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Prepared by

Energy Efficient Strategies

with

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Costs and Benefits of proposed revisions to the method of test and energy labelling algorithms for household refrigerators and freezers

Report 2007/15 - Prepared by Energy Efficient Strategies

This Cost-Benefit Analysis was prepared by Energy Efficient Strategies Pty Ltd for the Australian Greenhouse Office, 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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Chair, Equipment Energy Efficiency Committee

Australian Greenhouse Office

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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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GLOSSARY

ABARE	Australian Bureau of Agricultural and Resource Economics
AGO	Australian Greenhouse Office
BAU	Business As Usual
COAG	Council of Australian Governments
CPI	Consumer Price Index (Australian Bureau of Statistics)
E2WG	Energy Efficiency Working Group
E3	Equipment Energy Efficiency Committee (federal-state-NZ)
EECA	Energy Efficiency and Conservation Authority of New Zealand
EES	Energy Efficient Strategies (E3 consultants)
EEWG	Energy Efficiency Working Group (federal-state-NZ)
ETS	Emissions Trading Scheme
GHG	Greenhouse gas(es), mass of CO_2 equivalent
GWA	George Wilkenfeld and Associates (E3 consultants)
GWh	GigaWatt hours (measure of energy = 10^9 Wh)
IEA	International Energy Agency
kt	kilotonnes GHG (10^6 tonnes) (equivalent of 10^{12} grams or 1 Gg)
kWh	Kilowatt hours (measure of energy = 10^3 Wh = 3.6 MJ)
MCE	Ministerial Council on Energy (federal-state-NZ)
MEPS	Minimum Energy Performance Standards
MJ	Megajoule (measure of energy = 10^6 Joules)
Mt	Megatonne GHG (10^6 tonnes)
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
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^{15} 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

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)*

This Document Seeks Industry Comments

Australian and New Zealand government agencies responsible for product energy efficiency are currently investigating whether to mandate the re-grading of energy star labels for household refrigerators and freezers that are imported or manufactured and sold in Australia and New Zealand.

This document aims to communicate to stakeholders the most important issues and questions relating to the regulatory proposal and to seek stakeholder comment and to focus the development of the regulatory proposal. Particular issues where comment is sought are the transition arrangements and timing, the proposed algorithms and the requirements to test to the revised test method AS/NZS4474.1-2007.

This document is called a "Cost-Benefit Analysis" (CBA) and has been issued by the Equipment Energy Efficiency Committee (E3 Committee) reporting to the Ministerial Council on Energy of the Australian federal, state and territory governments and the New Zealand Government. It has been prepared in accordance with COAG Guidelines for National Standards Setting and Regulatory Action (COAG 2004). The CBA is a discussion draft providing the rationale for the regulatory proposal. The CBA and stakeholder responses to it will be used to prepare a regulatory impact statement (RIS) (see http://www.obpr.gov.au for RIS requirements) on the changes to ASNZS4474.2 requirements for household refrigerators and freezers imported and sold in Australia and New Zealand. The proposal will be considered by the Ministerial Council on Energy and, if endorsed, will result in Australian state and territory legislation and New Zealand legislation being amended to require household refrigerators and freezers to re-register to the re-graded energy star label algorithms.

Stakeholders are invited to make written comments on the proposal. The Australian Greenhouse Office (AGO) in Australia and the Energy Efficiency and Conservation Authority (EECA) in New Zealand are managing the process of obtaining stakeholder views and comments on the regulatory proposal. The AGO and EECA will accept written submissions from stakeholders until the close of business 21 January 2008 on any of the issues raised in the document. If required, public meetings addressing the proposal will be held in Sydney, Melbourne and Auckland at dates to be determined.

The Consultation RIS and any further stakeholder responses will then be used to prepare the Decision RIS considered by the Ministerial Council on Energy.

Executive Summary

This is a cost-benefit analysis which examines the impacts arising from a proposal to change the star rating algorithm for the energy rating labelling system for refrigerators and freezers. It is a precursor to a formal Regulatory Impact Statement, which is will prepared once public comments on this document are received and considered. The proposed regulation is an element of the Equipment Energy Efficiency (E3) program, which is an initiative of the Ministerial Council on Energy (MCE) forming part of both the Australian National Framework for Energy Efficiency and the New Zealand National Energy Efficiency and Conservation Strategy.

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). Australia has several programs in place that are actively reducing greenhouse gas emissions through increasing the efficiency of appliances. 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.

Refrigerators and freezers are estimated to make up 13.4% of residential electricity consumption in Australia in 2005, while this is set to decrease to 9.3% in 2020, as a result of increased energy efficiency from energy labelling and MEPS programs for these products as well as growth in electricity consumption of other end uses. Similarly, the share of electricity consumption for refrigerators and freezers is NZ is estimated to be approximately 15% and this too is expected to decline in the future. The energy saving from energy labelling alone in Australia in 2005 was estimated to be over 750 GWh per annum (EnergyConsult, 2006). Energy labelling for refrigerators and freezers has been in place in Australia since 1986, with a revision of the energy label algorithm undertaken in 2000. MEPS for refrigerators and freezers was implemented in 1999 and the levels were made substantially more stringent in 2005. New Zealand made the MEPS scheme mandatory in 2002 and the 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, while MEPS has removed the worst performing products. Stringent MEPS in 2005 has resulted in a market whereby most products with lower star ratings under the 2000 algorithm have been eliminated, leaving star ratings bunched for refrigerators and freezers, predominately with a rating of 3 and 4 stars (sales weighted average star rating was nearly 4 stars in 2006).

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 refrigerator and freezer market depends on several factors, including:

- A reasonable spread of star rating 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).
- That both suppliers and consumers have continued confidence in the integrity of the program.

The main aim of this project is to implement an energy labelling proposal for refrigerators and freezers 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 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.

There has also been identified a need to introduce a revision to the refrigerator and freezer test method; AS/NZS 4474.1. These changes are to facilitate improved accountability in testing procedures and reduce the possibility of manufacturers finding loopholes in the test procedure which can be exploited in terms of advantageous energy claims. While this action would normally be included as a separate future regulatory change (and accompanying RIS), it is proposed to couple the proposed energy labelling algorithm and label changes with a requirement to use the revised test method in order to minimise total cost for suppliers and manufacturers. Transition costs to the new test method are included in the estimated costs and benefits for this project.

The Proposal

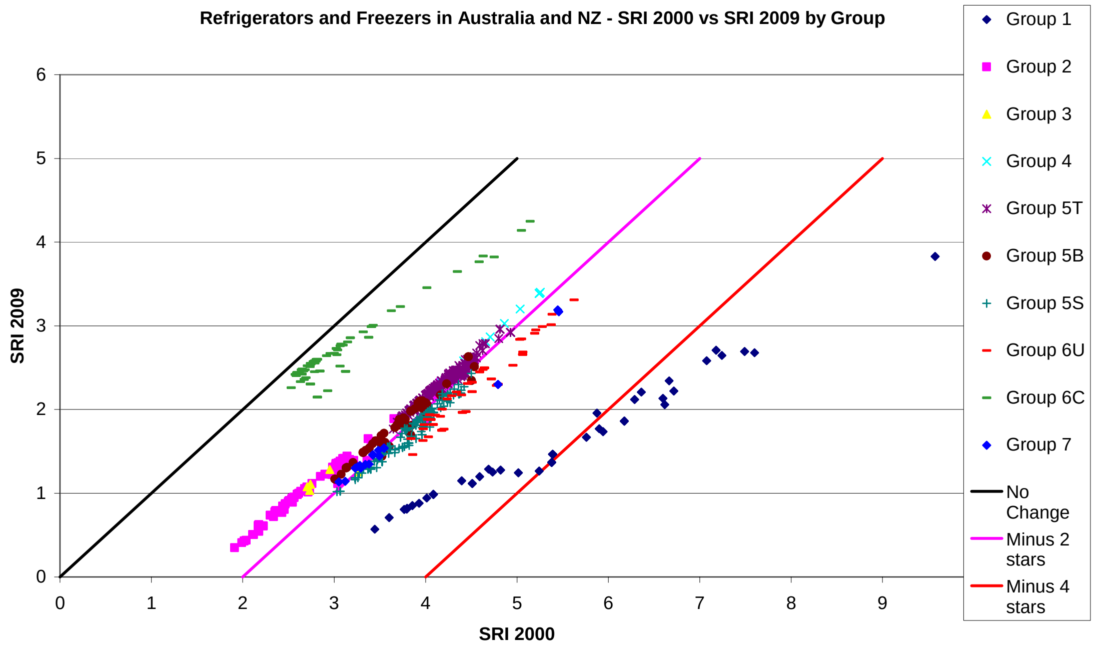
The proposal is to revise AS/NZS 4474.2 as follows:

- Change energy labelling algorithms so that most Groups lose approximately 2 stars, which is intended to maintain the value of the label as a selection aid for refrigerator and freezer buyers and as a motivation for suppliers. The new label is to be phased in over the period October 2008 to October 2009. A new approach based on a de facto surface area function is used to better represent changes in energy consumption across a wide range of cabinet sizes.

- Incorporate the revised test method AS/NZS 4474.1-2007 as a prerequisite for registration[1] for use of the new energy label in 2009.

The new algorithms result in a reduction of about 2 stars for nearly all groups as illustrated in Figure 1 below. The exceptions to this general rule are Group 6C, where the reductions in star rating are less than 1 star and Group 1, where the reduction in star rating is typically 4 stars (varies).

Figure 1: Refrigerators and Freezers in Australia and New Zealand – SRI 2000 vs SRI 2009 by Group



Costs and Benefits

The follow stages have been identified in this transition process and the associated cost factors.

[1] Refer to Section 2.6 for details of registration requirements for energy labelling and MEPS.

Table 1: Transition Stages – Registration

Description	Registration Status	Additional Costs Imposed:
Product registered prior to 1 October 2008 (1) - AS/NZS4474.2-2001	Expires 1 October 2009	For obsolete registrations: none For models removed from sales during overlap period (1): none For models continuing on market after overlap period: label re-registration and display transition costs (2)
Product registered with 'old' label between 1 October 2008 and 31 March 2009 (1) - AS/NZS4474.2-2001	Expires 1 October 2009	For models removed from sales during overlap period (1): none For models continuing on market after overlap period: label re-registration and display transition costs (2)
Product registered with 'new' label between 1 October 2008 and 30 September 2009 (1) - AS/NZS4474.2-2008	Expires up to 5 years from date of registration (subject to annual rollover review) (5)	No additional costs
Product registered after 30 September 2009 - AS/NZS4474.2-2008	Expires up to 5 years from date of registration (subject to annual rollover review) (5)	No additional costs

Notes:

1) Overlap period (1 October 2008 – 31 March 2009): new registrations of both label versions accepted – new labels must show transition data.

2) New label start date (1 April 2009): all new registrations must be with new energy label and AS/NZS4474.1-2007.

3) Display transition period (1 October 2008 – 1 October 2009): 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) Registrations for products which have test reports to AS/NZS4474.1-1997 expire on 30 September 2009. Registrations to AS/NZS4474.2-2008 for the new energy label will only be permitted for products which have test reports to AS/NZS4474.1-2007. Suppliers and manufacturers will be permitted to test to AS/NZS4474.1-2007 on publication from September 2007 which will avoid the need for retesting of many products during the label transition.

5) For models listed in New Zealand, there is no expiry date.

Supplier costs regarding registration and re-labelling are summarised in Table 2 below.

Table 2: Total Costs per Element for Retesting and/or Re-registering

	Number of Models	Element Cost	Total Cost ($'000)	Comments
Total number of models that will require complete re-testing to satisfy new standard	200	$4,800	$960	53% (continuing models)
Number of registrations that can reprocess existing test data to satisfy new Standard	175	$750	$131	47% (of continuing models)
Number of new models registered from September 2007 that will require re-registration for the new label only	350	$300	$105	
		Total Cost	**$1,196**	

Note – New Zealand is part of the above analysis, as the figures come from total approved registrations. Same cost of registration assumed for models listed in NZ, but actual cost is zero.

The supplier (including manufacturer, importer and retailer) costs, are estimated at about $1.8 million. Given the normal retail mark-ups, this implies a potential cost which could be passed on to appliance purchasers of over $3.6 million. The total costs of the introduction of new labels would amount to about $4.0 million, 92% of which would be passed onto consumers, the rest being government administration costs which are covered internally. This costs equates to about $4.00 per appliance sold if spread over one year and $0.40 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 2005 (this is the second round of MEPS, the first being introduced in 1999) as these MEPS levels were stringent and there is now only a low incentive to improve star ratings as many products already receive high ratings.

It has also been assumed in the Base Case analysis that the new label revision and associated regrading of the star rating algorithm in 2009 will result in an additional 0.5% per annum increase in efficiency over and above the BAU case for a 4 year period and that then the relative annual increase in efficiency will be comparable to the no label case thereafter. This assumption is based on the maintenance, and for some groups widening, of the proposed star rating bands while reducing the absolute number of stars to provide greater incentive for suppliers to put more energy efficient models on the market, as they seek to differentiate their products from competitors and to increase sales. This mechanism is strengthened by the labelling program now having become the driver for further improvements in energy efficiency in these markets, as a review of the current MEPS levels are unlikely in the short term (more detail on the proposed re-scaling of the star rating and its rationale are in section 2.7.1).

The following tables outline the BAU and Expected Impact costs and benefits for Australian refrigerators and freezers.

Discount rates applied in the following tables and throughout the report, are real (ie the additional effect of inflation has been excluded from the calculations).

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
- Expected – expected impacts of the proposal, using the Base Case assumptions. The Impact is the BAU Scenario minus Expected Scenario.

Table 3: BAU vs Expected Costs and Benefits for Australian Refrigerators by Year

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	6184	6184	0	$0.0	0	$0.0
2010	5887	5880	7	$0.9	7	$2.8
2015	5622	5569	54	$7.1	51	$6.1
2020	5536	5430	106	$14.0	94	$6.2

Table 4: BAU vs Expected Costs and Benefits for Australian Freezers by Year

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1568	1568	0	$0.0	0	$0.0
2010	1412	1411	1	$0.1	1	$0.7
2015	1251	1246	5	$0.6	5	$1.0
2020	1100	1091	9	$1.2	8	$1.0

The below tables outline the cumulative costs and benefits for Australian refrigerators and freezers for the years 2005 to 2020.

Table 5: Cumulative Costs and Benefits for Australian Refrigerators – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	92585	$7,103	89746	$8,056
Expected	91982	$7,071	89191	$8,085
Impact	-603	-$32.2	-555	$28.8

Table 6: Cumulative Costs and Benefits for Australian Freezers – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	21322	$1,694	20730	$774
Expected	21269	$1,692	20681	$779
Impact	-53	-$2.9	-49	$5.2

The tables below summarise the cumulative costs and benefits for Australian refrigerators and freezers 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 7: Cumulative Costs and Benefits for Australian Refrigerators – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	136158	$8,317	128210	$8,056
Expected	134454	$8,255	126682	$8,085
Impact	-1704	-$61.9	-1528	$28.8

Table 8: Cumulative Costs and Benefits for Australian Freezers – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	30912	$1,952	29186	$774
Expected	30731	$1,946	29025	$779
Impact	-181	-$6.0	-161	$5.2

The following tables outline the BAU and Expected Impact costs and benefits for New Zealand refrigerators and freezers. It is important to note that the Base Case results presented below for New Zealand have been calculated using a discount rate of 7.5%.

The New Zealand Government has stated that its preferred discount rate for assessment of program financial impacts is now 5%. The results for a 5% discount rate are fully documented in Scenario C in Section 5.2 and, as expected, show a net benefit that is higher than for the Base Case discount rate of 7.5% shown below.

Table 9: BAU vs Expected Impact Costs and Benefits for New Zealand Refrigerators by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1030	1030	0	$0.0	0	$0.0
2010	980	979	1	$0.2	1	$0.4
2015	936	927	9	$1.5	6	$0.9
2020	922	904	18	$3.0	12	$0.9

Table 10: BAU vs Expected Impact Costs and Benefits for New Zealand Freezers by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	502	502	0	$0.0	0	$0.0
2010	452	452	0	$0.0	0	$0.1
2015	401	399	2	$0.3	1	$0.1
2020	352	349	3	$0.5	2	$0.1

The tables below outline the cumulative costs and benefits for New Zealand refrigerators and freezers for the years 2005 to 2020.

Table 11: Cumulative Costs and Benefits for New Zealand Refrigerators – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	15417	$1,516	10761	$1,208
Expected	15317	$1,509	10691	$1,213
Impact	-100	-$6.9	-70	$4.3

Table 12: Cumulative Costs and Benefits for New Zealand Freezers – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	6827	$687	4765	$108
Expected	6810	$686	4754	$109
Impact	-17	-$1.2	-12	$0.7

The tables below outline the cumulative costs and benefits for New Zealand refrigerators and freezers 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 13: Cumulative Costs and Benefits for New Zealand Refrigerators – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	22673	$1,776	15826	$1,208
Expected	22389	$1,763	15628	$1,213
Impact	-284	-$13.2	-198	$4.3

Table 14: Cumulative Costs and Benefits for New Zealand Freezers – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	9898	$791	6909	$108
Expected	9840	$789	6868	$109
Impact	-58	-$2.4	-40	$0.7

An analysis of actual price paid and the registered energy consumption on the energy label was conducted on more than 1000 models sold in Australia in 2006. Almost no correlation was found between the energy efficiency of refrigerators and freezer models and their price, except for Group 7, where a weak correlation was found. 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. 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 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.

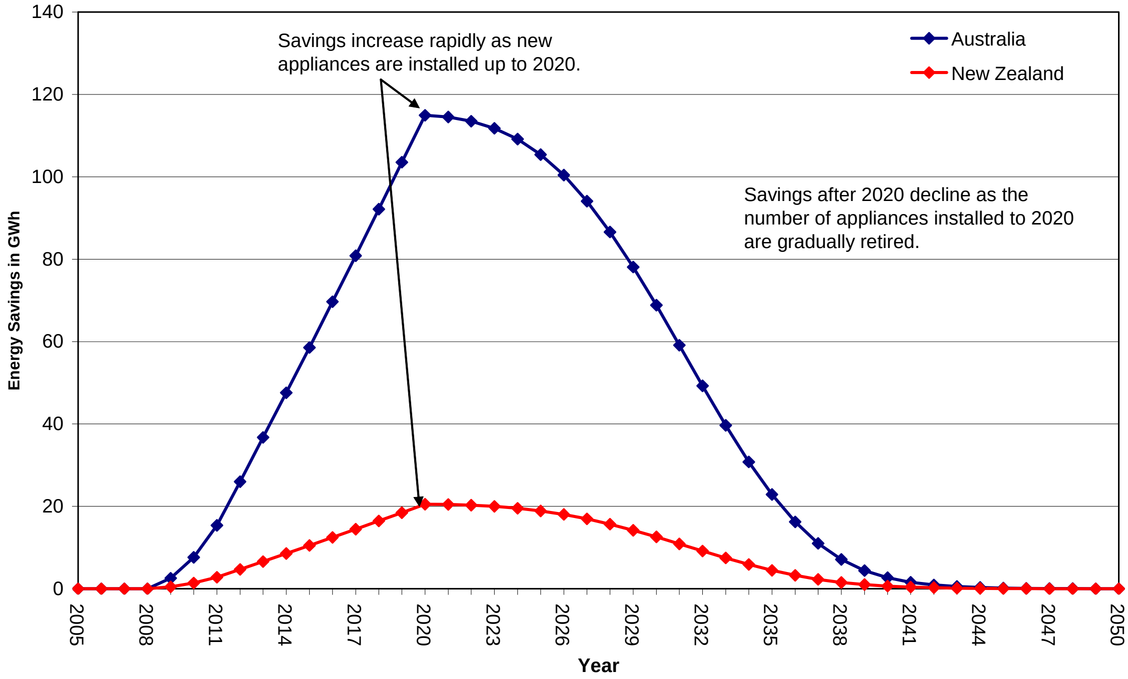
Table 15: Australia and New Zealand NPV Benefits and Costs of Program – Cumulative to 2050

Country	Discount Rate	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Australia	7.5%	$67.9	$36.9	$31.0	1.8
New Zealand	7.5%	$15.7	$5.1	$10.6	3.1

Note: For the preferred discount rate of 5% for NZ (Scenario C), the overall B/C ratio is 3.6.

Figure 2 below shows the energy savings in GWh by year for aggregated refrigerators and freezers for Australia and New Zealand. It can be seen that there are steep increases in savings up to the year 2020, and after which these savings taper off to nothing by 2050. Only appliances installed up to 2020 are considered in the program modelling and analysis, so overall savings decline after this date.

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



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

Table 16: Sensitivity Analysis Scenarios

Scenario Title	Scenario Notes
Scenario A	Energy impact of program 40% of base case (Low Impact)
Scenario F	Price impact double the projected rate
Scenario G	Shadow CO_2 cost at AU $10/tonne of CO_2-e
Scenario I	Energy tariff increasing at 1% per annum in real terms

Table 17: Summary of NPV Benefits and Costs of Base Case versus Low Impact Scenario (Scenario A) for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario A	Australia	$20.0	$14.0	$6.0	1.4
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario A	New Zealand	$4.7	$1.7	$3.0	2.8

Table 18: Summary of NPV Benefits and Costs of Base Case versus Scenario F for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario F	Australia	$67.9	$71.0	-$3.1	1.0
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario F	New Zealand	$4.7	$3.3	$1.4	1.4

Table 19: Summary of NPV Benefits and Costs of Base Case versus Scenario G for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario G	Australia	$70.4	$36.9	$33.4	1.9
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario G	New Zealand	$16.0	$5.1	$11.0	3.2

Table 20: Summary of NPV Benefits and Costs of Base Case versus Scenario I for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario I	Australia	$79.6	$36.9	$42.6	2.2
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario I	New Zealand	$5.5	$1.7	$3.8	3.3

Conclusions and Recommendations

The case for a change of algorithm for the energy star rating of refrigerators and freezers for the Australian and New Zealand market has been clearly set out in this report and the need for this is widely acknowledged and supported by industry. For both refrigerators and freezers, 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. 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 this change would have on the refrigerator and freezer market and on product prices has been undertaken in this report. It was found that even with the worst case scenario of doubling consumer costs due to efficiency increases (Scenario F), the cost-benefit ratio for the Program will still remain above 1. This indicates that the analysis and modelling underpinning the algorithm change and associated market effects is robust (in all likelihood no price rise will result from the small increases in energy efficiency that are expected). The cost-benefit ratio of the Program for 1.8 Australia and 3.1 for New Zealand under modelled Base Case conditions (B/C ratio of 3.6 for NZ under a 5% discount rate). In the current policy climate, scenarios with real increases in either energy tariffs or the introduction of some pricing structure for CO_2 are more likely; in both of these cases the cost-benefit ratio increases well above the Base Case.

This proposal is required to ensure that the energy labelling program continues to be an effective measure for both consumers and suppliers in the refrigerator and freezer market. The mandatory introduction of the revised test method AS/NZS4474.1-2007 has wide support from industry and will provide greater certainty and credibility to the program. The introduction of the test method change has been bundled with the energy label and star rating algorithm change in order to minimise costs to industry.

The recommendations from this report are:

- New energy labelling algorithms be implemented in AS/NZS4474.2 for refrigerators and freezers as set out in this report.
- Transition arrangements over the period October 2008 to October 2009 as set out in this report be implemented.
- All new registrations from April 2009 will require the new energy label.
- All products manufactured or imported after 1 October 2009 will be required to carry the new energy label and have a current approved registration/listing for this label.

- 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 October 2009.
- Test reports to AS/NZS4474.1-2007 to be required for all registrations or listings which use the new energy label and the new algorithm.

Submissions on the Proposal

Submissions on this proposal should be submitted by 21 January 2008 and forwarded to either:

AUSTRALIA
Ms Catherine Corver
Equipment Energy Efficiency Team
Australian Greenhouse Office
Department of the Environment and Water Resources
GPO Box 787
CANBERRA ACT 2601
Or via email to:
energy.rating@environment.gov.au

NEW ZEALAND
Refrigerator Submissions
Products Programme
Energy Efficiency and Conservation Authority
PO Box 388
WELLINGTON
Or via email to:
regs@eeca.govt.nz

1. Scope

1.1 General

This Cost-Benefit Analysis (CBA) has been prepared to demonstrate the benefits of making revisions to the method of test and energy labelling algorithms for household refrigerators and freezers. It is being released by the E3 Committee to seek initial industry comment related to the regulatory proposal, and is a precursor to the preparation of a consultation Regulatory Impact Statement (RIS).

RISs are prepared whenever new mandatory or voluntary measures are proposed for E3, if it is proposed to make existing mandatory measures more stringent, or if existing regulations are to be retained beyond their ‘sunset’. The document must be prepared (or commissioned) by the department, agency, statutory authority, or board responsible for a regulatory proposal, and it must set out the costs and benefits of each option and make recommendations. National product regulation can only be justified where the benefits outweigh the costs to the community, and the cost of improving appliance efficiency is outweighed by the energy savings made over the lifetime of the product.

1.2 Australian and New Zealand Policy Responses to Global Warming

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

1.2.1 Australia’s Response to Climate Change

The development of Australia’s climate change policies has followed a consistent policy direction for more than 15 years or since the *National Greenhouse Response Strategy* was released produced bipartisan support for Australia wide energy efficiency measures. Appendix 9 records some of the more important stages in that development.

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

> *“Energy efficiency is an important way to reduce greenhouse gas emissions cheaply. Demand for electricity in Australia is expected to more than double by 2050. Improvements in energy efficiency have the potential to low that projected growth, and avoid greenhouse gas emissions. They can also deliver a net financial gain for firms and consumers. The scale of these savings, both*

in emissions and outlays, is often underestimated. For example, in June 2007, the IEA published energy efficiency recommendations which, if adopted globally in 2030, would save 5,700 million tonnes of CO2 – the equivalent of the United States total emissions in 2004 (IEA, Energy Efficiency Policy Recommendations to the G8 2007 Summit, Heiligendamm, June 2007, page 2) … The MEPS program is one the main success stories of the National Framework for Energy Efficiency (NFEE). The NFEE was developed cooperatively across jurisdictions and covers a range of policy measures, designed to overcome market barriers to energy efficiency." (pp 16-17)

1.2.2 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 it if cannot meet its target).

In October 2007, the New Zealand Minister of Energy released the New Zealand Energy Efficiency and Conservation Strategy (NZEECS), which proposes ways to promote energy efficiency, energy conservation and use of renewable sources of energy. 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 NZEECS 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 New Zealand Energy Strategy (NZES).

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

1.2.3 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.

1.2.4 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.

1.2.5 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 household refrigerators and freezers 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 household refrigerators and freezers has been a topic of discussion with key industry leaders for many years.

2. The Problem

Climate change is a serious global challenge, requiring an effective global response (IPCC 2007).

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.

The Kyoto Protocol to the UNFCCC was agreed in December 1997, and came into force in 2005. The Australian Government has decided not to ratify the Protocol as it does not require all countries to act – only developed countries were required to reduce their emissions. Nevertheless, the Australian Government committed to meet its Kyoto target of 108% of 1990 emissions, on average, over 2007 to 2012.

New Zealand ratified the Kyoto Protocol on 19 December 2002, and has committed to reducing its greenhouse gas emissions back to 1990 levels, on average, over 2008 to 2012 or to take responsibility for any emissions above this level if it cannot meet this target.

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

2.1 Energy and Greenhouse Gas Emissions

Table 21 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_2-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_2-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_2-e (0.4%) from 2004 to 2005, and by 64.8 Mt CO_2-e (50.1%) from 1990 to 2005.

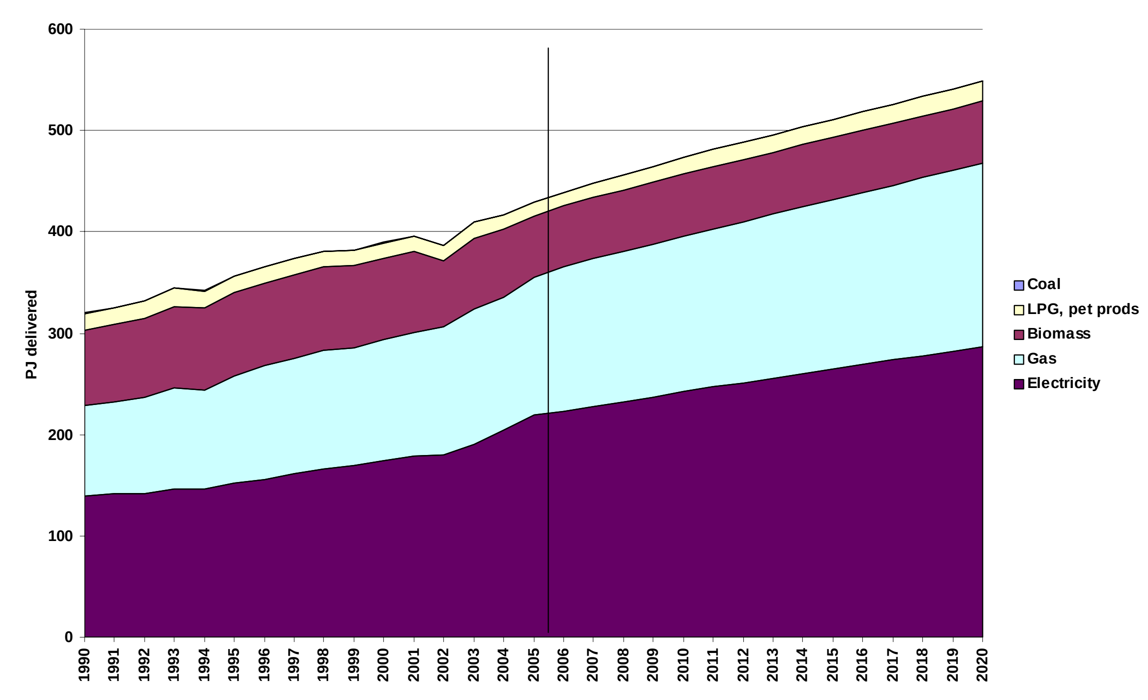
Table 21: National Greenhouse Gas Inventory 2005

IPCC Sector	Emissions (million tonnes)			Change in Emissions (%)	
	1990	2004	2005	04-05	90-05
Energy Sector	287.0	386.1	391.0	**1.3%**	**36.3%**
- Stationary Energy	196.0	276.1	279.4	**1.2%**	**42.6%**
Electricity generation	129.4	193.7	194.3	**0.3%**	**50.2%**
- Transport	61.9	79.5	80.4	**1.3%**	**30.0%**
- Fugitive Fuels	29.1	30.5	31.2	**2.2%**	**7.3%**
Industrial Processes	25.3	30.6	29.5	**-3.6%**	**16.5%**
Agriculture	87.7	89.8	87.9	**-2.1%**	**0.2%**
- Livestock	65.9	61.6	62.1	**0.8%**	**-5.8%**
- Other Agriculture	21.8	28.2	25.8	**-8.5%**	**18.4%**
Waste	18.3	17.1	17.0	**-0.7%**	**-6.9%**
Land Use Changes and Forestry	128.9	35.5	33.7	**-5.2%**	**-73.9%**
- Forestry Sinks	0	-17.8	-19.6	**-10.3%**	**-100.0%**
- Land Use Change	128.9	53.3	53.3	**0.0%**	**-58.7%**
Australia's Net Emissions	**547.1**	**559.1**	**559.1**	**0.0%**	**2.2%**

(Australian Greenhouse Office, 2007)

Figure 3 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 3: ABARE Residential Electricity Consumption, Historical and Projected

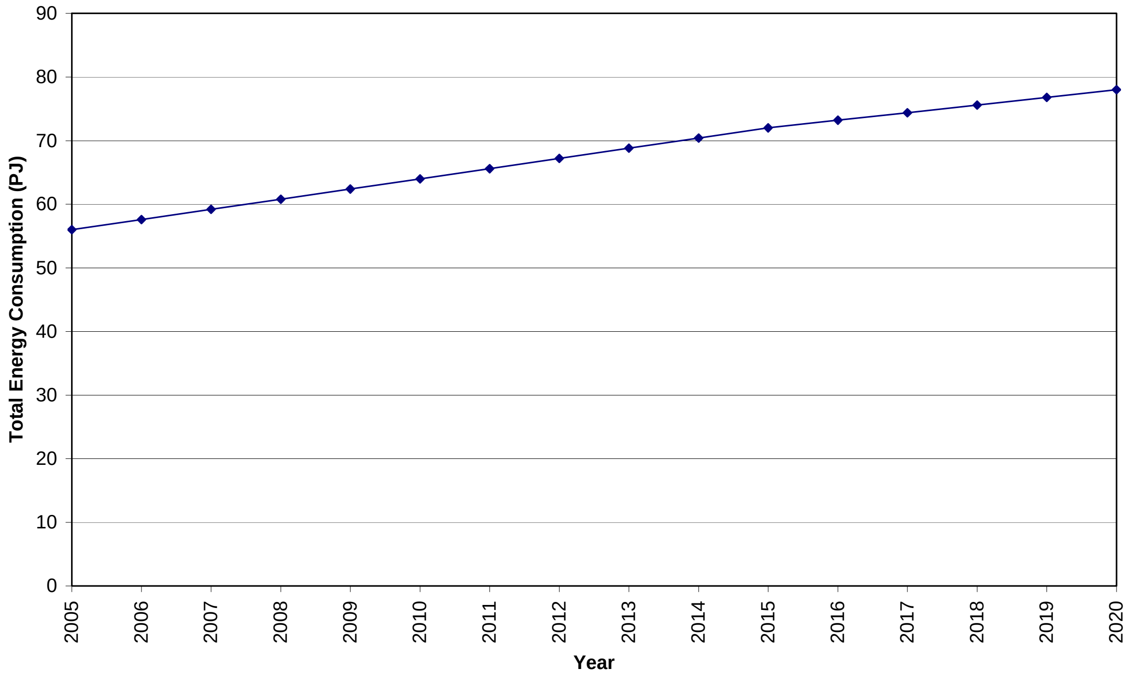


Source: ABARE 2006

In New Zealand, thermal electricity generation accounted for 24.5% of CO_2 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_2-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 4 below.

Figure 4: 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 Refrigerators and Freezers to National Energy Use and Emissions - Australia

Table 22 below shows the electricity consumption share of refrigerators and freezers in Australia. It can be seen that over the course of time, that the absolute electricity consumption of refrigerators and freezers is expected to decrease as a result of Minimum Energy Performance Standards (MEPS) and energy labelling programs. The share of electricity consumption is also expected to decrease as a result of the proliferation of other electricity end uses.

Table 22: Projected Refrigerator and Freezer Share of Household Electricity Consumption – Australia

Year	Refrigerator Electricity Consumption (PJ)	Freezer Electricity Consumption (PJ)	Residential Electricity Consumption (PJ)	Refrigerator and Freezer Share (%)
2005	22.3	5.6	220.9	13%
2006	22.1	5.5	222.9	12%
2007	21.8	5.4	226.9	12%
2008	21.6	5.3	232.1	12%
2009	21.4	5.2	237.1	11%
2010	21.1	5.1	242.1	11%
2011	20.9	5.0	246.8	10%
2012	20.6	4.8	251.2	10%
2013	20.4	4.7	255.7	10%
2014	20.1	4.6	260.1	9%
2015	19.9	4.5	264.5	9%
2016	19.7	4.4	268.9	9%
2017	19.6	4.3	273.3	9%
2018	19.4	4.1	277.8	8%
2019	19.3	4.0	282.2	8%
2020	19.2	3.9	286.6	8%

Source: Refrigerator and Freezer figures from EES stock model estimates for BAU case. Residential Electricity Consumption Projections from ABARE 2006.

Table 23 below shows the estimated refrigerator and freezer emissions for Australia. It can be seen that like electricity consumption, emissions are estimated to be decreasing over time due to MEPS and energy labelling programs

Table 23: Refrigerator and Freezer Emission Estimates - Australia

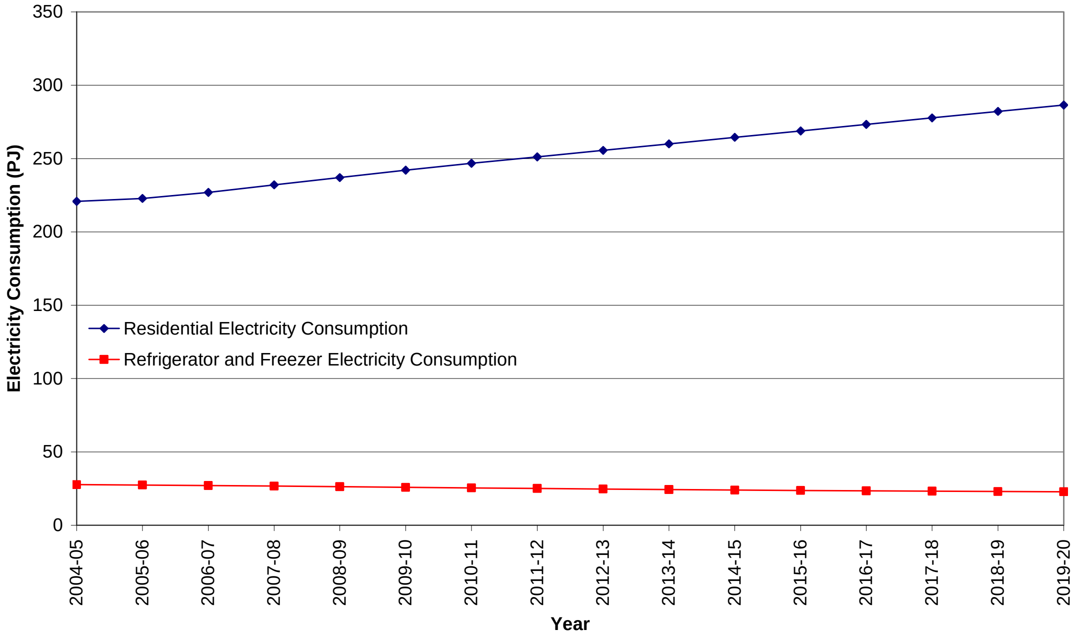
Year	Refrigerator Emissions - kt	Freezer Emissions - kt
2005	6350	1605
2006	6301	1579
2007	6329	1571
2008	6182	1519
2009	5932	1441
2010	5808	1394
2011	5691	1347
2012	5669	1323
2013	5492	1263
2014	5559	1257
2015	5312	1182
2016	5208	1137
2017	5057	1082
2018	5014	1047
2019	4956	1011
2020	4888	971

EES stock model estimates, BAU case

Figure 5 below shows the ABARE projections for residential electricity from 2004 to 2020. 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 refrigerator and freezer electricity consumption are also shown. Even though refrigerator and freezer electricity use is projected to fall slightly, it is still projected to be the largest single end user of electricity after water heating. Therefore it is still worthwhile to consider further possibilities for reducing this energy use, and how this could be achieved.

For New Zealand, electricity consumption of refrigerators and freezers amounted to about 5.5 PJ, which is about 10% of total energy consumption and about 15% of total electricity consumption for NZ.

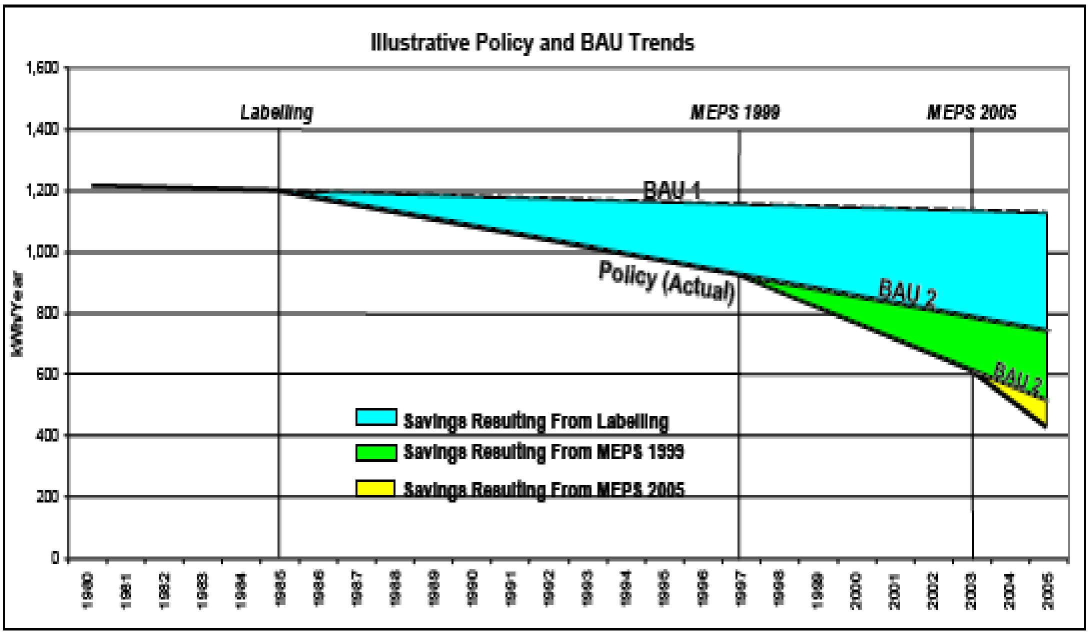
Figure 5: ABARE Projections for Residential Electricity Consumption - Australia



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

Energy labelling and MEPS have already had a significant impact on refrigerator and freezer energy use. Figure 6 below shows the estimated savings resulting from the implementation of labelling and MEPS for refrigerators and freezers based on an analysis of the program impacts from 1985 to 2005 (EnergyConsult 2006).

Figure 6: Average annual electricity use of refrigerators and freezers, showing estimated impacts of energy Labelling and MEPS - Australia.



In Australia, the total impact of energy labelling for refrigerators and freezers on energy consumption is significant, with savings rising from 20 GWh in 1986 to over 750 GWh per annum in 2005 (compared to a no labelling case).

One reason for the maintenance of the market impact of energy labelling over such a long period was the adjustment of the energy labelling algorithms (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 refrigerators and freezers, 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.

The 1999 MEPS achieved annual energy savings of just under 700 GWh per annum in 9 years. While the impact of the 2005 MEPS will take some years to be fully realised, is still well underway and is yet to be precisely quantified, the most recent sales data indicate very large long term savings. These impacts will become clearer in 2 to 3 years (EnergyConsult, 2006). Because they affect the market in different ways, the impacts of changes in energy labelling take longer to become evident than for the introduction of MEPS, which are tied to specific compliance dates. 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.

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.

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. This will reduce the range of star ratings which the buyers sees in the showroom, and so reduce the apparent energy value of seeking out a higher-rated product.

2.3 Ownership

Nearly every household in Australia and New Zealand has at least one refrigerator, and many have more than one. Between 1994 and 2005, the average number of refrigerators in Australia per household increased from 1.26 to 1.37. Conversely, the proportion of households with freezers in Australia has been steadily falling, from 45% in 1994 to 37% in 2005. It appears that the average number of refrigeration products per household has been fairly steady, but the share of refrigerators within that stock is growing while the share of freezers is falling.

Table 24: % of Households with Refrigerators and Freezers

% of Households with Refrigerators				
	1994	**1999**	**2002**	**2005**
1 Refrigerator	75.8%	70.8%	70.4%	66.9%
2 Refrigerators	21.9%	26.0%	26.5%	29.4%
3 or more Refrigerators	2.0%	2.8%	3.0%	3.6%
None	0.3%	0.3%	0.1%	0.1%
Total	100%	99.9%	100%	100%
Average Refrigerators/HH	1.26	1.31	1.32	1.37
% of HH with Freezers				
	1994	**1999**	**2002**	**2005**
1 Freezer	41.2%	36.8%	35.3%	33.5%
2 Freezers	3.4%	3.1%	2.5%	3.0%
3 or more Freezers	0.4%	0.2%	0.3%	0.4%
None	55.1%	59.9%	62.0%	63.1%
Total	100%	100%	100%	100%
Average Freezers/HH	0.49	0.44	0.41	0.41
Refrigeration products/HH	1.75	1.75	1.74	1.77

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

Ownership data for New Zealand is less complete than for Australia. Statistic New Zealand recorded the following information in the 2001 census for New Zealand as shown in Table 25. This data is only penetration and no reliable estimate of the total stock of refrigeration appliances can be made from this data. Note that the second and third product in this table are both classified as refrigerators in this study and many NZ households appear to incorrectly self-categorise these sub-types.

Table 25: Penetration of Refrigeration Products – New Zealand

NZ Census 2001	Penetration
Separate deep-freeze unit	49.7
Combination refrigerator/freezer	82.2
Separate refrigerator	28.7

Other data sources for New Zealand such as BRANZ (2006) suggest that there are a comparable number of refrigerators (including single door models as well as refrigerator freezers) in Australia and New Zealand. The NZ Statistic data above together with BRANZ data shows that there are considerably more freezers in New Zealand. The penetration is on average 10% higher than in NZ (49% in NZ versus 39% in Australia in 2001) and it would appear that the number of appliances per home with the product is also much higher (saturation of 1.35 for NZ freezers with 1.08 for Australia). The average number of refrigeration appliances per home in NZ is 1.99 (BRANZ 2006) compared to about 1.75 in Australia over the period 2000 to 2005. The main difference is the significantly higher freezer ownership in NZ.

As no trend data is available for NZ, it has been assumed that ownership trends in NZ will be comparable to those in Australia for the analysis period.

2.4 Technology and Energy Efficiency

2.4.1 Product Classifications

Under the standard AS/NZS4474.1-2007, household refrigeration products are classified into one of 10 possible groups. These groups have remained unchanged since 2001.

Table 26: Group definitions under AS/NZS4474.1-2007

Appliance group	Group description	Other Criteria and Notes
1	All refrigerator	Automatic defrost
2	Refrigerator with ice maker	Most common configuration for small bar refrigerators, usually small (<150L)
3	Refrigerator with short term freezer	Becoming rare, but some new products appearing in 2005/6, usually small size
4	Refrigerator with long term freezer	Automatic defrost fresh food, manual defrost freezer, used to be common, now rare
5T	Top mounted frost free refrigerator-freezer	Both compartments are automatic defrost, freezer at top, majority of sales
5B	Bottom mounted frost free refrigerator-freezer	Both compartments are automatic defrost, freezer at bottom, growing sales, dominate in NZ
5S	Side×side frost free refrigerator-freezer	Both compartments are automatic defrost, growing sales
6C	Chest freezer	Includes all configurations and frost types
6U	Manual defrost vertical (upright) freezer	Door at front, manual defrost
7	Frost free vertical freezer	Door at front, automatic defrost

2.4.2 Australian Data

Since 1993, the Australian refrigerator and freezer market has been systematically monitored using sales data collected by GfK (a market research company). The most recently published version of this report is Greening Whitegoods 2005 (EES, 2006). GfK 2006 data, obtained in April 2007, has been analysed and used throughout this report. This will be fully analysed for all whitegoods for the Greening Whitegoods report, 2007, to be released in the near future.

Refrigerators

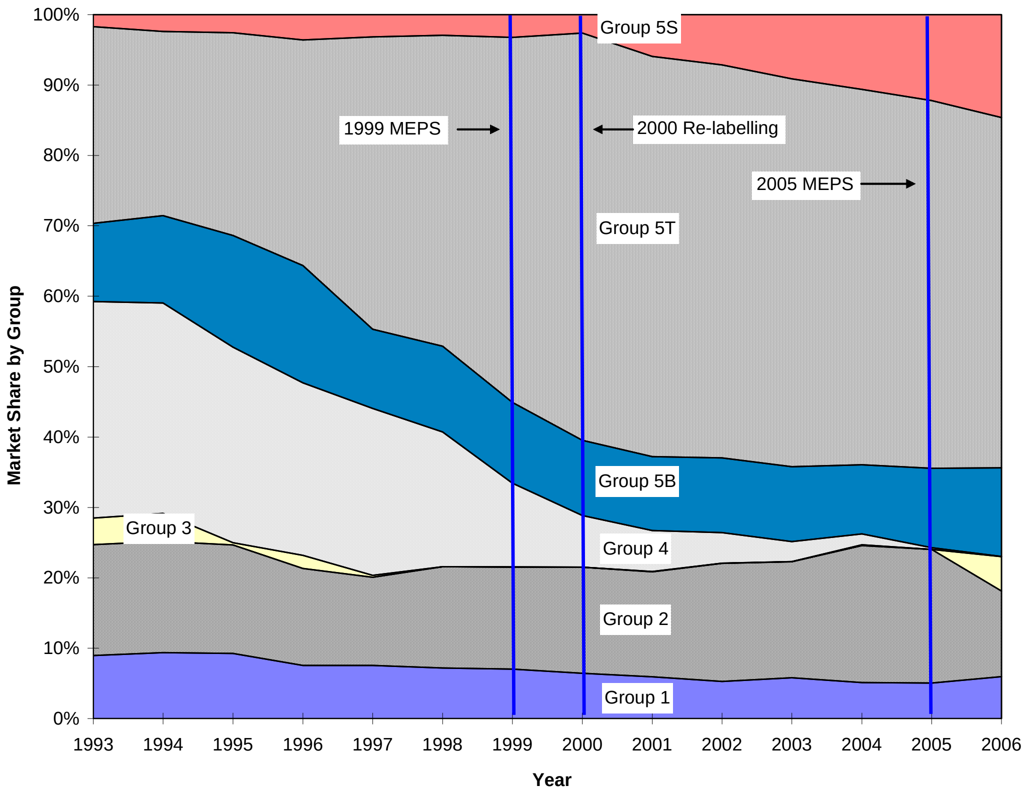
In 2006, over 950,000 unit sales were identified for retail sales of refrigerators across Australia. The main findings for 2006 were:

- Total retail refrigerator sales for the period 1993 to 2006 increased at an average of about 3% per annum.
- The market share of Group 1 declined from 9% in 1993 to 6% in 2006.
- The market share of Group 2 was steady at around 12% share (Group 2 plus Group 3 have remained steady at about 16% to 18% share).

