



July 2006

Report for the
Equipment Energy
Efficiency Committee
(E₃)

Report 2006/06

GREENING WHITEGOODS

A report into the energy efficiency trends
of Major Household Appliances in
Australia From 1993 to 2005



FOREWORD

The development and promotion of energy efficient appliances and equipment is a key component in any strategy to reduce global warming. In Australia and New Zealand, equipment energy efficiency requirements are mandated under various Acts of Parliament with the technical requirements contained in relevant Australian Standards for each product type.

This report measures the effectiveness of minimum energy performance standards for two product types, domestic refrigerators and freezers, which were first imposed in Australia during 1999 and updated again in 2005. It also measures the impact of comparative energy efficiency label on five major consumer appliances (refrigerators, freezers, dishwashers, clothes washers and dryers) first imposed nationally in Australia in 1992.

Using appliance sales data first purchased in 1993 and purchased every year since, the report demonstrates that these labels have become the most visible and recognised of government's many energy efficiency programmes and that mandatory performance requirements are amongst the most cost-effective of government measures.

The continued publication of the report is an important, regular milestone to maintaining consumer confidence in the appliance label and mandatory energy efficiency standard scheme. The results show the real benefits in maintaining such energy efficiency programs, which deliver greenhouse gas abatement and economic benefit to the community.

The report is commissioned by a committee of officials from relevant agencies in all Australian jurisdictions and the New Zealand government. *Equipment Energy Efficiency* activities are funded through the Ministerial Council on Energy and forms part of Australia's National Framework for Energy Efficiency and New Zealand's National Energy Efficiency and Conservation Strategy.



Shane Holt
Chair
Equipment Energy Efficiency

The lead Commonwealth agency on greenhouse matters



Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office



TABLE OF CONTENTS

1.	<i>Executive Summary</i>	1
1.1	Overview	1
1.2	Background	1
1.3	Coverage	2
1.4	Key Findings	3
	<i>General</i>	3
	<i>Refrigerators</i>	3
	<i>Freezers</i>	4
	<i>Clothes Washers</i>	5
	<i>Clothes Dryers</i>	6
	<i>Dishwashers</i>	7
2.	<i>Detailed Results</i>	8
2.1	Overview	8
2.2	Data Interpretation Issues	8
3.	<i>Refrigerators & Refrigerator/Freezers</i>	9
3.1	Market Trends – Main Findings	9
3.2	Energy Efficiency Trends – Main Findings	12
4.	<i>Separate Freezers</i>	16
4.1	Market Trends – Main Findings	16
4.2	Energy Efficiency Trends – Main Findings	18
5.	<i>Clothes Washers</i>	21
5.1	Market Trends – Main Findings	21
5.2	Energy Efficiency Trends – Main Findings	24
6.	<i>Clothes Dryers</i>	27
6.1	Market Trends – Main Findings	27
6.2	Energy Efficiency Trends – Main Findings	29
7.	<i>Dishwashers</i>	31
7.1	Market Trends – Main Findings	31
7.2	Energy Efficiency Trends – Main Findings	31
	<i>Annex A: Source Data, Methodology and Notes on Data</i>	35
	Source Data	35
	Analysis Methodology	38
	Further Notes on Data	39
	<i>Clothes Washers – AS/NZS 2040</i>	39
	<i>Clothes Dryers – AS/NZS 2442</i>	40
	<i>Dishwashers – AS/NZS 2007</i>	41
	<i>Refrigerators and Freezers – AS/NZS 4474</i>	41
	<i>Annex B: Comparison of Full & Reduced Data Sets for Selected Attributes</i>	42
	Summary	42
	Refrigerators	42
	Freezers	42
	Clothes Washers	44
	Clothes Dryers	44
	Dishwashers	44



<i>Annex C: Monitoring and Reporting on the E₃ Program</i>	46
Monitoring Compliance	46
Monitoring Impact	46
Impact Projections	47
Achievements	47
<i>Acknowledgements</i>	47



LIST OF FIGURES

Figure 1: Energy Consumption of Refrigerators	4
Figure 2: Energy Consumption of Freezers	5
Figure 3: Energy Consumption of Clothes Washers	6
Figure 4: Energy Consumption of Clothes Dryers	7
Figure 5: Energy Consumption of Dishwashers	7
Figure 6: Market Share by Refrigerator Group	10
Figure 7: Refrigerator Fresh Food Compartment Size Trends	11
Figure 8: Annual Trends in Key Performance Characteristics since 1993 - Refrigerators	13
Figure 9: Energy Efficiency Trends by Refrigerator Group	14
Figure 10: National Sales Distribution by Old Star Rating - Refrigerators	15
Figure 11: National Sales Distribution by New Star Rating - Refrigerators	15
Figure 12: Market Share by Freezer Group	16
Figure 13: Separate Freezer Size Trends	17
Figure 14: Annual Trends in Key Performance Characteristics - Freezers	18
Figure 15: Energy Efficiency Trends by Freezer Group	19
Figure 16: National Sales Distribution by Old Star Rating - Freezers	20
Figure 17: National Sales Distribution by New Star Rating - Freezers	20
Figure 18: Sales Share by Washer Type - 1993 to 2005	21
Figure 19: Rated Capacity Distribution by Washer Type – 2005	22
Figure 20: Changes in Rated Capacity Distribution for All Types – 1993, 1999 & 2005	23
Figure 21: Trends in Top and Front Loading Clothes Washer Energy	24
Figure 22: Annual Trends in Key Performance Characteristics - Clothes Washers	25
Figure 23: National Sales Distribution by Old Star Rating - Clothes Washers	26
Figure 24: National Sales Distribution by New Star Rating - Clothes Washers	26
Figure 25: Market Share of Clothes Dryer Types	28
Figure 26: Capacity of Clothes Dryer Types	28
Figure 27: Annual Trends in Key Performance Characteristics - Clothes Dryers	29
Figure 28: National Sales Distribution by Old Star Rating - Clothes Dryers	30
Figure 29: National Sales Distribution by New Star Rating - Clothes Dryers	30
Figure 30: Annual Trends in Key Performance Characteristics - Dishwashers	32
Figure 31: Sales Weighted Trends in New Dishwasher Energy and Water Consumption	33
Figure 32: National Sales Distribution by Old Star Rating - Dishwashers	33
Figure 33: National Sales Distribution by New Star Rating – Dishwashers	34



LIST OF TABLES

Table 1: Changes in Refrigerator Characteristics - 1993 to 2005	13
Table 2: Changes in Freezer Characteristics - 1993 to 2005	18
Table 3: Changes in Clothes Washer Characteristics - 1993 to 2005	25
Table 4: Changes in Clothes Dryer Characteristics - 1993 to 2005	29
Table 5: Changes in Dishwasher Characteristics - 1993 to 2005	32
Table 6: Sample sizes NOT including new retail chains & “rest of market” estimate	36
Table 7: Sample sizes including new retail chains & “rest of market” estimate	36
Table 8: Comparison of full and reduced data set for refrigerators – 2001 to 2005	43
Table 9: Comparison of full and reduced data set for freezers – 2001 to 2005	43
Table 10: Comparison of full and reduced data set for clothes washers – 2001 to 2005	44
Table 11: Comparison of full and reduced data set for clothes dryers – 2001 to 2005	45
Table 12: Comparison of full and reduced data set for dishwashers – 2001 to 2005	45

Separate Appendices - Detailed Output Tables

Detailed output tables for all characteristics by product by year are available as a separate set of appendices (total 128 pages) as follows:

Appendix A: Refrigerators and Freezers

Appendix B: Clothes Washers

Appendix C: Clothes Dryers

Appendix D: Dishwashers



ABBREVIATIONS

AGO	Australian Greenhouse Office
MEPS	Minimum Energy Performance Standards
EES	Energy Efficient Strategies P/L
E ₃	Equipment Energy Efficiency Committee
MCE	Ministerial Council on Energy
EEWG	Energy Efficiency Working Group
kWh	Kilowatt hours
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
SRI	Star Rating Index



1. Executive Summary

1.1 Overview

This report presents the changes to the energy efficiency of energy labelled whitegoods sold in Australia since the introduction of the mandatory energy labelling program in the late 1980's and early 1990's.

All product groups analysed in this report have shown an improvement in energy efficiency with some product groups showing a very positive and significant improvement since 1993. In addition, the introduction of mandatory minimum energy performance standards (MEPS) for refrigerators and freezers in 1999 and which were subsequently made more stringent in January 2005, have made a substantial impact on energy efficiency of new products.

As energy consumption is not apparent to the general consumer without information programs such as mandatory energy labelling, the credit for much of this improvement in products which are only subjected to energy labelling must be attributed to the national energy labelling program. The program has increased consumer awareness of energy efficiency and thereby created demand for energy efficient products.

1.2 Background

This report has been prepared under contract to E₃¹, which operates under the direction of the EEWG² which in turn reports to MCE³. E₃ is made up of Australian federal, state and territory government representatives together with New Zealand officials who are responsible for implementing energy efficiency programs or regulating the efficiency of appliances and equipment in both countries. This report is one of a number of projects being undertaken to evaluate the impact of efficiency programs in Australia – more information on the activities of E₃ can be found in Annex C on page 46.

In 1995, Energy Efficient Strategies (EES) was first commissioned to undertake an analysis of appliance retail sales data purchased by the then National Appliance and Equipment Energy Efficiency Committee (NAEEEC, recently renamed E₃) from a commercial source, GfK Market Research. This report includes analysis of sales data in Australia for the calendar years 1993 to 2005 inclusive, thus giving 13 years of appliance efficiency trends. This report is an update of the edition released in 2002 and it examines the energy impact of the mandatory energy labelling and MEPS programs on these appliance types.

¹ E3 is the Equipment Energy Efficiency Committee, which was formerly NAEEEC.

² EEWG is the Energy Efficiency Working Group.

³ MCE is the Australian Ministerial Council on Energy.



From 2001 GfK provided a full data set of sales by model for each appliance. Prior to 2001, data for approximately 75% to 90% of total sales⁴ for each of the appliance groups was provided. In this report, trends and comparisons have utilised the full data sets provided since 2001. Annex B on page 42 provides a comparison of the impact of using the full data sets and reduced data set (in a form equivalent to years prior to 2001). This analysis concludes that the reduced data set from earlier years does not unduly affect estimates of the key parameters. The main improvement is better identification of product types that have a small market share. Where any important trends or new information have emerged in the full data set (compared with the reduced version), these have been noted in the text.

In the period 2003 to 2005, GfK converted their databases to a new international format. Also in this period a number of new retail chains were included into the data set. Where trends in total sales are quoted, these are based on the original retailer participants without the sales from the new retailers in 2005. More information on source data and the analysis methodology can be found in Annex A on page 35.

1.3 Coverage

This report covers five major household electrical appliances:

- Refrigerators;
- Freezers;
- Dishwashers;
- Clothes washers; and
- Clothes dryers.

The report does not cover any additional household appliances subject to mandatory energy labelling (such as single-phase air conditioners) at this stage nor any other appliances or equipment falling within the scope of the E₃ program (such as gas appliances, electric storage water heaters or commercial and industrial equipment).

Throughout this report there is reference to an average sales weighted “star rating” within each appliance type. The original energy label star rating scale was first introduced in the late 1980’s and was revised in late 2000 to make it more “stringent” (star ratings for most models decreased on the new scale). This report shows both old (late 1980’s) and new (2000) star rating scales for the appliance types tracked.

All attributes quoted in this report (such as energy, star rating, capacity and so on) are “sales weighted” values (i.e. individual appliance attributes by model weighed in accordance with the sales of the model).

⁴ Total sales implies total sales of appliances of the retail stores from which GfK collect data. GfK claim to cover more than 90% of total retail appliance sales in Australia in 2005, although the share is probably more like 70% prior to 2003.



1.4 Key Findings

General

For all appliances covered by the energy labelling program in Australia, the sales weighted energy consumption⁵ is decreasing.

