rebate approach but the program costs remain unchanged.

The other negative consequence of rebates is that retail prices often rise to absorb some of, if not all of, the value of the rebate, which means that the consumer is little better off compared to a non rebate approach. This impact is well documented market effect but has not been factored into the above analysis, which assumes that retail prices are unaffected by any rebate.

Rebates are only effective for consumers that are active in the purchasing process. Rebates will have no effect on many of the main market failures identified in this RIS (refer to Section 2.7), so this market segment, which is considerable for air conditioners, will not be addressed by such a proposal.

Given the poor benefit cost outcomes from a rebate approach and the wide range of possible negative outcomes, this option has not been fully costed as an alternative in this RIS but this analysis has been included for completeness.

## 4.2 Proposed Regulatory Options

The regulatory options quantified in this RIS cover a range of proposals regarding air conditioners. One option is to increase current cooling MEPS levels for most single phase products. It also proposes changes to the MEPS levels for some three phase products to rationalise the MEPS requirements for single and three phase ducted products for the smaller size ranges. These changes only cover products that use air as their heat source for heating or heat sink for cooling. The other option is a re-grading of the mandatory energy labelling algorithm for single phase non-ducted products. Other issues such as MEPS for heating efficiency, standby power and crankcase heaters and an indication of demand response capability, which have all become significant problems, have also been addressed as options under the proposal.

The main options considered are to look at new MEPS levels together with a labelling algorithm upgrade (Scenario A), MEPS alone (Scenario B) and labelling alone (Scenario C). The option of MEPS and labelling together (Scenario A) is documented here to provide all of the technical details. The benefits and costs of each of these program options is compared to the status quo (Base Case – no change to current labelling and MEPS) and is documented in the next section.

A note concerning the Proposal: products subjected to mandatory labelling and MEPS are assumed to have an effect from both program elements while products where energy labelling is voluntary (ducted and three phase systems) are assumed to have a program impact from MEPS only.

#### 4.2.1 *Outline of Regulatory Elements*

The proposal, including all of the options considered, will require a revision to AS/NZS3823.2 to include the following relevant elements:

- more stringent MEPS levels for selected products for cooling mode;
- MEPS levels for heating mode for the first time for all products;
- measures that reduce standby power consumption and the energy used by crankcase heaters for air conditioners, or which require a corresponding increase in on mode efficiency to compensate for non operating mode energy consumption;
- a new energy labelling algorithm and energy label for air conditioners;
- new requirements for minimum power factor;
- collection of Demand Response capability of air conditioners at the time of energy registration and voluntary marking of this capability on the energy label and website.

The technical details of the proposal are set out in the following sections.

#### 4.2.2 *More Stringent MEPS Levels – Cooling*

MEPS levels proposed for introduction in October 2008 were published by government in 2005 as a result of an international review of MEPS levels earlier in 2005 (EnergyConsult, 2005, E3 report 2005/03) and these were included in AS/NZS3823.2-2005. These new levels were also included in a consultation RIS that was released in 2005 (Syneca 2005). The new MEPS levels represent a modest increase in the minimum mandatory efficiency levels when compared to the 2006/2007 levels which have already been implemented.

After discussions between industry and government in 2007, it was agreed to delay the implementation of the published 2008 MEPS levels by 12 to 18 months (refer to letter from the chair of E3 dated 16 May 2007 – refer <http://energyrating/pubs/2007-meps-ac.pdf> ). The deletion of the 2008 MEPS levels from AS/NZS3823.2-2005 was included in Amendment 4 which was published on 29 February 2008. These levels will again be included in a revision of AS/NZS3823.2 that is prepared to include proposals in this RIS, once approved.

The new MEPS levels for non-ducted units are now proposed for introduction in April 2010 and are set out in Table 33 and will be upgraded in 2011 by the inclusion of non-operating energy. The new levels only apply to air source and air sink products and are intended to replace the published levels in Table 3.1 of AS/NZS3823.2-2005 (and are fully comparable with the levels listed for 2008). These new levels apply to both single phase and three phase products of the nominated capacities.

The second part of the MEPS proposal for cooling is to rationalise the requirements for ducted single phase and three phase products. Currently there are differing requirements for the same sized ducted products in single and three phase variants below 10kW. The proposal is to lift the MEPS levels for all ducted products (up to 19kW) to be an EER of 2.75, which is comparable to the requirements for three phase ducted products and all non-ducted products in this size range. As indicated, ducted systems warrant high MEPS levels as they usually have a much larger capacity, higher utilisation levels (typically used for whole house heating/cooling) and have losses associated with ducting which significantly lowers in use efficiency.

This proposal does not include any proposals to increase MEPS levels for air conditioners with water cooled condensers.

**Table 33: New MEPS levels for Air Conditioners (EER W/W)**

			<b>New MEPS – 2011 Annual</b>
			2.84
			No Change
			3.33
			2.93
			No Change
			2.75
			2.75
			No Change
			No Change
			No Change

Notes: Unitary are mostly window wall units. Types refer to Cooling Only or Reverse Cycle. Air source only.

The EER levels 2010 will be based on operating EER while the levels in 2011 will be based on annual EER as calculated in Section 4.2.4. The annual EER level based on both the tested EER values and the rated EER values must exceed the relevant MEPS level.

**4.2.3 New MEPS Levels – Heating**

As noted in the previous discussion, there have been no minimum energy performance standards (MEPS) on heating mode for air conditioners to date in Australia or New Zealand. This is despite the fact that over 30% of total air conditioner

energy is in fact used for heating and substantial parts of the population have a heating requirement that is larger than their cooling requirement (heating requirements dominate in Tasmania, New Zealand, Victoria and are substantial in parts of NSW, SA and WA).

The proposal for heating MEPS is to set a minimum COP which is equal to the minimum EER (MEPS level) for cooling for the same product category. This only applies to products capable of heating – that is reverse cycle models or models that are designed for heating only (heat pump) and that use air as a heat source for heating (which are currently unregulated for MEPS and which are currently rare in Australia and NZ).

This essentially sets a MEPS level on heating performance (COP) that is equal to the EER levels specified in Table 33. While this mandatory level will not drive the market to any great extent (as the inherent efficiency of an air conditioner is better for heating than for cooling as set out in Section 2.11), it will ensure that poorly designed products which have compromised heating performance in order to meet cooling MEPS levels will be eliminated from the market. Some 95% of models already easily comply with this requirement. While the energy impact will be small (but positive), this initiative needs to be seen as a consumer protection issue more than a means of lifting the overall heating performance of products. The cost of elimination of the few poorly performing heating products is negligible.

As for cooling EER, the COP levels in 2011 will be based on annual COP calculated in Section 4.2.4. The annual COP level based on both the tested COP values and the rated COP values must exceed the relevant MEPS level.

#### *4.2.4 New Requirements Regarding Standby and Crankcase Heaters*

As set out Section 2.13, the energy consumption associated with crankcase heaters, and to a lesser extent standby and off modes, is of major concern. The energy consumption associated with these features is likely to be as much as the total “on mode” or operating energy consumption for small products in some cases, yet this data is not explicitly included in either the energy label star rating or the MEPS levels for air conditioners. Consumers are understandably horrified when they find out that their air conditioner is using 50W, 100W or even 200W when not in use and cannot be eliminated. However, in most cases they can never find out this information, most manufacturers are reluctant to disclose it, and almost all such systems are hard wired into the building power circuits at the time of installation, meaning that in use power measurements are almost impossible with modifications to the power systems and installation of expensive metering by an electrician.

Data on standby, off mode and crankcase heaters has been collected since early 2006 and about 70% of current registrations currently have this data included.

The government has a policy of reducing standby power to a level of not more than 1 Watt by 2012 as part of its standby power strategy. However, a hard limit on standby and off mode for every product may eliminate products that have a high level of

energy efficiency during operation and that may in fact use less energy overall when compared to a product with lower efficiency but with good standby attributes.

The issue of crankcase heaters is more complex. Elements of industry argue that crankcase heaters are a technical requirement to eliminate damage to compressors during starting (to ensure that the refrigerant is kept in a vapour state when not operating to allow immediate start). However, many of these heaters consume large amounts of energy (most of these operate on a continuous basis and consume as much as 90W, which is the equivalent energy consumption of 2 large refrigerators over a year, some models have a heater power of 180W). However, designs or configurations that do not require crankcase heaters are readily available – nearly 80% of the 1,870 registrations as at March 2008 with this data recorded state that they do not have a crankcase heater. This includes all types and sizes. The share of crankcase heaters does vary somewhat by products type, but more than half of all products in each category do not have crankcase heaters.

Recent advances in the approach to standby power have acknowledged that in many cases it makes sense to bundle the operational energy with the non-operational energy (various low power modes – including standby) into a so called vertical approach where the total energy consumption of the product is used as the basis for regulation. This approach has already been implemented for dishwashers and clothes washers and is also proposed for televisions and a number of other products. As noted above, this approach keeps the standby energy (and crankcase heater energy, where applicable) in perspective with the operational energy consumption. In cases where products are covered by vertical measures, it is envisaged that separate standby requirements would not be included under the 1 Watt approach.

There are two possible approaches to deal with these issues, both include combining operational and non operational energy into an overall rating within a so called vertical approach.

The first option is to include the implied energy consumption through standby and/or crankcase heaters into the energy label star rating algorithm – this would in effect reduce the overall star rating as the power consumption for these secondary features (crankcase heaters and standby) increases. This measure would be mandatory in that they reduced star rating would have to be displayed, but it would not necessarily eliminate of poor product from the market. The problem with this approach is that many air conditioner products are not required to carry an energy label (ducted systems, three phase systems) and that some purchasers are not responsive to label information (label resistant or where there are market failures).

The second option is to include a penalty into the measured EER/COP value for cooling/heating on the basis of reduced overall annual efficiency during a typical usage profile. This would not affect a product that has low standby and no crankcase heater, but products that do use significant standby power and/or where there is a crankcase heater will have to have a measured EER/COP that is well above the specified MEPS level to compensate for the energy consumption of the product when not in use. Hence the product would have to meet an annual EER/COP requirement

where the output is the total cooling or heating and the input is the energy when operating plus the energy when not operating.

A sensible variant of the above two options would be an integrated combination of both of these approaches – this would involve the calculation of an “annual” EER/COP which takes into account any crankcase heater energy and any standby power in the total energy consumption used to regulate the product (MEPS and labelling). The tested EER would be reduced to take into account the crankcase heater energy and any standby power in order to calculate an operational EER/COP. All products would be required to have an “annual” EER/COP that meets the published MEPS levels. The same value would be used to assess MEPS and used to calculate the star rating shown on the energy label. This would be the most internally consistent approach.

To calculate the impact of standby and crankcase heater energy consumption on total operational energy, it is necessary to assume a usage pattern for the product. The total operational energy consumption of an air conditioner is directly proportional to assumed hours of operation (at rated capacity), but standby and crankcase energy consumption will be less affected by assumed hours (as this is proportional to 8760 minus the assumed hours of operation). For air conditioners with a larger input power (larger compressors) the impact of crankcase heaters and standby will also be smaller (in a relative sense, although the absolute energy is still substantial).

The hours of operation for an air conditioner is known to be highly variable and depends on a range of factors such as climate and occupancy. For some household systems, typical hours of operation may be as low as 500 hours (or less). For central systems and commercial systems a figure of 1500 hours per year is probably more typical (2000 hours per year would be an upper limit for many commercial establishment occupancy = 200 working days a year × 10 hours per day). As demonstrated in Section 2.13, the effect of non-operational energy is lower in systems with a larger input power and reduces quickly with increased hours of operation. So to have an ameliorating effect on standby power and crankcase heaters, an assumed usage that is towards the lower end of the expected typical range will be more effective from a policy perspective.

The consultation RIS proposed the use of 1000 hours for this calculation. As a result of industry feedback and consultation arising from the consultation RIS, an assumed usage of 2000 hours per year is recommended for use in the calculation of the annual EER/COP in this decision RIS. While this assumption is more favourable to suppliers than previously proposed, the assumed hours can be adjusted within future MEPS proposals once better user data has been obtained. Suppliers also requested a longer transition for incorporation of this requirement into the MEPS levels. Hence the MEPS proposed for 2010 is based on operating EER or COP while the MEPS for 2011 is based in annual EER or COP. The timing for the inclusion of the annual EER or COP for energy labelling remains the same at April 2010.

The annual EER /COP used to calculate the star rating and determine compliance with MEPS is calculated using the following equation:

$$\frac{[\text{Tested output} \times 2000]}{[\text{Tested input} \times 2000 + \text{Non-operational Power} \times 6.760]}$$

Where:

Tested output is the measured output in kW for cooling \*

Tested input is the measured input in kW for cooling \*

Non-operational power is the maximum of off mode, standby mode or crankcase heater power, in Watts

\* except for heating only products where it is based in heating output

This equation assumes that the product is used for 2000 hours for heating or cooling or a combination of both modes (ie non operating period is 6760 hours per year for all products). For reverse cycle products, the heating and cooling calculation is done using the same assumption, which effectively shares the non-operational energy over both modes.

In cases where the manufacturer can provide evidence of a crankcase heater that has a positive temperature coefficient or where the operation and energy consumption of the heater is controlled on the basis of ambient conditions, the non operational energy in the equation above can be substituted for the estimated annual energy consumption based on hourly temperature data NatHERS AccuRate Climate Zone 28 (Richmond, NSW) scaled by a factor of 6760/8760.

The number of products eliminated as a result of this proposal are small because:

- Only a minority of products use substantial power when not operating and alternative designs to reduce or limit this energy consumption are readily available (but there has been no incentive to adopt these until now);
- Crankcase heaters are more prevalent on larger systems where non-operational energy has a much smaller effect.
- In cases where the supplier cannot eliminate crankcase heaters, they will have to ensure that they source products with a higher on mode efficiency (which are readily available) to compensate for the non-operational energy consumption.
- The efficiency of most products lie well above the current or proposed MEPS limits and even significant non-operation energy consumption (through standby or crankcase heaters) will not force their removal from the market (but it may affect their MEPS margin and/or energy label value).

This proposal to include non-operational energy into the efficiency requirements for MEPS and energy labelling will focus the attention of manufacturers on this important issue and will provide a strong incentive to minimise this wasted energy consumption. It will also provide a fairer indication to consumers of the overall efficiency of products including periods of non-operation, which are substantial.

The energy impacts and cost impacts of an additional 0.05 increase in EER and COP as a result of this measure have been included onto the costs and benefits estimated in this RIS.

#### 4.2.5 *New Requirements for Power Factor*

As noted in Section 2.14, a small minority of products appear to have poor power factors. This is of significant concern as electricity supply systems are most stressed during summer peaks and these are driven by air conditioner operation. The capacity of generation, transmission and distribution systems are at their lowest during extreme hot weather events. Products with poor power factors can contribute to overall system losses through high currents.

Only a handful of products have power factors lower than 0.85. The issue of power factor for air conditioners can be readily addressed through small changes in product design and the inclusion of low cost filters or capacitors in most cases.

The consultation RIS proposed the use of a minimum power factor of 0.90. As a result of industry feedback and consultation arising from the consultation RIS, the proposal has been modified to set a minimum power factor for heating and cooling operation at rated capacity of 0.85 as a minimum performance requirement for all air conditioners in this decision RIS. This requirement will be mandatory from 1 April 2011 to give industry more time to adjust to the new requirements.

As noted, this is not an energy efficiency issue but will result in benefits through better utilisation of the electricity supply system, particularly during peak load events. These benefits have not been included in the benefits estimated in this RIS. The proposal only affects a small minority of models and the costs of rectification are negligible in most cases and can be safely ignored. The proposal has strong support from electricity suppliers.

#### 4.2.6 *Collection of Demand Response Capability During Registration*

It is proposed that the revision of AS/NZS3823.2 should include the following provision:

If an air conditioner complies with the requirements of AS4755.3.1 – *Interaction of Demand Response Enabling Devices and Electrical Products: Operational Instructions and Connections for Air Conditioners*, then:

- The absence or presence and level of demand response capability must be reported at the time of registration for energy labelling and MEPS, using the report form in AS4755.3.1 (which will be reflected in AS/NZS3823.2).
- The level of capability *may* be indicated on the energy label by means of the marking in Table 34, Table 35, Table 36 and Table 37 as appropriate.
- Indications on the energy label shall be printed in accordance with the AS/NZS3823.2.
- If a level of capability is indicated on the energy label an identical indication, in the same format, must be permanently and indelibly marked on the compliance plate.

**Table 34: Optional Energy Label Marking for Air Conditioner Capable of DRM 1 Only**

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**Table 35: Optional Energy Label Marking for Air Conditioner Capable of DRM 1 and 2**

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**Table 36: Optional Energy Label Marking for Air Conditioner Capable of DRM 1 and 3**

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**Table 37: Optional Energy Label Marking for Air Conditioner Capable of DRM 1, 2 and 3**

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The purpose of the measure is to inform potential buyers of the presence of a feature of the product that could be of high monetary value to them. As the value is likely to be different according to where the air conditioner is installed, the mode of marking is intended to enable buyers to identify products which meet their needs and have value in their areas.

The cost of the obligation to report the absence or presence of such capability is negligible as the product is already regulated for energy efficiency; the supplier simply ticks the appropriate box. The benefit is that electricity suppliers and other stakeholders will be able to interrogate the energy labelling database to determine whether products they may encounter in the field are compatible with their demand response communications devices.

The additional cost of indicating demand response capability on the label and the rating plate is also negligible. Only those suppliers that perceive a commercial benefit in providing the demand response capability will do so, and only those who perceive a further advantage in communicating this information at the point of sale will do so. If however, the information is included, it would be in the expectation that a customer could benefit from the presence of the feature. The realisation of such a benefit would be greatly facilitated if the information is permanently marked on the product's compliance plate where it can be seen by the installer, and is not lost when the point of sale energy label is removed.

It should be noted that energy savings from demand response are negligible as products are only controlled on a few peak load days per year. However, the benefits arising from the collection and marking of this information are potentially substantial in terms of electricity supply infrastructure and related capital cost savings. These savings have not been quantified or included in the benefits of this RIS. However, future programs may wish to use this information for incentive programs or even as a basis for regulatory requirements in some jurisdictions, so early information collection is critical. Any such proposals may more fully quantify the costs and benefits of demand response measures.

In summary, the benefits of demand response capability are likely to be substantial if utilised, but these have not been included in benefits arising from this RIS. Similarly, any marginal costs associated with indicating demand response capability are negligible and have been bundled and amortised within other regulatory costs for re-registration which are required for MEPS and labelling.

#### 4.2.7 Revised Part Load Allowances for MEPS Compliance

Until 2008, AS/NZS3823.2 allowed variable output products to comply with MEPS at any load down to 50% of rated capacity. As part of Amendment 3 to AS/NZS 3823.2-2005 (published in February 2008), a revised part load requirement was introduced for products that do not meet MEPS at capacity. This has two elements:

- At rated capacity the measured EER shall not be less than 0.95 of the MEPS level;
- At a part load between 83.3% and 100% of the rated capacity the tested EER must exceed MEPS; or a part load between 50% and 83.3% of the rated capacity the tested EER must exceed the line defined by  $1.25 - 0.3 \times \text{Part load}$ .

These issues were canvassed widely with industry in the Inverter MEPS Discussion Paper released on the Energy Rating website [www.energyrating.gov.au](http://www.energyrating.gov.au) in 2007. The standard also set a sunset date and transition provisions for the current registrations that use part load for MEPS compliance (less than 20 models out of 3000 at the end of 2007). Despite this new more stringent requirement, the amendment stated that:

*Australian and New Zealand regulators intend to carefully review and possibly remove the part load MEPS compliance option for variable output products as part of the next MEPS level (nominally October 2009) (April 2010 in this RIS).*

Given the small number of models that use part load for MEPS compliance, there is a strong argument to eliminate this part load compliance option for MEPS. This will simplify compliance considerably and will eliminate a potential loophole in the requirements. The proposal in the consultation RIS was to eliminate all part load allowances for MEPS compliance as part of the new MEPS requirements.

As a result of extensive industry feedback arising from the consultation RIS and subsequent direct consultation with stakeholders, the proposal has been modified to retain the current Amendment 3 part load requirement in this decision RIS. This was favoured by the major industry associations, but not by all commentators.

The retention of the current Amendment 3 part load requirements for MEPS compliance is proposed on the basis that:

- Products registered using the old 50% output requirement to comply with MEPS (prior to Amendment 3) will be grandfathered on 1 April 2009 as stated in Amendment 3;
- Registrations to Amendment 3 will remain valid to 1 April 2010 (same as all other products);

- New MEPS levels from 1 April 2010 will include equivalent technical part load requirements in Amendment 3. These will be based on annual EER and/or COP (for both heating and cooling) from 2011;
- That suppliers provide the measured part load efficiency of their products at a standard rating point of 50% output as part of this requirement (to allow fair comparisons);
- A note remains in the standard stating that governments will review the part load MEPS allowance during development of future MEPS levels and may amend or delete the requirement as part of this process.

#### 4.2.8 *New Star Rating Algorithm and Energy Label – Heating and Cooling*

The proposal to introduce new energy labelling algorithms for air conditioners for both heating and cooling. This will result in the loss of between 1.5 stars and 4 stars, depending on the mode and product efficiency. This is intended to maintain the value of the stars on the energy label as a selection aid for air conditioner purchasers and as a motivation for suppliers to improve their star rating over and above the mandatory MEPS levels over the next 10 years. The algorithm change will also fill many of the lower star rating bins which have now been left empty due to increasing MEPS levels over time. The new algorithm therefore has a higher EER/COP for the 1 star threshold and a larger increase in efficiency per star (increasing the star size from 0.3 to 0.5 EER/COP bins). The other primary change is the alignment of heating and cooling equations for the first time (previous algorithms had a more stringent equation for heating which was a reflection of the inherently higher efficiency on heating mode for most products).

The new star rating algorithms for both heating and cooling are:

$$SRICooling = \frac{[(AnnualEER \times 8) - 18]}{4}$$

$$SRIHeating = \frac{[(AnnualCOP \times 8) - 18]}{4}$$

Where the annual EER and annual COP is determined as set out in Section 4.2.4.

These were prepared in consultation with industry in 2005 and were published in AS/NZS3823.2-2005 as Appendix F. These were designed to take account of the MEPS levels in 2006/7 and the levels proposed originally for 2008 (now comparable to 2010 levels in this proposal). It is important to note that the algorithm for heating and cooling star rating will be the same under this proposal.

The other important element to be introduced with the new energy label in 2010 is the inclusion of star ratings from 7 to 10 stars where products exceed the six star requirements defined in the new star rating algorithms. This will reduce the need to regrade star rating algorithms as product ratings increase in the future, which will reduce overall compliance costs for industry.

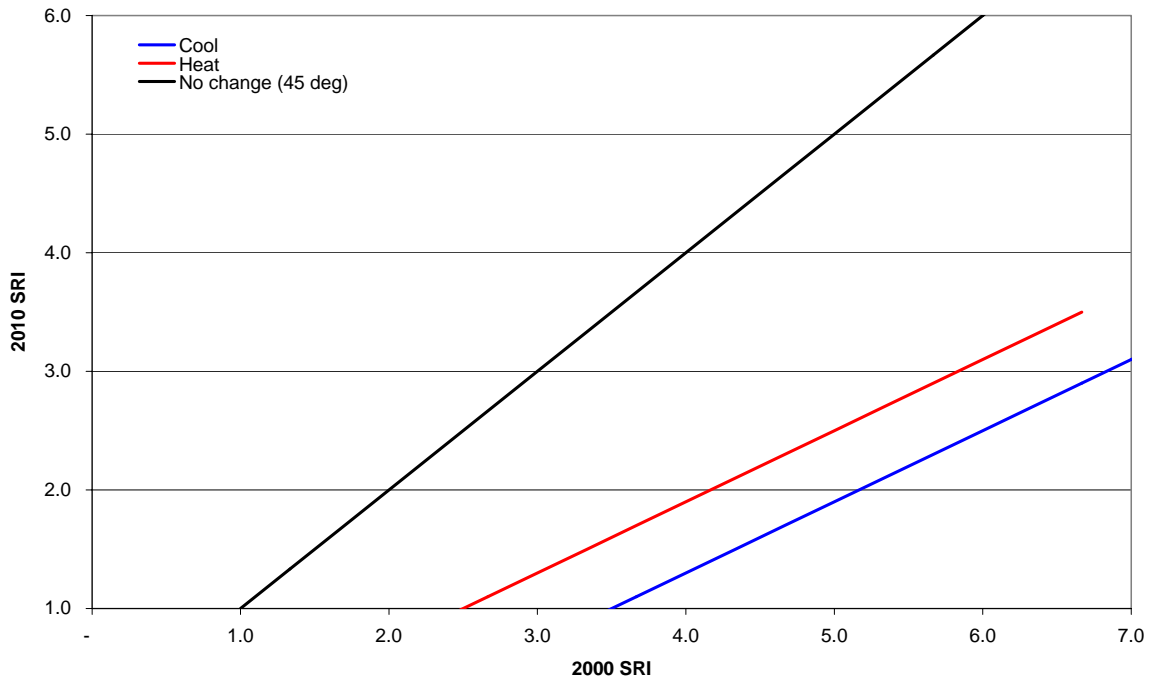
The effect of the new algorithms are set out in Table 38 and Figure 31.

**Table 38: Star Ratings: 2000 and 2010 Comparison**

			2010 star rating index heating and cooling
			-0.5
			0.1
			0.7
			1.3
			1.9
			2.5
			3.1
			3.7
			4.3
			4.9
			5.5

Note: Under the 2010 algorithm, 1 star is 2.75 with 0.5 steps per star. 6 stars is an EER/COP of 5.25 and 10 stars is an EER/COP of 7.25.

**Figure 31: Air conditioners – Star Rating 2000 vs Star Rating 2010**



For example, a product that current rates 2.5 stars for heating in 2000 will rate 1 star under the new algorithm. Similarly, a product that rates 6 stars for cooling in 2000 will rate 2.5 stars under the new algorithm.

The transition to the new label is to occur over the period April 2009 to April 2010 with all new products by April 2010 to carry the new label (or as soon as the revised part 2 standard is published).

Figure 32 below shows the proposed energy labelling algorithm for cooling for air conditioners. (with products eliminated by MEPS 2010 removed from the figure). Some units (not shown) may be below the 1 star line as they may have met MEPS using part load (inverters). The same comment is also true for Figure 33.

The lowest of any EER for non ducted units for 2007 was 2.75 (MEPS level) and that is now equal to the 1 star level under the new algorithm.

**Figure 32: Algorithm: 2010 Energy Labelling Algorithm for Air Conditioners - Cooling**

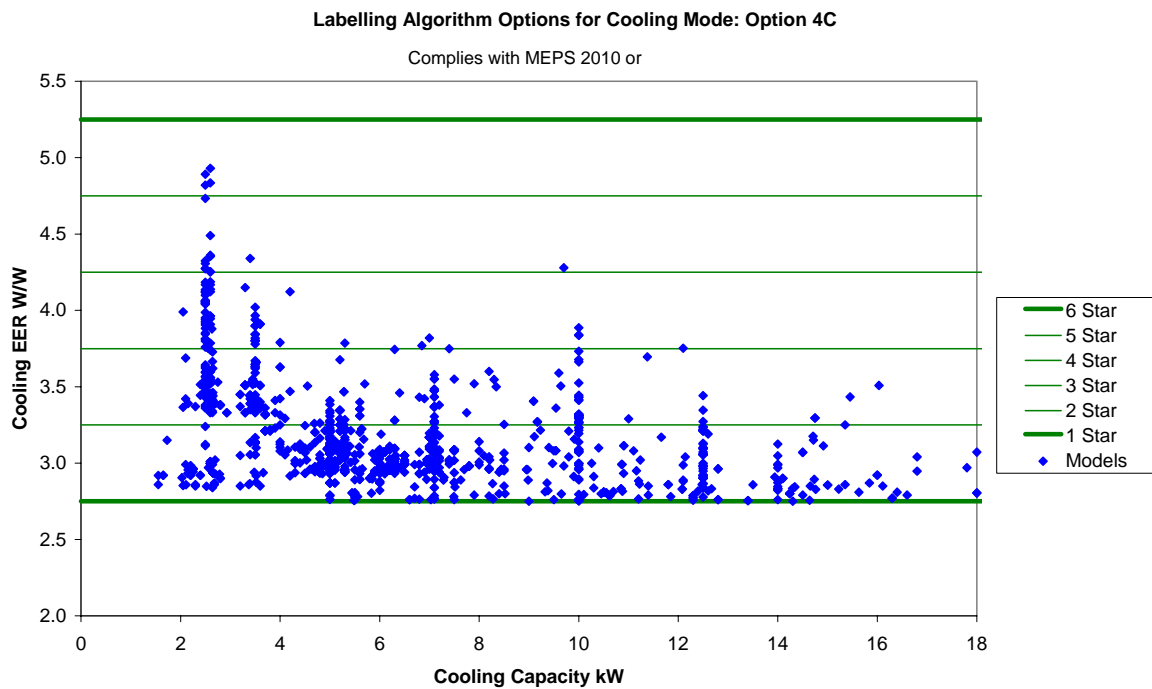
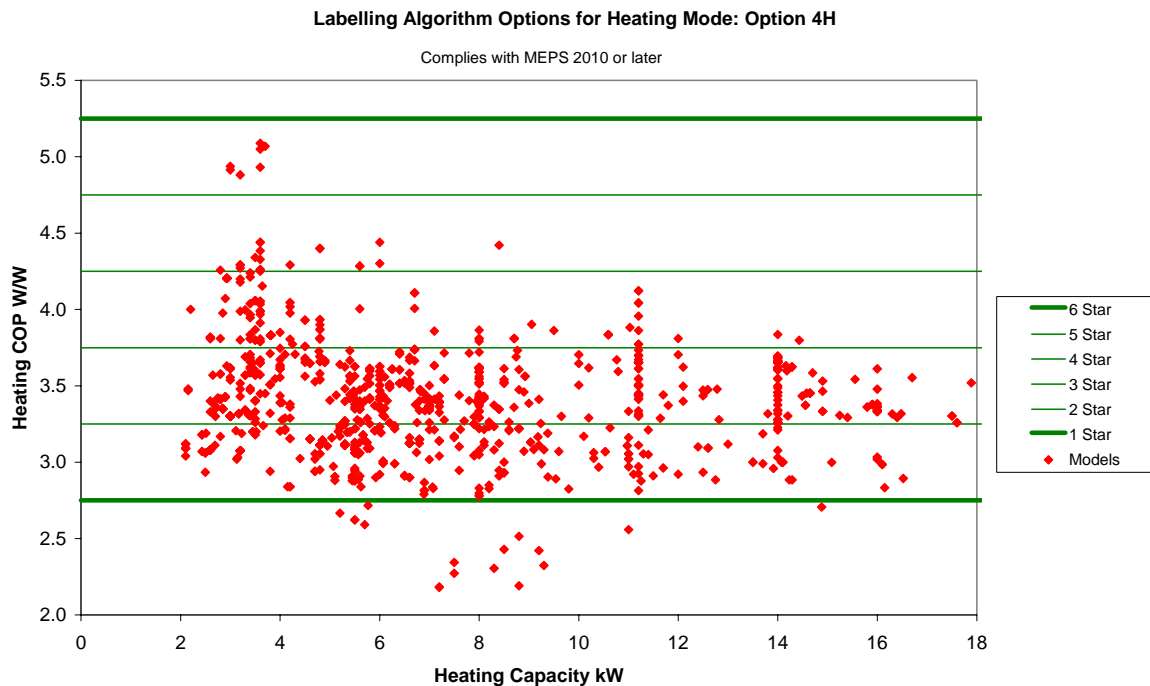


Figure 33 below shows the energy labelling Algorithm for air conditioners heating. The few products that have an COP lower than the corresponding cooling MEPS level will also be eliminated from this figure.

**Figure 33: Algorithm: 2010 Energy Labelling Algorithm for Air Conditioners – Heating**



The new algorithm has the following advantages:

- It provides the basis for good differentiation across different types and different size ranges and also within types.
- All products will achieve a star rating 1 star or better, except for those few products that use part load to achieve MEPS.
- Most products lie in the range 1 star to 3 stars under the new system, but there are a significant number of models for both cooling and heating that already achieve 3 stars or above due to MEPS.
- This algorithm provides a sound basis for the development of future high efficiency criteria such as Energy Star.

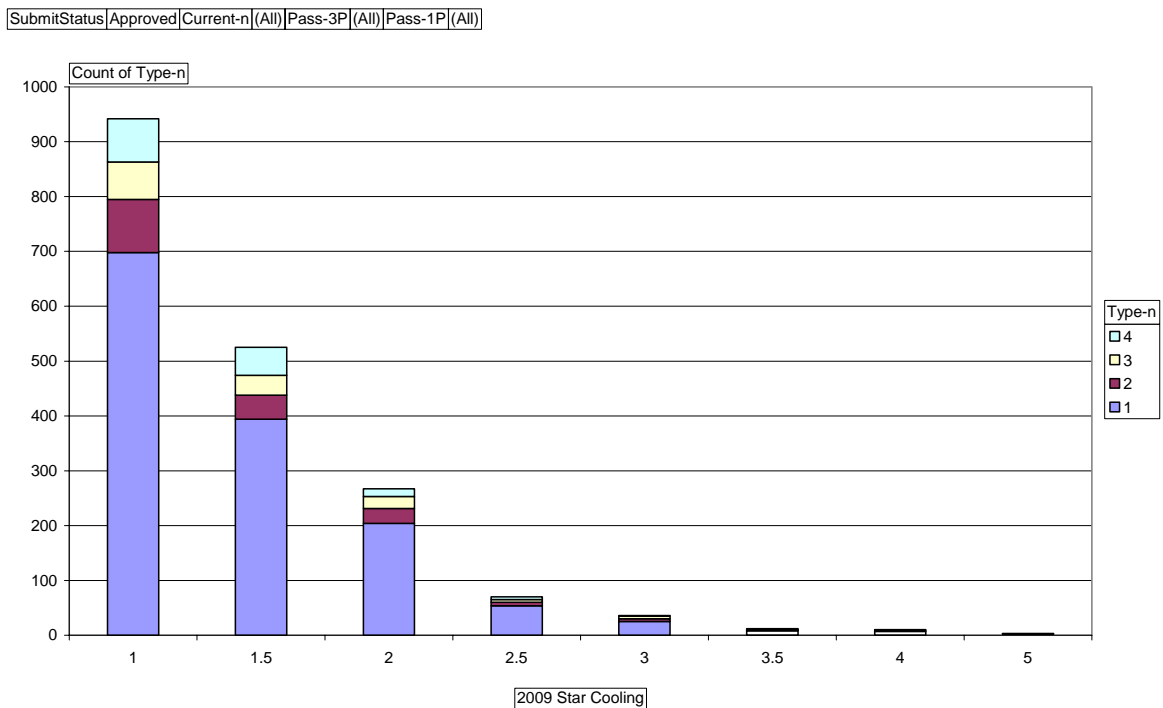
The algorithm provides a consistent star rating system that consumers can use during the selection process to compare products that perform comparable tasks.

The algorithm will be in the same form as it has been in the past. Consisting of horizontal lines indicating star rating levels that are unrelated to capacity. These lines have obviously been 'moved up' in relation to coefficient of performance (EER for

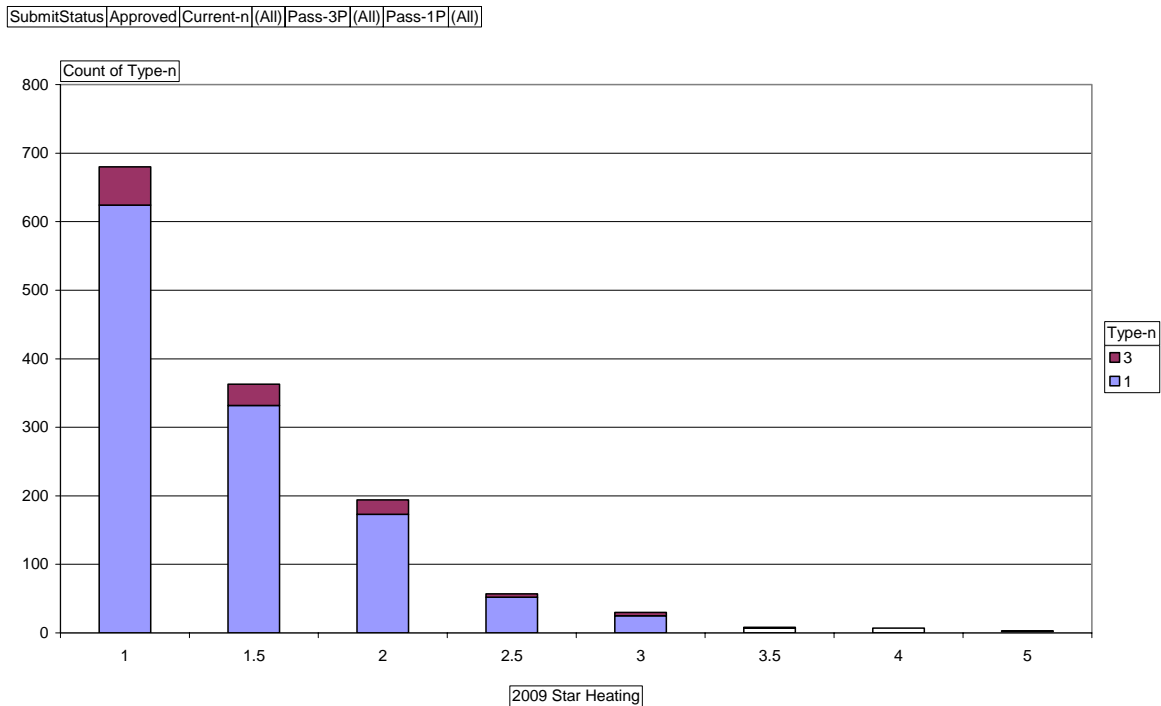
cooling or COP for heating – output over input, although this will now be based on the calculated annual value).

Under this algorithm for cooling the lower star rating bins are filled evenly except for small units which have significantly higher MEPS levels. Each type has more models in the lowest star rating level and a decreasing number as the star ratings increase. There are a very small number of non ducted single split system reverse cycle models that receive 4 or even 5 stars for cooling. The distribution of this proposal is illustrated in Figure 34 below.

**Figure 34: Distribution of Star Ratings Under New Star Rating Algorithm 2010 - Cooling**



For heating, under this algorithm, the lower star rating bins are filled more evenly. Each type has more models in the lowest star rating level and a decreasing number as the star ratings increase. Like cooling, there are a very small number of non ducted single split system reverse cycle models that receive 4 or even 5 stars. The distribution of this proposal is illustrated in Figure 35 below.

**Figure 35: Distribution of Star Ratings Under New Star Rating Algorithm 2010 – Heating**

#### 4.2.9 *New Energy Label Design*

As part of the algorithm change for energy labelling, a new energy label will be introduced. A range of options have been trialled in focus groups and the design details will be finalised by government in consultation with industry and other standards committee members and will ultimately be published in a revision of AS/NZS3823.2 along with the other elements of this proposal. The salient points are a standard label that provides from 1 to 6 stars in half star increments and additional stars (7 up to 10 stars) for super efficient products that have an SRI greater than 7. A new layout for the energy label air conditioner for reverse cycle models is also proposed. The new label will be visibly distinguishable from the current energy label for air conditioners.

#### 4.2.10 *Proposed Transition Arrangements*

All elements of the proposal such as revised algorithms, label designs, transition dates and new MEPS levels and other technical requirements will be published by mid 2009 as AS/NZS3823.2-2009, subject to regulatory impact outcomes.

In the discussion below, existing requirements means any registration to a Part 2 standard prior to the 2009 revision. Products registered to the 2009 revision of the standard will comply with the following elements:

- carry the new energy label based on the new algorithm (where applicable) based on annual EER and annual COP

- meet revised MEPS levels for heating and cooling when assessed against annual EER and annual COP (assessed against 2010 and 2011 levels)
- meet power factor requirements from 2011
- report demand response capability where present.

The proposed regulatory date for this proposal is as follows:

- As of the 1 April 2010, all products manufactured or imported will have to be registered to the new requirements in AS/NZS3823.2-2009. Any products not meeting these requirements will be grandfathered. Grandfathered products will be on display on the energyrating website for only a limited period after April 2010.

The following associated arrangements form part of the transition process for this proposal:

- Products may be registered to AS/NZS3823.2-2009 from the time of publication.
- Products can be supplied shipped or displayed for sale with the new energy label once registered.
- New registrations (and listings) from October 2009 must use AS/NZS3823.2-2009 (noting that registration to previous standards will be retired by April 2010). The corollary to this is that new registrations to previous editions of Part 2 will no longer be permitted from 1 October 2009.
- As of 1 April 2010, all products not registered to AS/NZS3823.2-2009 will be grandfathered. From this date, all current models will have to be registered to AS/NZS3823.2-2009 (or listed in NZ). Grandfathered products will be on display on the energyrating website for only a limited period after April 2010.

Retailers will be encouraged to sell products on display with the old label during the transition period. Industry government discussions have suggested that products that carry the new energy label be marked on their packaging (eg different coloured packaging, addition of a stylised new sticker) to assist in the identification of older products to be sold during the transition period. This is part of a communications package that will need to be developed with suppliers and retailers.

Transition wording to assist with the label changeover is being considered in consultation with industry. Any transition label details will be refined in consultation with industry for inclusion in the new Part 2 regulatory standard.