- Sales of Group 3 have been virtually non existent since the late 1990's with only 47 units sold in 2005. However, several new models have appeared on the market in 2006 though, these have sold well and have boosted Group 3's market share to around 5%. The sales of these units has resulted in reduced Group 2 sales as the products cover comparable markets.
- Group 4 refrigerators made up 25% of the market in 1993. In 2005 Group 4 had a 0% market share and has all but disappeared from the market apart from a couple of specialised European products.
- The market share of Group 5B has been steady at around 12.5%.
- The market share of Group 5S refrigerators is increasing gradually. Sales share of models in this group doubled from 2002 to 14.5% in 2006.
- The market share of Group 5T peaked in 2000 at 58% after which they have had a slight decrease in sales share. In 2005, Group 5T made up 50% of all refrigerator sales, still by far the largest group.

These findings are shown graphically for all study years in Figure 7 below. Also note that the major regulatory actions regarding refrigerators have been marked using blue lines.

Figure 7: Market Share by Refrigerator Group for Australia



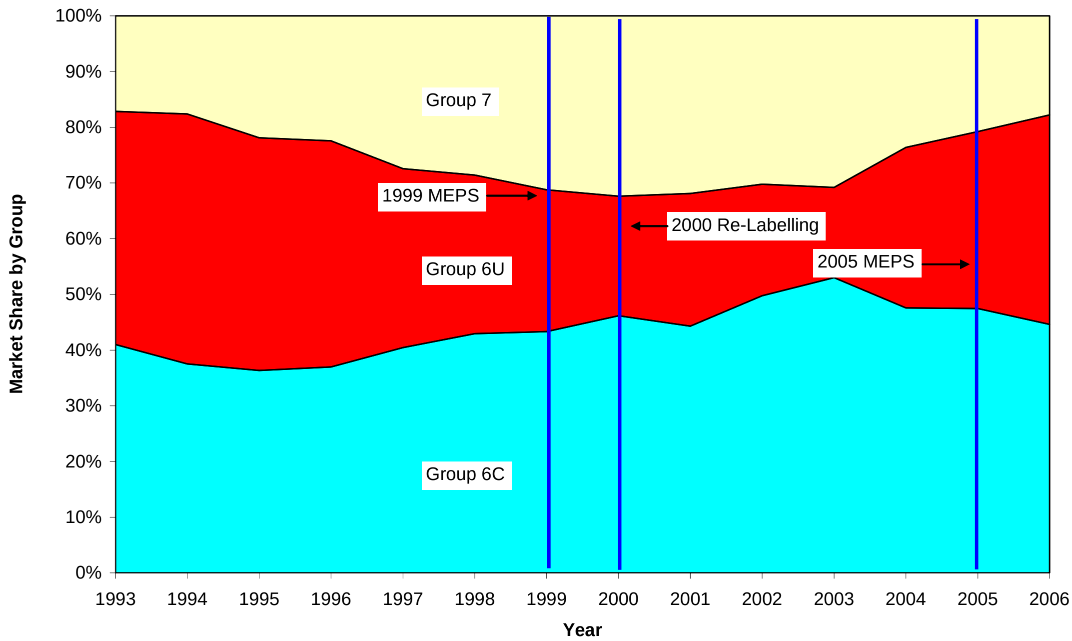
Freezers

In 2006, almost 230,000 unit sales were identified for freezers. The main findings were:

- Total retail freezer sales for the period 1993 to 2006 grew at an average of 4% per annum, although the majority of this increase occurred in the years 2004 and 2006 for reasons which are not clear (the sales up to 2003 were fairly static).
- Group 6C sales constitute nearly 45% of the market in 2006 and this share has been fairly steady over the analysis period (typically from 40% to 50% share).
- The market share of Group 6U freezers declined to 17% in 2003 then sharply increased to 38% in 2006. These sales of these very small vertical manual defrost freezers increased 3 fold in nearly 2 years from 2003 to 2006. Many appear to be low cost imports. The source of the demand for such products is unclear.
- The market share of Group 7 freezers is around 18% in 2006 and its market share appears to have diminished since 2003, although absolute sales have been steady or growing.

These findings are shown graphically for all study years in Figure 8 below. Once again the major regulatory actions regarding refrigerators have been marked using blue lines.

Figure 8: Market Share by Freezer Group for Australia

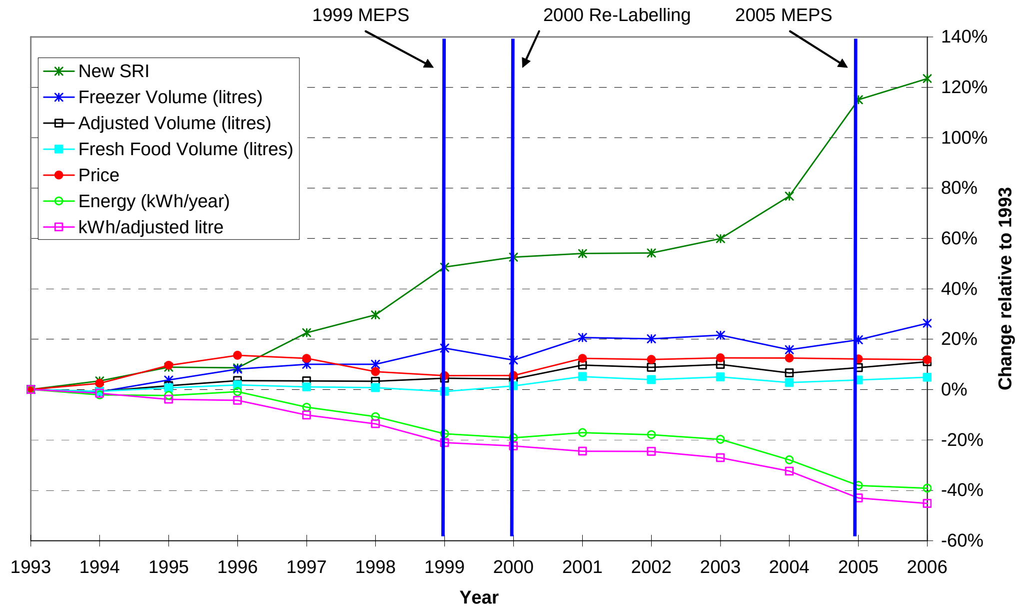


Key Characteristics – Refrigerators

Figure 9 below shows the annual trends in key performance characteristics for refrigerators for the study period; 1993 to 2006. The main findings are:

- The energy consumption of refrigerators is trending downwards at -3.8% per annum over the 14 year study period. The most significant falls in energy consumption occurred with the introduction of MEPS in late 1999 and with the more stringent MEPS levels in 2005. Average energy consumption across all refrigerators in 2003 was 619 kWh/year compared to a significantly lower figure of 469 kWh/year in 2006 (24% decrease in 3 years).
- All groups have achieved significant reductions in energy consumption from 1993 to 2006: Group 1 (40%), Group 2 (27%), Group 3 (55%), Group 4 (45%), Group 5T (55%), Group 5B (40%) and Group 5S (60%).
- While the adjusted volume[2] is still increasing slowly, the total energy efficiency of the refrigerator market is also increasing, at a rate of around +4.5% per annum (ie kWh per adjusted litre is trending downwards at -4.5% per annum). However, the change from year to year has varied substantially.

Figure 9: Annual Trends in Key Performance Characteristics Since 1993 – Refrigerators –Australia



Key Characteristics – Freezers

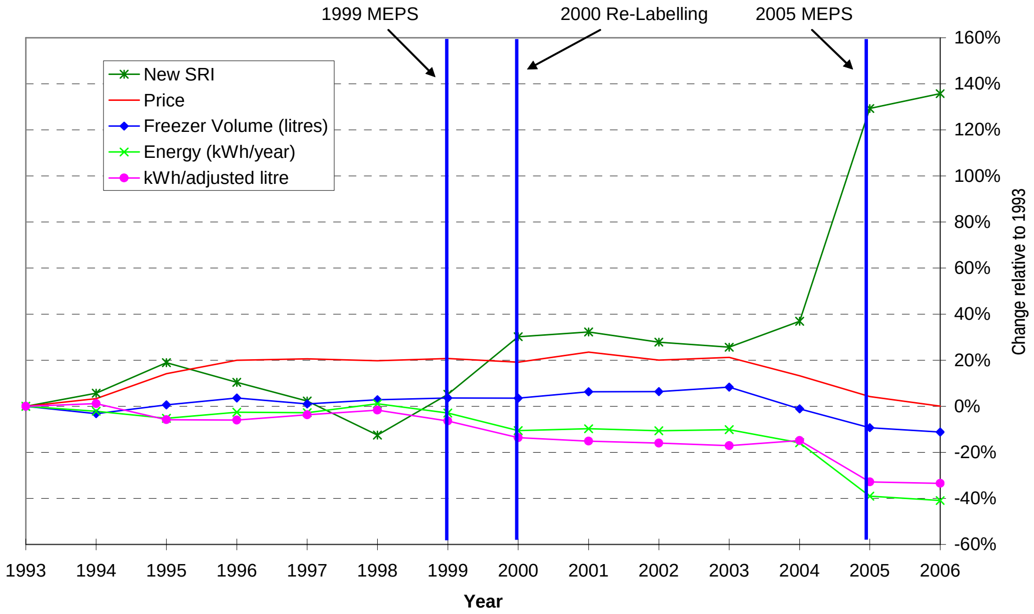
Figure 10 below shows the annual trends in key performance characteristics for freezers for the study period; 1993 to 2006. The main findings are:

- The energy consumption of freezers is trending downwards at -3.8% per annum, with the most significant gains in energy efficiency being made since 2003 in response to 2005 MEPS.

[2] Adjusted volume is the sum of the total volume of each compartment which has been weighted to take into account it temperature of operation: fresh food compartment has a weighting factor of 1.0 while a freezer compartment has a weighting of 1.6 (this factor is also called a freezer adjustment factor).

- As the volume is decreasing slightly, the total energy efficiency of the freezer market is increasing at a rate of around +3.1% per annum (ie kWh per adjusted litre is trending downwards at -3.1% per annum). Freezer energy efficiency had improved markedly from 1998 to 2006.

Figure 10: Annual Trends in Key Performance Characteristics Since 1993 – Freezers –Australia



2.4.3 New Zealand Data

The monitoring of sales in New Zealand started in 2002 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. Figure 11 below shows the market share by group of 2006 refrigerator sales for New Zealand. Groups 5B and 5T comprise the far greatest market shares, with group 1, 2 and 5S together making up a smaller percentage of the market and groups 3 and 4 being almost non-existent.

Figure 11: Market Share by Group for New Zealand 2006 Refrigerator Sales

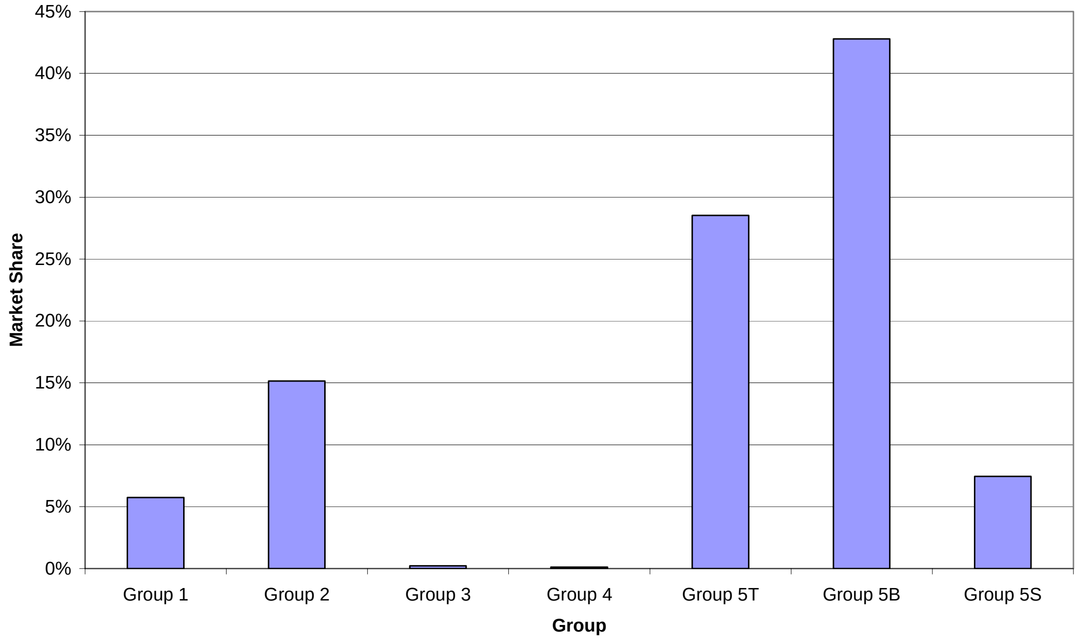
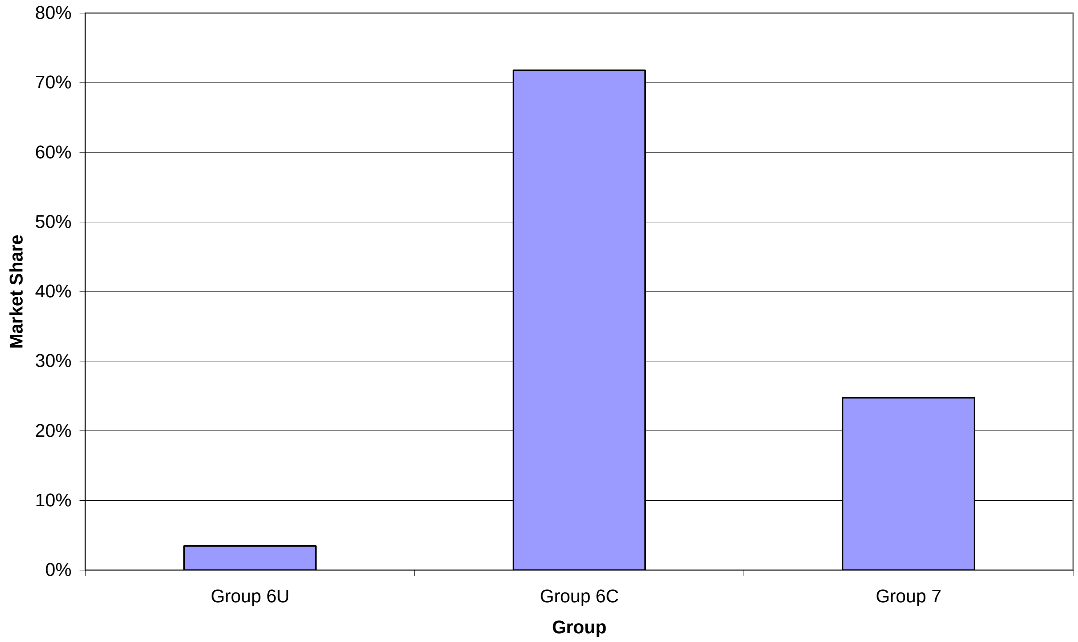


Figure 12 below shows the market share by group of 2006 freezer sales for New Zealand. Group 6C has the predominant share of the market, with groups 7 and 6U making up far smaller shares.

Figure 12: Market Share by Group for New Zealand 2006 Freezer Sales



No data on product prices or efficiency trends over time are available for New Zealand for this study. Although data across 4 years of mandatory labelling may be available through EECA, there was insufficient time to have this analysed for this report. Trends are assumed to be comparable to those in Australia, based on comparison of the 2006 data and also the high overlap of models registered for sale in both markets.

2.4.4 Comparison between NZ and Australian Key Data Attributes for 2006

Table 27 below shows the refrigerator group sales share comparison between Australian and New Zealand sales for 2006. For groups 1, 2, 3 and 4 the sales share are very similar, with only slight variations. The comparison for group 5S indicates that there is a larger market share in Australia than in New Zealand for this group. The greatest variation is seen in groups 5B and 5T with almost a complete reversal in market shares for these two groups for Australia and New Zealand (Australian market is predominately Group 5T, while the New Zealand market is predominately Group 5B).

Table 27: Refrigerator Group Share: Australian and New Zealand 2006 Sales

Group	1	2	3	4	5T	5B	5S
Australia (%)	6.0	12.1	4.9	0.0	49.8	12.6	14.6
New Zealand (%)	5.7	15.2	0.2	0.1	28.5	42.8	7.4

Table 28 below shows the freezer group share comparison between Australian and New Zealand sales for 2006. For Group 7 the market share is comparable, but in Australian sales are almost evenly split between Group 6U and 6C, while for New Zealand sales are heavily weighted towards Group 6C with Group 6U being almost non-existent. Note that sales of Group 6U products have increased rapidly in the past couple of years in Australia and the explanation for this is not clear.

Table 28: Freezer Group Share Comparison Between Australian and New Zealand 2006 Sales

Group	6U	6C	7
Australia (%)	37.6	44.6	17.8
New Zealand (%)	3.5	71.8	24.8

Table 29 below shows a comparison of key sales weighted characteristics for refrigerators for 2006 sales for Australia and New Zealand. The average energy for refrigerators (sales weighted by group) is almost the same. The average volumes for refrigerators (fresh food volume, freezer volume and adjusted volume) are on average, larger for Australia than for New Zealand. These two factors are implicit in the Star Rating Index (SRI) being slightly higher for Australia than New Zealand (although for both countries, the typical star rating would be the same – SRI is rounded down to the nearest 0.5 to get the star rating). Similarly, the kWh/adjusted Litre is slightly lower for Australia than New Zealand. Overall it shows that an average refrigerator in the Australian market is slightly larger but significantly more efficient than the average refrigerator in the New Zealand market (energy is similar). This difference in efficiency could be partly due to the greater effectiveness of energy labelling in Australia compared to New Zealand (noting that labelling was only mandatory in NZ from 2002 and MEPS was introduced in NZ in 2003). A study in 2006 found that only 75% of respondents from New Zealand were aware that refrigerators were energy labelled, whereas 93% of respondents from Australia were aware (Artcraft, 2006).

Table 29: Refrigerator Characteristics Comparison Between Australian and New Zealand 2006 Sales

	New SRI	Fresh Food Volume (L)	Freezer Volume (L)	Adjusted Volume * (L)	Energy (kWh/yr)	kWh/adj L
Australia	3.93	262	103	428	469	1.10
New Zealand	3.56	223	78	350	465	1.63

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

* Adjusted volume values include adjustment for the relevant freezer adjustment factor.

Table 30 below shows the comparison of adjusted volume and energy by refrigerator groups for Australia and New Zealand. These are the average values for each group.

Table 30: Refrigerator Volume and Energy Comparison Between Australian and New Zealand by Group

Group	1	2	3	4	5T	5B	5S
Australia Adjusted Volume* (L)	320	108	129	312	420	554	755
New Zealand Adjusted Volume* (L)	301	98	127	323	412	441	747
Australia Energy (kWh/yr)	1.08	2.64	2.24	1.30	1.07	1.04	0.94
New Zealand Energy (kWh/yr)	1.14	2.95	2.30	1.27	1.55	1.19	1.01

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

Note * Adjusted volume values include adjustment for the relevant freezer adjustment factor.

Table 31 below shows a comparison of the key characteristics for freezers for 2006 sales for Australia and New Zealand. The average energy for freezers (sales weighted by group) is higher for New Zealand than for Australia. The average volume for freezers (freezer volume and adjusted volume) are on average, higher for New Zealand than for Australia. These two factors are implicit in the new SRI being slightly higher for New Zealand than for Australia as well as the kWh/adj L also being slightly higher for New Zealand than for Australia. Overall it shows that the average freezer sold in New Zealand in 2006 was slightly more efficient than the average freezer sold in Australia in that year, but because it was about 15% larger it used about 10% more electricity.

Table 31: Freezer Characteristics Comparison Between Australian and New Zealand 2006 Sales

	New SRI	Freezer Volume (L)	Adjusted Volume * (L)	Energy (kWh/yr)	kWh/adj L
Australia	3.50	194	310	366	1.18
New Zealand	3.58	223	358	403	1.20

Note * Adjusted volume values include adjustment for the relevant freezer adjustment factor.

Table 32 below shows the comparison of adjusted volume and energy by refrigerator groups for Australia and New Zealand. These are the average values for each group.

Table 32: Freezer Volume and Energy Comparison Between Australian and New Zealand by Group

Group	6U	6C	7
Australia Adjusted Volume (L)*	181	342	504
New Zealand Adjusted Volume (L)*	197	464	412
Australia Energy (kWh/yr)	1.66	0.98	1.16
New Zealand Energy (kWh/yr)	1.49	0.86	1.26

Note * Adjusted volume values include adjustment for the relevant freezer adjustment factor.

For the purposes of data analysis in this report, the relative energy characteristics of refrigerators and freezer 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

Table 33 below shows the value and number of annual sales of refrigerators and freezers for Australia. Quite clearly, the number and value of sales for both refrigerators and freezers for Australia has increased each year over the past 4 years. These increases have seen steady increases in both the number and value of sales from 2003 to 2006.

Table 33: Value and Number of Annual Sales of Refrigerators and Freezers for Australia

	2003	Value ($)	2004	Value ($)	2005	Value ($)	2006	Value ($)
	Units	**('000)**	**Units**	**('000)**	**Units**	**('000)**	**Units**	**('000)**
Refrigerators	539,673	553,168	625,403	629,947	648,594	669,537	683,009	701,743
Freezers	102,538	67,975	131,046	79,360	153,264	86,468	175,208	93,862

Source: GfK data sets

Table 34 below shows the number of annual sales of refrigerators and freezers for New Zealand. The annual sales of freezers appear to be increasing each year from 2004 to 2006, whereas the sales of refrigerators have fluctuated suggesting that they are stable or slightly increasing. The sales value or average price of these annual sales was not available for New Zealand. It can be seen that the overall market for refrigerators and freezers in New Zealand is only about a 1/6 of the size of the Australian market for each of these two appliance types.

Table 34: Number of Annual Sales of Refrigerators and Freezers for New Zealand

	2004 – Units	2005 - Units	2006 - Units
Refrigerators	141,439	154,768	148,910
Freezers	20,697	26,710	32,562

Source: EECA

Analysis of GfK data from 1993 to 2006 has shown that the average price of a new refrigerator in Australia has increased slightly at +0.9% per annum in nominal terms (ie uncorrected for CPI changes) (EES, 2006a). However, this price change needs to be understood in term of the historical change in mix of refrigerator groups over that time. If the price trends within each group are examined, the nominal price has generally been strongly declining within each group. This decline is even stronger once prices have been corrected for the Consumer Price Index (CPI) (ABS 2001, ABS 2007).

In 1993 the sales of manual defrost and frost free products were roughly equal in Australia. Since that time Group 4 and Group 3 have largely disappeared, being replaced by larger and generally more expensive frost free products. Once historical prices are corrected for CPI, the real average price of all refrigerators has been falling at -1.7% per annum. So the trend towards slightly larger and more sophisticated and expensive models (frost free products) has masked the underlying price decreased for most groups (for example Group 5T prices in Australia have declined at an average of 5% pa from 1993 to 2006 in real terms). Appendix 3 outlines the nominal versus real prices for all refrigerator groups.

In the case of freezers, nominal prices have been roughly steady over the period 1993 to 2006. Once CPI corrections are made, the real price of freezers has declined by 3% per annum over the same period. Appendix 4 outlines the nominal versus real prices for all freezer groups.

Table 35 below shows the country of origin of sales for refrigerators and freezers for Australia in 2006. Over three quarters of the Australian market is supplied from four countries; Australia, Korea, China and the USA. These four countries all contribute above 10% of market share, with Australia having almost a quarter of the share. Five countries contribute less than 10% of the market share, with a multitude of countries supplying less than 1% (these have been aggregated into Other).

Table 35: Country of Origin of 2006 Sales for Refrigerators and Freezers for Australia

Country	Share of Market for 2006 (% of total market)
Australia	24.4
Korea	20.2
China	17.7
USA	13.2
Thailand	6.1
New Zealand	6.0
Mexico	4.1
Brazil	2.4
Germany	1.8
Other	4.1

Table 36 below the country of origin of sales for refrigerators and freezers for New Zealand in 2006. Almost half of the market is made up units supplied from Australia, with Korea and China contributing a little over 10% each. Seven countries supply less than 10% of the market, with a number of countries contributing less than 1% (aggregated into Other). It should be noted that the sole New Zealand manufacturer (Fisher & Paykel) also has factories in Australia.

Table 36: Country of Origin of 2006 Sales for Refrigerators and Freezers for New Zealand

Country	Share of Market for 2006 (% of total market)
Australia	46.0
Korea	10.8
China	10.3
Slovenia	7.0
Thailand	6.7
New Zealand	6.0
Denmark	4.3
USA	3.4
Brazil	1.9
Mexico	1.4
Other	2.1

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 run, 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. Consumers engage in a two stage buying process for appliances. In the first stage they assess a number of aspect of an appliance such as will the appliance fit the available space, does it have sufficient capacity for the task, do they like the features, design, colour 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 refrigerators and freezers in late 1986 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 household refrigerators and freezers, and the other products to which labelling applies (dishwashers, clothes washers, clothes dryers and air conditioners).

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 (as kWh per year) 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 refrigerator or freezer and the energy cost over the product's life is often 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 refrigeration product types and groups. In 2000, a more complex system was introduced under which refrigerators were classified into 5 categories, each with a distinct algorithm for the determination of individual star ratings. These were broadly aligned with the MEPS levels introduced in 1999, which were used to set the minimum 1 star rating for some product groups (similar groups were bundled into a single star rating category).

MEPS were first introduced for refrigeration products in 1999, with the aim of taking the less efficient products off the marketplace. More stringent MEPS levels were introduced in 2005. In 2003 New Zealand introduced a mandatory MEPS scheme that aligned with the existing program. Although the MEPS levels are were not formally related to the number of stars on the energy label, the introduction of more stringent MEPS level removed many products with a lower star ratings from the market (EES, 2007). This narrowed the range of ratings that buyers encountered during their search. New Zealand first introduced MEPS and labelling for refrigerators and freezers in 2002.

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 prior to their sale. 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).

Applications for registration may be made on paper or electronically on the website 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. (For refrigerators and freezers, three samples of each model have to be tested)
- A declaration that the that the product meets all relevant performance requirements.

- A sample label (if applicable).
- A declaration that the product meets MEPS requirements (if applicable).
- 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.
- 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.
- 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.

Regulatory Instrument AS/NZS 4474 – 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 refrigerators and freezers, Part 1 and 2 of AS/NZS4474 was first published in 1997. Part 2 contained the then existing energy labelling algorithm (first adopted in 1986) and the MEPS levels that were to be introduced in 1999. Part 2 was revised in 2000 (new label and algorithm) and again in 2001 (to include 2005 MEPS levels).

A revised Part 1 test method was published on 15 August 2007. Amendment 4 to Part 2 was published in parallel with the new Part 1 and it contains a number of changes to complement the new test method and to allow its immediate use for energy labelling and MEPS registrations.

A revision of Part 2 containing the revised energy labelling algorithm, label design changes and transition arrangements will be prepared and published in late 2007 or early 2008, subject to the satisfactory completion of the RIS process following this cost-benefit analysis.

Membership of EL15/23

Standard AS/NZS 4474 comes under the jurisdiction of Standards Australia committee; EL 15/23. As with all standards committee constituted under Standards Australia, EL15/23 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.

EL15/23 originated as committee ME-023 in the 1980's (reflecting the mechanical origin of early refrigeration products) and this was placed under the coordination of EL-015 (household appliances) in the mid 1990's as EL15/23 as part of the committee restructure for government regulation. EL15/23 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 EL15/23 documents and are permitted a courtesy vote on any ballot).

As required under Standards Australia rules, all proposed standards 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 Australian Greenhouse Office (on behalf of E3) exists requires E3 approval prior to the publication of any specified “Part 2” regulatory standard.

2.6.2 Consultation

Since 2003, EL15/23 and its test method working group have been developing a revision of AS/NZS4474.1. The test method was originally published in 1997 and a number of issues needed to be addressed in terms of new configurations and technologies, particularly electronic controls.

The test method was issued for public comment as DR06500 in August 2006. While the number of changes were substantial, the basic approach of the test method and the results were expected to be equivalent to the published standard. The main issues were to deal with new technology and configurations and to close a number of loopholes where cheating appeared to be apparent.

There were a substantial number of public comments on the draft, but the majority of these were editorial or minor in nature. However, some significant issues were raised. At its meeting in November 2006, EL15/23 considered all of the public comments and prepared a revised public comment draft which was released on 20 March 2007 as a combined procedure (parallel voting and comment) – DR07173CP. This closed on 1 May 2007. EL15/23 decided to release the test method for a second round of comment as some new requirements to thwart circumvention (cheating) were included and a fundamental change to one parameter – temperature determination period – was also made.

Under the published standard AS/NZS4474.1-1997, the temperature in a compartment was determined over the stable 3 hour period prior to a defrost. However, the energy consumption was measured over a whole defrost cycle. It has become obvious in recent years that some manufacturers were programming controls to reduce energy consumption by maintaining warmer temperatures outside of the temperature determination period. Apart from under-stating energy use, this has some potentially dangerous consequences – extended periods of warm temperatures inside the refrigerator can result in degradation of food quality and possible growth of pathogens. While some revision were introduced in an attempt to stop these practices, these have not been entirely successful.

The 3-hour temperature determination period was a hangover from a period when temperatures were manually determined from chart readings. Collection of data at 1-minute intervals (or less) is now mandatory, so the use of a 3-hour period is now irrelevant. It is proposed to change the test method to make the temperature determination period the same as the energy determination period (ie from the start of a defrost event until the start of the next defrost event in most cases).

This approach has several advantages:

- It is simple – the energy determination period is well defined and a simple average over the same period means there is less chance of numerical mistakes.

- It almost completely removes any incentive for manufacturers to design products that to operate at warm temperatures for extended periods (even though these may meet the new temperature performance requirements) as the whole control cycle is used to determine the average temperature.
- It provides a strong incentive for manufacturers to limit temperature rise in compartments during the defrost operation, which is good for food quality.
- It gives some advantage to products that pre-cool prior to a defrost in order to limit temperature rises during defrost, which is also good for food quality.
- It aligns with the likely approach that will be adopted in the new international test method which is being developed by IEC.

The only potential disadvantage is that compartment temperatures determined under the existing test method AS/NZS4474.1-1997 may be slightly different to those determined under the proposed revision. The impact is generally small but varies at the individual product level, making some retesting necessary.

This change in the temperature determination period does not impact on the actual testing of products – it is purely a change in the post test evaluation of the data. If the original 1-minute data for products previously tested can be retrieved, the values can be recalculated under the proposed revisions (in most cases) without the need to retest.

A detailed separate discussion paper quantifies the impact of the test method change on energy consumption (EES 2007a). The paper concludes that the energy consumption impact was about 1% for Group 5T Group 7 and less for Group 5B and 5S. While adjustments to the MEPS levels are recommended, no change to the star rating equations is proposed as a result.

2.6.3 Keeping the Energy Label Relevant

The continuing impact of the energy rating label as a driver of increasing energy efficiency for the refrigerator and freezer 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 the more efficient of their options;
- Sufficient space at the top of the energy rating scale so that suppliers can exploit the commercial value of introducing more efficient products;
- 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 refrigerators and freezers as early as 2003 in anticipation of 2005 MEPS. Many of the lower efficiency products were eliminated in January 2005 with the introduction of these new stringent MEPS levels. There are now no 1 or 1.5 star products on the market in any Group. During 2006 E3 agreed that the introduction of a new energy label algorithm should be delayed until 2009 following discussions with industry.

The main project aim is for an energy labelling proposal for refrigerators and freezers 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 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. Re-scaling was recommended at this point, but no action was taken (GWA, 1991).

When MEPS was introduced in 1999, it eliminated the least efficient and lowest rated refrigerator and freezer products from the market. This in turn made the clustering of stars at top of the energy rating scale even more pronounced. A general re-scaling for all labelled appliances was proposed in 1999 and implemented in 2000. When energy labelling was first introduced, there was one algorithm for all groups. In the re-scaling done in 2000, this algorithm was rewritten and adjusted in five different algorithms, as follows (see Table 26 for a full description of each group):

- Group 1 (all refrigerator)
- Group 2, 3 (refrigerators with short term freezer)
- Groups 4, 5 – split into Group 5B, 5S and 5T (covering manual defrost and frost free products and all freezer configurations for refrigerator- freezers)
- Group 6C (chest freezer)
- Group 6U, 7 (vertical freezers – manual defrost and frost free)

This split by group better reflected the different configurations of refrigerators and freezer and similarities in energy service functions (GWA, 2001).

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. Conversely, if there were only labelling, there would be nothing to stop the ongoing supply of low star rating and low efficiency products to the segments of the market that are not sensitive to lifetime operating costs.

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 again since the implementation of MEPS 2005; this can be seen in the below figures. Figure 13 shows the national sales distribution by star rating for refrigerators. It can be seen that the majority of the market for 2006, a little over 80%, was 3 and 4 star models. This contrasts quite starkly with the sales distribution for 2002, with the majority of sales for this year being of 2 and 3 star models.

Figure 13: National Sales Distribution by Star Rating - Refrigerators

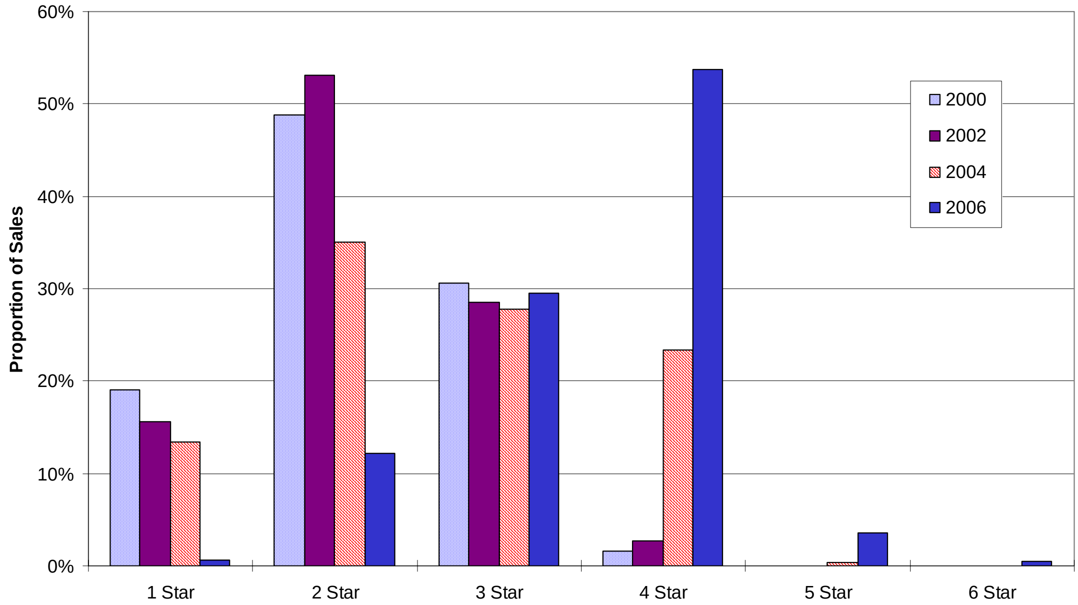


Figure 14 shows the national sales distribution by star rating for freezers. It can be seen that the majority of the market for 2006, around 65%, was 3 and 4 star models. This contrasts quite starkly with the sales distribution for 2002, with the majority of sales for this year being of 1 and 2 star models. This change primarily being due to the effect of MEPS taking out the least efficient products.

Figure 14: National Sales Distribution by Star Rating – Freezers

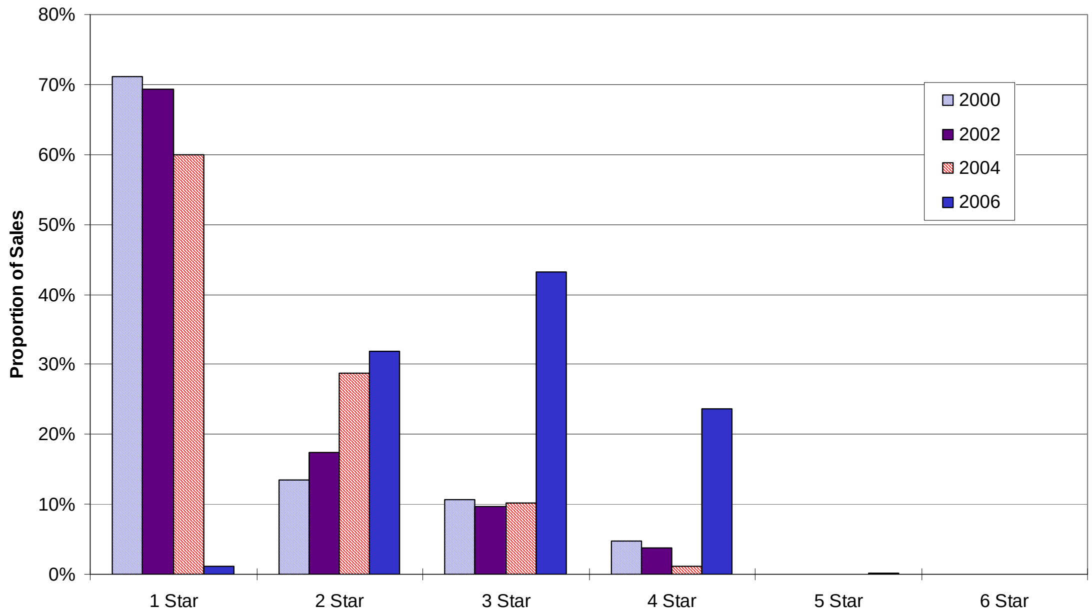


Figure 15 shows the distribution of the current star rating algorithm for August 2007 Groups 5B, 5S and 5T approved registrations, which includes listings in New Zealand. It can be seen that although the distribution varies according to group, the majority of approved registrations are for 3.5 and 4 star models. Figure 16 shows the distribution of the current star rating algorithm for August 2007 Groups 1, 2, 3 and 4 approved registrations. It can be seen that the distribution varies according to group, with the majority of Groups 2 and 3 being equal or less than 3 stars and the majority of Groups 1 and 4 being equal to or greater than 3.5 stars. Figure 17 shows the distribution of the current star rating algorithm for August 2007 Groups 6C, 6U and 7 approved registrations. It can be seen that the distribution varies according to group, with the majority of Groups 6C being equal or less than 3 stars, and Groups 6U and 7 being spread between 3 and 5.5 stars.

Figure 15: Distribution of 2000 Star Rating for August 2007 Group 5B, 5S and 5T Approved Registrations

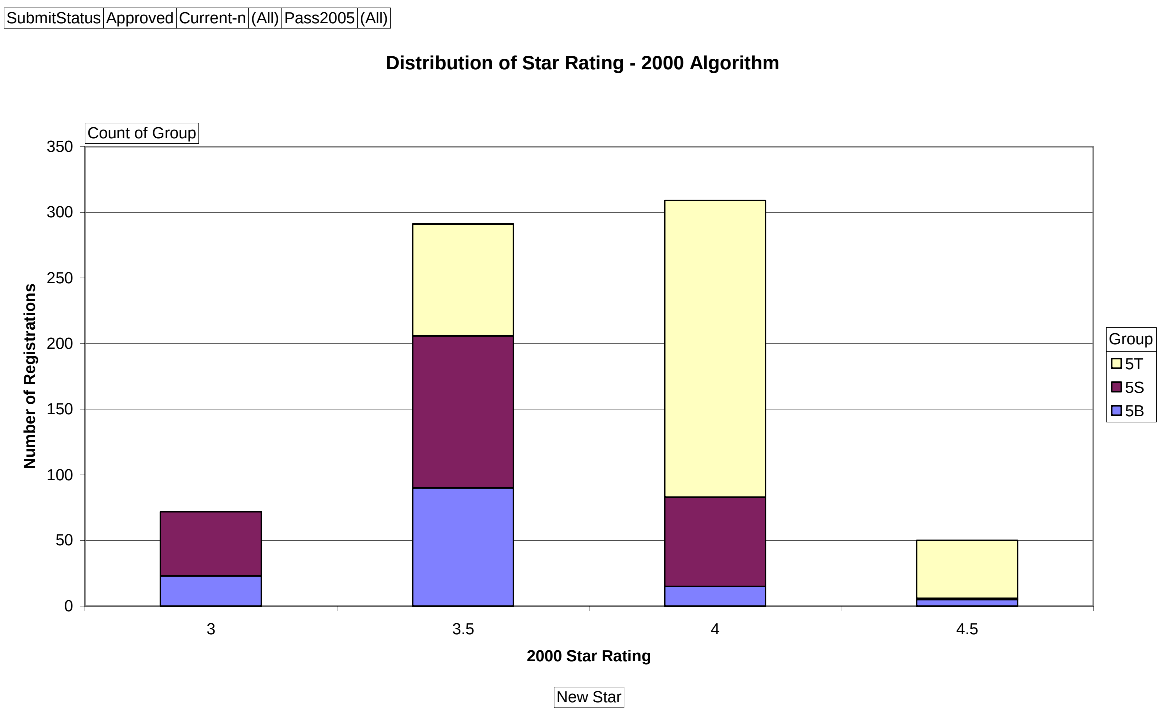


Figure 16: Distribution of 2000 Star Rating for August 2007 Group 1, 2, 3 and 4 Approved Registrations

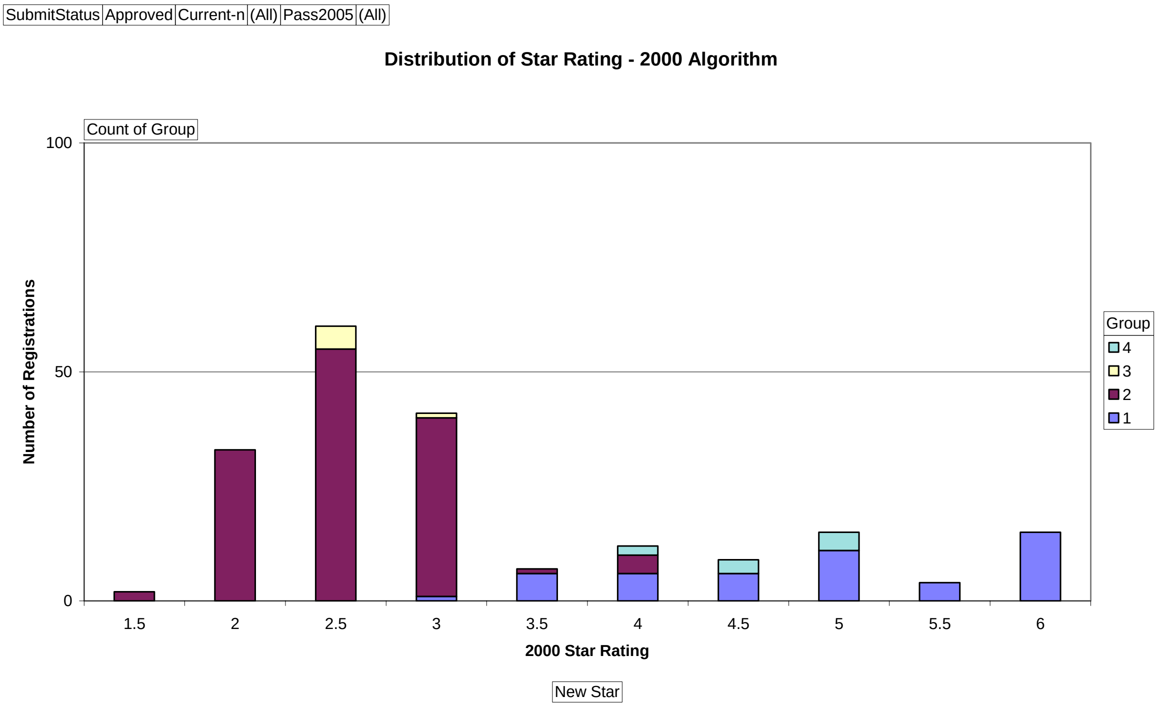
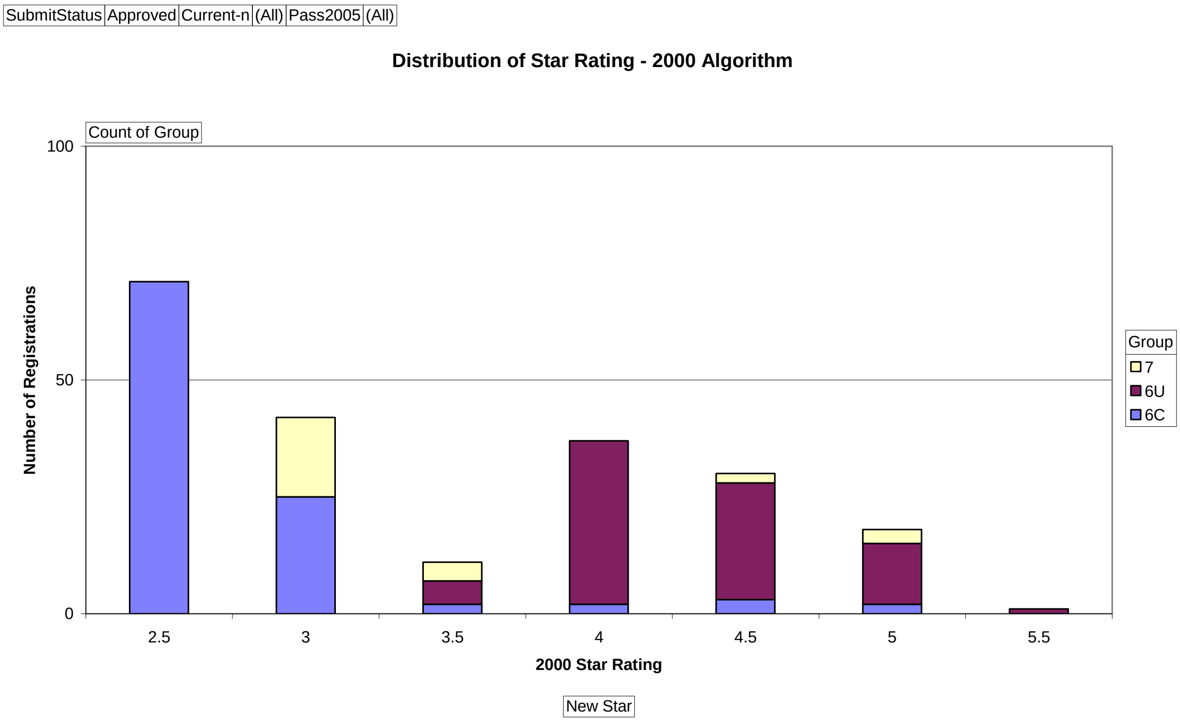


Figure 17: Distribution of 2000 Star Rating for August 2007 Group 6C, 6U and 7 Approved Registrations



With the rapid increase in average refrigerator and freezer efficiency in 2004 and 2005 due to MEPS, the ratio of lower star-rated products on the market has fallen, and the most common rating facing customers is now 4 stars. 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.