Refrigerators

Market Trends: Total sales⁶ increased at 2.6% per annum over the 13 year period. Side by side (Group 5S) refrigerators sales doubled from 2003 to 2005 (to 12% share) although 2 door frost free refrigerator/freezers (top and bottom freezers) – Group 5T and 5B - still dominate the market with 63% of sales. Single door refrigerators with a short-term freezer compartment (Group 3) and two-door cyclic defrost refrigerator/freezers (Group 4) have virtually disappeared from the market. Average fresh food and freezer volumes now appear to be stable after freezer volumes increased during the 1990's. Prices (within each Group) have generally decreased slightly in real terms over the analysis period.

Energy: Energy consumption decreased at an average of 3.9% per annum from 1993 to 2005 (see Figure 1). Energy efficiency (taking account of changes in volume) increased at 4.6% per annum over the period. The average star rating under the old rating system climbed from 3.58 in 1993 to 4.39 in 2005. Under the new star rating system this increased from 1.76 in 1993 to 3.78 in 2005. The relative fall in energy from 2003 to 2005 was 23% for refrigerators, which is likely to be in response to new MEPS levels introduced on 1 January 2005. In 2003, 88% of refrigerators sold did not pass 2005 MEPS levels while in 2005 only 6% sold failed to meet 2005 MEPS⁷.

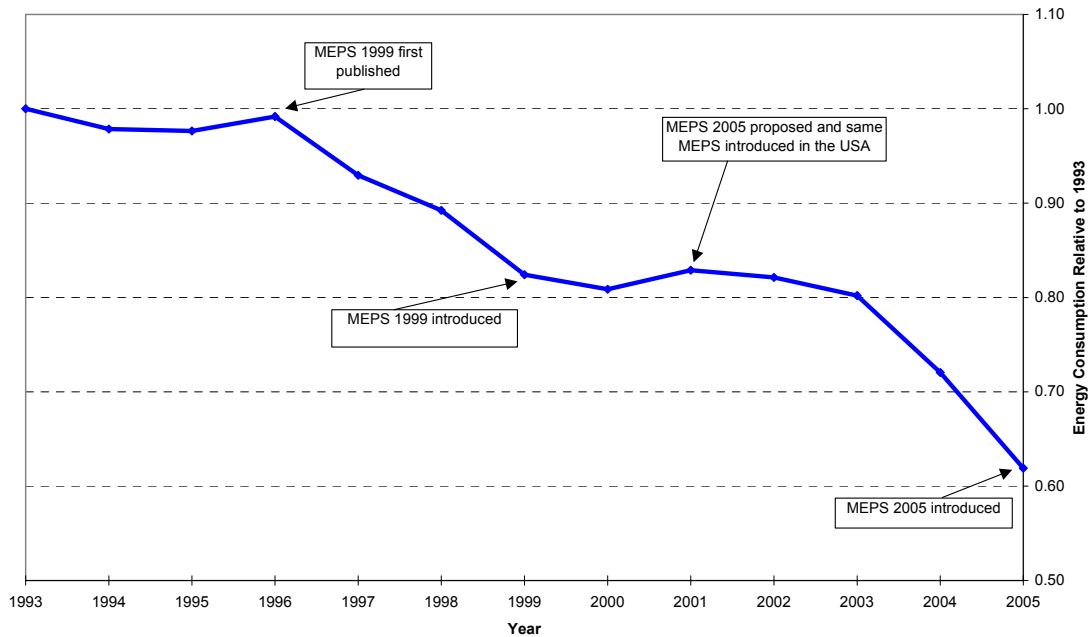
⁵ "Sales weighted energy consumption" is based on the energy label consumption (also called the comparative energy consumption) for each model weighted by the actual sales of each model. This is generally referred to as just "energy consumption" throughout the report.

⁶ This value and all subsequent trends for total sales are based on 2005 sales numbers without new retailers included. Note that detailed output tables include new retailers for 2005.

⁷ The 6% of models that failed MEPS were older models that were still in the market place but which were no longer imported or manufactured.



Figure 1: Energy Consumption of Refrigerators



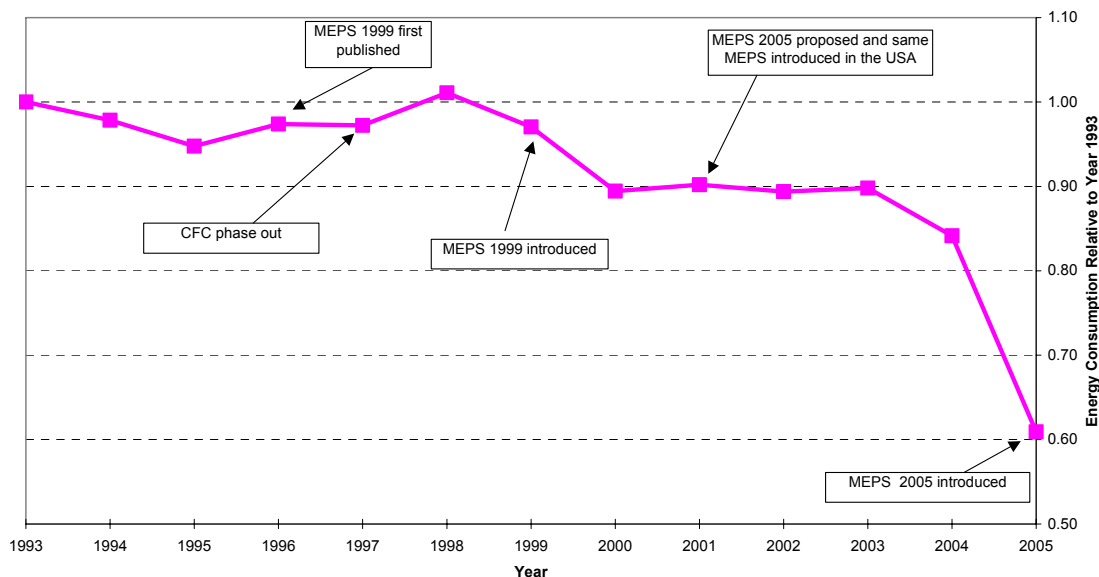
Freezers

Market Trends: Total sales grew at an average of 4.8% per annum, although the majority of this increase occurred in years 2004 and 2005 (sales before this date were fairly static). The average volume of freezers is fairly static overall. The sales of frost free vertical freezers (Group 7) is continuing to slowly increase while manual defrost vertical freezers (Group 6U) increased very sharply in 2004 and 2005 – this trend is not understood and is being investigated more closely. Chest freezer (Group 6C) sales constitute nearly 50% of the market and have been fairly steady. Prices (within each Group) decreased or were stable in real terms over the analysis period.

Energy: Energy consumption decreased at an average of 4.0% per annum from 1993 to 2005, with the most significant decline occurring in 2005 (see Figure 2), linked to the introduction of the more stringent freezer MEPS in January 2005. Energy efficiency (taking account of changes in volume) increased at 3.3% per annum over the period. The average star rating under the old rating system climbed from 4.24 in 1993 to 5.22 in 2005. Under the new star rating system this increased from 1.48 in 1993 to 3.4 in 2005.



Figure 2: Energy Consumption of Freezers



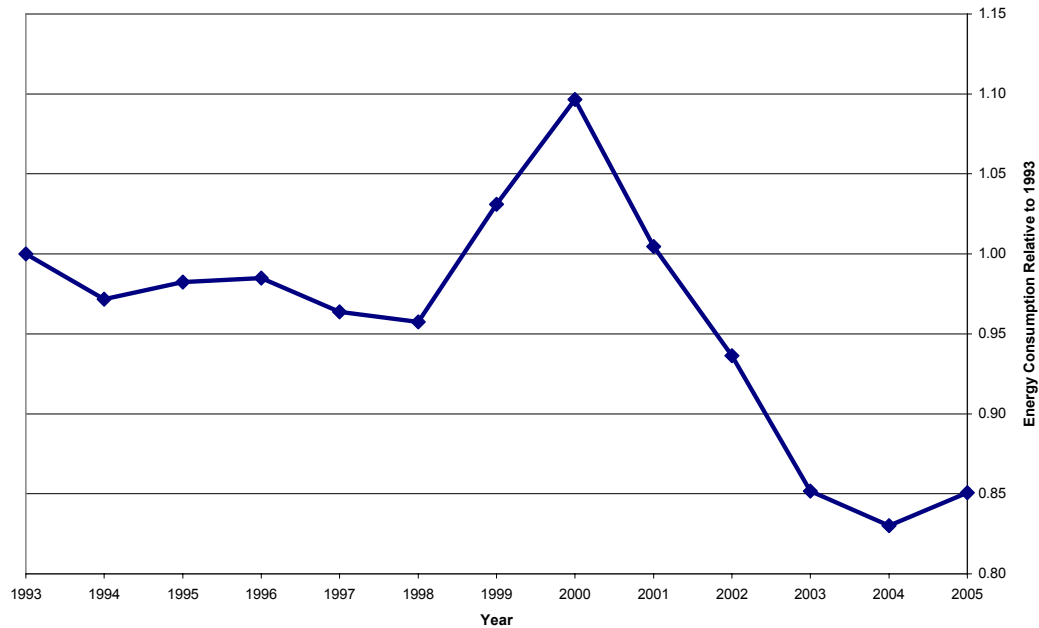
Clothes Washers

Market Trends: Total sales increased at 2.2% per annum over the analysis period. Front loading machines are dramatically increasing their market share and constituted 30.9% of all machines sold in Australia in 2005. The market share of front loaders in Western Australia and South Australia are the highest at 39% and 37% respectively. Average capacity is increasing steadily for both front and top loading machines and is now 6.7kg and 6.4kg respectively for these types. Water consumption decreased by 2.8% per annum over the period. Prices have decreased in real terms for top and front loaders over the analysis period. Twin tubs have increased in price in recent years but the average capacity for this type is now much larger and sales share remains at about 2%, so this only has a minor overall impact.

Energy: Energy consumption showed a slight decrease until 1998, but there was a significant increase in energy in 1999 and 2000 (see Figure 3). This increase was attributed to top loading machines only. Since 2000, energy consumption has been declining although a slight increase was noted in 2005. Most of the decrease is a result of increased market share of front loaders. The average star rating under the old rating system climbed from 3.39 in 1993 to 4.28 in 2005. Under the new star rating system this increased from 1.28 in 1993 to 2.4 in 2005, noting however that both old and new star ratings decreased in the years 1999 and 2000.



Figure 3: Energy Consumption of Clothes Washers



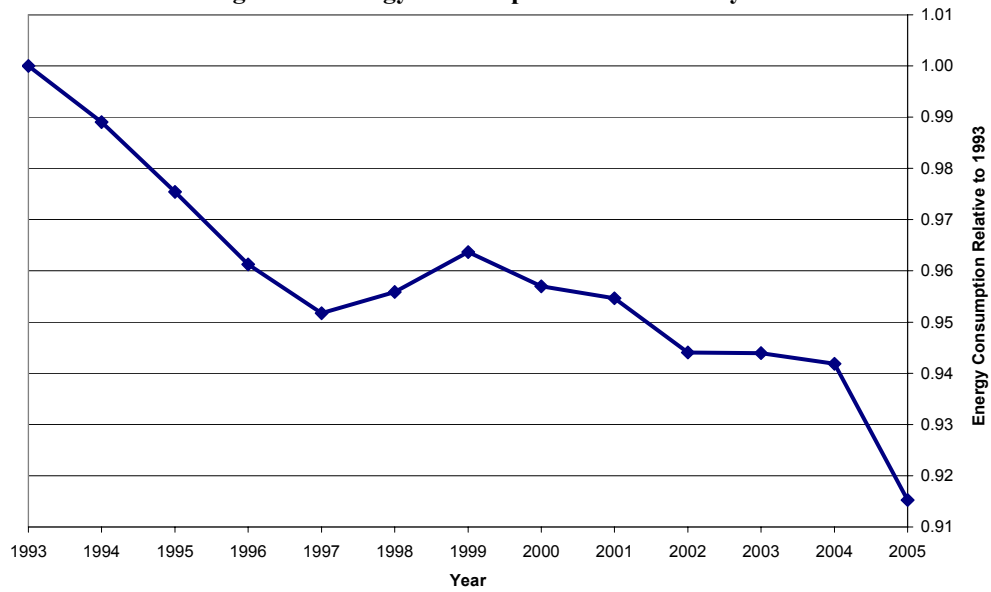
Clothes Dryers

Market Trends: Total sales increased at an average of about 4% per annum from 1993 to 2005, but there has only been a small increase in sales since 1995. The market share of auto-sensing dryers has increased significantly from 10% in 1993 to 44% in 2005. Average load capacity has been static since 1993. Prices for timer dryers were generally steady in real terms over the analysis period while auto-sensing dryers have decreased in real terms over the analysis period.