If AS/NZS3823.2 is revised and implemented as proposed and the changes are validated in State, Territory and New Zealand MEPS regulations, air conditioner suppliers will need to take the following steps:

- a. For models currently on the market, which would have been retired by April 2010: no impact (given sufficient lead time).
- b. For models currently on the market which would normally remain on the market after April 2010, the supplier will have to:

- Estimate the new label rating from the new algorithm.
- Decide whether to retain the model on the market after April 2010.
- Re-register for the new label after 1 January 2009 and before April 2010.
- Plan transition arrangements (placement of new labels on products) in collaboration with retailers (some costs associated with managing two labels).

c. For models to be introduced after mid 2009: no impact (given sufficient lead time).

There are about 50 new models entered into the online registration system per month, therefore there are about 600 new registrations per year. There are around 2500 models approved in the registration system at the moment for Australia and New Zealand. Based on experience and knowledge of the market, around 700 of these could be regarded as redundant registrations<sup>5</sup>. Of the 1800 active models currently on the market, 1200 of them could be expected to be obsolete by April 2010 and the other 600 could be expected to continue beyond April 2010.

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<sup>5</sup> Model number estimates include those that are approved in New Zealand. New Zealand lists products and does not charge for this service (products are registered). To simplify the analysis, it has been assumed that these models would have had to pay a registration fee in Australia, thus the cost estimates in the following section are most probably a slight overestimate. There are special rules regarding listing with the NZ regular and supply of products to the Australian market under the TTMRA, so only some models are eligible to list in NZ.

## 5. Review and Monitoring Process

Air conditioners have been subjected to regulatory requirements for energy efficiency since 1987. Government officials responsible for implementation have an ongoing and close dialogue with industry about current and future requirements. The details of the current regulatory process and the role of the standards committee are set out in Section 2.6.

Once a particular proposal has been accepted by the Ministerial Council on Energy for implementation, the requirements set out in this RIS will be included in a new edition of AS/NZS3823.2. This document is a special regulatory standard that sets out government requirements with respect to performance and energy efficiency. The standard will be prepared by Standards Committee EL15/16 and will be issued for public comment. The normal process for publication of an Australian Standard is followed – this requires 6 weeks of public comment and a full committee ballot. The public process provides adequate opportunity for scrutiny of the detailed technical proposals by the public and major stakeholders. It is important to note that energy regulators play an active role on this committee.

Once published, the new standard will be incorporated into the relevant state energy efficiency regulations. The precise process for this varies by state, but including new standards into state regulations is done for many different products on a regular basis, so this is a well established procedure. It is important to note that the new edition of AS/NZS 3823.2 is effectively an update of an existing regulatory document. The standard is drafted in a way that takes into account the existing requirements in the previous edition and/or amendment(s) as well as the required transition arrangements to the new requirements.

As indicated in the labelling section, energy regulators will work with appliance retailers to ensure that the energy label transition is as smooth as possible. It is likely that communication consultants and field officers will be engaged for this process as set out in the previous section.

Regulators have a well established system of dealing with existing product registrations where new more stringent requirements are subsequently introduced. Existing products in stock that no longer meet the requirements of a new standard are “grandfathered”. This means that existing stock can legally be sold in the future without the need to meet new MEPS levels or have new labels attached. But any new products manufactured or imported after the specified date must meet the requirements of the new standard and they must hold a valid registration with regulators to confirm these requirements. The standard includes a requirement for determining the date of manufacture for each model registered which assists in enforcement of this requirement.

E3 has a well established program of check testing and market surveillance. These program elements ensure that manufacturer claims are valid and that products comply with the regulatory requirements. Processes that governments have undertaken to follow in the case of possible non compliance are set out in the Administrative Guidelines on [www.energyrating.gov.au](http://www.energyrating.gov.au)

Assessing the need for a new energy labelling algorithm or new MEPS levels in the future is done on an ad hoc basis. From time to time E3 reviews international MEPS levels and where more stringent levels are adopted by a major trading partner, these levels are also considered for adoption in Australia. Labelling algorithms are reviewed when products bunch into high star rating bins. However, the process is one of ongoing dialogue between industry and government. For example, the MEPS proposals in this RIS recommended for implementation in 2010 were first suggested by government as early as 2005.

## 6. Key Assumptions for Analysis

Chapter 6 provides detailed information on the assumed parameters for modelling the costs and benefits of the proposal. It has been split into several sections as follows:

- Section 6.1 Overview
- Section 6.2 Basis for Energy Estimates: provides an overview of the basis for the energy estimates used throughout the report.
- Section 6.3 Modelling Approach and Product Sales: provides an overview of the modelling approach and estimated future sales generated from the stock model.
- Section 6.4 Commercial Use of Air Conditioners: discussion of the commercial air conditioner market and what impact this has on the overall air conditioner market and the proposal.
- Section 6.5 Ownership Trends - Australia: analysis of the historical and assumed future ownership of air conditioners in Australia over time. It is assumed that the proposal will have no impact on future ownership.
- Section 6
- Air Conditioner Price Trends – Australia: analysis of the assumed future price trends for air conditioner types.
- Section 6.7 Energy Efficiency Trends: analysis of the historical and assumed future capacity trend for air conditioners by type in Australia over time. It is assumed that the proposal will have no impact on future product capacity.
- Section 6.8 Climate Impacts on Energy: provides an analysis of trends in energy consumption of air conditioners per appliance without the proposal (BAU case) as well as the impact of the proposed label changes on energy consumption trends compared to the BAU case.
- Section 6.9 Electricity Tariffs: marginal energy tariffs for each Australian State and Territory and New Zealand. This provides the basis for estimating long term operating cost impacts resulting from the proposal.
- Section 6.10 Greenhouse Gas Emission Factors: greenhouse gas emission factors for each Australian State and Territory and New Zealand.
- Section 6.11 Changes in Energy Consumption as a Result of the Proposal: analysis of the changes to total energy consumption as a result of the proposal.
- Section 6.12 Changes in Purchase Price as a Result of Reduced Energy Consumption: cross sectional price efficiency analysis on the potential change to purchase price as a result of reduced energy consumption due to the proposal.

- Section 6.13 Effect of MEPS on the Air Conditioner Performance and Price: analysis of the effect of MEPS and energy labelling on the air conditioning market.
- Section 6.14 Transition Costs: costs of transition to the new label borne by suppliers, retailers, government and consumers when compared to the case of no change in energy label algorithm.

## 6.1 Overview

Elements of the costs and benefits associated with the proposal can be broken up into a number of main areas:

- changes in energy consumption as a result of the increases in sales-weighted energy efficiency brought about by proposal and the corresponding changes in energy costs to consumers;
- changes in greenhouse gas emissions due to energy consumption changes as a result of the proposal;
- changes in the purchase cost of appliances which result from the greater efficiency for new products as a result of the proposal;
- program costs associated with the program for government and suppliers.

The parameters used for this study are set out in the following sections.

The costs above are the costs that customers voluntarily assume through preferring more efficient products than they would otherwise (through energy labelling) or which they are forced to accept through MEPS, and the associated benefits that accrue from the associated lower running costs. It is assumed that there are no other costs in terms of reduced utility or related characteristics will result, because there are so many products on the market (close to 2,500 models approved to MEPS 2006 or 2007 in early 2008) that there is always an option with equivalent capacity and features but with higher efficiency. The performance requirements in AS/NZS3823.1.1 or AS/NZS3823.1.2 ensure that all products on the market in Australia are reasonably fit for purpose and broadly meet consumer needs in terms of function. Manufacturers are well aware of these requirements and design their products to ensure compliance.

This section also sets out the assumed future product sales, market share for each group, ownership assumptions and energy consumption with and without the proposed measures acts.

For this RIS, the primary analysis has been done using Australian data because this is very detailed and complete for most key elements. Some detailed data for New Zealand is available over the period 2000 to 2006, but a long time series required for modelling is not available. For the purposes of modelling, detailed estimates of the relative energy consumption in New Zealand has been made using the best data available (eg based on sales, sales mix by group, energy efficiency, ownership etc) and this relative ratio is assumed to remain constant between Australia and New Zealand over the modelling period.

The Estimated Resident Population and household figures in ABS3236 have been used in this report to ensure a consistent data set for historical and projected household numbers. Adjusted Census data has been used prior to 1990 (but this data is used only for modelling completeness and has no impact on the estimation of future costs and benefits). ABS3236 has three projection series as follows:

- Series I - No change in propensities. Living arrangement propensities for 2001 remain constant to 2026.
- Series II - Low rate of change in propensities. The linear trend in propensities from 1986 to 2001 continues at the full rate of change to 2006, half the rate of change to 2011, one-quarter the rate of change to 2016, and then remains constant to 2026.
- Series III - Continuation of 1986 to 2001 rate of change in propensities. The linear trend in propensities from 1986 to 2001 continues at the full rate of change to 2026.

Propensities are essentially the proportion of the population broken down by 5 year age group and by living arrangement (such as couple with children, couple without children, one parent family, other families, group households, lone persons). The trends in these propensities were examined from census data in 1986 to 2001 and trends established and household estimates generated within the bounds of the projected Estimated Resident Population to 2021. Series III has been used for modelling in this report (continuation of current trends in the main propensities) as this appears to be the most realistic in terms of future household projections.

Discount rates used in this RIS are real rates with the effect of any inflation removed. All historical and projected costs and benefits are real costs adjusted by the real discount rate and therefore also have any effects of inflation removed.

## 6.2 Basis for Energy Estimates

The primary basis for energy estimates used in this RIS has drawn on previous work by Energy Efficient Strategies from a study that has estimated the energy consumption of air conditioners in the residential sector using a bottom up end use energy model that has been developed at a state level in a study titled *Australian Residential Sector; Baseline Energy Estimates 1986-2020* (EES, 2008). This end use model was developed using a very wide range of data sources and provides estimates at a state level for all major energy sources. The end use model takes the following factors into account when estimating energy consumption by end use:

- Number households over time and the average size of these households.
- Number of each appliance type per household over time.
- Key characteristics of new appliances entering the market each year, plus average appliance life and associated retirements which are used to give a stock average value in each year.

- Data on usage patterns and other aspects of user behaviour and interaction that impact on energy consumption of appliances.
- Impact of climate on space heating and cooling requirements (all households were divided into one of 10 national climate zones).
- Information on new house construction at a state level (materials, size etc).

Although nearly 60 different end use and fuel combinations were separately modelled using this approach, only the applicable aspects for the relevant air conditioners were used for this RIS. Importantly, the air conditioner energy consumption for both heating and cooling has been included. The heating and cooling demands were estimated using a sophisticated building shell model which used data on historical building stock attributes (together with forecasts of future building shell trends). Annual energy consumption was determined on the basis of many hundred of building simulations in each of the relevant climate zones using AccuRate (now used as the basis of NatHERS in Australia) to reflect the share of building shell types, orientations and so forth. Information on typical occupancy and zoning was included to give a more realistic estimate of actual energy consumption at a state level.

The share of heating and cooling loads within the total energy consumption for air conditioning ranges from all cooling in the Northern Territory to almost all heating in Tasmania. Refer to EES (2008) for further details.

Input data was synthesised by means of an end use model to estimate energy consumption from 1986 to 2020 under a scenario - Business as Usual (BAU) with existing energy program measures. A BAU scenario incorporates the impact of energy policy programs that were already in place up to mid 2007 or which are finalised and scheduled to be introduced over the forecast period. For this study this includes MEPS up to 2007 and the energy labelling algorithm implemented in 2000 at the time the new energy label was introduced.

As far as possible, estimates for each end use were compared and verified against known third party sources. As an overall check, total energy consumption estimates by fuel at a state level were compared to top down data sources such as ABARE, AGA and ESAA. Some private utility data was also made available for the purposes of internal checks.

The end use or “bottom up” model is based on a stock model which takes into account the average technical characteristics of both new appliances and buildings entering the stock and old ones leaving the stock to provide a stock weighted average for each year during the modelling period.

The main inputs into the appliance end use model are:

- Appliance attributes – these are typically capacity or other attributes that affect energy consumption, including energy efficiency. Average attributes of new products by year that flow into the stock are estimated from 1966 to 2020. These are estimated from a wide range of sources including energy labelling registration data, store measurements and other surveys.

- Ownership – this is data on the presence of the total number of products that consume energy in households. Note that penetration (% of households with one or more of the nominated appliance) versus ownership (which is average stock per household) are both estimated where relevant. Some products vary considerably by state, whereas other products are fairly uniform across all states. Data from 1966 to 2020 is estimated at a state level, which in turn is used to estimate stock in each year. The main data sources were ABS surveys of household appliance ownership (ABS4602) but other key sources were also used such as BIS Shrapnel appliance market reports (BIS 2006) as well as various surveys commissioned by the AGO (EES 2001, EES 2006a).
- Determination of appliance usage parameters – this was derived from the building shell model which estimated heating and cooling loads for a wide range of dwelling types at a state level. The AccuRate simulated energy consumption was constrained through ownership (only households with air conditioners can use energy in an air conditioner), occupancy and zoning. The stock average attributes then determined the final energy consumption.

The housing stock model is the most complex element of the system as it takes into account the key attributes of the building shell stock in each state based on construction approvals since 1986 as well as weather data. Dwellings in each state are allocated into one of 10 standard AccuRate climate zones which were selected to cover the major climate zones/population centres in Australia. Dwellings in each state were apportioned to each relevant climate zone on the basis of the number of households in each postcode area as reported by Australia Post. Appliance ownership data and occupancy information together with estimated zoning within the residential stock was applied to AccuRate thermal performance simulation output data to generate heating and cooling demand.

Further discussion on the stock model and its operation can be found in Section 6.3.

The above model was used for this RIS, with adjustments made to account for the particular situation of air conditioners in Australia and New Zealand. The adjustments include a comparison of characteristics, ownership and stock forecasts for air conditioners in New Zealand in order to estimate their energy consumption, which is dominated by heating.

The residential sector energy consumption was increased to include estimated energy consumption in commercial sector establishments. Analysis of detailed market data suggests that about 20% of the air conditioner types covered by this study are sold into the commercial sector. Hence the energy consumption in the residential sector has been increased by 25% to better estimate the energy consumption of air conditioners covered by this RIS. This is likely to give a slight underestimate of the energy consumption of the commercial sector (as hours of use is likely to be longer than for the residential sector), but this is seen as a conservative assumption. The energy consumption of air conditioners is set out in details in Section 2.2.

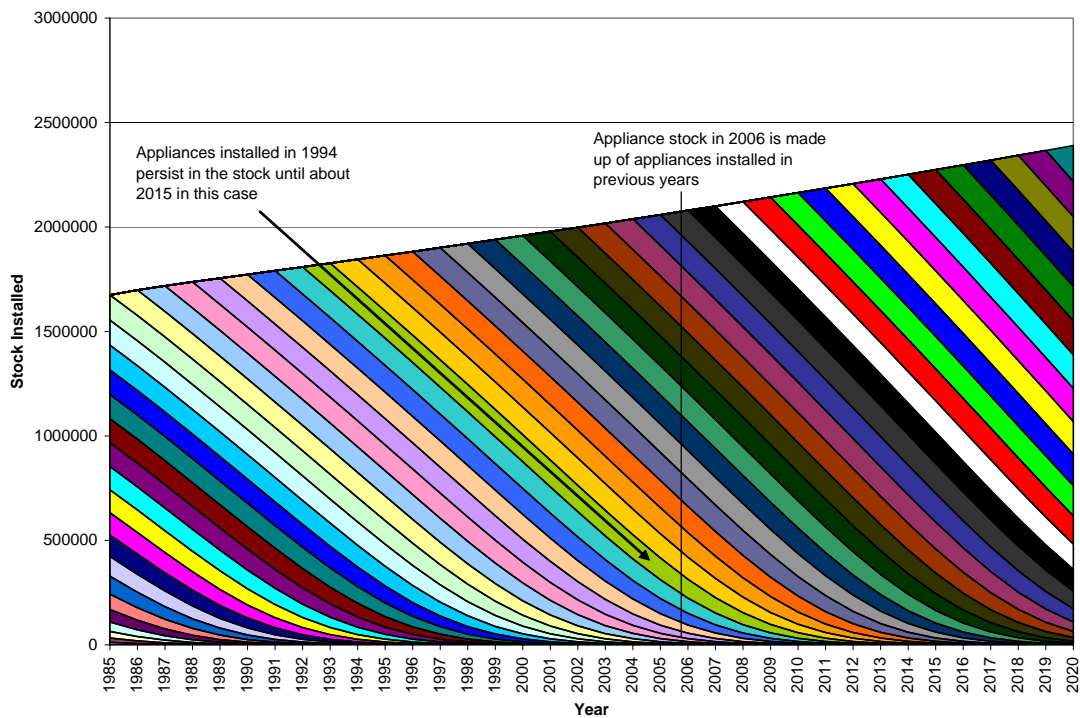
### 6.3 Modelling Approach and Product Sales

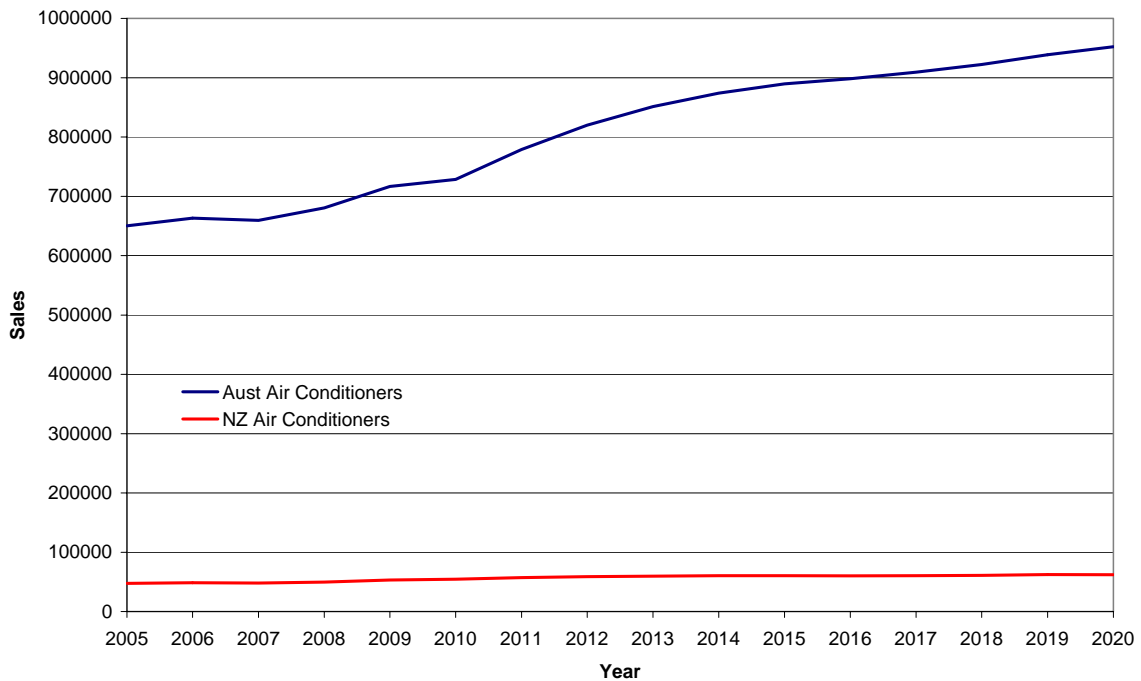
Product sales are not used directly in the modelling for this project, but sales are a useful indicator to demonstrate that the key modelling parameters are correct (ownership/stock levels and the assumed lifetime of products).

Product sales in future year have been estimated from the stock model developed by EES. This uses the trends in ownership together with household numbers to estimate total stock since 1966. The estimated number of sales are based on the increase in stock each year plus estimated retirements based on the year of installation in previous years. For this study, an average life of 10 years was assumed for non-ducted air conditioners and an average life of 14 years for ducted air conditioner types. A retirement function has been developed based on a normal distribution curve which is centred around the average life. For this study, a standard deviation on average life has been assumed to be 3 years.

The values assumed for the stock model generate a sales stream which closely matches the known sales data over the period 2000 to 2006, although actual sales from year to year will fluctuate in response to a number of external factors such as economic growth, housing starts and, possibly, weather.

Figure 36: Schematic Representation of the Stock Model



**Figure 37: Projected sales of Air Conditioners, Australia and New Zealand**

The projected sales are assumed to be identical with and without the proposed measures (i.e. the absolute sales of products and the mix of sales by type remain unaffected).

#### 6.4 Commercial Use of Air Conditioners

The commercial sector use of air conditioners is not known with great accuracy, but is likely to be around 30% of the market. The sales are probably spread across a range of types due to different segments of the commercial market requiring different types of air conditioning (similar to the residential market). However, ducted systems are unusual in the commercial sector. A commercial multiplier has been used to adjust the residential air conditioner sales and energy consumption estimates to include the commercial sector.

Any additional costs imposed on commercial end users (over and above those imposed on residential sector users) as a result of this RIS would be small and any additional benefits, would almost certainly exceed those costs due to the following factors:

- Commercial energy tariffs are generally higher than residential tariffs, so the benefits of any energy reductions are likely to be greater (although the share of energy and tariffs for each sector have been explicitly included in this RIS);
- Commercial sector purchasers are probably less likely to take the energy label into account (they are not paying the bill personally) and market failures such as split incentives are more prevalent, so label changes will have a lower direct impact but MEPS are therefore more critical.

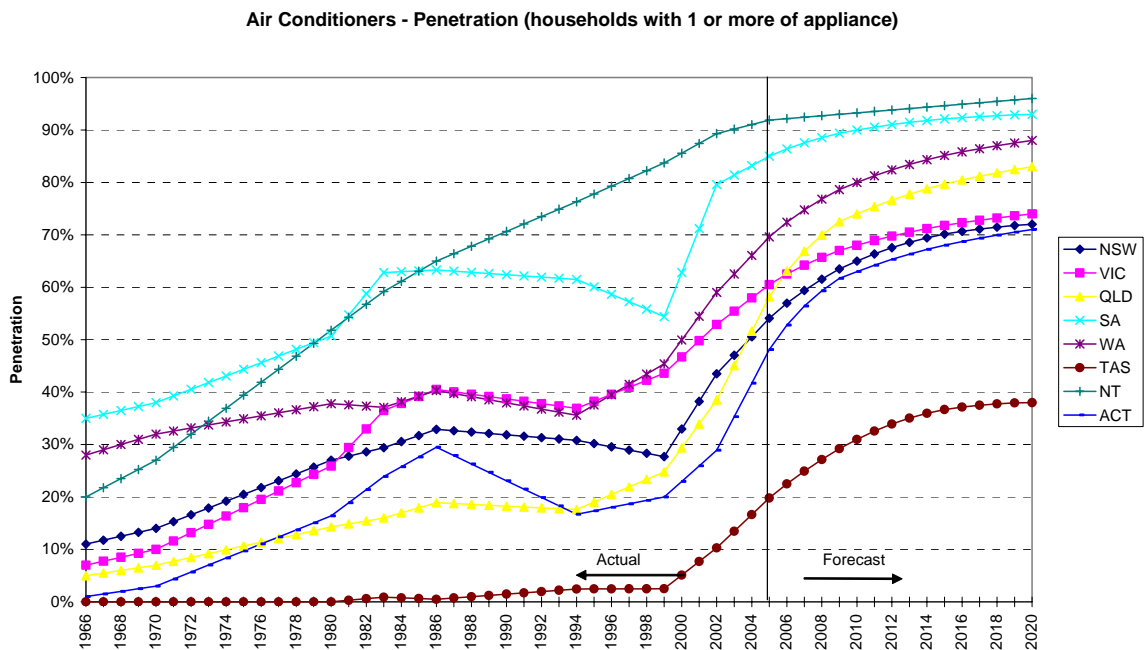
It is important to note that separate regulatory proposals have already been completed for commercial chillers (large commercial sector systems) and close control air conditioners (computer rooms). A separate regulatory proposal for regulation of multi-split air conditioners, which have a significant presence on the commercial sector and which are currently unregulated, will commence in 2009. All of these proposals complement the technical recommendations of this proposal.

### 6.5 Ownership Trends - Australia

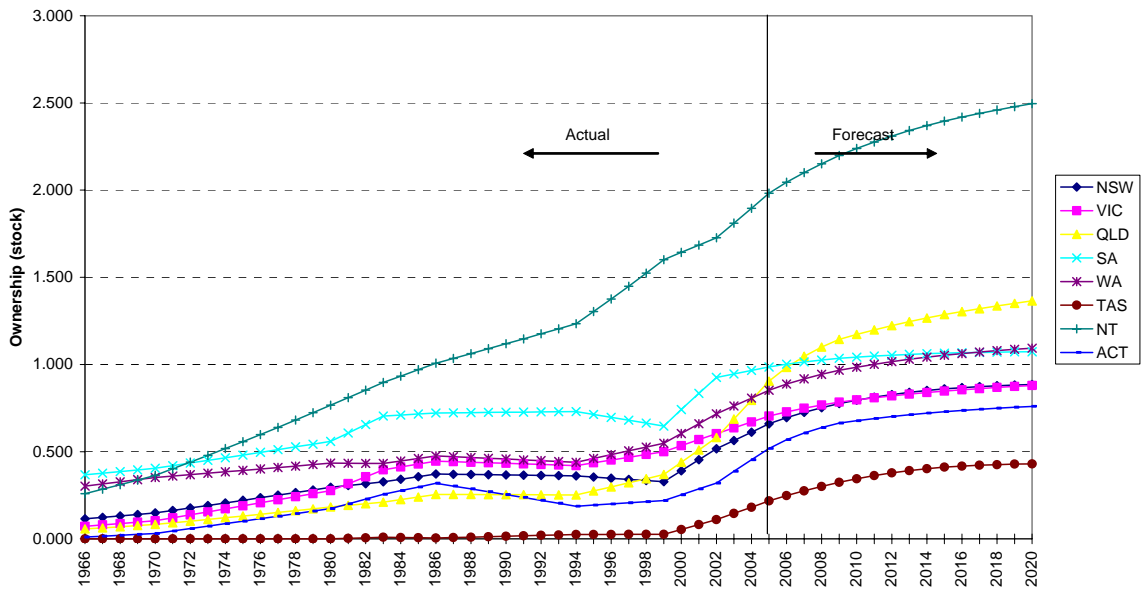
The actual historical and assumed future ownership for air conditioners is shown in Figure 38. Ownership in this context is an indicator of the average number of products per house (i.e. an indicator of the stock). Note that the future ownership is not expected to be affected by the proposal.

Figure 38 and Figure 39 below show the ownership trends for non ducted cooling and reverse cycle units. For any data past 2005, it should be viewed as forecast data.

**Figure 38: Penetration Trends for Air Conditioners – Australia**



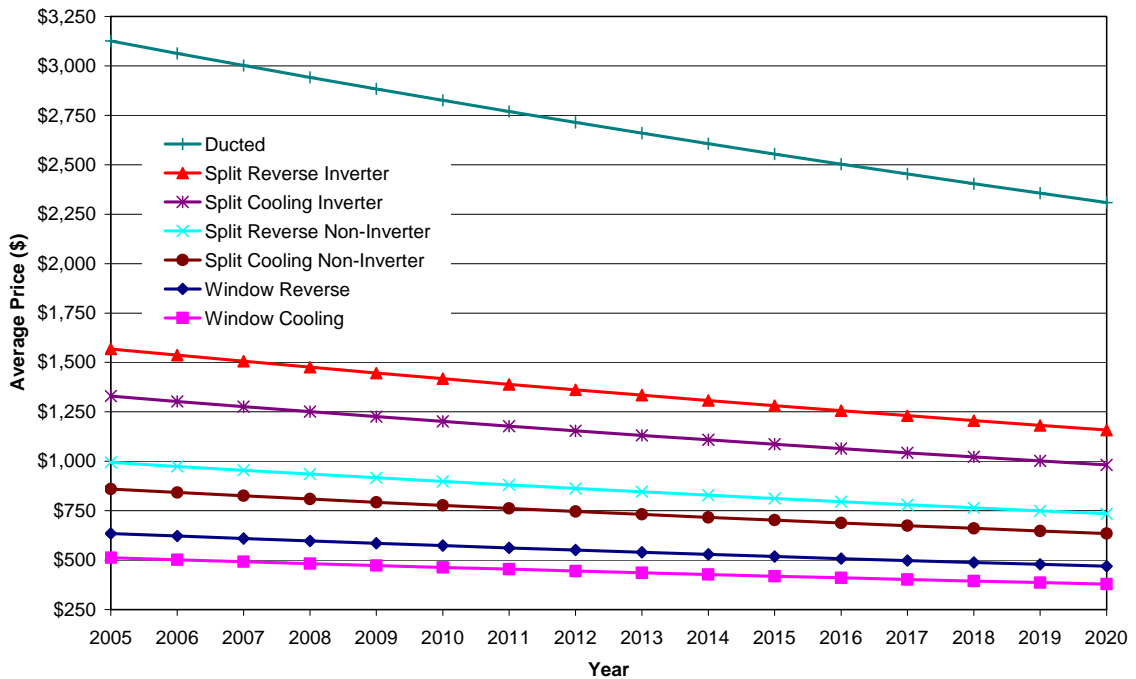
**Figure 39: Ownership Trends for Air Conditioners – Australia**  
 Air Conditioners (all types) - Ownership (stock/households)



### 6.6 Air Conditioner Price Trends – Australia

The average price of air conditioner types for 2005 to 2020 is shown below in Figure 40. Also see Section 2.5.1 for discussion on the historical trends for air conditioner prices.

**Figure 40: Average Real Prices of Air Conditioner Types 2005 to 2020**



## 6.7 Energy Efficiency Trends

The analysis sets out costs, energy and emissions for four main combinations of policies:

**Base Case:** MEPS 2007, label 2000 – this is the Business As Usual (BAU) case, with no changes for either the energy labelling algorithm or the current MEPS levels. This would see a slowing in efficiency gains for air conditioners as the effect of MEPS declines and products on the market become increasingly bunched towards the upper end of the star rating bands.

**Scenario A:** MEPS 2010 + label re-grade 2010 – in this scenario both energy labelling and MEPS levels are upgraded to new levels. The results of the upgrade would see an strong increase in the efficiency of new air conditioners generated by both MEPS and labelling. It would promote higher base efficiency levels due to more stringent MEPS and also create a stronger pull for high efficiency products due to the re-grading of the star rating algorithm.

**Scenario B:** MEPS 2010, label 2000 – in this scenario MEPS levels are being upgraded, while the labelling algorithm stays the same. This would see an increase in the efficiency of air conditioners due to the implementation of more stringent MEPS levels. However, the market pull from energy labelling subsequently would become very weak to negligible as the bunching of star ratings in the higher star bands becomes extreme.

**Scenario C:** MEPS 2007, label regrade 2010 – in this scenario the labelling algorithm is upgraded, while the MEPS levels stay the same (2007 levels). This would see an increase in efficiency of air conditioners due to the increased market pull from the re-grade of the energy label algorithm. However, the overall effect increase in energy efficiency is relatively modest as there is not increase in MEPS levels.

Under each of the Scenarios above, products subjected to mandatory labelling and MEPS are assumed to have an effect from both program elements while products where energy labelling is voluntary (ducted and three phase systems) are assumed to have a program impact from MEPS only. So ducted systems, for example, are assumed to have no program impact from Scenario C (although some of these products are in fact labelled and may respond to the algorithm re-grade – ie the assumptions are conservative).

It is assumed that the impact of the proposed label changes would be a stronger consumer preference for more energy efficient models than under the BAU case (ie without the proposed changes). This would produce a more rapid reduction in sales-weighted average energy consumption than under the BAU case. The increase in MEPS levels would remove the non-compliant stock from the market, thereby 'forcing' the average efficiency of products to a higher level.

The following tables list the assumed measures rates of annual change in efficiency, for each air conditioner types under each Scenario. Values for NZ were based on adjustments at a group level as based on the sales weighted comparisons in 2006 with similar trends assumed by group over time.

The differences in sales weighted energy consumption by group has been taken into account when estimating NZ relative energy consumption.

**Table 39: Base Case Cooling EER for Air Conditioners by Group and Year**

			DuctC
			2.67
			2.72
			2.77
			2.78
			2.79
			2.80
			2.81
			2.81
			2.82
			2.83
			2.83
			2.84
			2.84
			2.85
			2.85
			2.86

Legend: **RRCC** – Reverse Cycle Non Ducted Cooling (split and window wall); **RCOC** – Cooling Only Non Ducted (split and window wall); **DuctC** – Ducted Cooling (cooling and reverse cycle types).

**Table 40: Scenario A Cooling EER for Air Conditioners by Group and Year**

			DuctC
			2.67
			2.72
			2.77
			2.87
			2.98
			3.08
			3.09
			3.09
			3.10
			3.10
			3.11
			3.12
			3.12
			3.13
			3.13
			3.14

Legend: **RRCC** – Reverse Cycle Non Ducted Cooling (split and window wall); **RCOC** – Cooling Only Non Ducted (split and window wall); **DuctC** – Ducted Cooling (cooling and reverse cycle types).

**Table 41: Scenario B Cooling EER for Air Conditioners by Group and Year**

			DuctC
			2.67
			2.72
			2.77
			2.87
			2.98
			3.08
			3.09
			3.09
			3.10
			3.10
			3.11
			3.12
			3.12
			3.13
			3.13
			3.14

Legend: **RRCC** – Reverse Cycle Non Ducted Cooling (split and window wall); **RCOC** – Cooling Only Non Ducted (split and window wall); **DuctC** – Ducted Cooling (cooling and reverse cycle types).

**Table 42: Scenario C Cooling EER for Air Conditioners by Group and Year**

			DuctC
			2.67
			2.72
			2.77
			2.78
			2.79
			2.80
			2.81
			2.81
			2.82
			2.83
			2.83
			2.84
			2.84
			2.85
			2.85
			2.86

Legend: **RRCC** – Reverse Cycle Non Ducted Cooling (split and window wall); **RCOC** – Cooling Only Non Ducted (split and window wall); **DuctC** – Ducted Cooling (cooling and reverse cycle types).

Time series energy estimates for New Zealand have been determined from a number of factors as set out below:

- Number of households – the number of households in New Zealand and this sets the primary basis of differences in energy between the two countries. A ratio of 7.5 to 1 for New Zealand to Tasmania has been used.
- Ownership – there is little trend data for New Zealand so the general trends apparent in Tasmania are assumed.
- Attributes – it has been found that the general attributes for air conditioners in New Zealand are comparable to those in Australia, thus the same attributes have been assumed (dominated by split system reverse cycle models).
- Climate – it has been assumed that the climate impacts for New Zealand are comparable to Tasmania.

Taking all of these factors into account, for air conditioners, New Zealand total energy consumption is estimated to be 18% of that in Australia.

## 6.8 Climate Impacts on Energy Consumption

The national trend for building shell efficiency (i.e. total potential space conditioning load per square metre of floor area), shows a modest but steady improvement over the study period, down from 280 MJ/m<sup>2</sup> to approximately 200 MJ/m<sup>2</sup>.

The national residential building shell efficiency improvement trend is being driven by policy initiatives that commenced in Victoria and ACT in 1990 and by 2005 had expanded to include all states in various incarnations. Unfortunately over the study period the rate of increase in average floor area has outpaced the rate of improvement in building shell efficiency to the extent that on a per household basis the potential space conditioning load is projected to increase from about 30GJ to 35GJ per household per annum. Modelling of heating and cooling energy was done using end use models developed for the report *Australian Residential Sector; Baseline Energy Estimates 1986-2020* (EES 2008) and adapted for this RIS.

## 6.9 Electricity Tariffs

Table 43 below shows the marginal energy tariffs for each Australian State and Territory and New Zealand.

**Table 43: Marginal energy tariffs**

		c/kWh Commercial (a)
		17.0
		16.0
		15.0
		16.0
		15.0
		14.0
		17.0
		19.0
		16.0
		13.7

Source: Household estimates from *Electricity Australia 2004*, except; (a) Published default tariffs from 1 July 2007. (b) Advised by EECA, October 2007 – 20.4 NZ, at the exchange rate 10/4/2008 this is AU17.5 cents/kWh. All other tariffs in AU cents/kWh. Other sector estimates by GWA.

The marginal energy tariffs used in the analysis are the c/kWh household (day rate) for each state listed in Table 43 (column 2). This set of tariffs was deemed most relevant as air conditioners are generally operating during the day, thus shoulder and peak times are not necessarily applicable. Residential tariffs were deemed as most appropriate as the cost/benefit impacts on residential consumers are the primary

focus of the entirety of this analysis. The same tariff assumptions are always applied to the BAU and in the case of the proposal.

For the purposes of modelling costs and benefits, a constant real electricity price is assumed for both the BAU scenario and the proposal. The impact of an escalating and declining real tariff is examined as part of the sensitivity analysis. This affects both cases equally except for the small differences in energy consumption that are expected as result of the proposal. All future electricity costs are discounted to a Net Present Value (NPV) using the assumed discount rate.

## 6.10 Greenhouse Gas Emission Factors

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

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

The marginal intensity takes into account the merit order of generators. A measure that reduces overall electricity demand – such as MEPS or in this case the improved impact of a change in the energy label– will tend to reduce the operation of power stations at the margin, so the CO<sub>2</sub>-intensity per kWh avoided should be calculated using the marginal coefficients.

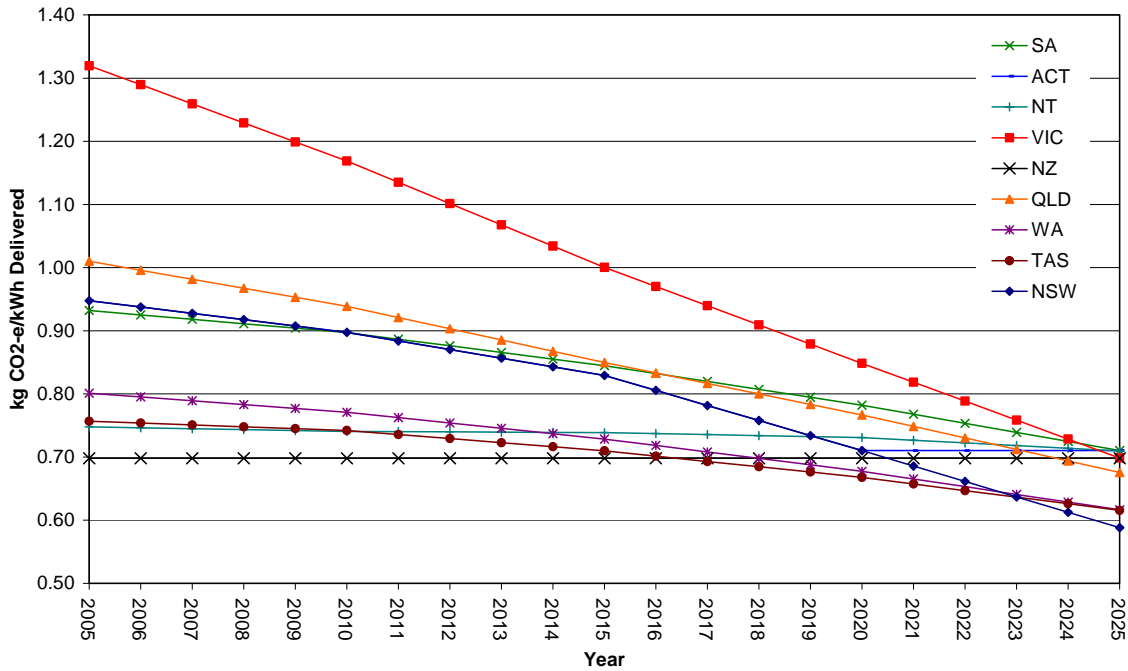
Table 44 below shows the projected marginal emissions intensity of electricity supply, from 2005 to 2025. These numbers are for each Australian State and Territory and New Zealand. For the purposes of analysis of emission impacts beyond 2025 (for example, to account for the energy consumption of appliances installed in 2025 and which operate to 2045), a constant marginal emission factor has been assumed beyond that year. These values were based on updated estimates provided in early 2008.

The marginal electricity system CO<sub>2</sub>-e intensities for Australia used are illustrated in Figure 41 below. These were calculated from data spreadsheets published by the AGO ([www.greenhouse.gov.au/ggap/round3/emission-factors.html](http://www.greenhouse.gov.au/ggap/round3/emission-factors.html)). The marginal coefficient for New Zealand (0.698 kg/kWh in all years) was supplied by the EECA (2007). The coefficients embody assumptions about the scheduling of future generation and transmissions projects.

In the base case analysis no monetary value is assigned to projected emissions reduction between the BAU and the proposal. However, a shadow price for CO<sub>2</sub> and its impact on costs and benefits is examined as an additional scenario. Where it is necessary to project emissions beyond 2025, a constant emission intensity after that date has been assumed for modelling purposes.



Figure 41: Projected marginal emissions-intensity of electricity supply by State 2005-2025



(GWA, 2008)

### 6.11 Changes in Energy Consumption as a Result of the Proposal

The proposal would lead to energy savings due to the following mechanisms:

- Re-scaling will accelerate the introduction of more efficient models than otherwise (within each Type)
- Even if a consumer makes a random choice from the range of available products, this choice will be more energy efficient.
- The re-scale will have an additional impact on consumers if they prefer to make their purchases nearer to the (new) maximum than in the past.
- Elimination of products with lower efficiency via MEPS.
- Elimination of products with poor heating performance via MEPS
- Forcing suppliers to source higher efficiency products for those units that have crankcase heaters or standby consumption.