There is not likely to be a review of MEPS levels for many years, so the labelling program has become the driver for further improvements in energy efficiency in the refrigerator and freezer markets. This makes it important to maximise its impact from an energy and greenhouse policy perspective.

As in 2000, re-scaling is again 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 2009, so this would be about nine years between 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.

2.7 Proposed Changes to AS/NZS4474

2.7.1 Proposed Changes to Regulatory Standard AS/NZS4474.2

AS/NZS4474.2-2001 Amendment 4 was published in August 2007 in parallel with the new Part 1. The main changes are a number of consequential changes associated with the new Part 1, mostly to permit the new standard to be used immediately, as well as a number of minor corrections. There are also some clarifications to the scope of products covered, although this is not regarded as a technical change[3]. There are some provisions regarding an energy penalty in the energy label Comparative Energy Consumption (CEC) where anti-circumvention controls have been detected during testing. It also deals with energy labelling for products that could fall into more than one group (eg through options for compartment temperature control). A revised registration application form is also included.

It is proposed to issue a revised edition of AS/NZS4474.2 in early 2008, once this cost-benefit analysis and the subsequent RIS process has been completed and released.

This will include:

- new energy label design
- new energy label algorithms

[3] In the previous edition of the standard, the scope of products covered by energy labelling and MEPS was specified through a combination of requirements in both the Part 1 and Part 2 standards. In the 2007 revision of Part 1 and Amendment 4 to Part 2, the scope of products covered by MEPS and labelling was consolidated into Part 2 only. Certain sorts of products are now explicitly excluded from the Part 2 scope (such as small portable products and small products where a cooling is a secondary function).

- transition arrangements for the new energy label
- a change in the definition of MEPS from a model average energy (in the current edition) to a maximum permitted energy for any model
- any adjustment to MEPS results that may result from the change to the test method in AS/NZS4474.1-2007 (see EES, 2007a).

The latter two points above are not considered to be within the scope of the analysis in this report as these changes are merely an adjustment of the existing requirements to provide an equivalent MEPS level to those already defined in the published standard. They do not constitute a change to the technical MEPS requirements of the standard. The details of these changes (for inclusion in the Part 2 revision) are being discussed with industry through mid 2007. Separate consultation processes are being conducted for each of these issues.

2.7.2 Changes to Test Method AS/NZS4474.1-2007

The main objective of rescaling is to maintain the effectiveness of the labelling program in influencing consumer choice. However, a change of this type offers other opportunities to make other changes which maintain or enhance the effectiveness of the labelling and MEPS programs in other ways. For example, the new test method, which was published in August 2007, includes measures to minimise the opportunity for suppliers to manipulate the test procedure to their commercial advantage.

The most important elements of the new test procedure are:

- Introduction of a number of anti-circumvention provisions in the test (so product control software cannot be programmed to give a result that is optimised for the test only);
- Changes in how compartment temperatures are measured during test in order to encourage minimisation of temperature rises during defrost.

The revised test method has been prepared on a consensus basis by industry, government and consumer groups and there is strong bipartisan support for its implementation as soon as practicable.

In order minimise total costs to both industry and government, it is proposed to make testing to AS/NZS4474.1-2007 a prerequisite for products that carry the re-scaled energy label in 2009. This effectively means that all products will need to be tested to the revised test method by October 2009 for models that are continuing beyond that date.

The proposed changes may lead some suppliers to choose to revise the energy test results they have registered for labelling and, in a very few cases, to remove models from the market. All refrigerator and freezer models will need to be re-registered to the new test method by 2009. This re-registration process will require suppliers to meet the changes, with any models that do not meet the new requirements to be grandfathered. As the new test method will be available for use on publication, the transition costs associated with the introduction of the new test method are minimised.

In order to minimise inconvenience and costs to industry, it is proposed to bundle the transition to the new test method with the introduction of the new energy label in 2009.

So a test report to AS/NZS4474.1-2007 would be a mandatory requirement for registrations for the new energy label.

The new test method is being accepted by regulators on a voluntary basis and manufacturers are strongly encouraged to use the new test method for new models. This will further reduce the need for any retesting during the transition to the new energy label in 2009.

3. The Proposed Regulation and its Objectives

3.1 Objective

The primary objectives are to minimise the social costs (economic and environmental) of supplying and consuming household refrigeration 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. The objectives of the proposal are to maintain the continuing impact of the energy rating label as a driver of increasing energy efficiency for the refrigerator and freezer market by:

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

3.1.1 Assessment Criteria

The primary assessment criteria are the comparison of the projected costs and the projected benefits.

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?

3.2 Proposed Regulation

3.2.1 The Proposal

To revise AS/NZS 4474.2 as follows:

1. Change energy labelling algorithms for refrigerator and freezers to the new equations documented in this report. This will result in the loss of approximately 2 stars for most models and groups, which is intended to maintain the value of the stars on the energy label as a selection aid for refrigerator and freezer 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 transition to the new label is to occur over the period October 2008 to October 2009 with all new products by October 2009 to carry the new label.
2. Incorporate the revised test method 4474.1-2007 as a prerequisite for registration or listing of products that use the new energy label.

Table 37 below sets out the star rating of the 1130 products currently registered to MEPS 2005 in Australia and New Zealand under the 2000 energy labelling algorithm as at August 2007. The coloured cells show (approximately) the MEPS levels for that particular group. Red cells show that that star rating is below the MEPS level and yellow cells show that some products for these star ratings are affected by MEPS (depending on the size). Cells that have no colour are for star ratings that are better than the MEPS levels, indicating (comparatively) efficient products. The colours in the top row of cells containing the Group number show the groups that under the 2000 algorithm use the same star rating equations (ie Groups 2 and 3 have the same algorithm, whereas Group 6C is different from all others).

The main point is that MEPS 2005 has made the 2000 energy labelling algorithms fairly redundant and there is now a need to revise these to make them more relevant. MEPS also appears to have had a strong impact on the available products on the market (energy range is narrow) and many lie along the relevant MEPS lines.

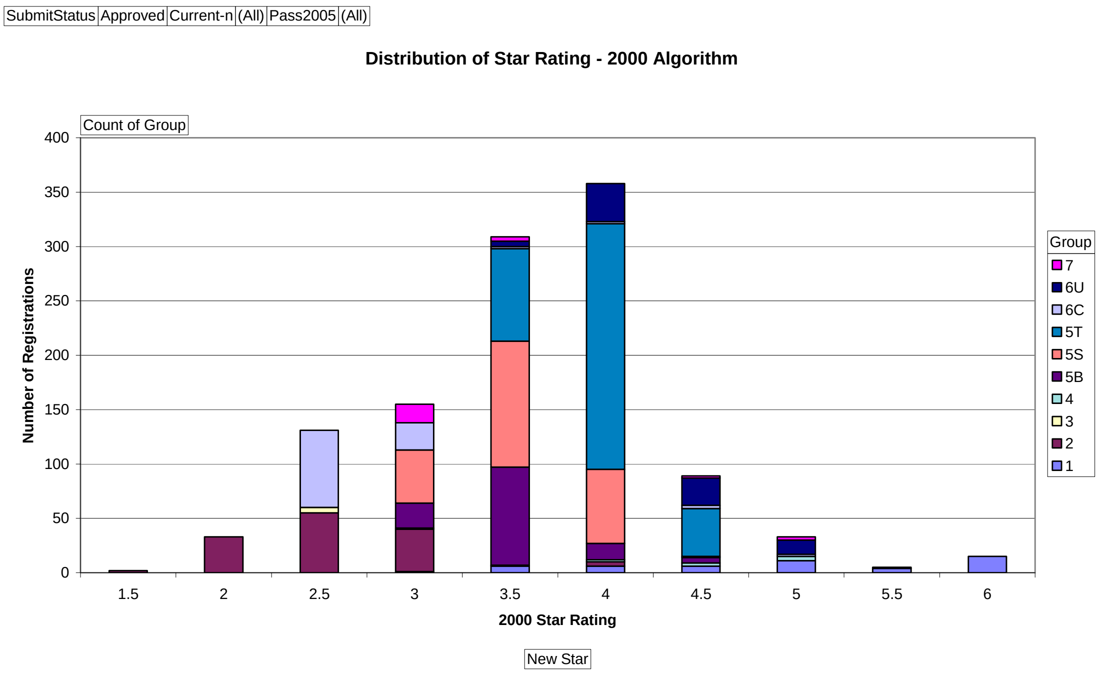
Table 37: Group by Star Rating for August 2007 Approved Registrations

Group → 2000 Stars ↓	Group 1 (% / star)	Group 2 (%/ star)	Group 3 (%/ star)	Group 4 (%/ star)	Group 5B (%/ star)	Group 5S (%/ star)	Group 5T (%/ star)	Group 6C (%/ star)	Group 6U (%/ star)	Group 7 (%/ star)	Total (%/ star)
Approved Registrations (August 2007)											
Total (number)	**49**	**134**	**6**	**9**	**133**	**234**	**355**	**105**	**79**	**26**	**1130**
1											**0**
1.5		2									**2**
2		33									**33**
2.5		55	5					71			**131**
3	1	39	1		23	49		25		17	**155**
3.5	6	1			90	116	85	2	5	4	**309**
4	6	4		2	15	68	226	2	35		**358**
4.5	6			3	5	1	44	3	25	2	**89**
5	11			4				2	13	3	**33**
5.5	4								1		**5**
6	15										**15**
Models Sold in Australia, 2006											
Total ('000)	**57**	**117**	**47**	**0**	**121**	**140**	**479**	**103**	**87**	**41**	**1193**
1								0.1		1.5	**1.7**
1.5		5.4								1.1	**6.5**
2		22.9				0.1	0.3				**23.4**
2.5		45.4	47.2			0.1	1.4	73.4	0.1		**167.6**
3		42.6			0.8	12.4	1.7	13.7		29.7	**101.1**
3.5	3.2				78.3	61.2	83.6	15.5	32.0	8.6	**282.5**
4	1.9	0.6			41.5	63.4	311.7		28.2		**447.3**
4.5	13.6			0.1	0.7	3.1	80.0		26.3		**123.7**
5	26.4								0.1	0.1	**26.5**
5.5	7.4										**7.4**
6	4.8										**4.8**
Models Sold in New Zealand, 2006											
Total ('000)	**9**	**22**	**0**	**0**	**63**	**11**	**42**	**23**	**1**	**8**	**181**
1		1.3				0.6		0.1			**2.0**
1.5		0.2					0.3	0.2		0.1	**0.8**
2		2.6			1.1		6.1	0.4			**10.3**
2.5		15.8	0.3	0.1		0.1	0.0	17.5	0.2		**34.0**
3		2.6			4.6	2.5	0.2	5.0		7.0	**21.9**
3.5	0.2				56.0	3.7	5.7			0.5	**66.1**
4	1.5				1.6	4.1	29.5		0.1	0.0	**36.8**
4.5	2.3			0.1			0.3			0.4	**3.1**
5	2.5								0.8		**3.4**
5.5	2.0										**2.0**
6	0.1										**0.1**

Note: Groups with a common algorithm have the same colour in the first row. Red cells indicate that the star rating is below the MEPS level. Yellow cells indicate that the star rating is within the MEPS level. Clear cells indicate that the star rating is far above the MEPS level. The Group 2 units in the red area are just below 2 stars and passes MEPS by about 1 kWh.

It is important to note that the 1 star, 1.5 star and 2 star bins are empty for virtually all groups. The only products with a star rating of 2 stars is Group 2. Group 1 has a relatively weak algorithm so low energy products now achieve very high star ratings. The distribution by stars and group is show in Figure 18 below.

Figure 18: Distribution of 2000 Star Rating by Group for August 2007 Approved Registrations



The most complex issue to consider for refrigerators and freezer is whether to continue to rate products in sub-groups (continuation of the so called “splitting” of groups for energy labelling which was introduced in 2000) or whether to develop a more integrated labelling approach which can be applied across different groups (more of a “lumping” approach which is similar to the original labelling algorithm in 1986 which had a single set of equations for all Groups) while incorporating all of the improved features of the 2000 labelling system. After extensive analysis and careful consideration, a set of three rating equations which cover all product groups appears to be most feasible and workable. This is a reduction from five categories in 2000, but most will facilitate comparisons across a range of product types and sizes.

In 2005 the E3 Stakeholder Working Group considered a selection of possible energy labelling algorithm options during the development of the original discussion paper. The one agreed to be most promising was depicted in the original discussion paper as so called Option 14, which was a single equations for all Groups. While this algorithm offered some advantages over the existing algorithms and seemed to provide a broad fit against the range of current products on the market, its non-alignment with many of the MEPS lines presented a serious longer term problem for the star rating system and for a high efficiency scheme such as Energy Star which needs to link with the star rating system.

After further discussions between EECA (Energy Efficiency and Conservation Authority, NZ) and the AGO (Australian Greenhouse Office) in mid 2007, extensive work and analysis was undertaken to develop new star rating algorithms to redress some of these issues. The new approach provides three separate equations which each cover specific collections of groups.

The fundamental principle of the new algorithm developed was to move from a system that was based on adjusted volume to one that is based on a de facto measure of the surface area of the cabinet. This should better represent the key driving factor for energy consumption of refrigerators. In geometrical terms, for simple rectangular prisms it can be shown that the relationship between surface area and volume is that surface area is proportional to volume to the power of 2/3. This is the factor that has been adopted as the basis for the new algorithms.

Three new algorithms were developed to cover products that were similar in design, function and operation as follows:

- Algorithm 1: Groups 1, 2 and 3 (typically single door, simple design);
- Algorithm 2: Groups 4, 5T, 5B and 5S (two door refrigerator-freezers);
- Algorithm 3: Groups 6U, 6C and 7 (separate freezers – all types).

The equations were developed to fit the products currently available on the market. For all three algorithms, the energy reduction per additional star is set to be the same as the energy reduction under the 2000 labelling algorithm for groups 4, 5T, 5B and 5S (ie ERF = 0.23, or 23% per additional star or 12.25% per additional half star).

Figure 19 below shows the energy labelling Algorithm 1 (Option 30) for refrigerator groups 1, 2 and 3.

Figure 19: Algorithm 1: 2009 Energy Labelling Algorithm for Refrigerator Groups 1, 2 and 3 (Option 30)

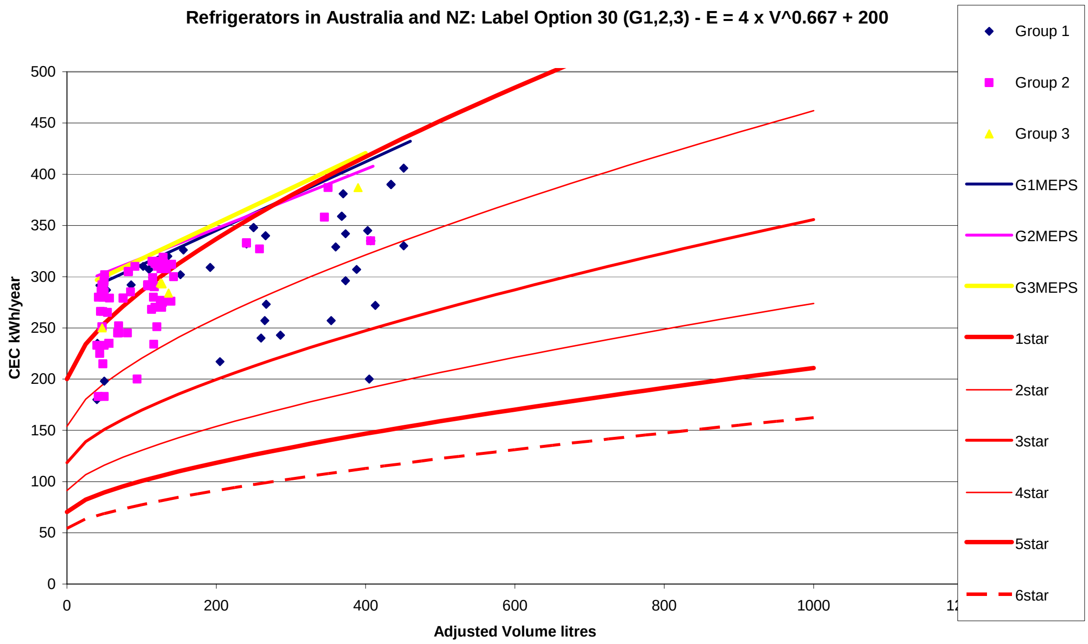
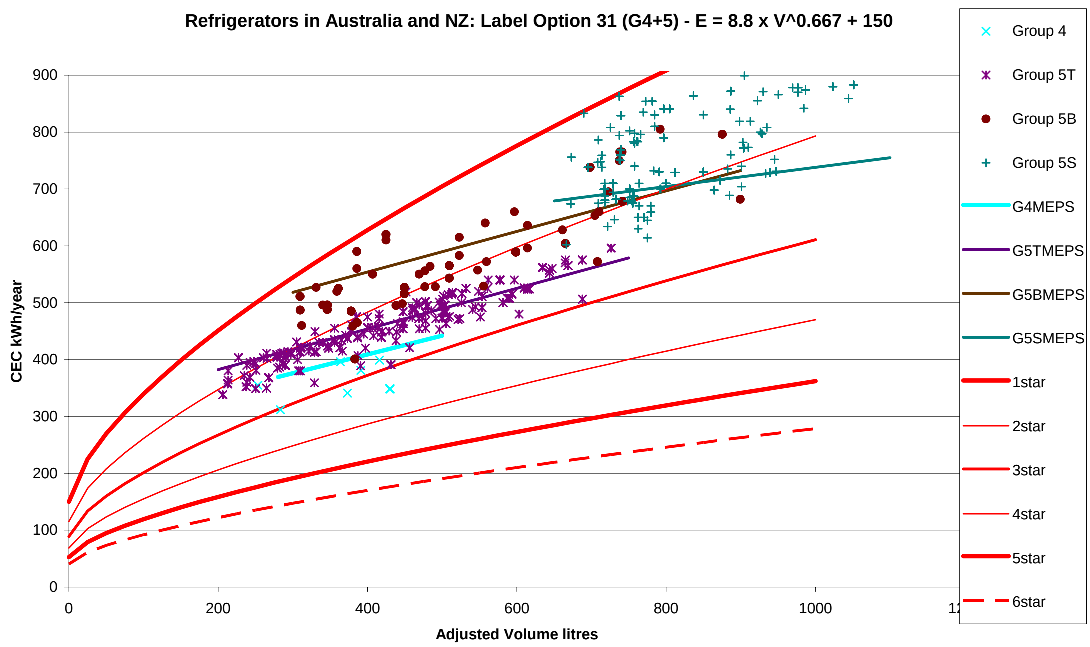


Figure 20 below shows the energy labelling Algorithm 2 (Option 31) for refrigerator groups 4, 5B, 5T and 5S.

Figure 20: Algorithm 2: 2009 Energy Labelling Algorithm for Refrigerator Groups 4, 5B, 5T and 5S (Option 31)

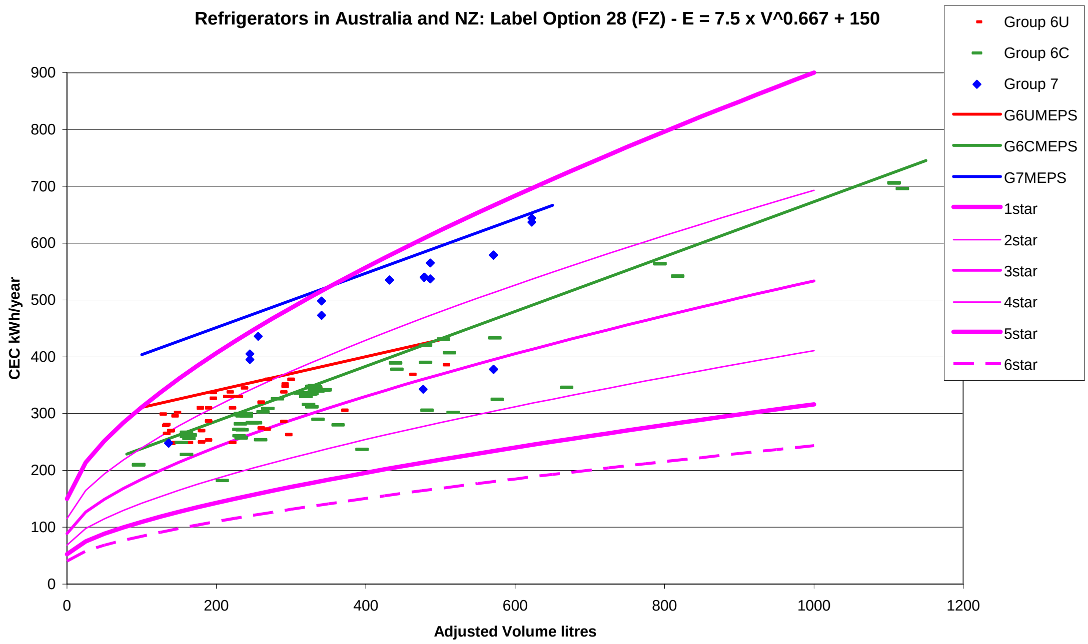


For refrigerators, these new algorithms have the following advantages:

- They appear to provide the basis for reasonable differentiation across different Groups and different size ranges and also within Groups.
- All products achieve a star rating of better than 1 star, except for very small Group 2 products which are by and large simple and in most cases very low efficiency (for their size). MEPS levels for these products are relatively weak as they are based on straight lines with a reasonable large fixed intercept.
- Most products lie in the range 1 star to 3 stars under the new system, but there are a significant number of models in several groups that already achieve 3 stars.
- The surface area function developed appears to provide a sound basis for describing the energy consumption of products across a very wide size range.
- The equations to determine the star rating appear to provide a fair basis for comparative energy efficiency and they simplify the requirements for energy labelling of refrigerators which allows a comparison of efficiency across comparable groups.
- These algorithms provide a sound basis for the development of future high efficiency criteria such as Energy Star. While there is some mismatch between the star rating lines and MEPS lines, the inherent energy consumption trends of many products appear to track the proposed star rating lines in most groups.

Figure 21 below shows the energy labelling Algorithm 3 (Option 28) for freezers.

Figure 21: Algorithm 3: 2009 Energy Labelling Algorithm for Freezers (Option 28)



For freezers, the most salient points are:

- The MEPS requirement for chest freezers is roughly parallel to the (curved) 2 star line.
- There are already some products in all Groups that achieve 3 stars and a few high-end chest freezers that already exceed 4 stars (noting that these have very low energy values and are very efficient).

Further Algorithm Proposal Discussion for Refrigerators and Freezers

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

Conceptually, these algorithms can be seen as one star lines with a fixed energy consumptions at a volume of zero litres plus an additional energy allowances based on the surface area of the refrigerator. This is very similar to the approach for the 2000 algorithms except that instead of straight lines based on adjusted volume, these are now curves based on adjusted volume.

For all groups the equation for the Base Energy Consumption (BEC) is of the form:

$$BEC = a \times (V_{adj})^{b} + c$$

Where:

- *a* is a coefficient which is an indicator of the insulation thickness and the typical compartment geometry
- V_{adj} is the adjusted volume as defined in AS/NZS4474.2 and represents a total volume in terms of fresh food equivalent volume (colder compartments have their volume adjusted up based on the difference in temperature between the compartment and the ambient air temperature)
- *b* is the relationship between volume and surface area, which is 2/3
- *c* is a constant in kWh/year (y intercept on the figures)

Note: The 2000 equations had exactly the same form except that *b* then had a value of 1.

The coefficients for the Base Energy Consumption (1 Star) equations are set out below:

Groups	a	c
1, 2, 3	4	200
4, 5T, 5B, 5S	8.8	150
6U, 6C, 7	7.5	150

The equation for the star rating index in all Algorithms is the same as the 2000 star rating equation:

$$SRI = 1 + \left[\frac{\log_e\left(\frac{CEC}{BEC}\right)}{\log_e(1 - ERF)} \right]$$

Where:

SRI is the star rating index (fractional star rating)

CEC is the comparative energy consumption (energy that appears on the energy label)

BEC is the base energy consumption – the equation for a product with an SRI of 1.0

ERF is the energy reduction factor – reduction in CEC for each additional star (0.23 in all cases for the new algorithms)

More details on the previous star rating algorithms for refrigerators and freezers are provided in Appendix 8.

The following table sets out the star rating of the 1130 products currently registered for MEPS 2005 in Australia and New Zealand as they would be under the proposed 2007 energy labelling Algorithms 1, 2 and 3 (Options 30, 31 and 28 respectively).

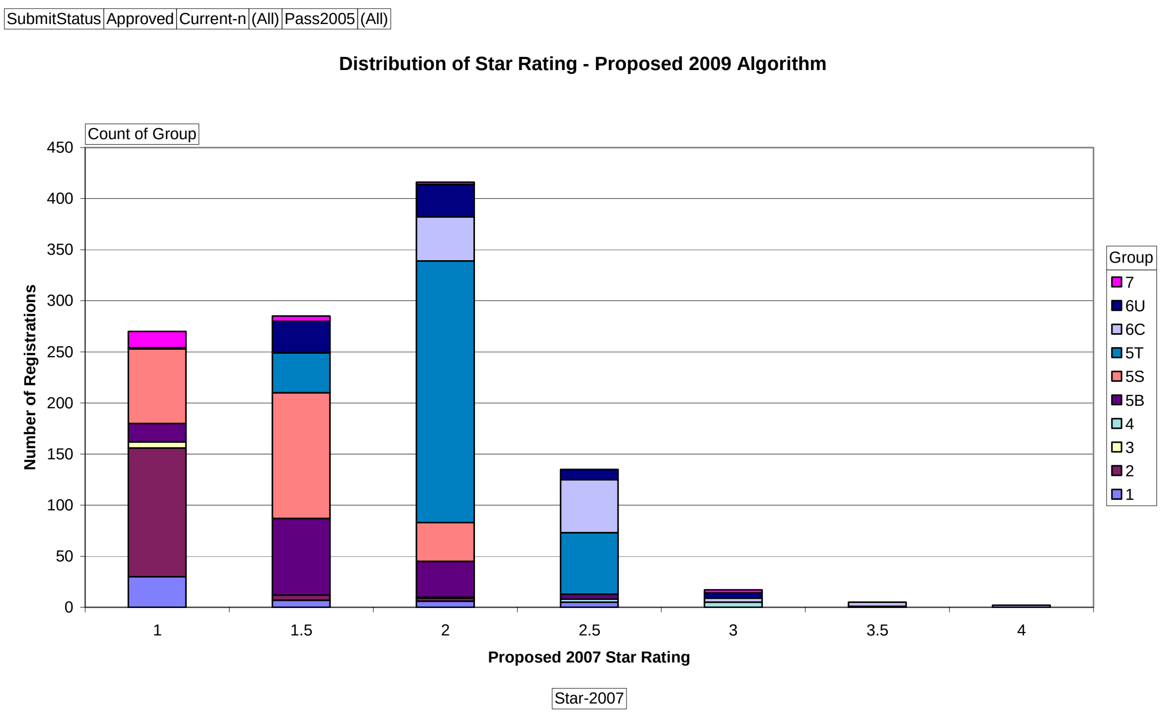
Table 38: Group by 2009 Star Rating for August 2007 Approved Registrations

Group → 2009Stars ↓	1	2	3	4	5B	5S	5T	6C	6U	7	Total
Approved Registrations (August 2007)											
Total (number)	**49**	**134**	**6**	**9**	**133**	**234**	**355**	**105**	**79**	**26**	**1130**
1	30	126	6		18	73			1	16	**270**
1.5	7	5			75	123	39		31	5	**285**
2	6	3		1	35	38	256	43	32	2	**416**
2.5	5			3	5		60	52	10		**135**
3				5				4	5	3	**17**
3.5	1							4			**5**
4								2			**2**
4.5											
5											
5.5											
6											
Models Sold in Australia, 2006											
Total ('000)	**57**	**117**	**47**	**0**	**121**	**140**	**479**	**103**	**87**	**41**	**1193**
1	45.1	109	47.2		1.1	37.9	3.3	0.1	0.1	30.5	**274.5**
1.5	7.4	7.2			47.9	71.0	51.9		41.8	10.4	**237.7**
2	4.7	0.6			72.0	31.4	260	40.0	44.6		**453.2**
2.5	0.1				0.5		163.5	47.1	0.1		**211.3**
3				0.1				15.5		0.1	**15.7**
3.5											
4											
4.5											
5											
5.5											
6											
Models Sold in New Zealand, 2006											
Total ('000)	**9**	**22**	**0**	**0**	**63**	**11**	**42**	**23**	**1**	**8**	**181**
1	6.4	22.4	0.3	0.1	5.7	3.9	6.7	0.1	0.2	7.2	**52.9**
1.5	2.0				18.4	4.7	5.4	0.2	0.1	0.5	**31.3**
2					39.2	2.4	25.3	11.3		0.4	**78.6**
2.5	0.1						4.8	11.7	0.9		**17.5**
3				0.1							**0.1**
3.5								0.1			**0.1**
4											
4.5											
5											
5.5											
6											

Note: Groups with a common algorithm have the same colour in the first row.

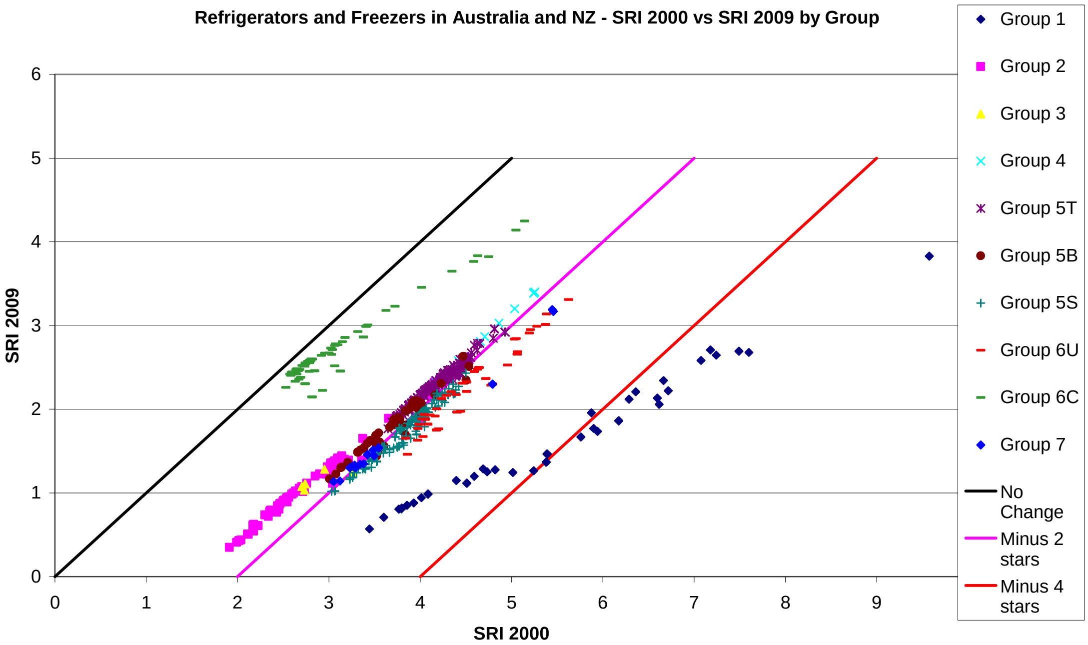
Under this algorithm, the lower star rating bins are filled more evenly, but there are several groups with no 1 star products. These are Group 4 (only a handful of mostly higher end European products remain on the market), Group 5T (very stringent MEPS levels with only a few products at 1.5 stars) and Group 6C (chest freezers, which are an inherently efficient configuration, with the current MEPS level at about 2 stars or above). However, some groups continue to have a small available energy range as a result of MEPS – this is a key issue that this new algorithm is attempting to address. The majority of the 1 and 1.5 star products are Group 2, Groups 5B and 5S. This is not unexpected as Group 5S and 5B are generally higher energy configurations and most of the poorly rating products are well above their respective MEPS levels. The Group 2 products are mostly very small, low cost, simple and inefficient products. The distribution of this proposal is illustrated in Figure 22 below.

Figure 22: Distribution of Star Ratings Under New Star Rating Algorithm in 2009



The new algorithms result in a reduction of about 2 stars for nearly all groups as illustrated in Figure 22 below. The exceptions to this general rule are Group 6C, where the reductions in star rating fall less than 1 star (with new ratings fallings by as little as -0.1 stars to as much as -1.0 stars) and Group 1, where the reduction in star rating is typically 4 stars (with new ratings ranging from -3 stars for lower efficiency products to as much as -5 stars for higher efficiency products). One Group 1 product currently rates 9.5 stars (high end European product) and this is rated almost 4 stars under the new algorithm. It is important to note that the Group 1 algorithm from 2000 was very weak and used an ERF of 0.12 (12% energy reduction per star), which is less than half the ERF in the new proposal. This was by far the lowest ERF of all the groups.

Figure 23: Refrigerators and Freezers in Australia and New Zealand – SRI 2000 vs SRI 2009 by Group



More detailed information on the proposed algorithms is available in EES (2007).

3.2.2 Proposed Transition Arrangements

Revised tests procedures IN AS/NZS4474.1-2007 were published in August 2007 and are have been available for use in the testing and the registration of products for energy labelling and MEPS since mid September 2007. Revised algorithms, label designs, transition procedures and MEPS compliance rules will be published in early 2008 as AS/NZS4474.2-2008 and could be available for use in the registration of products for the new energy label from mid 2008, subject to the agreement of regulators.

The proposed transition arrangements are as follows:

- Products may be registered to the new Part 2 (AS/NZS4474.2-2008) from July 2008, but only on the understanding that these products will not be shipped or put on display with the new label until October 2008.
- From October 2008, products can be supplied shipped or displayed for sale with the new energy label provided that the agreed "transition label" elements are also affixed. From April 2009 products will be able to display the new label with or without the transition wording.

- October 2008 will be the cut off date for new products to be registered using AS/NZS4474.1-1997 (noting that the only permitted registrations using this test method are using the 2000 label – such registrations will be retired by October 2009 in any case) – after this date AS/NZS4474.1-2007 must be used.
- April 2009 will be the cut in date after which all new registrations (and listings) will use AS/NZS4474.2-2008 with the new energy label (noting that registration to previous standards will be retired by October 2009 in any case).
- As of the 1 October 2009, all products not tested to AS/NZS4474.1-2007 or not registered to the new energy label specified in AS/NZS4474.2-2008 will be grandfathered. From this date, all current models will be tested to AS/NZS4474.1-2007 and will be registered to AS/NZS4474.2-2008 (or listed in NZ). Grandfathered products will be on display on the energyrating website for only a limited period after October 2009.

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.

Initial market research has suggested that the most suitable "transition" label would in fact be both the 2000 and 2009 labels on display together on products that are on display. Information on focus group findings is documented in the report by Winton Sustainable Research (2007). Other transition label options are also under consideration. The transition label details will be refined in consultation with industry for inclusion in the new Part 2 regulatory standard.

Impact on Suppliers

If both parts of AS/NZS 4474 are revised and implemented as proposed and the changes are validated in State, Territory and New Zealand MEPS regulations, refrigerator and freezer suppliers will need to take the following steps:

a. For models currently on the market, which would have been retired by October 2009: no impact (given sufficient lead time).

b. For models currently on the market which would normally remain on the market after October 2009, the supplier will have to:

- Estimate the new label rating from the new algorithm (assuming no energy change)
- Decide whether to retain the model on the market after October 2009
- If yes, get a new test report for the product to AS/NZS4474.1-2007 (or recalculate results, if original the data still available)
- Re-register for the new label after July 2008 and before October 2009
- Plan transition arrangements (placement of new labels on products) in collaboration with retailers.

c. For models introduced after the publication of AS/NZS4474.1-2007 and prior to October 2008: conduct registration testing to AS/NZS4474.1-2007 (marginal cost compared to AS/NZS4474.1-1997 is assumed to be negligible) with an energy labelling and MEPS registration to AS/NZS4474.2-2001 (2000 label) and then a re-registration to the new label after October 2008 and before October 2009 (some costs associated with managing two labels).

d. For models to be introduced after October 2008 (or April 2009 if no transition label is used): no impact (given sufficient lead time).

In the cases of c. and d. above, there may be some cases where a supplier elects to test to AS/NZS4474.1-1997 after the publication of AS/NZS4474.1-2007 (August 2007). It is assumed that there is no legitimate reason why a supplier would elect to conduct a new test to an obsolete test method that is known to have a very short validity period, other than to take advantage of a loophole in the test method in order to gain some short term market advantage at the expense of the buyers of those products, who would have to bear the risk of under-stated running costs and higher risk of food spoilage. In these cases, even though there may be subsequent retesting costs, there would also be benefits from removal of these risks to consumers.

There are about 20 to 25 new models entered into the online registration system per month, therefore there are about 250-300 new registrations per year. There are around 1000 models approved in the registration system at the moment for Australia and New Zealand. Based on experience and knowledge of the market, around 250 of these could be regarded as redundant registrations[4]. Of the 750 active models currently on the market, half of them could be expected to be obsolete by October 2009 and the other half could be expected to continue beyond October 2009. Of the 375 continuing models, just over half of them are assumed to require complete re-testing to satisfy the new standard, while the rest are assumed to have the opportunity to reprocess their existing test data.

It is estimated that around 600 new model registrations will use AS/NZS4474.1-2007, and about 60% of these will require re-registration for the new label. The rest would incur no additional costs.

[4] Analysis of 2006 GfK data for all models sold in Australia suggests that in fact there were about 650 active models, but we have used 750 for analysis purposes as there are some NZ only models. 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.

4. Key Assumptions for Analysis

Chapter 4 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 4.1 – Overview.
- Section 4.2 – Modelling Approach and Projected Sales: provides an overview of the modelling approach and estimated future sales generated from the stock model.
- Section 4.3 – Sales Share by Group: analysis of the historical and assumed future group share for refrigerators and freezers in Australia over time.
- Section 4.4 – Ownership Trends: analysis of the historical and assumed future ownership of refrigerators and freezers in Australia over time. It is assumed that the proposal will have no impact on future ownership.
- Section 4.5 – Refrigerator and Freezer Volume Trends: analysis of the historical and assumed future volume trend of refrigerators and freezers in Australia over time. It is assumed that the proposal will have no impact on future product volume.
- Section 4.6 – Energy Consumption Trends: provides an analysis of trends in energy consumption of refrigerators and freezers 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 4.7 – 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 4.8 – Greenhouse Gas Emission Factors: greenhouse gas emission factors for each Australian State and Territory and New Zealand.
- Section 4.9 – Change in Total Stock Energy Consumption as a Result of the Proposal: analysis of the changes to total energy consumption as a result of the proposal.
- Section 4.10 – Change in the 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 4.11 – 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.

4.1 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, and the 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, because there are so many products on the market (close to 1,000 units approved to MEPS 2005) that there is always an option with equivalent capacity and features but with higher efficiency. The performance requirements in AS/NZS4474.1-2007 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 study, 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. 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 report 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.

4.2 Modelling Approach and Projected 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).

Total product sales for refrigerator and freezers have been provided by GfK since 1993 and the results are reported in Greening Whitegoods (EES, 2006). It is important to note that GfK claim to only cover the total market from 2003 and total market sales data has only been provided for 2005 and 2006. Prior to these years, the GfK reported data was somewhat less than the total market (around 70% of refrigerators and about 75% of freezers). However, the models covered are highly representative of average model characteristics sold.

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 16 years was assumed for refrigerators and 20 years for freezers. 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 HEEP project in NZ found that an average refrigerator was 14 years old and an average freezer was 19 years old (based on a stock sample), which is very close to the values assumed for modelling in this study (BRANZ 2007a). Small differences in assumed product life have only very small effects on the rate of change of key attributes such as energy efficiency.

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 24: Schematic Representation of the Stock Model

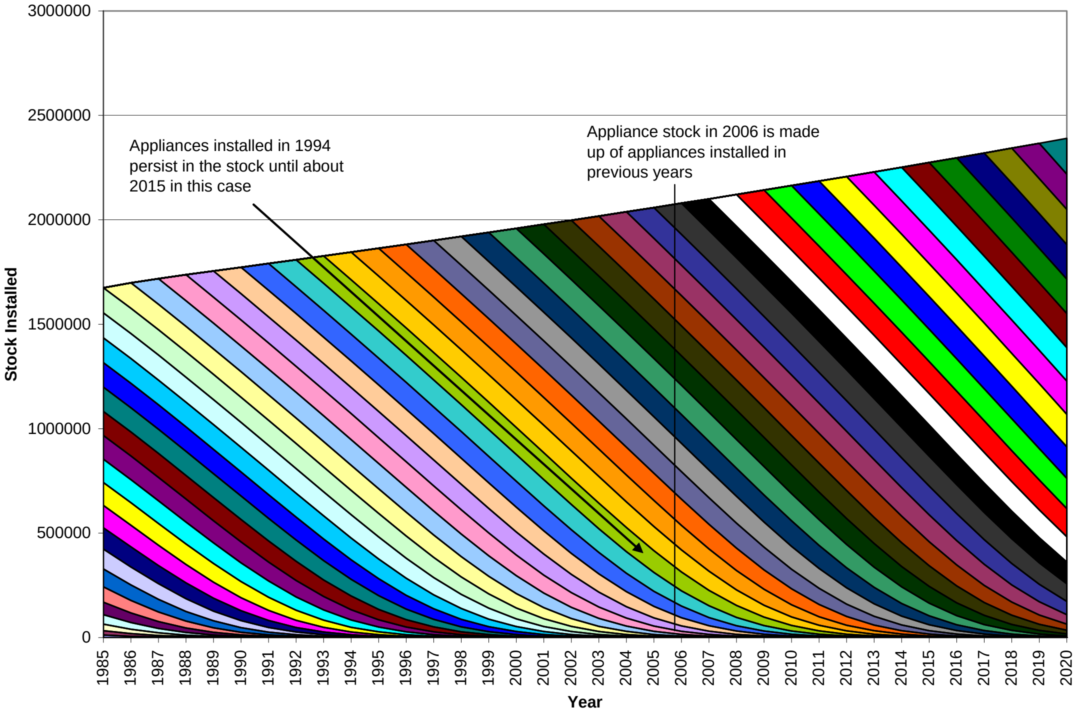
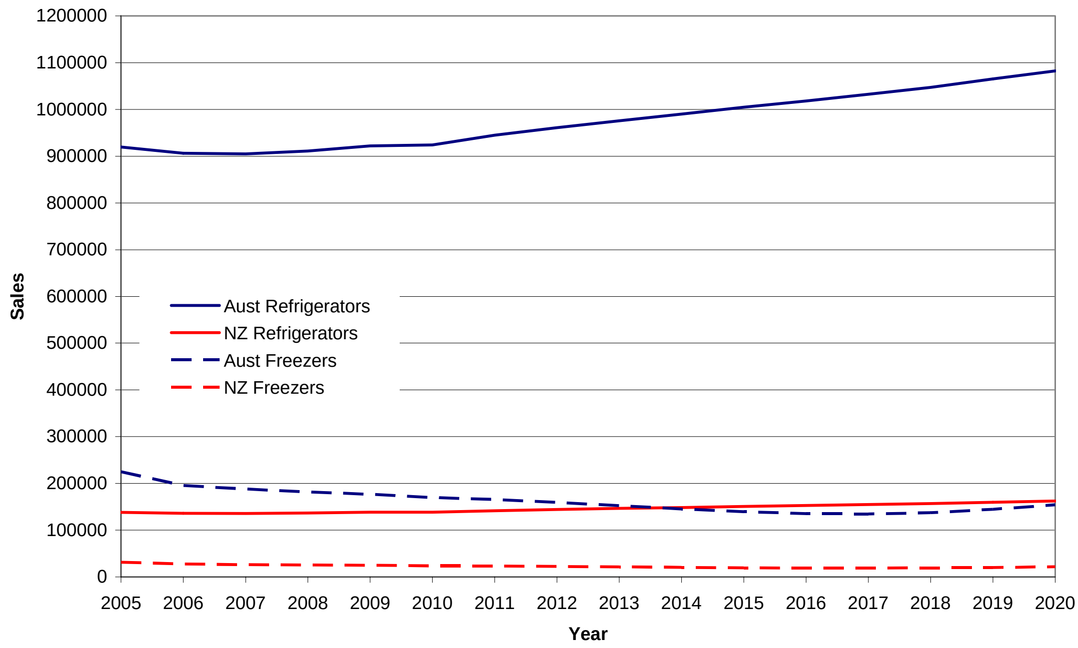


Figure 25: Projected sales of Refrigerators and Freezer, Australia and New Zealand



The projected sales are assumed to be identical with and without the proposed measures (ie the absolute sales of products nor the mix of sales by group remain unaffected).

4.3 Sales Share by Group - Australia

Figure 26 and Figure 27 below outline the actual historical and assumed future group share for refrigerators and freezers in Australia over time. Note that the sales share by group is not expected to be affected by the proposed measure.

The sales share by group is very different for New Zealand, but these differences have been taken into account when estimating NZ relative energy consumption.

Figure 26: Share of Refrigerator Sales Over Time, by Group

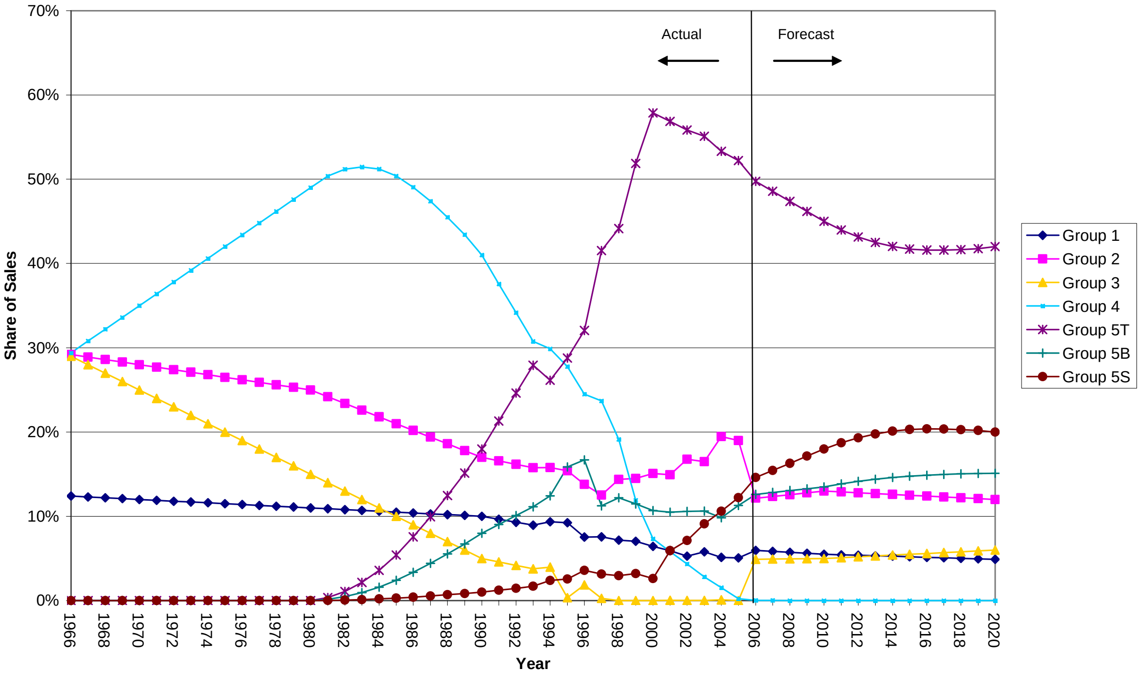
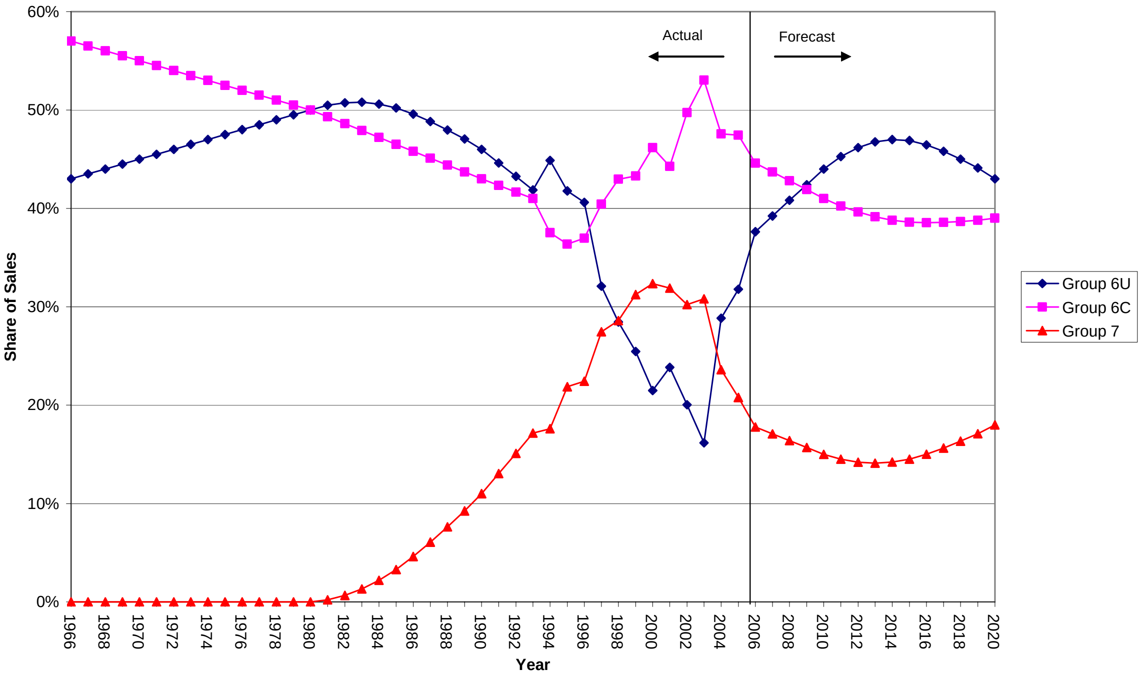


Figure 27: Share of Freezer Sales Over Time, by Group



4.3.1 Commercial Use of Household Refrigerators and Freezers

The commercial sector use of household refrigerators is not known with great accuracy, but is likely to be low (around 10% of total sales) but with a greater proportion of sales in some groups such as Group 2 (small bar refrigerators typically used on small commercial buildings). It has been assumed that commercial sector ownership of household refrigerators is small and therefore does not need to be modelled separately as part of this study. The stock model used for this study has been configured to match its generated sales stream to the estimated retail sales for the residential sector only. Therefore, this study does not explicitly deal with units sold to the commercial sector that are sold through normal retail outlets, so their numbers and characteristics are additional to the values which have been used for modelling in this study.