Energy: Energy consumption decreased at an average of 0.7% per annum from 1993 to 2005 (see Figure 4). All dryers appeared to decline slightly in efficiency in 2000 as a result of the new test method (lower initial moisture content). The average star rating under the old rating system increased only slightly from 2.40 in 1993 to 2.49 in 2005. Under the new star rating system this increased from 1.52 in 1993 to 1.59 in 2005. These increases are primarily due to an increase in market share of auto-sensing dryers.



Figure 4: Energy Consumption of Clothes Dryers

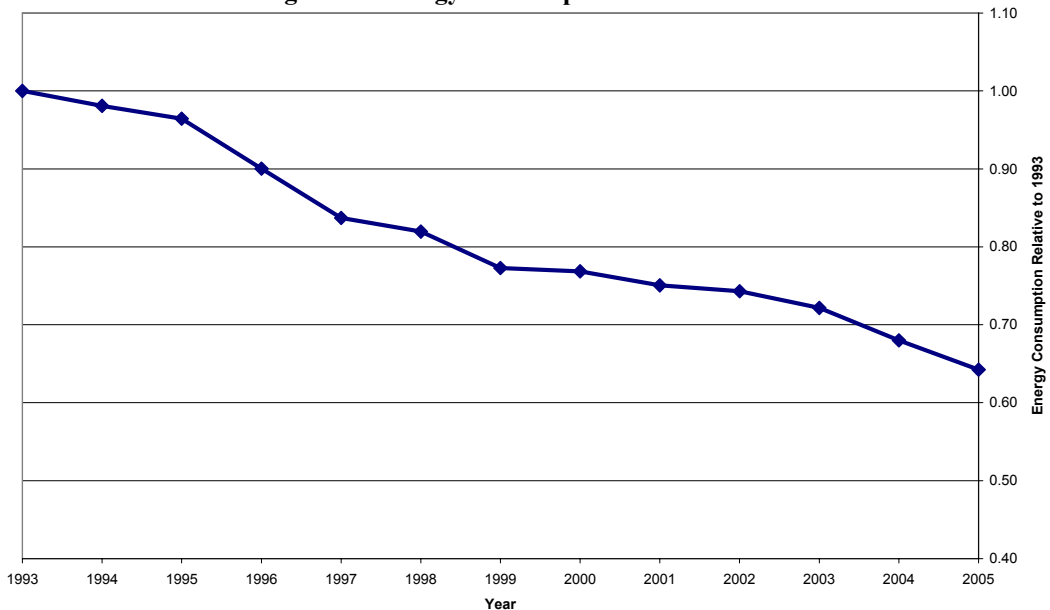


Dishwashers

Market Trends: Total sales are continuing to increase with a growth of 5.4% per annum from 1993 to 2005. Average capacity (place settings) has been stable since 1996 although there has been a slight decline since 2000. Water consumption decreased by over 4.0% per annum over the period. Prices were steady in real terms to 2003 but fell slightly through to 2005.

Energy: Energy consumption decreased at an average of 3.6% per annum from 1993 to 2005 (see Figure 5). The average star rating under the old rating system climbed from 4.07 in 1993 to 5.4 in 2005. Under the new star rating system this increased from 1.88 in 1993 to 2.8 in 2005.

Figure 5: Energy Consumption of Dishwashers



2. Detailed Results

2.1 Overview

The analysis in this report provides an in depth look at appliance performance trends in Australia over the calendar years 1993 to 2005 inclusive. The whitegoods market grew significantly over this period: the analysis in this report now includes 2.45 million appliances sold in 2005 with a total retail value of AU\$1.93 billion. Generally, there has been a significant improvement in efficiency for all products as a result of mandatory energy labelling. In the case of refrigerators and freezers, additional improvements have occurred as a result of the MEPS introduced in 1999 and subsequently made more stringent in 2005.

Generally, sales of all appliance types have been increasing. This is a result of increasing numbers of households, increasing penetration and ownership of some appliance types (eg dishwashers), and the replacement of products as they are retired.

2.2 Data Interpretation Issues

The detailed trends by appliance type are discussed in the following sections. Where trends are quoted in terms of change per annum, this usually refers to the 13 years of data from 1993 to 2005 (based on 12 data points), except where otherwise stated. A positive percentage change is an increase in the attribute while a negative percentage change is a decrease in the attribute. Note that for some characteristics a lower value is an improvement, while for others, a higher value is an improvement. In the case of sales, a larger sample base was provided in 2005 (additional retailers were included) so sales growth figures have been corrected to take account of this change.

The data shown in the following sections is based on the EES analysis of the product lists provided by GfK. The Star Rating frequency distributions for each appliance have been shown for both the old star rating (the original scale) as well as the new star rating (revised scale introduced in 2000). This has been possible as EES has calculated the old and new star rating index for every product identified by GfK and listed on the energy labelling registration database since 1993.

For the thirteen calendar years analysed, a clear trend for most performance characteristics generally emerged, although, even at the detailed level, there is some variation in the results from year to year. Some caution is required in the interpretation of these results. Shifts in the various parameters from year to year may be due to a combination of actual sales weighted trends in appliances sold together with some effect from the actual mix of models for which GfK have provided sales data. It is hoped these variations will now be minimised as full data sets are used to track trends from 2001. Care is required when interpreting data where there are less than 5 models identified in a particular year and product category.

While the data in this report and the associated detailed output tables provides a good basis for analysing appliance trends, it needs to be noted that the values reported are



as registered for energy labelling, which are based on the relevant Australian Standards for determination of performance and energy consumption. While these provide good indicators of trends in performance for different models, anyone who intends to use this data needs to have a good understanding of the definitions and requirements within these standards before drawing any conclusions with respect to the impact on actual energy consumption in households. Under Australian Standards products are generally tested at rated capacity and for a specified number of cycles per year under defined conditions. Actual use will vary for different consumers. For example, many consumers are known to run machines at lower than rated capacity for many cycles, many clothes loads are washed in cool or cold water compared to the Australian Standard specification of a warm wash, and so forth. More information on these issues is provided in Annex A under “Further Notes on Data” on page 39.

Since 2001, GfK have supplied a full data set for each appliance (excluding “exclusive” models which generally make up less than 1% of total sales for most product types). In past years, data for approximately 75% to 90% of total sales for each of the appliance groups was provided by GfK. The data included a list of models with the largest sales in order of decreasing sales (so called “hit list”).

Where any important trends or new information have emerged in the full data set (compared with the cut down version), these have been noted in the text and tables. In this report, trend data shown in figures and tables use the full data sets. Annex B on page 42 includes both the full data set and the cut down versions, to allow continuity of trends to be examined and any significant differences in the data to be highlighted.

3. Refrigerators & Refrigerator/Freezers

Energy labelling for refrigerators was introduced in 1986 and the labelling algorithm was revised in 2000. MEPS for refrigerators was first introduced in October 1999 and new stringent MEPS levels (based on US 2001 levels) were introduced on 1 January 2005.

3.1 Market Trends – Main Findings

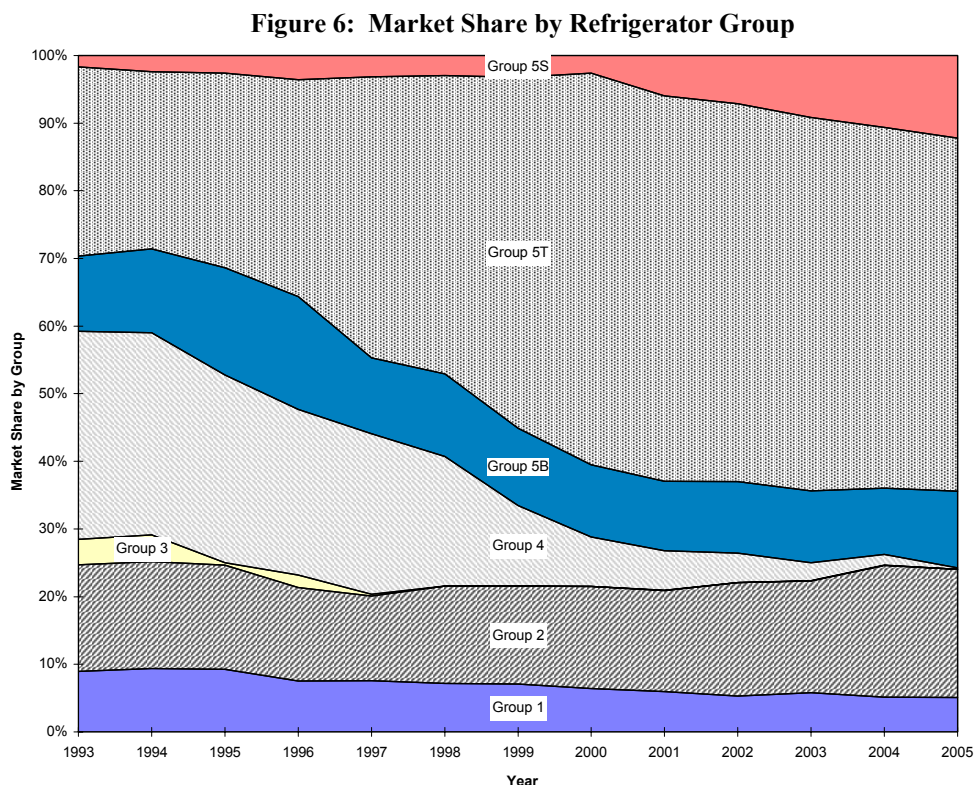
In 2005, 884,384 unit sales were identified which made up 99.8% of retail sales collected by GfK. The main findings were as follows:

- Total retail refrigerator sales for the period 1993 to 2005 increased at an average 2.6% per annum.
- The market share of Group 5S (side by side) refrigerators is increasing. Sales of models in this group doubled from 2003 to 2005 to about 12%.



- The market share of Group 5T (2 door frost free refrigerator/freezer with top-mounted freezer) peaked in 2000 at 58% after which they have had a slight decrease in sales share. In 2005 Group 5T made up 52.2% of all refrigerator sales, still by far the market leader.
- The market share of Group 5B (2 door frost free refrigerator/freezer with bottom-mounted freezer) have been steady over the analysis period at around 10%.
- The market share of Group 2 (typically small bar refrigerators – many are used in offices) was steady at around 15% to 20% share, while the market share of Group 1 (all refrigerators) declined from 9% in 1993 to 5% in 2005.
- Group 4 (2 door cyclic defrost) refrigerators made up 25% of the market in 1993. In 2005 it had 0.2% market share and has all but disappeared.
- Sales of Group 3 (refrigerator with short term freezer) have been virtually non-existent since the late 1990's with only 47 units sold in 2005⁸.

The market share by Group is shown in Figure 6.