It has been assumed in the BAU analysis that there is slow improvement in the background model energy efficiency after MEPS 2006 and MEPS 2007, which have already been implemented.

Figure 42 below shows the change in key characteristics over time for air conditioner types under the modelled scenarios. As can be seen, the change in characteristics per annum is dependant on the type of scenario modelled. For the Base Case, there is

slight improvements in efficiency for both time periods, due to the programs (MEPS and labelling) that are already in place. These improvements decline as time passes and the program measures near the end of their life. Scenario A sees a large increase in efficiency for the period 2007 to 2010 as a result of MEPS and then a lower, although still comparatively significant increase for the years 2010 to 2020 through energy labelling. Scenario B shows a similar increase in efficiency as Scenario A for the years 2007 to 2010 also due to MEPS, but a much lower increase thereafter as the energy label is not regraded. Scenario C has a similar increase in efficiency as the Base Case for the initial time period and the highest increase for the 2010 to 2020 of all scenarios due to the label regrade. However, the overall savings from Scenario C are smaller overall as the saving from labelling alone are much smaller than from MEPS.

**Figure 42: Change in Key Characteristics Over Time for Air Conditioner Types Under Modelled Scenarios**

						W/W RCH COP
Change per annum – 2007 to 2010						
						0.13%
						1.08%
						1.08%
						0.13%
Change per annum – 2010 to 2020						
						0.10%
						0.22%
						0.03%
						0.25%

Legend: **RCC** – Reverse Cycle Non Ducted Cooling; **CO** – Cooling Only Non Ducted; **RCH** – Reverse Cycle Non Ducted Heating.

The determination of these energy impacts was estimated using complex sub-models for each of the categories of air conditioners examined under this RIS and model sales databases for the years from 2003 to 2006 in addition to the registration database over the period 1987 to early 2008.

The long term energy impact of energy labelling up to 2004 (introduction of single phase MEPS) can be determined from an analysis of the energy registration system since 1987. The average efficiency over this period increased from about an EER (W/W) of 2.2 to 2.5 over 14 years, which is equivalent to about 1% improvement per annum. As is obvious with other products, the natural rate of efficiency improvement declined somewhat after the introduction of MEPS in 2004 (refer EES 2007 for details for refrigerators). Even after an algorithm regrade, the underlying efficiency improvement from labelling is expected to decline somewhat when implemented in conjunction with MEPS. Very stringent MEPS proposals reduce the labelling effect

further, at least in the short term. The labelling impact from the various options considered under the proposal were developed as follows:

- Base Case – only slow improvements resulting from labelling without an algorithm regrade are assumed and these have been determined from apparent rates from current registrations – this rate is only about 20% of the pre-MEPS level of improvement. The improvement rate slows in the long term with no labelling regrade.
- Scenario C (label regrade only) has the same assumed energy improvement to 2010 (as the same label is used under both cases), but an increased response from the label regrade is assumed after 2010 (roughly double the Base Case level of improvement, but still only 0.4 of the pre-MEPS improvement rate to 2004).
- Scenario A (MEPS and label regrade) has a large impact to 2010 resulting from MEPS but improvement from energy labelling is somewhat higher than the Base Case but not as high as Scenario C (no MEPS but label regrade). This is because the more stringent MEPS levels in 2010 have a dampening effect on energy labelling.
- Scenario B (MEPS but no label regrade) has the same impact as Scenario A to 2010 but the impact after 2010 MEPS is very small due to the extreme bunching of products in the upper end of the star rating system.

The estimates of MEPS impacts under Scenarios A and B were determined from an analysis of existing model registrations. These estimates are inherently conservative as it was assumed that each model which was eliminated by MEPS under the proposal would be replaced by a model of equivalent capacity which just met MEPS. The reality is that most suppliers will source new products that well above MEPS (rather than equal to MEPS). This will mean that the new products on the market will tend to be a bit more efficient than assumed in this analysis.

The impact of each scenario is dependant on its regulatory makeup in terms of the options which are included within each scenario. A scenario that focuses primarily on energy labelling (such as Scenario C), which promotes consumer discretion, will not have the same impact as one which 'forces' efficiency levels using MEPS (such as Scenario B). Of course, the combination of these two measures (seen in Scenario A), rather than their use in isolation, will see the largest initial and on-going efficiency increases in products when compared to the Base Case where no changes to MEPS or energy labelling are undertaken.

Section 6.7 shows more detailed forecasts for the cooling EER by group and year for new and stock air conditioners for the BAU, Scenario A, Scenario B and Scenario C.

For each of the energy scenarios where a future reduction in new model average energy is assumed as a result of the program, it has also been assumed that there is some cost penalty for this in accordance with the assume cost-energy coefficients stated (see section 6.12). For the purposes of modelling, the impact of increased purchase costs as a result of the program continue to persist for the period where new

products are considered to enter the stock, that is up to 2020. However, the energy benefits that accrue from products installed up to 2020 continue to persist until 2045, when the last of the units installed in 2020 is assumed to be retired. The apparent energy benefits from the program decrease after 2020 as the number of products affected by the program to 2020 starts to decrease.

All benefit and cost streams are expressed as a net present value (NPV) using the assumed discount rate for the particular analysis scenario. Using a discount rate that is above zero will mean that more distant future benefits and costs appear to be smaller in NPV terms as the discount impact accumulates over time.

Projected sales for air conditioners can be found in Appendix 1: Projected Air Conditioners Sales for Australia and New Zealand and these are shown graphically in Figure 37. The sales figures are based on household number projections which can be found in Appendix 2: Air Conditioner Stock Projections for Australia and New Zealand. These household number projections are based on ABS forecasts, found in ABS 3236.0. It must be noted that estimates for New Zealand forecast sales are based on sales data for New Zealand in 2006, this is then forecast forward against the Australian sales projections

Figure 43 and Figure 44 below, outline the BAU versus Scenario A energy for air conditioners for the Australian and New Zealand markets. The top line (blue for Australia, red for New Zealand) shows BAU projections of energy, while the green line indicates energy under the proposal.

**Figure 43: BAU versus Scenario A Energy for Australian Air Conditioners**

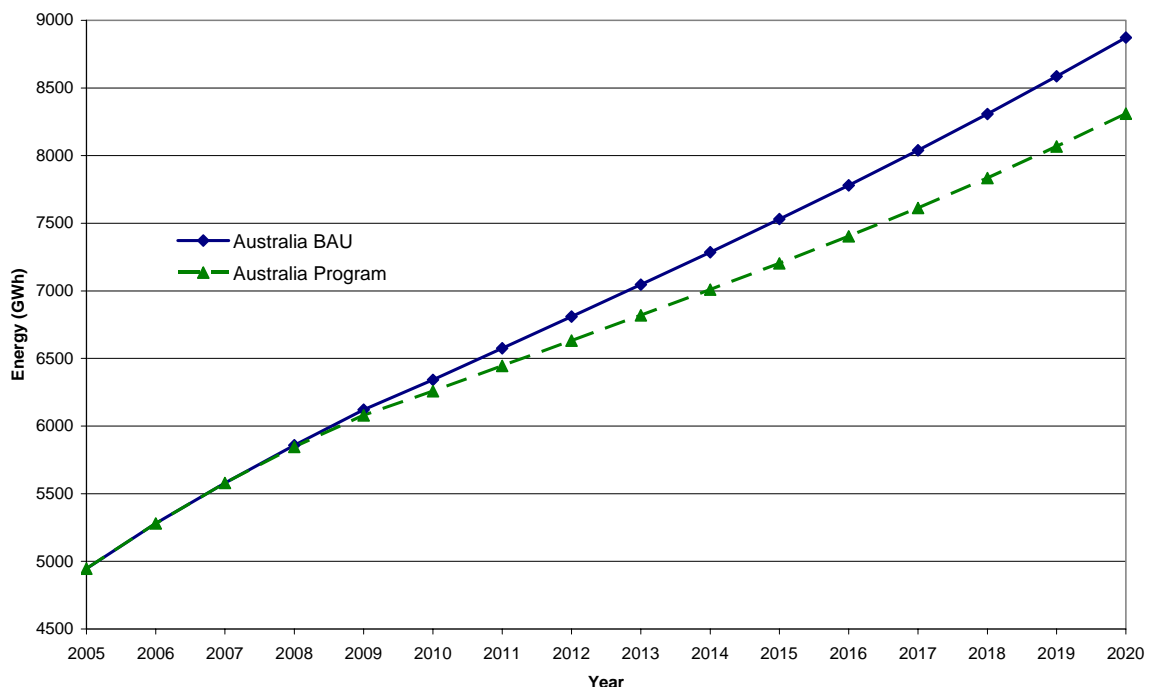


Figure 44: BAU versus Scenario A Energy for New Zealand Air Conditioners

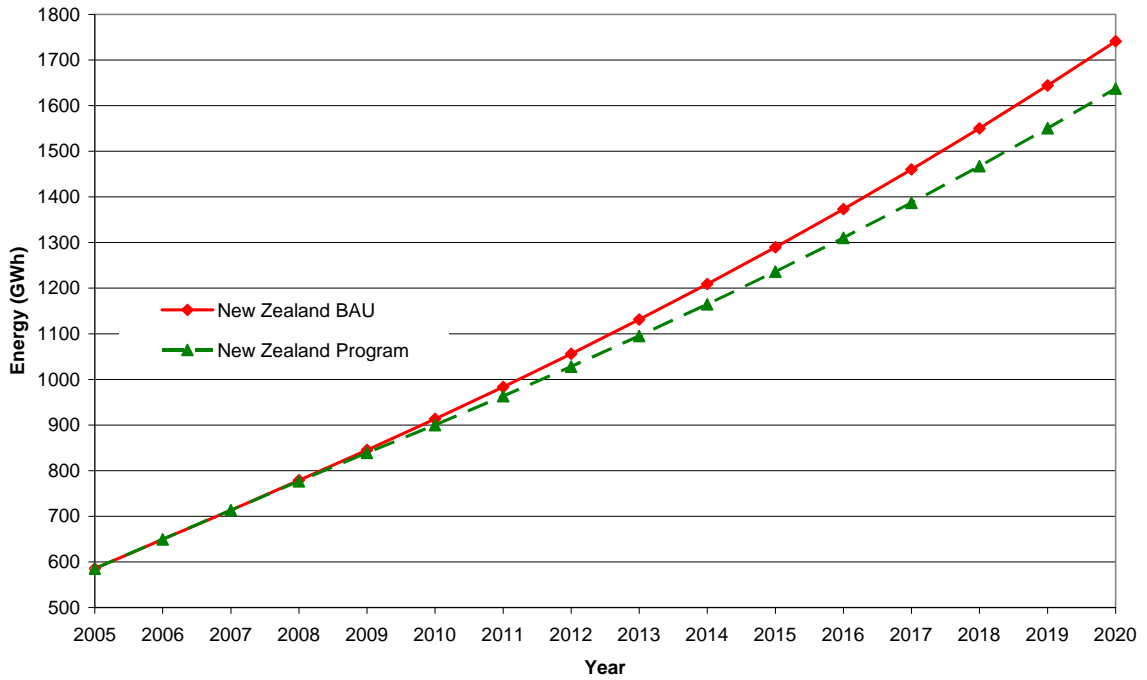


Figure 45 and Figure 46 below, outline the BAU versus Scenario A emissions saved (Base Case) for air conditioners for the Australian and New Zealand markets. The top line (blue for Australia, red for New Zealand) shows BAU projections of energy, while the green line indicates energy under the proposal.

Figure 45: kt CO<sub>2</sub>-e Saved for Australian Air Conditioners

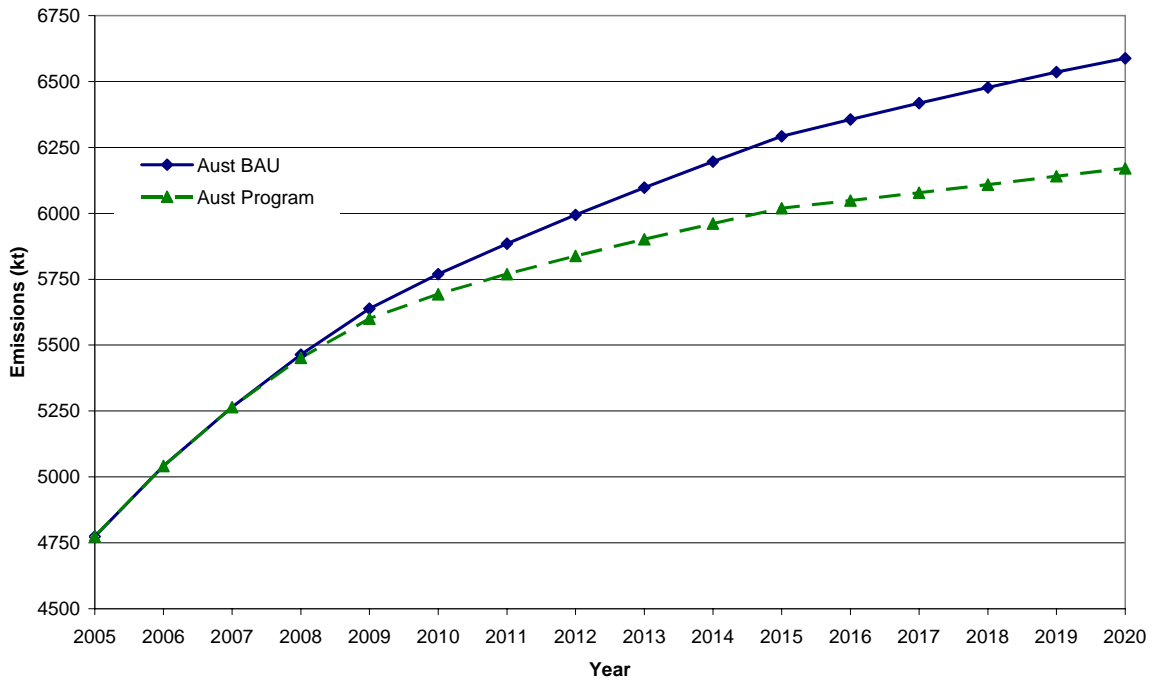
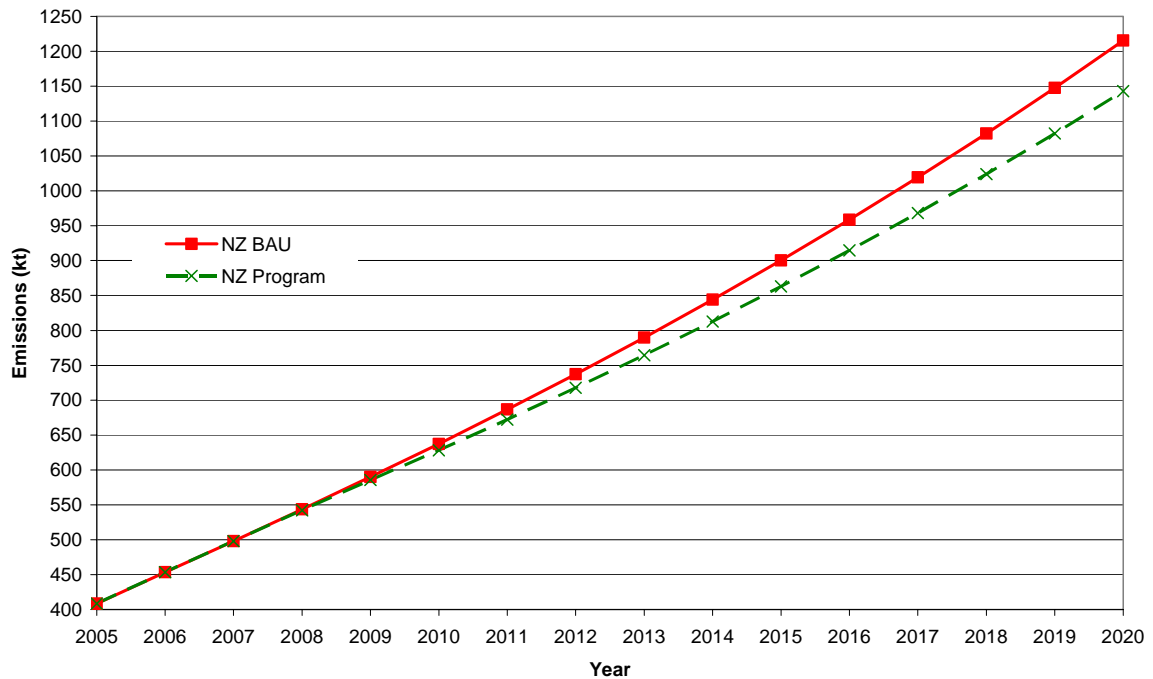


Figure 46: kt CO<sub>2</sub>-e Saved for New Zealand Air Conditioners

## 6.12 Changes in Purchase Price as a Result of Reduced Energy Consumption

### *Cross-sectional Analysis of Product Price and Energy Efficiency*

An analysis of the price efficiency relationship on the Australian market was conducted using 2006 sales data for air conditioners. The primary data source for the analysis was the GfK model sales list for the year 2006. This dataset reports each brand and model sold during the period January 2006 to December 2006 by retailers in Australia and the actual average retail price paid by consumers for each model (GfK data, 2006). About 1600 models had sales reported during the period (covering around 1300 different registrations).

While there have been attempts to quantify price efficiency trends in the past for refrigerators and freezers (eg GWA 1993, 2001; EES 2007), no similar analysis has been completed on air conditioners in Australia. In spite of this, essentially the process for undertaking such analysis on air conditioners is very similar to that carried out on refrigerators and freezers. The 2006 dataset obtained for analysis in this project is one of the most comprehensive ever analysed in Australia as energy efficiency and actual price data for virtually every model has been reported.

### *Methodology*

The general approach is to split all air conditioners into their respective types. In total, there were 4 main types for analysis (Types 1, 2, 3 and 4 – refer Table 18: Air Conditioner Types), each of these has then been split into subgroups defined by

whether they have an inverter function or not (which has a significant influence on cost) and size groups according to MEPS levels. MEPS size groups were chosen because the MEPS levels appear to have a strong influence on the available efficiency levels of products offered for sale, although an analysis across all size groups yielded similar results.

Analysis of air conditioners found that the presence or not of an inverter had a significant impact on price (and some impact on efficiency). It would appear that consumers are selecting inverter models for a range of reasons other than energy efficiency at full load (which is the basis for this analysis). Factors such as part load performance and quieter continuous operation are also factors in the consumer decision making process. There may also be a correlation between inverter models and more reputable brands (and hence an associated price premium), but this relationship was not explored in any detail. For these reasons, inverter types were analysed as a separate grouping.

Another factor that was found to have an impact was that of size. It is clear that larger air conditioners are more expensive, so that relationship was a fundamental building block for the analysis. With regard to efficiency, MEPS 2007 had a market impact on the available energy efficiency levels, so eliminate this effect as far as possible, size ranges which aligned with the MEPS size categories were used. An interesting effect for most size categories was the decline in overall system efficiency with increasing size.

The models that did not meet 2006 and 2007 MEPS levels were eliminated from the analysis as these models are now obsolete and can no longer be imported. This reduced the data set to about 500 models. Under energy labelling and MEPS rules, models that were legally manufactured or imported before the MEPS implementation date can continue to be sold after the MEPS date. In 2006 a small share of sales were not MEPS compliant (although the number of models was significant). These have been eliminated from the analysis as the energy efficiency of non-MEPS compliant models in many cases is much lower than MEPS compliant models but typically prices are comparable, so these no longer represent a valid sample of models that are currently supplied to the market.

The first step in the analysis was to determine a price/cooling output relationship for each type. A linear regression for cooling output vs price was used in the form:

Price =  $a \times \text{Output} + b$  (where  $a$  and  $b$  are constants).

Similarly, a linear regression was determined for energy efficiency and cooling output for each type in a similar form. Together, these functions represented a so called representative energy efficiency and price function for each individual air conditioner group as defined by the common parameter of cooling output.

The next step was to look at the price and cooling output of each individual model sold in 2006 relative to the representative regression for price and output determined for the type as a whole. The ratio of actual price to the regression price for a particular model of a certain energy is called normalised price. A normalised price of greater than 1.0 means that the model was more expensive than an expected average model

for the type and size and configuration. Similarly, the ratio of actual efficiency to the regression efficiency for a particular model of a certain output is called the normalised efficiency. A normalised efficiency of greater than 1.0 means that the model is more efficient than an expected average model for the type and size and configuration.

A plot of normalised efficiency versus normalised price is then examined for each type to see if there is a correlation between normalised efficiency and normalised price. The expected relationship is that more expensive models are more energy efficient (ie use less energy) – if this were the case there would be a correlation with a positive slope between normalised efficiency and normalised price (ie as normalised efficiency increases, normalised price should increase).

A regression of normalised efficiency versus normalised price was conducted for each type, where possible and the results are reported below.

As noted above, this analysis was only done on models that have approved registrations in November 2007 (ie that met MEPS 2006 and MEPS 2007 requirements).

*Summary of Results*

The follow table summarises the values of the regression found for each type.

**Table 45: Summary of Volume, Price and Energy Correlations by Type**

					Energy Fixed
					3.295
					3.076
					2.723
					4.878
					3.474
					2.437
					3.400
					3.077
	=				-9.376
					4.856
					3.825
					2.328
					3.037
					2.611
					3.053

Note: \* The units larger than 7.5kW output for types 1c and 2c appear to be a mixture of standard single phase split systems and a few larger scale specialised three phases systems which were much more expensive, hence the strong skew on the size price regression.

When examining the normalised data for price and energy efficiency, the relationships found are summarised in the following table. The slope gives an indication of the relationship between price and energy efficiency. A slope of close to 0.0 means that

there is no apparent relationship between energy efficiency and price for the group: a slope of between 0.2 and -0.2 is considered a small effect. A slope of -1.0 would mean that a 1% increase in energy efficiency would result in a 1% reduction in price. Similarly, a slope of +1.0 would mean that a 1.0% increase in energy efficiency would result in a 1.0% increase in price.

A price-efficiency slope that is positive indicates that there is a possible relationship between price and efficiency (ie the more expensive the product, the more efficient or lower the energy). This is the expected relationship (normally more expensive products should deliver better efficiency). The other important variable to consider from the analysis is the correlation coefficient. The closer that the correlation coefficient ( $R^2$ ) value is to 1, the stronger the relationship (a correlation coefficient of 1 indicates that there is a perfect relationship between two variables). Conversely, a correlation coefficient of zero indicates that there is no relationship between two variables. A correlation coefficient ( $R^2$ ) of less than 0.4 is generally considered to be an indication of a weak relationship from a statistical perspective. All of the regressions undertaken in this analysis had an  $R^2$  value that was weak to negligible.

### Conclusions

Table 46 summarises the energy efficiency vs price regression analysis undertaken for this study. The results for each type analysed can be summarised as follows:

- Types 1a, 1ai, 2a, 2b, 4a 4b: a positive slope correlation between price and energy efficiency with a slope in the range 0.1 to 0.4, but all with extremely weak correlation coefficients.
- Types 1b, 1bi, 3a, 3b: all had a negative slope correlation, which can be discounted (this suggests that more efficient products are cheaper).
- Types 1c, 1ci, 2c, 2ai, 2bi: all of these sub-types had insufficient sample sizes to conduct a meaningful regression (6 or less models in the type).

It must be stressed that these figures are based on simple model-price evaluations. The analysis approach taken can not take into account sales weighted correlations. Thus a model that has sales of 100 units has the same influence on the regression as a model that has 10,000 sales. Generally all models were included, but a total of about 5 models were excluded that had very high prices for no apparent reason (all of these had total national sales of less than 15 per model in 2006), so this will not influence the results significantly.

**Table 46: Summary of Price – Efficiency Regressions by Air Conditioner Type**

					Comments
					Very weak R <sup>2</sup>
					No correlation
					Inadequate sample size *
					Very weak R <sup>2</sup>
					Negative slope, very weak R <sup>2</sup>
					Inadequate sample size *
					Very weak R <sup>2</sup>
					Very weak R <sup>2</sup>
		-			Inadequate sample size
		-			Inadequate sample size
		-			Inadequate sample size
					Negative slope, weak R <sup>2</sup>
					Negative slope
					Very weak R <sup>2</sup>
					Very weak R <sup>2</sup>

Note: \* The units larger than 7.5kW output for types 1c and 2c appear to be a mixture of standard single phase split systems and a few larger scale specialised three phases systems which were much more expensive, hence the strong skew on the size price regression.

A negative slope in the price-efficiency regression means that for this type a unit which is more expensive tends to be less efficient. This does not make sense in terms of an expected price impact of efficiency and there must be other factors that have influenced the price of certain products in the group which may or may not be related to efficiency (eg different types of external finish, possibly filter functions, brand, quality etc). So this type of analysis is limited to some degree by the information that is available in each product. There is some evidence that reputable brands can command a higher market price and this partly relates to quality and performance of their products, which is not directly considered in this type of analysis.

For this study a small positive correlation between efficiency and price has been assumed for all types, even though the analysis suggests no correlation or even a negative slope correlation for some types. For modelling purposes, an energy efficiency-price slope of 0.25 has been assumed for all air conditioner types in the Base Case and a higher value of 0.4 has been assumed to test the sensitivity to changes in product prices which may be generated by MEPS, which eliminates the lowest efficiency products.

Even though analysis of the data suggests that there is only a weak efficiency price relationship, this assumption only holds true for the products on the market in 2006 and it does not mean that endless efficiency gains can be forced onto manufacturers without a cost penalty. If this were assumed, there would be no purchase cost impacts of pushing MEPS to levels that are way beyond the current commercially available products, which is clearly a poor basis for energy policy analysis.

Furthermore, consumers continue to exercise individual judgement about the relative value of energy efficiency and other product attributes, which should restrain price effects to low levels. For almost all types, a range of prices was available for the same efficiency level, although this does not take into account other factors such as brand or quality. The impact of MEPS and energy labelling expected from this proposal are modest in that existing products on the market even in 2006 can meet the future 2010 requirements with only minimal cost impacts.

Another interesting finding, which has been documented in international studies for a range of appliance types (Ellis et al. 2007), is that the trend over time is that the price of products is declining in real terms while energy efficiency is increasing substantially. This is a remarkable finding and supports the detailed analysis in this report that suggests that the linkage between energy efficiency and price is at best very weak and that this trend is continuing – real prices are falling and energy efficiency is increasing.

### **6.13 Effect of MEPS on the Air Conditioner Performance and Price**

One concern is that stringent MEPS levels could eliminate many brands and concentrate market power into the hands of a few major companies. Another concern is that MEPS may eliminate the lowest cost models on the market. The intent of MEPS is to eliminate the lowest efficiency models from the market. So, by its very nature, for such a program measure to be effective some market impact must be

sustained. The question is whether the expected market impact from the measures is acceptable in terms of competition and product price.

This section documents the likely impact of the proposed MEPS levels on competition and price. It also examines the impact on features and other aspects of air conditioner performance.

**6.13.1 Market Competition**

As of mid 2008, there were a total of 2687 air conditioner models on the market which were supplied under 167 different brands. The average number of models per brand on this basis is 16. The smallest number of models per brand is 1 and the largest number of models per brand is 144. There were 15 brands that had over 60 current models registered with regulators.

Of these registrations, some 420 are for three phase models while the remaining 2267 were single phase models.

The air conditioner market is extremely competitive. Based on retail sales data for some 1500 models sold in 2006 (GfK 2006), no one brand had a market share of more than 15% and the top 15 brands covered about 75% of the market. A further 70 brands covered the remaining 25% of the market. This data is broadly corroborated by the brand market share analysis in BIS Shrapnel (2006).

One way to assess the possible impact of MEPS on the market is to examine the number of brands and models, based on current registrations, that would remain on the market after the introduction of MEPS. The following table shows the number of brands and models for each of the main product categories.

**Table 47: Impact of MEPS 2010 on current registrations**

						Models meet MEPS 2010 (b)
						272
						230
						42
						861
						207
						531
						123

Notes: (a) This is the MEPS level specified in Table 33 without any requirement to include standby.

(b) This is the MEPS level specified in Table 33 including standby/crankcase factored in an annual EER.

Table 47 shows that while many models and some brands currently on the market may be removed by the MEPS proposal, a large number of models and brands would remain on the market after the MEPS requirement has been implemented. The impact on market competition is likely to be minimal. Although as many as 60 brands may be removed from the split system market, more than 80 remain. A significant number of brands and models may be affected in the single phase ducted market, but this is partly because the MEPS levels for these products are relatively weak. With 30 brands and 200 models remaining, it is considered that market competition in this segment will remain adequate.

This is a very conservative assessment of the market impact on competition (ie an overstatement of the impact) as it assumes that suppliers will not source alternative models of higher efficiency to meet the new MEPS requirements. As indicated previously, such models are readily available on the international market.

It is useful to examine the impact of previous MEPS levels on the number of available models on the market. Just prior to the introduction of stringent new single phase MEPS levels in April 2006, there were some 2400 approved single phase registrations. Immediately after the introduction of MEPS, the number of registrations fell to 1045. Within 12 months, the number of approved models had risen again to over 2000. The market impact of this MEPS proposal is somewhat less than in 2006 in terms of a reduction in the number of models. Similarly, for three phase models, the number of approved models on the market in mid 2007 was over 1200. Immediately after stringent new MEPS levels were introduced in October 2007, the number of models fell to about 400. The number of three phase models is continuing to increase.

Part of the reason for the large apparent impact of MEPS on available models is that registrations have a duration of 5 years (pending any new regulatory requirements that may come into force in the mean time). However, information from industry indicates that the model life is typically 1 to 3 years. This means that the approved model listing held by regulators is likely to include many obsolete models which are no longer on the market.

Suppliers in Australia and New Zealand have been aware for some time that new MEPS levels are likely (these were published in 2005 in AS/NZS3823.2) and many will be planning their future product acquisitions around the possible new MEPS requirements. Suppliers have nearly 2 years to source more efficient products where necessary, which is adequate lead time for this type of commodity.

In conclusion, although there is likely to be some market impact from the MEPS proposal, based on current registration data, a large number of models and brands will remain on the market and therefore adequate competition will continue. It is necessary to cause some market impact if energy efficiency is to be improved through MEPS.

### 6.13.2 Impact of MEPS on Product Price

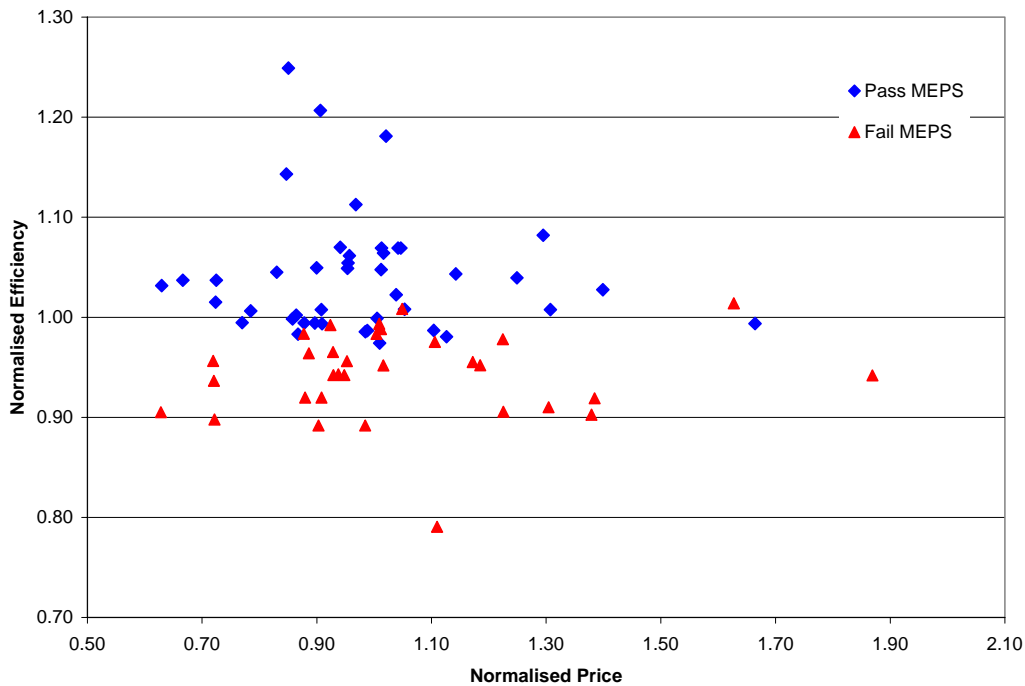
Section 6.12 examines the relationship between efficiency and price for a wide range of air conditioner types. This analysis is based on the capacity, efficiency and actual retail price paid for more than 600 air conditioner models sold in 2006 (GfK 2007). The analysis establishes a general relationship between efficiency and price, which was found to be generally weak for most groups.

One of the concerns raised is whether MEPS will eliminate the lowest cost models and therefore force consumers to purchase higher priced products. Analysis of 15 of the most common air conditioner groups (Section 6.12 for details) has found that in all but one of these groups<sup>6</sup>, products that meet MEPS are amongst the lowest price products on the market. Therefore, consumers will continue to have access to low cost products after the introduction of MEPS. An example of the analysis is included for split systems in the range 4kW to 7.5kW output with an inverter in Figure 47. The blue points pass the 2010 MEPS requirements while the red points fail the 2010 MEPS requirements. Naturally all the of blue points lie above the red points as the Y axis is efficiency. This chart shows that MEPS compliant models are amongst the cheapest of all air conditioners in this category (furthest to the left on the chart). There are even some very high efficiency models that are below average price. Note that a price of 1.0 is an average price for this category of produce while a efficiency of 1.0 is an average efficiency for this category of product. Charts for air conditioner product categories are shown in Appendix 4: Figures for Cross-sectional analysis of product price and energy efficiency (Figure 87 to Figure 99).

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<sup>6</sup> One model in the category of split systems above 7.5kW with inverter had a price significantly lower than all other products in this category but only accounted for 1% of sales in this category. Although this model claims to be inverter driven, consumer reviews state it does not run as an inverter and is very noisy and otherwise undesirable.

Figure 47: Normalised Price vs Normalised Efficiency – Type 1bi



### 6.13.3 Other Aspects of Performance

One concern often voiced is that MEPS may have an adverse impact on capacity or other performance parameters.

The main energy service from an air conditioner is cooling output (capacity). MEPS is structured to take account of capacity and different efficiency levels are set that reflect the technical efficiency capability for each size and type of air conditioner. Detailed analysis over many years indicates that regulatory requirements have had no impact on capacity of products offered for sale on the market. There has been a trend towards smaller capacity window wall units, but this is due to strong drift towards split systems, leaving the window wall market to cater for the low cost small end of the market. Even within split systems, the capacity appears to have peaked and is now declining. This is despite the fact that smaller capacity systems have more stringent MEPS levels. If MEPS were affecting capacity, a strong move towards larger capacity systems would be expected towards products with weaker MEPS levels. Table 33 sets out the proposed MEPS levels by capacity and type.

The other key performance parameters of concern are noise (low noise attributes) and availability of inverters (or not): these are generally attributes found in split systems. The market has been moving rapidly towards split systems because they provide a much better energy service (larger capacity, quieter operation, inverter options) despite their substantially higher cost compared to window wall units. Split systems are generally more efficient as well. The MEPS level for split systems are in fact more stringent than for the same capacity window wall models because they can technically meet higher efficiency levels and low marginal cost. Because separate MEPS levels

are set for window wall and split systems, a substantial number of very low cost models will remain on the market after MEPS. But consumers tend not to select these low cost models because they do not have the features they want.

Since their introduction in the early 1990's, inverter air conditioners have slowly gained market share. However, their share appears to have increased rapidly in recent years, which some 65% of split system reverse cycle models and 5% of split system cooling only models having inverters in 2006. There is a cost premium for inverter models (typically around 30% more expensive), but consumers appear to prefer these types for a range of reasons including better capacity range, flexibility of operation, quieter operation on part load and generally higher efficiency, especially on part load. Hence MEPS will not have an adverse effect on any of the other key performance parameters for air conditioners.

### 6.14 Transition Costs

#### 6.14.1 Costs to Suppliers

##### Transition Categories

Table 48 below shows the estimated number of models in each transition category.

**Table 48: Air Conditioners Models April 2008 – Transition Numbers**

			Comments
			72% (of Approved 2008 registrations)
			28% (of Approved 2008 registrations)
			66% (of active models) – models disappear
			33% (of active models) – all will have to be re-registered
			Most may have to be re-registered to new Part 2
			All will be registered to new Part 2

Note: There are about 600 new registrations per year for labelled air conditioners.

It is proposed that from 1 January 2009 products will be able to be registered to the new AS/NZ3823.2-2009, but on the understanding that these products will not be on display with a new label until 1 April 2009. Products can still be registered to AS/NZS3823.2-2005 up until 1 October 2009, but all registrations to the older edition of the Part 2 standard will expire on 1 April 2010. Suppliers would avoid re-registration costs if they refrained from introducing new models with the old label during the overlap period, but they may judge that the commercial advantage of being able to display a higher star rating, if only for a few months, outweighs the costs.

A major potential source of buyer confusion is the possibility of seeing models with old labels next to models with new labels in the same showroom. At first glance the new label models could appear less efficient than the old label models because they will display fewer stars for the same level of energy efficiency.

In order to minimise the possibility, there will be correspondence with suppliers and retailers from early 2009 to educate and provide information on the new label program. E3 plans to work with appliance suppliers and retailers to try and ensure that:

- Whenever a new unit is put on display after 1 October 2009, the retailer selects a unit with a new label from the stock in preference to a unit with an old label. This will require retail staff to take more care in selecting floor stock (E3 is working with suppliers to indicate products with new labels on the packaging).
- Stock on showroom floors after 1 October 2009 with the old energy label are gradually converted to new labels wherever possible. The aim is to have all products on display converted by April 2010. In some cases new labels may be required to replace old labels - this will require coordination between suppliers and retailers.
- Initial focus groups have suggested that products during the early transition period should carry both the new and old label where possible. The details need to be finalised with industry and included in the Part 2.

E3 has budgeted up to \$500,000 for retailer information and other targeted publicity for this 'display transition' program, the objective of which is that no labels should remain on showroom display after 1 April 2010. Clearly, suppliers and retailers will also bear some costs in printing, distributing and fixing over-sticking labels and in managing the showroom stock more carefully during the transition process.

While the transition to new labels in 2000 took some time, it was achieved with minimal disruption, even though the earlier transition was more complex as it covered all labelled appliances. There will inevitably be some showrooms where both label types are on display for significant periods.

For obsolete or grandfathered models old labels remain on display after 1 April 2010, and some where new labels come on display before 1 October 2009<sup>7</sup>. There may be some cases where old labels are replaced with incorrect new labels, but these are likely to be rare<sup>8</sup>. The presence of both labels could disrupt consumer use of the label, but this is for a limited period and other steps are being taken to minimise this impact.

Furthermore, some customers may select a model on the basis of a new label in the showroom, but have a unit with the old label delivered from the warehouse. This would not impact on the selection process, but may generate some follow-up inquiries to the retailers, the product supplier or government authorities. If the reverse should occur (ie selection on the basis of the old label, but having a unit with a new label delivered) the chance of confusion would be less if a transition label is used. In both cases the transition label is recommended for use as soon as possible to minimise consumer questions and negative feedback.

It is impossible to estimate a monetary cost for these temporary disruptions to consumers. On the one hand, consumers who visit showrooms where the display transition is not well managed may find it more difficult to take energy efficiency into account in their purchase decision, and may purchase a somewhat less efficient model than otherwise. On the other hand, noticing the new labels could increase consumer interest in energy efficiency, even if there are many old labels in the same showroom. For customers who use leaflets or the internet to compare product energy efficiency, the task will be made much easier by the removal of obsolete registrations and the display of both star ratings for the transition period.

As a result of these arrangements, appliance models can be categorised into distinct classes, as shown in Table 49 below. The table summarises the quantifiable cost factors associated with changing labelling arrangements for each class.

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<sup>7</sup> Some companies may choose to add 'new' label to their 'old' label on their stock between 1 January 2009, when new label registrations become possible, and 1 April 2009, when the 'display transition' period commences. This would extend the period in which costs are incurred from 3 to 6 months, but not necessarily increase the total costs.

<sup>8</sup> In the past, manufacturers have advised that correctly labelling all units leaving the factory was the most cost-effective way of ensuring that the correct label appeared on the correct model in the showroom.

**Table 49: Transition Stages - Regulation**

Table 49: Transition Stages - Regulation		
		For obsolete registrations: none  For models removed from sale during overlap period (1): none  For models continuing on market after overlap period: MEPS/label re-registration and display transition costs (2)
		For models removed from sales during overlap period (1): none  For models continuing on market after overlap period: MEPS/label re-registration and display transition costs (2)
		No additional costs
		No additional costs

Notes:

- 1) Overlap period (1 April 2009 – 30 September 2009): new registrations to old or new Part 2 accepted – new labels may show transition data. Registrations to new Part 2 must also meet all new requirements for MEPS, power factor, standby/crankcase heaters and demand response.
- 2) New label start date (1 October 2009): all new registrations must be to new Part 2 (AS/NZS3823.2-2009). Only products that carry an energy label will have display transition costs.
- 3) Display transition period (1 April 2009 – 1 October 2010): labels changed from ‘old’ to ‘new’ on showroom display models, or ‘new’ labelled models selected for display in preference to ‘old’ labelled models. Mixture of labels on display.
- 4) For models listed in New Zealand, there is no expiry date. Future requirements for 2012 may be considered in a subsequent RIS.