Any additional costs imposed on commercial purchasers of program measures which are intended for household refrigerators would be small and any additional benefits, although also small, would almost certainly exceed those costs due to the following factors:

- Commercial energy tariffs are higher than residential tariffs, so the benefits of any energy reductions are likely to be greater;
- Many refrigeration units would be installed in air conditioned buildings, and so will have indirect energy costs for cooling in addition to the direct electricity consumption costs (commercial buildings use far more energy for cooling than heating);
- Commercial sector purchasers are probably less likely to take the energy label into account (they are not paying the bill personally), so label changes will have a lower direct impact.

Therefore, omission of an explicit commercial sector analysis will not have much effect on the overall analysis and their omission for this study is conservative.

4.4 Ownership Trends - Australia

The actual historical and assumed future ownership for refrigerators and freezers are shown in Figure 28 and Figure 29 below. Ownership in this context is an indicator of the average number of products per house (ie an indicator of the stock). Note that the future ownership is not expected to be affected by the proposed measure.

The ownership of refrigerators in New Zealand is very similar to that in Australia. However, the ownership of freezers appears to be somewhat higher in New Zealand. These differences have been taken into account when estimating NZ relative energy consumption.

Figure 28: Ownership Trends for Refrigerators in Australia

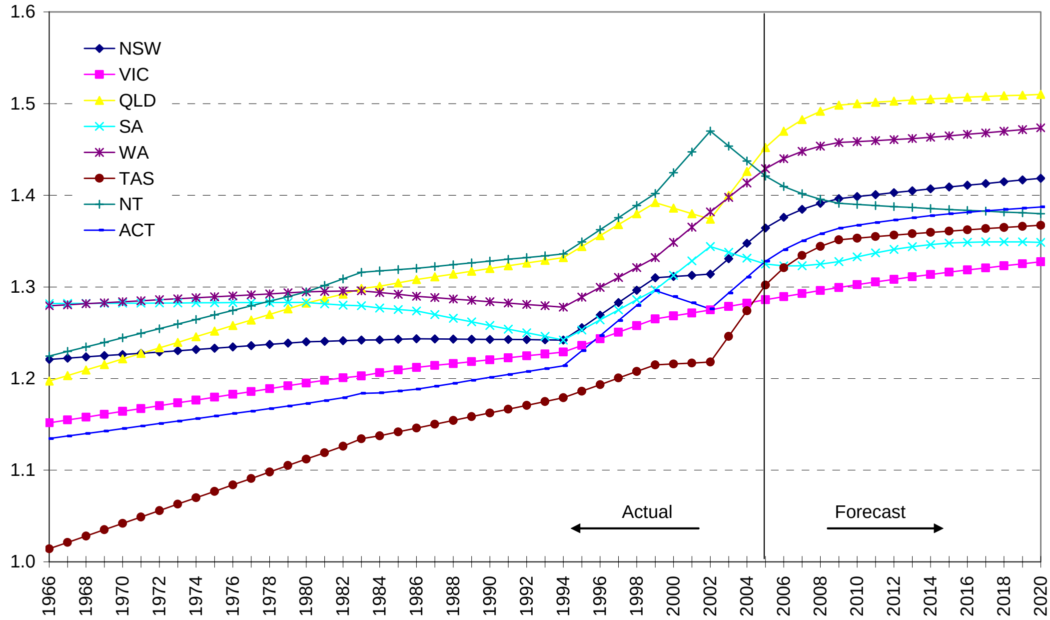
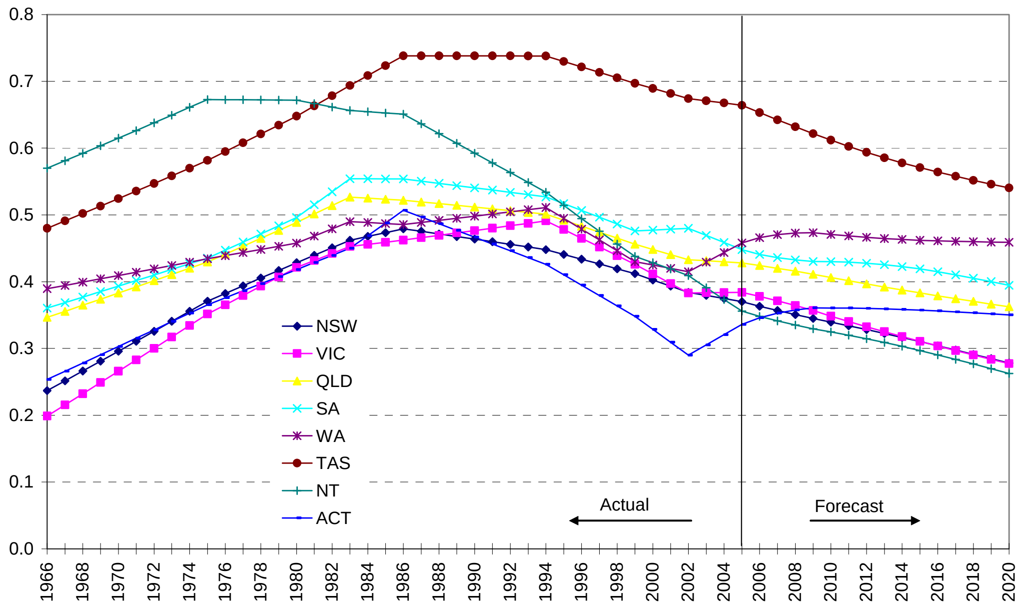


Figure 29: Ownership Trends for Freezers in Australia



4.5 Refrigerator and Freezer Volume Trends - Australia

The actual historical (to 2006) and assumed future volume trend for refrigerators and freezers are shown in Figure 30, Figure 31 and Figure 32 below. Volume shown is the uncorrected volume for each main compartment type. Note that the future volume trend is not expected to be affected by the proposed measure. For this study, data has been tracked at a group level as shown below. For the purposes of stock modelling, aggregated volume data has been used.

Figure 30: Refrigerator Fresh Food Volume Trends Over Time, by Group, Australia

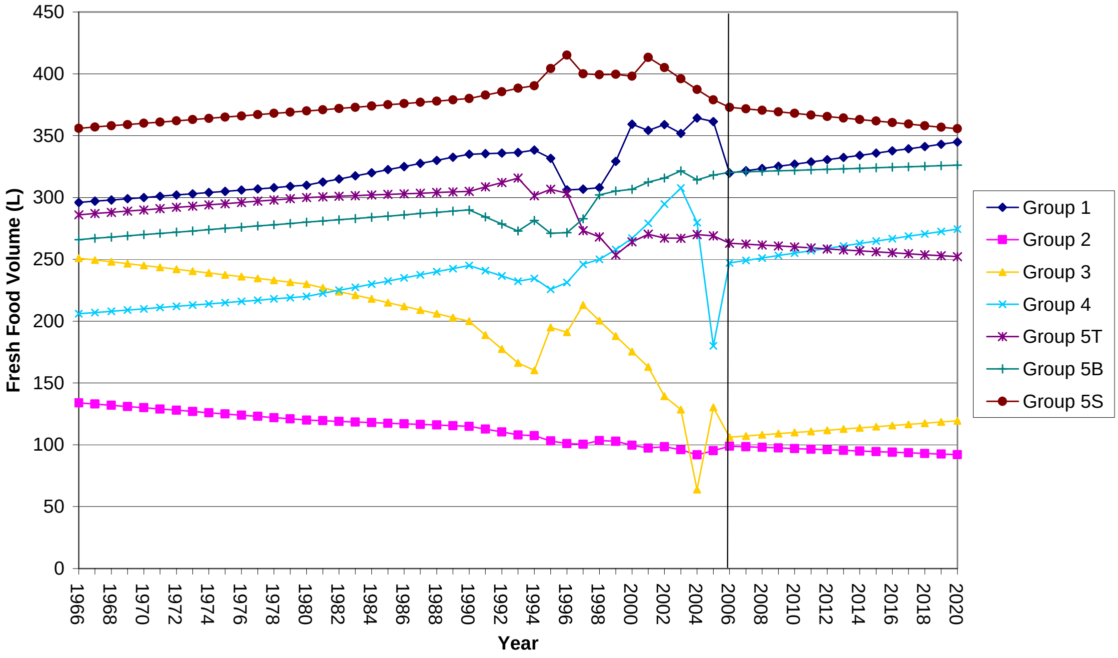


Figure 31: Refrigerator Freezer Volume Trends Over Time, by Group, Australia

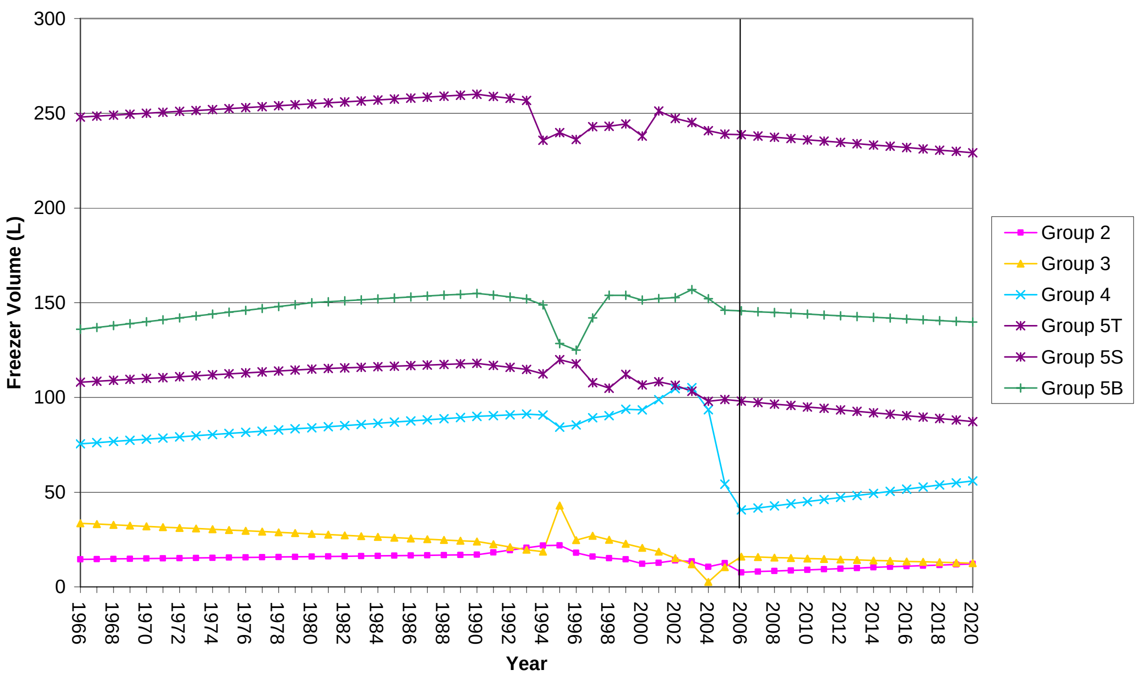
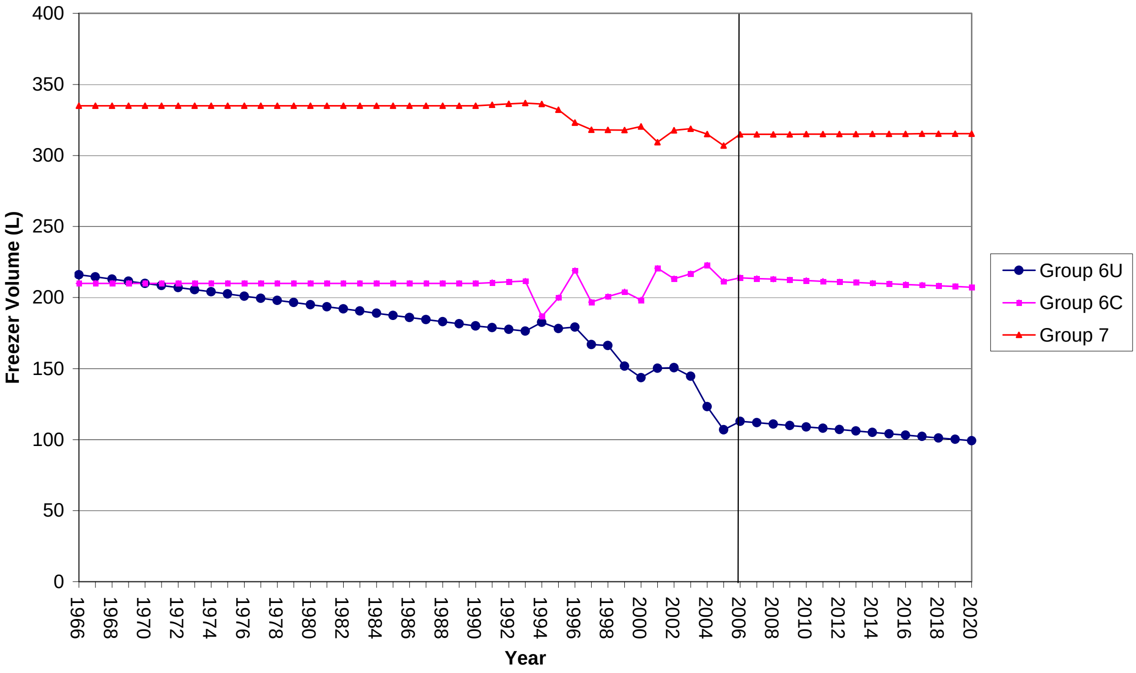


Figure 32: Separate Freezer Volume Trends Over Time, by Group, Australia



4.6 Energy Consumption Trends

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 following tables list the assumed measures rates of annual change in efficiency, for each Group under each Scenario. Also see Appendix 5 for further detail on changes in energy consumption under each Scenario, by Group. 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 Specific Energy Consumption (kWh/Adjusted L) by Group and Year

Year	1	2	3	4	5T	5B	5S	6U	6C	7
2005	1.05	2.67	2.60	2.03	1.11	1.04	0.94	1.73	0.99	1.22
2006	1.08	2.64	2.24	1.30	1.07	1.04	0.94	1.66	0.98	1.16
2007	1.07	2.63	2.23	1.29	1.07	1.03	0.93	1.65	0.97	1.16
2008	1.07	2.62	2.22	1.28	1.06	1.02	0.93	1.65	0.96	1.15
2009	1.06	2.61	2.22	1.27	1.06	1.02	0.92	1.64	0.96	1.15
2010	1.06	2.60	2.21	1.26	1.06	1.01	0.91	1.64	0.95	1.15
2011	1.06	2.59	2.20	1.25	1.06	1.00	0.90	1.64	0.94	1.15
2012	1.05	2.58	2.20	1.24	1.06	1.00	0.90	1.63	0.94	1.15
2013	1.05	2.57	2.19	1.23	1.05	0.99	0.89	1.63	0.93	1.14
2014	1.04	2.56	2.19	1.22	1.05	0.99	0.88	1.62	0.92	1.14
2015	1.04	2.55	2.18	1.22	1.05	0.98	0.88	1.62	0.92	1.14
2016	1.03	2.54	2.18	1.21	1.05	0.98	0.87	1.62	0.91	1.14
2017	1.03	2.54	2.17	1.20	1.05	0.97	0.87	1.61	0.91	1.14
2018	1.03	2.53	2.17	1.19	1.04	0.97	0.86	1.61	0.90	1.13
2019	1.02	2.52	2.16	1.19	1.04	0.96	0.85	1.60	0.90	1.13
2020	1.02	2.51	2.16	1.18	1.04	0.96	0.85	1.60	0.89	1.13

Table 40: Expected Impact Specific Energy Consumption (kWh/Adjusted L) by Group and Year

Year	1	2	3	4	5T	5B	5S	6U	6C	7
2005	1.05	2.67	2.60	2.03	1.11	1.04	0.94	1.73	0.99	1.22
2006	1.08	2.64	2.24	1.30	1.07	1.04	0.94	1.66	0.98	1.16
2007	1.07	2.63	2.23	1.29	1.07	1.03	0.93	1.65	0.97	1.16
2008	1.07	2.62	2.22	1.28	1.06	1.02	0.93	1.65	0.96	1.15
2009	1.06	2.60	2.21	1.26	1.05	1.01	0.91	1.64	0.95	1.15
2010	1.04	2.57	2.19	1.25	1.04	1.00	0.90	1.62	0.94	1.14
2011	1.03	2.55	2.18	1.23	1.03	0.99	0.88	1.61	0.93	1.13
2012	1.02	2.52	2.16	1.22	1.02	0.98	0.87	1.60	0.92	1.12
2013	1.02	2.51	2.15	1.21	1.02	0.97	0.86	1.60	0.91	1.12
2014	1.01	2.50	2.15	1.20	1.02	0.97	0.86	1.59	0.91	1.12
2015	1.01	2.49	2.14	1.19	1.01	0.96	0.85	1.59	0.90	1.11
2016	1.00	2.48	2.14	1.19	1.01	0.96	0.85	1.58	0.90	1.11
2017	1.00	2.47	2.13	1.18	1.01	0.95	0.84	1.58	0.89	1.11
2018	1.00	2.47	2.13	1.17	1.01	0.95	0.83	1.58	0.88	1.11
2019	0.99	2.46	2.13	1.17	1.01	0.95	0.83	1.57	0.88	1.11
2020	0.99	2.45	2.12	1.16	1.00	0.94	0.82	1.57	0.87	1.10

Table 41: Low Impact Specific Energy Consumption (kWh/Adjusted L) by Group and Year

Year	1	2	3	4	5T	5B	5S	6U	6C	7
2005	1.05	2.67	2.60	2.03	1.11	1.04	0.94	1.73	0.99	1.22
2006	1.08	2.64	2.24	1.30	1.07	1.04	0.94	1.66	0.98	1.16
2007	1.07	2.63	2.23	1.29	1.07	1.03	0.93	1.65	0.97	1.16
2008	1.07	2.62	2.22	1.28	1.06	1.02	0.93	1.65	0.96	1.15
2009	1.06	2.61	2.21	1.27	1.06	1.02	0.92	1.64	0.96	1.15
2010	1.05	2.59	2.20	1.25	1.05	1.01	0.91	1.63	0.95	1.15
2011	1.05	2.58	2.19	1.24	1.05	1.00	0.90	1.63	0.94	1.14
2012	1.04	2.56	2.18	1.23	1.05	0.99	0.89	1.62	0.93	1.14
2013	1.04	2.55	2.17	1.22	1.04	0.98	0.88	1.62	0.92	1.14
2014	1.03	2.54	2.17	1.21	1.04	0.98	0.88	1.61	0.92	1.14
2015	1.03	2.53	2.16	1.20	1.04	0.97	0.87	1.61	0.91	1.13
2016	1.02	2.52	2.16	1.20	1.04	0.97	0.87	1.60	0.91	1.13
2017	1.02	2.51	2.15	1.19	1.03	0.96	0.86	1.60	0.90	1.13
2018	1.02	2.51	2.15	1.18	1.03	0.96	0.85	1.60	0.89	1.13
2019	1.01	2.50	2.15	1.18	1.03	0.96	0.85	1.59	0.89	1.13
2020	1.01	2.49	2.14	1.17	1.03	0.95	0.84	1.59	0.88	1.12

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.
- Ownership – there are some differences in ownership between Australia and NZ – in general terms these are very similar for refrigerators while NZ appears to have substantially higher ownership of separate freezers. This increases the share of freezer energy in the NZ case. There is little trend data for NZ so the general trends apparent in Australia are assumed for NZ (eg steady refrigerator ownership, declining freezer ownership).
- Attributes – this is analysed in some detail above in Section 4. The energy consumption of an average NZ refrigerator is almost the same as an average Australian refrigerator, although there are some size differences and a higher share of Group 5B products in NZ. On the other hand, NZ freezers are generally a bit larger and use a bit more energy compared to an average Australian freezer.
- Climate – adjustments to the standardised energy consumption in AS/NZS4474.1 have been made as set out Section 4.6.1. It has been assumed that the climate impacts for NZ are the same as Tasmania.

Taking all of these factors into account, for refrigerators, NZ total energy consumption is estimated to be 16.7% of that in Australia while for freezers NZ total energy consumption is estimated to be 32% of that in Australia. The much higher fraction for freezers is a reflection of the significantly higher ownership levels in NZ and the slightly higher energy for an average freezer in NZ.

The following figures show the aggregated trends in stock energy use with and without the proposed measure.

Figure 33: BAU versus Program Energy Consumption Forecasts for Aggregated Refrigerators and Freezers for Australia

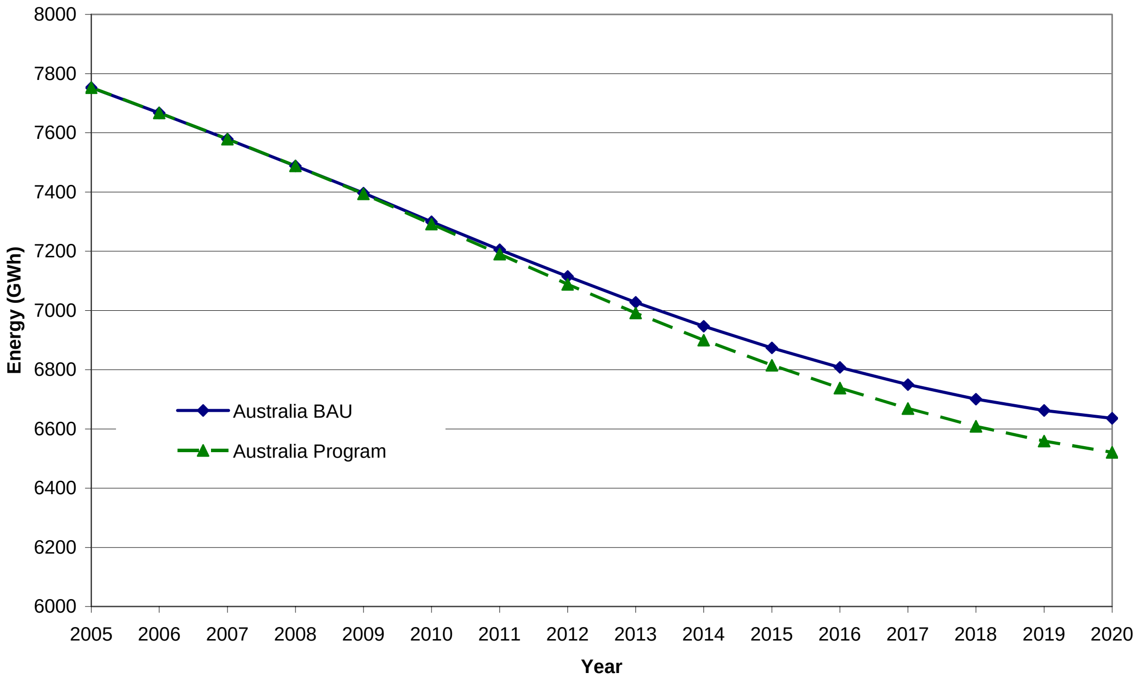


Figure 34: BAU versus Program Energy Consumption Forecasts for Aggregated Refrigerators and Freezers for New Zealand.

4.6.1 Climate Impacts on Energy

The main factor affecting energy consumption of refrigerators is ambient temperature. The performance of refrigerators and freezers is complex and changes in energy consumption per ^{o}C change in temperature varies considerably between models and depends on the design and construction of each unit. Monitored data monitored has shown that refrigerators in Sydney on average consume about 90% of the energy value shown on the units energy label (under standard conditions). However this factor varies somewhat by unit (EES, 1999). For this study, an overall climatic adjustment factor has been estimated for each State to adjust for the average difference between AS4474 energy consumption and actual in use consumption. For refrigerators, the values range from 80% in Tasmania to 100% in the Northern Territory. For freezers, the values range from 75% in Tasmania to 95% in the Northern Territory. The issue of an increase in average temperatures as a result of climate change has not been considered in this study. However, any impact of increased temperatures as a result of global warming would tend to result in higher energy of refrigerators and freezers and therefore units with higher efficiency under the proposal would result in greater savings than those estimated. For New Zealand, the factors adopted for Tasmania have been assumed to be representative on average.

Table 42: Assumed Climatic Adjustment Factors by State for Refrigerators and Freezers in Australia (all years)

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	NZ
Refrigerators	90%	85%	95%	90%	90%	80%	100%	90%	80%
Freezers	85%	80%	90%	85%	85%	75%	95%	85%	75%

4.7 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 Household (day rate)
NSW	17.9(a)
Victoria	15.6
Queensland	16.6(a)
SA	20.0 (a)
WA	14.7
Tasmania	12.5
NT	15.4
ACT	9.8
Australia (weighted)	13.4
New Zealand	17.0(b)

Source: Household estimates from *Electricity Australia 2004*, except; (**a**) Published default tariffs from 1 July 2007. (**b**) Advised by EECA, October 2007 – 20.4 cents NZD, at the exchange rate at 25/10/07. Other sector estimates by GWA. Note, all rates are in AUD.

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 refrigerator and freezers are operating 24 hours a 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.

4.8 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_2-intensity per kWh avoided should be calculated using the marginal coefficients.

Table 44 below shows the projected marginal emissions intensity of electricity supply, from 2000 to 2020. These numbers are for each Australian State and Territory and New Zealand. For the purposes of analysis of emission impacts beyond 2020 (for example, to account for the energy consumption of appliances installed in 2020 and which operate to 2045), a constant marginal emission factor has been assumed beyond that year.

The marginal electricity system CO_2-e intensities for Australia used are illustrated in Figure 35 below. Theses were calculated from data spreadsheets published by the AGO (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.

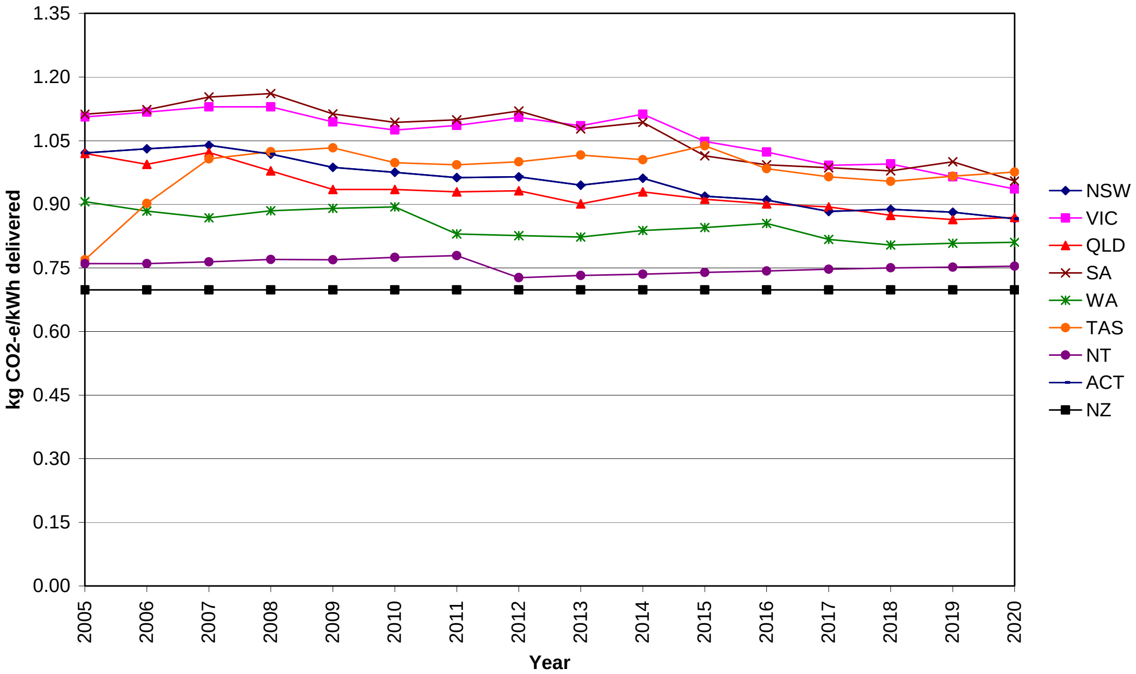
In the base case analysis no monetary value is assigned to projected emissions reduction between the BAU and with-measures case. However, a shadow price for CO_2 and its impact on costs and benefits is examined as an additional scenario. Where it is necessary to project emissions beyond 2020, a constant emission intensity after that date has been assumed for modelling purposes.

Table 44: Projected Marginal Emissions-intensity of Electricity Supply, 2000-2020

Year	NSW+ACT	VIC	QLD	SA	WA	NT	TAS	New Zealand*
2000	0.95	0.988	1.053	1.02	1.04	0.008	0.651	0.698
2001	0.95	0.988	1.053	1.02	1.04	0.008	0.651	0.698
2002	0.958	0.992	1.035	1.003	0.996	0.008	0.663	0.698
2003	1.018	1.122	1.021	1.163	1.038	0.754	0.84	0.698
2004	1.027	1.128	0.991	1.167	1.029	0.757	0.769	0.698
2005	1.021	1.106	1.02	1.112	0.906	0.76	0.769	0.698
2006	1.031	1.117	0.994	1.123	0.884	0.76	0.902	0.698
2007	1.039	1.13	1.022	1.153	0.868	0.764	1.007	0.698
2008	1.018	1.13	0.979	1.161	0.885	0.77	1.024	0.698
2009	0.987	1.094	0.935	1.113	0.89	0.769	1.033	0.698
2010	0.975	1.075	0.935	1.093	0.894	0.775	0.998	0.698
2011	0.963	1.086	0.929	1.099	0.83	0.779	0.993	0.698
2012	0.965	1.105	0.932	1.12	0.826	0.727	1.00	0.698
2013	0.945	1.085	0.901	1.078	0.823	0.732	1.016	0.698
2014	0.961	1.112	0.929	1.093	0.838	0.735	1.005	0.698
2015	0.919	1.048	0.912	1.014	0.845	0.739	1.038	0.698
2016	0.91	1.023	0.901	0.993	0.855	0.743	0.984	0.698
2017	0.883	0.992	0.894	0.986	0.817	0.747	0.965	0.698
2018	0.888	0.995	0.874	0.979	0.804	0.75	0.954	0.698
2019	0.881	0.965	0.864	1.00	0.808	0.752	0.966	0.698
2020	0.866	0.936	0.869	0.955	0.810	0.754	0.976	0.698

(GWA, 2005) *Advice from EECA, 2007

Figure 35: Projected marginal emissions-intensity of electricity supply by State 2000-2020



(GWA, 2005)

4.9 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 Group)
- 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.

It has been assumed in the BAU analysis that there is slow improvement in the background model energy efficiency after MEPS 2005. This is typically in the range of 0.2% per annum to 0.5% per annum, depending on the historical trend within each product group. The slow rate of change compared to historical trends in efficiency is because the 2005 MEPS were very stringent, which resulted in a large fall in energy in 2003 and 2004. In 2005 and 2006 many products only just meet the new MEPS requirements with a small margin, indicating that many of the easier energy savings had already been attained. The other factor that is expected to slow improvement in the future is the core subject of the cost-benefit analysis – many products now have relatively high star ratings after 2005 MEPS and the incentive to further improve model efficiency through market pull from the star rating system is now somewhat diminished. Historically, energy efficiency has been increasing at a rate of 3% to 4% per annum average for the past 15 years in response to both labelling (since 1986) and MEPS (1999 and 2005). Closer examination of data shows that the rate of change varies in response to various regulatory measures. As indicated above, it is expected the BAU rate of improvement will be lower in the years after the introduction of stringent MEPS levels in 2005. There may be a future MEPS proposal for these products, but this has not been considered for this study as no proposal is under development at this stage. Note that in this report, energy efficiency is always referenced back to the technical (inverse of) efficiency in kWh per adjusted litre rather than the star rating or SRI, which is non linear and not comparable between groups.

It is assumed in the program analysis that the label revision in 2009 and the corresponding reduced star ratings for most products on a re-graded scale (see EES 2007 Algorithm Paper) will increase the incentive to improve their model efficiency above what would have been the case otherwise. For the purposes of modelling is has been assumed that the expected impact of the new label will be to increase the overall efficiency of products from the base case improvement of around 0.4% per annum to around 0.9% per annum for the 4 years from 2009 to 2012 (inclusive) and then track at an efficiency level that is parallel to the base case trend (called Expected program impact). This essentially means that for the assessment of costs and benefits the overall energy consumption of new products is expected to fall by a total of about 2% by 2012 with little marginal impact after this date (but the average energy consumption will remain below and roughly parallel to the base case). A low impact case has also been examined (Low Impact, Scenario A); in this case the effect of the regarded label scale is only a 0.2% per annum increase in efficiency above the base case from 2009 to 2012 inclusive, resulting in an overall energy reduction of new products of only 0.8% by 2012, again tracking parallel to the base case after this year. This is considered to be very conservative and is a much lower impact than previous efficiency trends resulting from energy labels both in Australia and other countries.

Appendix 5 shows the kWh/adjusted litre by Group and the kWh by year for new and stock refrigerators and freezers for the BAU, Expected Impact (Base Case) and Low Impact scenarios (Scenario A).

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 4.10). 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 refrigerators and freezers can be found in Appendix 1 and these are shown graphically in Figure 26 and Figure 27. The sales figures are based on household number projections which can be found in Appendix 2. 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 36 and Figure 37 below, outline the BAU versus Expected Impact energy for refrigerators 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 36: BAU versus Expected Impact Energy for Australian Refrigerators

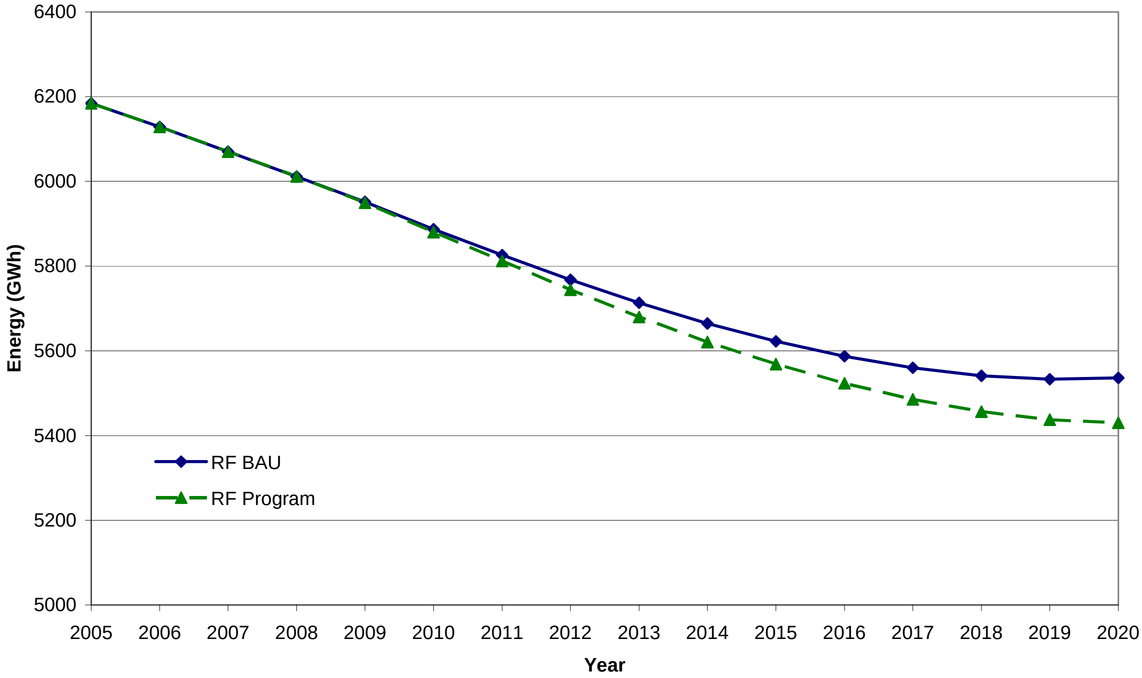


Figure 37: BAU versus Expected Impact Energy for New Zealand Refrigerators

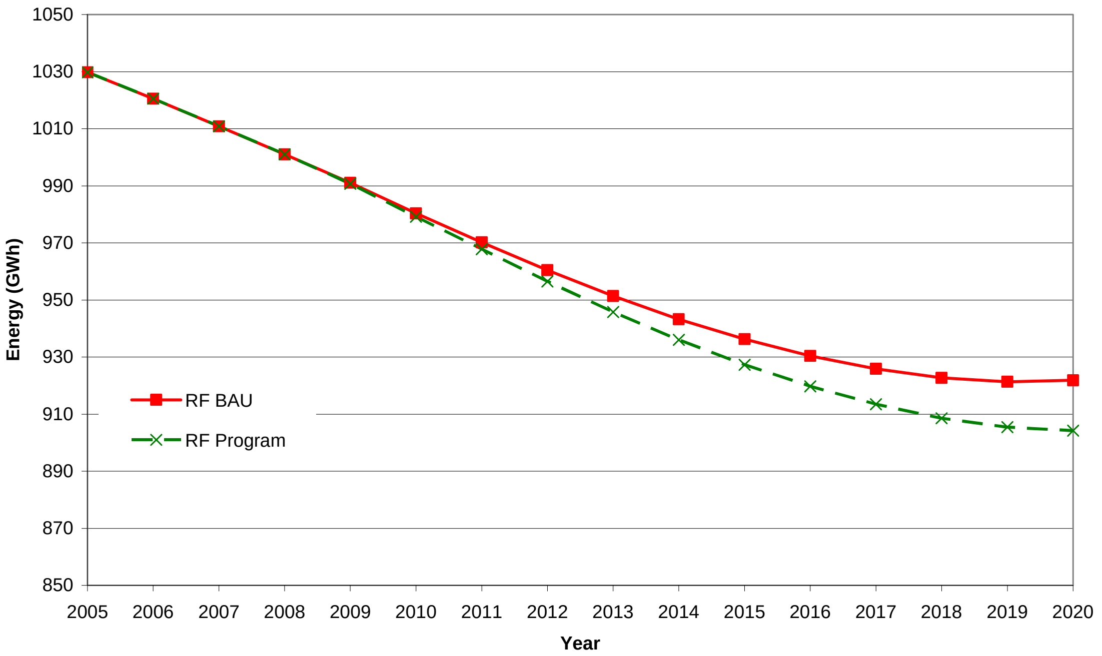


Figure 38 and Figure 39 below, outline the BAU versus Expected Impact energy for freezers for the Australian and New Zealand markets. The top line (blue for Australia, red for New Zealand) shows BAU projections of energy, while the green line indicates energy under the proposal.

Figure 38: BAU versus Expected Impact Energy for Australian Freezers

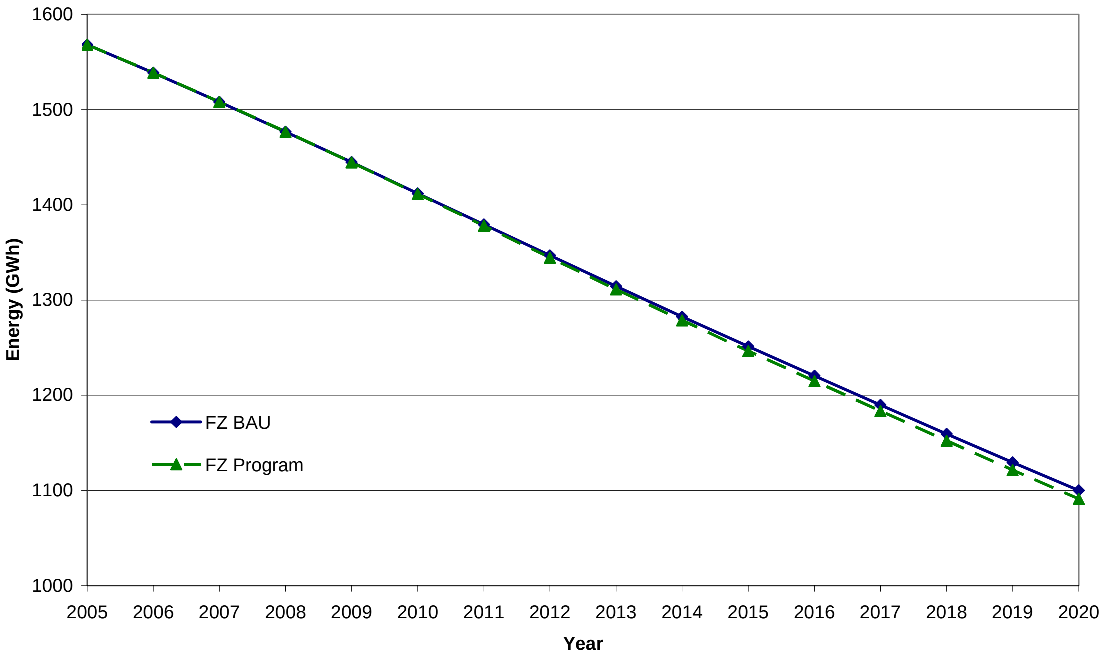


Figure 39: BAU versus Expected Impact Energy for New Zealand Freezers

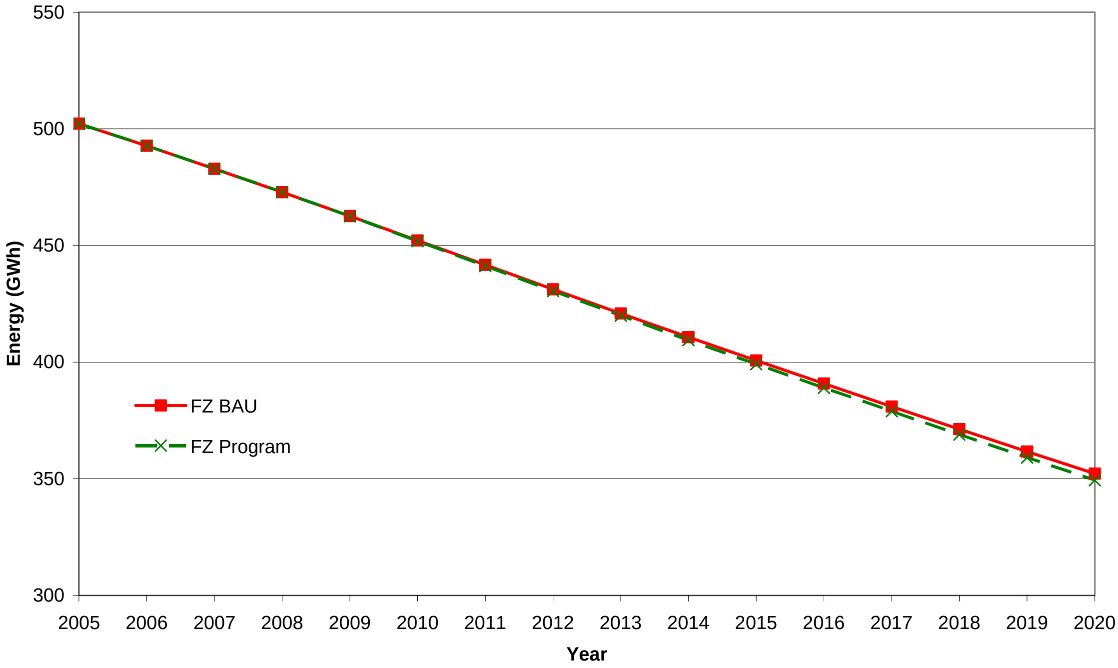


Figure 40 and Figure 41 below, outline the BAU versus Expected Impact emissions saved (Base Case) for refrigerators for the Australian and New Zealand markets. The top line (blue for Australia, red for New Zealand) shows BAU projections of energy, while the green line indicates energy under the proposal.

Figure 40: kt CO_2-e Saved for Australian Refrigerators

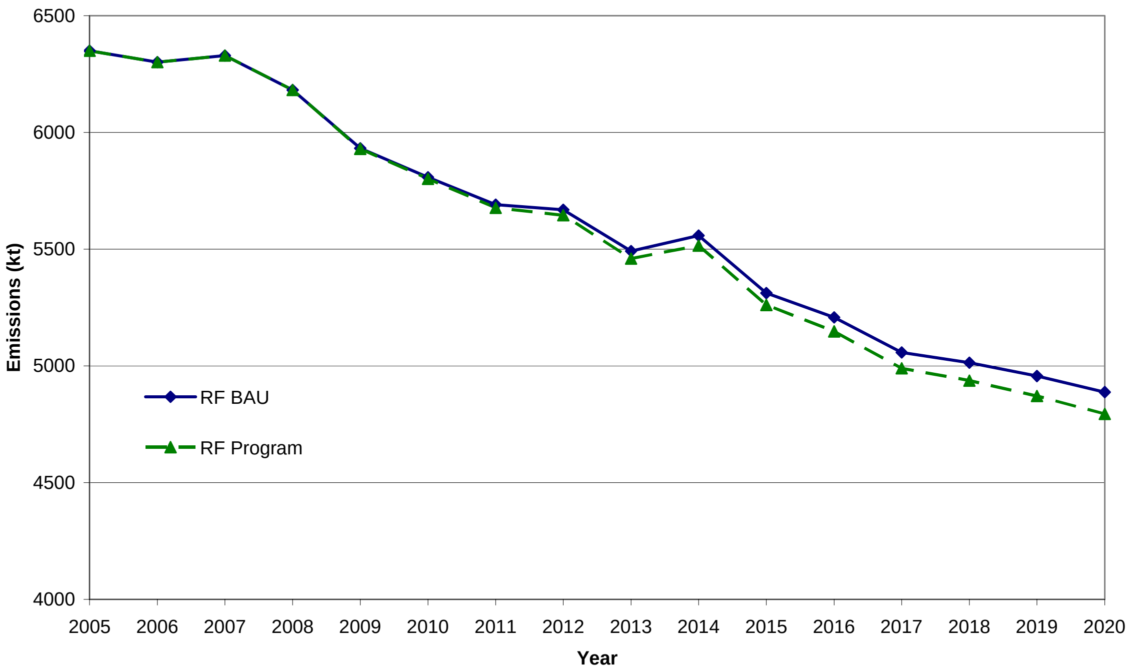


Figure 40 does not have smooth curves due to changes in the marginal GHG emission factors from year to year. As these factors are for a State level, any forecast changes in electricity generation for that State will affect them.