A summary of the patterns emerging among the key characteristics of refrigerators and refrigerator/freezers in Australia is as follows:

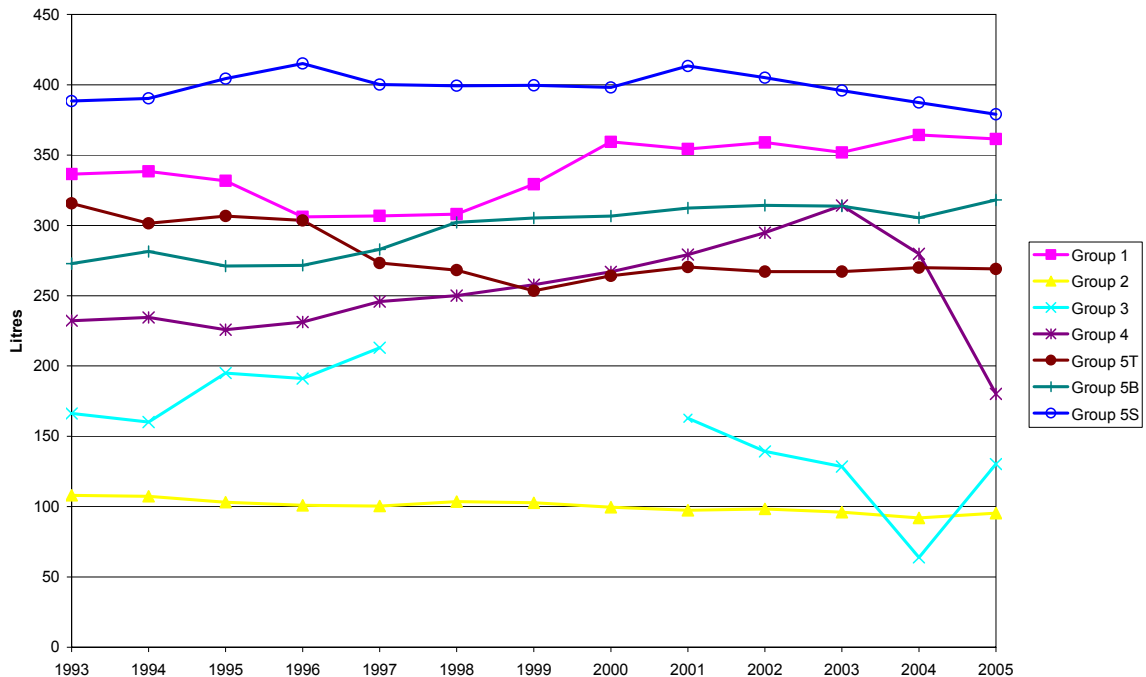
⁸ The introduction of MEPS 2005 stipulates that any models manufactured prior to January 2005 that fail MEPS can no longer be sold in the retail market. None of the Group 3 and Group 4 models identified in the 2005 GfK dataset passed the 2005 MEPS levels. Only a few models registered have been re-engineered by suppliers to meet these new MEPS requirements.



- Fresh food compartment size:** the average fresh food compartment size for all refrigerators and refrigerator/freezers has remained very stable since 1993. In 2005 the overall average size was 259 litres. However, there have been notable changes within some of the groups:
 - Group 1 (all refrigerator) compartment size increased sharply from 1998 (308 litres) to 2000 (359 litres), but has remained stable since.
 - Group 4 (2 door cyclic defrost refrigerators) showed a significant decrease in its fresh food compartment size from 314 litres in 2003 to 180 litres in 2005. However, sales of Group 4 models are extremely small (0.2% market share in 2005) so this trend is highly skewed by the few remaining models left on the market and is of little interest.
 - Group 5S (side by side frost free refrigerators) size has declined since 2001 where fresh food compartment size was 413 litres. In 2005 it was 379 litres.

Figure 7 illustrates the changes in fresh food compartment size since 1993. Group 3 shows zero litres for the years 1998, 1999 and 2000 because there were no recorded sales of Group 3 models in those years in the data provided.

Figure 7: Refrigerator Fresh Food Compartment Size Trends



Note: Sales of Group 3 are very small for all years, and sales of Group 4 in 2005 were also very small.



- **Freezer compartment size:** Average freezer compartment size has increased from 1993 (81 litres) to 2005 (97 litres). Freezer volume has been stable at around 98 litres since 2001. Within Groups, freezer volume has been fairly stable from 1993 to 2005. The reduced data set showed a slight bias of around -7% when compared to the full data set for all years from 2001 to 2005, which suggested that average freezer volumes prior to 2001 (which used a reduced data set) may be slightly underestimated. Refer to Annex B of this report for more information.
- **Purchase Price:** The price of an average refrigerator increased at around 1.0% per annum, which is lower than the inflation rate for the period. The price trends for refrigerators are complicated substantially by the change in sales share by Group (as illustrated in Figure 6). For instance:
 - 2-door frost free models (Group 5T & 5B) are on average slightly larger and more expensive than 2-door cyclic defrost models (Group 4), so the increasing share of Group 5T/5B refrigerators increases the apparent price of an average refrigerator.
 - Prices of Group 5S (side by side frost free) refrigerators have significantly declined since 2001 where the average price was just under \$3,000. In 2005 the average price was \$2,131. This can only be partly explained by decreasing size of these types.
 - Group 3 (refrigerator with short term freezer) average nominal price increased from \$505 in 2001 to \$1,638 in 2005. The remaining groups were generally steady over the analysis period. This is an anomaly as the few remaining models were higher end European models.

Within each group, the average price has been steady or declining in real terms. Detailed output tables in Appendix A provide price trends at a group and state level for years 1993 to 2005.

3.2 Energy Efficiency Trends – Main Findings

- The energy consumption of refrigerators is trending downwards at -3.9% per annum over the 13 year 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 619kWh/year compared to a significantly lower 478kWh/year in 2005 (23% decrease in 2 years).
- Within groups, significant improvements to energy consumption were noted in Group 1 and Group 5B.



- While the adjusted volume⁹ is still increasing slowly, the total energy efficiency of the refrigerator market is also increasing, at a rate of around +4.6% per annum (i.e. kWh per adjusted litre is trending downwards at -4.6% per annum). However, the change from year to year has varied substantially.

Table 1 summarises the key attributes from 1993 to 2005.

Table 1: Changes in Refrigerator Characteristics - 1993 to 2005

Characteristic	1993 Value	2005 Value	Change pa
Fresh Food Volume (litres)	250	259	0.3%
Freezer Volume (litres)	81	98	1.5%
Energy (kWh/year)	772	478	-3.9%
Adjusted Volume (litres)	385	419	0.7%
kWh/adjusted litre	2.00	1.14	-4.6%
Old SRI (star rating)	3.58	4.39	1.7%
New SRI (star rating)	1.76	3.78	6.6%
Price	\$911	\$1,021	1.0%

A year by year breakdown of key performance characteristics is shown in Figure 8.

Figure 8: Annual Trends in Key Performance Characteristics since 1993 - Refrigerators

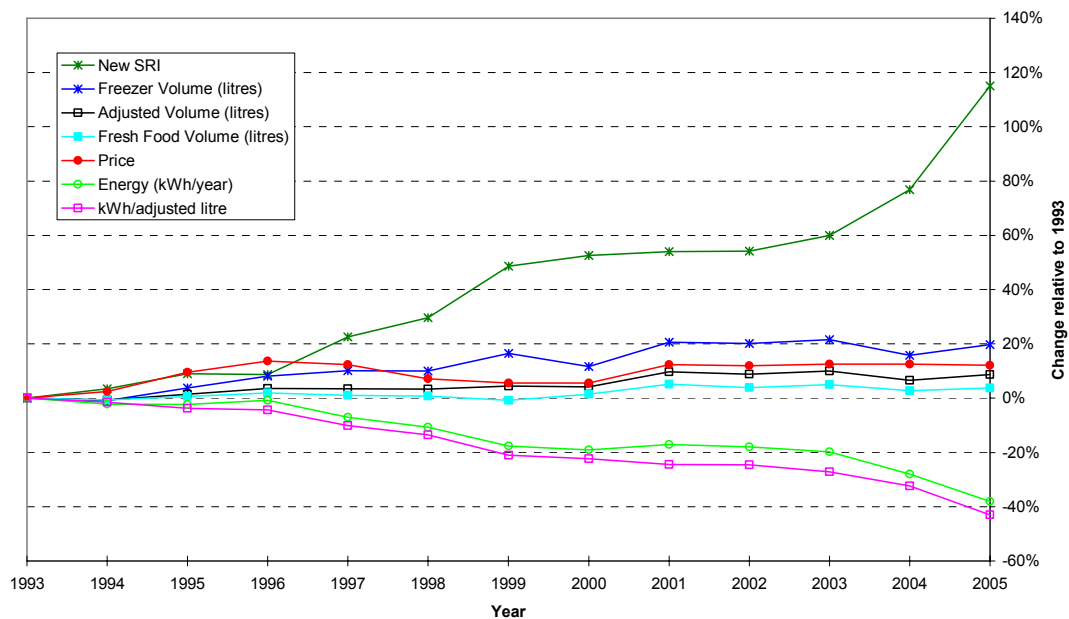


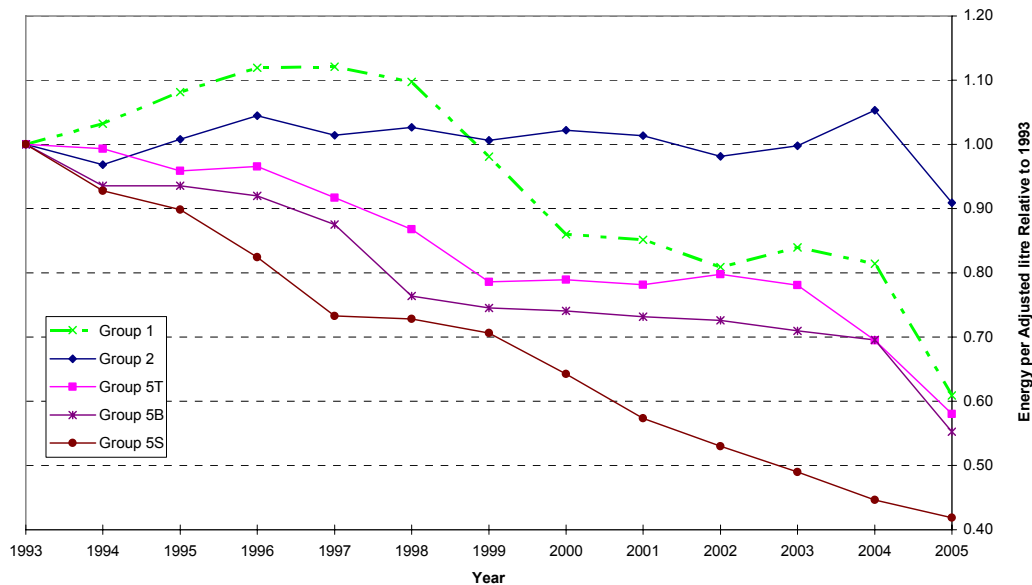
Figure 9 shows the trend in the inverse of energy efficiency (expressed as kWh per adjusted litre of volume) for each of the main refrigerator Groups. Groups 3 and 4 are

⁹ Adjusted volume is the sum of the total volume of each compartment which has been weighted to take account of its 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).



not shown because of their small market share. All groups show a marked decline since the introduction of MEPS in 1999 and the more stringent MEPS of January 2005.

Figure 9: Energy Efficiency Trends by Refrigerator Group



All groups clearly responded to the first round of MEPS in 1999 (apart from Group 2) and again in 2005 (apart from Group 5S). The impact on Group 2 in 1999 was small because the MEPS levels were relatively mild and most products in this group are very small and their total energy consumption lies well within the defined MEPS levels (which tended to be a larger fixed energy and a smaller variable energy per litre of adjusted volume). The case of Group 5S in 2005 is more interesting – the energy consumption of this group dropped continuously from about 1999. This is partly because of the very high energy consumption for this group in the early 1990's, but also because most of these products are sourced from North America and the USA MEPS levels (on which the Australian 2005 levels were based) came into force in 2001. So these MEPS levels in the USA appeared to have some flow on effect in Australia well before our MEPS levels came into force in 2005. It may also be that the growing market share and smaller size for this group from 2000 meant that labelling was also having some impact on the overall energy trend.

Figure 10 shows the sales distribution of refrigerator old star ratings in selected years from 1993 to 2005. The overall market trend is a general reduction in the proportion of 2, 3, and 4 star units sold with a corresponding increase in the proportion of 5 and 6 star units sold.

Figure 11 shows the sales distribution of refrigerator new star ratings in selected years from 1993 to 2005. Note that new half star ratings (from 2000) have been amalgamated for this figure (e.g. 1 + 1.5 star share is shown as 1 star). The overall market trend is a general reduction in the proportion of 1 star units sold with an increase in those 3 stars and above. The share of 2 star units increased initially then



decreased in 2005. The first 4 star unit appeared in 1999. In 2005 a large number of 4.5 star models appeared on the market as a result of MEPS.