Under E3’s proposed transition arrangements, all existing registrations to AS/NZS3823.2-2005 (as amended) will be grandfathered on 1 April 2010. The only mechanism previously available for retiring registrations was voluntary notification of

cancellation. A five year limit on registration life was introduced as part of the revised label RIS in 1999 for Australia (GWA, 1999a). This means that there are a lower number of redundant models in the registration system compared to past experience. It is estimated that about one third of current registrations are not actively available or sold on the market. However, all states and NZ now annually review the validity of registrations/listings and where a regulatory change is introduced (such as the new energy label), then records that do not comply can be grandfathered as required.

### *Individual Element Costs*

The cost of label and MEPS revision is estimated as the sum of the following factors:

- Costs to suppliers of re-registration of models. This is estimated at \$300 per unit (\$150 registration fee and \$150 in internal administrative costs – unit already tested to AS/NZS3823.1-2007).
- Costs to supplier and/or retailers of verifying labels, re-labelling units or selecting new-label units for display during the transition period. This is estimated at \$10 for every unit displayed in appliance showrooms during the display transition periods.
- Costs to government of supporting the label and algorithm development and cost/benefit analysis (\$150,000) and the display transition period (up to \$500,000 budgeted).

The New Zealand regulator does not charge a fee for listing of products. However, for the purposes of this cost-benefit analysis, it is assumed that all registrations occur in Australia and therefore attract a \$150 registration fee. This is conservative as it over-estimates the supplier costs.

The cost/benefit model ultimately aggregates all costs and benefits from the perspective of the appliance buyer, although business compliance costs and administrative costs are distinctly identified. Given that compliance is mandatory, all suppliers incur labelling costs, which they are more or less equally able to pass onto consumers<sup>9</sup>. It is assumed that when supplier labelling costs are passed onto appliance buyers they are marked up in the same proportion as the ratio of retail to wholesale price, ie a factor of 2. Therefore the total costs to consumers of elements 1 to 4 above is estimated as twice the calculated amount. Government costs are not marked up.

### *Total Costs for Transition per Category*

It should be noted that for Table 50, Table 51 and Table 52 the data and costs contained are all one off costs associated with the re-registration costs as set out in the proposal. The ongoing costs of the overall air conditioner program with the new

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<sup>9</sup> The testing and administrative costs per unit sold would be somewhat greater for suppliers with lower sales per model, and competitive pressures may force such suppliers to absorb somewhat more of these costs in the short term, but these factors may be less significant than the ability of suppliers to increase sales of more efficient – the higher margin – products as a result of the existence of universal labelling.

proposals is introduced are assumed to be the same as the program costs without the proposal. There are no ongoing costs associated with this change, just the three one off costs to different sectors.

Table 50 below shows the total costs per element for re-registering of air conditioners.

**Table 50: Total Costs Per Element for Re-registering**

				Comments

Note – New Zealand is part of the above analysis, as the figures come from total approved registrations.

**6.14.2 Costs to retailers**

The display transition costs to retailers which have been estimated at \$10 per unit, could include the following elements:

- Staff training
- Label replacement in showrooms (if necessary)
- Stock handling
- Handling extra inquiries and complaints (eg 'I bought a 5 star model but you shipped a 3 star model')

Table 51 summarises the assumptions regarding the number of units which will incur re-labelling (or label selection) costs during the display transition period. It is assumed that 5% of units sold pass through showrooms and will incur label change costs, while 95% are delivered direct from warehouse to buyer and will need no label change. The 5% assumption is probably an overestimate as there is limited detail available on the total number of air conditioner units found on display. Thus a conservative estimate was used. It is also possible that the cost of this process will be lower due to management procedures being implemented by suppliers, which increase the ease that retailers identify units displaying the new label.

**Table 51: Assumptions Regarding Display Transition Cost Estimates**

				Costs of label change (\$'000)
				\$300
				\$30
				\$330

6.14.3 *Costs to Government*

Table 52 below shows the assumptions regarding the estimated costs to government. The administrative costs include market research for revised label designs, the documentation and analysis behind the changes required to the algorithm, the writing of this RIS, including any re-writes and consultations required and contributions to revise the relevant standards.

**Table 52: Assumptions Regarding Estimated Costs to Government**

		Comments
		Label and Algorithm Development, RIS

6.14.4 *Costs to Consumers – Program Costs*

The supplier (manufacturers and retailers) costs, calculated from the cost estimates given earlier are estimated at about \$0.5 million. Given the normal retail markups, this implies a cost to appliance buyers of over \$1.0 million. Therefore, in total the cost of the introduction of new labels would amount to about \$1.7 million. About 60% of this would be supplier costs passed onto consumers and the rest being government administration costs. The costs equate to less than \$0.50 per appliance sold if spread over 10 years, the likely minimum interval before the next possible label revision.

There is a possibility that consumers will pass up more advantageous purchase options during the transition period due to confusion over the star rating of some appliances, depending on whether these have the new label or the old. The possible costs of this confusion are impossible to quantify and no attempt has been made to include this element in this RIS. Unlike the last re-labelling transition in 2000, the visible label differences to consumers will be small. The pre-2000 label was a distinctly different shape to the current label and the proposed 2010 label will retain this shape and basic setup, with only the bar at the very bottom of the label will be a different colour. However, this will be quite obvious to informed consumers. The relationship between the new and old star rating will be different for any particular model, but the mechanisms behind this change (a change in algorithm) will not be apparent to consumers.

For the purposes of assessing overall costs and benefits, all program costs have been allocated to Australia in order to simplify the analysis.

## 7. Results on Analysis

This section sets out the results of the cost-benefit analysis. This is split into the Base Case (primary assumptions and expected program impact) followed by a sensitivity analysis of key variables.

In terms of an approach for the cost-benefit analysis, it is necessary to do this from either a consumer or societal perspective, although the ratio between retail and resource costs will be much the same for both electricity prices and any additional labelling costs, so the cost/benefit outcomes will be similar.

Analysis from a consumer or product purchaser perspective involves the use of retail product prices and marginal retail energy prices. Since the objective is to assess whether product buyers (consumers) as a group would be better off, transfer payments such as taxes are included.

Analysis from societal or resource perspective, involves assessing the cost to the economy of manufacturing more efficient products using the marginal cost of resources diverted from other activities. Only the extra costs involved in the manufacturing and distribution process (ie extra materials, handling, storage costs) are counted and any benefits are valued at the marginal cost of electricity production rather than the retail price. Price components not related to costs, such as retail mark-ups and taxes are not included.

The dollar value of both costs and benefits will be lower from the resource perspective than from the consumer perspective, although if they both fall in the same proportion, then the cost/benefits ratios will be much the same. Carrying out a separate cost/benefit analysis from the resource perspective is only necessary if the ratios of private to public costs are significantly different for costs and benefits.

For this analysis, a consumer perspective has been assumed as the published data corresponds to that perspective and this is the most readily available information. Retail mark-ups and taxes will be passed onto the consumer and this perspective will simplify the process (while still remaining appropriate), whereas a new set of factors and assumptions have to be introduced, particularly regarding manufacturing costs, if assessing from a resource perspective. The impact of varying discount rates is very much more difficult to assess from a resource perspective.

The analysis in this study also include estimates for New Zealand. The data is less complete in a number of areas for New Zealand compared to Australia. Time series energy estimates for New Zealand have been determined using a number of factors as set out in previous sections.

All values reported for New Zealand are in Australian dollars. The exchange rate assumed for this report is NZ \$1.17 per AU \$1.00.

## 7.1 Summary of Analysis Results – Base Case

### 7.1.1 Base Case Assumptions

The basic assumptions in the Business As Usual (BAU) scenario (ie without the change of energy label and increase in MEPS levels) for each of the key parameters is compared to the values that are expected as a result of implementation of the proposal (Scenario A). The sensitivity of the results to some key aspects is also explored in the following section to test the robustness of the assumptions.

Base Case assumptions for analysis:

- BAU energy projections (refer Section 6.11) are estimated using household projections, ownership patterns and other stock assumptions at a state level and for New Zealand, as set out in Section 6.
- Increases in efficiency of new units entering the stock from 2009 to 2020 as set out for the BAU in section 6.7 (note that new units that enter the stock in 2020 consume energy to 2045)
- NZ stock energy consumption for air conditioners based on sales weighted data for new products in Tasmania.
- Standard residential and commercial electricity tariffs are applied at a state level and for NZ (refer Section 6.9).
- Stable real future prices for electricity tariffs (0% real change).
- Projected marginal carbon intensity for electricity supply at a state level and NZ as set out in Section 6.10 with constant intensity for energy consumption beyond 2020.
- Discount rate of 7.5% per annum<sup>10</sup>.
- Shadow price of CO<sub>2</sub> of \$0 per tonne CO<sub>2</sub>-e.
- Real air conditioner purchase prices declining at 2.0% per annum in real terms (continuation of trends established over past 3 years).

Scenario A program impact assumptions (as set out in Section 0) for analysis are the same as Base Case except where noted below:

- Increases in efficiency of new units entering the stock from 2009 to 2020 for the expected program impact as set out in section 6.7 (note that new units that enter the stock in 2020 consume energy to 2045).
- Increased price as a result of reduced electricity consumption for new models purchased up to 2020 as set out in Section 6.12.
- Reduced greenhouse gas emissions as a result of reduced electricity consumption of new units entering the stock from 2009 to 2020.

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<sup>10</sup> While the base case discount rate is 7.5% for Australia, the preferred discount for the New Zealand government is now 5% - this has been included under Scenario C and separately reported.

- Inclusion of program costs for government, retailers and appliance suppliers as a result of the program measures.
- Sales, average size and market share by type are assumed to be unaffected by the program measures (only energy efficiency is affected).

It is important to note that it is the overall cost/benefit ratio for the proposal that matters. While all data is tracked at a group level, the overall analysis of costs and benefits does not take into account any effects within each type (although assumptions across all air conditioner types are generally similar and therefore costs and benefits are expected to be broadly comparable). Many of the costs are applied across product types and groups and it is not possible to separate these.

**7.1.2 Base Case Results – Australia**

Table 53 below show the Base Case for air conditioners in Australia. The net costs and benefits are based on the difference between the BAU and Scenario A costs and benefits for Australian air conditioners in the years 2005, 2010, 2010 and 2020. A full table of results is available in Appendix 3: BAU Versus Scenario A, B and C Costs and Benefits – Air Conditioners, Australia and New Zealand.

**Table 53: BAU Scenario A Costs and Benefits for Australian Air Conditioners by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$21.0
						\$23.3
						\$25.8

Table 54 below shows the cumulative costs and benefits for Australian air conditioners for the years 2005 to 2020. Scenarios are defined as:

- BAU - Business as Usual case, using Base Case assumptions
- Scenario A – expected impacts of the proposal, using the Base Case assumptions
- Impact – impact of the proposal compared to BAU (BAU minus Scenario A).

**Table 54: Cumulative Costs and Benefits for Australian Air Conditioners – 2005 to 2020**

				NPV Purchase Cost (\$m)
				\$11,274
				\$11,406
				\$132

Table 55 shows the cumulative costs and benefits for Australian air conditioners for the years 2005 to 2050. The analysis examines the impact on new appliances installed up to 2020. Appliances installed in 2020 will continue to have an impact on the stock energy consumption up to around 2048, hence the cumulative tables to 2050 give a more accurate overall program impact.

**Table 55: Cumulative Costs and Benefits for Australian Air Conditioners – 2005 to 2050**

				NPV Purchase Cost (\$m)
				\$11,274
				\$11,406
				\$132

**7.1.3 Base Case Results – New Zealand**

Table 56 below shows the Base Case for air conditioners in New Zealand. The net costs and benefits are based on the difference between the BAU and Expected Impact costs and benefits for New Zealand air conditioners in the years 2005, 2010, 2010 and 2020. A full table of results for all scenarios considered is available in Appendix 3: BAU Versus Scenario A, B and C Costs and Benefits – Air Conditioners, Australia and New Zealand. New Zealand has stated that they wish to use 5% as its primary discount rate.

**Table 56: BAU vs Scenario A Costs and Benefits for New Zealand Air Conditioners by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$1.8
						\$1.9
						\$2.1

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Table 57 shows the cumulative costs and benefits for New Zealand air conditioners for the years 2005 to 2020.

**Table 57: Cumulative Costs and Benefits for New Zealand Air Conditioners – 2005 to 2020**

				NPV Purchase Cost (\$m)
				\$1,188
				\$1,202
				\$14

Table 58 below shows the cumulative costs and benefits for New Zealand air conditioners for the years 2005 to 2050. The analysis examines the impact on new appliances installed up to 2020. Appliances installed in 2020 will continue to have an impact on the stock energy consumption up to around 2048, hence the cumulative tables to 2050 give a more accurate overall program impact.

**Table 58: Cumulative Costs and Benefits for New Zealand Air Conditioners – 2005 to 2050**

				NPV Purchase Cost (\$m)
				\$1,188
				\$1,202
				\$14

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

### 7.1.4 Cost-Benefit ratios – Base Case

Table 59 below outline the Net Present Value (NPV) of difference between the BAU and Scenario A costs and benefits the program for Australia and New Zealand. The NPV includes all costs and benefits that occur from 2005 to 2050 for both cases.

**Table 59: Summary of NPV Benefits and Costs of Scenario A for Australia and New Zealand**

					B/C Ratio
					2.9
					6.5
					7.4

The overall cost-benefit ratio for Australia is 2.9 and for New Zealand is 6.5, indicating that they both comfortably fall into the no regrets category of program measures. The benefit cost ratio for New Zealand is 7.4 when the preferred discount rate of 5% is used.

## 7.2 Scenario and Sensitivity Analysis Results

The following section documents various scenarios and sensitivities which quantify the impact of key variables on the overall cost/benefit ratios. Besides Scenario A, two more scenarios (B and C) are analysed to quantify the impact of different levels of regulation (note that these scenarios do not have the subsequent set of sensitivity analysis which has been completed on Scenario A).

- Scenario B: MEPS 2010, label 2000 – in this case, the MEPS levels are being upgraded, while the labelling algorithm stays the same.
- Scenario C: MEPS 2007, label regrade 2010 – in this case, the labelling algorithm is upgraded, while the MEPS levels stay the same.

Each sensitivity examines the effect of a variable in order to assess the robustness of the overall analysis. In order to keep the assessment of the results manageable, combinations of changed variables are not examined, but this could be done if required.

The following parameters have been examined across a range of values to test the sensitivity and robustness of the results to the input assumptions:

- Discount rate variations: 0%, 5%, 7.5%, 10%.
- Price impact of reduced energy consumption – a value of twice the assumed cost energy coefficient as well as 0.5 of the assumed impact are examined.
- Two sliding shadow prices for CO<sub>2</sub> have been investigated (options 1 and 2). The first starts at AU \$10 per tonne in 2010 and reaches a maximum of AU \$30 per tonne in 2050 and the second starts at AU \$10 per tonne in 2010 and reaches a maximum of AU \$70 per tonne in 2050. Both are compared to the base case of \$0 per tonne CO<sub>2</sub>-e throughout the modelling period.
- Increases or decreases in real electricity costs at -1% pa, 0% (base) and +1% pa.
- Changes in the projected real cost of appliances to be 1% greater and 1% less per annum compared to the base case.

The following factors were not varied as part of this study as there was no firm basis on which to set projected values (noting that they tend to affect all scenarios in a similar fashion):

- Increases (escalation) of the shadow price of CO<sub>2</sub> over time.
- A decrease on the carbon intensity of electricity supply after 2020.

Table 60 below lists the scenarios and sensitivities which are documented. This is followed by key results of each of these, with the results for Australia and New Zealand being shown separately. All cases compare the BAU with the expected program impact under Base Case assumptions except for the parameter noted.

**Table 60: Scenarios and Sensitivity Analysis**

	Notes
	As per Chapter 4.1 – BAU vs Scenario A
	MEPS 2010, Label 2000
	MEPS 2007, label regrade 2010
	Base Case with 0% discount rate
	Base Case with 5% discount rate for Australia & 7.5% for New Zealand
	Base Case with 10% discount rate
	Price impact of 60% greater than the Base Case
	Sliding scale shadow CO <sub>2</sub> cost 1
	Sliding scale shadow CO <sub>2</sub> cost 2
	Energy tariff increasing at 1% per annum real
	Energy tariff decreasing at 1% per annum real
	Purchase price escalation factor set to 0% real price change pa (+2% pa above the base case (more expensive))
	Purchase price escalation factor set to -4% real price change pa (-2% pa below the base case (less expensive))

Detailed output tables for the Base Case and each scenario above are included in Appendix 7: Scenarios and Sensitivity Analysis .

### *Scenario B*

Scenario B: MEPS 2010, label 2000 – in this case, the MEPS levels are being upgraded, while the labelling algorithm stays the same. This would see an increase in the efficiency of air conditioners due to the promotion of more stringent MEPS levels. The market would become more constrained in an energy labelling sense as the increased MEPS levels enhanced bunched star ratings in the higher star bands.

In this Scenario, the expected program impact is reduced due to no label upgrade when compared to the Scenario A. As this scenario (Scenario B) is a key part of the analysis, more detailed results have been shown. The Scenario B assumptions for analysis are the same as the Base Case except where noted below:

**Table 61: Summary of NPV Benefits and Costs of Base Case versus Scenario B for Australia and New Zealand**

					B/C Ratio
					2.9
					3.0
					7.4
					7.9

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Under Scenario B, the benefit cost ratio has increased slightly due to the lower program costs, but very similar benefits. As the difference between Scenario B and Scenario A is the incorporation of an algorithm change into the proposal, the slightly increased benefit cost ratio is completely in response to more stringent MEPS. This Scenario does not solve the issue of bunching of the energy star ratings towards the more efficient end of the label, and therefore could not be said to increase or continue consumer purchase discretion.

*Scenario C*

Scenario C: MEPS 2007, label regrade 2010 – in this case, the labelling algorithm is upgraded, while the MEPS levels stay the same. This would see an increase in efficiency of air conditioners due to the evolution of market due to a re-grade of the energy label algorithm. The overall effect of MEPS is lessened as the currently inadequacies are not resolved.

In this Scenario, the expected program impact is reduced due to no label upgrade when compared to the Scenario A. As this scenario (Scenario C) is a key part of the analysis, more detailed results have been shown. The Scenario C assumptions for analysis are the same as the Base Case except where noted below:

**Table 62: Summary of NPV Benefits and Costs of Base Case versus Scenario C for Australia and New Zealand**

					B/C Ratio
					2.9
					1.8
					7.4
					3.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Under Scenario C, the benefits cost ratio has been reduced substantially due to the absence of the introduction of more stringent MEPS levels and associated reduced energy savings. As the program changes in this Scenario only include the change of the energy rating algorithm, both the costs and benefits are a lot lower than Scenario A which incorporate both MEPS and labelling changes.

*Sensitivities 1, 2, 3*

These Sensitivities examine the changes in the assumed discount rate. In Sensitivities 1, 2 and 3 all assumptions for analysis are the same as Base Case except for the discount as shown below.

**Table 63: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 1 for Australia and New Zealand**

					B/C Ratio
					2.9
					4.4
					7.4
					10.1

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

**Table 64: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 2 for Australia and New Zealand**

					B/C Ratio
					2.9
					3.3
					7.4
					6.5

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

**Table 65: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 3 for Australia and New Zealand**

					B/C Ratio
					2.9
					2.6
					7.4
					5.7

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Changing the discount rate will affect the net present value for both future savings and costs. Discount rate is essentially an indicator of time/preference for money or can be used as a proxy for certainty or required rate of return. At a very low discount rate, distant future costs and savings are treated as if they are of a similar value to costs and savings that occur close to the present. At a very high discount rate, distant future costs and savings are discounted heavily and are assigned little value in today's terms. The more distant the cost or saving, the less value these are in terms of current value under a high discount rate sensitivity.

The reference discount rate is 7.5% (used in the Base Case). Discount rates of 0% and 5% (ie lower than the Base Case rate) are often used to assess government based programs with a positive social impact. These give a higher benefit-cost ratio as the net present value of the energy savings in the distant future are discounted less and hence are worth more today. Conversely, a discount rate of 10%, which is considered to be a more commercial rate, results in a lower benefit-cost ratio as the net present value of distant future savings is discounted more and therefore these appear to be worth less today. Similarly, capital cost increases, which are associated with increased appliance costs as a result of the program, appear to have more weight under a higher discount rate as they occur at the start (ie earlier) in the appliance's life compared to the resulting energy savings stream from that appliance.

Even under the highest discount rate considered, the benefit-cost ratio remains above 2.5 for Australia and above 5.5 New Zealand, indicating that the results are robust. Under a low discount rate of 0%, the benefit-cost ratio climbs to almost 4.5 for Australia and above 10 for New Zealand. The New Zealand government prefer to assess projects using a 5% discount rate when assessing their benefit cost ratio.

*Sensitivity 4*

In this Sensitivity, the cost-energy coefficient is varied to test robustness. Sensitivity 4 assumptions for analysis are the same as Base Case except the price-energy coefficient is set to increase by a factor of 60% of the assumed value (ie the appliance purchase cost increases resulting from reductions in energy of new products is 60% greater than the assumed rate).

**Table 66: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 4 for Australia and New Zealand**

					B/C Ratio
					2.9
					1.8
					7.4
					4.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

The price-energy coefficient is used to estimate the effect that any increases in efficiency have on the cost of appliances paid by consumers. A more in-depth discussion on the effects of this has been included in Section 6.12. The coefficients that are used for the Base Case are outlined in section 6.12, and these have based on analysis of current models sold in Australia in 2006.

The premise for the use of a price-energy coefficient is that there can be no increases in energy efficiency without some corresponding increase in the purchase price of appliances. Even though the detailed analysis into the relationship between energy efficiency and price in this report found the relationship was weak (and in some cases even negative) for most product categories, the Base Case includes an assumed relationship between efficiency and price which is reflective of some of the more common product types. The coefficients used in the Base Case are conservative in nature (ie are thought to overstate any impact on price of energy efficiency changes) as for any particular efficiency level there always appears to be a wide range of price available.

To check the robustness of these factors Sensitivity 4 have been examined. By increasing by a factor of 60% the assumed value of the coefficients in Sensitivity 4, there is a major impact on the cost benefit ratio (as expected), with a large decrease compared to the Base Case. This is because the assumed marginal appliance purchase costs have been effectively increased by over 50% in this sensitivity but the benefits remain the same.

Not surprisingly, in Sensitivity 4, the benefit-cost ratio increases to 1.8 for Australia and to over 4 for New Zealand. As indicated, the Base Case coefficients are considered to be very conservative and increasing these by a factor of 60% is considered to be a very extreme case, so the proposed program measure can be seen as robust, with benefits roughly equalling costs even in extreme circumstances.

### *Sensitivities 5 and 6*

The potential impact of an Australian emissions trading scheme (ETS) on the cost-benefit ratio is assessed in this sub section and is based on information provided by the Department of the Environment, Water, Heritage and the Arts . On 3 June 2007, the Prime Minister announced that Australia will implement a domestic emissions trading system beginning no later than 2012, and that the Government will set a national emissions target in 2008. The New Zealand Government is also working towards establishing an ETS in the next few years.

It is hoped that through the implementation of the Australian ETS, the cost imposed on GHG emissions will result in favourable net community benefits including investment in energy efficiency technologies. Therefore, the RIS should take into account the reduction in carbon permits required by electricity generators as a result of the decrease in energy demand (as the uptake of energy efficient appliances increases). This reduction will result from the proposed label change and therefore reduce the consumption and generation of electricity at the margin.

These valuations are included as a trial in this RIS. The valuation methodology will be finalised once the Australian Government has set out parameters for how the ETS will operate and this trial methodology has been reviewed.

A number of possible methodologies could be used to value the GHG emissions abatement, such as using a separate carbon price or using retail electricity tariffs that include the effects of the ETS. The most appropriate approach can be determined once the Government has made decisions on how the ETS will operate (which will clarify how a new MEPS/labelling scheme and the ETS will interact) and once modelling of future electricity prices under the emissions trading is available.

In the interim, the MCE E3 Committee plans to use the valuation methodology discussed below and to revisit the choice of methodology once more information is available. The approach essentially involves sensitivity testing of a range of plausible carbon prices.

The methodology values abatement at the shadow price of the carbon permit price on the basis that by introducing emissions trading, the Government has placed a carbon constraint on the economy and created a market value for emissions reductions (ie 'commoditised' emissions). Abatement is also shown in tonnes of GHG for information. With an ETS operating in the economy, any new MEPS or labelling should have its abatement valued in terms of the counterfactual cost of achieving the same abatement through other complementary measures in the ETS.

As this RIS is a partial equilibrium analysis, it values the costs and benefits of the proposed measure at the prevailing prices in the economy, assuming the impact of the measure has negligible impact on those prices. MEPS and labelling will reduce the consumption of electricity at the margin and this reduction is valued at the retail tariff (ie the avoided cost of electricity expenditure for consumers) and hence provides the basis of the consumer benefits as noted above in the Results of Analysis section.

Similarly, a partial equilibrium analysis takes the ETS cap as given, assuming any new individual MEPS or labelling will have negligible impact on the carbon market and cap. Therefore the GHG emissions reduction is valued at the expected prevailing carbon permit price. This implicitly recognises that the emissions avoided through the [MEPS/labelling] will obviate the need for an equivalent amount of abatement elsewhere in the economy. Using the same approach as for the reduction in the cost of consumption of electricity (which is valued at the retail electricity price), the avoided cost of carbon permits is added to the total benefits

The carbon prices for both sensitivity analysis start at AU \$10/t CO<sub>2</sub>-e, with Sensitivity 5 reaching a maximum price of AU \$30/t CO<sub>2</sub>-e in 2050 and Sensitivity 6 reaching a maximum price of AU \$70/t CO<sub>2</sub>-e in 2050. The tables below report the effect of this on the RIS results. Although the future carbon price under the ETS is uncertain at present, emissions trading will mean the estimated benefits will always be higher than without emissions trading (i.e. the benefits will always be higher when the carbon price is above zero). Any scenario where carbon is costed yields a greater benefit cost ratio.

In these Sensitivities 5 and 6, the impact of a shadow price for carbon dioxide is examined.

Sensitivities 5 assumptions for analysis are the same as Base Case except the shadow CO<sub>2</sub> price is set to AU \$10/tonne CO<sub>2</sub>-e in 2010 reaching a maximum of AU \$30/tonne CO<sub>2</sub>-e in 2050.

**Table 67: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 5 for Australia and New Zealand**

					B/C Ratio
					2.9
					3.0
					7.4
					7.7

Note: Shadow prices for CO<sub>2</sub> are treated as an add-on to electricity energy costs. Figures in this table use a 5% discount rate for New Zealand as requested by EECA

Sensitivities 6 assumptions for analysis are the same as Base Case except the shadow CO<sub>2</sub> price is set to AU \$10/tonne CO<sub>2</sub>-e in 2010 reaching a maximum of AU \$70/tonne CO<sub>2</sub>-e in 2050.

**Table 68: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 6 for Australia and New Zealand**

					B/C Ratio
					2.9
					3.1
					7.4
					7.8

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

By modelling a shadow price for CO<sub>2</sub>, any possible effect of the Program when coupled with a future market costing of CO<sub>2</sub> emissions can be partly assessed. This is a one-sided assessment as only benefits are increased as a result of the carbon price and energy savings from the MEPS and label revision. In reality a carbon price would have corresponding effects on energy prices and the carbon intensity of electricity supply as industry responded to the ETS carbon price, which have been ignored for this simplified analysis. The carbon price, energy prices and emissions carbon intensities will all be inter-related under emissions trading, so these trial benefits based on carbon values should be considered as informative only.

Under increasing carbon prices the benefits from reduced energy consumption will be larger and correspondingly, the benefit-cost ratio will increase. Under the Base Case (with no ETS) a reduction in emissions is not explicitly valued, so any increase in carbon prices will only increase the apparent value of increasing energy efficiency. As expected, the higher the carbon price, the higher the benefits and therefore the higher the benefit-cost ratio.

**Sensitivities 7 and 8**

Sensitivities 7 and 8 examine the impact of changes in real tariffs.

Sensitivity 7 assumptions for analysis are the same as Base Case except that the energy tariffs are set to increase at 1% per annum in real terms.

**Table 69: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 7 for Australia and New Zealand**

					B/C Ratio
					2.9
					3.3
					7.4
					8.6

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Sensitivity 8 assumptions for analysis are the same as Base Case except that the energy tariffs are set to decrease at 1% per annum in real terms.

**Table 70: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 8 for Australia and New Zealand**

					B/C Ratio
					2.9
					2.5
					7.4
					6.4

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

By increasing energy tariffs in real terms (Sensitivity 7), the benefits from increasing the energy efficiency of appliances (ie reducing the energy consumption) will increase. Therefore, any measure to reduce the energy consumption of appliances will result in lower total energy costs and an increased benefit-cost ratio. Conversely, decreasing energy tariffs in real terms (Sensitivity 8) will result in a decrease in the benefits of increasing the energy efficiency of appliances. It is doubtful that energy prices will decrease in real terms in the future given the pressure to reduce carbon intensity of electricity supplies. However, even under a scenario of a 1% per annum decrease in real tariffs the benefit-cost ratio remains above 2.5 for Australia and almost 6.5 for New Zealand, indicating that the proposal is robust under a range of future tariff scenarios.

**Sensitivities 9 and 10**

Under Sensitivities 9 and 10, the sensitivity to changes in real purchase prices of appliances is examined. Note that the escalation factors for real purchase price as applied equally to the BAU and the Expected Impact cases.

Sensitivity 9 assumptions for analysis are the same as Base Case except that the purchase price escalation factor is set to increase at 2.0% per annum above the base case.

**Table 71: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 9 for Australia and New Zealand**

					B/C Ratio
					2.9
					2.5
					7.4
					6.3

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

Sensitivity 10 assumptions for analysis are the same as Base Case except that the purchase price escalation factor is set to decrease at 2.0% per annum below the base case.

**Table 72: Summary of NPV Benefits and Costs of Base Case versus Sensitivity 10 for Australia and New Zealand**

					B/C Ratio
					2.9
					3.4
					7.4
					8.7

Note: figures in this table use a 5% discount rate for New Zealand as requested by EECA

The price escalation factor for air conditioners assesses the impact of changes to real prices of appliances in comparison to the base case. For air conditioners, analysis of prices versus CPI showed that real prices were decreasing over time. The factor assessed for these scenarios examine a faster or slower rated of decrease in real prices.

The purchase price of appliances is essentially a cost for both the BAU and Scenario A cases, therefore any increase in the purchase price escalation factor should affect both cases equally (as the same number of appliances are purchased in each case). However, the differences between the Base Case and Sensitivities 9 and 10 arise due

to the impact of the price-energy coefficient assumed (refer to Sensitivity 4). In Sensitivity 9, the real cost of appliances is increasing over time (in comparison to the Base Case) therefore the purchase price impacts from increased energy efficiency resulting from the program (in response to the price-energy coefficients) will also increase over time. Hence in Sensitivity 9, the apparent benefit-cost ratio will decline slightly, although the effect is small. Conversely, in Sensitivity 10 the opposite effect increases the benefit-cost ratio. The same effect could be simulated using an escalation in price-energy coefficients (Sensitivity 4 considers only a static relationship between price and efficiency).

## 8. Consultations and Comments

The following consultations and documents have been released and undertaken in relation to the policy development for air conditioners:

- **Regulatory Impact Statement: Minimum Energy Performance Standards and Alternative Strategies for Air conditioners and Heat Pumps: September 2000.** Sets out the case for MEPS for three phase products in 2001.
- **International Review of Minimum Energy Performance Standards for Air Conditioners: May 2002.** Report 2002/16.
- **MEPS Profile - Air Conditioners: August 2002.** Sets out government proposals for air conditioner MEPS levels in 2004 (single phase) and 2007 (single phase and three phase). Report 2002/11
- **Minimum Energy Performance Standards for Air Conditioners, Regulatory Impact Statement: August 2003.** This RIS set out the proposed changes to MEPS for air conditioners falling in the scope of AS/NZS3823. The analysis includes a range of options; various MEPS regimes, voluntary programs, levies and other measures. Report 2003/08. The recommendations were:
  - Energy labelling to continue in a revised format on a mandatory basis for single phase models (except for ducted systems).
  - MEPS levels be introduced for all single phase models from October 2004 and revised in October 2007.
  - More stringent MEPS levels for three phase models (to 65kW) be introduced in October 2007 (first regulated in 2001).
  - A high efficiency level for three phase units to be set from October 2007.
  - Existing State and Territory regulations governing appliance energy labelling and MEPS be amended to implement the proposed standards.
- **A National Demand Management Strategy for Small Air Conditioners: the role of the National Appliance and Equipment Energy Efficiency Program (NAEEEP): November 2004.** This paper documented the arguments for the need for a uniform set of Demand Management rules and the development of a task force and strategy to enable their implementation and creation.
- **Comparison of International MEPS: Room Air Conditioners: January 2005.** This paper provides a comparison of international MEPS for single phase room air conditioners. It is used as a basis for proposing new MEPS levels for Australia in 2006 and 2008. In addition, recommendations are made to the future of Australia's MEPS levels for these types of air conditioners.

- **Proposal to increase MEPS for Room Air Conditioners and harmonise MEPS for single and three-phase units (consultation RIS): June 2005.** Report 2005/16. Sets out basis for accelerated MEPS levels for some non ducted types from October 2007 to April 2006. Some of the proposals canvassed were not implemented (outstanding points have been addressed in this RIS).
- **Air Conditioner Algorithm Working Group Discussion Paper: July 2005.** This discussion paper proposed a revised star rating algorithm for both cooling and heating modes for air conditioners that carry an energy label. The revised algorithms aim to take into account new MEPS levels that will be introduced in 2006 to 2008 (now 2010 in this proposal) and provides better differentiation of higher efficiency products.
- **Status of Air Conditioners in Australia: August 2005.** This report quantifies some of the issues surrounding air conditioners in Australia where there is data available in the public domain, with the specific aim: *'to provide the best available data to industry and policy makers on current trends with respect to air conditioners in Australia'*.
- **Publication of Standard AS/NZS3823.2-2005: December 2005.** Contains new MEPS requirements and the new algorithm included in this proposal.
- **Inverter MEPS Discussion Paper: March 2007.** This discussion paper outlines the status of inverters including an in-depth analysis of the issues surrounding part load registration of inverters and proposals to address identified issues. Provided a technical basis for the development of AS/NZS3823.2-2005 Amendment 3.
- **Industry Government Round Table: April 2007.** A round table meeting to formulate a range of proposals for further discussion and implementation through the relevant committees with respect to whitegoods and air conditioners (and other products). The main issues for discussion concerning air conditioners were:
  - Air conditioner label transition details – timing of transition, option for transition labels, colours for the new label, any other changes, standard timing and arrangements for considering retail replacement of labels.
- **Stakeholder Letter: May 2007.** A letter from regulators to all stakeholders informing them of the postponement of proposed 2008 MEPS levels for air conditioners.
- **Final Report on Consumer Research to Guide the Next Round of Refrigerator and Air Conditioner Labels: October 2007.** This report was based on a series of six focus group discussions with consumers and 15 in-depth interviews with retailers in Australia and New Zealand concerning the proposed refrigerator and air conditioner labels. The conclusions and recommendations were:

- Replace the green band at the bottom of the label with a purple band.
  - During the transition period, include messages in the purple band to show in detail, the difference between the old and new star ratings for the product.
  - For stock already on the showroom floor at the time of transition, add the new label as soon as practicable, retaining rather than replacing or covering up the old label. Include the messages; 'revised star rating' and 'from 2009', in the purple band.
  - For new stock during the time of transition, use only the new label with the purple band now containing the messages; 'revised star rating', 'from 2009', and 'rated xx stars on the old scale'.
  - For new stock after the transition period ceases, use the new label with a plain purple band and no messages.
- **Amendment 3 AS/NZS3823.2-2005: February 2008.** Sets out revised part load requirements for MEPS compliance as set out in previous consultations with industry. Became effective on publication. Stated that approvals to previous part load requirements will be grandfathered on 1 April 2009.
  - **Towards a 10-Star Energy Efficiency Rating System for Major Household Appliances – Final Report on a Series of Focus Group Discussions in Australia and New Zealand: May 2008.** This report was based on a series of nine focus group discussions with consumers, retailers and manufacturers in Australia and New Zealand concerning the proposal to move to a ten star label. It was found that although the current six star label works well, redefinition of the label and test method was essential, so that consumers could see what products were more efficient on the current scale.
  - **Air Conditioner Industry Stakeholder Forum, Sydney: June 2008.** Outlined to industry the detailed technical proposals in the forthcoming consultation RIS (see next document).
  - **Consultation Regulatory Impact Statement for the Revision to the Energy Labelling Algorithms and Revised MEPS Levels and Other Requirements for Air Conditioners: September 2008.** This document aimed to communicate to stakeholders the most important issues and questions relating to the regulatory proposal (finalised in this decision RIS), to seek stakeholder comment and to focus the development of the regulatory proposal. In particular, comment was sought on each of the Scenario proposals, including aspects of the individual options, compliance costs, transition arrangements and timing, and related issues. The case for new MEPS levels and a change of algorithm for the energy star rating of air conditioners for the Australian and New Zealand market was clearly set out in the report. This 'need' was also widely acknowledged and supported by industry. The final recommendations were:

- New energy labelling algorithms to be implemented in AS/NZS3823.2 for air conditioners. This will have associated with it a new label design, the details of which will be set out in a public comment version of AS/NZS3823.2.
  - The introduction of more stringent MEPS levels for selected products in cooling mode.
  - The introduction of more stringent MEPS levels for heating mode for all products with a heating function.
  - Introduction of minimum requirements for power factor.
  - Introduction of measures to reduce standby power consumption and crankcase heater energy use by inclusion of this energy into the energy labelling and MEPS requirements as part of an annual efficiency requirement.
  - Introduction of requirements to report the presence of DRED capabilities in air conditioner units at the time of product registration with regulators.
  - All products manufactured or imported after 1 April 2010 will be required to have a current approved registration/listing for this label (including compliance with new MEPS levels and the new energy label).
  - Transition arrangements over the period April 2009 to April 2010 to be implemented.
  - All new registrations from October 2009 will be required to meet all requirements of the revised Part 2 standard including the new energy label, MEPS and other performance requirements.
  - Development of a retailer communication package to be developed to ensure that new energy labels appear on all new display products as far as possible by April 2010.
- **AS4755.1:2007, Framework for demand response capabilities and supporting technologies for electrical products.** This standard went through the normal standards development and public comment process.
  - **AS4755.3.1:2008 – Interaction of Demand Response Enabling Devices and Electrical Products: Operational Instructions and Connections for Air Conditioners.** This standard went through the normal standards development and public comment process.
  - **Air Conditioner Industry Stakeholder Forum, Sydney: February 2009.** Communicated the outcomes of the RIS consultation process and outlined recommendation in this decision RIS.

## 8.1 Summary of Comments: Consultation RIS

In September 2008, E3 Committee on behalf of MCE released a **Consultation Regulatory Impact Statement: Revision to the Energy Labelling Algorithms and Revised MEPS Levels and Other Requirements for Air Conditioners**, seeking comments. Stakeholders were asked to comment on the proposals found in the RIS, including the changes to the algorithm, new MEPS levels, the data and assumptions. The document was advertised in the Australian and New Zealand press, asking for comments by the 31 October, 2008. Table 73 shows the summary of stakeholder comments that were received and the responses to these comments.

## 8.2 Responses to Comments: Consultation RIS

The comments from stakeholders were considered and a number of changes to the decision RIS were deemed appropriate. These concern small technical adjustments regarding standby and crankcase heaters, power factor, part load MEPS allowance. All of the changes made to the consultation RIS are in response to concerns raised by industry in the consultation process and all the changes are slightly more favourable to industry (more lenient) and address the concerns raised.

Other comments regarding the proposal were either regarding specific issues regarding multi-split systems (not included in the proposal – will be covered by a separate proposal), minor comments on MEPS levels and label issues, or general supportive of the proposal. The detailed responses can be found in Table 73. Some other issues were also raised which were not part of the proposal – these are covered in following section.

The section below provides a summary of the proposals in the RIS and any key changes to these proposals as a result of the comments and the consultation process.

### *Summary of Proposals and Changes to the RIS Arising from Public Comments*

- **Section 4.2.2 – More Stringent MEPS Levels for Cooling:** Only a few general comments regarding future product costs were received on this element of the RIS proposal. It is recommended the proposed EER levels should be implemented.
- **Section 4.2.3 – Introduction of MEPS Levels for Heating Mode:** Only a few general comments regarding future product costs were received on this element of the RIS proposal. It is recommended the proposed COP levels should be implemented.