Figure 41: kt CO_2-e Saved for New Zealand Refrigerators

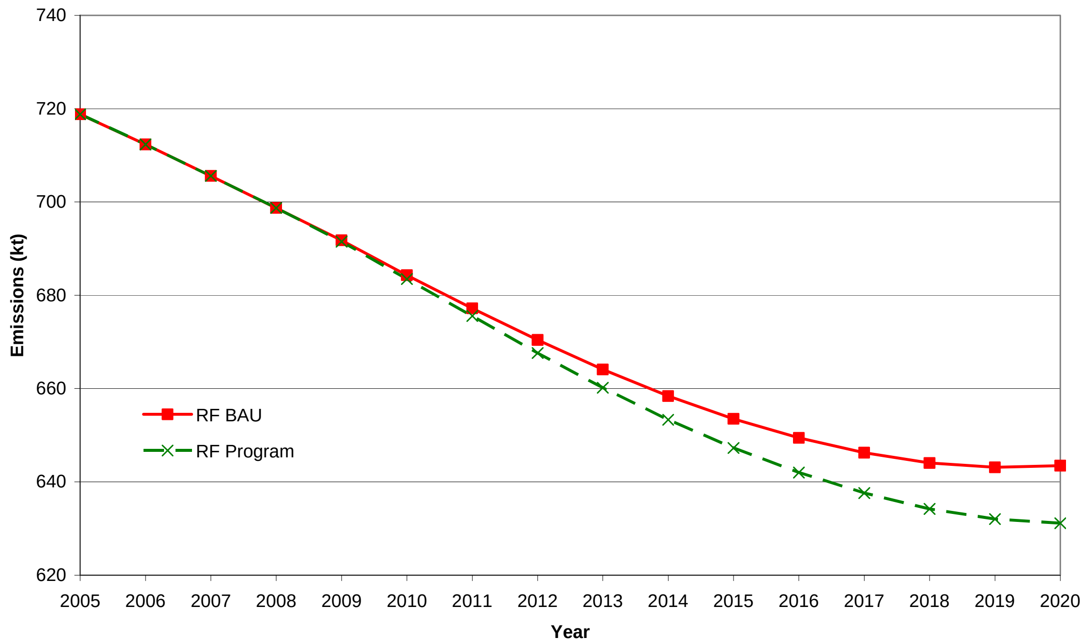


Figure 42 and Figure 43 below, outline the BAU versus Expected Impact emissions saved for freezers for the Australian and New Zealand markets. The top line (blue for Australia, red for New Zealand) shows BAU projections of energy, while the green line indicates energy under the proposal.

Figure 42: kt CO_2-e Saved for Australian Freezers

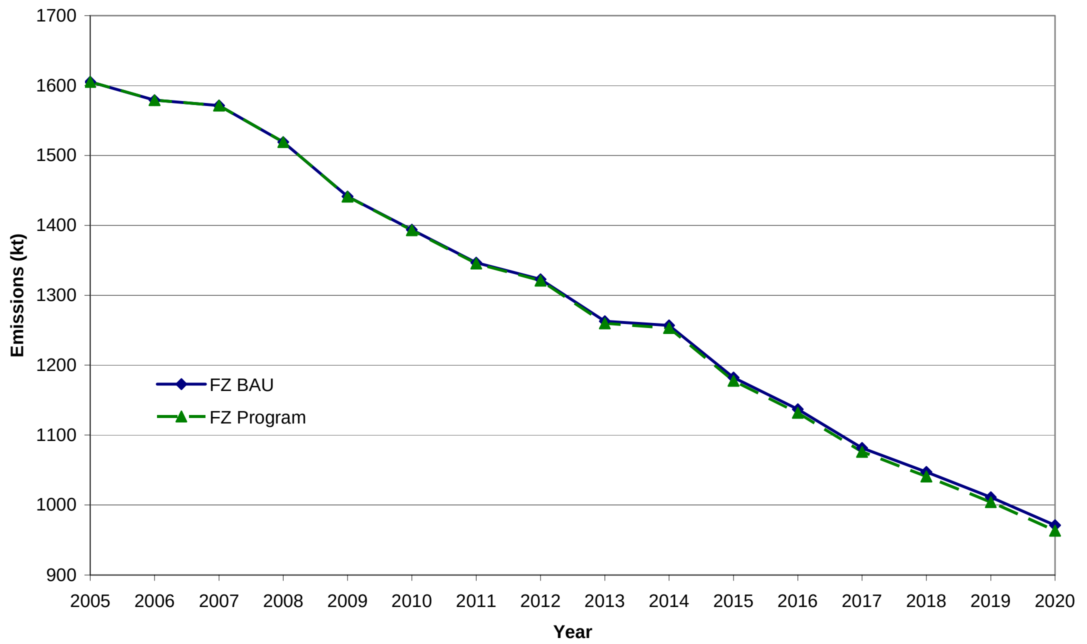
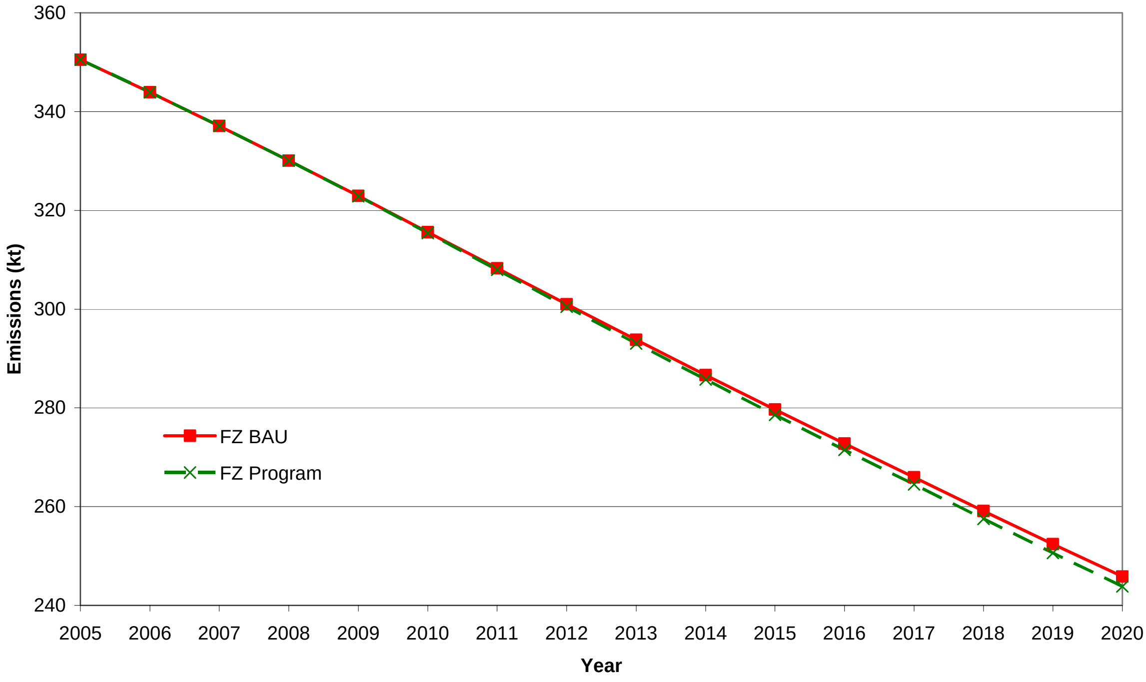


Figure 43: kt CO_2-e Saved for New Zealand Freezers



4.10 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. 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 for each model (GfK data, 2006). Just over 1000 models had sales reported during the period (around 650 different registrations). EES has conducted an analysis of GfK retail sales data in Australia since 1993 (EES, 2006).

Refrigerators and freezers range in complexity and size and accordingly, their price and energy efficiency varies considerably. There have been attempts to quantify price efficiency trends in the past (eg GWA 1993, 2001). Some refrigerator types have historically shown some correlation between price and efficiency, but the trends tend not to be strong. The 2006 dataset obtained for analysis in this project is one of the most comprehensive ever analysed in Australia as energy and actual price data for virtually model has been reported.

Methodology

The general approach it to split all refrigerators into their respective groups in accordance with AS/NZS 4474.1. In total, there were 10 groups for analysis (1, 2, 3, 4, 5B, 5T, 5S, 6C, 6U and 7).

Both the price and energy consumption are generally correlated with the volume of a refrigerator. However, the price and energy per unit of volume vary considerably between groups and by model within a group, so this analysis has considered each group as a separate self-contained category. It must be noted that only models that had sales of greater than or equal to 100 units were used in the analysis. This was done to create a more accurate representation of the market, by taking out models that cater to a more niche market, which generally contain specialised features or are more expensive due simply to brand name or unrelated features such as stainless steel finishes.

In addition to the above elimination of 'unrepresentative models', the models that did not meet 2005 MEPS were also eliminated from the analysis. 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 few percent of sales were against such models (although the number of models was significant). These have been eliminated from the analysis as the energy of non-MEPS compliant models in many cases is much higher than MEPS compliant models and these are no longer a valid representation of models that are currently supplied to the market.

The first step in the analysis was to determine a volume/energy relationship for each group. This was done the basis of the adjusted volume (in accordance with AS/NZS 4474.2) and the declared Comparative Energy Consumption (CEC) on the energy label. A linear regression for energy was used in the form Energy = a $\times$ Volume + b (where b is a fixed energy plus a variable component related to the adjusted volume).

Similarly, a linear regression was determined for adjusted volume and price for each group. Together, these functions represented a so called representative energy and price function for each group.

The regression was reviewed for consistency with the data and few models with a very high price or volume (as noted above) as well as non-approved models were removed to make the regression more representative of the bulk of the models being supplied to the market.

The next step was to look at the price and energy consumption of each individual model sold in 2006 relative to the representative regression for price and energy determined for the group as a whole. The ratio of actual price to the regression price for a particular model of a certain volume is called normalised price. A normalised price of greater than 1.0 means that the model was more expensive than an average model in the group for that size and configuration. Similarly, the actual energy to the regression energy for a particular model of a certain volume is called the normalised energy. A normalised energy of greater than 1.0 means that the model uses more energy than an average model in the group for that size and configuration.

A plot of normalised price versus normalised energy consumption is then examined for each group to see if there is a correlation between normalised energy consumption 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 negative slope between normalised price and normalised energy (ie as normalised price increases, normalised energy should decrease = efficiency increases).

A regression of normalised price versus normalised energy consumption was conducted for each group, where possible, with the results reported below.

As noted above, this analysis was only done on models that have approved registrations in May 2007 and have sales of greater than or equal to 100 units in 2006.

Summary

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

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

Group	Description	Price - Variable	Price - Fixed	Energy – Variable	Energy – Fixed
1	All refrigerator	1.9642	405.14	0.3725	215.66
2	Refrigerator with ice box	1.3149	127.31	0.4436	239.11
3	Refrigerator/short term freezer	N/A	N/A	N/A	N/A
4	Refrigerator-Freezer cyclic/manual	N/A	N/A	N/A	N/A
5T	Refrigerator-Freezer frost free (freezer @ top)	5.9434	-1637.1	0.5041	297.2
5B	Refrigerator-Freezer frost free (freezer @ bottom)	2.434	-125.7	0.405	279.79
5S	Refrigerator-Freezer frost free (side/side)	11.617	-6476.3	0.4534	373.93
6U	Vertical freezer manual defrost	1.2369	80.687	0.4756	174.56
6C	Chest freezer	1.387	100.92	0.4804	208.87
7	Vertical freezer automatic defrost	1.5255	404.11	0.5683	276.25

Note: Group 3 and 4 had less than 5 approved models with over 100 sales, thus a meaningful analysis could not be completed on these Groups.

When examining the normalised data for price and energy, the relationships found are summarised in the following table. The slope gives an indication of the relationship between price and energy consumption. A slope of 0.0 means that there is no apparent relationship between energy 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 price would accompany a 1% reduction in energy use. Similarly, a slope of -0.5 would mean that a 0.5% increase in price would accompany a 1% reduction in energy. A zero slope indicates that changes in price have no overall correlation to energy (and vice versa).

A price energy slope that is negative indicates that there is a possible relationship between price and efficiency (ie the more expensive the product, the more efficient or lower the energy). The other important variable to consider 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.

For all Groups except Group 7, no significant relationship between price and energy consumption was found. This suggests that by re-grading the star rating algorithm to encourage greater efficiency, the price of units should remain unaffected, and therefore should not increase purchase costs to consumers. The results for Group 7 indicate that there is a relationship between price and energy, but it should be noted that the price and energy range for this Group is very small and spans less than 10% variation from the standardised price and energy consumption. Thus it would be difficult to assess whether this relationship would be valid for a larger energy change (but this is not relevant to this study). However, the impact of the proposal to re-grade the label is expected to fall within the current range of available models so this relationship is assumed to be valid.

The analysis is based on the actual price paid and the efficiency of about 1200 individual models sold in retailers. The nature of the analysis is such that the price – energy relationship is established without regard to the sales of individual models. The number of a model sold is not directly relevant to efficiency and price relationship established in this analysis. However, models with a larger sales base may be able to incorporate more energy efficiency at a lower marginal cost into their inherent design and therefore their efficiency should appear to be better for a given price. Any such effect would show up in the analysis.. As noted, models with very small sales have been eliminated from the analysis as some of these are of special design or boutique in nature and are not representative of mainstream models.

Table 46: Summary of Price – Energy Regressions by Group

Group	Description	Price-energy slope	Correlation Coefficient (R^2)	Comments
1	All refrigerator	0.0656	0.1619	Slope close to zero
2	Refrigerator with ice box	0.0698	0.0137	Slope close to zero
3	Refrigerator/short term freezer	N/A	N/A	Too few models
4	Refrigerator-Freezer cyclic/manual	N/A	N/A	Too few models
5T	Refrigerator-Freezer frost free (freezer @ top)	-0.0156	0.0066	Slope close to zero
5B	Refrigerator-Freezer frost free (freezer @ bottom)	-0.0426	0.0397	Slope close to zero
5S	Refrigerator-Freezer frost free (side/side)	0.0837	0.1854	Slope close to zero
6U	Vertical freezer manual defrost	0.1104	0.0839	Inverse relationship, very low R^2
6C	Chest freezer	0.0969	0.0722	Inverse relationship, very low R^2
7	Vertical freezer automatic defrost	-0.363	0.3312	Narrow energy and price range, moderate R^2

Group 3 and 4 only had less than 5 approved models with over 100 sales, this meant that meaningful analysis was not possible for these Groups.

In Table 46 above a positive slope in the price-energy regression means that for this group a unit which is more expensive tends to also use more energy. 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 stainless steel finish, possibly through the door icemakers for Group 5S). Groups 1, 2, 5S, 6U and 6C all had small positive price energy coefficients and therefore these should be ignored for analysis purposes in this CBA. Groups 5T and 5B showed only very weak negative price coefficient despite the large sample sizes, which indicates only a very small correlation between price and lower energy for these groups. The only group with a discernable correlation was Group 7 (vertical frost free freezers).

According to the analysis above, it could be argued that a price coefficient of zero would be a justified assumption for all groups except Group 7 in this study. However, it is reasonable to assume a small negative coefficient because suppliers are likely to reduce their efforts in other potential areas of product improvement in favour of achieving slightly higher star ratings in response to customer demand resulting from the proposal. Therefore buyers as a group are likely to incur some costs, although these are likely to be small and limited by competition or other factors. An orderly transition to the new label also provides opportunities for manufacturers to minimise these costs. Even though analysis of the data suggests that there is no price efficiency 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.

Furthermore, consumers continue to exercise individual judgement about the relative value of energy efficiency and other product attributes, which should restrain price effects more than is the case for MEPS, where efficiency improvements are in effect forced on consumers without their knowledge.

Table 47 below shows the price coefficients that were used for each group for the analysis in this report as well as the values that were used in GWA (2001) for the 2005 MEPS RIS. The GWA factors were based in a range of engineering data from Australia, USA and Europe and are more suited to cases were regulation forced large changes in the efficiency of products. For this study, these values are considered to be too severe as the changes in energy consumption expected as a result of the proposal are small and well within the currently available range of efficiencies on the market. The following table documents the price coefficient used in analysing the 2005 MEPS and the lower values adopted for the present CBA. For all groups the values in this study are lower except for Group 7, where the value used is the same and this has been supported by the price efficiency analysis conducted on models sold in 2006 in Australia.

Table 47: Price Coefficients for Refrigerator and Freezer Groups Assumed for this Study

Group	Price Coefficient (MEPS 2005 RIS)	Price coefficient (this CBA)
1	-0.20	-0.10
2	-0.20	-0.10
3	-0.20	-0.10
4	-0.20	-0.10
5B	-0.15	-0.10
5T	-0.15	-0.10
5S	-0.25	-0.15
6U	-0.35	-0.30
6C	-0.25	-0.20
7	-0.40	-0.40

Price-Efficiency Relationship

The costs of the proposed algorithm change are more difficult to estimate than the benefits. It is generally assumed that if measures are taken that lead to an increase in the energy efficiency of products, the cost of those products will rise or if not, there will be some other hidden penalty in reduced product performance or durability. This is usually true with products that are relatively simple in design, and where there is a direct relationship between material quality or quantity and energy efficiency. However, the relationship between price and energy is much more complex for products like refrigerators and freezers, where there are many ways to increase efficiency as well as possibilities for rationalising or eliminating some costs along the way. At the early part of the energy efficiency improvement process, the focus on efficiency led to the elimination of many cost components such as separate defrost tray heaters, anti-sweat heaters and butter conditioners. In effect, energy efficiency increased at negative cost.

Once these early options were taken up, it may be expected that a positive correlation between energy and price would emerge. The RIS for the introduction of MEPS 2005 (GWA 2001) found that this was somewhat true for freezers, but less so for refrigerators. It was estimated that there would be an almost direct relationship between increases in the price and efficiency of freezers, despite the fact that the 1999 MEPS were accompanied by a reduction in real average price. For refrigerators, it was found that the trend over time was the opposite of what would be expected, price was found to decrease at almost the same rate as the efficiency increased. This was a remarkable finding as the quality of refrigeration services increased over the period (GWA, 2001) (EES 2006a, Ellis et al. 2007). Analysis undertaken for this study shows this trend is continuing to date – real prices are falling and energy efficiency is increasing.

There is no historical (longitudinal) link between rising efficiency and retail price. Appendix 3 outlines the difference between nominal and real prices for refrigerators at a group level. Appendix 4 outlines the difference between nominal and real prices for freezers at a group level. Table 48 below outlines the changes in real price for refrigerator and freezer groups, over the time that data has been analysed (1993 to 2006). It can be seen that for all groups but one, the change in real price per annum, has been downward. Group 4 is the only group in which real prices appeared to increase, but this must be viewed with some caution as the sales in this group have become very small in recent years, with just a few high end European models remaining with low sales and low energy.

This data confirms that although efficiency of refrigerators and freezers has increased, through MEPS and energy labelling, the average real price for models has decreased at the same time and almost appears to be unaffected by these measures. The other interesting aspect is that prices have decreased despite a slight increase in volume in some groups, although average volume in most groups is now stable or falling.

Table 48: Summary of Changes in Real Price for Refrigerator and Freezer Groups

Group	Change in Real Price (per annum) 1993 - 2006
1	-1.2%
2	-4.0%
3	-4.5%
4	6.0%
5T	-5.0%
5B	-1.2%
5S	-2.7%
6U	-5.0%
6C	-2.1%
7	-1.3%

An analysis completed for the International Energy Agency (IEA) found that as the energy consumption of Australian refrigerators, has declined over time and so has real price, even though average volumes have increased slightly. This real price has not fluctuated over time as much as in other countries (notably the USA) and this was put down to energy labelling 'smoothing' the process for MEPS (energy labelling gives suppliers an incentive to drive for more efficient product, which in turn helps to alleviate the impacts of a MEPS at implementation). It was also found that when comparing product prices to CPI each year, these prices have not exceeded CPI, suggesting that the introduction of MEPS regulations have not adversely affected the price of equipment compared to the general basket of goods and service (Ellis et al. 2007).

4.11 Transition Costs

4.11.1 Costs to Suppliers

Transition Categories

Table 49 below shows the estimated number of models in each transition category.

Table 49: Refrigerator and Freezer Models May 2007 – Transition Numbers

	Number of Models	Comments
Current number of Approved registrations in 2007	1000	
Active models	750	75% (of Approved 2007 registrations)
Number of redundant registrations (not active models)	250	25% (of Approved 2007 registrations)
Current active models expected to be obsolete by October 2009	375	50% (of active models)
Number of Approved 2007 registrations that are expected to be active beyond October 2009 (continuing models)	375	50% (of active models)
Total number of models that will require complete re-testing to satisfy new standard	200	53% (continuing models)
Number of registrations that can reprocess existing test data to satisfy new Standard	175	47% (of continuing models
New models registered using AS/NZS4474.1-2007 (from publication to October 2009)	600	
Number of new models registered from mid 2007 that will require re-registration for the new label only	350	
New models registered from October 2008 to October 2009	250	Current rate of new registrations per year

It is proposed that from 1 July 2008 products will be able to be registered to the new AS/NZ 4474 Part 2, but on the understanding that these products will not be on display with a new label until 1 October 2008. Between 1 October 2008 and 1 April 2009 (the 'overlap period'), products can be supplied and displayed which display the new label with transition wording. Products can still be able to be registered with the old label up until 1 April 2009, but all registrations to the old label will expire on 1 October 2009. 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, E3 has planned a 'display transition period' running from 1 October 2008 to 1 October 2009 (after which all products will be required to display the new label). There will also be some correspondence with suppliers and retailers from late 2008 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 April 2009, the retailer selects a unit with a new labelled 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 April 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 October 2009. 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 $200,000 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 October 2009. 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 October 2009, and some where new labels come on display before 1 April 2009[5]. There may be some cases where old labels are replaced with incorrect new labels, but these are likely to be rare[6]. 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

[5] Some companies may choose to add 'new' label to their 'old' label on their stock between 1 July 2008, when new label registrations become possible, and 1 October 2008, 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.

[6] 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.

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 50 below. The table summarises the quantifiable cost factors associated with changing labelling arrangements for each class.

Table 50: Stages in Transition to New Label

Description	Registration Status	Additional Costs Imposed:
Product registered with 'old label' prior to 1 October 2008 (1) – AS/NZS4474.2-2001	Expires 1 October 2009	For obsolete registrations: none For models removed from sales during overlap period (1): none For models continuing on market after overlap period: label re-registration and display transition costs (2)
Product registered with 'old' label between 1 October 2008 and 31 March 2009 (1) – AS/NZS4474.2-2001	Expires 1 October 2009	For models removed from sales during overlap period (1): none For models continuing on market after overlap period: label re-registration and display transition costs (2)
Product registered with 'new' label between 1 October 2008 and 31 March 2009 (1) – AS/NZS4474.2-2008	Expires up to 5 years from date of registration (subject to annual rollover review) (5)	No additional costs
Product registered from 1 April 2009 (new label) – AS/NZS4474.2-2008	Expires up to 5 years from date of registration (subject to annual rollover review) (5)	No additional costs

Notes:

1. Overlap period (1 October 2008 – 31 March 2009): new registrations with either label accepted – new labels must show transition data (possibly both old and new energy labels). Registrations

may be accepted from July 2008 as long as product not displayed or supplied prior to October 2008 (details to be confirmed).

2. New label start date (1 April 2009): all new registrations must be with new energy label and with a test report to AS/NZS4474.1-2007.

3. Display transition period (1 October 2008 – 1 October 2009): 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. Registrations for products which have test reports to AS/NZS4474.1-1997 and which are registered to the old energy label expire on 30 September 2009. Registrations to AS/NZS4474.2-2008 for the new 2009 energy label will only be permitted for products which have test reports to AS/NZS4474.1-2007. Suppliers and manufacturers have been permitted to test to AS/NZS4474.1-2007 since September 2007 which will avoid the need for retesting of products during the label transition. New registrations after October 2008 must have a test report to AS/NZS4474.1-2007.

5. For models listed in New Zealand, there is no expiration date.

Under E3's proposed transition arrangements, all existing registrations to AS/NZS4474.2 prior to 2007 will be grandfathered on 1 October 2009. The only mechanism previously available for retiring registrations was voluntary notification of cancellation. A 5 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 revision is estimated as the sum of the following factors:

- Costs to suppliers of re-testing and re-registration of models. This is estimated at $4,800 per unit ($4,500 for retesting to AS/NZS4474.1-2007, $150 registration fee and $150 in internal administrative costs borne by the supplier).
- Costs to suppliers of reprocessing of test data (where applicable) and re-registration. This is estimated at $750 per unit ($450 for recalculation of existing test data to AS/NZS4474.1-2007, $150 registration fee and $150 in internal administrative costs).
- 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/NZS4474.1-2007).

- 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 ($80,000) and the display transition period ($300,000 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 of less equally able to pass onto consumers[7]. 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 51, Table 52 and Table 53 the data and costs contained are all one off costs associated with the change of energy label as set out in the proposal. The ongoing costs of the overall refrigerator freezer labelling program with the new label is introduced are assumed to be the same as the program costs without a new label. There are no ongoing costs associated with this label change, just the three one off costs to different sectors.

Table 51 below shows the total costs per element for retesting and/or re-registering of refrigerators and freezers.

[7] 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.

Table 51: Total Costs Per Element for Retesting and/or Re-registering

	Number of Models	Element Cost	Total Cost ($'000)	Comments
Total number of models that will require complete re-testing to satisfy new standard	200	$4,800	$960	53% (continuing models)
Number of registrations that can reprocess existing test data to satisfy new Standard	175	$750	$131	47% (of continuing models
Number of new models registered from mid 2007 that will require re-registration for the new label only	350	$300	$105	
		Total Cost	**$1,196**	

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

4.11.2 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 52 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 refrigerator and freezer units found on display (although store number estimates from GfK confirms that 5% is plausible). 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 52: Assumptions Regarding Display Transition Cost Estimates

	Annual Sales ('000)	% of sales displayed in showroom	Units needing label change ('000)	Costs of label change ($'000)
Refrigerators & Freezers – Australia	1000	5%	50	$500
Refrigerators & Freezers - New Zealand	200	5%	10	$100
			Total	$600

4.11.3 Costs to Government

Table 53 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 cost-benefit analysis document and the future RIS, including any re-rewrites and consultations required and contributions to revise the relevant standards.

Table 53: Assumptions Regarding Estimated Costs to Government

Item	Cost ($'000)	Comments
Administrative costs – Australia and New Zealand	$80	Label and Algorithm Development, CBA, RIS
Support for the display transition period - Australia	$200	
Support for the display transition period – New Zealand	$100	
Total	**$380**	

4.11.4 Costs to Consumers – Program Costs

The supplier (manufacturers and retailers) costs, calculated from the cost estimates given earlier are estimated at about $1.8 million. Given the normal retail markups (100%), this implies a cost to appliance buyers of over $3.6 million. Therefore, in total the cost of the introduction of new labels would amount to about $4 million. Nearly 92% of this would be supplier costs passed onto consumers and the rest being government administration costs. The costs equate to about $0.40 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 CBA. 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 2009 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.

5. Results of 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 markups 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 markups 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.

5.1 Summary of Analysis Results – Base Case

5.1.1 Base Case Assumptions

The basic assumptions in the Business As Usual (BAU) scenario (ie without the change of energy label) for each of the key parameters is compared to the values that are expected as a result of implementation of the proposal (expected program impact). 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 4.6) are estimated using household projections, ownership patterns and other stock assumptions at a state level and for New Zealand, as set out in Section 4.2.
- Electricity consumption of new units entering the stock from 2009 to 2020 as set out for the BAU in Appendix 5 (note that new units that enter the stock in 2020 consume energy to 2045)
- Fixed ratio of NZ stock energy consumption for refrigerators and a separate ratio for freezers based on sales weighted data for new products in 2006 from both countries, which comparable trends over time.
- Standard residential electricity tariffs are applied at a state level and for NZ (refer Section 4.7)
- 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 4.8 with constant intensity for energy consumption beyond 2020
- Discount rate of 7.5% per annum[8].
- Shadow price of CO_2 of $0 per tonne CO_2-e.
- Real refrigerator purchase prices declining at 1.7% per annum in real terms (continuation of trends established over past 15 years).
- Real freezer purchase prices declining at 2.8% per annum in real terms (continuation of trends established over past 15 years).

Expected program impact assumptions for analysis are the same as Base Case except where noted below:

- Reduced electricity consumption of new units entering the stock from 2009 to 2020 for the expected program impact as set out in Appendix 5 (note that new units that enter the stock in 2020 consume energy to 2045)

[8] 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.

- Increased price as a result of reduced electricity consumption for new models purchased up to 2020 as set out in Section 4.10.
- Reduced greenhouse gas emissions as a result of reduced electricity consumption of new units entering the stock from 2009 to 2020
- Inclusion of program costs for government, retailers and appliance suppliers as a result of the program measures.
- Sales, average size and market share by group are assumed to be unaffected by the program measures (only energy 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 group (although assumptions across all groups 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. The assessment of the algorithm change has been done from a holistic viewpoint with uniform application to all groups. A solution that rescales some groups, but not others or that re-labels only some products will not satisfy the requirements of an integrated and coherent energy labelling scheme for refrigerators and freezers. Thus in the same way that the proposal is for a complete re-grade of star rating scales and new labels for all groups, the subsequent costs and benefits are assessed at an overall program level.

5.1.2 Base Case Results – Australia

Table 54 and Table 55 below show the Base Case for refrigerators and freezers in Australia. The net costs and benefits are based on the difference between the BAU and Expected Impact costs and benefits for Australian refrigerators and freezers in the years 2005, 2010, 2010 and 2020. A full table of results is available in Appendix 5.

Table 54: BAU vs Expected Impact Costs and Benefits for Australian Refrigerators by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Energy Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	6184	6184	0	$0.0	0	$0.0
2010	5887	5880	7	$0.9	7	$2.8
2015	5622	5569	54	$7.1	51	$6.1
2020	5536	5430	106	$14.0	94	$6.2

Table 55: BAU vs Expected Impact Costs and Benefits for Australian Freezers by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1568	1568	0	$0.0	0	$0.0
2010	1412	1411	1	$0.1	1	$0.7
2015	1251	1246	5	$0.6	5	$1.0
2020	1100	1091	9	$1.2	8	$1.0

Table 56 and Table 57 below show the cumulative costs and benefits for Australian refrigerators and freezers for the years 2005 to 2020. Scenarios are defined as:

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

Table 56: Cumulative Costs and Benefits for Australian Refrigerators – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	92585	$7,103	89746	$8,056
Expected	91982	$7,071	89191	$8,085
Impact	-603	-$32.2	-555	$28.8

Table 57: Cumulative Costs and Benefits for Australian Freezers – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	21322	$1,694	20730	$774
Expected	21269	$1,692	20681	$779
Impact	-53	-$2.9	-49	$5.2

Table 58 and Table 59 show the cumulative costs and benefits for Australian refrigerators and freezers 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 Australian Refrigerators – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	136158	$8,317	128210	$8,056
Expected	134454	$8,255	126682	$8,085
Impact	-1704	-$61.9	-1528	$28.8

Table 59: Cumulative Costs and Benefits for Australian Freezers – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	30912	$1,952	29186	$774
Expected	30731	$1,946	29025	$779
Impact	-181	-$6.0	-161	$5.2

5.1.3 Base Case Results – New Zealand

Table 60 and Table 61 below show the Base Case for refrigerators and freezers 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 refrigerators and freezers in the years 2005, 2010, 2010 and 2020. A full table of results for all scenarios considered is available in Appendix 5. New Zealand has stated that they wish to use 5% as its primary discount rate. To avoid depicting results for Australia and New Zealand with different discount rates (thus making aggregation of figures meaningless), the Base Case in this report uses 7.5%, but the effects of a 5% discount rate can be viewed in Scenario C in the Sensitivity Analysis Results section below.

Table 60: BAU vs Expected Impact Costs and Benefits for New Zealand Refrigerators by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1030	1030	0	$0.0	0	$0.0
2010	980	979	1	$0.2	1	$0.4
2015	936	927	9	$1.5	6	$0.9
2020	922	904	18	$3.0	12	$0.9

Table 61: BAU vs Expected Impact Costs and Benefits for New Zealand Freezers by Year

Year	BAU (GWh)	Expected (GWh)	Energy Savings (GWh)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	502	502	0	$0.0	0	$0.0
2010	452	452	0	$0.0	0	$0.1
2015	401	399	2	$0.3	1	$0.1
2020	352	349	3	$0.5	2	$0.1

Table 62 and Table 63 show the cumulative costs and benefits for New Zealand refrigerators and freezers for the years 2005 to 2020.

Table 62: Cumulative Costs and Benefits for New Zealand Refrigerators – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	15417	$1,516	10761	$1,208
Expected	15317	$1,509	10691	$1,213
Impact	-100	-$6.9	-70	$4.3

Table 63: Cumulative Costs and Benefits for New Zealand Freezers – 2005 to 2020

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	6827	$687	4765	$108
Expected	6810	$686	4754	$109
Impact	-17	-$1.2	-12	$0.7

Table 64 and Table 65 below show the cumulative costs and benefits for New Zealand refrigerators and freezers 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 64: Cumulative Costs and Benefits for New Zealand Refrigerators – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	22673	$1,776	15826	$1,208
Expected	22389	$1,763	15628	$1,213
Impact	-284	-$13.2	-198	$4.3

Table 65: Cumulative Costs and Benefits for New Zealand Freezers – 2005 to 2050

Scenario	Energy (GWh)	NPV Energy Cost ($m)	GHG (kt)	NPV Purchase Cost ($m)
BAU	9898	$791	6909	$108
Expected	9840	$789	6868	$109
Impact	-58	-$2.4	-40	$0.7

5.1.4 Cost-Benefit ratios – Base Case

Table 66 below outline the Net Present Value (NPV) of difference between the BAU and Expected Impact 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 66: Summary of NPV Benefits and Costs of Expected Impact Scenario for Australia and New Zealand

Country	Discount Rate	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Australia	7.5%	$67.9	$36.9	$31.0	1.8
New Zealand	7.5%	$15.7	$5.1	$10.6	3.1

The overall cost-benefit ratio is same for both Australia and NZ and is 1.8, indicating that this comfortably falls into the no regrets category of program measures. As indicated in Scenario C, the benefit cost ratio for New Zealand is 3.6 when the preferred discount rate of 5% is used.

5.2 Sensitivity Analysis Results

The following section documents various scenarios which quantify the impact of key variables on the overall cost/benefit ratios. Each scenario 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:

- The Low Impact scenario is essentially a test of the sensitivity of a 40% reduction in the assumed electricity consumption savings arising from the program
- Discount rate variations: 0%, 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

- A shadow price for CO_2 of AU $10 and $20 per tonne compared to the base case of $0 per tonne CO_2-e.
- 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_2 over time.
- A decrease on the carbon intensity of electricity supply after 2020.

Table 67 below lists the sensitivity scenarios which are documented. This is followed by key results of these scenarios, 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 67: Sensitivity Analysis Scenarios

Scenario Title	Scenario Notes
Base Case	As per Chapter 4.1 – BAU vs Expected Impact
Scenario A	Energy impact (savings) of program 40% of Expected Impact (Low Impact)
Scenario B	Base Case with 0% discount rate
Scenario C	Base Case with 5% discount rate
Scenario D	Base Case with 10% discount rate
Scenario E	Price energy coefficient half of the estimated values
Scenario F	Price energy coefficient double the estimated values
Scenario G	Shadow cost of CO_2 at AU $10/tonne
Scenario H	Shadow cost of CO_2 at AU $20/tonne
Scenario I	Energy tariff increasing at 1% per annum real
Scenario J	Energy tariff decreasing at 1% per annum real
Scenario K	Purchase price escalation factor set to +1% pa (above) base case (more expensive)
Scenario L	Purchase price escalation factor set to -1% pa (below) base case (less expensive)

Detailed output tables for the Base Case and each scenario above are included in Appendix 8.

Scenario A

In this Scenario, the expected program impact is reduced to give only 40% of the energy savings (Low Impact) when compared to the Expected Impact. As this scenario (Scenario A) is a key part of the sensitivity analysis, more detailed results have been shown. The Low Impact assumptions for analysis are the same as the Base Case except where noted below:

- Lower electricity savings from new units entering the stock from 2009 to 2020 as set out in Appendix 5 when compared to Expected Impact
- Lower corresponding purchase price of new units as a result of smaller electricity consumption reductions for new models as set out in Section 4.10.
- Lower greenhouse gas emission savings as a result of reduced electricity of new units entering the stock from 2009 to 2020.

Table 68: Summary of NPV Benefits and Costs of Base Case versus Low Impact Scenario (Scenario A) for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario A	Australia	$20.0	$14.0	$6.0	1.4
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario A	New Zealand	$4.7	$1.7	$3.0	2.8

Under Scenario A, the benefits have been reduced substantially due to the lower program impact and associated reduced energy savings. However, the costs have also been reduced substantially under this scenario. This is because under the analysis model developed for this report, there is an assumed relationship between changes in energy consumption which are generated by the program measure and the costs of those appliances (refer to Section 4.10 and Table 46). In Scenario A the energy savings are much less than expected but as a result, the price increases of appliances are also less than expected. The overall cost-benefit ratio deteriorates slightly because the fixed program costs remain unchanged in Scenario A and these become a large share of the total costs.

Scenarios B, C, D

These Scenarios examine the changes in the assumed discount rate. In Scenarios B, C and D all assumptions for analysis are the same as Base Case except for the discount as shown below.

Table 69: Summary of NPV Benefits and Costs of Base Case versus Scenario B for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case (7.5%)	Australia	$67.9	$36.9	$31.0	1.8
Scenario B (0%)	Australia	$249.7	$78.7	$171.0	3.2
Base Case (7.5%)	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario B (0%)	New Zealand	$58.1	$11.1	$47.0	5.2

Table 70: Summary of NPV Benefits and Costs of Base Case versus Scenario C for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case (7.5%)	Australia	$67.9	$36.9	$31.0	1.8
Scenario C (5%)	Australia	$101.7	$46.9	$54.7	2.2
Base Case (7.5%)	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario C (5%)	New Zealand	$23.5	$6.5	$17.0	3.6

Note: Scenario C using a 5% discount rate is the NZ government preferred option.

Table 71: Summary of NPV Benefits and Costs of Base Case versus Scenario D for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case (7.5%)	Australia	$67.9	$36.9	$31.0	1.8
Scenario D (10%)	Australia	$46.6	$29.4	$17.2	1.6
Base Case (7.5%)	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario D (10%)	New Zealand	$10.7	$4.0	$6.8	2.7

Changing the discount rate will affect the net present value for both future savings and costs. Discount rate is essentially an indictor 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 scenario.

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 1.5 for Australia and above 2.5 New Zealand, indicating that the results are robust. Under a low discount rate of 0%, the benefit-cost ratio climbs to above 3 for Australia and above 5 for New Zealand. The New Zealand government prefer to assess projects using a 5% discount rate when assessing their benefit cost ratio.

Scenarios E and F

In these Scenarios, the cost-energy coefficient is varied to test sensitivity. Scenario E assumptions for analysis are the same as Base Case except the price-energy coefficient is set to half of the assumed value (ie the appliance purchase cost increases resulting from reductions in energy of new products is half the assumed rate).

Table 72: Summary of NPV Benefits and Costs of Base Case versus Scenario E for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario E	Australia	$67.9	$19.9	$48.0	3.4
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario E	New Zealand	$15.7	$2.5	$13.2	6.2

Scenario F assumptions for analysis are the same as Base Case except the price-energy coefficient is set to double the assumed value (ie the appliance purchase cost increases resulting from reductions in energy of new products is double the assumed rate).

Table 73: Summary of NPV Benefits and Costs of Base Case versus Scenario F for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario F	Australia	$67.9	$71.0	-$3.1	1.0
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario F	New Zealand	$15.7	$10.1	$5.6	1.6

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 4.10. The coefficients that are used for the Base Case are outlined in Table 47, and these have based on analysis of current models and previous research by GWA (2001).

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 no significant link except for Group 7, the Base Case includes an assumed relationship between efficiency and price. The coefficients used in the Base Case are conservative in nature (ie are thought to overstate any impact on price of energy efficiency changes).

To check the robustness of these factors Scenarios E and F have been examined. By halving the assumed value of the coefficients in Scenario E, there is a major impact on the cost benefit ratio (as expected), with a large increase compared to the Base Case. This is because the assumed marginal appliance purchase costs have been effectively halved in this scenario but the benefits remain the same. Conversely, by doubling the assumed coefficients in Scenario F, there is a major impact on the cost benefit ratio, with a reduction to almost half of that of the Base Case. This is because the assumed marginal appliance purchase costs have been effectively doubled in this scenario but the benefits remain the same.

Not surprisingly, in Scenario E, the benefit-cost ratio increases to nearly 3.5 for Australia and to over 6 for New Zealand. For Scenario F, the benefit-cost ratio is very close to 1.0 for Australia and 1.6 for New Zealand. As indicated, the Base Case coefficients are considered to be very conservative and increasing these by a factor of 2 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.

Scenarios G and H

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 Australian Greenhouse Office. 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.

The Australian ETS has the potential to increase the national benefits as a cost is imposed on GHG emissions. Hence, the CBA should take into account the increased benefits due to the avoided cost of carbon permits for electricity generators, which will result from the proposed label change reducing the consumption and generation of electricity at the margin.

These valuations are included as a trial in this CBA. 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 and the ETS 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 counter factual cost of achieving the same abatement through other measures in the ETS.

As this CBA 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 sensitivity analysis are at AU \$10/t CO_2-e and AU \$20/t CO_2-e from 2012 and the tables below report the effect of this on the CBA results. Although the future carbon price under the ETS is uncertain present, emissions trading will mean the estimated benefits will always be higher than without emissions trading (ie the benefits will always be higher when the carbon price is above zero).

In these Scenarios G and H, the impact of a shadow price for carbon dioxide is examined.

Scenario G assumptions for analysis are the same as Base Case except the shadow CO_2 price is set to AU \$10/tonne CO_2-e.

Table 74: Summary of NPV Benefits and Costs of Base Case versus Scenario G for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario G	Australia	$70.4	$36.9	$33.4	1.9
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario G	New Zealand	$16.0	$5.1	$11.0	3.2

Note: Shadow prices for CO_2 are treated as an add-on to electricity energy costs.

Scenario H assumptions for analysis are the same as Base Case except the shadow CO_2 price is set to AU \$20/tonne CO_2-e.

Table 75: Summary of NPV Benefits and Costs of Base Case versus Scenario H for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario H	Australia	$72.8	$36.9	$35.9	2.0
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario H	New Zealand	$16.3	$5.1	$11.3	3.2

By modelling a shadow price for CO_2, any possible effect of the Program when coupled with a future market costing of CO_2 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 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.

Scenarios I and J

Scenarios I and J examine the impact of changes in real tariffs.

Scenario I 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 76: Summary of NPV Benefits and Costs of Base Case versus Scenario I for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario I	Australia	$79.6	$36.9	$42.6	2.2
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario I	New Zealand	$18.4	$5.1	$13.3	3.6

Scenario J 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 77: Summary of NPV Benefits and Costs of Base Case versus Scenario J for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario J	Australia	$58.1	$36.9	$21.1	1.6
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario J	New Zealand	$13.4	$5.1	$8.3	2.6

By increasing energy tariffs in real terms (Scenario J), 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 (Scenario I) 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 1.5 for Australia and above 2.5 for New Zealand, indicating that the proposal is robust under a range of future tariff scenarios.

Scenarios K and L

Under Scenarios K and L, 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.

Scenario K assumptions for analysis are the same as Base Case except that the purchase price escalation factor is set to increase at 1.0% per annum above the base case.

Table 78: Summary of NPV Benefits and Costs of Base Case versus Scenario K for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario K	Australia	$67.9	$40.4	$27.5	1.7
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario K	New Zealand	$15.7	$5.6	$10.1	2.8

Scenario L assumptions for analysis are the same as Base Case except that the purchase price escalation factor is set to increase at 1.0% per annum below the base case.

Table 79: Summary of NPV Benefits and Costs of Base Case versus Scenario L for Australia and New Zealand

Scenario	Country	NPV Benefits ($m)	NPV Costs ($m)	Net Benefit ($m)	B/C Ratio
Base Case	Australia	$67.9	$36.9	$31.0	1.8
Scenario L	Australia	$67.9	$33.8	$34.1	2.0
Base Case	New Zealand	$15.7	$5.1	$10.6	3.1
Scenario L	New Zealand	$15.7	$4.6	$11.1	3.4

The price escalation factor for refrigerators and freezers assesses the impact of changes to real prices of appliances in comparison to the base case. For both refrigerators and freezers, 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 Expected Impact 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 Scenarios K and L arise due to the impact of the price-energy coefficient assumed (refer to Scenarios E and F). In Scenario K, 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 Scenario K, the apparent benefit-cost ratio will decline slightly, although the effect is small. Conversely, in Scenario L the opposite effect increases the benefit-cost ratio. The same effect could be simulated using an escalation in price-energy coefficients (Scenarios E and F consider only a static relationship between price and efficiency).

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Other Data Sources

This report includes unpublished analysis of GfK data for 2006 for Australia. This data will be fully analysed for all whitegoods for the Greening Whitegoods report, 2007, to be released in the near future.

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 refrigerators and freezers, which is not publicly available.

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Appendix 1: Projected Refrigerator and Freezer Sales for Australia and New Zealand

Table 80: Projected Refrigerator Sales for Australia and New Zealand

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	NZ	Australia
2005	296207	195272	224435	56474	100337	24499	7038	15509	137966	919771
2006	286846	197168	218364	59598	98890	22806	7379	15311	135954	906362
2007	284460	199213	216416	61754	98311	21805	7657	15314	135740	904930
2008	285328	201535	217279	63793	98492	21269	8064	15421	136677	911181
2009	288669	204045	219237	65816	99572	21030	8213	15423	138301	922005
2010	288467	206813	216289	68815	99439	19935	8659	15445	138579	923862
2011	296645	210079	221202	69905	102277	20080	9048	15496	141710	944732
2012	303019	213138	224688	70699	104722	20119	9147	15589	144168	961121
2013	308114	216913	227121	71585	107218	20217	9339	15582	146413	976089
2014	312590	221046	229561	72015	109703	20554	9449	15496	148562	990414
2015	316537	225446	232926	72147	112051	21024	9595	15393	150768	1005119
2016	319851	229286	236974	71550	114208	21502	9370	15359	152715	1018100
2017	323112	233037	242580	70890	116212	22096	9223	15341	154874	1032491
2018	326656	235549	249727	69843	118250	22594	9067	15635	157098	1047321
2019	331291	237838	258098	69245	120557	23436	8955	16070	159824	1065490
2020	335810	239796	266376	68556	122474	23838	8926	16552	162349	1082328

Source: EES Stock Model, assumed 16 year life

Table 81: Projected Freezer Sales for Australia and New Zealand

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	NZ	Australia
2005	58926	54837	46132	13324	35815	8488	1565	5643	31462	224730
2006	50445	42681	42517	14598	31427	6779	2063	4875	27354	195385
2007	48440	40757	41461	15126	29456	6542	1982	4307	26330	188071
2008	46153	39395	40763	15404	28190	6323	1892	3835	25474	181955
2009	44125	38131	40260	15605	27254	6155	1724	3385	24729	176639
2010	43252	35694	39533	16648	24545	5903	1644	2792	23802	170011
2011	41270	34703	39576	15802	24504	5772	1517	2542	23196	165686
2012	39354	32778	39320	14827	23950	5584	1346	2335	22329	159494
2013	37684	30213	38799	13908	23118	5397	1221	2136	21347	152476
2014	36436	27245	38218	12994	22160	5286	1116	1943	20356	145398
2015	35642	24436	37756	12301	21272	5221	1061	1779	19526	139468
2016	35289	22280	37360	11837	20701	5190	975	1664	18941	135296
2017	35636	21234	37243	11974	20603	5242	959	1604	18829	134495
2018	36616	21410	37624	12459	21239	5356	971	1689	19231	137364
2019	38194	23011	38679	13275	22767	5741	1004	1902	20240	144573
2020	39716	25863	40370	13819	25017	6125	1032	2230	21584	154172

Source: EES Stock Model, assumed 20 year life

Appendix 2: Household Projections for Australia and New Zealand

Table 82: Household Projections for Australia and New Zealand

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Australia	New Zealand
2000	2604600	1945700	1543700	642000	789100	200600	66000	128300	7920000	1526000
2001	2640155	1971851	1580935	647053.1	805396.3	202102	67570.42	129745.5	8044808	1548000
2002	2675718	1999429	1619254	652260.5	821348.3	203453.4	68736.23	131469.7	8171669	1566200
2003	2711218	2026956	1657504	657458.4	837271.2	204802.4	69899.92	133190.7	8298300	1584600
2004	2746652	2054433	1695683	662646.9	853165.1	206148.9	71061.49	134908.5	8424699	1603100
2005	2782022	2081860	1733793	667825.8	869030.1	207493	72220.94	136623.3	8550869	1622000
2006	2817328	2109237	1771834	672995.4	884866.2	208834.7	73378.28	138334.9	8676809	1641000
2007	2852569	2136565	1809806	678155.6	900673.5	210173.9	74533.52	140043.4	8802519	1659000
2008	2887746	2163842	1847708	683306.3	916452	211510.6	75686.65	141748.8	8928001	1677200
2009	2922859	2191070	1885542	688447.7	932201.7	212844.9	76837.68	143451.1	9053254	1695600
2010	2957909	2218249	1923306	693579.7	947922.8	214176.8	77986.62	145150.3	9178280	1714200
2011	2992894	2245377	1961002	698702.4	963615.3	215506.3	79133.46	146846.4	9303077	1733000
2012	3027816	2272457	1998629	703815.7	979279.2	216833.3	80278.22	148539.4	9427648	1749700
2013	3062674	2299487	2036188	708919.8	994914.6	218158	81420.89	150229.4	9551991	1766500
2014	3097469	2326468	2073678	714014.5	1010521	219480.2	82561.48	151916.2	9676109	1783500
2015	3132200	2353400	2111100	719100	1026100	220800	83700	153600	9800000	1800700
2016	2604600	1945700	1543700	642000	789100	200600	66000	128300	7920000	1526000
2017	2640155	1971851	1580935	647053.1	805396.3	202102	67570.42	129745.5	8044808	1548000
2018	2675718	1999429	1619254	652260.5	821348.3	203453.4	68736.23	131469.7	8171669	1566200
2019	2711218	2026956	1657504	657458.4	837271.2	204802.4	69899.92	133190.7	8298300	1584600
2020	2746652	2054433	1695683	662646.9	853165.1	206148.9	71061.49	134908.5	8424699	1603100

Source: Data from 2001 is from ABS3236-2004 Series III and ABS3101 with adjustments – refer RIS Guide (GWA 2005).