Detailed information for energy and other characteristics for all years and groups is available in the separate output tables (Appendix A).

Figure 10: National Sales Distribution by Old Star Rating - Refrigerators

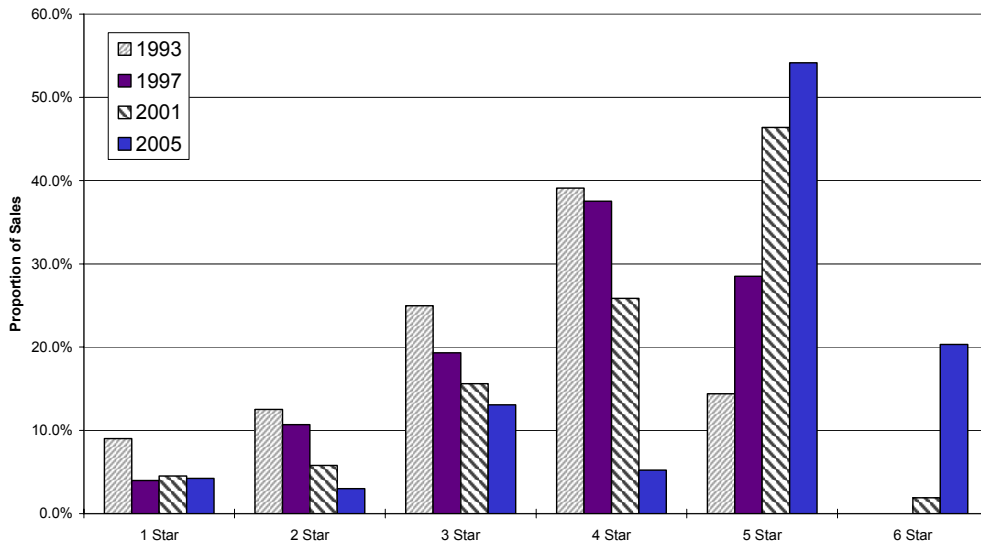
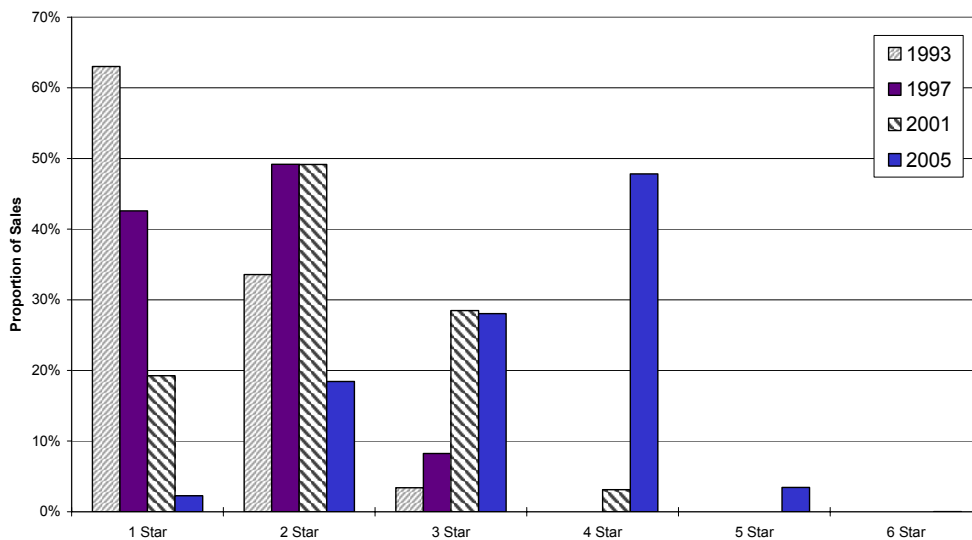


Figure 11: National Sales Distribution by New Star Rating - Refrigerators



4. Separate Freezers

Energy labelling for freezers was introduced in 1986 and the labelling algorithm was revised in 2000. MEPS for freezers was first introduced in October 1999 and new stringent MEPS levels (based on US 2001 levels) were introduced on 1 January 2005.

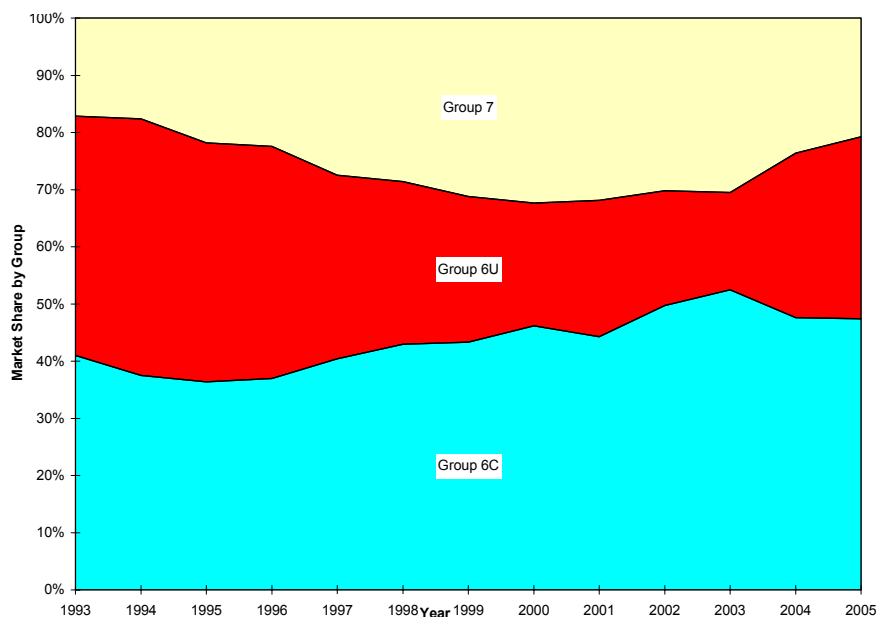
4.1 Market Trends – Main Findings

In 2005, 198,257 unit sales were identified which made up 100% of retail sales collected by GfK. The main findings were as follows:

- Total retail freezer sales for the period 1993 to 2005 grew at an average of 4.8% per annum, although the majority of this increase occurred in the years 2004 and 2005 for reasons which are not clear (sales to 2003 were fairly static).
- Chest freezer (Group 6C) sales constitute nearly 50% of the market in 2005 and this share has been fairly steady over the analysis period (typically from 40% to 50% share).
- The market share of vertical (or upright) manual defrost freezers (Group 6U) declined to 17% in 2003 then sharply increased to 32% in 2005. These sales of these very small vertical manual defrost freezers increased 3 fold in nearly 2 years from 2003 to 2005. Many appear to be low cost imports. The source of the demand for such products is unclear.
- The market share of vertical frost free freezers (Group 7) is around 21% in 2005 and its market share appears to have diminished since 2003, although absolute sales have been steady or growing.

Market share by Group is shown in Figure 12.

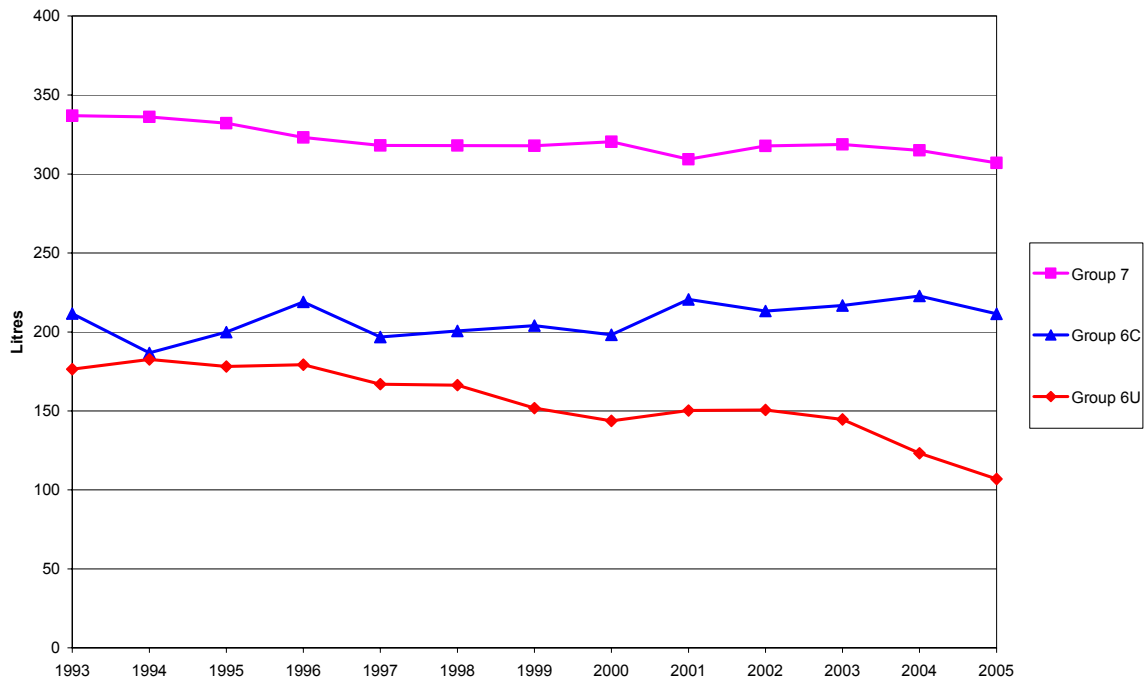
Figure 12: Market Share by Freezer Group



A summary of the patterns emerging among the key characteristics of freezers in Australia is as follows:

- The average freezer size for all freezers in Australia is 198 litres which is a slight decrease (-0.8% pa) since 1993 where average size was 218 litres.
- The average size among each segment varies substantially (group 6C = 212 litres, group 6U = 107 litres, group 7 = 307 litres). Chest freezers have been largely static in size (a slight decline then an increase), while vertical frost free units have been decreasing slightly (just under 1% per annum). Vertical manual defrost freezers have decreased from an average of around 180 litres in 1993 to about 107 litres in 2005, with the biggest falls coinciding with the increase in sales of this group in 2004 and 2005.
- Comparison of the full data set versus the reduced data set showed a difference in freezer volume of around 7% in 2001 and 6% in 2002. However, this bias had disappeared by 2005. This appears to be a short term anomaly and it is unclear whether this effect persisted before 2001. Refer to Annex B of this report for more information.
- The average nominal price of all freezers is increasing at around 0.1% per annum, which is below the inflation rate.
- The average price within each group has varied. Groups 6C and 7 have been increasing slightly in nominal terms (around 1% per annum). Group 6U prices were static until 2003 but then there was a large price fall in 2004 and 2005 coinciding with the increase in sales of this group in these years.

Figure 13: Separate Freezer Size Trends



4.2 Energy Efficiency Trends – Main Findings

- The energy consumption of freezers is trending downwards at -4.0% per annum, with the most significant gains in energy efficiency being made since 2003 in response to 2005 MEPS.
- As the volume is decreasing slightly, the total energy efficiency of the freezer market is increasing at a rate of around +3.3% per annum (i.e. kWh per adjusted litre is trending downwards at -3.3% pa). Freezer energy efficiency has improved markedly from 1998 to 2005.
- Table 2 summarises the key attributes from 1993 to 2005.

Table 2: Changes in Freezer Characteristics - 1993 to 2005

Characteristic	1993 Value	2005 Value	Change pa
Freezer Volume (litres)	218	198	-0.8%
Energy (kWh/year)	619	377	-4.0%
Adjusted Volume (litres)	349	317	-0.8%
kWh/adjusted litre	1.77	1.19	-3.3%
Old SRI	4.24	5.22	1.7%
New SRI	1.48	3.40	7.2%
Price	\$568	\$574	0.1%

A year by year breakdown of key performance characteristics is also shown in Figure 14 below.