- **Section 4.2.4 – Standby and Crankcase Heaters:** The RIS proposed that standby and crankcase heater energy be incorporated into the calculation of EER or COP in a vertical approach using an assumption of 1000 hours use per year. A number of commentators expressed concern that the assumption of 1000 hours operation per year was too short (and therefore 7760 hours per year in standby was too long) for some products like ducted systems and commercial systems. Given that actual use by different users is highly variable, the selected hours of use per year is somewhat arbitrary (1000 hours is possibly on the short side for commercial users). Given the high proportion of inverter products now sold, longer hours of operation at lower outputs is probably realistic during normal use. Concerns were expressed about differences in the calculations between assumed use of cooling only and reverse cycle products, but these were not relevant as the proposed calculation covers variable use by mode. Cooling only tend to be selected for hot climates and reverse cycle elsewhere. The balance of heating and cooling operation will depend on climate but total usage will even out if used as the primary device for both modes. The calculation approach adopted is independent of use for heating or cooling. On consideration of the submissions, it is recommended that a total assumed usage of 2000 hours per year be used as the basis for calculation of operation EER and COP with a 1 year delay in the inclusion of annual EER or COP for MEPS to 2011 (no delay for energy labelling in 2010).
- **Section 4.2.5 – Power Factor Requirements:** The RIS proposed a minimum power factor of 0.90 for all new air conditioners as a separate new performance requirement. A number of commentators expressed concern at this requirement. Many felt that three phase products and inverter based units may have trouble meeting this requirement and that 0.90 may discourage use of variable speed (controllable) fans. Most commentators recommended a minimum power factor of 0.85 be included. According to registration data, less than 4% of current models have a power factor less than 0.85. The data in the registration system has been supplied by manufacturers themselves and covers 80% of all products. It is recommended that a power factor of 0.85 only at rated capacity be included in the new standard with a 1 year delay to 2011 to give industry time to adjust to the new technical requirements. Some technical clarifications have been made with less stringent requirements for very small units. It is believed that this has widespread industry support.
- **Section 4.2.6 – Indication of Demand Response Capability:** No comments were received on this proposal. Requirements as proposed should be implemented.
- **Section 4.2.7 – Part Load Allowance:** The RIS proposed that the current part load MEPS allowance be removed from Part 2 of the Standard. The RIS stated that the *“Regulators undertake to review this proposal (to remove part load MEPS allowance) during the consultation phase of the RIS if manufacturers provide detailed and compelling information that show why a part load compliance option should be retained in the Standard and proposals for a mechanism to reduce abuse of the allowance in the future.”* A mix of views were submitted on the part load allowance (one supported its elimination, several supported its retention). No compelling evidence was submitted by industry regarding its retention. See separate detailed discussion on this issue below. On

consultation with stakeholders, the part load allowance in Amendment 3 will be retained as set out in Section 4.2.7 but it will be based on annual EER and COP from 2011.

- **Section 4.2.8 – New Star Rating Algorithm:** Only a few general comments were received on this element of the RIS proposal. It is recommended the proposed algorithm should be implemented.
- **Section 4.2.9 – New Label Design:** Only a few general comments were received on this element of the RIS proposal. It is recommended the proposed label should be implemented.
- **Section 4.2.10 – Transition Arrangements:** The proposed transition date in the RIS was April 2010. Few public comments were received on the timing of the transition. The proposed date should be implemented apart from the delay to annual EER and COP for MEPS to 2011 and the delay of power factor to 2011 as noted above.
- **Section 5 – Review and Monitoring Process:** No comments were received on this element of the RIS proposal. It is recommended that the proposed process be implemented.

#### *Summary of Other Issues Raised in Comments in the RIS*

- **Seasonal Rating System:** This issue was not canvassed in the RIS but was raised in a number of comments. A seasonal type rating system for inverter products would better acknowledge their higher efficiency during part load operation. While this is supported in principle, it is recommended that we wait until ISO settle on a set of standard rating points for variable output products so that any system developed in Australia and New Zealand is compatible with international test methods and approaches. Once standard rating points are decided, seasonal efficiency can be calculated or simulated for a range of relevant climates in Australia. This seasonal efficiency could be used as the basis for an expanded or modified star rating system to provide consumers with more accurate local climate performance information. But it should be noted that this is not a trivial task and will take considerable planning and analysis prior to implementation. The intention to implement such a scheme should be communicated to stakeholders.
- **MEPS Multi-head Systems:** One comment recommended the introduction of MEPS for multi-split systems. This was not canvassed in the RIS. A separate regulatory proposal to introduce MEPS for these products is in preparation. Part of the delay is waiting for the finalisation of ISO15042. The intention to implement such a scheme has been communicated to stakeholders.
- **Latent Heat Ratio:** One commentator expressed concern that more stringent EER levels can be attained by reducing the latent cooling capacity. It is recommended that EL015-16 be consulted to see whether a minimum latent heat ratio should be included as a separate performance requirement in the revised standard.

Table 73: Summary of Stakeholder Comments and Responses

				<p>Multi-head units with a single indoor controller are already covered by regulations (twin or triple split systems) and will be affected by the RIS proposals. Multi-head products (separate indoor controllers for each head) do not yet have a test method pending finalisation of the proposed ISO15042 method. A separate proposal to introduce equivalent MEPS levels for these products will be developed once the ISO test method is finalised and is expected to be implemented in parallel to the RIS proposals.</p>
				<p>Opposition to any inverter part load allowances for MEPS is noted. In response to public comments on the RIS, it is recommended that amendment 3 part load allowance as set out in Section 4.2.7 be retained. Support for some type of seasonal rating for air conditioners will be separately developed once standardised ISO rating points are developed, but will not be implemented in this round of changes.</p>
				<p>In response to public comments on the RIS, it is recommended that amendment 3 part load allowance as set out in Section 4.2.7 be retained.</p>

				<p>Support for some type of seasonal rating is noted. A proposal for a seasonal rating for air conditioners will be separately developed once standardised ISO rating points are developed, but will not be implemented in this round of changes.</p>
				<p>In response to public comments on the RIS, it is recommended that amendment 3 part load allowance as set out in Section 4.2.7 be retained. Support for some type of seasonal rating is noted.</p>
				<p>In response to public comments on the RIS, it is recommended that amendment 3 part load allowance as set out in Section 4.2.7 be retained. Support for some type of seasonal rating is noted. A proposal for a seasonal rating for air conditioners will be separately developed once standardised ISO rating points are developed, but will not be implemented in this round of changes.</p>

				The rated capacity of a product is declared by the supplier as set out in the test procedure. In the case of inverters, the frequency is also recorded as part of the test procedure. The rate capacity cannot exceed the maximum continuous output that can be sustained for an indefinite period.
				See response to comment 9.
				See response to comment 9.

				<p>Variable output models already have an option for declaring part load efficiency at 50% output. However, few of the 1,300 inverter models currently registered use this option. Support for some type of seasonal rating is noted. A proposal for a seasonal rating for air conditioners will be separately developed once standardised ISO rating points are developed, but will not be implemented in this round of changes.</p>
				<p>A power factor of 0.85 at rated capacity is recommended for inclusion in the standard as a separate performance requirement (less stringent than the original 0.90 proposed in the RIS on the basis of comments received) with a 1 year delay to 2011.</p>
				<p>Concern about the high proportion of reported power factor close to 1.00 is noted. However, this is data which has been supplied by manufacturers in their registrations. See comment 14.</p>

				See comment 14.
				See comment 15.
				See comment 14.
				See comment 14.

				Support for the majority of the proposals in the RIS are noted. See comment 14.
				The RIS sets out detailed proposals for dealing with crankcase heaters that have a positive temperature coefficient – these are subjected to the hourly temperature profile for ACDB climate zone 28 to calculate an average value.
				In consideration of the comments, an assumed usage of 2000 hours per year is to be used to calculate operational EER and COP for all units, which will be a better reflection of longer hours of part load operation. In the case of reverse cycle models, the balance of heating and cooling will be highly variable. The assumption of zero hours cooling for the calculation of operation COP and zero hours for heating for operation EER results in the same effective numbers, irrespective of the actual balance of heating or cooling operation.
				See comment 22 – assumed hours of operation are being increased to 2000 per year. The impact on MEPS levels is extremely small except for products with very large crankcase heaters and smaller input power. Delay of 1 year for MEPS requirement on annual EER and COP.

				See comment 22. The impact on MEPS levels is extremely small in most cases. As canvassed in the RIS, the inclusion of information on standby power and crankcase power on the energy label will be highly confusing for consumers and may result in poor purchase decisions.
				See comment 22.
				See comment 22. The regulatory proposals do not set a limit for standby or crankcase heaters.
				This issue was not raised in the RIS. It is recommended that this be considered by the standards committee EL015-16 to see whether a minimum latent heat ratio should be included as a separate performance measure in conjunction with MEPS.

				This is not within the terms of reference for this RIS. Stars are well established and are understood by consumers. "Raw" EER and COP data is readily available.
				Comment noted. Government does not wish to force suppliers to use the eligible star rating beyond 6 stars if they elect not to do so. Other elements of the energy labelling program remain mandatory.
				Comment noted.
				Comment noted. See comment 3.
				Comment noted.
				Comment noted. However, there are a large number of products on the market already that can easily meet the proposed requirements and there is no significant cost differential.

				Comment noted. See comment 33.
				Comment noted.

## 9. Conclusions and Recommendations

A range of regulatory and other options have been considered in this regulatory impact statement. On consideration of all the relevant factors, it is recommended that Scenario A (energy labelling regrade and new MEPS levels and other performance requirements) be implemented from 2010.

A case for new MEPS levels and a change of algorithm for the energy star rating of air conditioners for the Australian and New Zealand market is set out in this regulatory impact statement. The need for these measures is widely acknowledged by stakeholders and supported by industry. MEPS levels and new performance requirements will drive increased energy efficiency and help resolve power factor, crankcase heater and demand response issues. With energy labelling, the market is tending towards a majority of products having star ratings that are bunched around the range of 3.5 to 5 stars. Market research demonstrates that consumers use the star rating labels in purchase decisions and that it also provides suppliers with a means to differentiate their product with a view to increasing market share. For the labelling program to continue to be an effective tool for all stakeholders, a change in the star rating algorithm is recommended.

This regulatory impact statement also demonstrates that:

- There is significant market failure in the air conditioner market that can only be addressed through the implementation of MEPS;
- The introduction of MEPS as proposed will not have an adverse affect on market competition, availability of product features and performance or the availability of low cost models in each of the main product categories;
- Alternative approaches that save comparable energy are not feasible or cost effective.

Intensive modelling and analysis on the effects that these changes would have on the air conditioner market and on product prices has been undertaken in this report. It was found there is only a weak correlation between product efficiency and price. Even with the worst case scenario of greatly increasing the consumer costs due to efficiency increases (above the levels derived from market analysis) (Sensitivity 4), the cost-benefit ratio for the proposal will still remain above 1. This indicates that the analysis and modelling underpinning the MEPS levels and algorithm change and associated market effects is robust (in all likelihood only small price rises will result from the increases in energy efficiency that are expected as a result of this proposal). The cost-benefit ratio of the proposal is 2.9 for Australia and 7.4 for New Zealand under modelled Base Case conditions. In the current policy climate, scenarios with real increases in either energy tariffs or the introduction of some pricing structure for CO<sub>2</sub> are more likely; in both of these cases the cost-benefit ratio increases well above the Base Case. It should be noted that though Scenario B has a slightly higher cost-benefit ratio, this Scenario does not include an change to the star rating algorithm which could have a long term detrimental effect on the program.

The preferred proposal (Scenario A) would ensure that the energy labelling program continues to be an effective measure for both consumers and suppliers in the air conditioner market and that MEPS levels for Australian products continue to meet best practice. The introduction of the changes to the MEPS levels and other performance requirements have been bundled with the energy label change and star rating algorithm change into a single regulatory requirement in order to minimise costs to industry.

The recommendations from this report to implement the following requirements from 2010 are:

- New energy labelling algorithms be implemented in AS/NZS3823.2 (2009) for air conditioners as set out in this report. This will have a new label design associated with it. Details will be set out in a public comment version of AS/NZS3823.2;
- The introduction of more stringent MEPS levels for selected products for cooling mode in 2010 (based on operating EER) and in 2011 (based on annual EER);
- The introduction of MEPS levels for heating mode for all products with a heating function in line with cooling MEPS changes;
- Introduction of minimum requirements for power factor from 2011;
- Introduction of measures to reduce both standby power consumption and crankcase heater energy use by inclusion of this energy into the energy labelling and MEPS requirements into an annual efficiency requirement;
- Introduction of requirements to report the presence of DRED capabilities in air conditioner units at the time of product registration with regulators;
- All products manufactured or imported after 1 April 2010 will be required to have a current approved registration/listing for this label (including compliance with new MEPS levels and the new energy label);
  - Transition arrangements over the period April 2009 to April 2010 as set out in this report be implemented;
  - All new registrations from October 2009 will be required to meet all requirements of the revised Part 2 standard including the new energy label, MEPS and other performance requirements; and
- A retailer communication package be developed to ensure that the new energy label appears on all new products on display as far as possible by April 2010.

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### **Other Data Sources**

This report includes unpublished analysis of GfK data for 2006 for Australia.

This report includes analysed sales data from New Zealand for 2006 which has collected by EECA. This data is not published or publicly available.

This report also includes analysed data from the E3 Online Registration System for air conditioners, which is not publicly available.

This report also includes analysed data from Informark air conditioner sales analysis, which is not publicly available.

EES (2008), *Energy Use in the Australian Residential Sector 1986-2020*, published in June 2008, unpublished modelling data used for this report.

*Appendix 1: Projected Air Conditioners Sales for Australia and New Zealand*

**Table 74: Projected Air Conditioner Sales for Australia and New Zealand**

										Australia
										845475
										867231
										889571
										912512
										936071
										960265
										985112
										1010628
										1036834
										1063748
										1091393
										1119786
										1148950
										1178907
										1209678
										1241285

Source: EES Stock Model, assumed 10 year life for non ducted units and 14 year life for ducted units.  
 Note though that all units are aggregated in the above numbers.

*Appendix 2: Air Conditioner Stock Projections for Australia and New Zealand*

**Table 75: Air Conditioner Stock Projections for Australia and New Zealand**

										New Zealand
										1526000
										1548000
										1566200
										1584600
										1603100
										1622000
										1641000
										1659000
										1677200
										1695600
										1714200
										1733000
										1749700
										1766500
										1783500
										1800700
										1526000
										1548000
										1566200
										1584600
										1603100

*Appendix 3: BAU Versus Scenario A, B and C Costs and Benefits – Air Conditioners, Australia and New Zealand*

**Table 76: BAU and Scenario A Costs and Benefits for Australia by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$6.9
						\$13.9
						\$21.0
						\$21.4
						\$21.9
						\$22.4
						\$22.8
						\$23.3
						\$23.8
						\$24.3
						\$24.8
						\$25.3
						\$25.8

Note: Energy saving from products installed to 2020 continue to accrue to 2045

**Table 77: BAU and Scenario A Costs and Benefits for New Zealand by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$0.6
						\$1.2
						\$1.8
						\$1.8
						\$1.8
						\$1.9
						\$1.9
						\$1.9
						\$2.0
						\$2.0
						\$2.0
						\$2.0
						\$2.1
						\$2.1

Note: Energy saving from products installed to 2020 continue to accrue to 2045

**Table 78: BAU and Scenario B Costs and Benefits for Australia by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$6.9
						\$13.9
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$21.0
						\$20.9
						\$20.9
						\$20.9
						\$20.9

Note: Energy saving from products installed to 2020 continue to accrue to 2045

**Table 79: BAU and Scenario B Costs and Benefits for New Zealand by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$0.6
						\$1.2
						\$1.8
						\$1.8
						\$1.7
						\$1.7
						\$1.7
						\$1.7
						\$1.7
						\$1.7
						\$1.7
						\$1.7
						\$1.6
						\$1.6

Note: Energy saving from products installed to 2020 continue to accrue to 2045

**Table 80: BAU and Scenario C Costs and Benefits for Australia by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.5
						\$0.9
						\$1.4
						\$1.8
						\$2.3
						\$2.8
						\$3.3
						\$3.8
						\$4.3
						\$4.8

Note: Energy saving from products installed to 2020 continue to accrue to 2045

**Table 81: BAU and Scenario C Costs and Benefits for New Zealand by Year**

						Additional Appliance Cost (\$m)
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.0
						\$0.1
						\$0.1
						\$0.2
						\$0.2
						\$0.3
						\$0.3
						\$0.4
						\$0.4
						\$0.5

Note: Energy saving from products installed to 2020 continue to accrue to 2045

### Appendix 4: Figures for Cross-sectional analysis of product price and energy efficiency

The analysis in this chapter has been done on models that meet 2006/2007 MEPS (approved in November 2007). See Figure 87 to Figure 99 for an examination of MEPS on the distribution of air conditioner prices.

**Table 82: Description of Air Conditioner Types**

	Description
	Non Ducted Single Split System Reverse Cycle – non inverter <4kW
	Non Ducted Single Split System Reverse Cycle – non inverter 4<7.5kW
	Non Ducted Single Split System Reverse Cycle – non inverter >=7.5kW
	Non Ducted Single Split System Reverse Cycle – inverter <4kW
	Non Ducted Single Split System Reverse Cycle – inverter 4<7.5kW
	Non Ducted Single Split System Reverse Cycle – inverter >=7.5kW
	Non Ducted Single Split System Cooling Only – non inverter <4kW
	Non Ducted Single Split System Cooling Only – non inverter 4<7.5kW
	Non Ducted Single Split System Cooling Only – >=7.5kW
	Non Ducted Single Split System Cooling Only – inverter <4kW
	Non Ducted Single Split System Cooling Only – inverter 4<7.5kW
	Non Ducted Window Wall Reverse Cycle – <4kW
	Non Ducted Window Wall Reverse Cycle – >4kW
	Non Ducted Window Wall Cooling Only – <4kW
	Non Ducted Window Wall Cooling Only – >4kW