Appendix 3: Nominal and Real Prices for Refrigerators

Table 83: Nominal and Real Prices for Refrigerators

	Group	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	Change pa
Nominal Price	1	$752	$784	$821	$808	$812	$797	$842	$875	$889	$886	$870	$909	$971	$903	
Real Price	1	$1053	$1078	$1093	$1033	$1024	$1005	$1049	$1064	$1020	$989	$941	$961	$1002	$903	-1.2%
Nominal Price	2	$311	$320	$337	$342	$327	$323	$309	$298	$307	$297	$286	$265	$274	$257	
Real Price	2	$436	$440	$449	$437	$412	$407	$384	$363	$353	$331	$310	$280	$282	$257	-4.0%
Nominal Price	3	$338	$337	$526	$436	$504				$505	$596	$748	$1641	$1638	$261	
Real Price	3	$473	$463	$701	$557	$636				$580	$665	$809	$1735	$1690	$261	-4.5%
Nominal Price	4	$778	$801	$805	$822	$840	$786	$773	$742	$764	$776	$758	$694	$672	$2309*	
Real Price	4	$1089	$1101	$1073	$1051	$1059	$992	$963	$902	$876	$865	$821	$734	$693	$2309*	6.0%
Nominal Price	5T	$1218	$1202	$1265	$1251	$1102	$1013	$944	$911	$958	$937	$914	$910	$908	$870	
Real Price	5T	$1704	$1652	$1685	$1599	$1389	$1277	$1176	$1108	$1100	$1045	$989	$962	$937	$870	-5.0%
Nominal Price	5B	$1262	$1307	$1235	$1221	$1333	$1353	$1340	$1374	$1484	$1487	$1516	$1437	$1487	$1514	
Real Price	5B	$1766	$1796	$1645	$1560	$1681	$1706	$1669	$1672	$1703	$1659	$1641	$1519	$1534	$1514	-1.2%
Nominal Price	5S	$2099	$2222	$2505	$2817	$2331	$2296	$2118	$2107	$2997	$2924	$2716	$2307	$2131	$2046	
Real Price	5S	$2937	$3053	$3336	$3600	$2940	$2895	$2638	$2564	$3439	$3262	$2939	$2439	$2199	$2046	-2.7%

Group 4 has a price anomaly for 2005-06. This is due to the extremely small sample size, as any slight changes in average price will have a large impact on the Group as a whole. Note that prices have not been corrected for compartment volume.

Figure 44: Nominal vs Real Prices for Group 1

Figure 45: Nominal vs Real Prices for Group 2

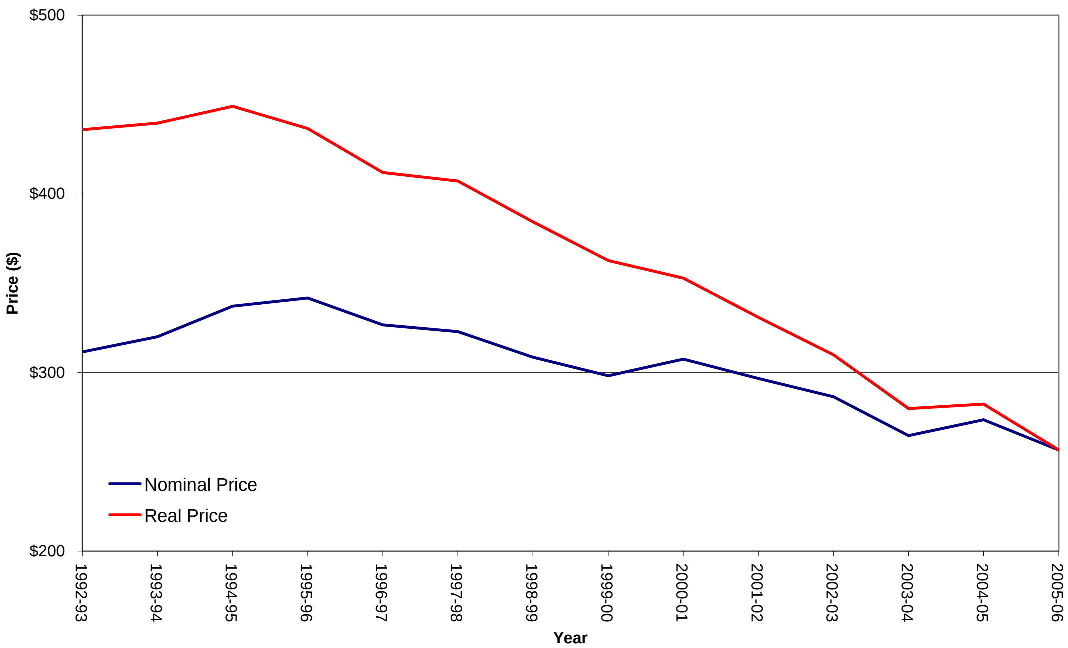
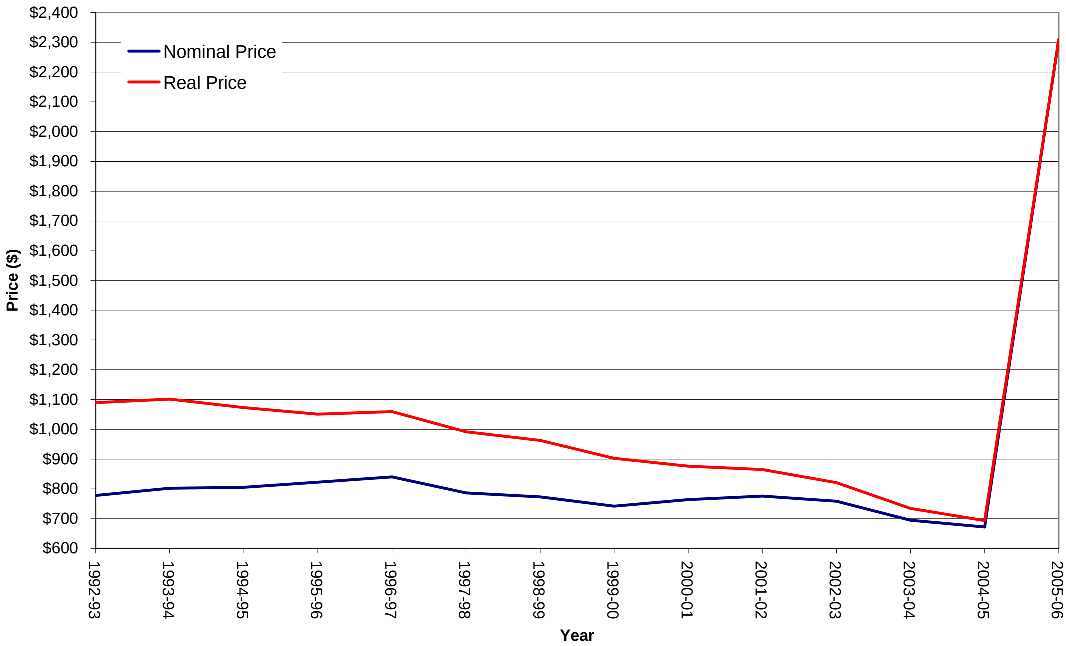


Figure 46: Nominal vs real Prices for Group 3

Note: Very few Group 3 models were present on the market after 1996.

Figure 47: Nominal vs Real Prices for Group 4



Note: Very few Group 4 models were present on the market after 2004. The few remaining models are high end European products.

Figure 48: Nominal vs Real Prices for Group 5T

Figure 49: Nominal vs Real Prices for Group 5B

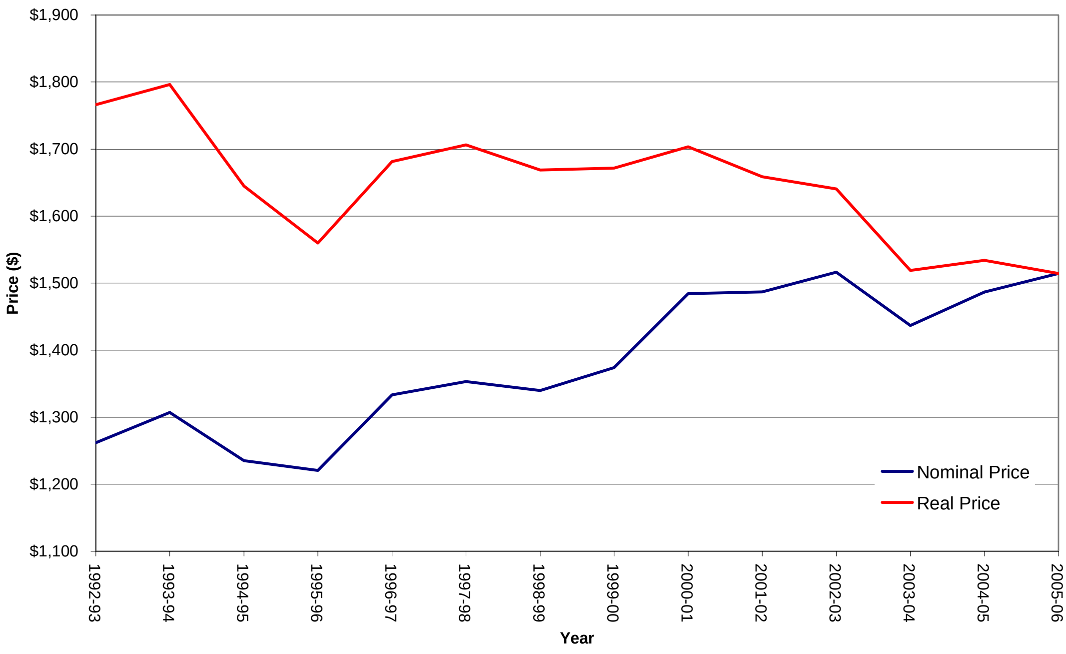
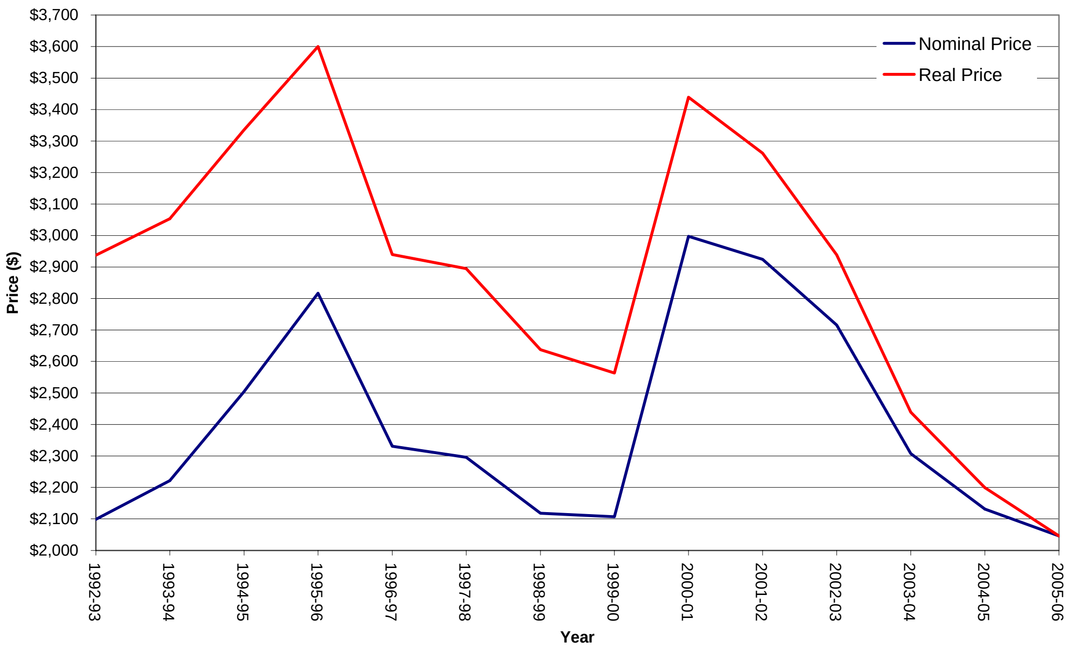


Figure 50: Nominal vs Real Prices for Group 5S



Note: The discontinuity between 1999 and 2000 is an artefact of the data set provided by GfK rather than a real change is real or nominal prices.

Appendix 4: Nominal and Real Prices for Freezers

Table 84: Nominal vs Real Prices for Freezers

	Group	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	Change pa
Nominal Price	6U	$460	$497	$516	$543	$517	$512	$474	$461	$486	$486	$479	$385	$328	$330	
Real Price	6U	$644	$683	$688	$694	$652	$645	$590	$561	$558	$542	$518	$407	$339	$330	-5.0%
Nominal Price	6C	$465	$445	$491	$533	$500	$495	$503	$488	$538	$513	$513	$524	$519	$495	
Real Price	6C	$650	$611	$654	$681	$630	$624	$627	$594	$617	$573	$555	$554	$536	$495	-2.1%
Nominal Price	7	$978	$1016	$1071	$1086	$1078	$1055	$1046	$1024	$1023	$1020	$1033	$1042	$1104	$1159	
Real Price	7	$368	$1397	$1426	$1387	$1359	$1330	$1302	$1246	$1174	$1138	$1118	$1102	$1139	$1159	-1.3%

Note that prices have not been corrected for compartment volume.

Figure 51: Nominal vs Real Prices for Group 6U

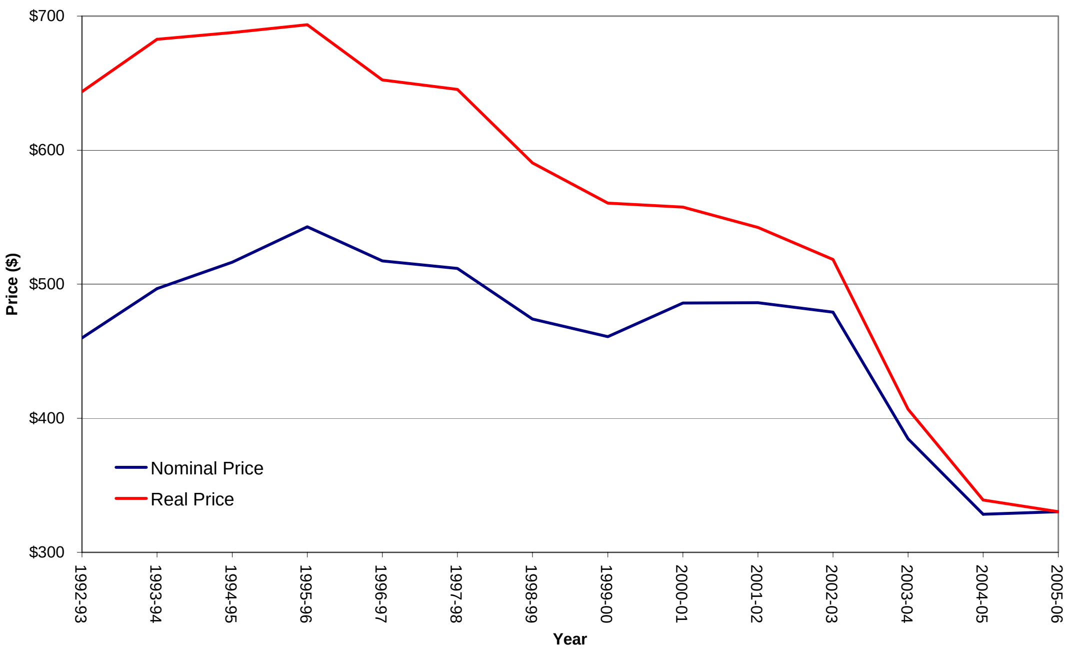


Figure 52: Nominal vs Real Prices for Group 6C

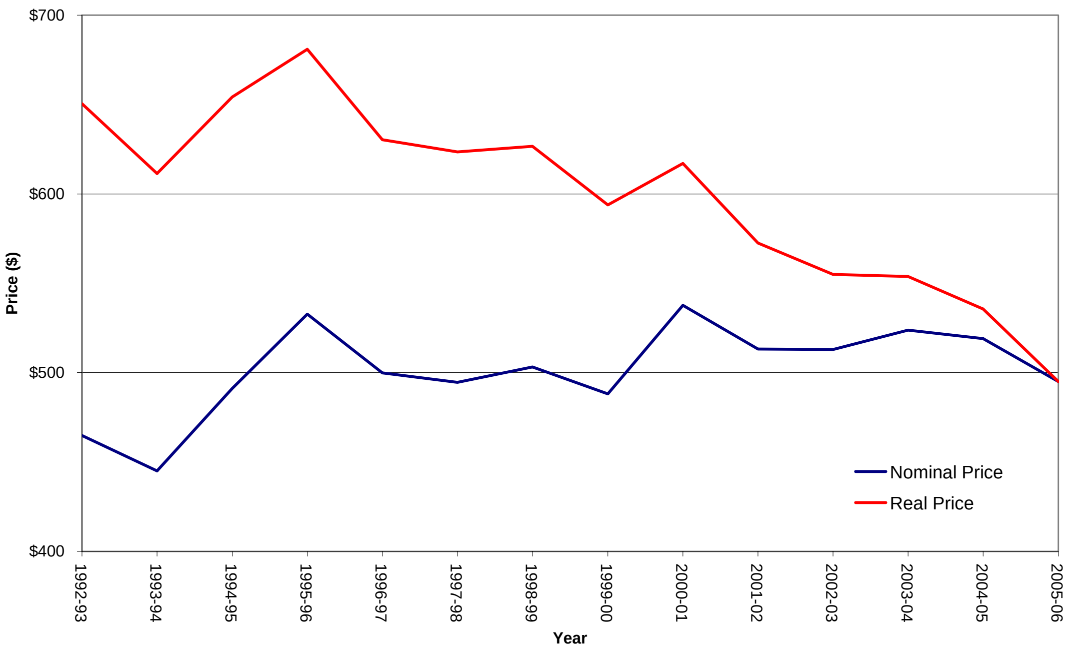
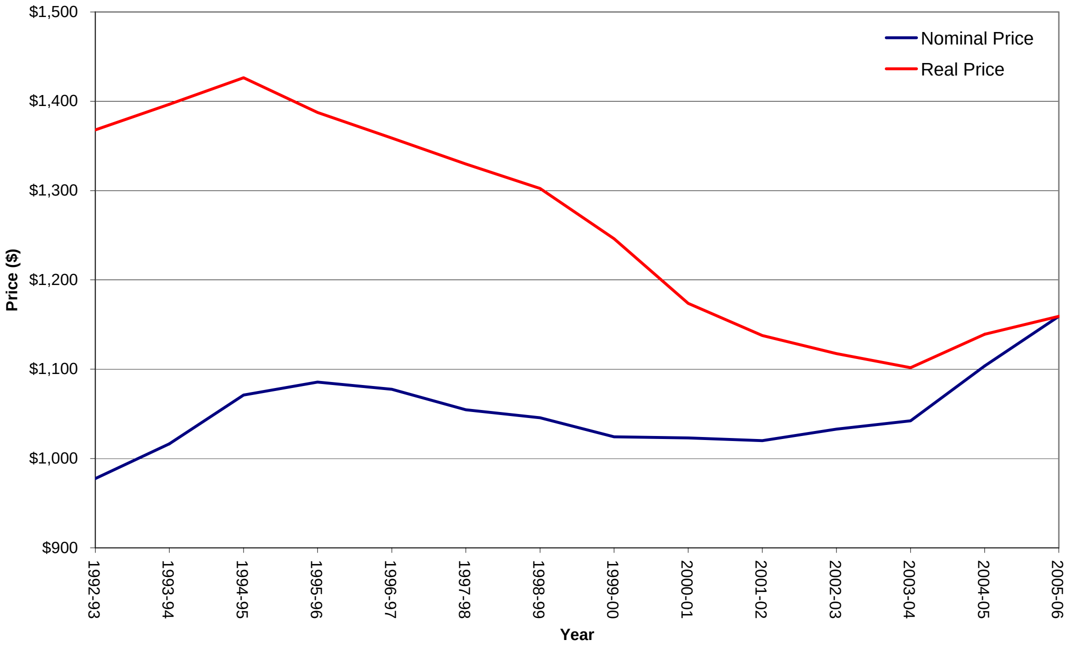


Figure 53: Nominal vs Real Prices for Group



Appendix 5: Changes in the Energy Consumption of Refrigerators and Freezers

In the follow two tables the values have been determined through analysis by the stock model and the column headings mean the following:

- BAU Stock Energy – the average energy consumption of all products that are installed and operating in the stock by year
- BAU New Energy – the average energy consumption of new products entering the stock by year
- Expected Impact BAU Energy – the average energy consumption of products that are installed and operating in the stock by year, after the program has been introduced
- Expected Impact New Energy – the average energy consumption of new products entering the stock by year, after the program has been introduced
- Low Impact BAU Energy – the average energy consumption of products that are installed and operating in the stock by year, if the program has lower than expected impacts
- Low Impact New Energy - the average energy consumption of new products entering the stock by year, if the program has lower than expected impacts

Table 85: kWh for Stock and New Refrigerators for Australia

Year	BAU Stock Energy	BAU New Energy	Expected Impact BAU Energy	Expected Impact New Energy	Low Impact BAU Energy	Low Impact New Energy
2000	724	588	724	588	724	588
2001	709	604	709	604	709	604
2002	695	598	695	598	695	598
2003	680	583	680	583	680	583
2004	662	525	662	525	662	525
2005	640	450	640	450	640	450
2006	619	438	619	438	619	438
2007	599	434	599	434	599	434
2008	580	430	580	430	580	430
2009	562	426	562	420	562	424
2010	545	422	544	409	545	418
2011	529	418	526	399	528	412
2012	513	413	508	388	511	405
2013	498	409	492	383	496	401
2014	484	405	476	379	481	397
2015	470	401	461	375	467	393
2016	458	397	447	371	454	389
2017	447	393	434	367	443	385
2018	436	389	422	364	432	381
2019	427	385	411	360	422	377
2020	419	381	402	356	414	373

Table 86: kWh for Stock and New Freezers for Australia

Year	BAU Stock Energy	BAU New Energy	Expected Impact BAU Energy	Expected Impact New Energy	Low Impact BAU Energy	Low Impact New Energy
2000	609	554	609	554	609	554
2001	606	558	606	558	606	558
2002	602	553	602	553	602	553
2003	597	556	597	556	597	556
2004	591	521	591	521	591	521
2005	575	377	575	377	575	377
2006	560	366	560	366	560	366
2007	546	360	546	360	546	360
2008	532	354	532	354	532	354
2009	519	348	518	343	518	346
2010	505	342	504	332	505	339
2011	492	337	490	322	491	332
2012	479	332	476	312	478	325
2013	466	328	463	308	465	321
2014	454	325	450	305	453	318
2015	442	322	438	303	441	315
2016	431	320	426	301	429	313
2017	420	318	414	299	418	312
2018	410	317	402	298	407	310
2019	399	316	390	296	396	309
2020	387	315	378	296	384	309

Figure 54: kWh/adjusted litre for Group 1 for Australia

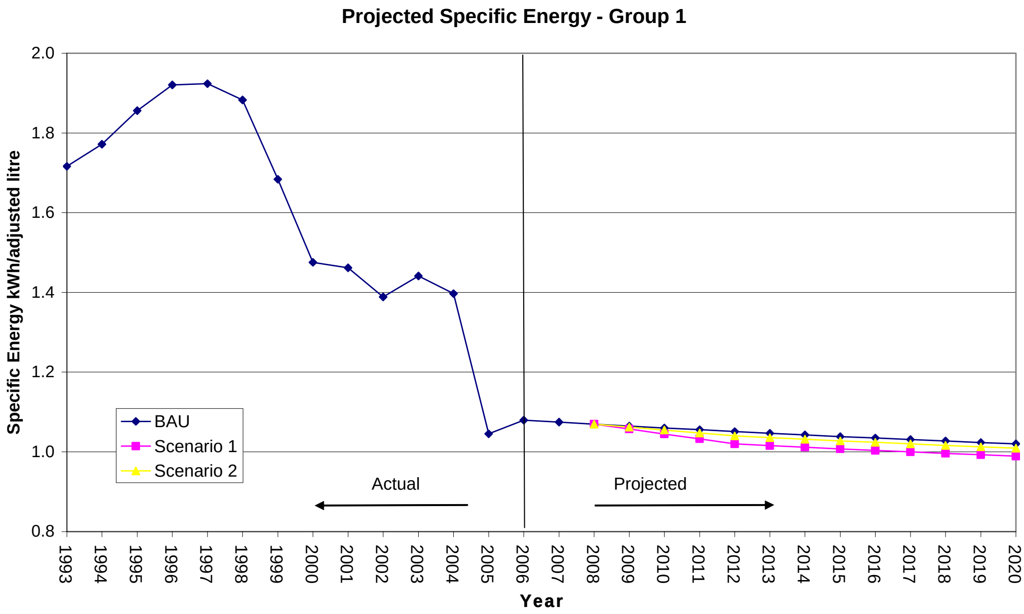


Figure 55: kWh/adjusted litre for Group 2 for Australia

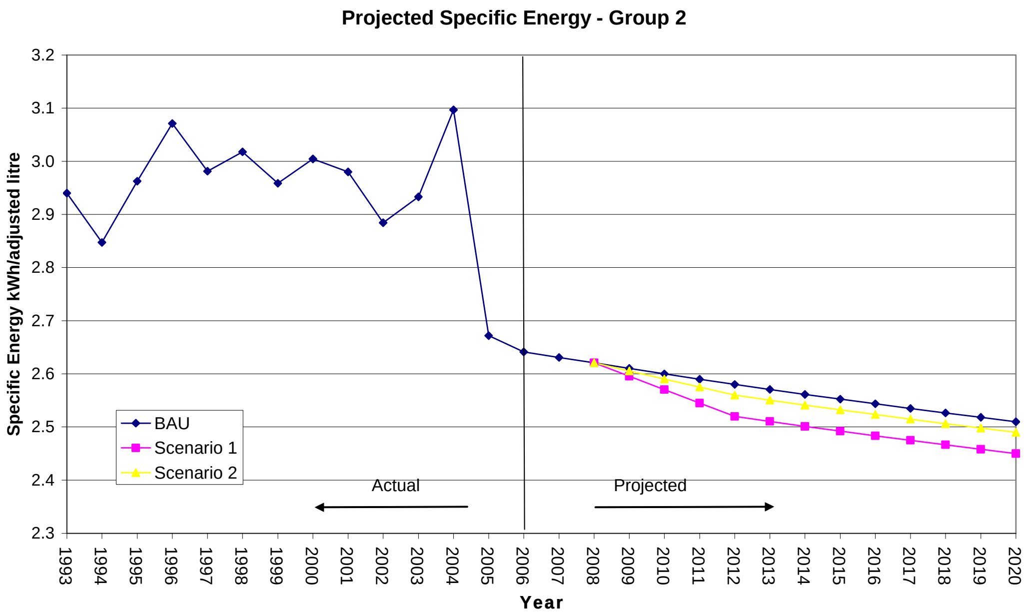


Figure 56: kWh/adjusted litre for Group 3 for Australia

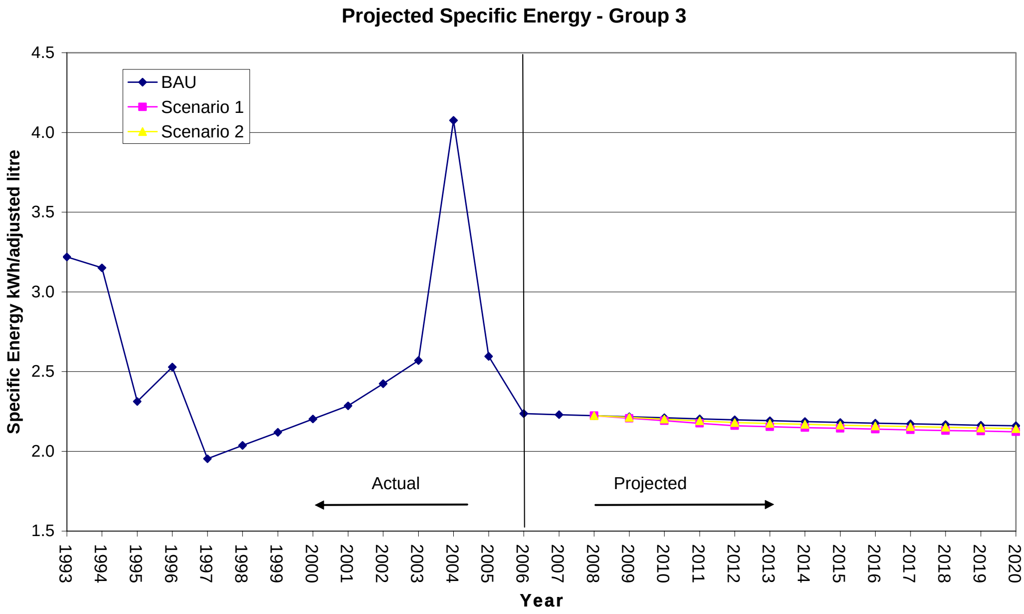


Figure 57: kWh/adjusted litre for Group 4 for Australia

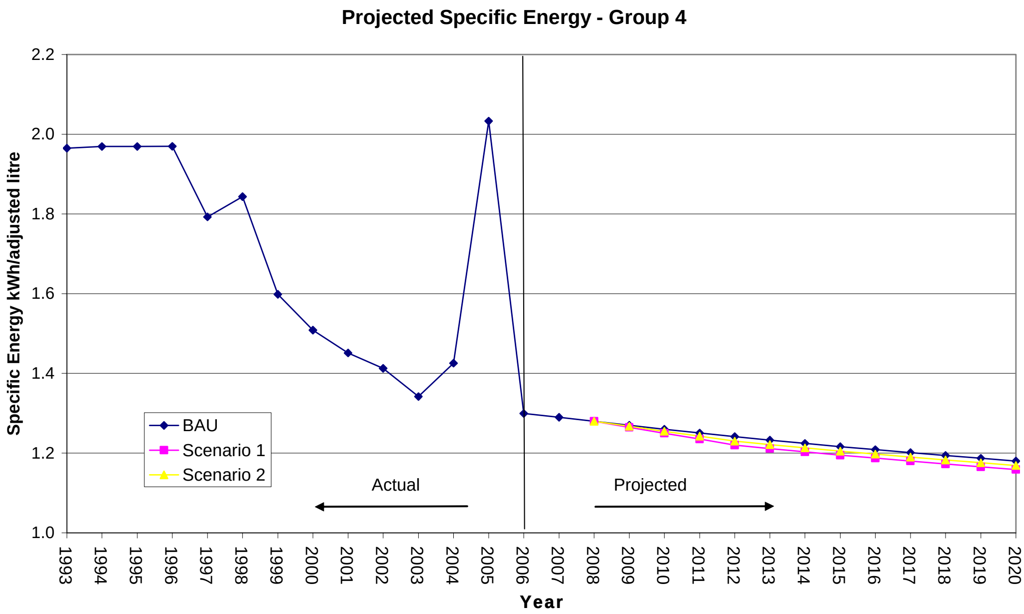


Figure 58: kWh/adjusted litre for Group 5T for Australia

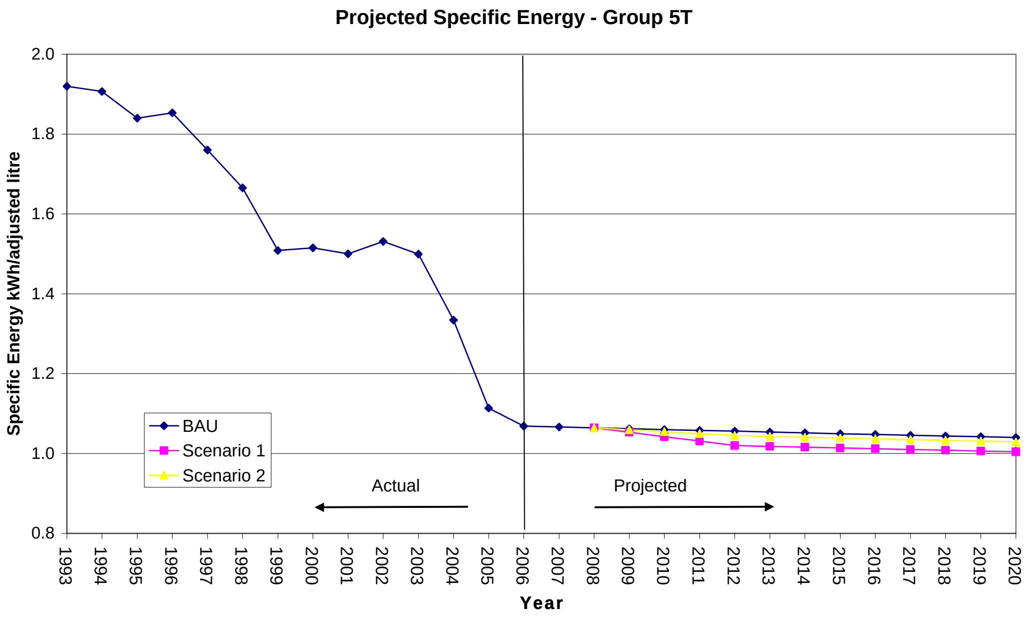


Figure 59: kWh/adjusted litre for Group 5B for Australia

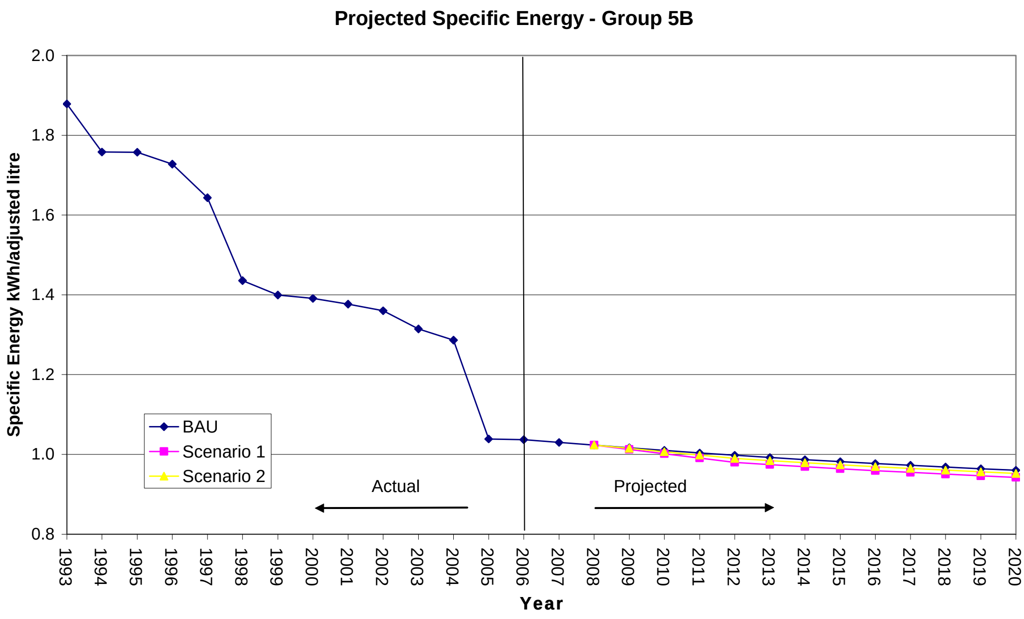


Figure 60: kWh/adjusted litre for Group 5S for Australia

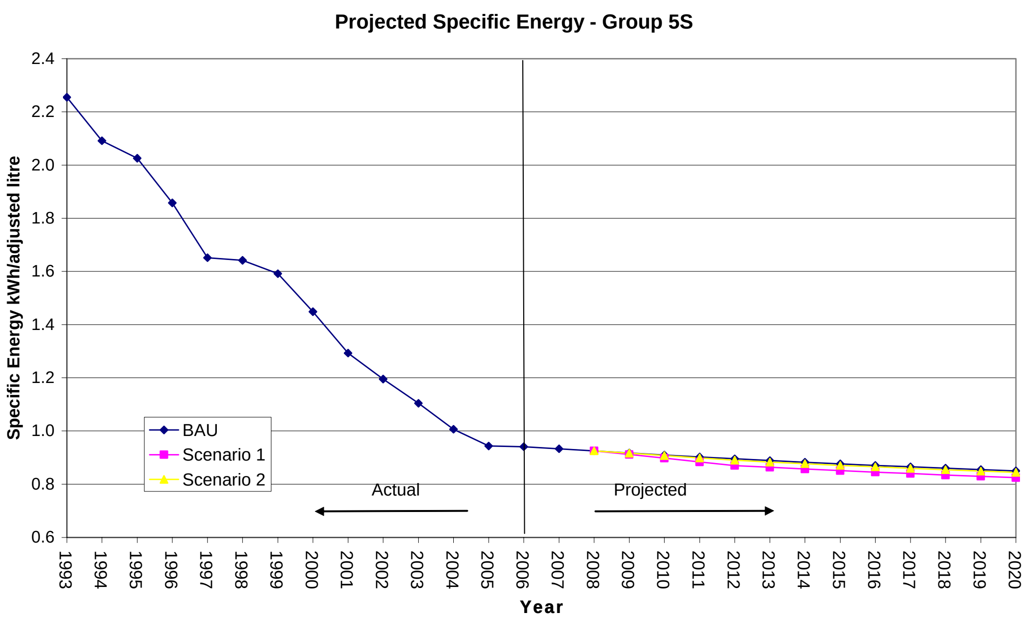


Figure 61: kWh/adjusted litre for Group 6U for Australia

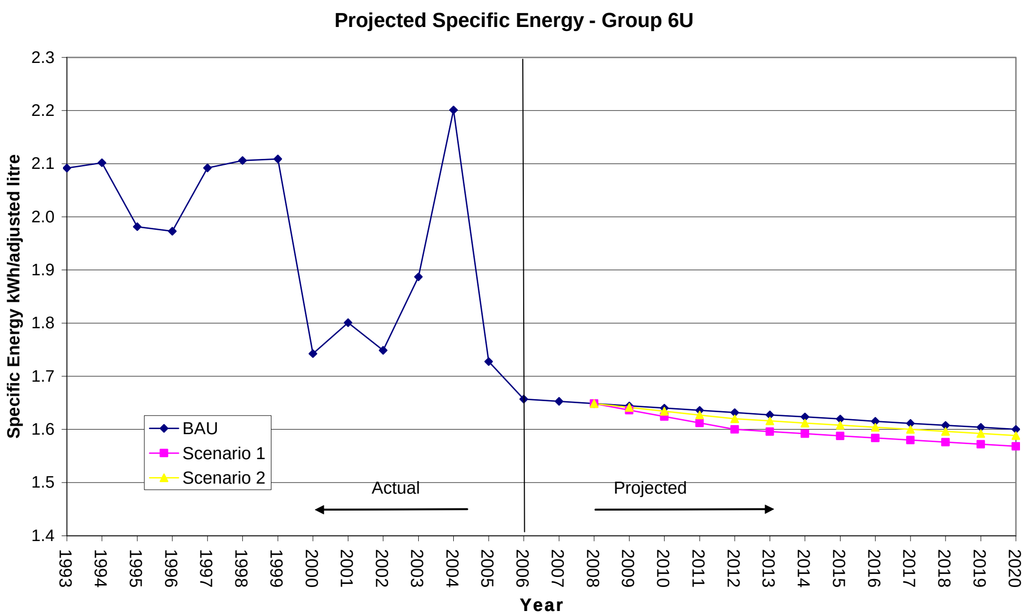


Figure 62: kWh/adjusted litre for Group 6C for Australia

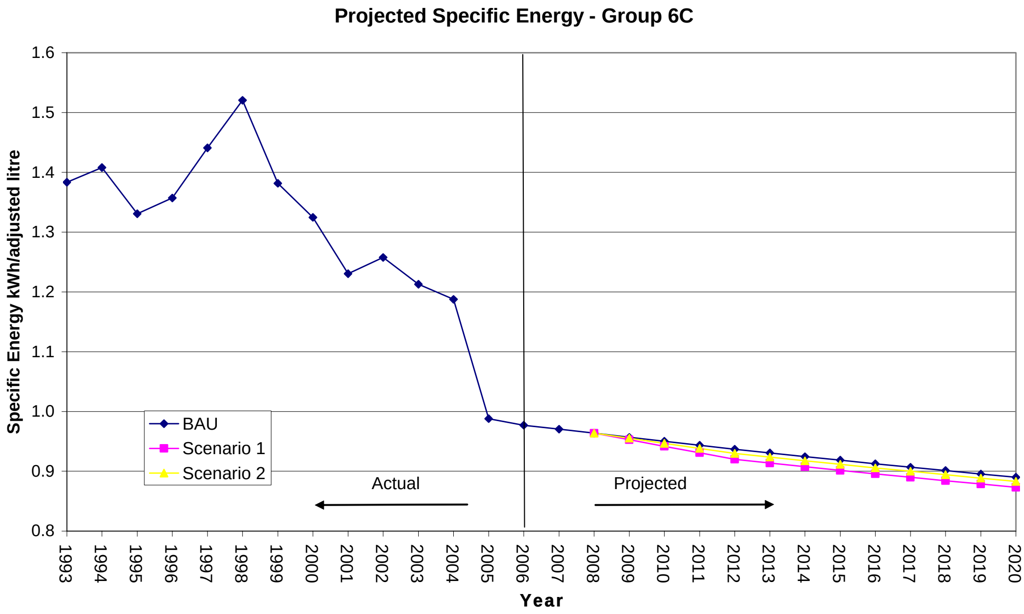
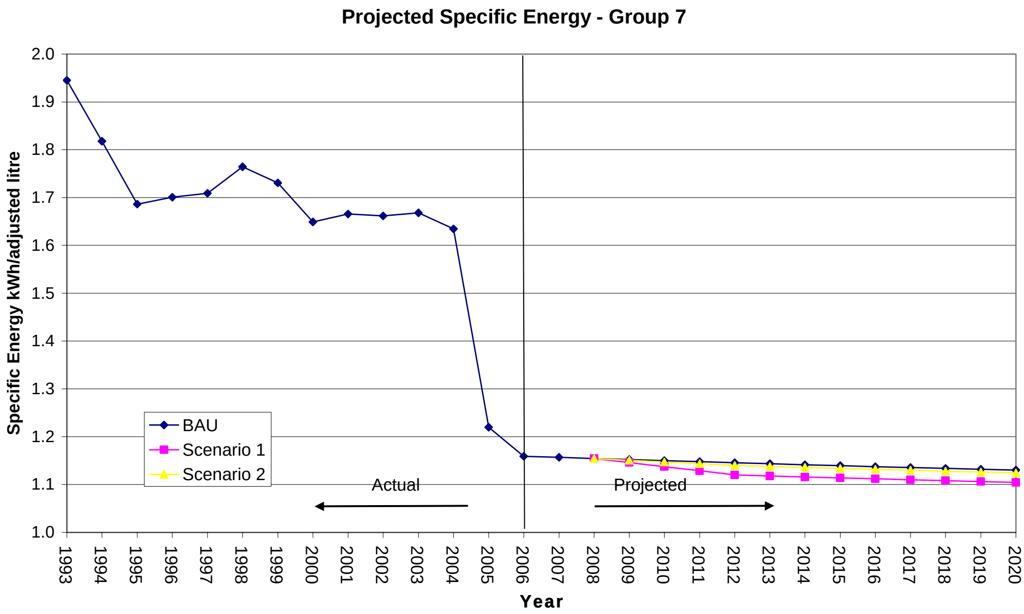


Figure 63: kWh/adjusted litre for Group 7 for Australia



Appendix 6: BAU Versus Expected Impact Costs and Benefits – Refrigerators and Freezers, Australia and New Zealand

Table 87: BAU and Expected Impact Costs and Benefits for Australian Refrigerators

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	6184	6184	0	$0.0	0	$0.0
2006	6128	6128	0	$0.0	0	$0.0
2007	6070	6070	0	$0.0	0	$0.0
2008	6011	6011	0	$0.0	0	$0.0
2009	5952	5949	2	$0.3	2	$1.4
2010	5887	5880	7	$0.9	7	$2.8
2011	5826	5812	14	$1.9	14	$4.3
2012	5768	5744	24	$3.1	23	$5.9
2013	5713	5680	34	$4.4	32	$6.0
2014	5664	5621	44	$5.8	43	$6.1
2015	5622	5569	54	$7.1	51	$6.1
2016	5587	5523	64	$8.5	60	$6.1
2017	5560	5486	74	$9.9	68	$6.2
2018	5541	5456	85	$11.2	77	$6.2
2019	5533	5438	95	$12.6	86	$6.2
2020	5536	5430	106	$14.0	94	$6.2

Note: Energy saving from products installed to 2020 continue to accrue to 2045

Table 88: BAU and Expected Impact Costs and Benefits for Australian Freezers

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1568	1568	0	$0.0	0	$0.0
2006	1539	1539	0	$0.0	0	$0.0
2007	1508	1508	0	$0.0	0	$0.0
2008	1477	1477	0	$0.0	0	$0.0
2009	1445	1445	0	$0.0	0	$0.4
2010	1412	1411	1	$0.1	1	$0.7
2011	1379	1378	1	$0.2	1	$1.0
2012	1347	1344	2	$0.3	2	$1.2
2013	1314	1311	3	$0.4	3	$1.1
2014	1283	1279	4	$0.5	4	$1.1
2015	1251	1246	5	$0.6	5	$1.0
2016	1220	1215	6	$0.8	5	$0.9
2017	1190	1183	6	$0.9	6	$0.9
2018	1159	1152	7	$1.0	6	$0.9
2019	1129	1121	8	$1.1	7	$1.0
2020	1100	1091	9	$1.2	8	$1.0

Note: Energy saving from products installed to 2020 continue to accrue to 2045

Table 89: BAU and Expected Impact Costs and Benefits for New Zealand Refrigerators

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1030	1030	0	$0.0	0	$0.0
2006	1021	1021	0	$0.0	0	$0.0
2007	1011	1011	0	$0.0	0	$0.0
2008	1001	1001	0	$0.0	0	$0.0
2009	991	991	0	$0.1	0	$0.2
2010	980	979	1	$0.2	1	$0.4
2011	970	968	2	$0.4	2	$0.6
2012	960	956	4	$0.7	3	$0.9
2013	951	946	6	$1.0	4	$0.9
2014	943	936	7	$1.2	5	$0.9
2015	936	927	9	$1.5	6	$0.9
2016	930	920	11	$1.8	7	$0.9
2017	926	913	12	$2.1	9	$0.9
2018	923	909	14	$2.4	10	$0.9
2019	921	905	16	$2.7	11	$0.9
2020	922	904	18	$3.0	12	$0.9

Note: Energy saving from products installed to 2020 continue to accrue to 2045

Table 90: BAU and Expected Impact Costs and Benefits for New Zealand Freezers

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	502	502	0	$0.0	0	$0.0
2006	493	493	0	$0.0	0	$0.0
2007	483	483	0	$0.0	0	$0.0
2008	473	473	0	$0.0	0	$0.0
2009	463	463	0	$0.0	0	$0.0
2010	452	452	0	$0.0	0	$0.1
2011	442	441	0	$0.1	0	$0.1
2012	431	430	1	$0.1	1	$0.2
2013	421	420	1	$0.2	1	$0.2
2014	411	409	1	$0.2	1	$0.1
2015	401	399	2	$0.3	1	$0.1
2016	391	389	2	$0.3	1	$0.1
2017	381	379	2	$0.3	1	$0.1
2018	371	369	2	$0.4	2	$0.1
2019	362	359	3	$0.4	2	$0.1
2020	352	349	3	$0.5	2	$0.1

Note: Energy saving from products installed to 2020 continue to accrue to 2045

Appendix 7: Figures for Cross-sectional analysis of product price and energy efficiency

The analysis in this chapter has been done on models that meet 2005 MEPS (approved in May 2007) and that have sales of greater than 100 units in 2006.