Figure 14: Annual Trends in Key Performance Characteristics - Freezers

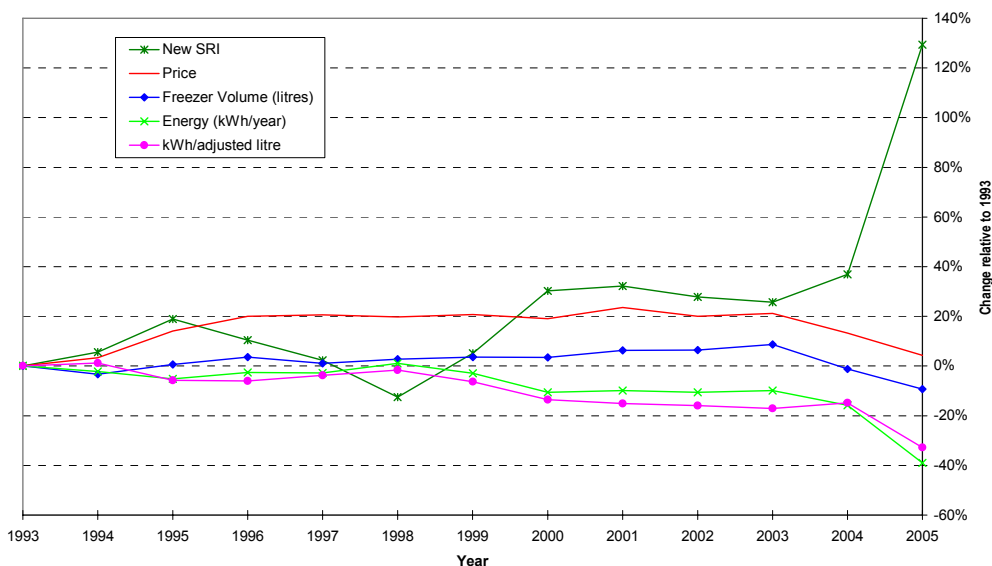
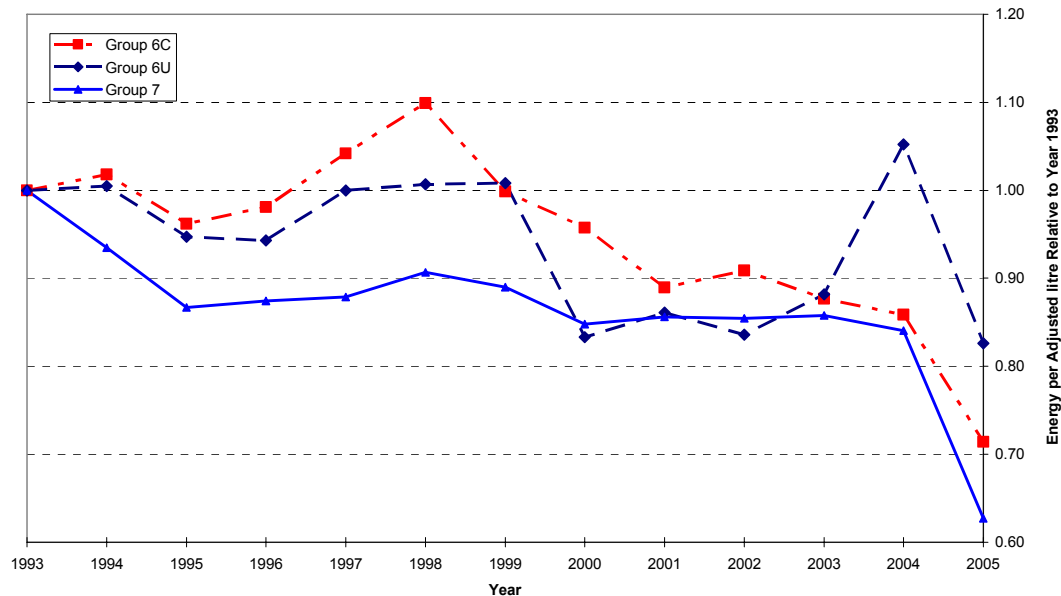


Figure 15 shows the trend in the inverse of energy efficiency (expressed as kWh per adjusted litre of volume) for each of the three freezer groups. All groups show a significant improvement from 2004 to 2005 as a result of the new 2005 MEPS coming into force.

Figure 15: Energy Efficiency Trends by Freezer Group



The overall efficiency of freezers deteriorated from 1995 to 1998. This is mostly due to a deterioration in chest freezer efficiency, but also there was some deterioration in vertical manual defrost freezers and frost free freezers during this period. This is most likely to be associated with the phase out of CFCs in 1994. HFC134a (now the dominant refrigerant used by local manufacturers which make most freezers) is less efficient at lower evaporator temperatures when compared with CFC12, but has better heat transfer capabilities. The net efficiency impact appears to be smaller on models which have tube type evaporators and condensers (such as vertical freezers Group 6U) or where forced air is used (Group 7) as in these cases the heat transfer capacity is high, but in the case of chest freezers (Group 6U) where the heat exchangers tend to be less efficient (flat wall heat exchangers for both the evaporator and condenser), the change to HFC134a appears to have had a bigger negative impact. The CFC phase out was quite rapid and manufacturers had little time to optimise designs for the new refrigerants in the first few years. By 1999 MEPS also had some impact on all groups.

Figure 16 and Figure 17 show the sales distribution of freezer old and new star ratings for selected years from 1993 to 2005 respectively. Note that new half star ratings (from 2000) have been amalgamated for this figure (e.g. 1 + 1.5 star share is shown as 1 star). The graphs clearly show that the proportion of higher star rating freezers sold in the market place is increasing, particularly in 2005.



Detailed information for energy and other characteristics for all years and groups is available in the separate output tables (Appendix A).

Figure 16: National Sales Distribution by Old Star Rating - Freezers

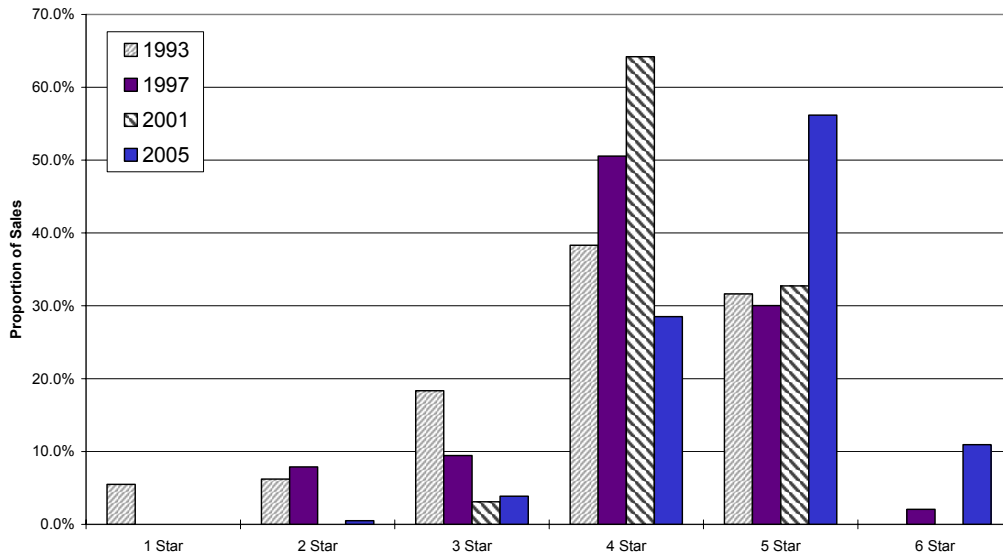
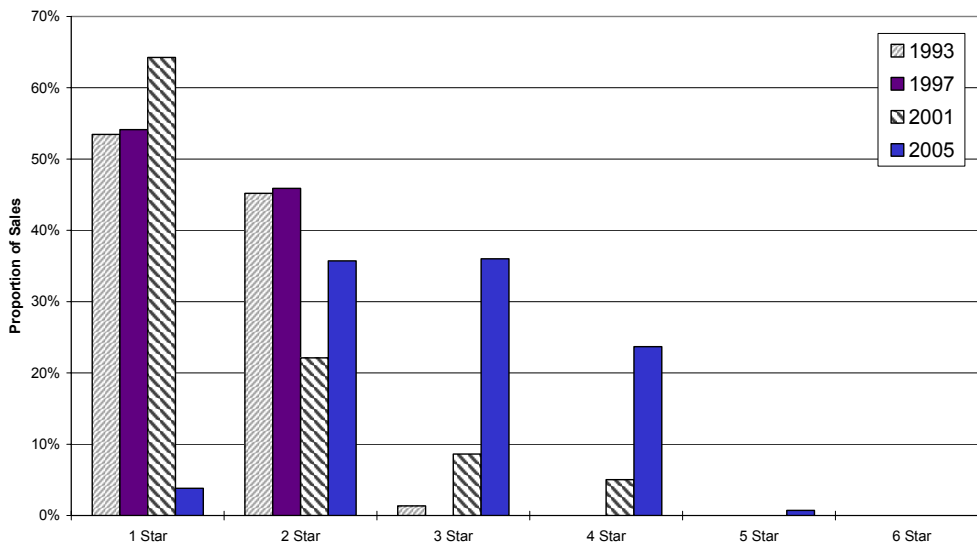


Figure 17: National Sales Distribution by New Star Rating - Freezers



5. Clothes Washers

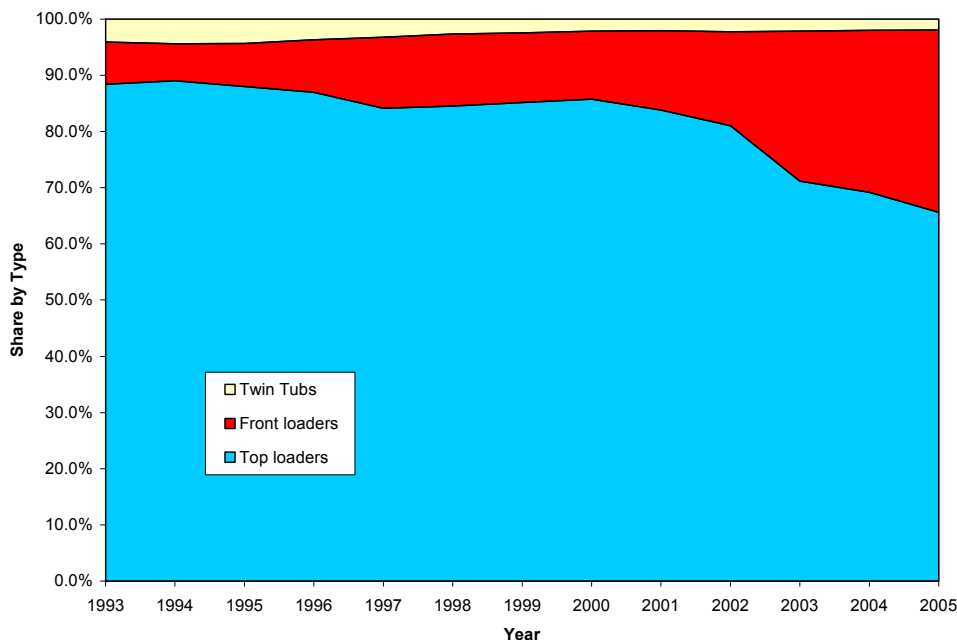
Energy labelling for clothes washers was introduced in 1990 and the labelling algorithm was revised in 2000. Voluntary water efficiency labelling commenced in the 1990's and mandatory water efficiency labelling commenced in July 2006.

5.1 Market Trends – Main Findings

In 2005, 722,950 unit sales were identified which made up 99.3% of retail sales collected by GfK. The main findings were as follows:

- Total retail sales for clothes washers for the period 1993 to 2005 increased at 2.2% per annum.
- Top loading machines are still the dominant type in Australia with 65.6% of the market in 2005. However, front loading machines are dramatically increasing their market share and constituted 30.9% of all machines sold in 2005. In 2000, the market share of front loading machines was just 12% and in the early 1990's it was around 7%. The market share of front loading machines is highest in Western Australia and South Australia with 39% and 37% market share in these states respectively.
- The market share of twin tubs is small but has been steady at about 2% since 1999 (about 1.9% in 2005). Sales share by washer type by year is shown in Figure 18.