Figure 48: Type 1a Energy Output v Price

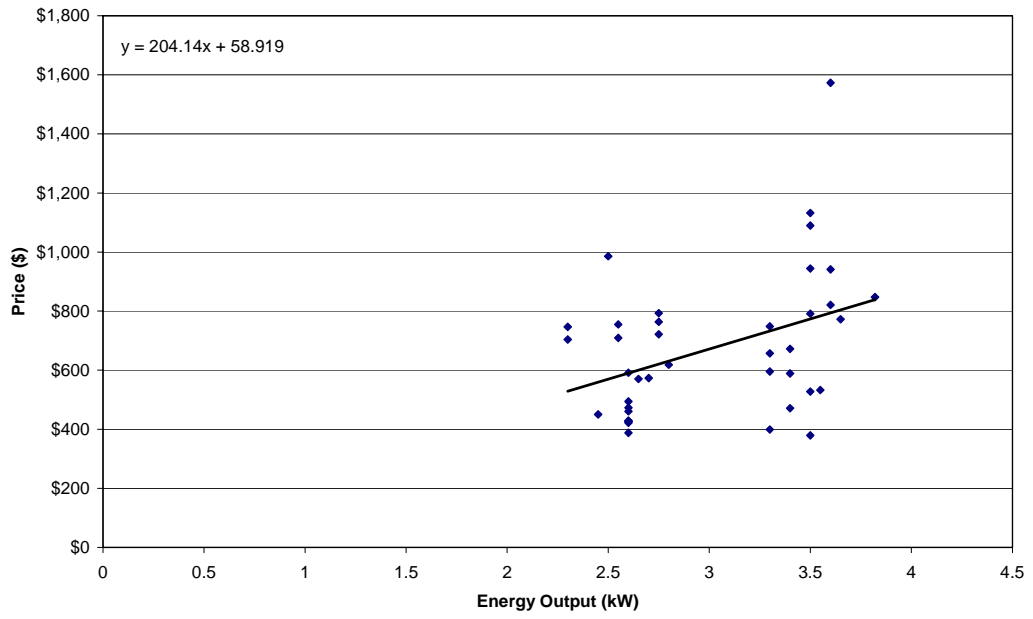


Figure 49: Type 1a Energy Output v Cooling Coefficient of Performance

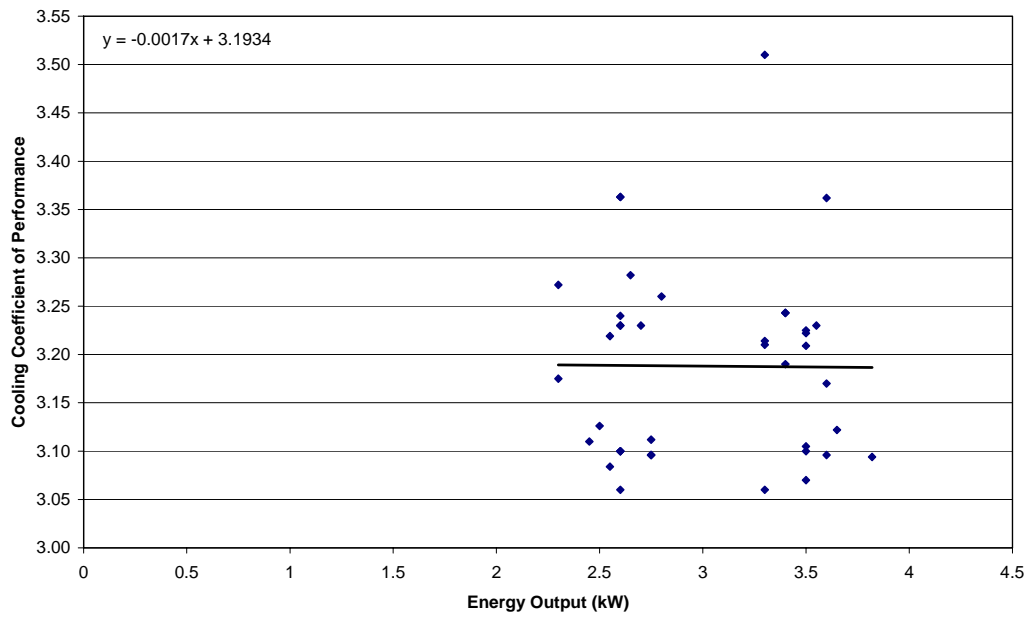


Figure 50: Type 1a Normalised EER v Normalised Price

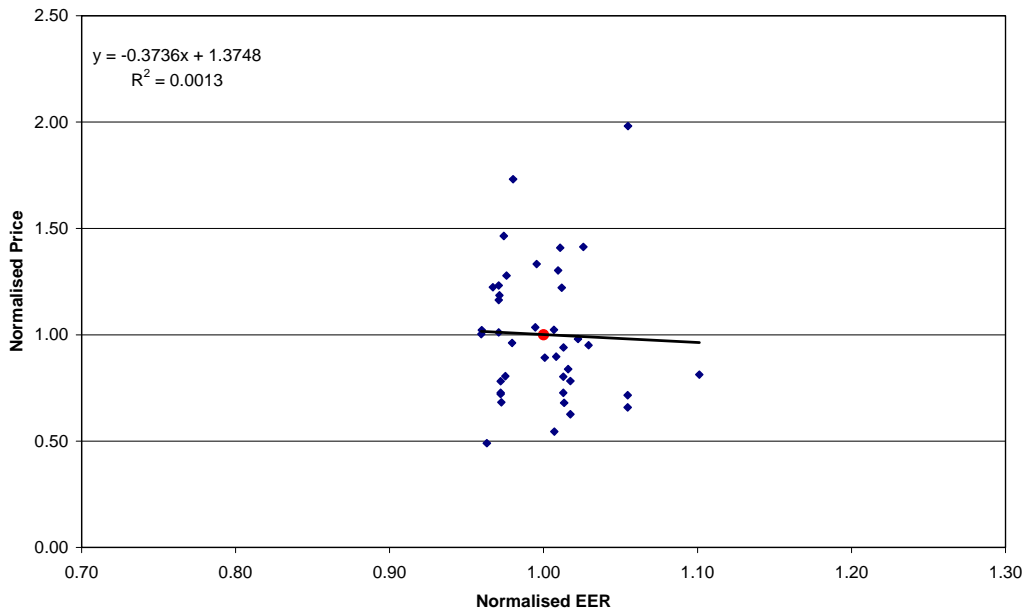


Figure 51: Type 1ai Energy Output v Price

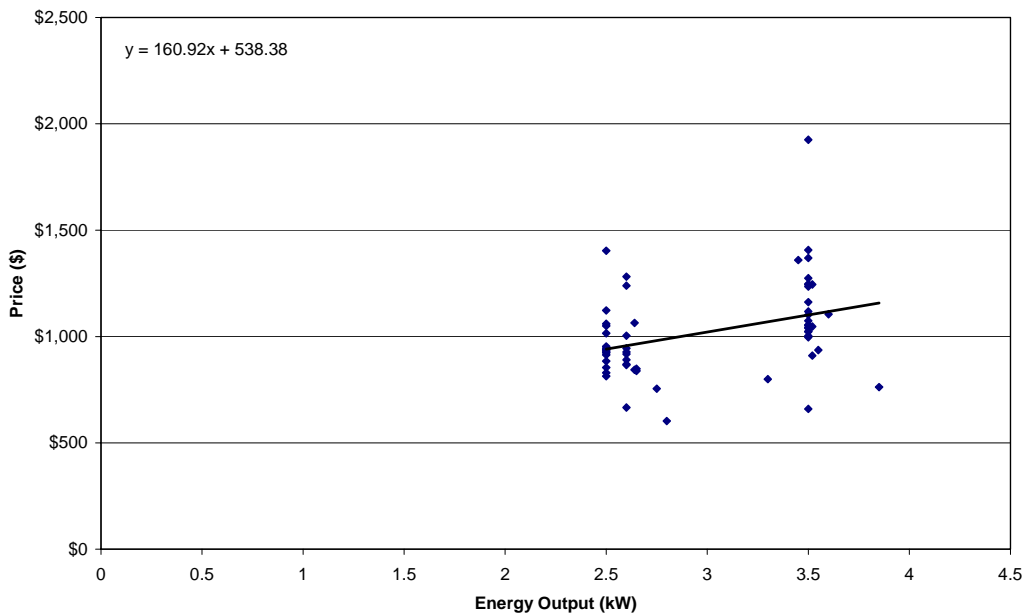


Figure 52: Type 1ai Energy Output v Cooling Coefficient of Performance

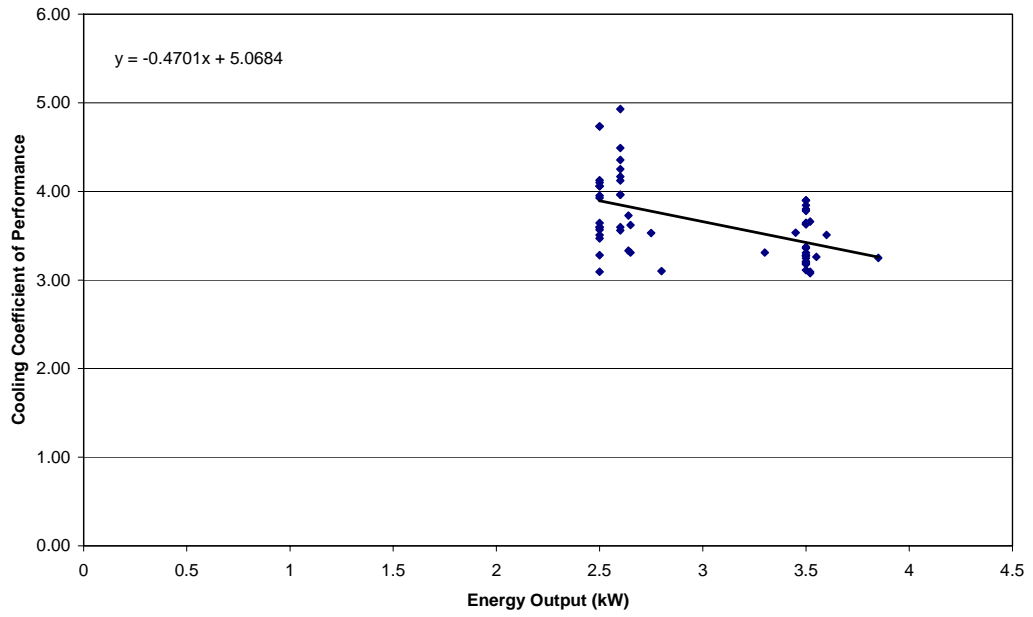


Figure 53: Type 1ai Normalised EER v Normalised Price

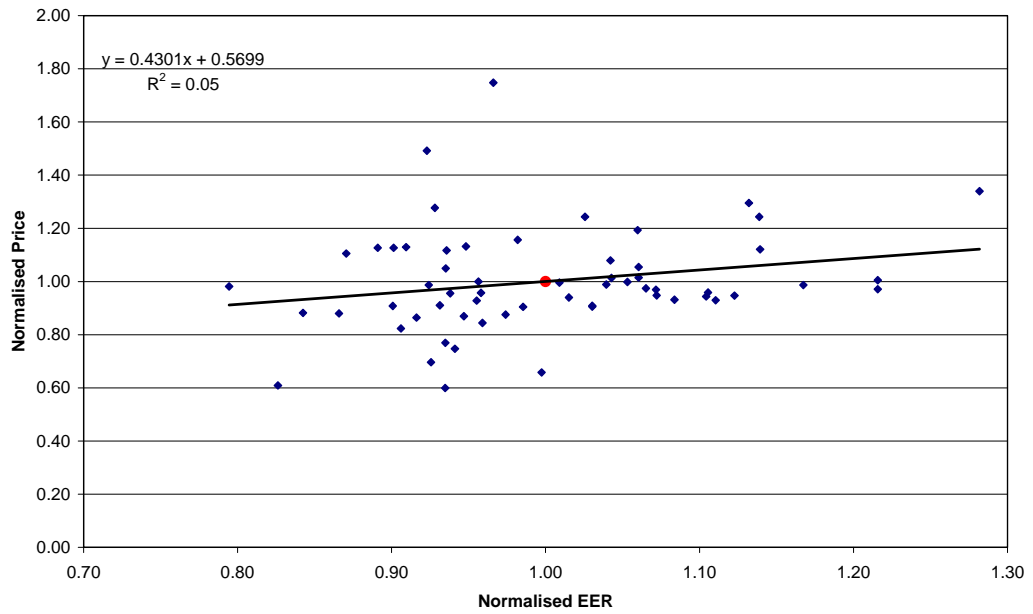


Figure 54: Type 1b Energy Output v Price

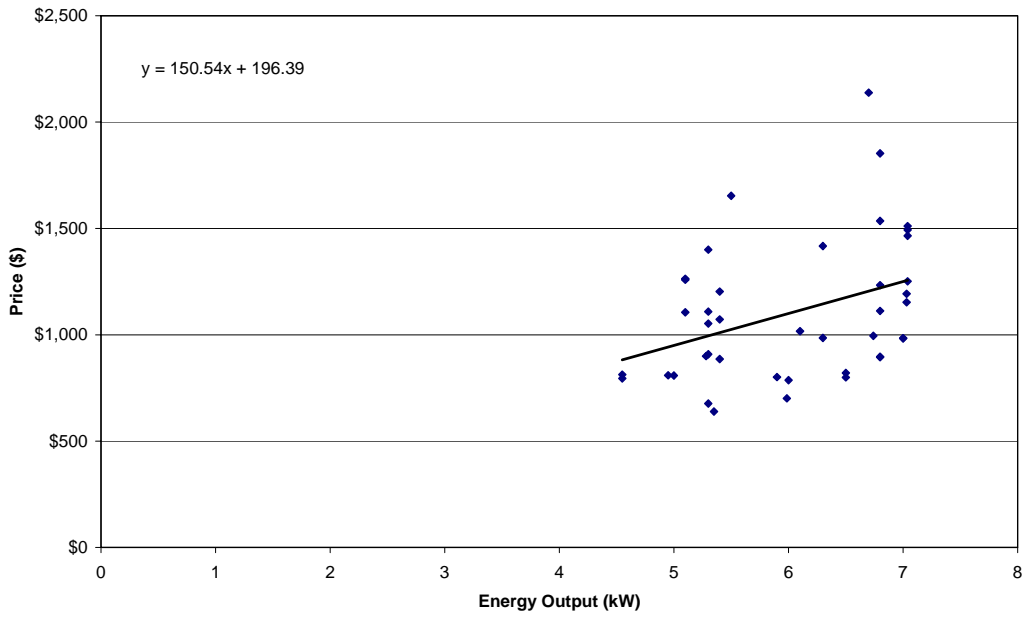


Figure 55: Type 1b Energy Output v Cooling Coefficient of Performance

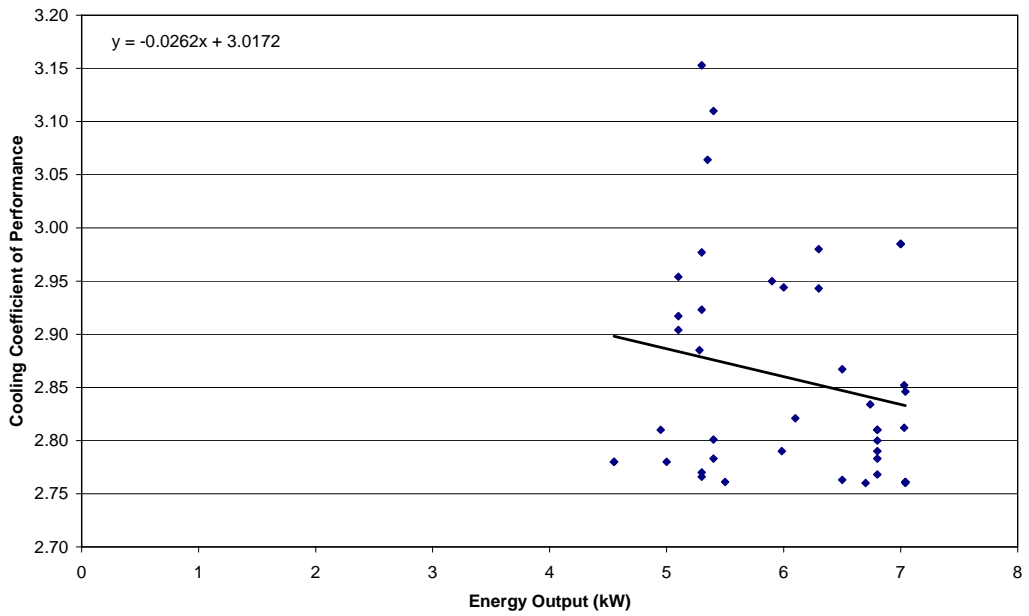


Figure 56: Type 1b Normalised EER v Normalised Price

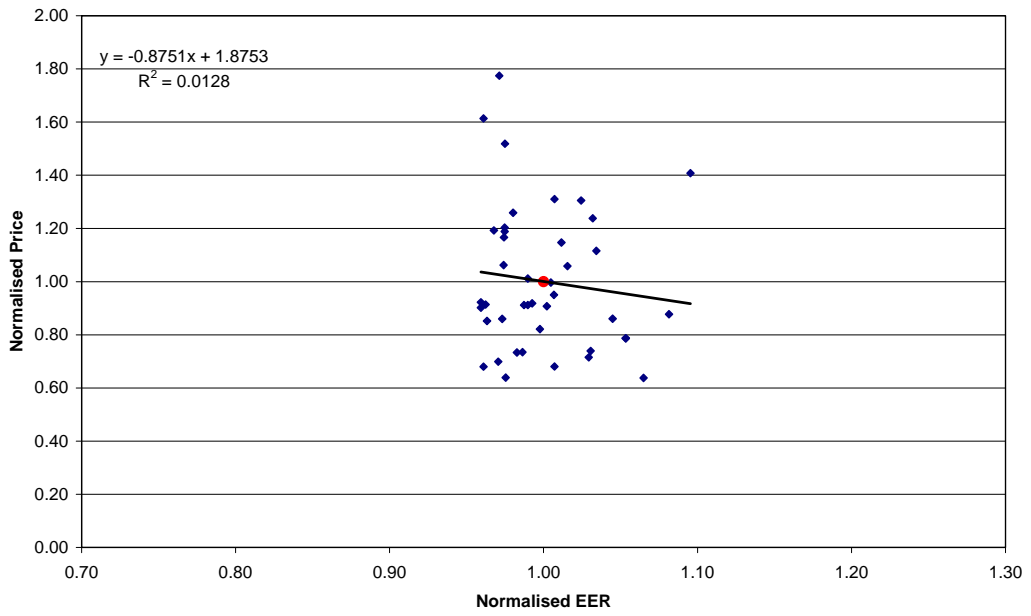


Figure 57: Type 1bi Energy Output v Price

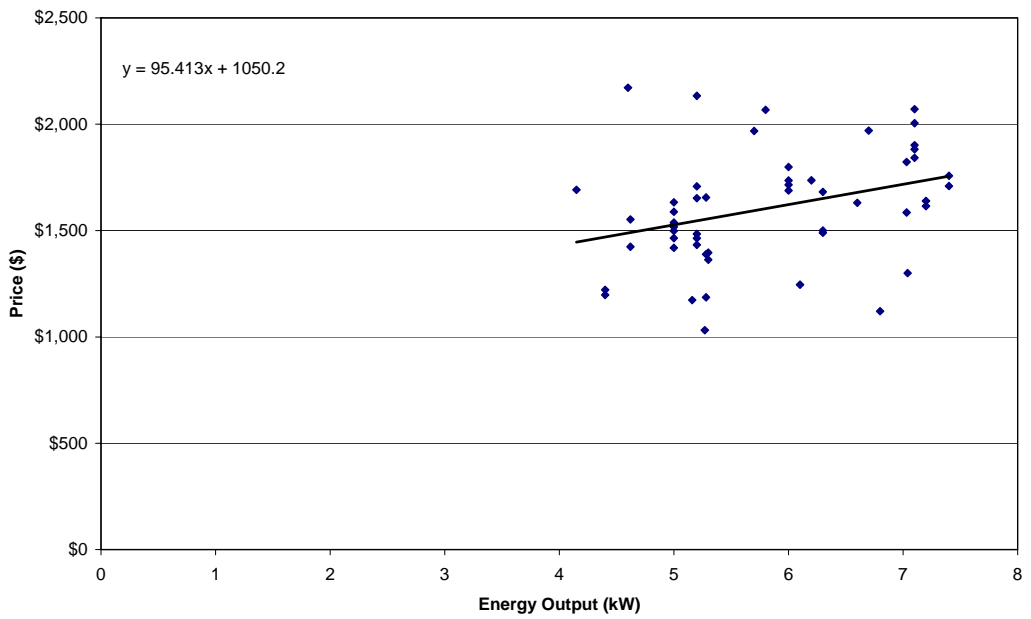


Figure 58: Type 1bi Energy Output v Cooling Coefficient of Performance

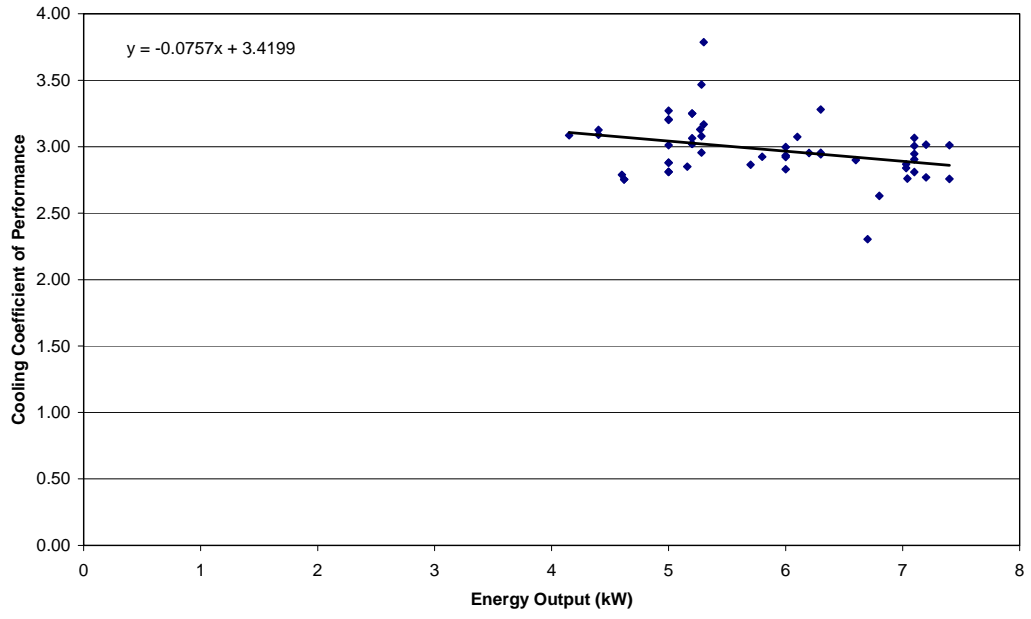


Figure 59: Type 1bi Normalised EER v Normalised Price

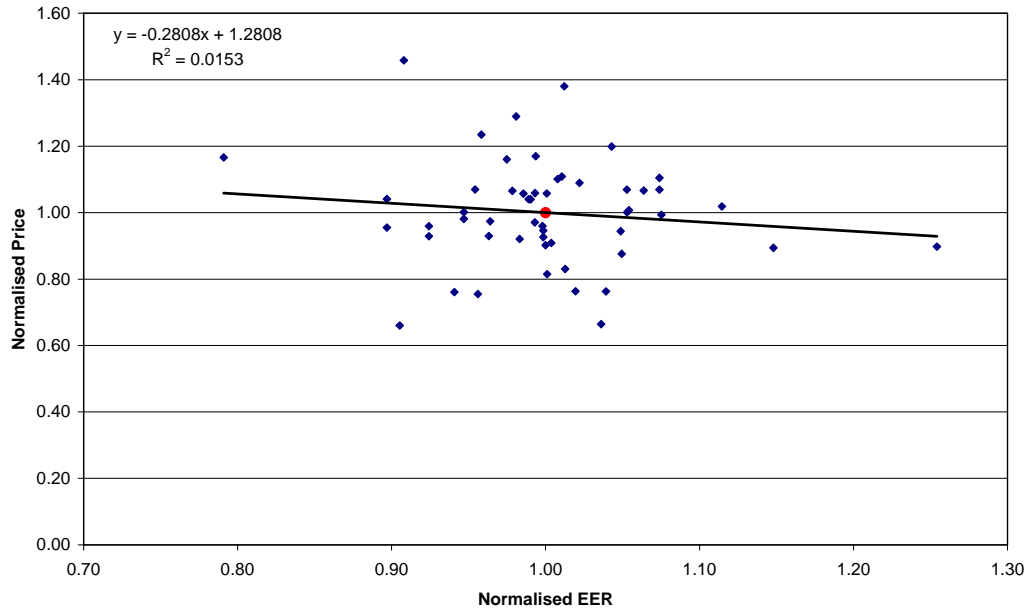


Figure 60: Type 1c Energy Output v Price

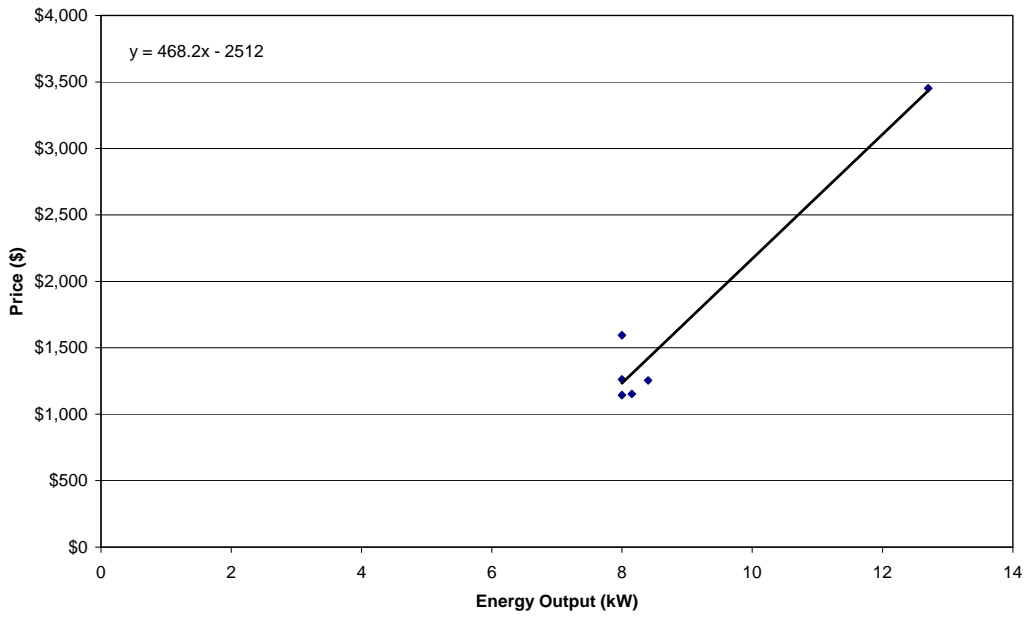


Figure 61: Type 1c Energy Output v Cooling Coefficient of Performance

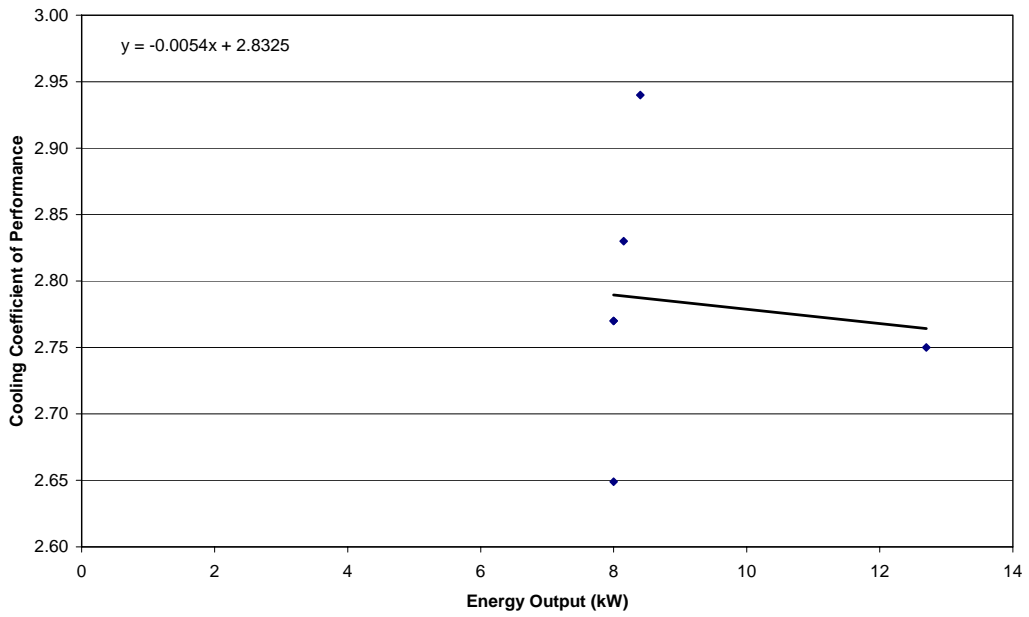


Figure 62: Type 1c Normalised EER v Normalised Price

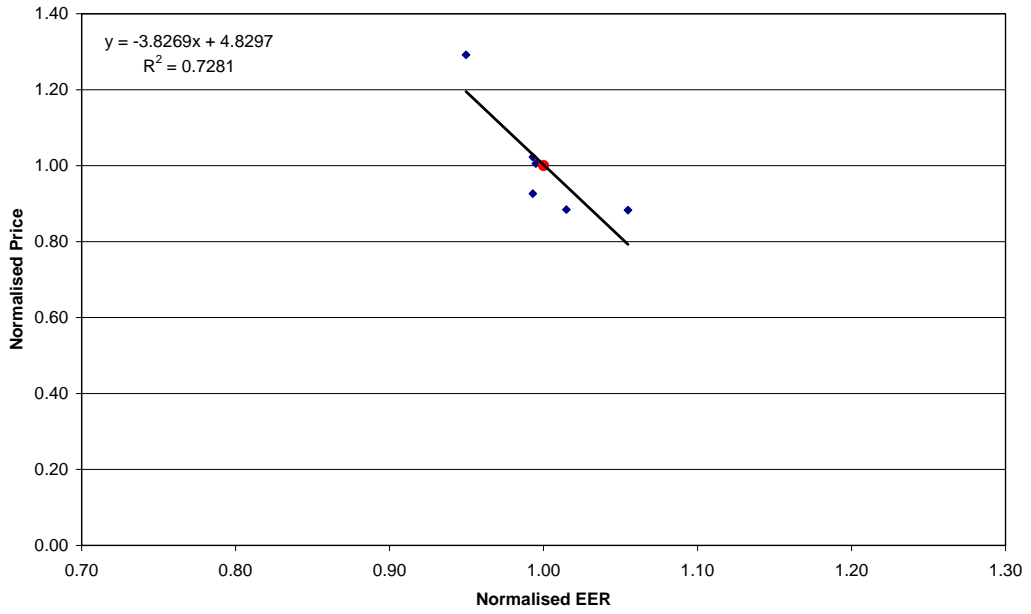
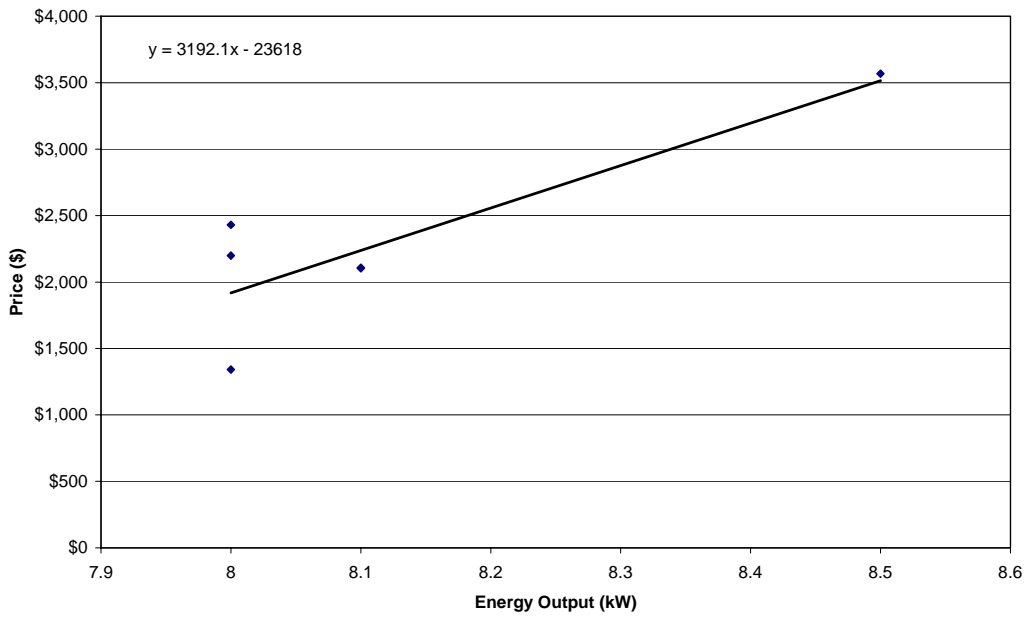
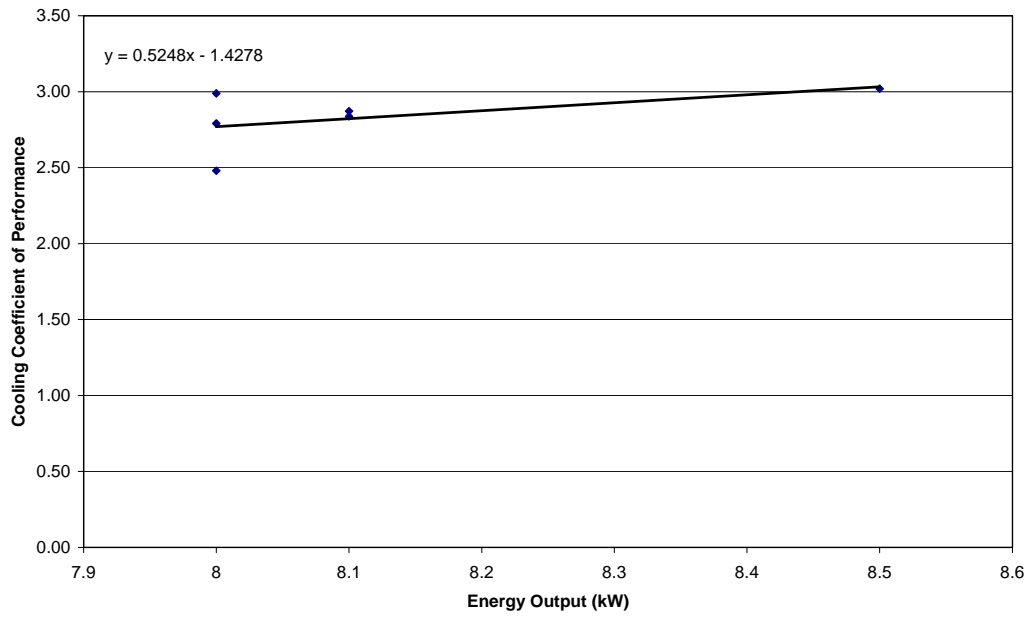


Figure 63: Type 1ci Energy Output v Price



**Figure 64: Type 1ci Energy Output v Cooling Coefficient of Performance**



**Figure 65: Type 1ci Normalised EER v Normalised Price**

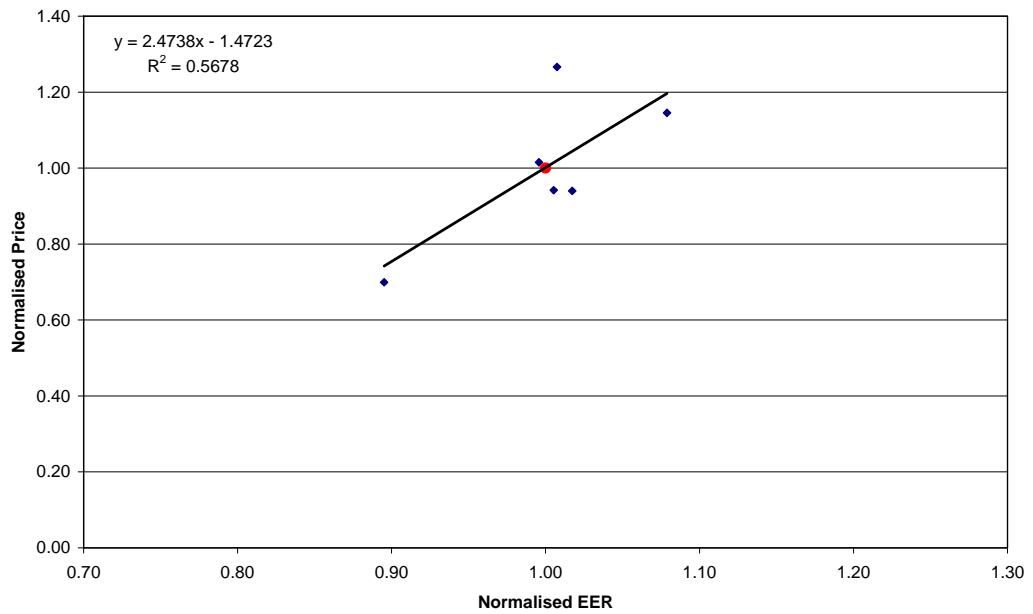


Figure 66: Type 2a Energy Output v Price

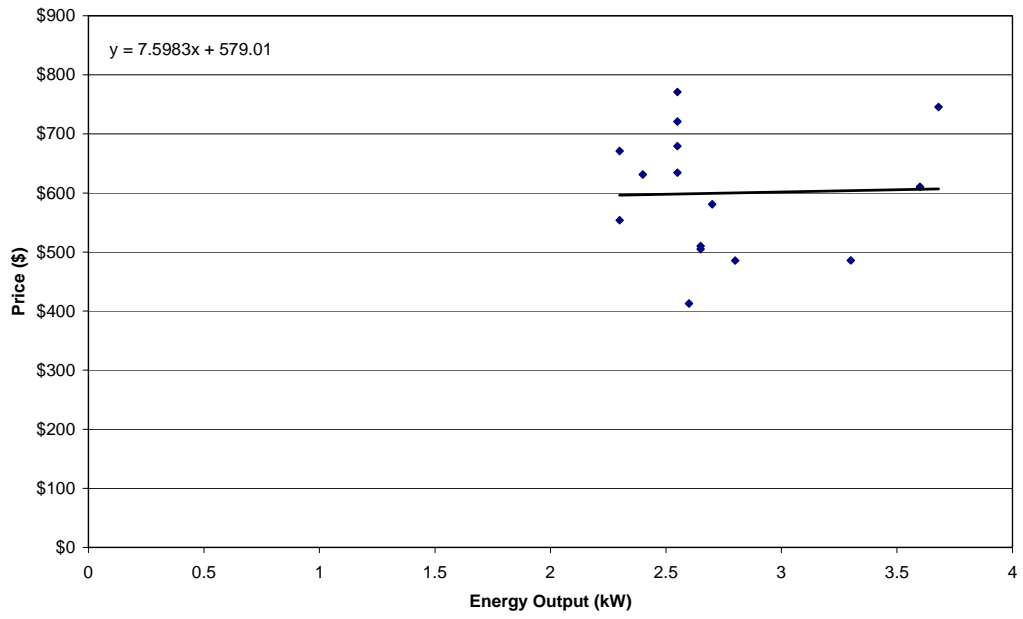


Figure 67: Type 2a Energy Output v Cooling Coefficient of Performance

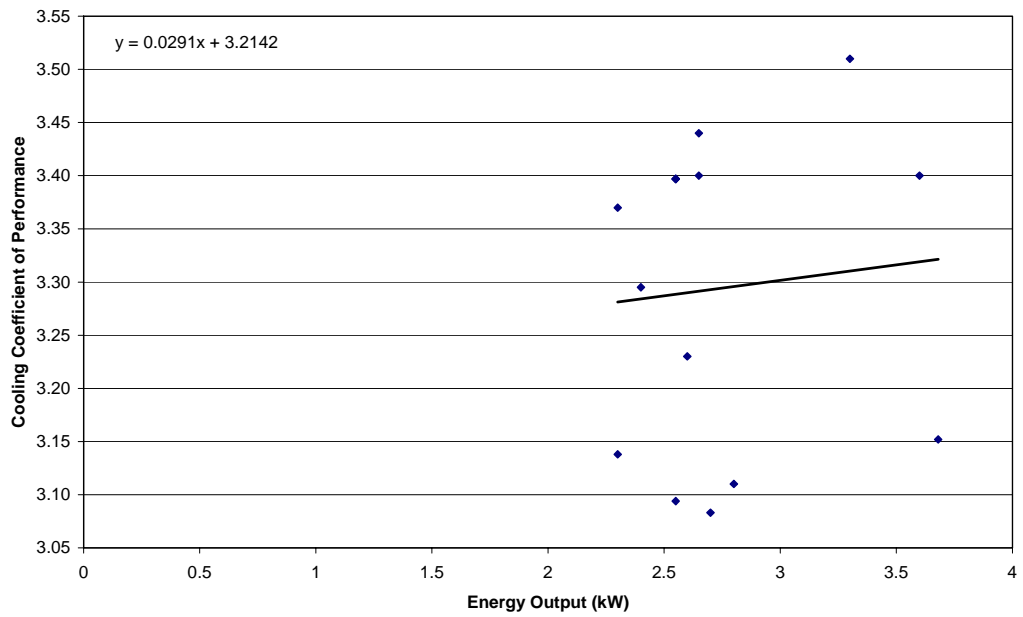


Figure 68: Type 2a Normalised EER v Normalised Price

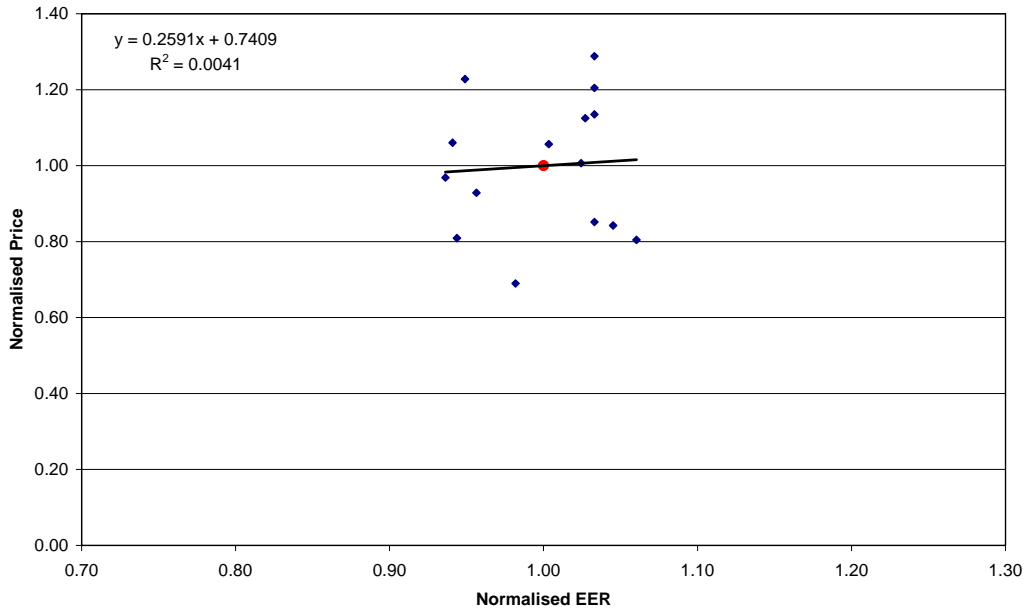
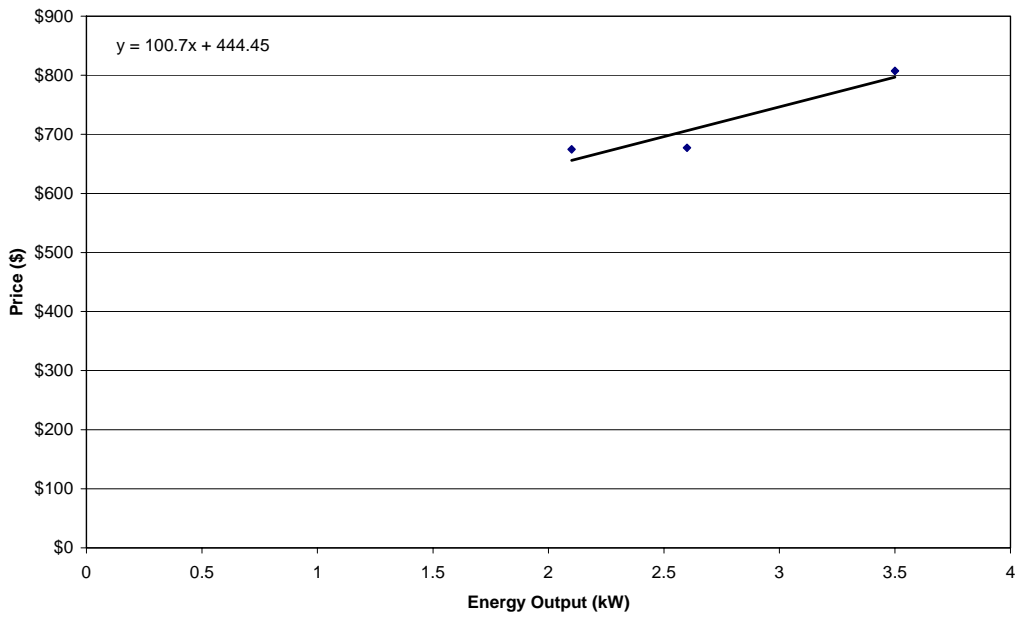
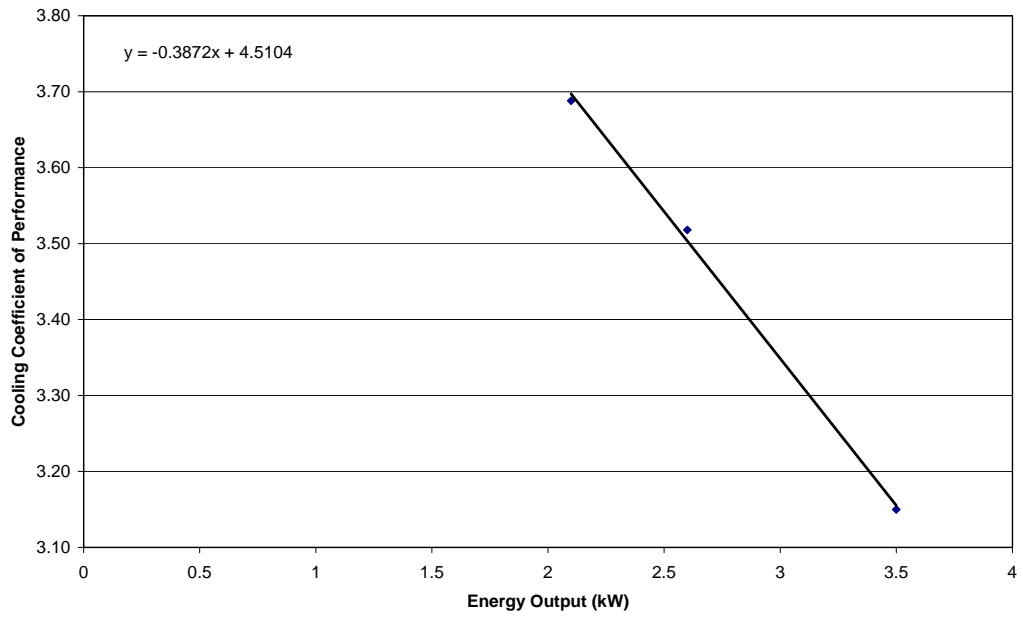


Figure 69: Type 2ai Energy Output v Price



**Figure 70: Type 2ai Energy Output v Cooling Coefficient of Performance**



**Figure 71: Type 2ai Normalised EER v Normalised Price**

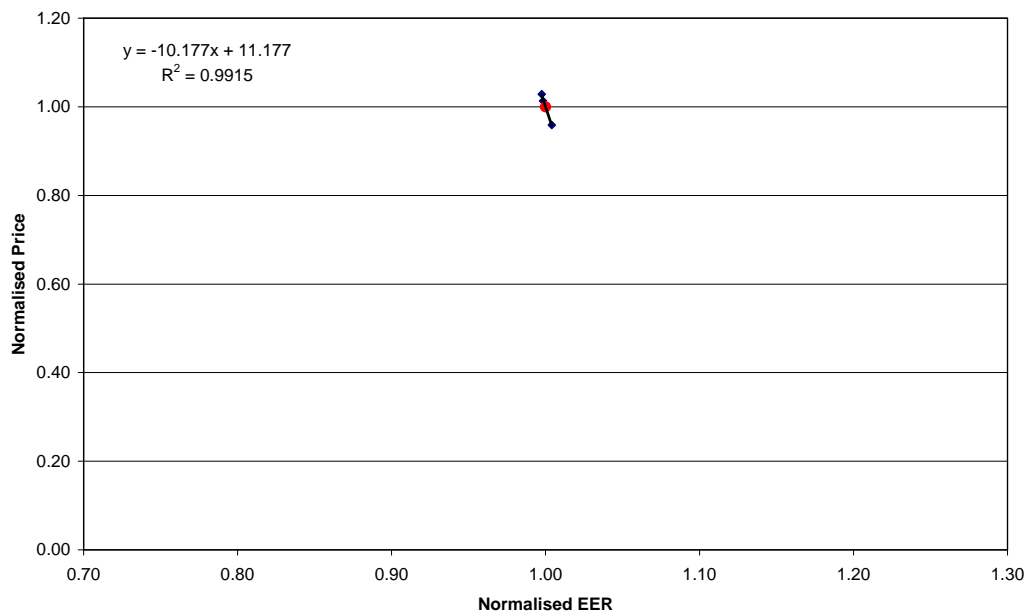


Figure 72: Type 2b Energy Output v Price

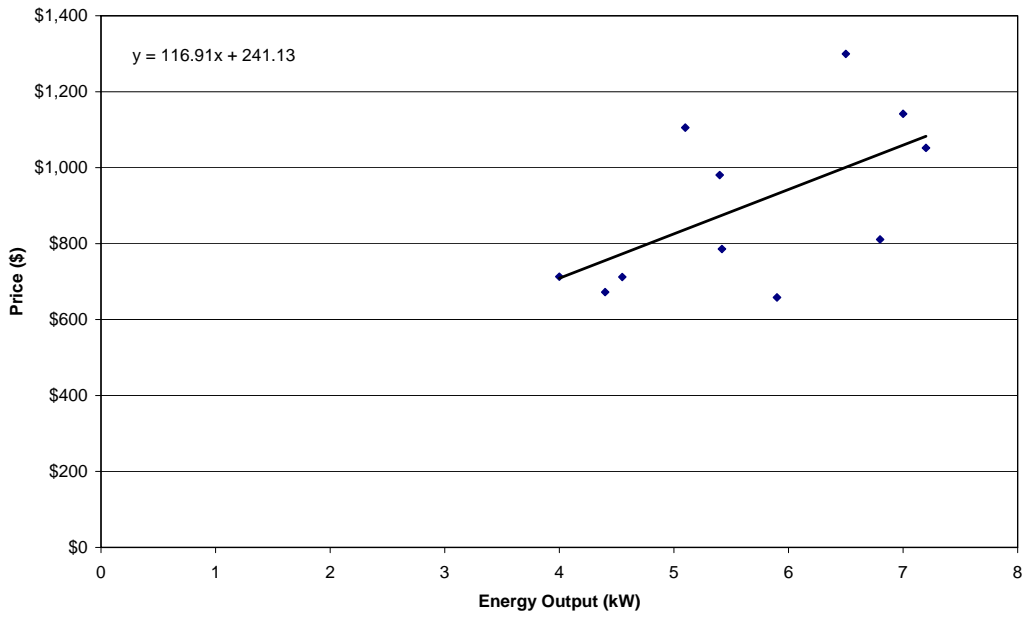


Figure 73: Type 2b Energy Output v Cooling Coefficient of Performance

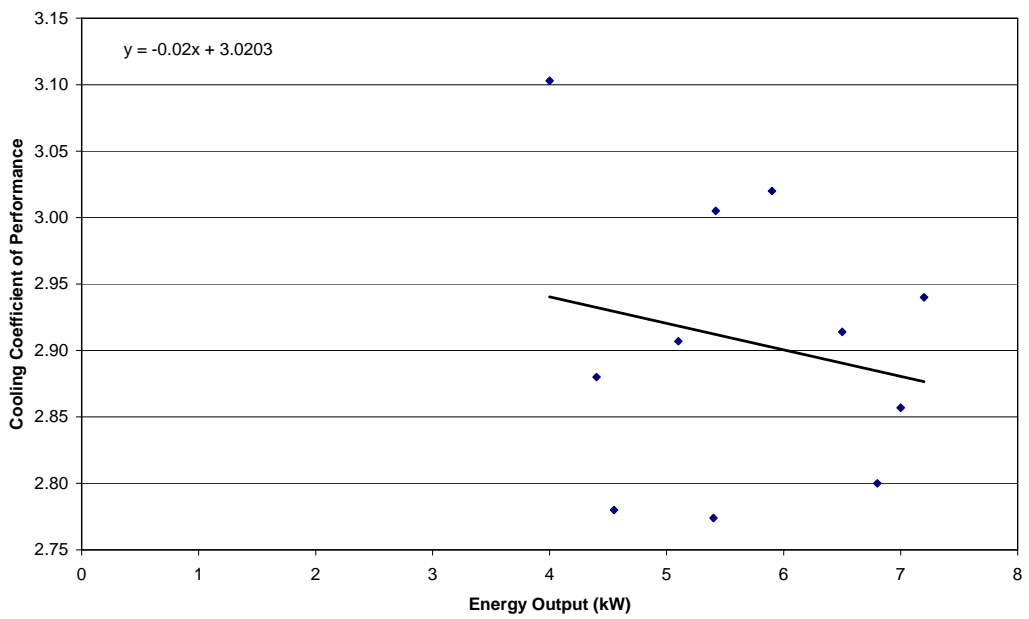


Figure 74: Type 2b Normalised EER v Normalised Price

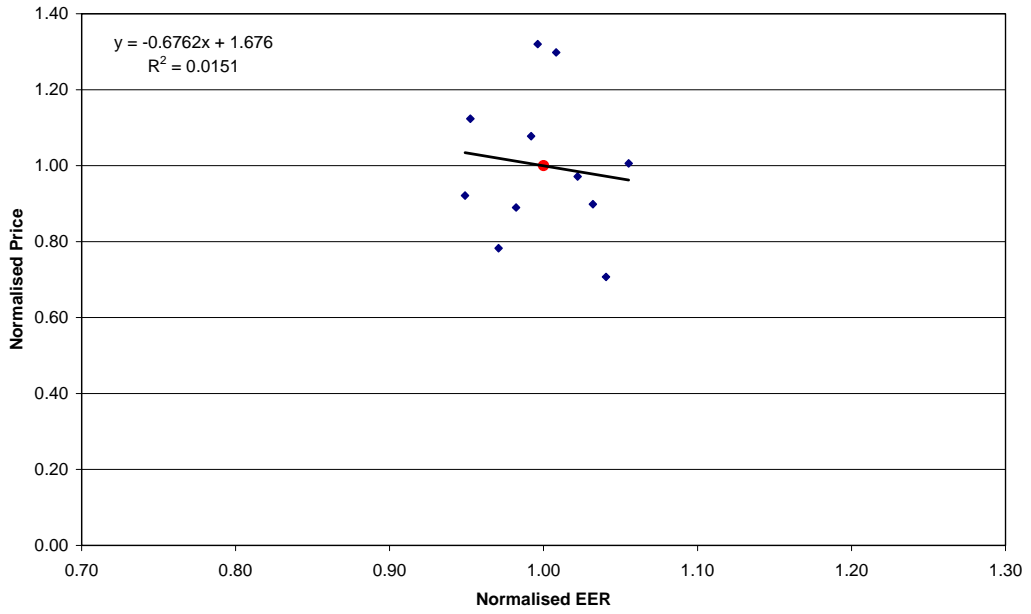
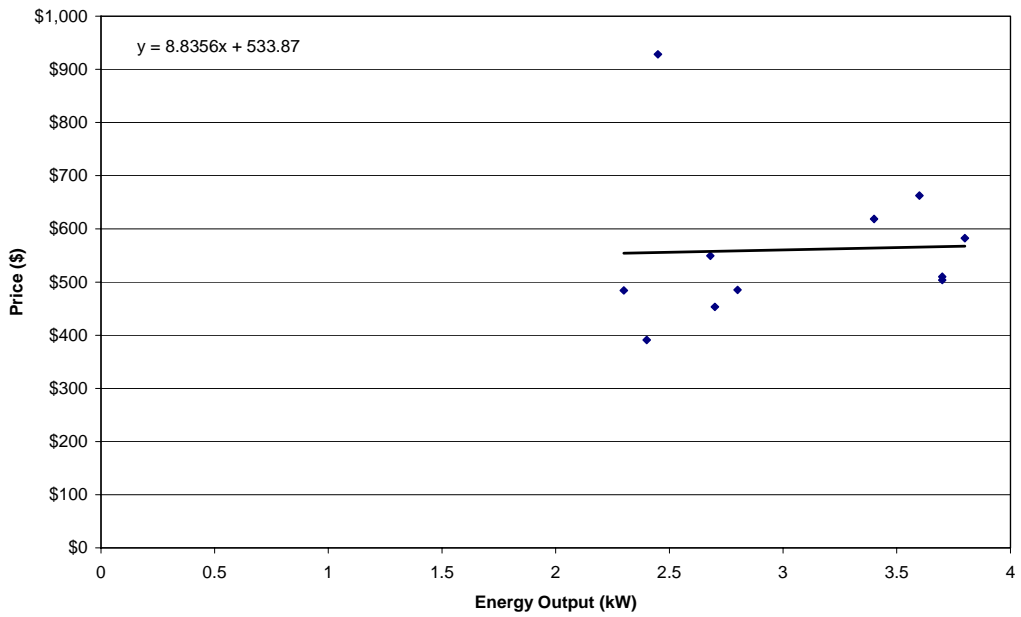
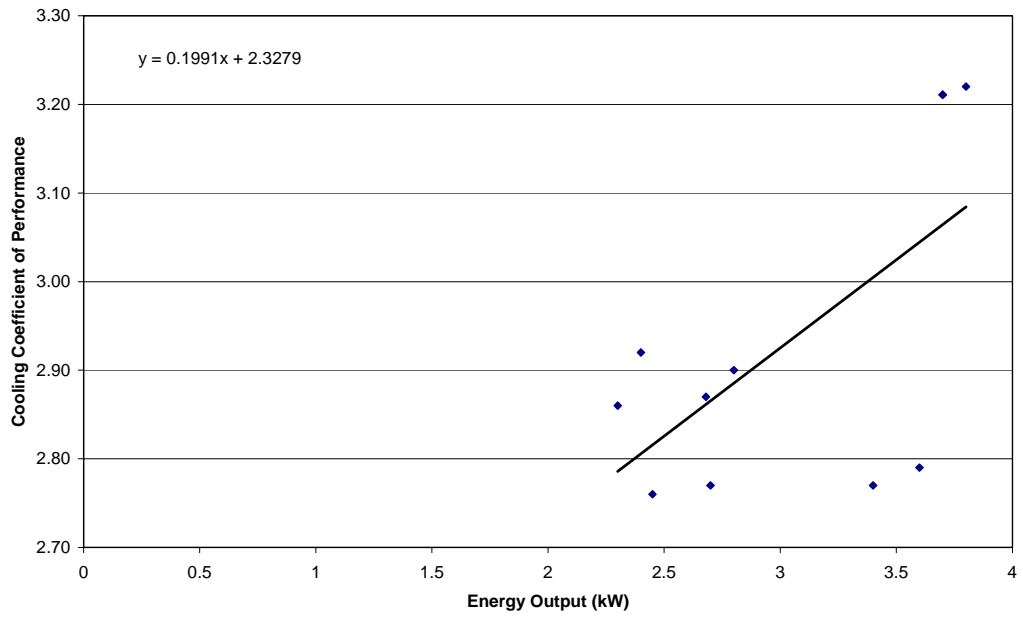