Figure 64: Group 1 Adjusted Volume v Price

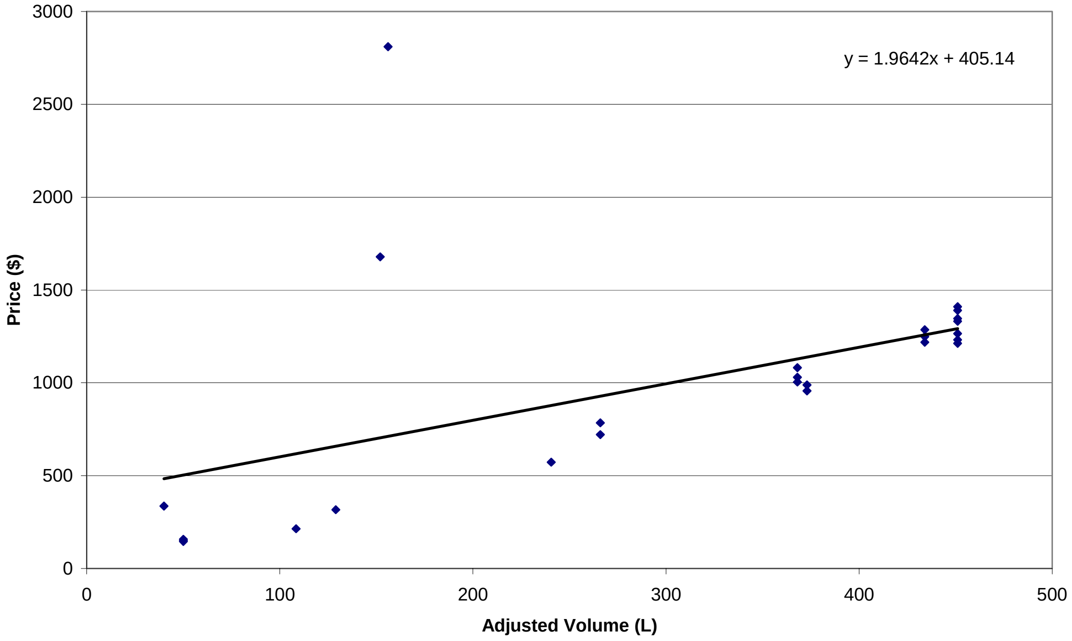


Figure 65: Group 1 Adjusted Volume v CEC

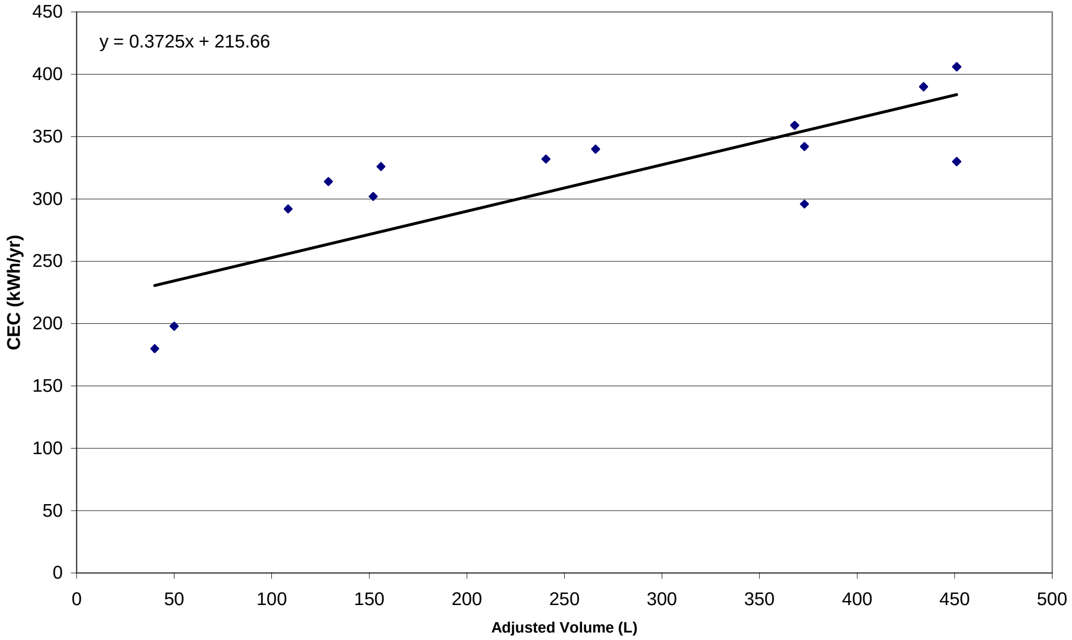


Figure 66: Group 1 Normalised Price v Normalised Energy

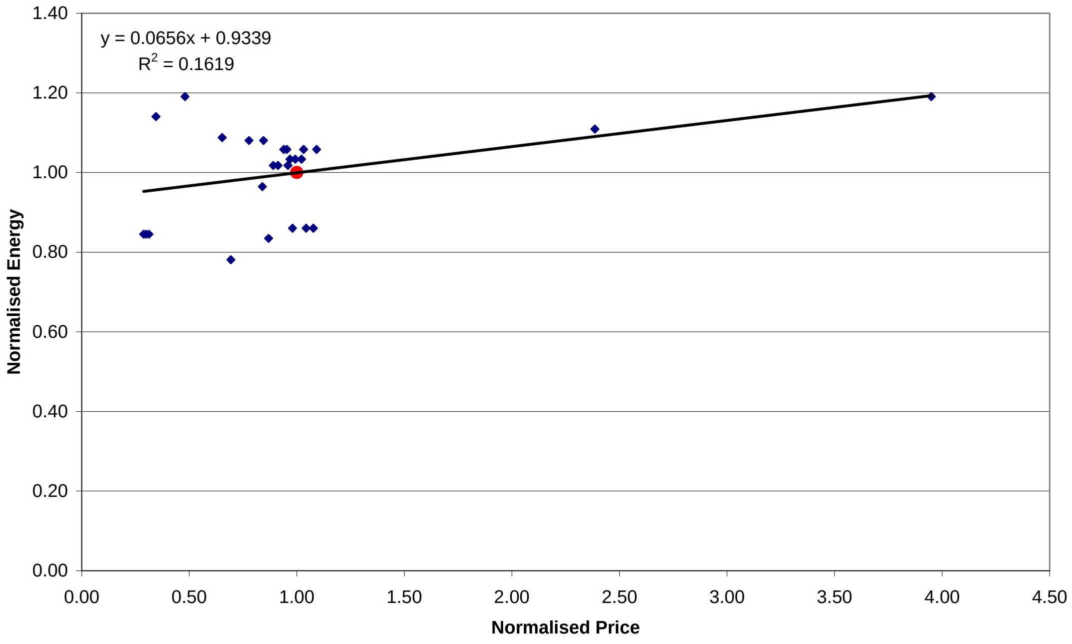


Figure 67: Group 2 Adjusted Volume v Price

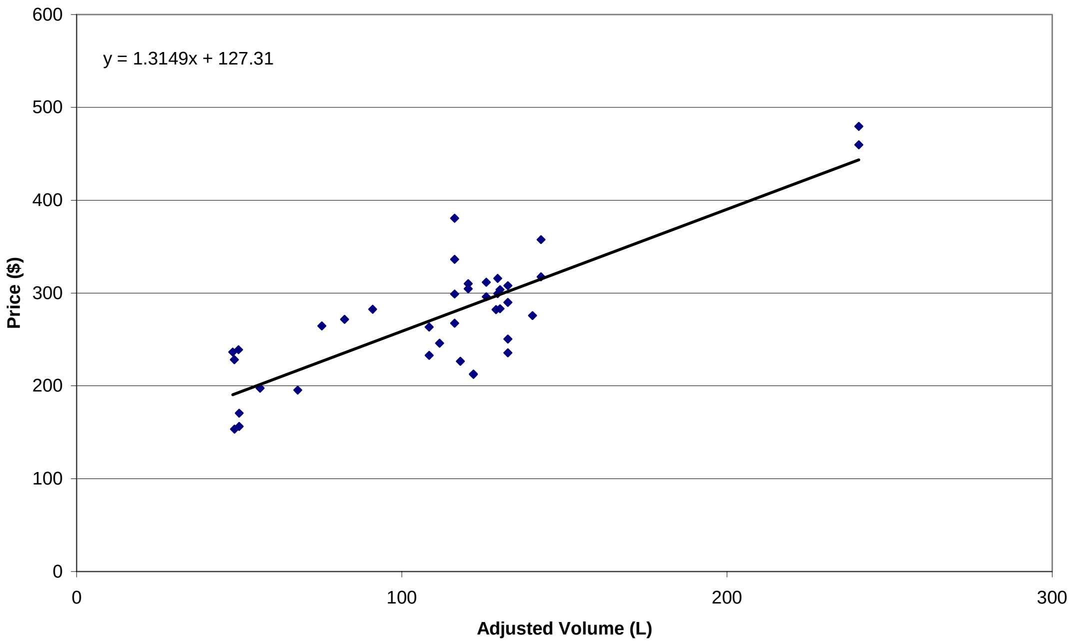


Figure 68: Group 2 Adjusted Volume v CEC

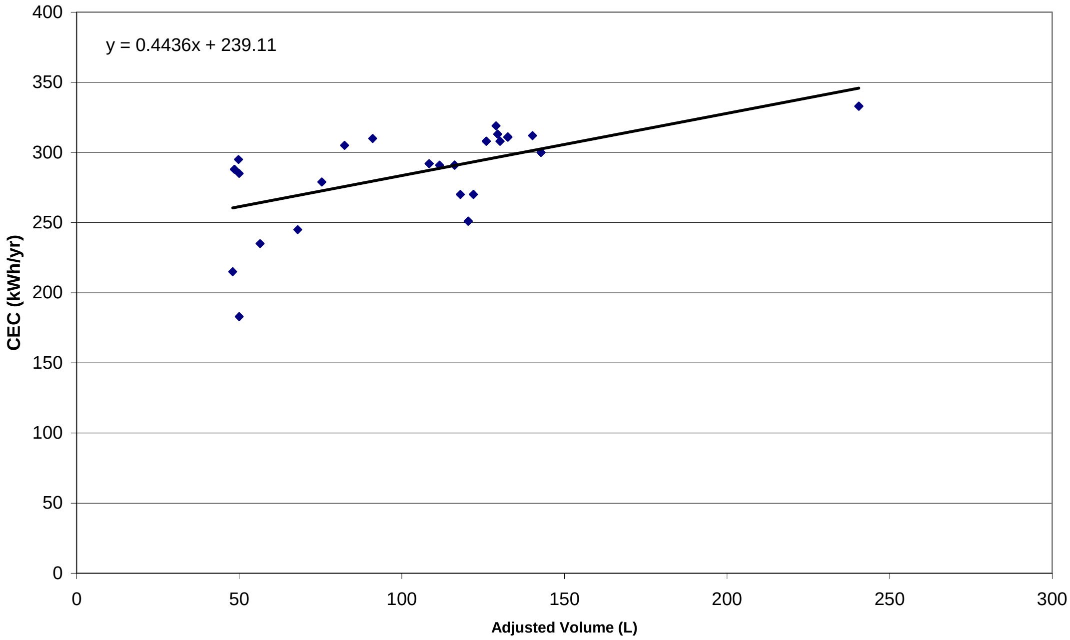


Figure 69: Group 2 Normalised Price v Normalised Energy

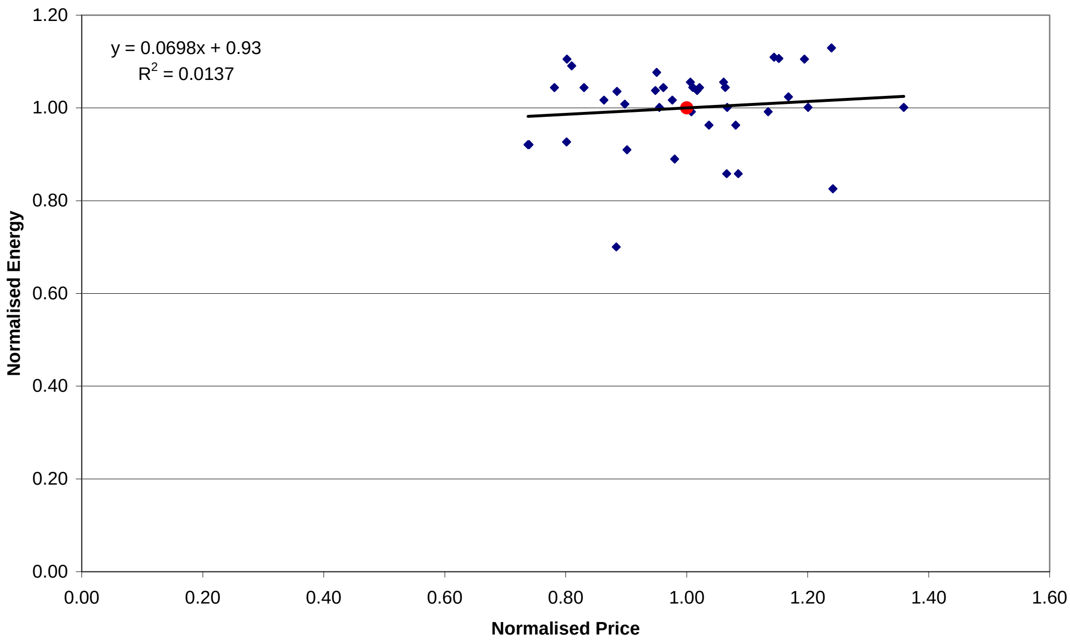


Figure 70: Group 5T Adjusted Volume v Price

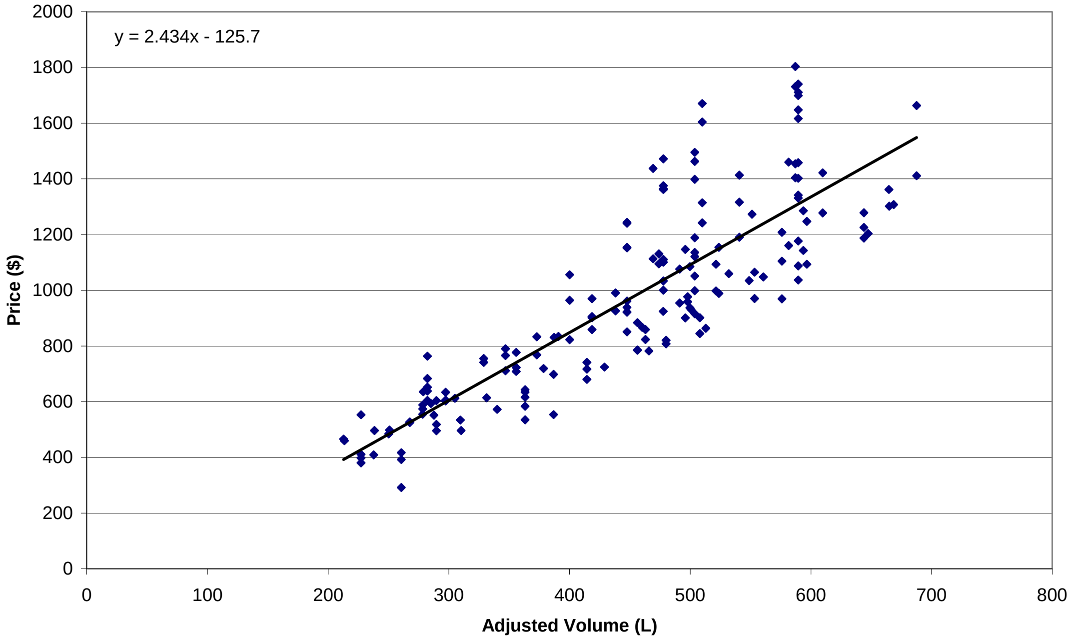


Figure 71: Group 5T Adjusted Volume v CEC

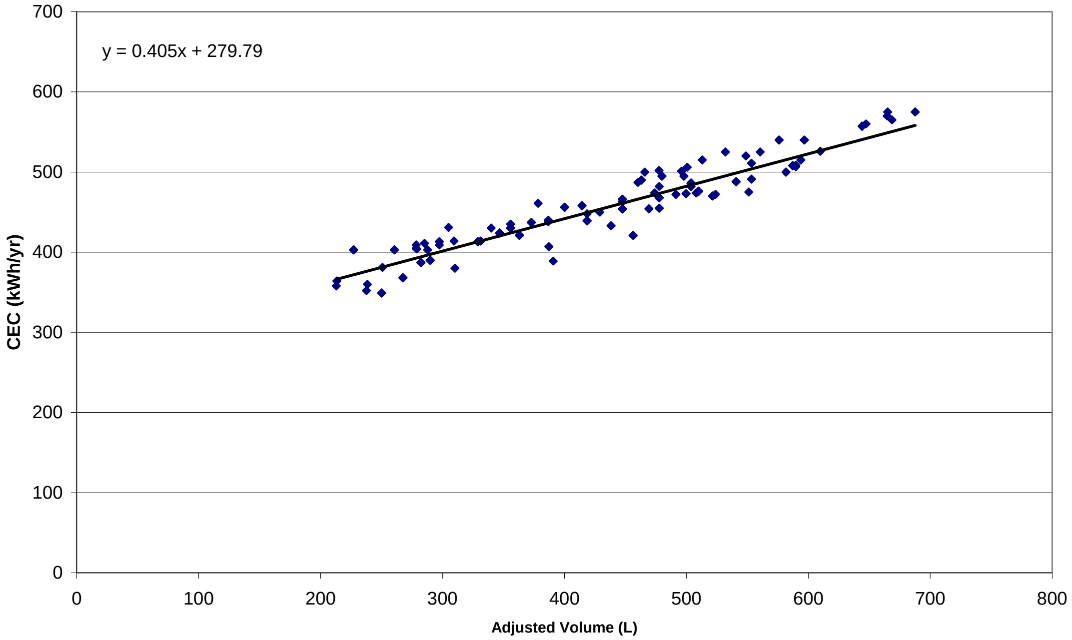


Figure 72: Group 5T Normalised Price v Normalised Energy

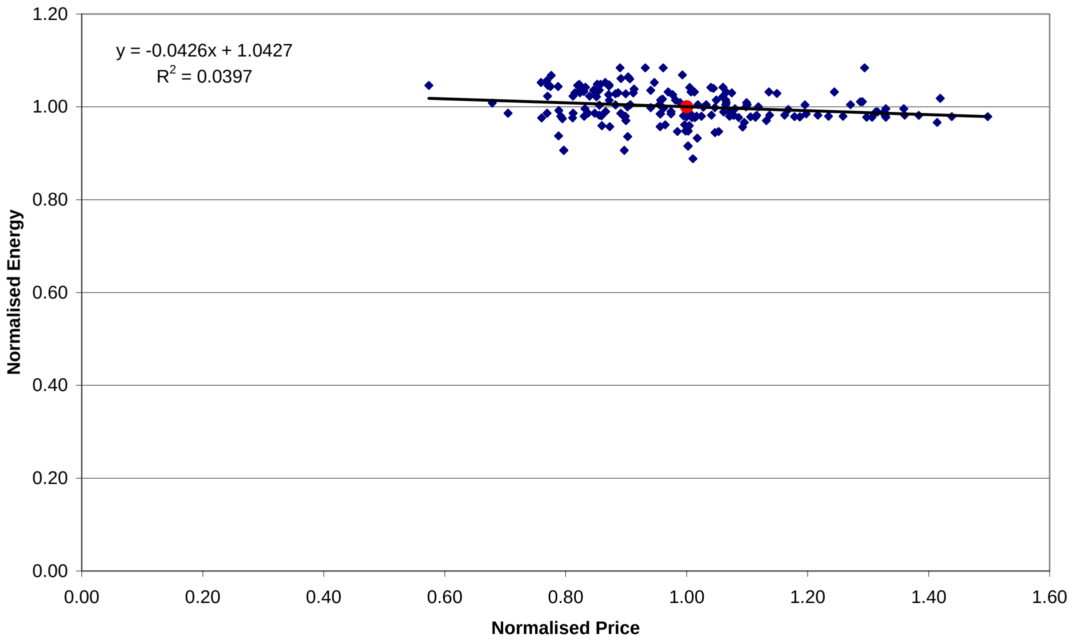


Figure 73: Group 5B Adjusted Volume v Price

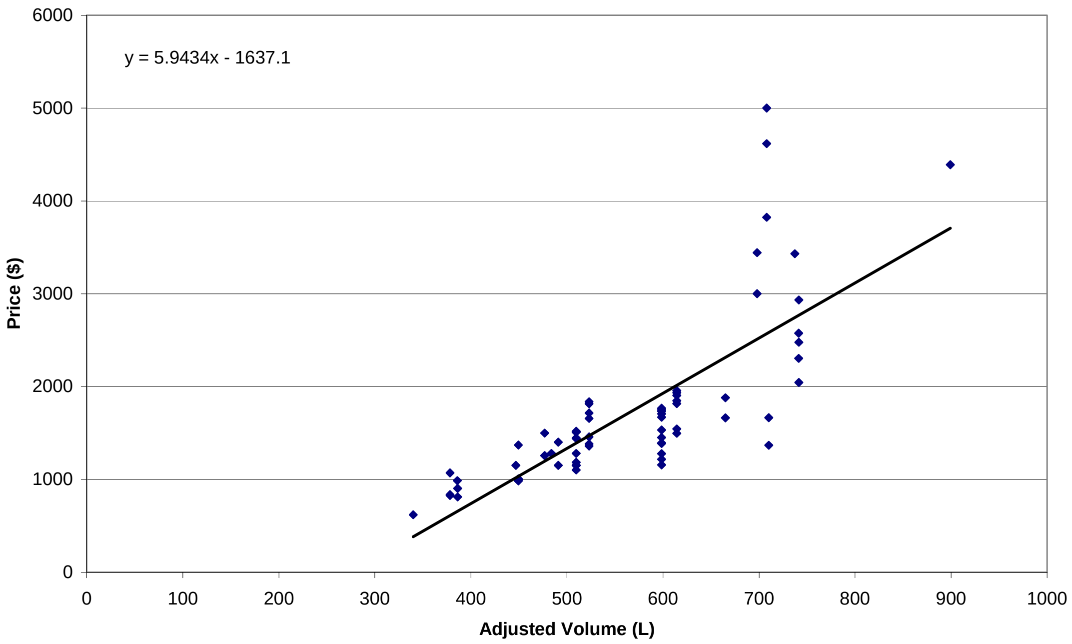


Figure 74: Group 5B Adjusted Volume v CEC

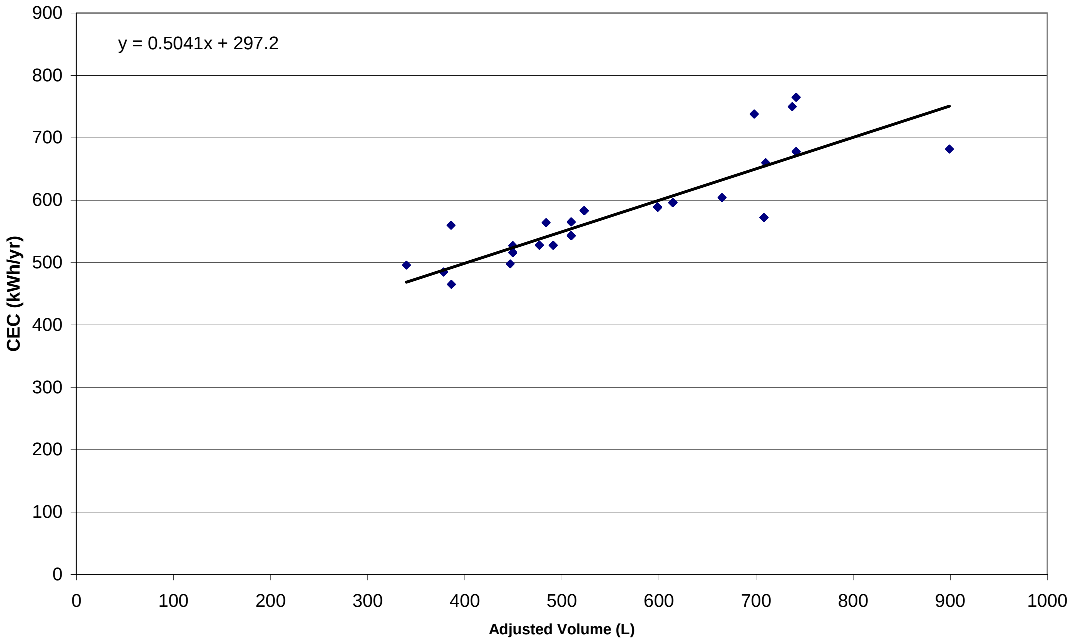


Figure 75: Group 5B Normalised Price v Normalised Energy

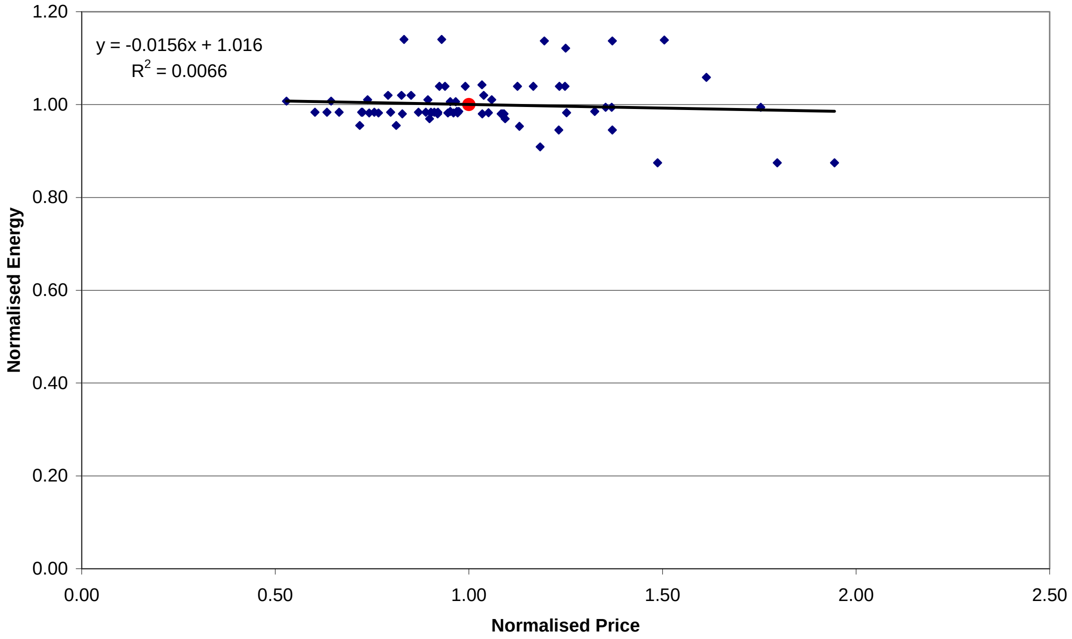


Figure 76: Group 5S Adjusted Volume v Price

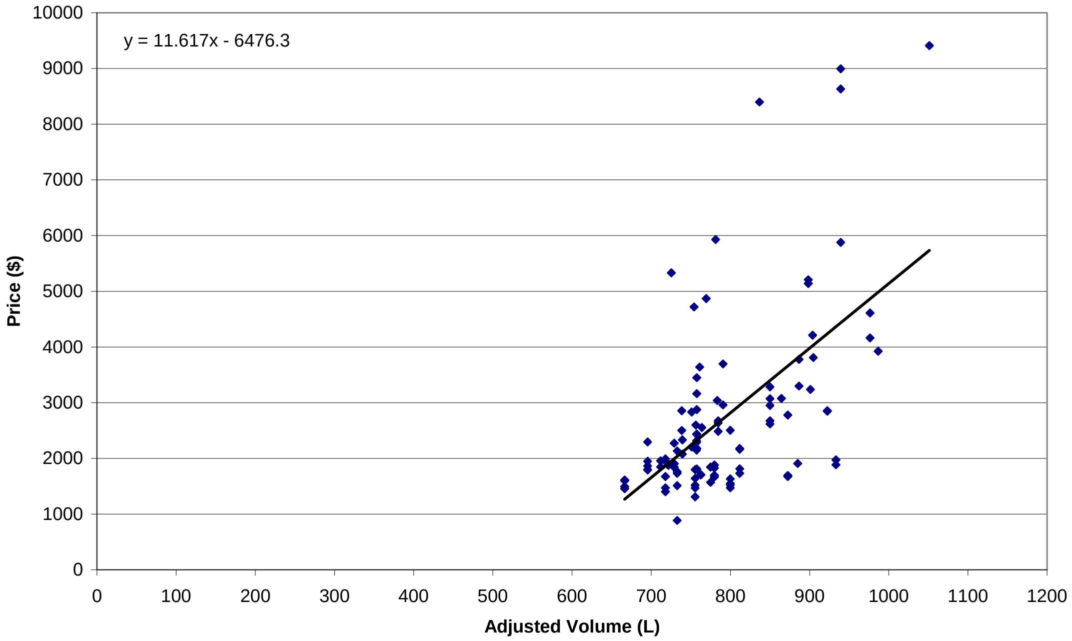


Figure 77: Group 5S Adjusted Volume v CEC

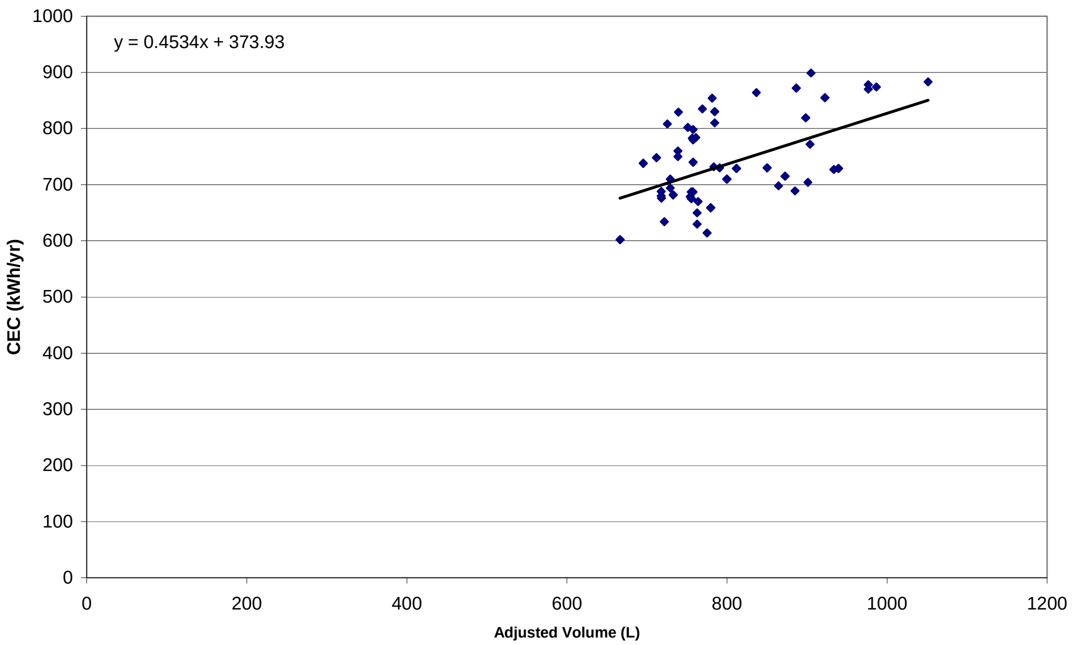


Figure 78: Group 5S Normalised Price v Normalised Energy

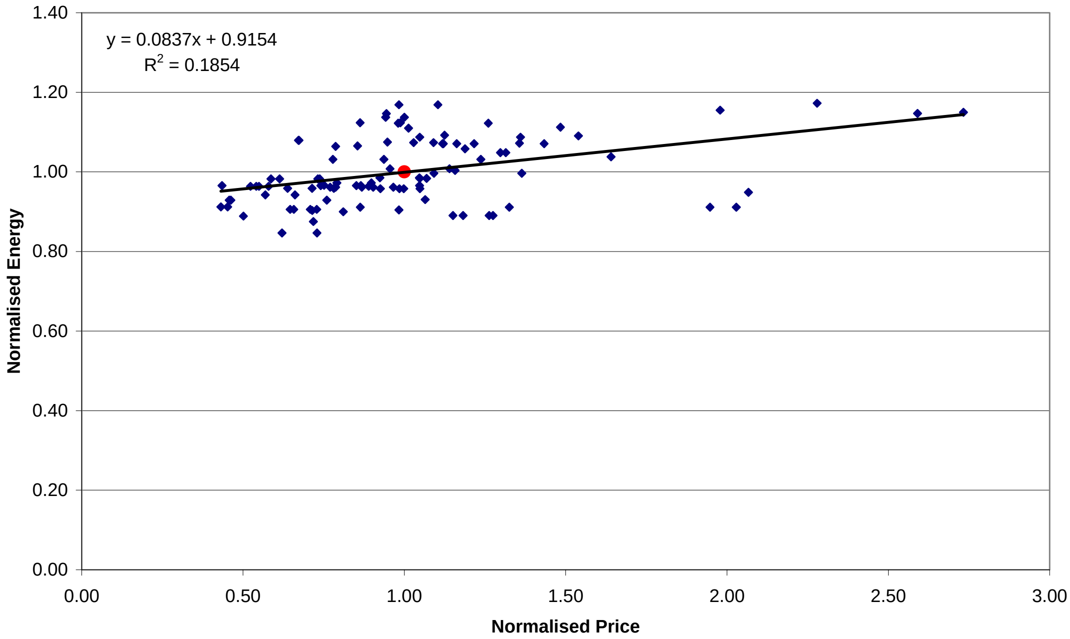


Figure 79: Group 6U Adjusted Volume v Price

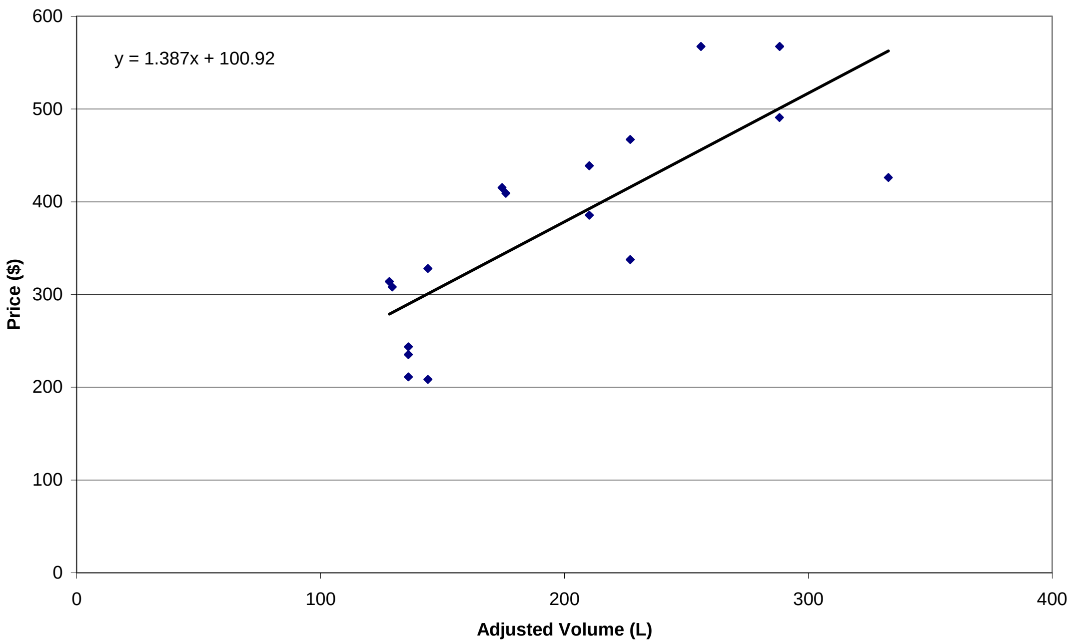


Figure 80: Group 6U Adjusted Volume v CEC

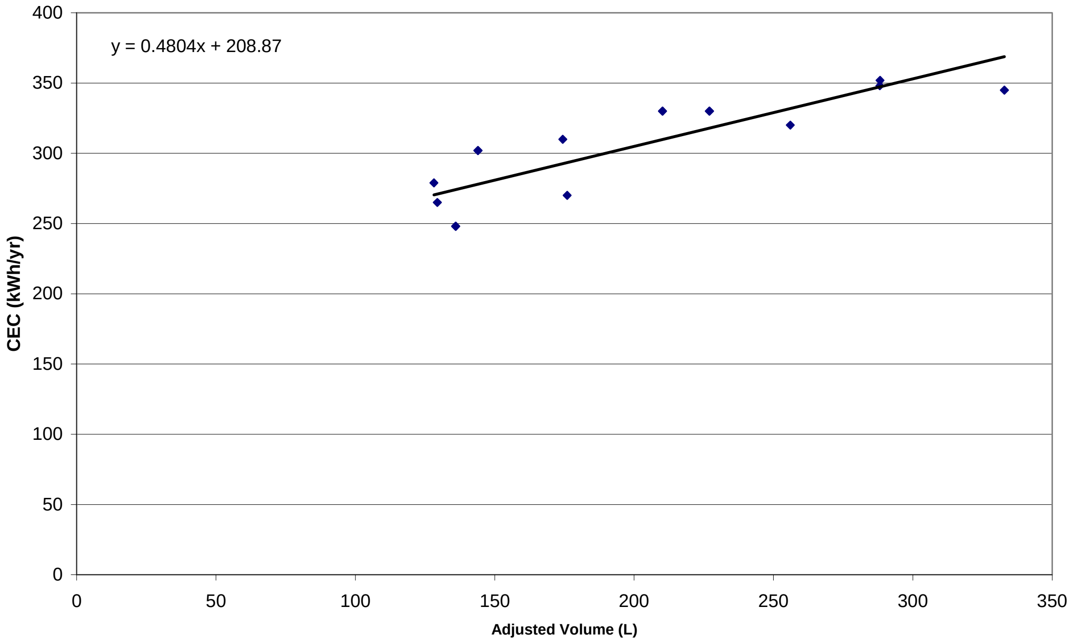


Figure 81: Group 6U Normalised Price v Normalised Energy

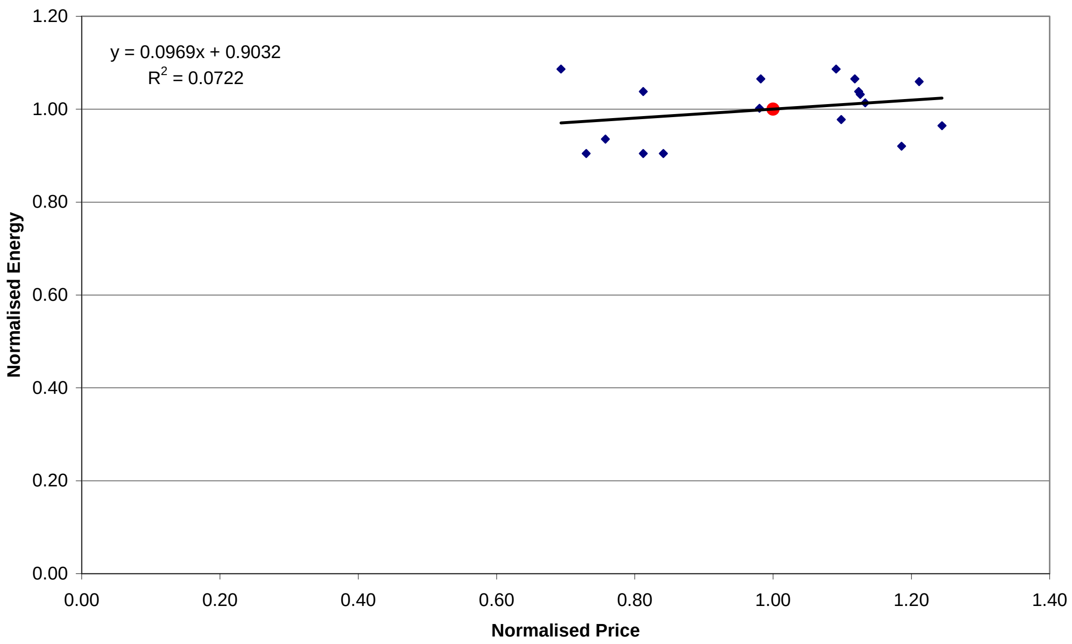


Figure 82: Group 6C Adjusted Volume v Price

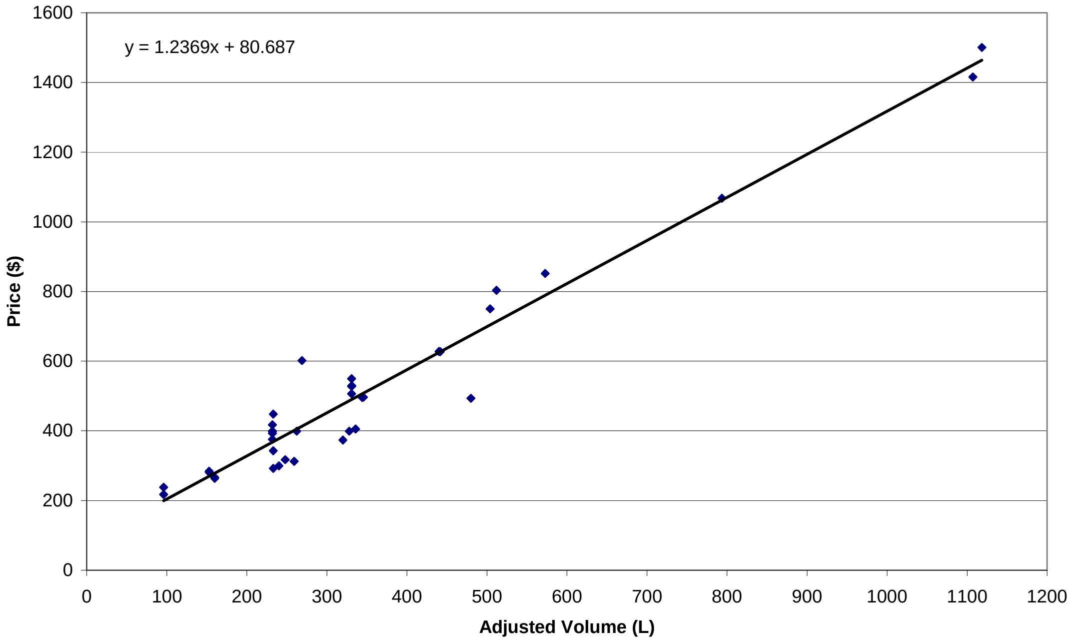


Figure 83: Group 6C Adjusted Volume v CEC

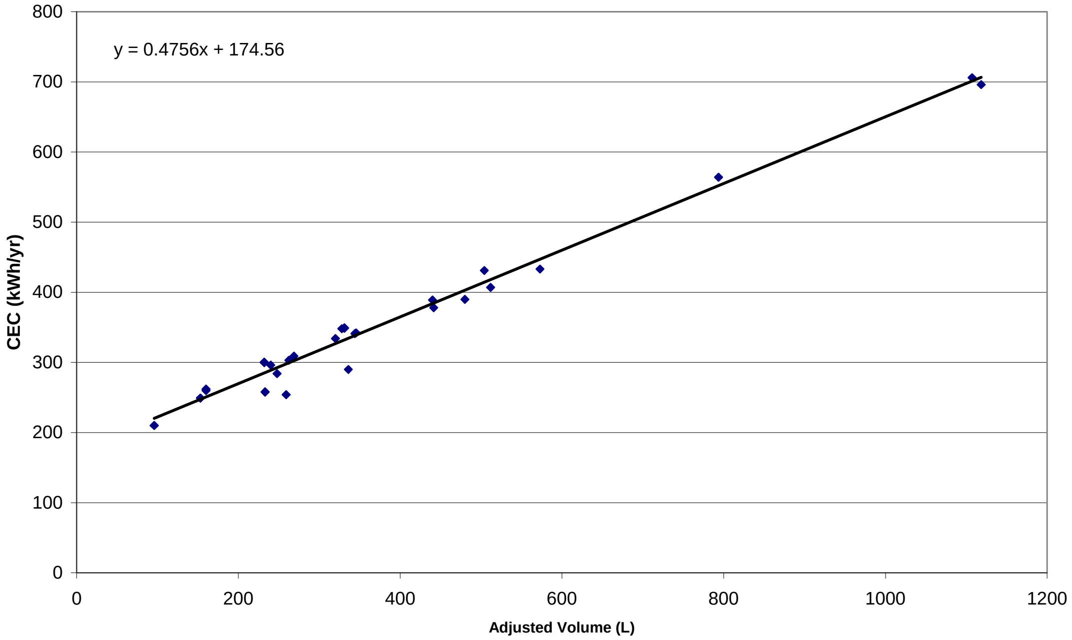


Figure 84: Group 6C Normalised Price v Normalised Energy

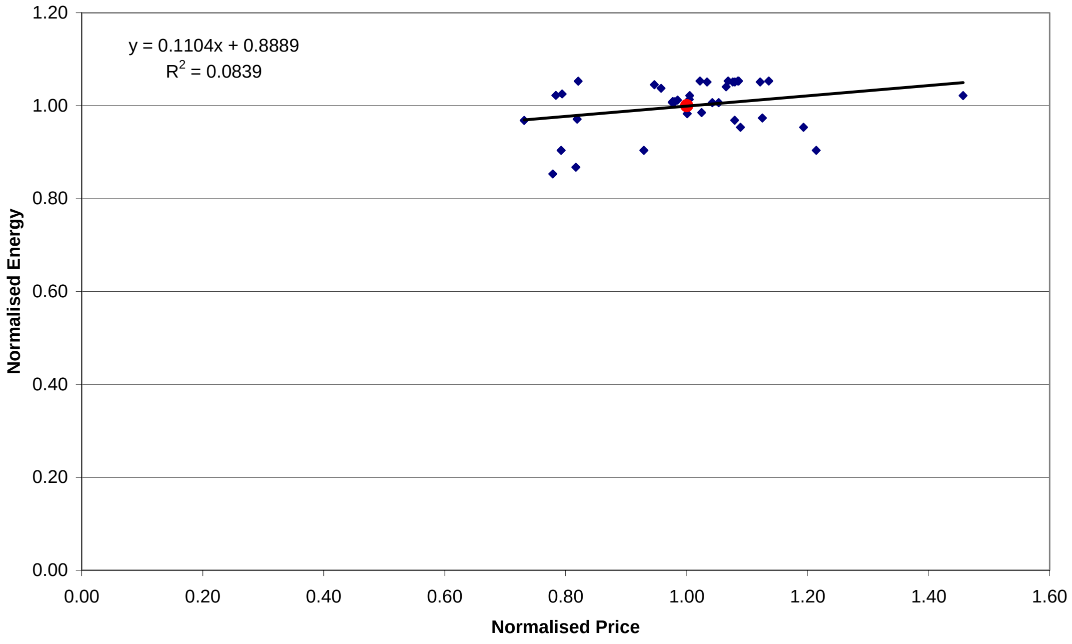


Figure 85: Group 7 Adjusted Volume v Price

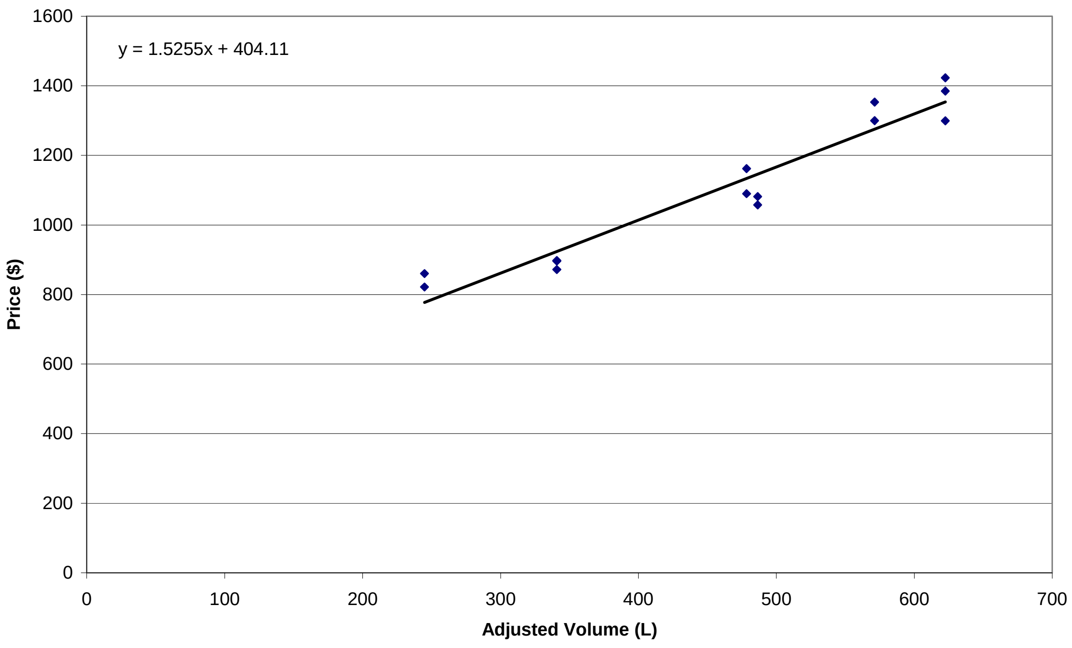


Figure 86: Group 7 Adjusted Volume v CEC

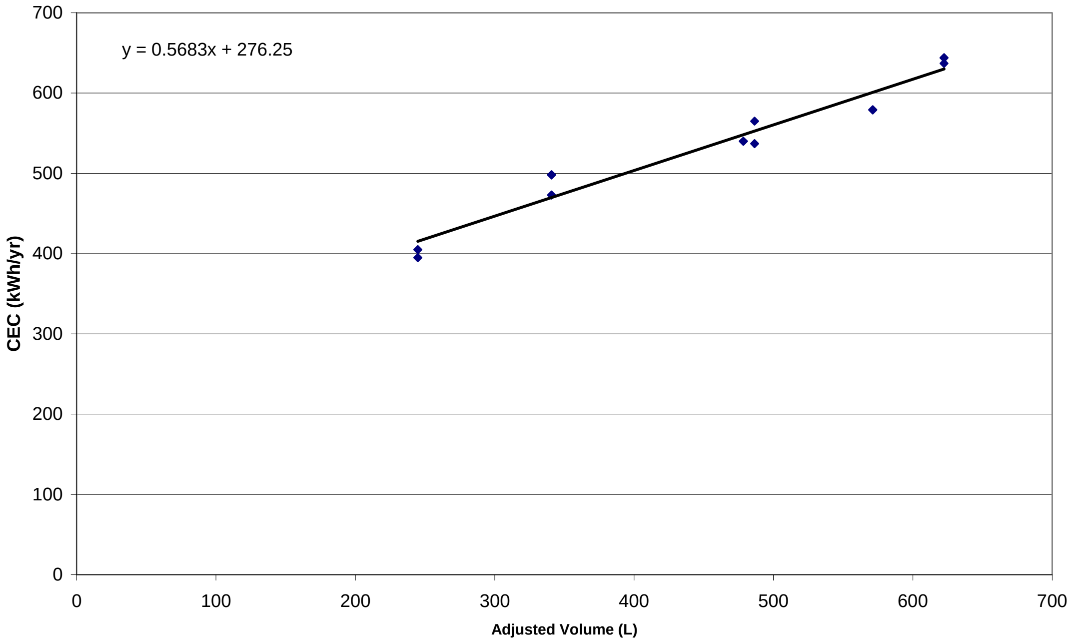
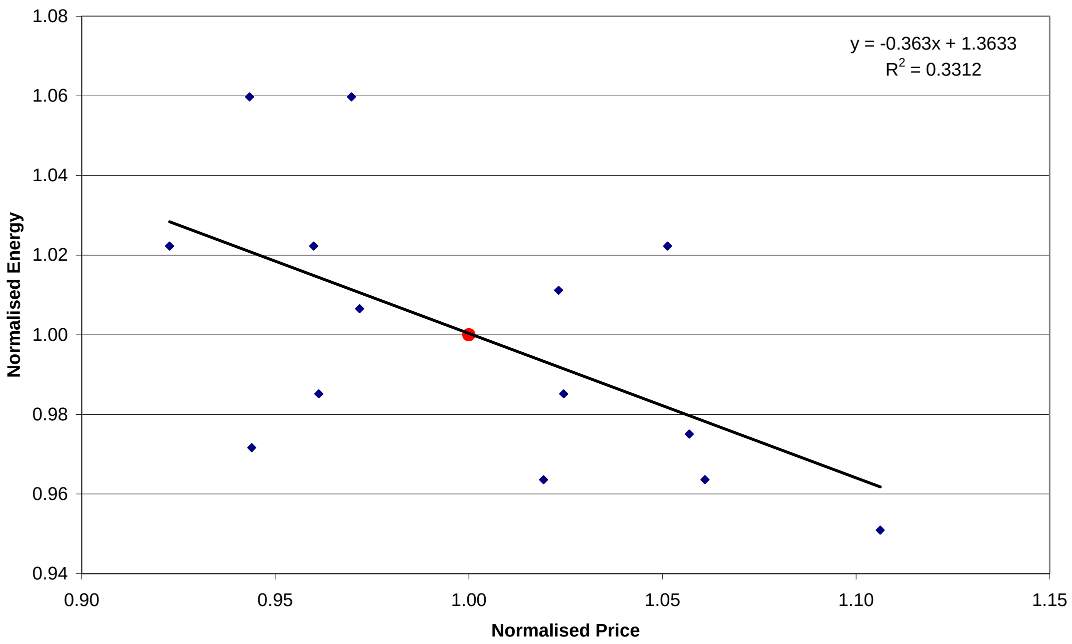


Figure 87: Group 7 Normalised Price v Normalised Energy



Appendix 8: Previous Energy Labelling Algorithms

Group Definitions Under AS/NZS4474.1

The following table sets out a brief description of each of the main refrigerator and freezer groups. See AS/NZS4474.1 for a more detailed definition.