Figure 18: Sales Share by Washer Type - 1993 to 2005

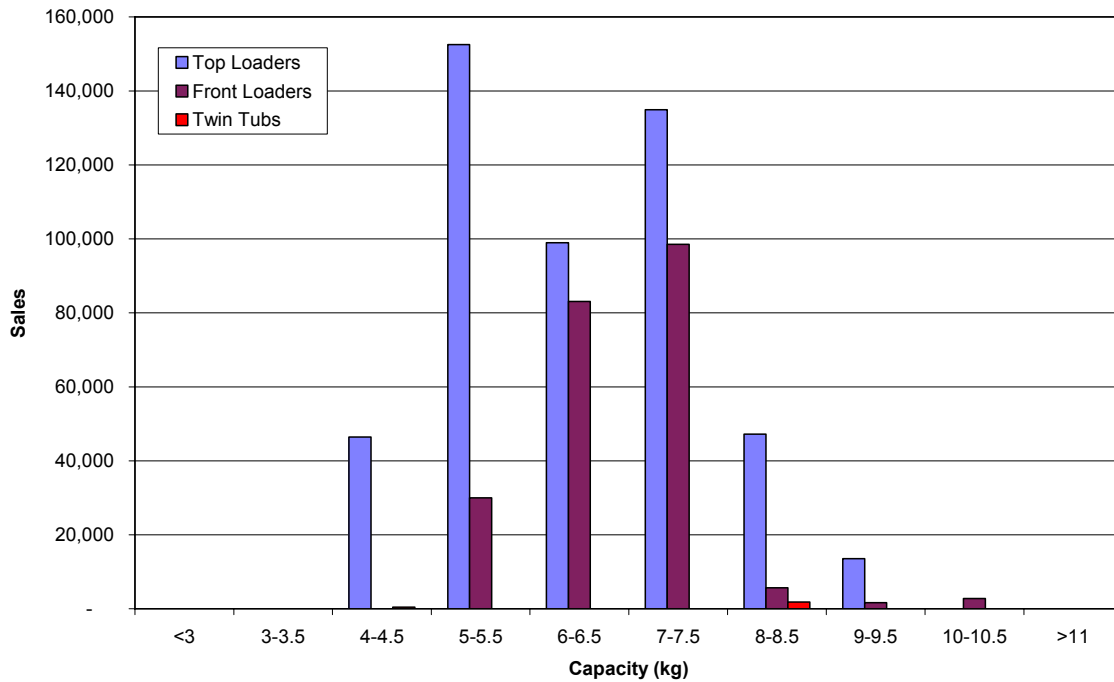


Note: Market share prior to 2001 is accurate in the figure above. Model data provided by GfK in the Appendices does not account for exclusive and other unidentified models so is less accurate.

A summary of the patterns emerging among the key characteristics of clothes washers in Australia is as follows:

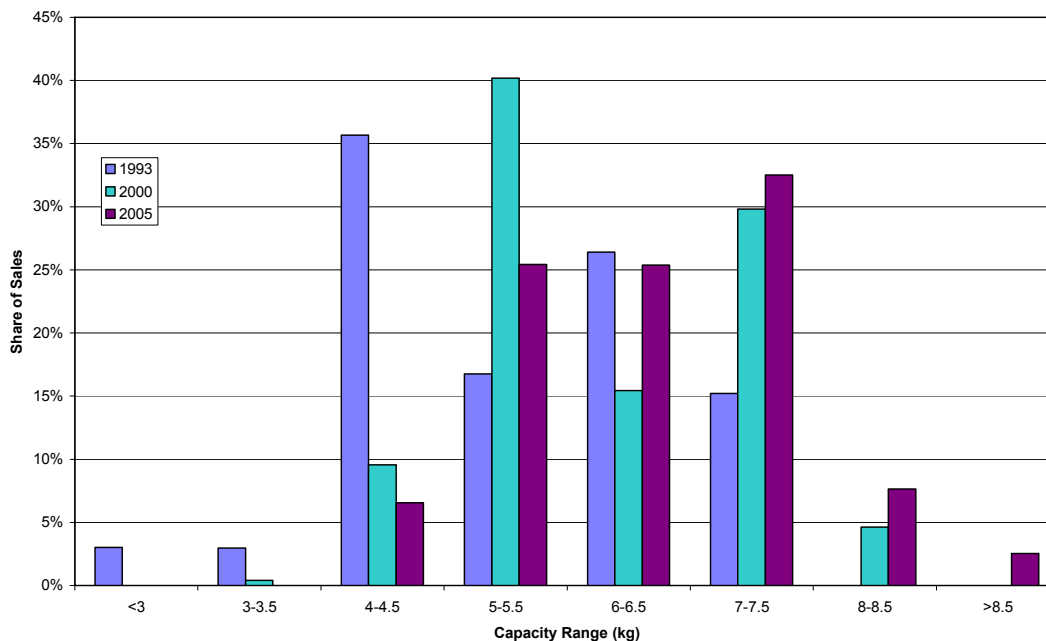
- **Load Capacity:** The average load capacity for all clothes washers in Australia was 6.5 kg in 2005 and this has increased at about 1.8% per annum since 1993. Figure 20 illustrates how the market share by rated capacity has changed in selected years from 1993 to 2005. Clearly the market share of larger washer types is increasing. Among the clothes washer types:
 - Top loaders increased steadily in size from 5.4kg in 1993 to 6.4kg in 2005.
 - Front loaders increased in capacity from 4.7kg in 1993 to 6.7kg in 2005¹⁰. In 2000, the average was around 5.6kg.
 - Figure 19 below shows the distribution of rated capacity in 2005 for top loaders, front loaders and twin tubs.

Figure 19: Rated Capacity Distribution by Washer Type – 2005



¹⁰ The average size of front loaders has increased (and surpassed) the average size of top loaders due to sales of some particularly large units (7.5kg, 8kg, 9kg and 10kg) in recent years.

Figure 20: Changes in Rated Capacity Distribution for All Types – 1993, 1999 & 2005

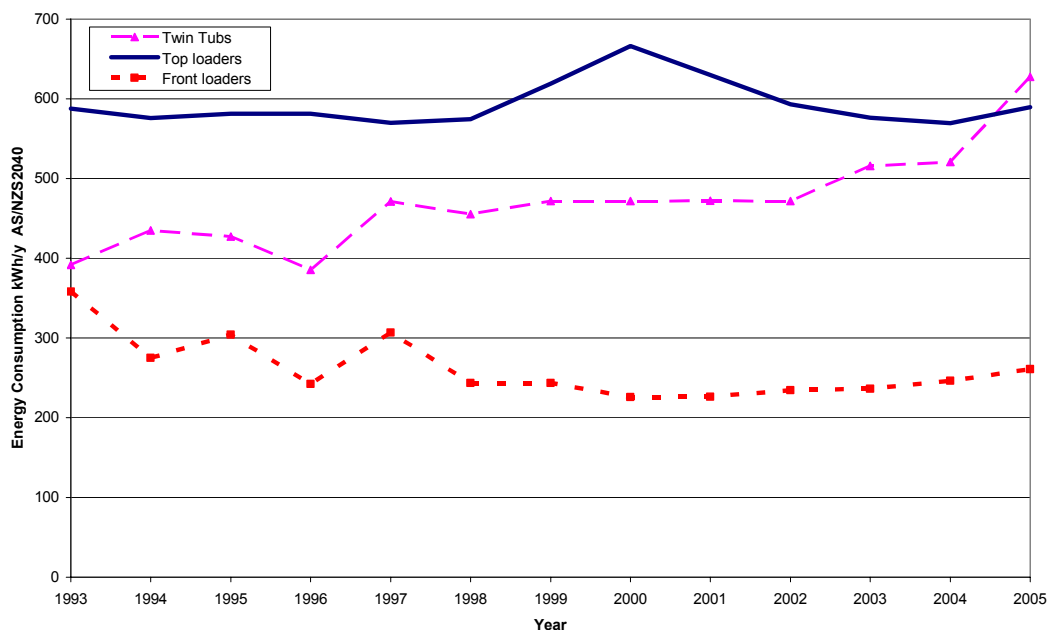


- **Water Consumption:** Water consumption of clothes washers has been trending downwards since 1993 (at -2.8% pa since 1993). Voluntary water labelling is being replaced with mandatory water labelling from 1 July 2006. Water consumption trends will be followed closely to monitor the effect of mandatory labelling on water efficiency.
 - Water consumption of front loaders declined significantly from 98 litres in 1996 to 67 litres in 2000 although has remained steady since.
 - The water consumption of top loaders has varied from year to year, although this is trending downwards with most significant improvement from 2003 where the average consumption was 139 litres compared to 2005 where it was 118 litres.
- **Spin performance:** Spin performance of all clothes washers has shown a very gradual improvement since 1993, down from 0.85 to 0.73 in 2005. The average spin performance of top and front loading machines is generally comparable (top=0.75 average, front=0.69 average in 2005) although there is significant variation in spin performance within each type.
- **Price:** The price of clothes washers decreased over the period 1993 to 2005 in real terms (nominal price actually decreased at 0.6% per annum), which is well below inflation for the period. This is despite the increased market share of front loaders, which are on average more expensive. Top loader prices have decreased in nominal terms and front loader prices have increased in nominal terms.

5.2 Energy Efficiency Trends – Main Findings

- The average energy consumption of all clothes washers sold has been trending downwards since 1993 at 1.3% per annum although there has been some variation year to year among clothes washer types. The overall energy trend is primarily driven by the increased market share of front loaders.
- Front loader energy consumption was relatively steady from 1998 to 2005, although there has been a slight increase in energy from 236 kWh/year in 2003 to 261 kWh/year in 2005 which may be explained by an increase in the capacity of front loading machines in 2005.
- Trends in twin tub energy need to be used with caution due to the very small market size and the significant ongoing increases in capacity in recent years.
- Top loader energy consumption declined from 2000, although it did increase again slightly in 2005. These energy trends are illustrated in Figure 21. It should be noted that the trends are based on AS/NZS2040 which specifies a warm wash for the purposes of energy labelling. ABS has found that more than 60% of households wash in cold water (see ABS4602.0-2005 - Environmental Issues: People's Views And Practices). More detail on the criteria used to analyse data for clothes washers in this report can be found in Annex A: Source Data, Methodology and Notes on Data.

Figure 21: Trends in Top and Front Loading Clothes Washer Energy



Note that an average front loader uses less than 50% of the energy of an average top loader. Around 50% of front loader models registered in 2005 have dual hot and cold water connections, which mean that this type can now take advantage of lower cost external hot water supplies such as gas, solar or off peak electric. This is a substantial change as in 2000 very few front loader models had dual connections. So the energy labelling data between these washer types is quite clear cut, but the in-use energy



consumption of machine in a typical household will be much more complex. A more detailed discussion on the energy consumption of clothes washers and the Australian Standard is contained in Annex B of this report.

Table 3 summarises the key clothes washer attributes from 1993 to 2005. A year by year breakdown of key performance characteristics is also shown in Figure 22.