Figure 75: Type 3a Energy Output v Price



**Figure 76: Type 3a Energy Output v Cooling Coefficient of Performance**



**Figure 77: Type 3a Normalised EER v Normalised Price**

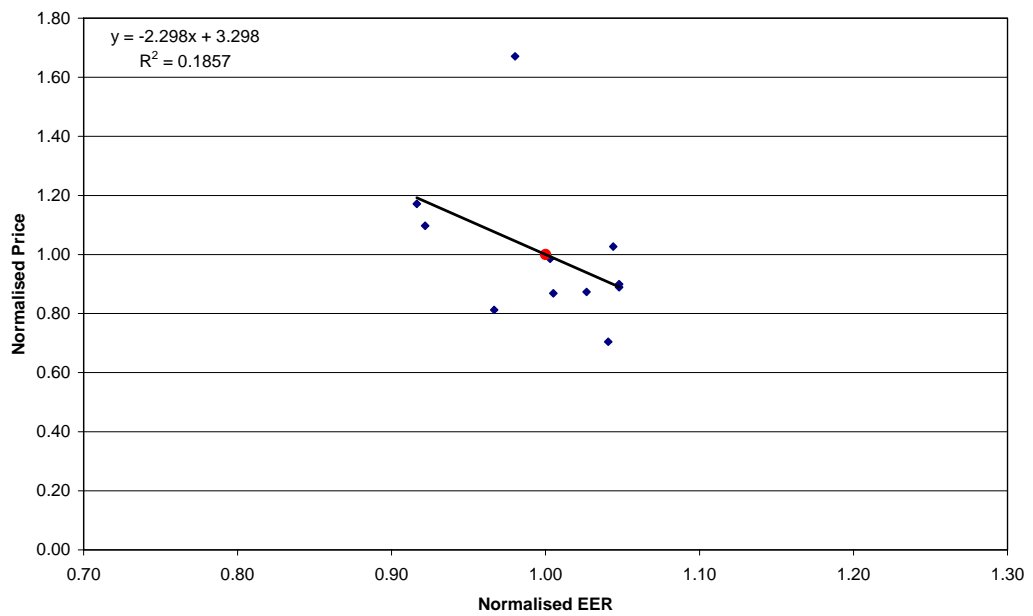


Figure 78: Type 3b Energy Output v Price

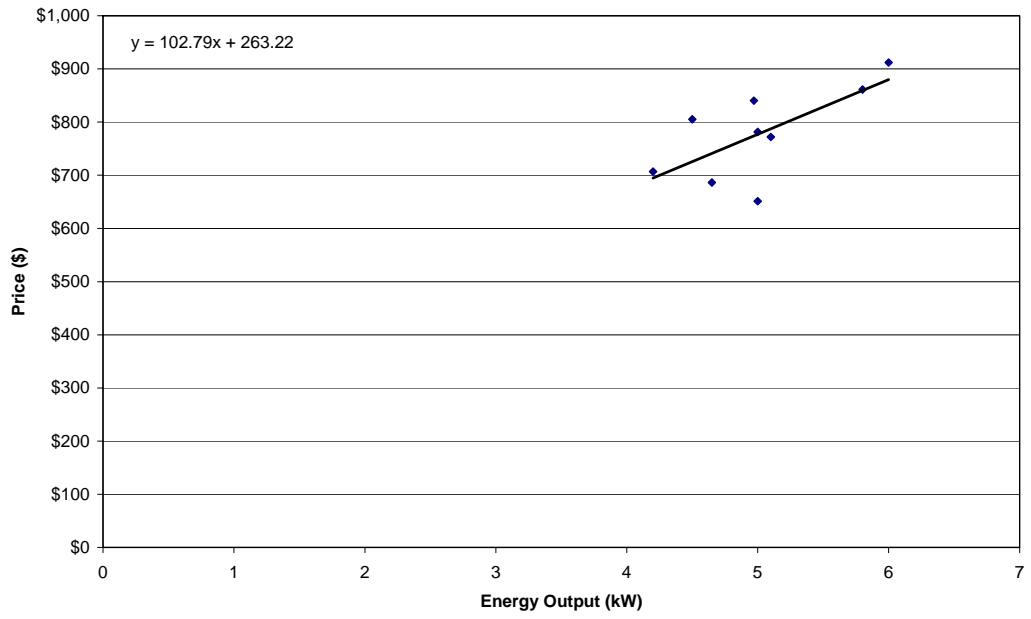


Figure 79: Type 3b Energy Output v Cooling Coefficient of Performance

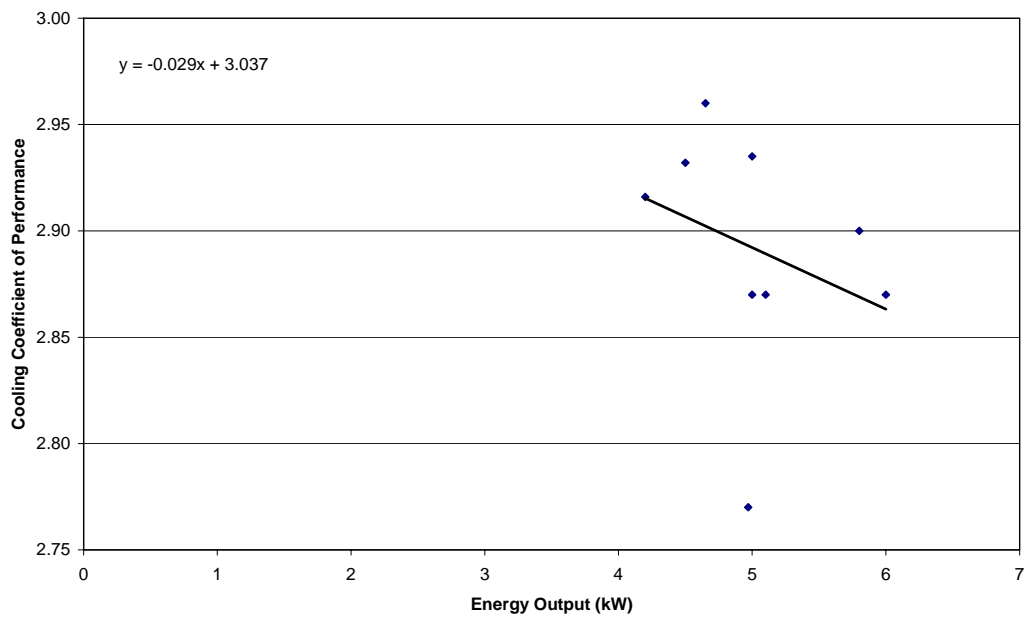


Figure 80: Type 3b Normalised EER v Normalised Price

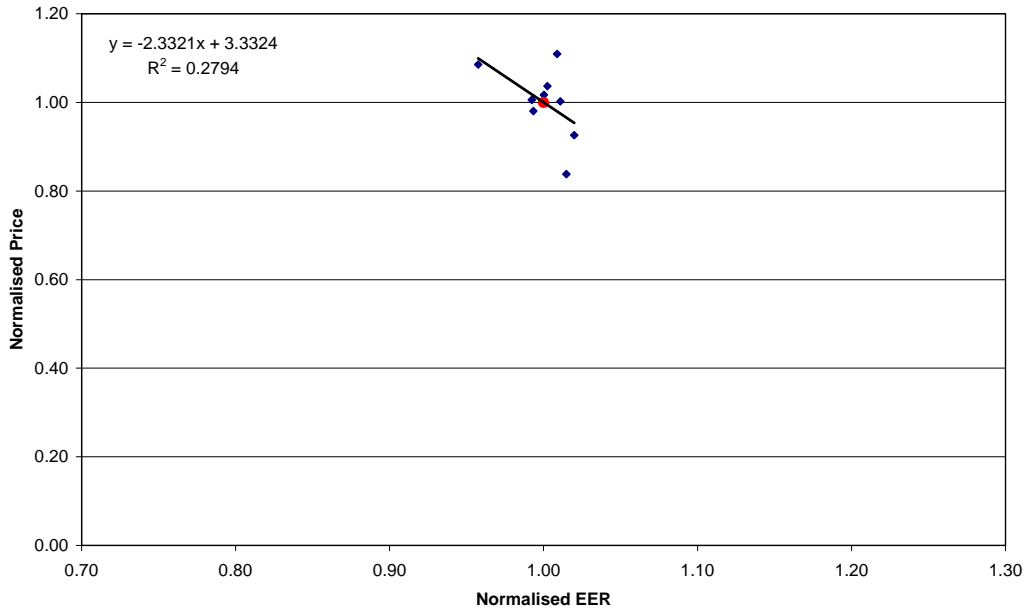
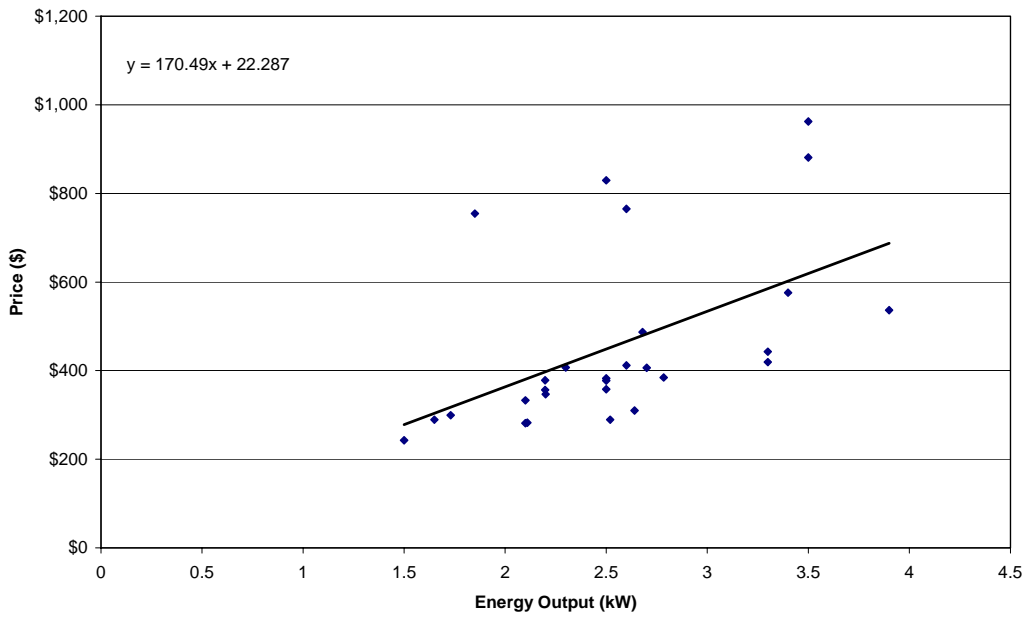
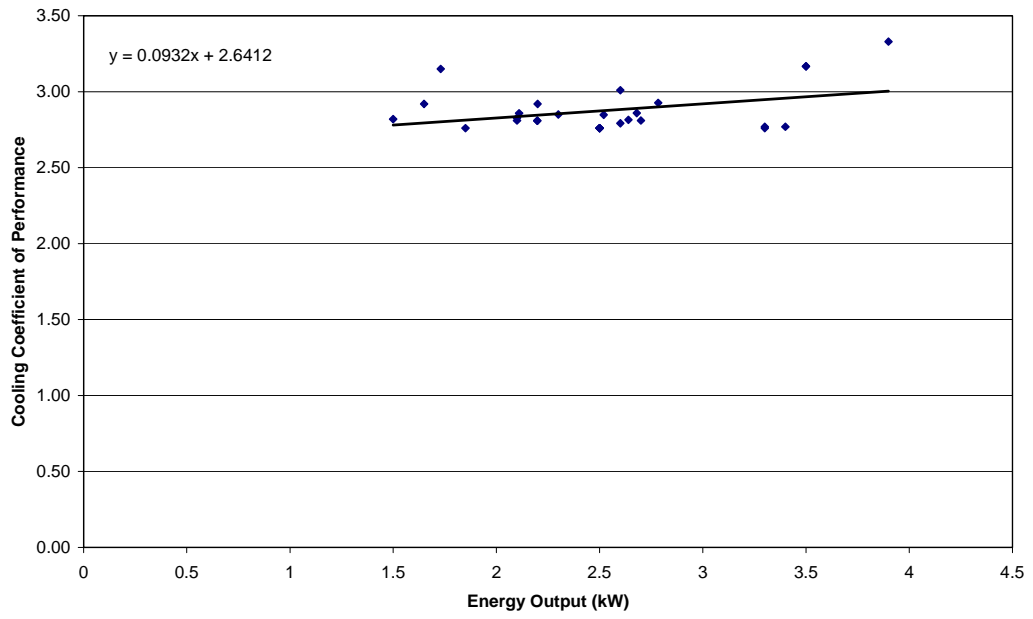


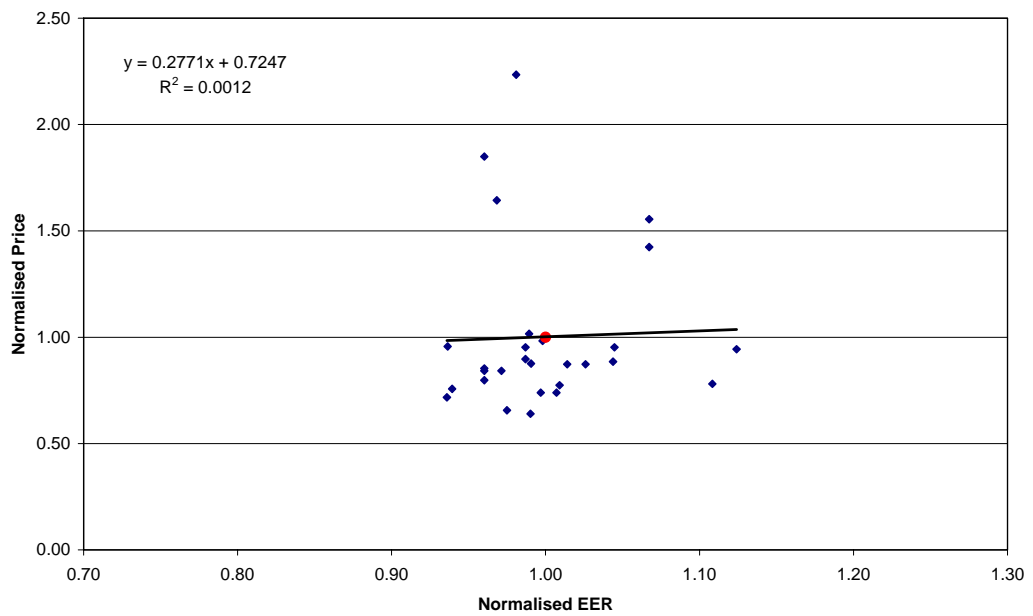
Figure 81: Type 4a Energy Output v Price



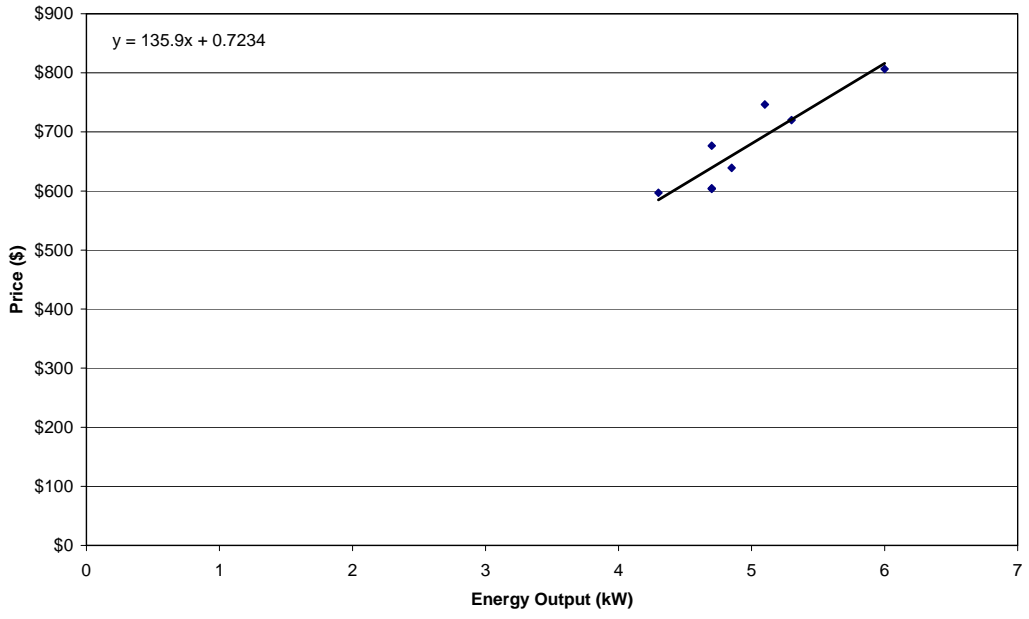
**Figure 82: Type 4a Energy Output v Cooling Coefficient of Performance**



**Figure 83: Type 4a Normalised EER v Normalised Price**



**Figure 84: Type 4b Energy Output v Price**



**Figure 85: Type 4b Energy Output v Cooling Coefficient of Performance**

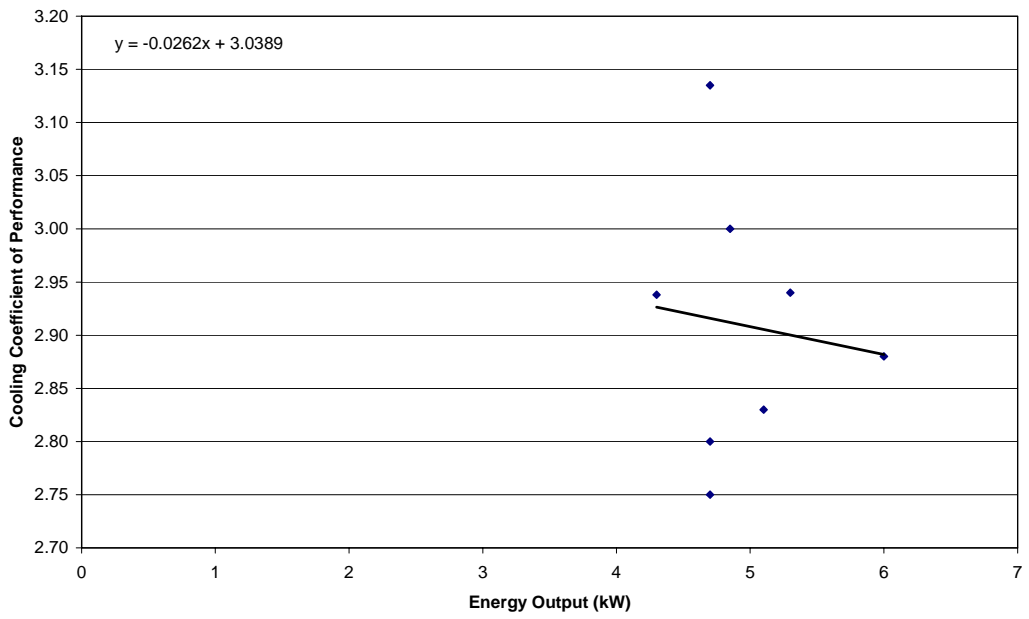
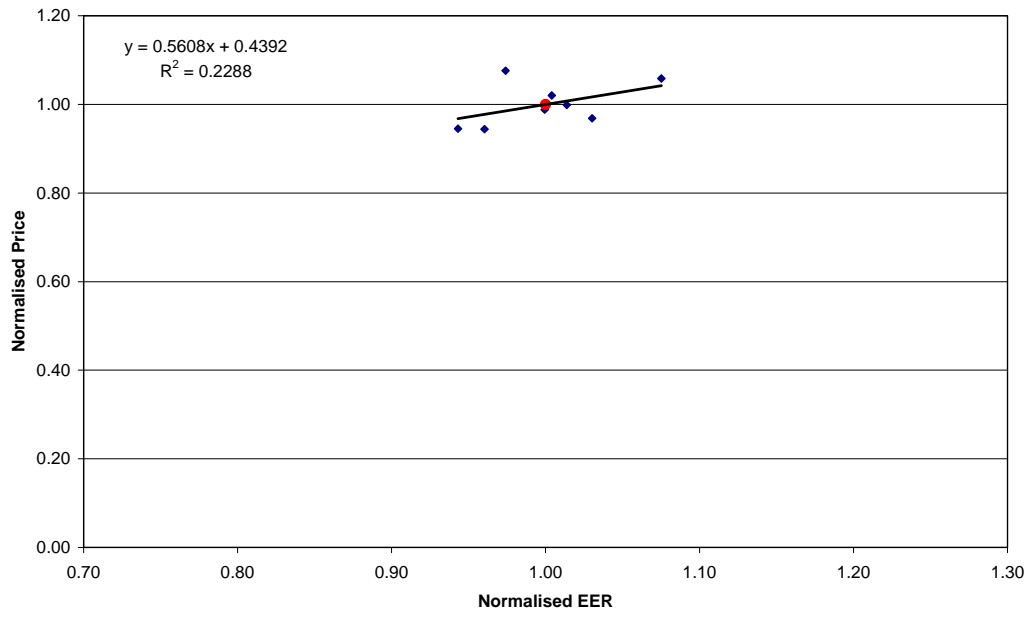


Figure 86: Type 4b Normalised EER v Normalised Price



### Impact of MEPS on Air Conditioner Availability by Price

The following figures show this normalised price versus normalised efficiency for each of the main product groups examined in this report. The models marked in blue pass the proposed 2010 MEPS requirement while the models marked in red fail the 2010 MEPS requirements. Note that the axis orientation is altered in comparison to the previous efficiency price regression analysis in this appendix (the following charts have price on the X axis and efficiency on the Y axis). See Section 6.13 (Page 121) for more detail and discussion.

Figure 87: Normalised Price vs Normalised Efficiency – Type 1a

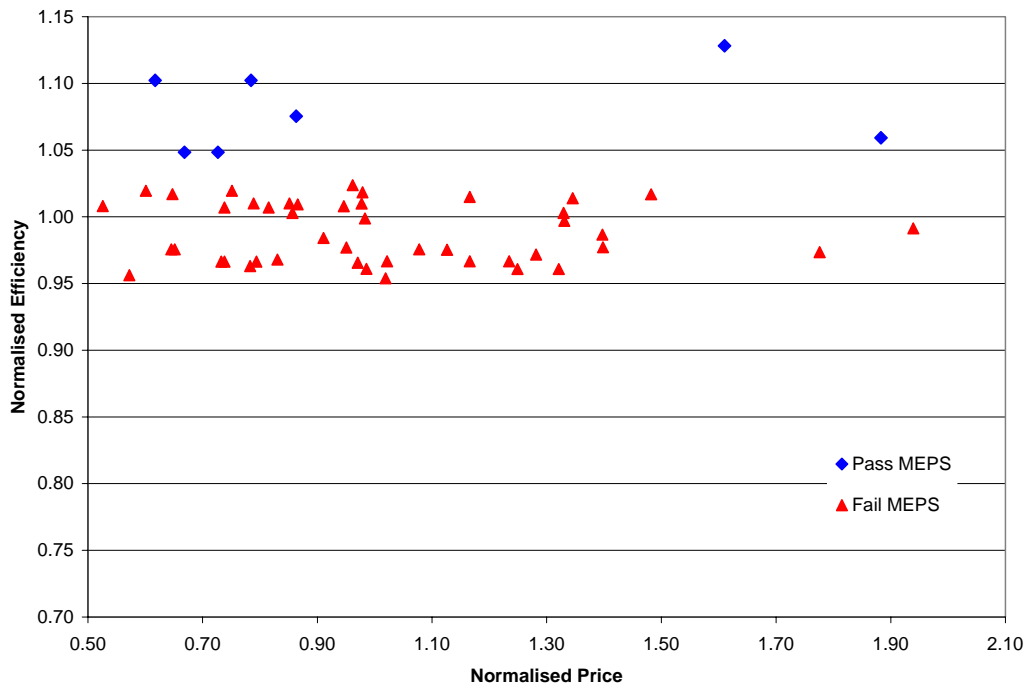


Figure 88: Normalised Price vs Normalised Efficiency – Type 1ai

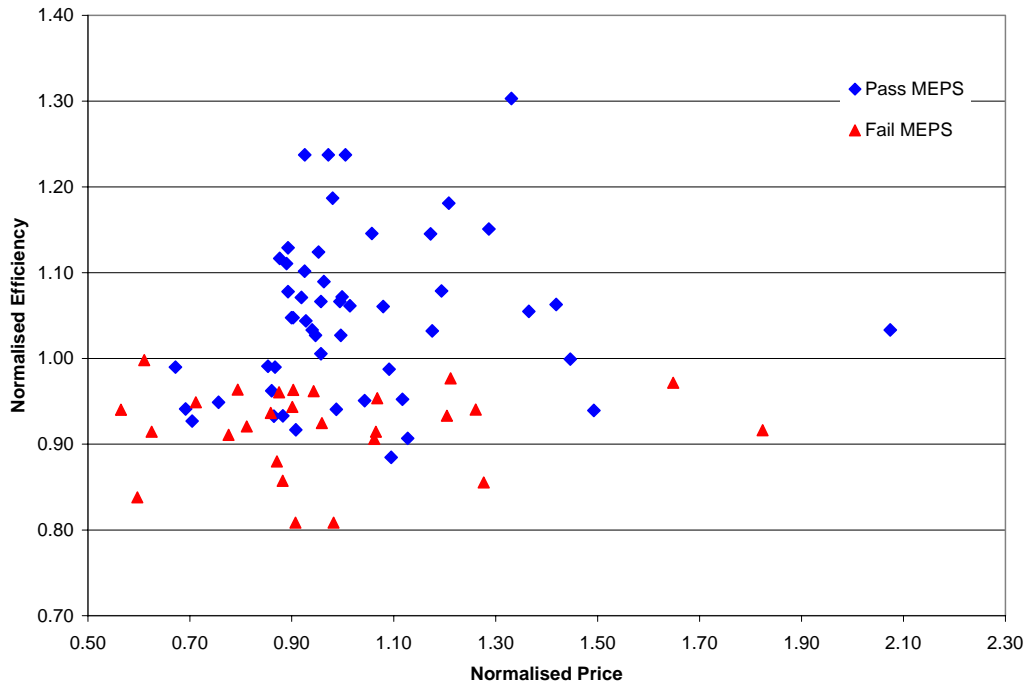


Figure 89: Normalised Price vs Normalised Efficiency – Type 1b

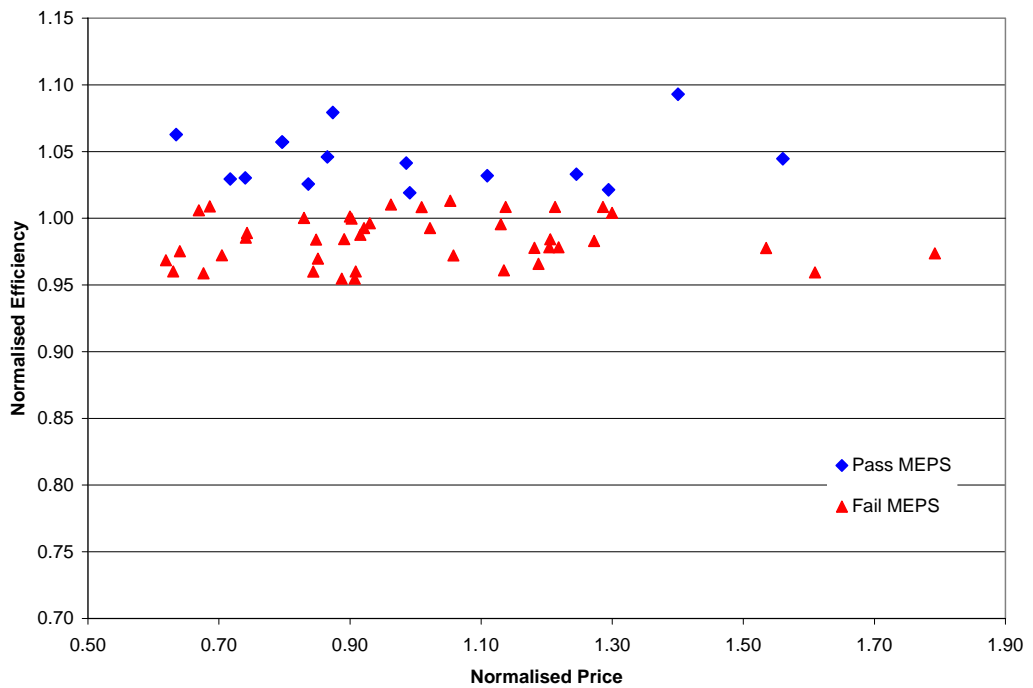


Figure 90: Normalised Price vs Normalised Efficiency – Type 1bi

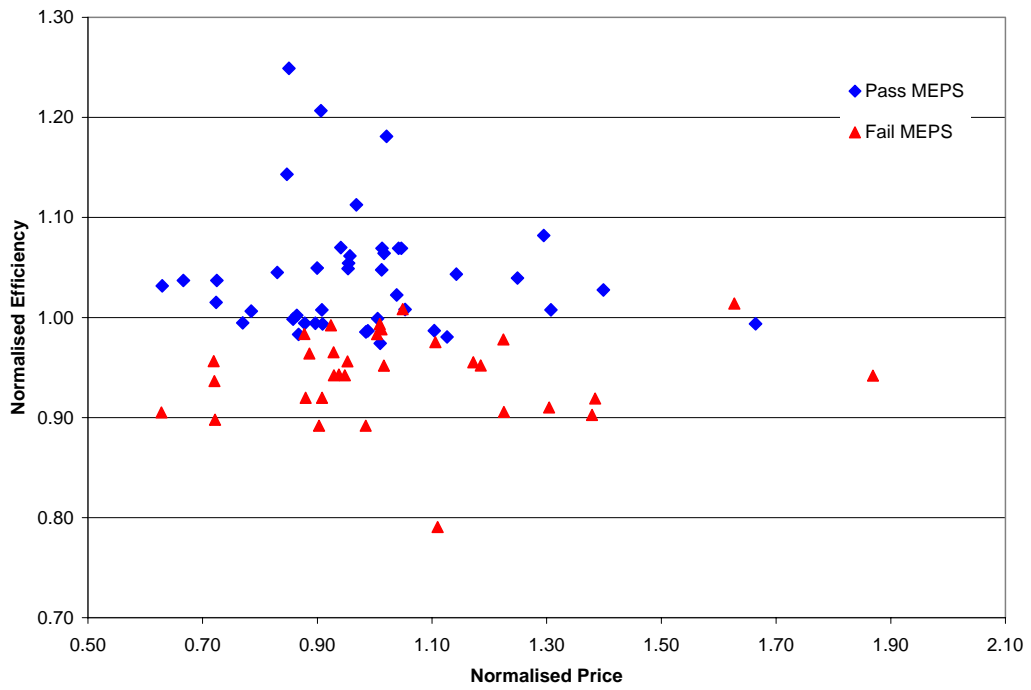


Figure 91: Normalised Price vs Normalised Efficiency – Type 1c

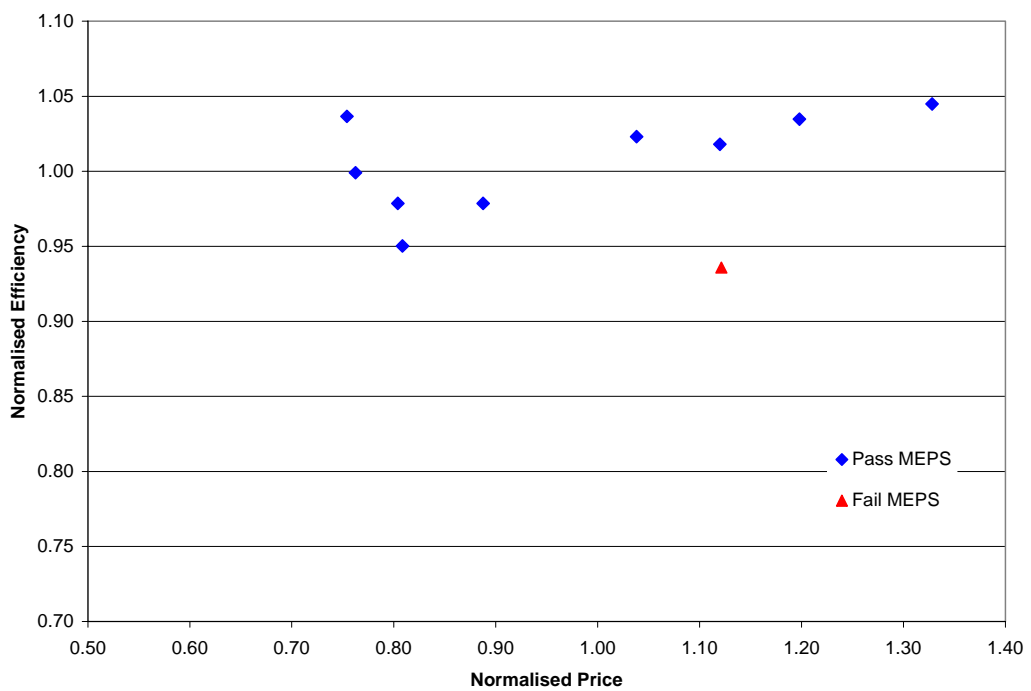


Figure 92: Normalised Price vs Normalised Efficiency – Type 1ci

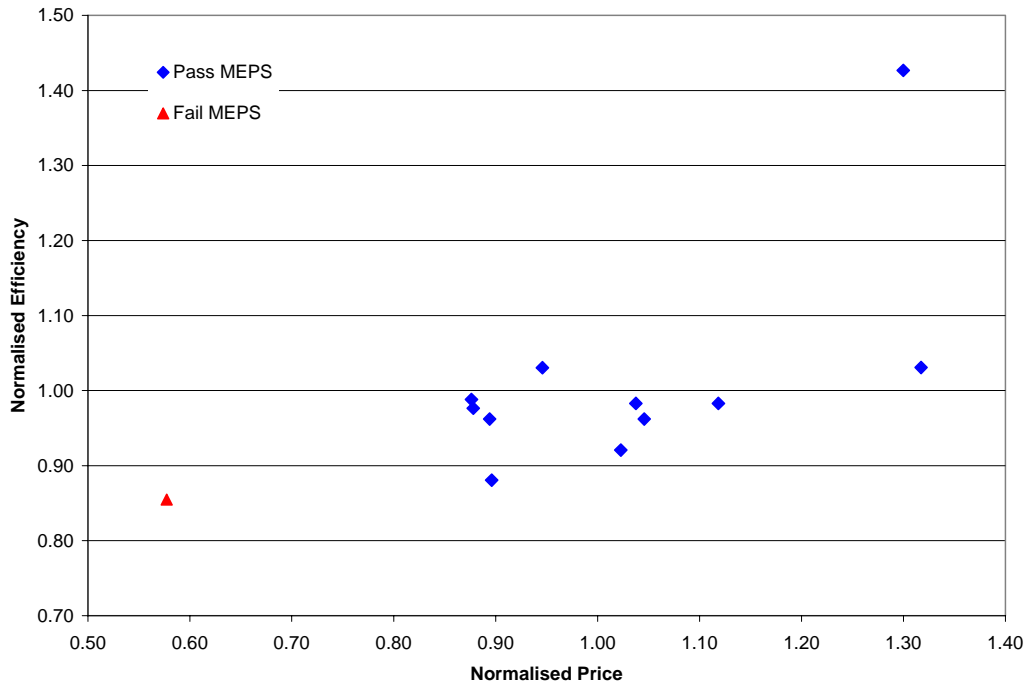


Figure 93: Normalised Price vs Normalised Efficiency – Type 2a

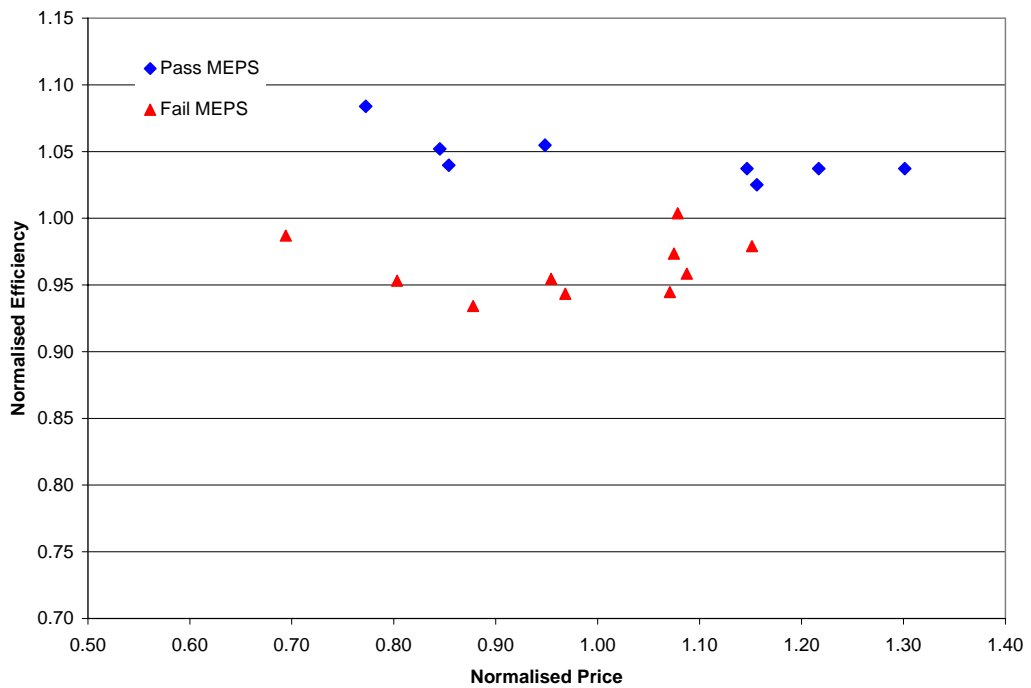


Figure 94: Normalised Price vs Normalised Efficiency – Type 2ai

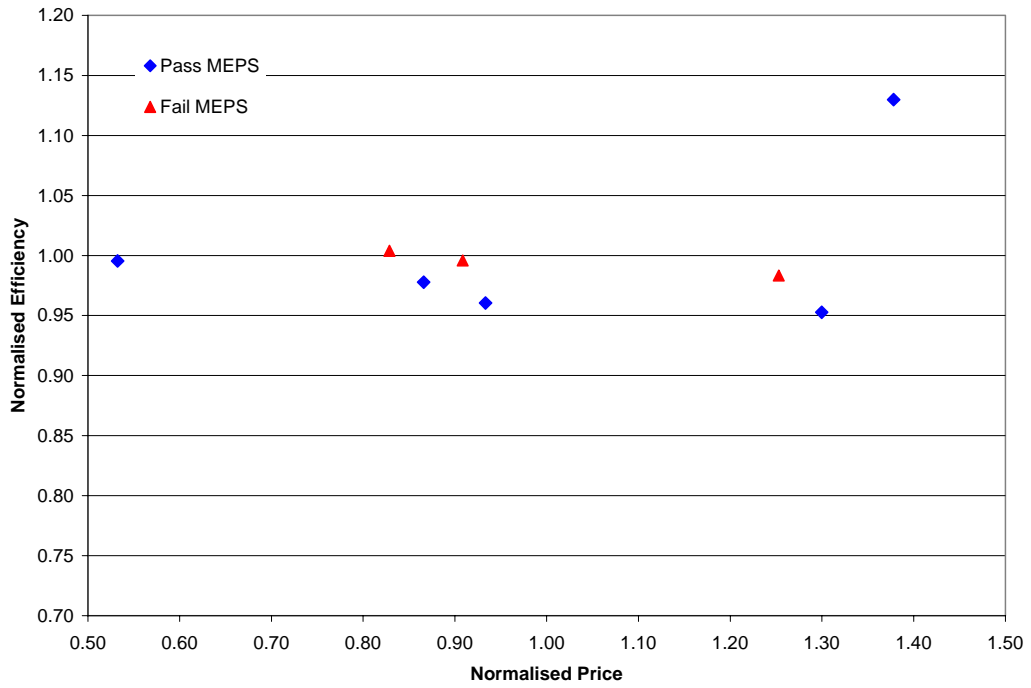
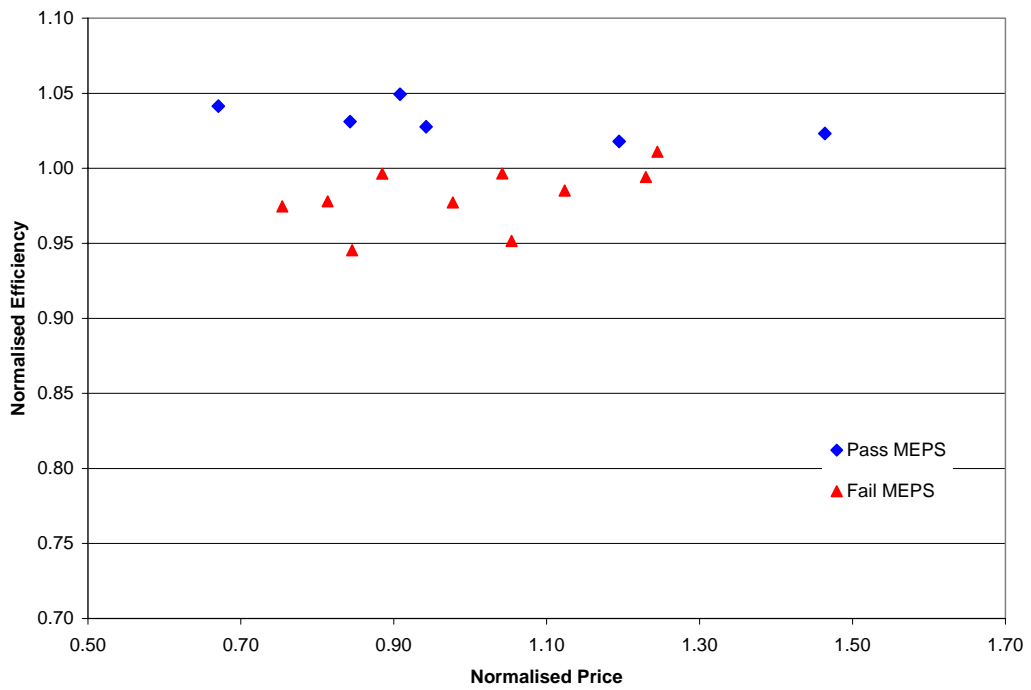
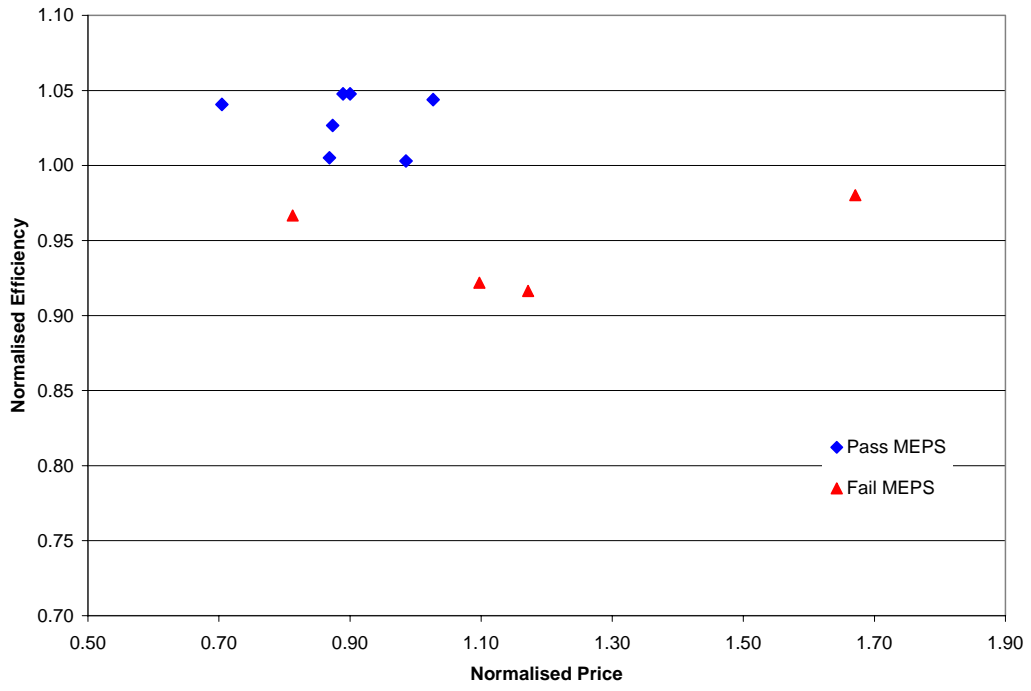


Figure 95: Normalised Price vs Normalised Efficiency – Type 2b



**Figure 96: Normalised Price vs Normalised Efficiency – Type 3a**



**Figure 97: Normalised Price vs Normalised Efficiency – Type 3b**

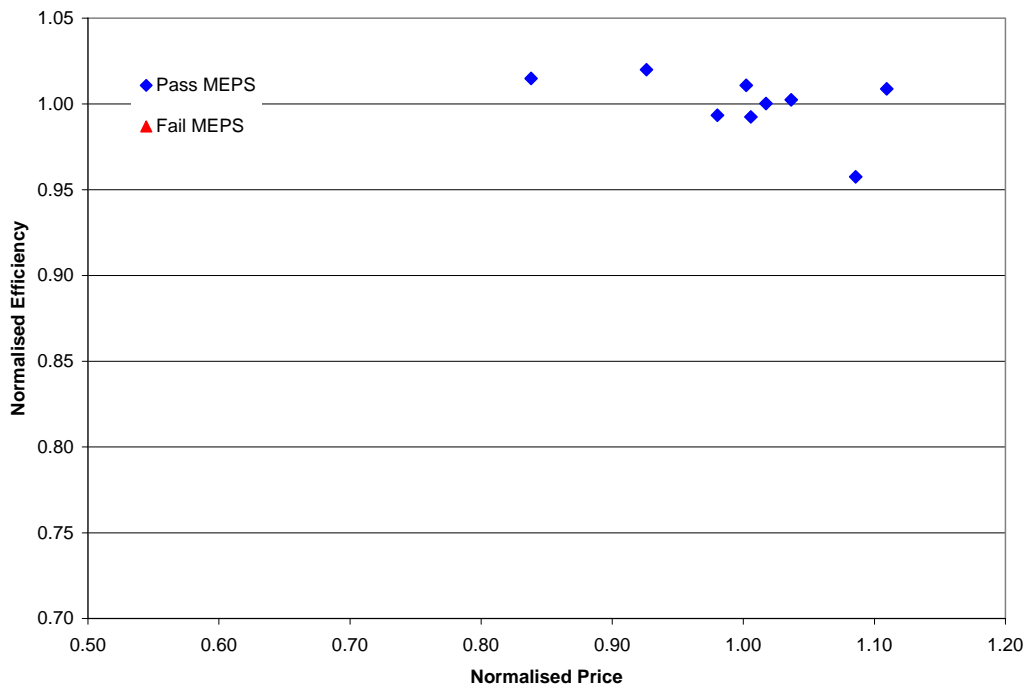


Figure 98: Normalised Price vs Normalised Efficiency – Type 4a

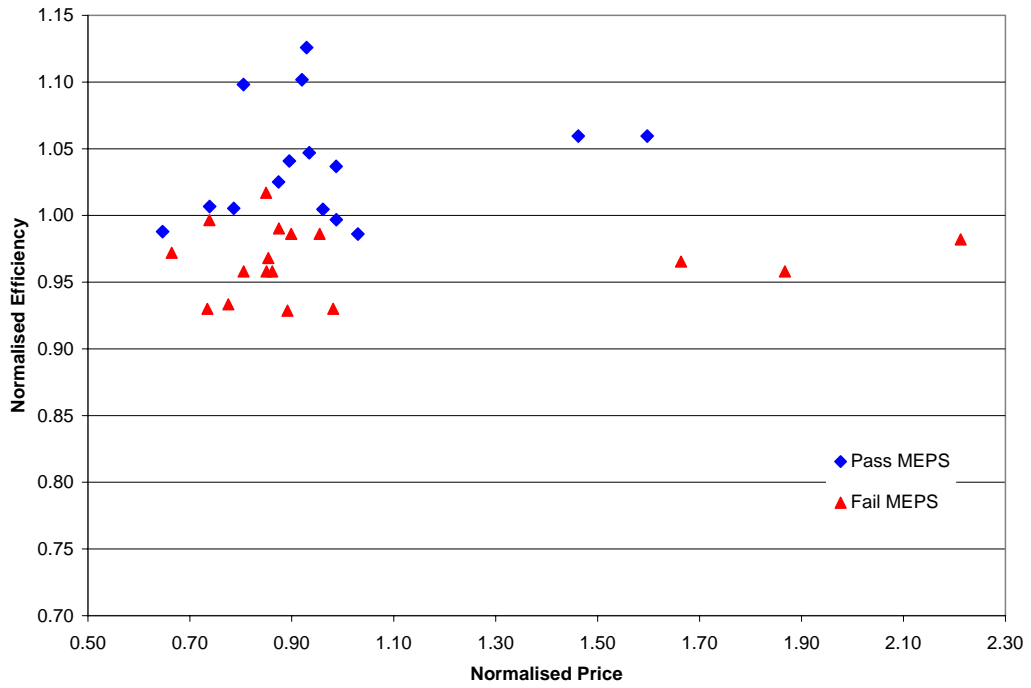
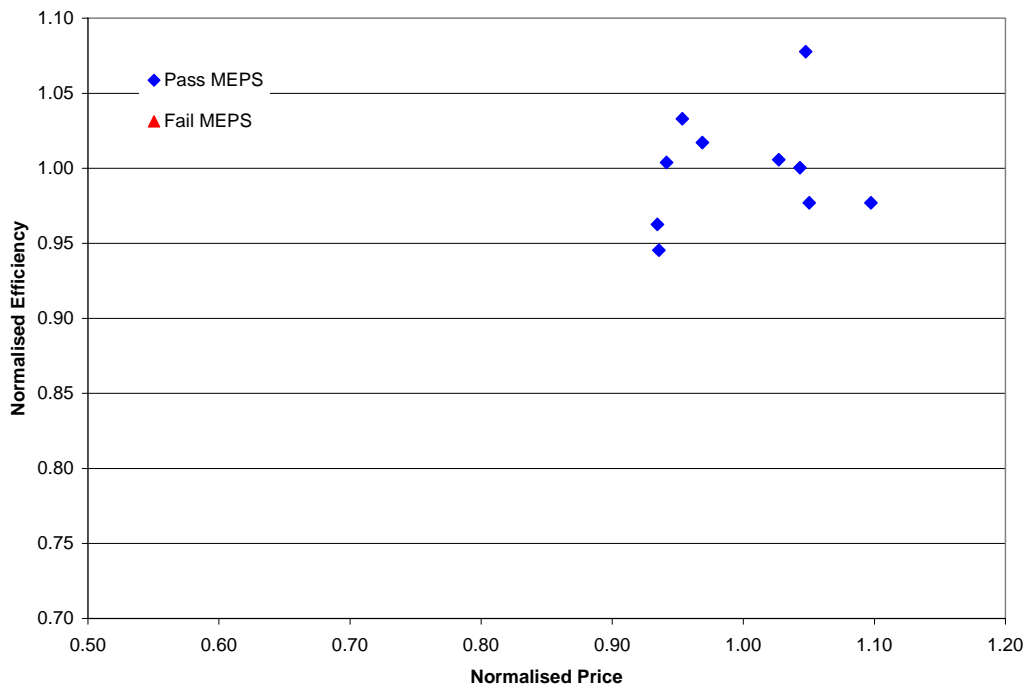


Figure 99: Normalised Price vs Normalised Efficiency – Type 4b



## Appendix 5: Previous Energy Labelling Algorithms

### Type Definitions Under AS/NZS3823.2-2005

The following table sets out a brief description of each of the main air conditioner types. See AS/NZS3823.2-2005 for a more detailed definition.