Table 91: Refrigerator and Freezer Group Definitions and Notes

Appliance Group	Group Description	Notes
1	All refrigerator	Automatic defrost
2	Refrigerator with ice maker	Most common configuration for small bar refrigerators, usually small (<150L)
3	Refrigerator with short term freezer	Becoming rare, but some new products appearing in 2005/6, usually small size
4	Refrigerator with long term freezer	Automatic defrost fresh food, manual defrost freezer, used to be common, now rare
5T	Top mounted frost free refrigerator-freezer	Both compartments are automatic defrost, freezer at top, majority of sales
5B	Bottom mounted frost free refrigerator-freezer	Both compartments are automatic defrost, freezer at bottom, growing sales
5S	Side×side frost free refrigerator-freezer	Both compartments are automatic defrost, growing sales
6C	Chest freezer	Includes all configurations and frost types
6U	Manual defrost vertical freezer	Door at front, manual defrost
7	Frost free vertical freezer	Door at front, automatic defrost

Refrigerators and Freezers – AS/NZS 4474.2 Pre 2000

The Australasian refrigerator and freezer star rating system started in 1986.

The test standard assumes continuous use at test conditions (32°C, no door openings). Actual in-use energy will vary somewhat by type and model but an assumed energy of about 0.65 to 0.9 of the energy label CEC would be a reasonable average estimate, depending on the group, model and the climate/operating conditions.

The key parameter is the adjusted volume, which is the equivalent volume of fresh food space when adjusted for the temperature of operation (colder compartments are assumed to be larger than measured).

Adjusted volume V_{adj} = Σ Ks $\times$ compartment volume (no change)

For each compartment in the refrigerator or freezer as set out in the table below.

Table 92: Compartment Volume Adjustment Factors

Compartment Type	Volume Adjustment Factor (K_s)
Cellar	0.7
Fresh food	1.0
Chill	1.1
Ice-making	1.2
Short term frozen food storage	1.4
Freezer	1.6

Star rating for all types of refrigerators and freezers is done of the same basis as follows:

$$\text{EER (SRI)} = \frac{23}{3} - \left(\frac{2}{3} \times \frac{1000}{365} \times \frac{CEC}{V_{adj}} \right)$$

Where

EER is the star rating index of the appliance (energy efficiency rating)

CEC is the comparative energy consumption (based on continuous use)

Post 2000 Star Rating System – Electrical Products

The revised algorithms for all star-rated electrical appliances was introduced on 1 October 2000.

The clothes washers, clothes dryers, dishwashers, refrigerators and freezers, the general form of the star rating algorithm is as follows:

$$SRI = 1 + \left[\frac{\log_e \left(\frac{CEC}{BEC} \right)}{\log_e (1 - ERF)} \right]$$

Where:

SRI is the star rating index (fractional star rating)

CEC is the comparative energy consumption (energy that appears on the energy label)

BEC is the base energy consumption – the equation for a product with an SRI of 1.0

ERF is the energy reduction factor – reduction in CEC for each additional star

Refrigerators and Freezers – AS/NZS 4474.2 Post 2000

The test procedure for the 2000 labelling algorithm remained unchanged. The adjusted volume is determined using the same factors as previously described.

BEC = $C_f + (C_v \times V_{adj\ tot})$

Other factors by groups are set out below:

Table 93: Refrigerator and Freezer Group Factors – Post 2000

Appliance Group	Group Description	Fixed Allowance Factor (C_f) kWh/year	Variable Allowance Factor (C_v) kWh/year/L	Energy Reduction Factor (ERF)
1	All refrigerator	368	0.892	0.14
2	Refrigerator with ice maker	330	0.800	0.20
3	Refrigerator with short term freezer	330	0.800	0.20
4	Refrigerator with long term freezer	465	1.378	0.23
5T	Top mounted frost free refrigerator-freezer	465	1.378	0.23
5B	Bottom mounted frost free refrigerator-freezer	465	1.378	0.23
5S	Side by side frost free refrigerator-freezer	465	1.378	0.23
6C	Chest freezer	248	0.670	0.17
6U	Manual defrost vertical freezer	439	1.020	0.20
7	Frost free vertical freezer	439	1.020	0.20

Note: Groups 1, 5 and 7 are fully automatic defrost. Groups 2, 3, 4 and 6 have manual defrost freezer.

Note that MEPS factors are separate from energy labelling factors and are set out in http://www.energyrating.gov.au/rf2.html MEPS for refrigerators also includes factors for additional doors and adaptive defrost. MEPS factors are not included when determining the star rating of products.

It should be noted that several groups have common energy labelling rating factors (eg Groups 2 & 3, Groups 4, 5T, 5B, & 5S, Groups 6U & 7). This has been done on the basis that these products are interchangeable and can provide more or less equivalent energy service and so should be rated for the energy label on the same basis. Note that the MEPS levels for each Group are different, even when the labelling equations are the same. For many of the group combinations, the 1 star line was set to be approximately the 1999 MEPS for the weakest group (highest energy).

Appendix 9: Australian Energy Efficiency Policy Background

Note – the text for this Appendix was supplied by the AGO.

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'*[9] *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 the COAG climate change agenda since COAG's agreement in June 2005 to

[9] 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.

establish a new Senior Officals 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 COAD 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 it 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.

Appendix 10: Sensitivity Analysis Scenarios

The following pages outline the sensitivity analysis scenarios 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 Label Change: Expected Impact
Case: Base Case

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$869	$0
2015	5569	$738	5261	$871	$0
2020	5430	$718	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	$0.0
2015	-54	-$7.1	-51	$6.1	$0.0
2020	-106	-$14.0	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$85	$0
2015	1246	$167	1178	$61	$0
2020	1091	$146	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.2	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,085	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,085	$0
Impact	Cum 2005-2020	-603	-$32.2	-555	$28.8	$0.0
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$28.8	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$779	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$779	$0
Impact	Cum 2005-2020	-53	-$2.9	-49	$5.2	$0.0
Impact	Cum 2005-2050	-181	-$6.0	-8505	$5.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$34.1
Total NPV Benefits	$67.9
Total NPV Costs	$36.9
Net Benefit	$31.0
Cost of CO2 reduction $/tonne	-$3.64
Benefit Cost Ratio	1.8

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Base Case

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$166	683	$130	$0
2015	927	$158	647	$131	$0
2020	904	$154	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	$0.0
2020	-18	-$3.0	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,213	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,213	$0
Impact	Cum 2005-2020	-100	-$6.9	-70	$4.3	$0.0
Impact	Cum 2005-2050	-284	-$13.2	-198	$4.3	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$0
BAU	Cum 2005-2050	9898	$791	6909	$108	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$109	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$109	$0
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.7	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.1
Total NPV Benefits	$15.7
Total NPV Costs	$5.1
Net Benefit	$10.6
Cost of CO2 reduction $/tonne	-$4.93
Benefit Cost Ratio	3.1

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Low Impact

Case: Scenario A

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Low Impact

2005	6184	$823	6350	$939	$0
2010	5885	$781	5806	$867	$0
2015	5607	$743	5297	$867	$0
2020	5505	$728	4860	$856	$0

Program Impact: BAU vs Label Change: Low Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-2	-$0.3	-2	$0.9	$0.0
2015	-16	-$2.1	-15	$2.0	$0.0
2020	-31	-$4.1	-27	$2.0	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Low Impact

2005	1568	$211	1605	$129	$0
2010	1412	$190	1393	$85	$0
2015	1250	$168	1181	$61	$0
2020	1097	$147	969	$58	$0

Program Impact: BAU vs Label Change: Low Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.2	$0.0
2015	-2	-$0.2	-2	$0.3	$0.0
2020	-3	-$0.4	-3	$0.3	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$0
Label Change: Low Impact	Cum 2005-2020	92410	$7,094	89585	$8,065	$0
Label Change: Low Impact	Cum 2005-2050	135661	$8,299	127765	$8,065	$0
Impact	Cum 2005-2020	-175	-$9.3	-161	$9.4	$0.0
Impact	Cum 2005-2050	-497	-$18.0	-445	$9.4	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$0
Label Change: Low Impact	Cum 2005-2020	21304	$1,693	20713	$775	$0
Label Change: Low Impact	Cum 2005-2050	30851	$1,950	20713	$775	$0
Impact	Cum 2005-2020	-18	-$1.0	-16	$1.8	$0.0
Impact	Cum 2005-2050	-61	-$2.0	-8472	$1.8	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$20.0
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$11.1
Total NPV Benefits	$20.0
Total NPV Costs	$14.0
Net Benefit	$6.0
Cost of CO2 reduction $/tonne	-$0.71
Benefit Cost Ratio	1.4

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Low Impact

Case: Scenario A

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Low Impact

2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	934	$159	652	$130	$0
2020	917	$156	640	$128	$0

Program Impact: BAU vs Label Change: Low Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	-$0.1	0	$0.1	$0.0
2015	-3	-$0.4	-2	$0.3	$0.0
2020	-5	-$0.9	-4	$0.3	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Low Impact

2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	400	$68	279	$8	$0
2020	351	$60	245	$8	$0

Program Impact: BAU vs Label Change: Low Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.0	$0.0
2015	-1	-$0.1	0	$0.0	$0.0
2020	-1	-$0.2	-1	$0.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$0
Label Change: Low Impact	Cum 2005-2020	15388	$1,514	10741	$1,210	$0
Label Change: Low Impact	Cum 2005-2050	22590	$1,772	15768	$1,210	$0
Impact	Cum 2005-2020	-29	-$2.0	-20	$1.4	$0.0
Impact	Cum 2005-2050	-83	-$3.9	-58	$1.4	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$0
BAU	Cum 2005-2050	9898	$791	6909	$108	$0
Label Change: Low Impact	Cum 2005-2020	6822	$686	4761	$109	$0
Label Change: Low Impact	Cum 2005-2050	9878	$790	4761	$109	$0
Impact	Cum 2005-2020	-6	-$0.4	-4	$0.2	$0.0
Impact	Cum 2005-2050	-19	-$0.8	-2147	$0.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$4.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$1.7
Total NPV Benefits	$4.7
Total NPV Costs	$1.7
Net Benefit	$3.0
Cost of CO2 reduction $/tonne	-$1.41
Benefit Cost Ratio	2.8

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario B

Key Variables

Discount Rate	0.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$869	$0
2015	5569	$738	5261	$871	$0
2020	5430	$718	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	$0.0
2015	-54	-$7.1	-51	$6.1	$0.0
2020	-106	-$14.0	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$85	$0
2015	1246	$167	1178	$61	$0
2020	1091	$146	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.2	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$12,273	89746	$13,995	$0
BAU	Cum 2005-2050	136158	$18,033	128210	$13,995	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$12,193	89191	$14,059	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$17,807	126682	$14,059	$0
Impact	Cum 2005-2020	-603	-$79.8	-555	$63.5	$0.0
Impact	Cum 2005-2050	-1704	-$225.5	-1528	$63.5	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$2,863	20730	$1,241	$0
BAU	Cum 2005-2050	30912	$4,151	29186	$1,241	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$2,856	20681	$1,252	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$4,127	20681	$1,252	$0
Impact	Cum 2005-2020	-53	-$7.1	-49	$11.2	$0.0
Impact	Cum 2005-2050	-181	-$24.2	-8505	$11.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$249.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$4.0
Impact - NPV Purchase incremental costs $m	$74.7
Total NPV Benefits	$249.7
Total NPV Costs	$78.7
Net Benefit	$171.0
Cost of CO2 reduction $/tonne	-$20.10
Benefit Cost Ratio	3.2

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario B

Key Variables

Discount Rate	0.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	979	$166	683	$130	$0
2015	927	$158	647	$131	$0
2020	904	$154	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	$0.0
2020	-18	-$3.0	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$2,621	10761	$2,099	$0
BAU	Cum 2005-2050	22673	$3,854	15826	$2,099	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$2,604	10691	$2,109	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$3,806	15628	$2,109	$0
Impact	Cum 2005-2020	-100	-$17.1	-70	$9.5	$0.0
Impact	Cum 2005-2050	-284	-$48.2	-198	$9.5	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$1,161	4765	$174	$0
BAU	Cum 2005-2050	9898	$1,683	6909	$174	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$1,158	4754	$175	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$1,673	4754	$175	$0
Impact	Cum 2005-2020	-17	-$2.9	-12	$1.6	$0.0
Impact	Cum 2005-2050	-58	-$9.8	-2155	$1.6	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$58.1
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$11.1
Total NPV Benefits	$58.1
Total NPV Costs	$11.1
Net Benefit	$47.0
Cost of CO2 reduction $/tonne	-$21.80
Benefit Cost Ratio	5.2

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario C

Key Variables

Discount Rate	5.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$869	$0
2015	5569	$738	5261	$871	$0
2020	5430	$718	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	$0.0
2015	-54	-$7.1	-51	$6.1	$0.0
2020	-106	-$14.0	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$85	$0
2015	1246	$167	1178	$61	$0
2020	1091	$146	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.2	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$8,386	89746	$9,527	$0
BAU	Cum 2005-2050	136158	$10,383	128210	$9,527	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$8,343	89191	$9,564	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$10,291	126682	$9,564	$0
Impact	Cum 2005-2020	-603	-$43.1	-555	$37.1	$0.0
Impact	Cum 2005-2050	-1704	-$92.5	-1528	$37.1	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,987	20730	$892	$0
BAU	Cum 2005-2050	30912	$2,416	29186	$892	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,983	20681	$899	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$2,407	20681	$899	$0
Impact	Cum 2005-2020	-53	-$3.9	-49	$6.7	$0.0
Impact	Cum 2005-2050	-181	-$9.2	-8505	$6.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$101.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$3.2
Impact - NPV Purchase incremental costs $m	$43.7
Total NPV Benefits	$101.7
Total NPV Costs	$46.9
Net Benefit	$54.7
Cost of CO2 reduction $/tonne	-$6.44
Benefit Cost Ratio	2.2

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario C

Key Variables

Discount Rate	5.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$166	683	$130	$0
2015	927	$158	647	$131	$0
2020	904	$154	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	$0.0
2020	-18	-$3.0	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,790	10761	$1,429	$0
BAU	Cum 2005-2050	22673	$2,218	15826	$1,429	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,781	10691	$1,435	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$2,198	15628	$1,435	$0
Impact	Cum 2005-2020	-100	-$9.2	-70	$5.6	$0.0
Impact	Cum 2005-2050	-284	-$19.8	-198	$5.6	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$805	4765	$125	$0
BAU	Cum 2005-2050	9898	$979	6909	$125	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$804	4754	$126	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$976	4754	$126	$0
Impact	Cum 2005-2020	-17	-$1.6	-12	$0.9	$0.0
Impact	Cum 2005-2050	-58	-$3.7	-2155	$0.9	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$23.5
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$6.5
Total NPV Benefits	$23.5
Total NPV Costs	$6.5
Net Benefit	$17.0
Cost of CO2 reduction $/tonne	-$7.90
Benefit Cost Ratio	3.6

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario D

Key Variables

Discount Rate	10.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$869	$0
2015	5569	$738	5261	$871	$0
2020	5430	$718	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	$0.0
2015	-54	-$7.1	-51	$6.1	$0.0
2020	-106	-$14.0	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$85	$0
2015	1246	$167	1178	$61	$0
2020	1091	$146	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.2	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$6,103	89746	$6,911	$0
BAU	Cum 2005-2050	136158	$6,854	128210	$6,911	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$6,079	89191	$6,934	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$6,812	126682	$6,934	$0
Impact	Cum 2005-2020	-603	-$24.3	-555	$22.7	$0.0
Impact	Cum 2005-2050	-1704	-$42.5	-1528	$22.7	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,465	20730	$680	$0
BAU	Cum 2005-2050	30912	$1,623	29186	$680	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,463	20681	$684	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,619	20681	$684	$0
Impact	Cum 2005-2020	-53	-$2.2	-49	$4.2	$0.0
Impact	Cum 2005-2050	-181	-$4.1	-8505	$4.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$46.6
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.6
Impact - NPV Purchase incremental costs $m	$26.8
Total NPV Benefits	$46.6
Total NPV Costs	$29.4
Net Benefit	$17.2
Cost of CO2 reduction $/tonne	-$2.02
Benefit Cost Ratio	1.6

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand
Title: BAU vs Label Change: Expected Impact
Case: Scenario D

Key Variables

Discount Rate	10.0%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$166	683	$130	$0
2015	927	$158	647	$131	$0
2020	904	$154	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	$0.0
2020	-18	-$3.0	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,302	10761	$1,037	$0
BAU	Cum 2005-2050	22673	$1,463	15826	$1,037	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,297	10691	$1,040	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,454	15628	$1,040	$0
Impact	Cum 2005-2020	-100	-$5.2	-70	$3.4	$0.0
Impact	Cum 2005-2050	-284	-$9.1	-198	$3.4	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$594	4765	$95	$0
BAU	Cum 2005-2050	9898	$658	6909	$95	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$593	4754	$96	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$656	4754	$96	$0
Impact	Cum 2005-2020	-17	-$0.9	-12	$0.6	$0.0
Impact	Cum 2005-2050	-58	-$1.6	-2155	$0.6	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$10.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$4.0
Total NPV Benefits	$10.7
Total NPV Costs	$4.0
Net Benefit	$6.8
Cost of CO2 reduction $/tonne	-$3.14
Benefit Cost Ratio	2.7

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario E

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	0.5
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$867	$0
2015	5569	$738	5261	$868	$0
2020	5430	$718	4794	$858	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$1.4	$0.0
2015	-54	-$7.1	-51	$3.1	$0.0
2020	-106	-$14.0	-94	$3.1	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$85	$0
2015	1246	$167	1178	$61	$0
2020	1091	$146	963	$58	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.3	$0.0
2015	-5	-$0.6	-5	$0.5	$0.0
2020	-9	-$1.2	-8	$0.5	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,070	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,070	$0
Impact	Cum 2005-2020	-603	-$32.2	-555	$14.4	$0.0
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$14.4	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$776	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$776	$0
Impact	Cum 2005-2020	-53	-$2.9	-49	$2.6	$0.0
Impact	Cum 2005-2050	-181	-$6.0	-8505	$2.6	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$17.0
Total NPV Benefits	$67.9
Total NPV Costs	$19.9
Net Benefit	$48.0
Cost of CO2 reduction $/tonne	-$5.64
Benefit Cost Ratio	3.4

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario E

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	0.5
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$166	683	$130	$0
2015	927	$158	647	$130	$0
2020	904	$154	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.2	$0.0
2015	-9	-$1.5	-6	$0.5	$0.0
2020	-18	-$3.0	-12	$0.5	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.0	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,211	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,211	$0
Impact	Cum 2005-2020	-100	-$6.9	-70	$2.2	$0.0
Impact	Cum 2005-2050	-284	-$13.2	-198	$2.2	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$0
BAU	Cum 2005-2050	9898	$791	6909	$108	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$109	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$109	$0
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.4	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.4	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$2.5
Total NPV Benefits	$15.7
Total NPV Costs	$2.5
Net Benefit	$13.2
Cost of CO2 reduction $/tonne	-$6.11
Benefit Cost Ratio	6.2

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario F

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	2.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$866	$0
2015	5622	$745	5312	$865	$0
2020	5536	$732	4888	$854	$0

Label Change: Expected Impact

2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$871	$0
2015	5569	$738	5261	$877	$0
2020	5430	$718	4794	$867	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$5.6	$0.0
2015	-54	-$7.1	-51	$12.2	$0.0
2020	-106	-$14.0	-94	$12.5	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$85	$0
2015	1251	$168	1182	$60	$0
2020	1100	$148	971	$58	$0

Label Change: Expected Impact

2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$86	$0
2015	1246	$167	1178	$62	$0
2020	1091	$146	963	$60	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$1.3	$0.0
2015	-5	-$0.6	-5	$2.0	$0.0
2020	-9	-$1.2	-8	$2.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,114	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,114	$0
Impact	Cum 2005-2020	-603	-$32.2	-555	$57.7	$0.0
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$57.7	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$784	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$784	$0
Impact	Cum 2005-2020	-53	-$2.9	-49	$10.5	$0.0
Impact	Cum 2005-2050	-181	-$6.0	-8505	$10.5	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$68.1
Total NPV Benefits	$67.9
Total NPV Costs	$71.0
Net Benefit	-$3.1
Cost of CO2 reduction $/tonne	$0.36
Benefit Cost Ratio	1.0

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario F

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	2.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$130	$0
2015	936	$159	653	$130	$0
2020	922	$157	643	$128	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	979	$166	683	$131	$0
2015	927	$158	647	$132	$0
2020	904	$154	631	$130	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.8	$0.0
2015	-9	-$1.5	-6	$1.8	$0.0
2020	-18	-$3.0	-12	$1.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$8	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	315	$12	$0
2015	399	$68	279	$9	$0
2020	349	$59	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.2	$0.0
2015	-2	-$0.3	-1	$0.3	$0.0
2020	-3	-$0.5	-2	$0.3	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,217	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,217	$0
Impact	Cum 2005-2020	-100	-$6.9	-70	$8.6	$0.0
Impact	Cum 2005-2050	-284	-$13.2	-198	$8.6	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$0
BAU	Cum 2005-2050	9898	$791	6909	$108	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$110	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$110	$0
Impact	Cum 2005-2020	-17	-$1.2	-12	$1.5	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$1.5	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$10.1
Total NPV Benefits	$15.7
Total NPV Costs	$10.1
Net Benefit	$5.6
Cost of CO2 reduction $/tonne	-$2.58
Benefit Cost Ratio	1.6

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario G

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$10 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$63
2010	5887	$781	5808	$866	$58
2015	5622	$745	5312	$865	$53
2020	5536	$732	4888	$854	$49

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$63
2010	5880	$780	5801	$869	$58
2015	5569	$738	5261	$871	$53
2020	5430	$718	4794	$861	$48

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	-$0.1
2015	-54	-$7.1	-51	$6.1	-$0.5
2020	-106	-$14.0	-94	$6.2	-$0.9

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$16
2010	1412	$190	1394	$85	$14
2015	1251	$168	1182	$60	$12
2020	1100	$148	971	$58	$10

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$16
2010	1411	$190	1393	$85	$14
2015	1246	$167	1178	$61	$12
2020	1091	$146	963	$59	$10

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.2	-8	$1.0	-$0.1

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$527
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$527
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,085	$525
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,085	$525
Impact	Cum 2005-2020	-603	-$32.2	-555	$28.8	-$2.3
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$28.8	-$2.3

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$125
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$125
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$779	$124
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$779	$124
Impact	Cum 2005-2020	-53	-$2.9	-49	$5.2	-$0.2
Impact	Cum 2005-2050	-181	-$6.0	-8505	$5.2	-$0.2

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	-$2.5
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$34.1
Total NPV Benefits	$70.4
Total NPV Costs	$36.9
Net Benefit	$33.4
Cost of CO2 reduction $/tonne	-$3.93
Benefit Cost Ratio	1.9

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand
Title: BAU vs Label Change: Expected Impact
Case: Scenario G

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$10 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$7
2010	980	$167	684	$130	$7
2015	936	$159	653	$130	$7
2020	922	$157	643	$128	$6

Label Change: Expected Impact

2005	1030	$175	719	$141	$7
2010	979	$166	683	$130	$7
2015	927	$158	647	$131	$6
2020	904	$154	631	$129	$6

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	-$0.1
2020	-18	-$3.0	-12	$0.9	-$0.1

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$4
2010	452	$77	316	$12	$3
2015	401	$68	280	$8	$3
2020	352	$60	246	$8	$2

Label Change: Expected Impact

2005	502	$85	350	$18	$4
2010	452	$77	315	$12	$3
2015	399	$68	279	$9	$3
2020	349	$59	244	$8	$2

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$62
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$62
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,213	$62
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,213	$62
Impact	Cum 2005-2020	-100	-$6.9	-70	$4.3	-$0.3
Impact	Cum 2005-2050	-284	-$13.2	-198	$4.3	-$0.3

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$28
BAU	Cum 2005-2050	9898	$791	6909	$108	$28
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$109	$28
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$109	$28
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.7	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	-$0.3
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.1
Total NPV Benefits	$16.0
Total NPV Costs	$5.1
Net Benefit	$11.0
Cost of CO2 reduction $/tonne	-$5.09
Benefit Cost Ratio	3.2

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario H

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$20 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$127
2010	5887	$781	5808	$866	$116
2015	5622	$745	5312	$865	$106
2020	5536	$732	4888	$854	$98

Label Change: Expected Impact

2005	6184	$823	6350	$939	$127
2010	5880	$780	5801	$869	$116
2015	5569	$738	5261	$871	$105
2020	5430	$718	4794	$861	$96

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	-$0.1
2015	-54	-$7.1	-51	$6.1	-$1.0
2020	-106	-$14.0	-94	$6.2	-$1.9

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$32
2010	1412	$190	1394	$85	$28
2015	1251	$168	1182	$60	$24
2020	1100	$148	971	$58	$19

Label Change: Expected Impact

2005	1568	$211	1605	$129	$32
2010	1411	$190	1393	$85	$28
2015	1246	$167	1178	$61	$24
2020	1091	$146	963	$59	$19

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	-$0.1
2020	-9	-$1.2	-8	$1.0	-$0.2

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,056	$1,055
BAU	Cum 2005-2050	136158	$8,317	128210	$8,056	$1,055
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,085	$1,050
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,085	$1,050
Impact	Cum 2005-2020	-603	-$32.2	-555	$28.8	-$4.5
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$28.8	-$4.5

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$774	$249
BAU	Cum 2005-2050	30912	$1,952	29186	$774	$249
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$779	$249
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$779	$249
Impact	Cum 2005-2020	-53	-$2.9	-49	$5.2	-$0.4
Impact	Cum 2005-2050	-181	-$6.0	-8505	$5.2	-$0.4

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	-$4.9
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$34.1
Total NPV Benefits	$72.8
Total NPV Costs	$36.9
Net Benefit	$35.9
Cost of CO2 reduction $/tonne	-$4.22
Benefit Cost Ratio	2.0

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand
Title: BAU vs Label Change: Expected Impact
Case: Scenario H

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$20 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$14
2010	980	$167	684	$130	$14
2015	936	$159	653	$130	$13
2020	922	$157	643	$128	$13

Label Change: Expected Impact

2005	1030	$175	719	$141	$14
2010	979	$166	683	$130	$14
2015	927	$158	647	$131	$13
2020	904	$154	631	$129	$13

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.9	-$0.1
2020	-18	-$3.0	-12	$0.9	-$0.2

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$7
2010	452	$77	316	$12	$6
2015	401	$68	280	$8	$6
2020	352	$60	246	$8	$5

Label Change: Expected Impact

2005	502	$85	350	$18	$7
2010	452	$77	315	$12	$6
2015	399	$68	279	$9	$6
2020	349	$59	244	$8	$5

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,208	$124
BAU	Cum 2005-2050	22673	$1,776	15826	$1,208	$124
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,213	$124
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,213	$124
Impact	Cum 2005-2020	-100	-$6.9	-70	$4.3	-$0.6
Impact	Cum 2005-2050	-284	-$13.2	-198	$4.3	-$0.6

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$108	$56
BAU	Cum 2005-2050	9898	$791	6909	$108	$56
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$109	$56
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$109	$56
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.7	-$0.1
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.7	-$0.1

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	-$0.7
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.1
Total NPV Benefits	$16.3
Total NPV Costs	$5.1
Net Benefit	$11.3
Cost of CO2 reduction $/tonne	-$5.24
Benefit Cost Ratio	3.2

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario I

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	1.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$821	5808	$866	$0
2015	5622	$823	5312	$865	$0
2020	5536	$849	4888	$854	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$820	5801	$869	$0
2015	5569	$815	5261	$871	$0
2020	5430	$833	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$1.0	-7	$2.8	$0.0
2015	-54	-$7.9	-51	$6.1	$0.0
2020	-106	-$16.3	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$199	1394	$85	$0
2015	1251	$186	1182	$60	$0
2020	1100	$171	971	$58	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$199	1393	$85	$0
2015	1246	$185	1178	$61	$0
2020	1091	$170	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.7	-5	$1.0	$0.0
2020	-9	-$1.4	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,534	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$9,016	128210	$8,056	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,498	89191	$8,085	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,944	126682	$8,085	$0
Impact	Cum 2005-2020	-603	-$36.0	-555	$28.8	$0.0
Impact	Cum 2005-2050	-1704	-$72.5	-1528	$28.8	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,792	20730	$774	$0
BAU	Cum 2005-2050	30912	$2,108	29186	$774	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,789	20681	$779	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$2,101	20681	$779	$0
Impact	Cum 2005-2020	-53	-$3.2	-49	$5.2	$0.0
Impact	Cum 2005-2050	-181	-$7.1	-8505	$5.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$79.6
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$34.1
Total NPV Benefits	$79.6
Total NPV Costs	$36.9
Net Benefit	$42.6
Cost of CO2 reduction $/tonne	-$5.01
Benefit Cost Ratio	2.2

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario I

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	1.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$175	684	$130	$0
2015	936	$176	653	$130	$0
2020	922	$182	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$175	683	$130	$0
2015	927	$174	647	$131	$0
2020	904	$178	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.7	-6	$0.9	$0.0
2020	-18	-$3.5	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$81	316	$12	$0
2015	401	$75	280	$8	$0
2020	352	$70	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$81	315	$12	$0
2015	399	$75	279	$9	$0
2020	349	$69	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.6	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,608	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,926	15826	$1,208	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,601	10691	$1,213	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,910	15628	$1,213	$0
Impact	Cum 2005-2020	-100	-$7.7	-70	$4.3	$0.0
Impact	Cum 2005-2050	-284	-$15.5	-198	$4.3	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$726	4765	$108	$0
BAU	Cum 2005-2050	9898	$855	6909	$108	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$725	4754	$109	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$852	4754	$109	$0
Impact	Cum 2005-2020	-17	-$1.3	-12	$0.7	$0.0
Impact	Cum 2005-2050	-58	-$2.9	-2155	$0.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$18.4
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.1
Total NPV Benefits	$18.4
Total NPV Costs	$5.1
Net Benefit	$13.3
Cost of CO2 reduction $/tonne	-$6.19
Benefit Cost Ratio	3.6

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario J

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	-1.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$743	5808	$866	$0
2015	5622	$673	5312	$865	$0
2020	5536	$629	4888	$854	$0

Label Change: Expected Impact

2005	6184	$823	6350	$939	$0
2010	5880	$742	5801	$869	$0
2015	5569	$667	5261	$871	$0
2020	5430	$617	4794	$861	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.8	$0.0
2015	-54	-$6.4	-51	$6.1	$0.0
2020	-106	-$12.1	-94	$6.2	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$180	1394	$85	$0
2015	1251	$152	1182	$60	$0
2020	1100	$127	971	$58	$0

Label Change: Expected Impact

2005	1568	$211	1605	$129	$0
2010	1411	$180	1393	$85	$0
2015	1246	$151	1178	$61	$0
2020	1091	$126	963	$59	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.0	$0.0
2020	-9	-$1.0	-8	$1.0	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$6,706	89746	$8,056	$0
BAU	Cum 2005-2050	136158	$7,699	128210	$8,056	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$6,677	89191	$8,085	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$7,646	126682	$8,085	$0
Impact	Cum 2005-2020	-603	-$28.7	-555	$28.8	$0.0
Impact	Cum 2005-2050	-1704	-$53.0	-1528	$28.8	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,604	20730	$774	$0
BAU	Cum 2005-2050	30912	$1,814	29186	$774	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,602	20681	$779	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,809	20681	$779	$0
Impact	Cum 2005-2020	-53	-$2.6	-49	$5.2	$0.0
Impact	Cum 2005-2050	-181	-$5.1	-8505	$5.2	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$58.1
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$34.1
Total NPV Benefits	$58.1
Total NPV Costs	$36.9
Net Benefit	$21.1
Cost of CO2 reduction $/tonne	-$2.48
Benefit Cost Ratio	1.6

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand
Title: BAU vs Label Change: Expected Impact
Case: Scenario J

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-1.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-2.8% change pa	**Tariff real escalation**	-1.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$158	684	$130	$0
2015	936	$144	653	$130	$0
2020	922	$135	643	$128	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$158	683	$130	$0
2015	927	$143	647	$131	$0
2020	904	$132	631	$129	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.4	-6	$0.9	$0.0
2020	-18	-$2.6	-12	$0.9	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$73	316	$12	$0
2015	401	$62	280	$8	$0
2020	352	$51	246	$8	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$73	315	$12	$0
2015	399	$61	279	$9	$0
2020	349	$51	244	$8	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.2	-1	$0.1	$0.0
2020	-3	-$0.4	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,431	10761	$1,208	$0
BAU	Cum 2005-2050	22673	$1,644	15826	$1,208	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,425	10691	$1,213	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,633	15628	$1,213	$0
Impact	Cum 2005-2020	-100	-$6.1	-70	$4.3	$0.0
Impact	Cum 2005-2050	-284	-$11.3	-198	$4.3	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$650	4765	$108	$0
BAU	Cum 2005-2050	9898	$735	6909	$108	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$649	4754	$109	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$733	4754	$109	$0
Impact	Cum 2005-2020	-17	-$1.0	-12	$0.7	$0.0
Impact	Cum 2005-2050	-58	-$2.1	-2155	$0.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$13.4
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.1
Total NPV Benefits	$13.4
Total NPV Costs	$5.1
Net Benefit	$8.3
Cost of CO2 reduction $/tonne	-$3.87
Benefit Cost Ratio	2.6

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario K

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-0.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-1.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$911	$0
2015	5622	$745	5312	$957	$0
2020	5536	$732	4888	$995	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$914	$0
2015	5569	$738	5261	$963	$0
2020	5430	$718	4794	$1,002	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.9	$0.0
2015	-54	-$7.1	-51	$6.8	$0.0
2020	-106	-$14.0	-94	$7.3	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$89	$0
2015	1251	$168	1182	$67	$0
2020	1100	$148	971	$67	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$90	$0
2015	1246	$167	1178	$68	$0
2020	1091	$146	963	$69	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.7	$0.0
2015	-5	-$0.6	-5	$1.1	$0.0
2020	-9	-$1.2	-8	$1.2	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$8,560	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$8,560	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$8,591	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$8,591	$0
Impact	Cum 2005-2020	-603	-$32.2	-555	$31.8	$0.0
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$31.8	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$814	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$814	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$819	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$819	$0
Impact	Cum 2005-2020	-53	-$2.9	-49	$5.7	$0.0
Impact	Cum 2005-2050	-181	-$6.0	-8505	$5.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$37.5
Total NPV Benefits	$67.9
Total NPV Costs	$40.4
Net Benefit	$27.5
Cost of CO2 reduction $/tonne	-$3.23
Benefit Cost Ratio	1.7

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario K

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-0.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-1.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$137	$0
2015	936	$159	653	$143	$0
2020	922	$157	643	$149	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	979	$166	683	$137	$0
2015	927	$158	647	$145	$0
2020	904	$154	631	$150	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$1.0	$0.0
2020	-18	-$3.0	-12	$1.1	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$12	$0
2015	401	$68	280	$9	$0
2020	352	$60	246	$9	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	315	$13	$0
2015	399	$68	279	$10	$0
2020	349	$59	244	$10	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.2	$0.0
2020	-3	-$0.5	-2	$0.2	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,284	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,284	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,289	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,289	$0
Impact	Cum 2005-2020	-100	-$6.9	-70	$4.8	$0.0
Impact	Cum 2005-2050	-284	-$13.2	-198	$4.8	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$114	$0
BAU	Cum 2005-2050	9898	$791	6909	$114	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$115	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$115	$0
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.8	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.8	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$5.6
Total NPV Benefits	$15.7
Total NPV Costs	$5.6
Net Benefit	$10.1
Cost of CO2 reduction $/tonne	-$4.69
Benefit Cost Ratio	2.8

* Costs assigned to Australia

Summary of Program Findings - Australia

Title: BAU vs Label Change: Expected Impact

Case: Scenario L

Key Variables

Discount Rate	7.5%		**GHG Shadow Price**	$0	$/T
Refrigerator Price Escalation	-2.7%	change pa	**Price Impact Multiplier**	1.0	
Freezer Price Escalation	-3.8%	change pa	**Tariff real escalation**	0.0%	change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5887	$781	5808	$823	$0
2015	5622	$745	5312	$780	$0
2020	5536	$732	4888	$733	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	6184	$823	6350	$939	$0
2010	5880	$780	5801	$825	$0
2015	5569	$738	5261	$786	$0
2020	5430	$718	4794	$738	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-7	-$0.9	-7	$2.6	$0.0
2015	-54	-$7.1	-51	$5.5	$0.0
2020	-106	-$14.0	-94	$5.4	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1412	$190	1394	$80	$0
2015	1251	$168	1182	$54	$0
2020	1100	$148	971	$49	$0

Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1568	$211	1605	$129	$0
2010	1411	$190	1393	$81	$0
2015	1246	$167	1178	$55	$0
2020	1091	$146	963	$50	$0

Program Impact: BAU vs Label Change: Expected Impact

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.1	-1	$0.6	$0.0
2015	-5	-$0.6	-5	$0.9	$0.0
2020	-9	-$1.2	-8	$0.9	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	92585	$7,103	89746	$7,593	$0
BAU	Cum 2005-2050	136158	$8,317	128210	$7,593	$0
Label Change: Expected Impact	Cum 2005-2020	91982	$7,071	89191	$7,619	$0
Label Change: Expected Impact	Cum 2005-2050	134454	$8,255	126682	$7,619	$0
Impact	Cum 2005-2020	-603	-$32.2	-555	$26.2	$0.0
Impact	Cum 2005-2050	-1704	-$61.9	-1528	$26.2	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	21322	$1,694	20730	$737	$0
BAU	Cum 2005-2050	30912	$1,952	29186	$737	$0
Label Change: Expected Impact	Cum 2005-2020	21269	$1,692	20681	$741	$0
Label Change: Expected Impact	Cum 2005-2050	30731	$1,946	20681	$741	$0
Impact	Cum 2005-2020	-53	-$2.9	-49	$4.8	$0.0
Impact	Cum 2005-2050	-181	-$6.0	-8505	$4.8	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$67.9
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$2.9
Impact - NPV Purchase incremental costs $m	$30.9
Total NPV Benefits	$67.9
Total NPV Costs	$33.8
Net Benefit	$34.1
Cost of CO2 reduction $/tonne	-$4.01
Benefit Cost Ratio	2.0

* Australia and NZ are aggregated

Summary of Program Findings - New Zealand

Title: BAU vs Label Change: Expected Impact

Case: Scenario L

Key Variables

Discount Rate	7.5%	**GHG Shadow Price**	$0 $/T
Refrigerator Price Escalation	-2.7% change pa	**Price Impact Multiplier**	1.0
Freezer Price Escalation	-3.8% change pa	**Tariff real escalation**	0.0% change pa

Refrigerators

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	1030	$175	719	$141	$0
2010	980	$167	684	$123	$0
2015	936	$159	653	$117	$0
2020	922	$157	643	$110	$0

Label Change: Expected Impact

2005	1030	$175	719	$141	$0
2010	979	$166	683	$124	$0
2015	927	$158	647	$118	$0
2020	904	$154	631	$111	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	-1	-$0.2	-1	$0.4	$0.0
2015	-9	-$1.5	-6	$0.8	$0.0
2020	-18	-$3.0	-12	$0.8	$0.0

Freezers

BAU

Year	Energy GWh	Energy Cost $m	GHG kt	Purchase Cost $m	NPV Shadow CO_2 Cost
2005	502	$85	350	$18	$0
2010	452	$77	316	$11	$0
2015	401	$68	280	$8	$0
2020	352	$60	246	$7	$0

Label Change: Expected Impact

2005	502	$85	350	$18	$0
2010	452	$77	315	$11	$0
2015	399	$68	279	$8	$0
2020	349	$59	244	$7	$0

Program Impact: BAU vs Label Change: Expected Impact

2005	0	$0.0	0	$0.0	$0.0
2010	0	$0.0	0	$0.1	$0.0
2015	-2	-$0.3	-1	$0.1	$0.0
2020	-3	-$0.5	-2	$0.1	$0.0

Summary Refrigerators

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	15417	$1,516	10761	$1,139	$0
BAU	Cum 2005-2050	22673	$1,776	15826	$1,139	$0
Label Change: Expected Impact	Cum 2005-2020	15317	$1,509	10691	$1,143	$0
Label Change: Expected Impact	Cum 2005-2050	22389	$1,763	15628	$1,143	$0
Impact	Cum 2005-2020	-100	-$6.9	-70	$3.9	$0.0
Impact	Cum 2005-2050	-284	-$13.2	-198	$3.9	$0.0

Summary Freezers

	Year	Energy GWh	NPV Energy Cost $m	GHG kt	NPV Purchase Cost $m	NPV Shadow CO_2 Cost
BAU	Cum 2005-2020	6827	$687	4765	$103	$0
BAU	Cum 2005-2050	9898	$791	6909	$103	$0
Label Change: Expected Impact	Cum 2005-2020	6810	$686	4754	$104	$0
Label Change: Expected Impact	Cum 2005-2050	9840	$789	4754	$104	$0
Impact	Cum 2005-2020	-17	-$1.2	-12	$0.7	$0.0
Impact	Cum 2005-2050	-58	-$2.4	-2155	$0.7	$0.0

Totals 2005-2050 Cumulative

Impact - NPV Energy Costs $m	-$15.7
Impact - NPV Carbon Cost $m	$0.0
Impact - NPV Program Costs $m *	$0.0
Impact - NPV Purchase incremental costs $m	$4.6
Total NPV Benefits	$15.7
Total NPV Costs	$4.6
Net Benefit	$11.1
Cost of CO2 reduction $/tonne	-$5.15
Benefit Cost Ratio	3.4

* Costs assigned to Australia