**Table 83: Air Conditioner Type Definitions and Notes**

					Compliance Date <sup>a</sup>
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004
					M – Since Oct 1001
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004
					M – Since Oct 2001
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					M – From Oct 2004
					M – Since Oct 2001
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001

					Compliance Date <sup>a</sup>
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004
					M – Since Oct 2001
					M <sup>bc</sup> – From Oct 2004
					M – From Oct 2004
					M – Since Oct 2001
					L <sup>b</sup> – Prior to Oct 2001
					M – From Oct 2004

Notes to table:

a - MEPS requirements shown as October 2001 were not mandatory in New Zealand until July 2002.

b – Mandatory energy labelling (L) for these systems was limited to 7.5 kW units up to October 2001 (single or three phase) and was altered to cover all single phase models only from October 2001.

c – Mandatory energy labelling (L) without MEPS is applicable prior to the introduction of MEPS (M) on the nominated date.

### Air Conditioners – AS/NZS 3823.2 Pre 2000

The Australasian air conditioner rating system started in 1987.

Air conditioner energy shown on the label is kWh per 500 hours of use for heating and cooling.

Air conditioner algorithms pre-2000 are of a very similar form to the equations used after 2000. However the original 1 star line was lower and the gap between stars was smaller.

The key parameter used is the coefficient of performance (COP) for heating and energy efficiency ratio (EER) for cooling, which itself is a measure of the efficiency of the product. This is the ratio of output (heating or cooling) to electrical power input.

$$\text{SRI cooling} = (\text{Tested EER} \times 5) - 8.5$$

$$\text{SRI heating} = (\text{Test COP} \times 5) - 9.5$$

SRI cooling is 1 star for an EER of 1.9 with 1 star for each increase in EER of 0.2.

SRI heating is 1 star for a COP of 2.1 with 1 star for each increase in COP of 0.2.

Note that the value used in the algorithm is the tested EER and COP (ie the value measured in the lab), not the rated value (which is rated output divided by rated input, both of which appear on the energy label). So it is not always possible to calculate the exact SRI from label values.

**Table 84: Star Ratings and Minimum EER and COP Pre-2000**

		Min COP (heating)
		2.10
		2.20
		2.30
		2.40
		2.50
		2.60
		2.70
		2.80
		2.90
		3.00
		3.10

**Air Conditioners – AS/NZS 3823.2 Post 2000**

Air conditioner energy shown on the label is kWh/hour or kW (continuous) at rated output.

Air conditioner star ratings are calculated on a different basis to other appliances. The key parameter is the coefficient of performance (COP) for heating and energy efficiency ratio (EER) for cooling, which itself is a measure of the efficiency of the product. This is the ratio of output (heating and cooling) to electrical power input.

$$\text{SRI cooling} = [ (\text{Tested EER} \times 10) - 17 ] / 3$$

$$\text{SRI heating} = [ (\text{Tested COP} \times 10) - 20 ] / 3$$

SRI cooling is 1 star for an EER of 2.0 with 1 star for each increase in EER of 0.3.

SRI heating is 1 star for a COP of 2.3 with 1 star for each increase in COP of 0.3.

**Table 85: Star Ratings and Minimum EER and COP Post-2000**

		Min COP (heating)
		2.30
		2.45
		2.60
		2.75
		2.90
		3.05
		3.20
		3.35
		3.50
		3.65
		3.80

Note that the value in the algorithm is the tested EER and COP (ie the value measured in the lab), not the rated value (which is rated output divided by rated input, both of which appear on the energy label). So it is not always possible to calculate the exact SRI from label values.

Note that three phase air conditioners have had MEPS in place since October 2001, single phase models will have MEPS introduced in October 2004. MEPS for single and three phase models will be upgraded in October 2007.

*Air Conditioners – AS/NZS 3823.2-2008 (from 2010)*

Air conditioner energy shown on the label is kWh/hour or kW (continuous) at rated output.

The key parameter used is the coefficient of performance (COP) for heating and energy efficiency ratio (EER) for cooling, which itself is a measure of the efficiency of the product. This is the ratio of output (heating and cooling) to electrical power input.

$$\text{SRI cooling} = [ (\text{Tested EER} \times 8) - 18 ] / 4$$

$$\text{SRI heating} = [ (\text{Test COP} \times 8) - 18 ] / 4$$

SRI cooling is 1 star for an EER of 2.75 with 1 star for each increase in EER of 0.5.

SRI heating is 1 star for a COP of 2.75 with 1 star for each increase in COP of 0.5.

This algorithm is published as Appendix F of AS/NZS3823.2-2005.

		Min COP (heating)
		2.75
		3.00
		3.25
		3.50
		3.75
		4.00
		4.25
		4.50
		4.75
		5.00
		5.25

Note that the value used in the algorithm is the tested EER and COP (ie the value measured in the lab), not the rated value (which is rated output divided by rated input, both of which appear on the energy label). So it is not always possible to calculate the exact SRI from label values.

## Appendix 6: Emissions Trading Schemes

### Australia

Note – the text for this section was supplied by DEWHA.

The Australian Government's initial response to concerns about the environmental economic and social impacts of global warming was set out in the Prime Minister's statement of 20 November 1997, *Safeguarding the Future: Australia's Response to Climate Change*. The Prime Minister noted that the Government was seeking "...realistic, cost effective reductions in key sectors where emissions are high or growing strongly, while also fairly spreading the burden of action across the economy." He also stated that the Government is "...prepared to ask industry to do more than they would otherwise be prepared to do, that is, go beyond a 'no regrets'<sup>11</sup> minimum cost approach where this is sensible in order to achieve effective and meaningful outcomes." This 'no regrets' rest was a key part of the guidelines adopted by the Council of Australian Governments (COAG) in 1997 that any initiative proposed by the MCE, including standards and labelling measures under the Equipment Energy Efficiency Program, must meet.

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

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

Since that time, COAG has remained the primary forum for progressing Australian, state and territory government collaboration on climate change issues requiring inter-jurisdictional attention. Significant progress has been made under

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<sup>11</sup> The Productivity Commission has defined "No regrets" policy options as measures that ... *have net benefits (or at least no net cost) in addition to addressing the enhanced greenhouse effect. A more intuitive interpretation of 'no regrets' measures could be that they are actions which would still be considered worthwhile even in the absence of concerns about the potential adverse impact of global warming.* (PC 1997: page vii). This may involve imposing additional business costs on suppliers if the resulting more efficient products deliver a net benefit to the wider community.

the COAG climate change agenda since COAG's agreement in June 2005 to establish a new Senior Officials Group to consider ways to further improve investment certainty for business, encourage renewable energy and enhance cooperation in areas such as technology development, energy efficiency and adaptation. This work culminated in the January 2006 COAG climate change action plan. In addition, climate change issues requiring national coordination have been managed through a number of inter-governmental ministerial councils including the Ministerial Council on Energy.

The Australian Government's climate change strategy is the mechanism through which Australia will meet its international commitments as a part to the United Nations Framework Convention on Climate Change (UNFCCC). The Government has an overall target of limiting Australia's emissions in 2008-12 to 108% of its 1990 emissions. This is a 30% reduction in BAU outcomes in the absence of interventions.

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

In 2007, emissions trading became a major new plank in the Australian Government's response to climate change. The Prime Minister, the Hon John Howard MP, announced in June 2007 that Australia will introduce a world class domestic emissions trading system by 2012. Emissions trading will be the primary mechanism for achieving the long term emissions reduction goal, which will be set in 2008. It will have a strong economic foundation and take account of global developments while preserving the competitiveness of our trade exposed emissions intensive industries. Through emissions trading, the market will help Australia develop the most cost effective technologies for cutting greenhouse emissions.

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

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

An emissions trading scheme will build on the success of past and ongoing measures. These measures include the *2004 Energy White Paper*, *2004-05 Climate Change Strategy*, earlier measures such as *Measures for a Better*

*Environment and Safeguarding the Future*, as well as new programs announced in 2006-07.

On 4 July 2008, Professor Ross Garnaut released his draft report on an emissions trading scheme. On 16 July 2008, the Federal government released its green paper on a Carbon Pollution Reduction Scheme (formally known as the Emissions Trading Scheme). The reports can be downloaded from:

<http://www.garnautreview.org.au>

<http://www.greenhouse.gov.au/greenpaper/index.html>

### *New Zealand*

Note – the text for this section was supplied by DEWHA.

In September 2007, the New Zealand Government announced an in-principle decision to use an Emissions Trading Scheme (ETS or scheme) as its core price-based measure to reduce greenhouse gas emissions and enhance forest carbon sinks. The intent is to introduce a scheme covering all sectors and all gases.

Public submissions on the Climate Change (Emissions Trading and Renewable Preference) Bill are currently being considered by a Parliamentary Select Committee which is due to report on 10 June 2008. The legislation is expected to introduce a New Zealand specific emissions trading scheme and to create a preference for renewable electricity generation by implementing a moratorium on new fossil-fuelled thermal electricity generation - except to the extent necessary to ensure the security of New Zealand's electricity supply.

The draft legislation proposes to implement the scheme from 2008, with various sectors phased in over the years to 2013. It was proposed that the first sector included will be forestry, followed by liquid fossil fuels, then stationary energy and industrial processes, followed by agriculture, and waste. It is expected that New Zealand units would be the primary domestic unit of trade and would allow purchase from, and sale to, international trading markets.

Feedback from stakeholders, including Maori, will inform ultimate decisions on coverage staging and design of the scheme, and the form of legislation required to implement it.

The scheme is one of a wide range of policies and measures – including the New Zealand Energy Strategy and the Energy Efficiency and Conservation Strategy - to reduce domestic greenhouse gas emissions and contribute to sustainable outcomes for New Zealand. Together the measures are intended to bring net emissions below business-as-usual levels and comply with New Zealand's international obligations, including existing commitments under the Kyoto Protocol.

The scheme is intended to shift New Zealand's economy towards investing in and consuming goods and services with lower greenhouse gas emissions (e.g. through investment in energy efficiency and renewable energy generation). This will be achieved by making the price of greenhouse gas emissions a factor in the decisions of both producers and consumers.

More information on the scheme (including the draft legislation, reports, Cabinet papers and other resources) can be found at:

<http://www.climatechange.govt.nz/nz-solutions/trading-scheme-reports.shtml>

## *Appendix 7: Scenarios and Sensitivity Analysis*

The following pages outline the scenarios and sensitivity analysis for Australia and New Zealand. Each is a one page summary that outlines the key findings of the analysis.

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Base Case

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$0
2015	7204	\$1,176	6019	\$1,292	\$0
2020	8310	\$1,353	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	\$0.0
2015	-327	-\$53.2	-273	\$23.3	\$0.0
2020	-563	-\$91.5	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$0
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$11,406	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$11,406	\$0
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$132.1	\$0.0
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$132.1	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$132.1
Total NPV Benefits	\$386.2
Total NPV Costs	\$133.3
Net Benefit	\$252.9
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 46.19
Benefit Cost Ratio	2.9

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Base Case

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$0
2015	1236	\$207	863	\$112	\$0
2020	1637	\$274	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	\$0.0
2020	-104	-\$17.4	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	NPV Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,202	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,202	\$0
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$13.9	\$0.0
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$13.9	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$13.9
Total NPV Benefits	\$102.8
Total NPV Costs	\$13.9
Net Benefit	\$89.0
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 91.64
Benefit Cost Ratio	7.4

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario B: MEPS 2010, label 2000

**Case:** N/A

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy		GHG kt	NPV	
	GWh	Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario B: MEPS 2010, label 2000

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$0
2015	7215	\$1,178	6029	\$1,290	\$0
2020	8350	\$1,359	6201	\$1,337	\$0

#### Program Impact: BAU vs Scenario B: MEPS 2010, label 2000

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	\$0.0
2015	-316	-\$51.4	-263	\$21.0	\$0.0
2020	-522	-\$85.2	-387	\$20.9	\$0.0

### Summary

	Year	Energy		NPV		NPV	
		GWh	Cost \$m	Energy Cost \$m	GHG kt	Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$0	
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$0	
Scenario B: MEPS 2010, label 2000	Cum 2005-2020	107490	\$9,568	91991	\$11,396	\$0	
Scenario B: MEPS 2010, label 2000	Cum 2005-2050	158825	\$11,458	126387	\$11,396	\$0	
Impact	Cum 2005-2020	-3471	-\$237.6	-2801	\$121.7	\$0.0	
Impact	Cum 2005-2050	-7021	-\$367.2	-5168	\$121.7	\$0.0	

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$367.2
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$121.7
Total NPV Benefits	\$367.2
Total NPV Costs	\$122.9
Net Benefit	\$244.3
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 47.28
Benefit Cost Ratio	3.0

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario B: MEPS 2010, label 2000

**Case:** N/A

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario B: MEPS 2010, label 2000

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$0
2015	1238	\$207	864	\$112	\$0
2020	1643	\$275	1147	\$112	\$0

#### Program Impact: BAU vs Scenario B: MEPS 2010, label 2000

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-52	-\$8.7	-36	\$1.7	\$0.0
2020	-98	-\$16.4	-68	\$1.6	\$0.0

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$0
Scenario B: MEPS 2010, label 2000	Cum 2005-2020	17328	\$1,834	12095	\$1,201	\$0
Scenario B: MEPS 2010, label 2000	Cum 2005-2050	28382	\$2,498	19811	\$1,201	\$0
Impact	Cum 2005-2020	-598	-\$54.9	-417	\$12.5	\$0.0
Impact	Cum 2005-2050	-1327	-\$98.3	-926	\$12.5	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$98.3
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$12.5
Total NPV Benefits	\$98.3
Total NPV Costs	\$12.5
Net Benefit	\$85.9
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 92.69
Benefit Cost Ratio	7.9

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario C: MEPS 2007, label 2010

**Case:** N/A

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy		GHG kt	NPV	
	GWh	Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario C: MEPS 2007, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7518	\$1,227	6282	\$1,271	\$0
2020	8827	\$1,437	6554	\$1,321	\$0

#### Program Impact: BAU vs Scenario C: MEPS 2007, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	0	\$0.0	0	\$0.0	\$0.0
2015	-12	-\$1.9	-10	\$2.3	\$0.0
2020	-45	-\$7.1	-34	\$4.8	\$0.0

### Summary

	Year	Energy		NPV		NPV	
		GWh	Cost \$m	GHG kt	Purchase Cost \$m	Shadow CO2 Cost	
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$0	
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$0	
Scenario C: MEPS 2007, label 2010	Cum 2005-2020	110781	\$9,795	94650	\$11,284	\$0	
Scenario C: MEPS 2007, label 2010	Cum 2005-2050	165373	\$11,805	131213	\$11,284	\$0	
Impact	Cum 2005-2020	-180	-\$10.5	-142	\$10.3	\$0.0	
Impact	Cum 2005-2050	-473	-\$21.0	-342	\$10.3	\$0.0	

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$21.0
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$10.3
Total NPV Benefits	\$21.0
Total NPV Costs	\$11.5
Net Benefit	\$9.6
Cost of CO2 reduction \$/tonne	-\$ 27.93
Benefit Cost Ratio	1.8

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario C: MEPS 2007, label 2010

**Case:** N/A

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO2 Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario C: MEPS 2007, label 2010

2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1288	\$215	899	\$110	\$0
2020	1735	\$290	1211	\$111	\$0

#### Program Impact: BAU vs Scenario C: MEPS 2007, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	0	\$0.0	0	\$0.0	\$0.0
2015	-2	-\$0.3	-1	\$0.2	\$0.0
2020	-7	-\$1.1	-5	\$0.5	\$0.0

## Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$0
Scenario C: MEPS 2007, label 2010	Cum 2005-2020	17900	\$1,887	12494	\$1,190	\$0
Scenario C: MEPS 2007, label 2010	Cum 2005-2050	29639	\$2,591	20688	\$1,190	\$0
Impact	Cum 2005-2020	-26	-\$2.2	-18	\$1.4	\$0.0
Impact	Cum 2005-2050	-70	-\$4.9	-49	\$1.4	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$4.9
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$1.4
Total NPV Benefits	\$4.9
Total NPV Costs	\$1.4
Net Benefit	\$3.6
Cost of CO2 reduction \$/tonne	-\$ 72.81
Benefit Cost Ratio	3.6

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 1

### Key Variables

Discount Rate	0.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$0
2015	7204	\$1,176	6019	\$1,292	\$0
2020	8310	\$1,353	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	\$0.0
2015	-327	-\$53.2	-273	\$23.3	\$0.0
2020	-563	-\$91.5	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$18,136	94792	\$19,950	\$0
BAU	Cum 2005-2050	165846	\$27,127	131555	\$19,950	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$17,544	91862	\$20,228	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$25,911	126079	\$20,228	\$0
Impact	Cum 2005-2020	-3634	-\$591.1	-2929	\$277.5	\$0.0
Impact	Cum 2005-2050	-7446	-\$1,215.9	-5475	\$277.5	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$1,215.9
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.7
Impact - NPV Purchase incremental costs \$m	\$277.5
Total NPV Benefits	\$1,215.9
Total NPV Costs	\$279.2
Net Benefit	\$936.7
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 171.07
Benefit Cost Ratio	4.4

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 1

### Key Variables

Discount Rate	0.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$0
2015	1236	\$207	863	\$112	\$0
2020	1637	\$274	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	\$0.0
2020	-104	-\$17.4	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$2,998	12512	\$1,757	\$0
BAU	Cum 2005-2050	29710	\$4,968	20737	\$1,757	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$2,894	12078	\$1,780	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$4,736	19766	\$1,780	\$0
Impact	Cum 2005-2020	-622	-\$103.9	-434	\$23.0	\$0.0
Impact	Cum 2005-2050	-1391	-\$232.6	-971	\$23.0	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$232.6
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$23.0
Total NPV Benefits	\$232.6
Total NPV Costs	\$23.0
Net Benefit	\$209.6
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 215.87
Benefit Cost Ratio	10.1

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 2

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO2 Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$0
2015	7204	\$1,176	6019	\$1,292	\$0
2020	8310	\$1,353	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	\$0.0
2015	-327	-\$53.2	-273	\$23.3	\$0.0
2020	-563	-\$91.5	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	110961	\$11,834	94792	\$13,413	\$0
BAU	Cum 2005-2050	165846	\$15,099	131555	\$13,413	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$11,508	91862	\$13,580	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$14,547	126079	\$13,580	\$0
Impact	Cum 2005-2020	-3634	-\$326.6	-2929	\$167.0	\$0.0
Impact	Cum 2005-2050	-7446	-\$551.8	-5475	\$167.0	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$551.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.4
Impact - NPV Purchase incremental costs \$m	\$167.0
Total NPV Benefits	\$551.8
Total NPV Costs	\$168.3
Net Benefit	\$383.5
Cost of CO2 reduction \$/tonne	-\$ 70.04
Benefit Cost Ratio	3.3

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 2

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$0
2015	1236	\$207	863	\$112	\$0
2020	1637	\$274	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	\$0.0
2020	-104	-\$17.4	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,539	12512	\$1,002	\$0
BAU	Cum 2005-2050	29710	\$1,974	20737	\$1,002	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,496	12078	\$1,013	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$1,903	19766	\$1,013	\$0
Impact	Cum 2005-2020	-622	-\$43.0	-434	\$11.0	\$0.0
Impact	Cum 2005-2050	-1391	-\$71.1	-971	\$11.0	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$71.1
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$11.0
Total NPV Benefits	\$71.1
Total NPV Costs	\$11.0
Net Benefit	\$60.1
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 61.96
Benefit Cost Ratio	6.5

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 3

### Key Variables

Discount Rate	10.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO2 Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$0
2015	7204	\$1,176	6019	\$1,292	\$0
2020	8310	\$1,353	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	\$0.0
2015	-327	-\$53.2	-273	\$23.3	\$0.0
2020	-563	-\$91.5	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	110961	\$8,250	94792	\$9,617	\$0
BAU	Cum 2005-2050	165846	\$9,520	131555	\$9,617	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$8,061	91862	\$9,723	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$9,244	126079	\$9,723	\$0
Impact	Cum 2005-2020	-3634	-\$189.3	-2929	\$105.7	\$0.0
Impact	Cum 2005-2050	-7446	-\$276.4	-5475	\$105.7	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$276.4
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.1
Impact - NPV Purchase incremental costs \$m	\$105.7
Total NPV Benefits	\$276.4
Total NPV Costs	\$106.8
Net Benefit	\$169.6
Cost of CO2 reduction \$/tonne	-\$ 30.98
Benefit Cost Ratio	2.6

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 3

### Key Variables

Discount Rate	10.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$0
2015	1236	\$207	863	\$112	\$0
2020	1637	\$274	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	\$0.0
2020	-104	-\$17.4	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,273	12512	\$857	\$0
BAU	Cum 2005-2050	29710	\$1,546	20737	\$857	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,241	12078	\$866	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$1,495	19766	\$866	\$0
Impact	Cum 2005-2020	-622	-\$32.8	-434	\$8.8	\$0.0
Impact	Cum 2005-2050	-1391	-\$50.4	-971	\$8.8	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$50.4
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$8.8
Total NPV Benefits	\$50.4
Total NPV Costs	\$8.8
Net Benefit	\$41.6
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 42.82
Benefit Cost Ratio	5.7

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 4

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.40
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO2 Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$0
2015	7530	\$1,229	6292	\$1,269	\$0
2020	8873	\$1,444	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,257	\$0
2015	7204	\$1,176	6019	\$1,306	\$0
2020	8310	\$1,353	6171	\$1,358	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$33.6	\$0.0
2015	-327	-\$53.2	-273	\$37.3	\$0.0
2020	-563	-\$91.5	-417	\$41.2	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$0
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$11,485	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$11,485	\$0
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$211.3	\$0.0
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$211.3	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$211.3
Total NPV Benefits	\$386.2
Total NPV Costs	\$212.5
Net Benefit	\$173.7
Cost of CO2 reduction \$/tonne	-\$ 31.72
Benefit Cost Ratio	1.8

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 4

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.40
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO2 Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$0
2015	1290	\$216	900	\$110	\$0
2020	1741	\$291	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$112	\$0
2015	1236	\$207	863	\$113	\$0
2020	1637	\$274	1143	\$114	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$2.8	\$0.0
2015	-54	-\$9.0	-37	\$3.1	\$0.0
2020	-104	-\$17.4	-73	\$3.4	\$0.0

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,211	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,211	\$0
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$22.2	\$0.0
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$22.2	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$22.2
Total NPV Benefits	\$102.8
Total NPV Costs	\$22.2
Net Benefit	\$80.6
Cost of CO2 reduction \$/tonne	-\$ 83.06
Benefit Cost Ratio	4.6

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 5

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$58
2015	7530	\$1,229	6292	\$1,269	\$94
2020	8873	\$1,444	6588	\$1,317	\$132

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$57
2015	7204	\$1,176	6019	\$1,292	\$90
2020	8310	\$1,353	6171	\$1,342	\$123

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	-\$0.8
2015	-327	-\$53.2	-273	\$23.3	-\$4.1
2020	-563	-\$91.5	-417	\$25.8	-\$8.3

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$454
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$454
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$11,406	\$435
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$11,406	\$435
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$132.1	-\$19.0
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$132.1	-\$19.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	-\$19.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$132.1
Total NPV Benefits	\$405.2
Total NPV Costs	\$133.3
Net Benefit	\$271.9
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 49.66
Benefit Cost Ratio	3.0

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 5

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO2 Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$6
2015	1290	\$216	900	\$110	\$14
2020	1741	\$291	1215	\$111	\$24

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$6
2015	1236	\$207	863	\$112	\$13
2020	1637	\$274	1143	\$113	\$23

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	-\$0.6
2020	-104	-\$17.4	-73	\$2.1	-\$1.5

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$87
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$87
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,202	\$83
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,202	\$83
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$13.9	-\$3.8
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$13.9	-\$3.8

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	-\$3.8
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$13.9
Total NPV Benefits	\$106.6
Total NPV Costs	\$13.9
Net Benefit	\$92.8
Cost of CO2 reduction \$/tonne	-\$ 95.54
Benefit Cost Ratio	7.7

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 6

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,038	5769	\$1,224	\$58
2015	7530	\$1,229	6292	\$1,269	\$126
2020	8873	\$1,444	6588	\$1,317	\$198

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,024	5693	\$1,245	\$57
2015	7204	\$1,176	6019	\$1,292	\$120
2020	8310	\$1,353	6171	\$1,342	\$185

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$21.0	-\$0.8
2015	-327	-\$53.2	-273	\$23.3	-\$5.5
2020	-563	-\$91.5	-417	\$25.8	-\$12.5

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$11,274	\$593
BAU	Cum 2005-2050	165846	\$11,826	131555	\$11,274	\$593
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$11,406	\$567
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$11,406	\$567
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$132.1	-\$25.9
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$132.1	-\$25.9

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	-\$25.9
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$132.1
Total NPV Benefits	\$412.1
Total NPV Costs	\$133.3
Net Benefit	\$278.8
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 50.92
Benefit Cost Ratio	3.1

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 6

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$153	637	\$109	\$6
2015	1290	\$216	900	\$110	\$18
2020	1741	\$291	1215	\$111	\$36

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$150	628	\$111	\$6
2015	1236	\$207	863	\$112	\$17
2020	1637	\$274	1143	\$113	\$34

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.8	\$0.0
2015	-54	-\$9.0	-37	\$1.9	-\$0.7
2020	-104	-\$17.4	-73	\$2.1	-\$2.2

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,188	\$117
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,188	\$117
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,202	\$111
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,202	\$111
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$13.9	-\$5.2
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$13.9	-\$5.2

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	-\$5.2
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$13.9
Total NPV Benefits	\$108.1
Total NPV Costs	\$13.9
Net Benefit	\$94.2
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 97.05
Benefit Cost Ratio	7.8

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 7

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	1.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO2 Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$1,091	5769	\$1,224	\$0
2015	7530	\$1,358	6292	\$1,269	\$0
2020	8873	\$1,677	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$1,077	5693	\$1,245	\$0
2015	7204	\$1,299	6019	\$1,292	\$0
2020	8310	\$1,570	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$14.3	-76	\$21.0	\$0.0
2015	-327	-\$58.7	-273	\$23.3	\$0.0
2020	-563	-\$106.3	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	110961	\$10,497	94792	\$11,274	\$0
BAU	Cum 2005-2050	165846	\$12,946	131555	\$11,274	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$10,222	91862	\$11,406	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$12,502	126079	\$11,406	\$0
Impact	Cum 2005-2020	-3634	-\$275.1	-2929	\$132.1	\$0.0
Impact	Cum 2005-2050	-7446	-\$443.8	-5475	\$132.1	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$443.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$132.1
Total NPV Benefits	\$443.8
Total NPV Costs	\$133.3
Net Benefit	\$310.6
Cost of CO2 reduction \$/tonne	-\$ 56.72
Benefit Cost Ratio	3.3

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 7

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	1.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV
					Shadow CO2 Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$161	637	\$109	\$0
2015	1290	\$238	900	\$110	\$0
2020	1741	\$338	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$158	628	\$111	\$0
2015	1236	\$228	863	\$112	\$0
2020	1637	\$318	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.3	-9	\$1.8	\$0.0
2015	-54	-\$9.9	-37	\$1.9	\$0.0
2020	-104	-\$20.2	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	NPV	GHG kt	NPV	NPV
			Energy Cost \$m		Purchase Cost \$m	Shadow CO2 Cost
BAU	Cum 2005-2020	17926	\$2,047	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,908	20737	\$1,188	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,984	12078	\$1,202	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,788	19766	\$1,202	\$0
Impact	Cum 2005-2020	-622	-\$63.7	-434	\$13.9	\$0.0
Impact	Cum 2005-2050	-1391	-\$119.6	-971	\$13.9	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$119.6
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$13.9
Total NPV Benefits	\$119.6
Total NPV Costs	\$13.9
Net Benefit	\$105.7
Cost of CO2 reduction \$/tonne	-\$ 108.88
Benefit Cost Ratio	8.6

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 8

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	-1.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,180	\$0
2010	6341	\$987	5769	\$1,224	\$0
2015	7530	\$1,112	6292	\$1,269	\$0
2020	8873	\$1,242	6588	\$1,317	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,180	\$0
2010	6258	\$974	5693	\$1,245	\$0
2015	7204	\$1,063	6019	\$1,292	\$0
2020	8310	\$1,163	6171	\$1,342	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.0	-76	\$21.0	\$0.0
2015	-327	-\$48.1	-273	\$23.3	\$0.0
2020	-563	-\$78.7	-417	\$25.8	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,172	94792	\$11,274	\$0
BAU	Cum 2005-2050	165846	\$10,837	131555	\$11,274	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$8,950	91862	\$11,406	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$10,501	126079	\$11,406	\$0
Impact	Cum 2005-2020	-3634	-\$222.0	-2929	\$132.1	\$0.0
Impact	Cum 2005-2050	-7446	-\$336.5	-5475	\$132.1	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$336.5
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$132.1
Total NPV Benefits	\$336.5
Total NPV Costs	\$133.3
Net Benefit	\$203.2
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 37.11
Benefit Cost Ratio	2.5

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 8

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-2.0% change pa	Tariff real escalation	-1.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$109	\$0
2010	913	\$145	637	\$109	\$0
2015	1290	\$195	900	\$110	\$0
2020	1741	\$250	1215	\$111	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$109	\$0
2010	900	\$143	628	\$111	\$0
2015	1236	\$187	863	\$112	\$0
2020	1637	\$235	1143	\$113	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.1	-9	\$1.8	\$0.0
2015	-54	-\$8.1	-37	\$1.9	\$0.0
2020	-104	-\$15.0	-73	\$2.1	\$0.0

### Summary

	Year	Energy GWh	Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,746	12512	\$1,188	\$0
BAU	Cum 2005-2050	29710	\$2,326	20737	\$1,188	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,695	12078	\$1,202	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,237	19766	\$1,202	\$0
Impact	Cum 2005-2020	-622	-\$51.0	-434	\$13.9	\$0.0
Impact	Cum 2005-2050	-1391	-\$88.6	-971	\$13.9	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$88.6
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$13.9
Total NPV Benefits	\$88.6
Total NPV Costs	\$13.9
Net Benefit	\$74.7
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 76.95
Benefit Cost Ratio	6.4

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 9

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	0.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,157	\$0
2010	6341	\$1,038	5769	\$1,327	\$0
2015	7530	\$1,229	6292	\$1,522	\$0
2020	8873	\$1,444	6588	\$1,747	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,157	\$0
2010	6258	\$1,024	5693	\$1,349	\$0
2015	7204	\$1,176	6019	\$1,550	\$0
2020	8310	\$1,353	6171	\$1,781	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$22.8	\$0.0
2015	-327	-\$53.2	-273	\$28.0	\$0.0
2020	-563	-\$91.5	-417	\$34.2	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$12,560	\$0
BAU	Cum 2005-2050	165846	\$11,826	131555	\$12,560	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$12,715	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$12,715	\$0
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$155.1	\$0.0
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$155.1	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$155.1
Total NPV Benefits	\$386.2
Total NPV Costs	\$156.3
Net Benefit	\$229.9
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 41.99
Benefit Cost Ratio	2.5

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 9

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	0.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$107	\$0
2010	913	\$153	637	\$119	\$0
2015	1290	\$216	900	\$132	\$0
2020	1741	\$291	1215	\$147	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$107	\$0
2010	900	\$150	628	\$121	\$0
2015	1236	\$207	863	\$134	\$0
2020	1637	\$274	1143	\$150	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.9	\$0.0
2015	-54	-\$9.0	-37	\$2.3	\$0.0
2020	-104	-\$17.4	-73	\$2.8	\$0.0

### Summary

	Year	Energy GWh	Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,334	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,334	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,350	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,350	\$0
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$16.4	\$0.0
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$16.4	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$16.4
Total NPV Benefits	\$102.8
Total NPV Costs	\$16.4
Net Benefit	\$86.5
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 89.07
Benefit Cost Ratio	6.3

\* Costs assigned to Australia

## Summary of Program Findings - Australia

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 10

### Key Variables

Discount Rate	7.5%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-4.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy	Energy	GHG kt	Purchase	NPV
	GWh	Cost \$m		Cost \$m	Shadow CO <sub>2</sub> Cost
2005	4946	\$815	4774	\$1,205	\$0
2010	6341	\$1,038	5769	\$1,127	\$0
2015	7530	\$1,229	6292	\$1,054	\$0
2020	8873	\$1,444	6588	\$986	\$0

#### Scenario A: MEPS 2010, label 2010

2005	4946	\$815	4774	\$1,205	\$0
2010	6258	\$1,024	5693	\$1,146	\$0
2015	7204	\$1,176	6019	\$1,073	\$0
2020	8310	\$1,353	6171	\$1,006	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-84	-\$13.6	-76	\$19.3	\$0.0
2015	-327	-\$53.2	-273	\$19.4	\$0.0
2020	-563	-\$91.5	-417	\$19.3	\$0.0

### Summary

	Year	Energy	NPV	GHG kt	NPV	NPV
		GWh	Energy Cost \$m		Purchase Cost \$m	Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	110961	\$9,805	94792	\$10,183	\$0
BAU	Cum 2005-2050	165846	\$11,826	131555	\$10,183	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	107327	\$9,558	91862	\$10,295	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	158400	\$11,439	126079	\$10,295	\$0
Impact	Cum 2005-2020	-3634	-\$247.2	-2929	\$112.7	\$0.0
Impact	Cum 2005-2050	-7446	-\$386.2	-5475	\$112.7	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$386.2
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$1.2
Impact - NPV Purchase incremental costs \$m	\$112.7
Total NPV Benefits	\$386.2
Total NPV Costs	\$113.9
Net Benefit	\$272.3
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 49.73
Benefit Cost Ratio	3.4

\* Australia and NZ are aggregated

## Summary of Program Findings - New Zealand

**Title:** BAU vs Scenario A: MEPS 2010, label 2010

**Case:** Sensitivity 10

### Key Variables

Discount Rate	5.0%	Price Impact Multiplier	0.25
Air Conditioner Price Escalation	-4.0% change pa	Tariff real escalation	0.0% change pa

### Air Conditioners

#### BAU

Year	Energy GWh	Energy Cost \$m	GHG kt	Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
2005	585	\$98	409	\$111	\$0
2010	913	\$153	637	\$101	\$0
2015	1290	\$216	900	\$91	\$0
2020	1741	\$291	1215	\$83	\$0

#### Scenario A: MEPS 2010, label 2010

2005	585	\$98	409	\$111	\$0
2010	900	\$150	628	\$102	\$0
2015	1236	\$207	863	\$93	\$0
2020	1637	\$274	1143	\$85	\$0

#### Program Impact: BAU vs Scenario A: MEPS 2010, label 2010

2005	0	\$0.0	0	\$0.0	\$0.0
2010	-13	-\$2.2	-9	\$1.6	\$0.0
2015	-54	-\$9.0	-37	\$1.6	\$0.0
2020	-104	-\$17.4	-73	\$1.6	\$0.0

### Summary

	Year	Energy GWh	Energy Cost \$m	GHG kt	NPV Purchase Cost \$m	NPV Shadow CO <sub>2</sub> Cost
BAU	Cum 2005-2020	17926	\$1,889	12512	\$1,066	\$0
BAU	Cum 2005-2050	29710	\$2,596	20737	\$1,066	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2020	17304	\$1,832	12078	\$1,077	\$0
Scenario A: MEPS 2010, label 2010	Cum 2005-2050	28319	\$2,493	19766	\$1,077	\$0
Impact	Cum 2005-2020	-622	-\$57.0	-434	\$11.8	\$0.0
Impact	Cum 2005-2050	-1391	-\$102.8	-971	\$11.8	\$0.0

### Totals 2005-2050 Cumulative

Impact - NPV Energy Costs \$m	-\$102.8
Impact - NPV Carbon Cost \$m	\$0.0
Impact - NPV Program Costs \$m *	\$0.0
Impact - NPV Purchase incremental costs \$m	\$11.8
Total NPV Benefits	\$102.8
Total NPV Costs	\$11.8
Net Benefit	\$91.1
Cost of CO <sub>2</sub> reduction \$/tonne	-\$ 93.80
Benefit Cost Ratio	8.7

\* Costs assigned to Australia