Table 3: Changes in Clothes Washer Characteristics - 1993 to 2005

Characteristic	1993 Value	2005 Value	Change pa
Capacity (kg)	5.22	6.48	1.8%
Water Consumption (litres)	146	103.8	-2.8%
Spin Performance	0.85	0.73	-1.3%
Energy (kWh/year)	574	488	-1.3%
Old SRI	3.39	4.28	2.0%
New SRI	1.28	2.4	5.4%
Price	\$802	\$745	-0.6%

Figure 22: Annual Trends in Key Performance Characteristics - Clothes Washers

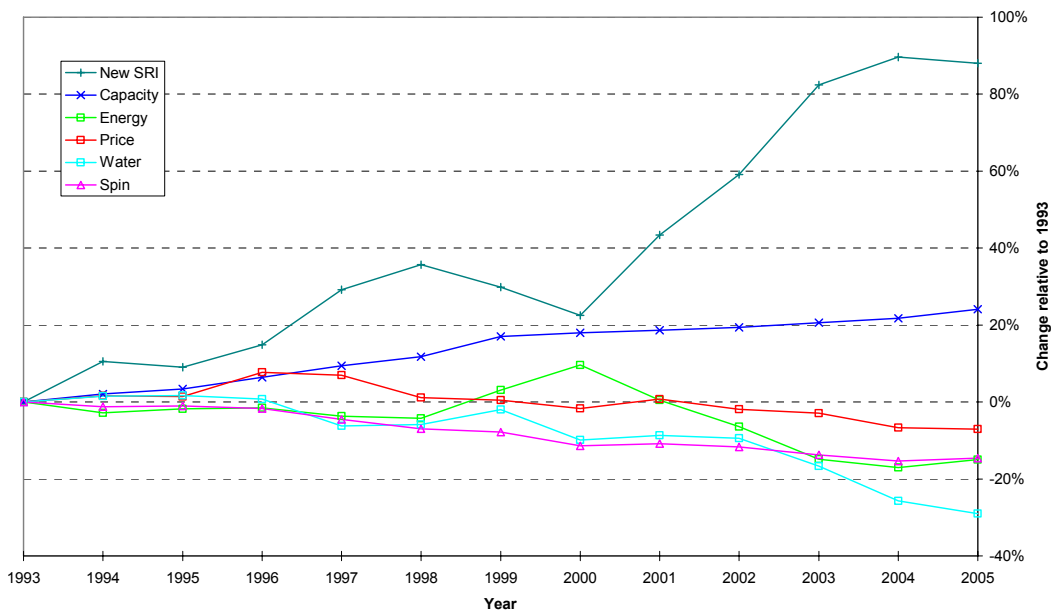


Figure 23 and Figure 24 show the sales distribution of clothes washer old and new star ratings for selected years from 1993 to 2005 respectively. Note that new half star ratings (from 2000) have been amalgamated for this figure (e.g. 1 + 1.5 star share is shown as 1 star). Under the old star rating, there is a decrease in number of 3 star units sold and an increase in the number of 5 star units. Under the new star rating



system, there is a decrease in 2 star units and an increase in 3, 4 and 5 star units being sold.

Detailed information for energy and other characteristics for all years and types is available in the separate output tables (Appendix B).

Figure 23: National Sales Distribution by Old Star Rating - Clothes Washers

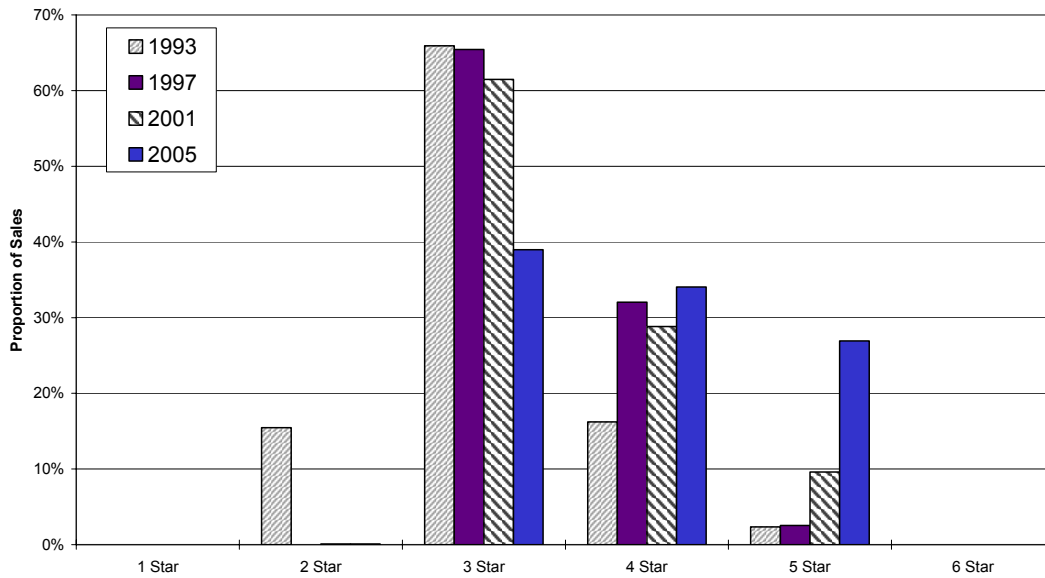
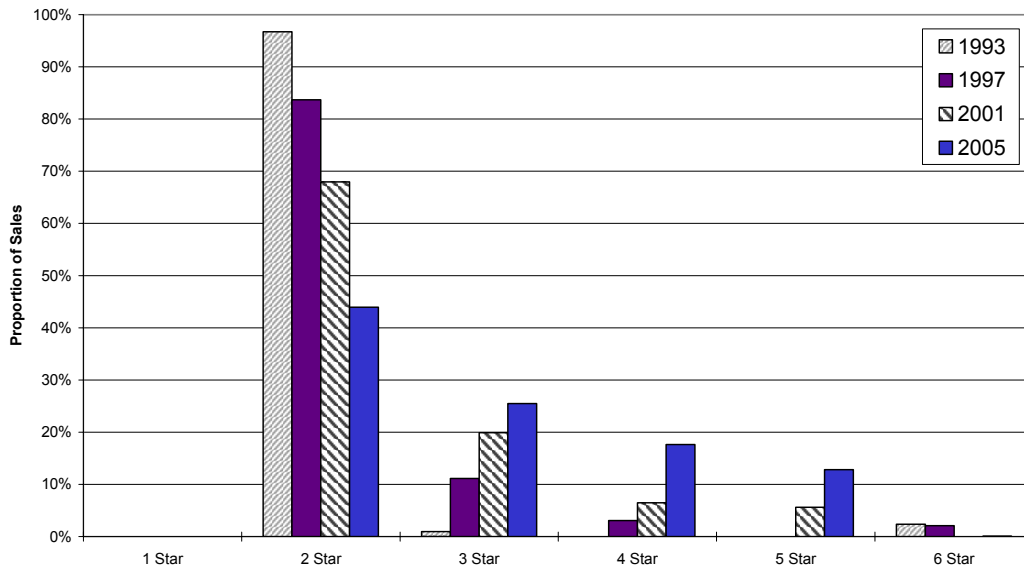


Figure 24: National Sales Distribution by New Star Rating - Clothes Washers



6. Clothes Dryers

Energy labelling for clothes dryers was introduced in 1989 and the labelling algorithm was revised in 2000.

6.1 Market Trends – Main Findings

In 2005, 278,811 unit sales were identified which made up 100% of retail sales collected by GfK (i.e. all models were identified in the data set). The main findings were as follows:

- Total sales increased at an average of about 4% per annum from 1993 to 2005, but there has only been a small increase in sales since 1995.
- The vast majority of clothes dryers sold in Australia were the vented type – condenser dryers are available but these are less common in the market place.
- Timer dryers made up about 56% of sales in 2005. The market share of auto-sensing dryers has increased significantly from 10% in 1993 to 44% in 2005. Figure 25 illustrates the market share of each clothes dryer type.
- The average load capacity for all clothes dryers in Australia was 4.4 kg in 2005 and this has been static since 1993. The three main capacities available in 2005 were: 3.0kg to 3.5kg (representing 32% of sales), 4.0kg to 4.5kg (33% of sales) and 5.0 to 5.5kg (34% of sales). Other sizes which range up to 9kg are available, but these have only a negligible market share. Figure 26 shows the rated capacity for each of the main clothes dryer types. Trends for condenser types need to be interpreted with caution due to the very small market share for these products. No condenser types were identified in the model lists provided prior to 2001 as the sales for each model were small.
- Average program time for clothes dryers was around 142 minutes and this has remained constant over the study period.
- The price of clothes dryers increased at around 1.2% per annum, which was slightly below inflation for the analysis period, despite the increasing market share of auto-sensing models, which were generally more expensive than timer models. The price trend within in the timer segment was +0.7% per annum while auto-sensing was -0.1% per annum (both well below inflation).



Figure 25: Market Share of Clothes Dryer Types

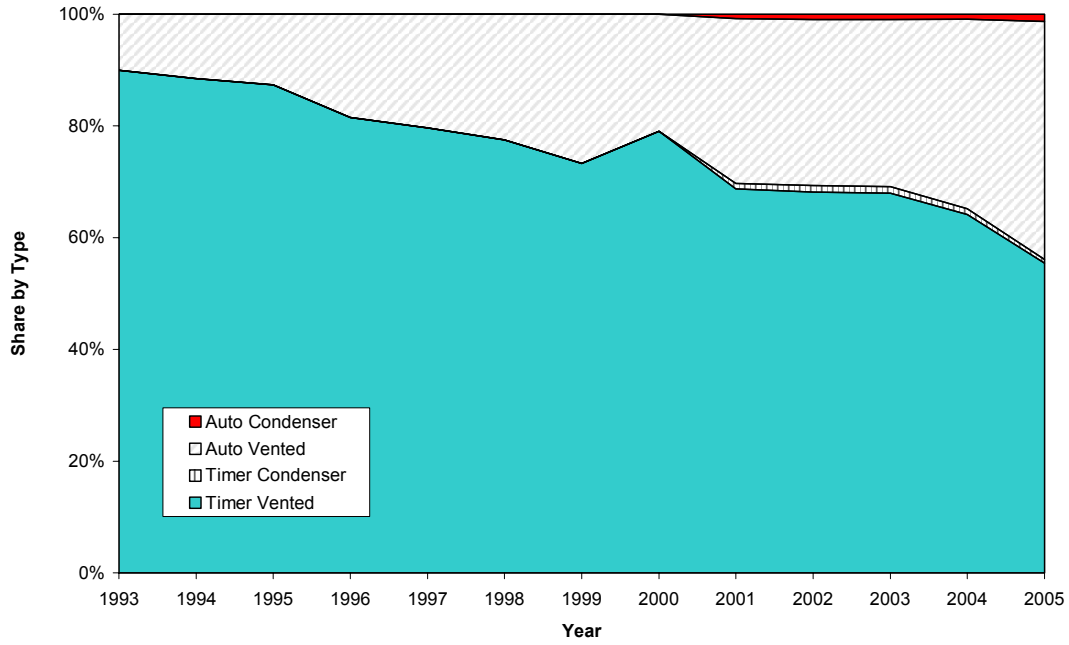
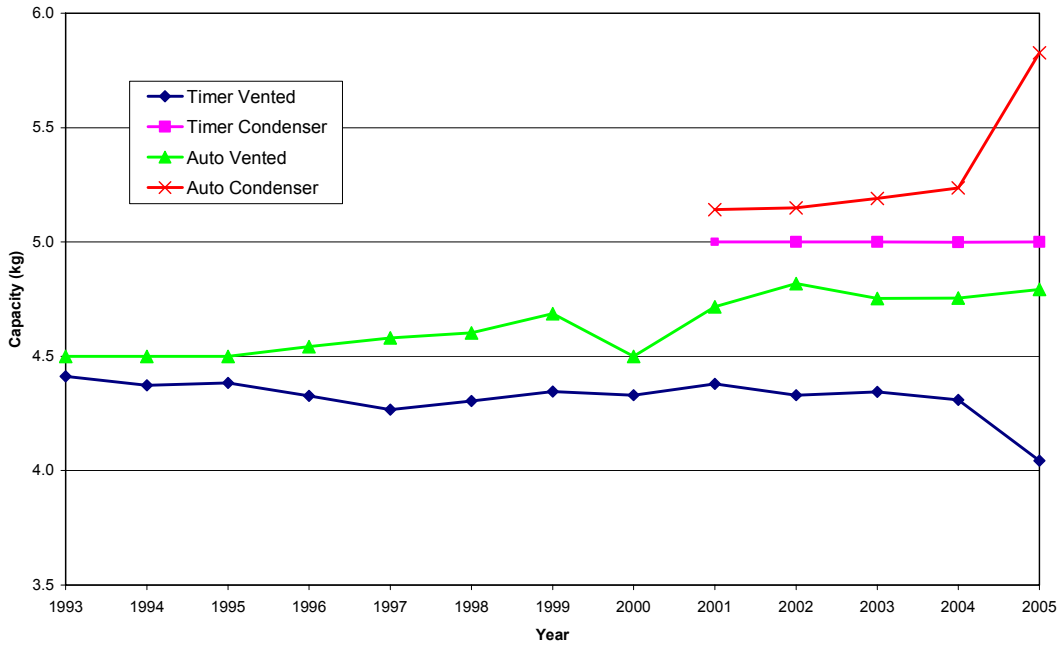


Figure 26: Capacity of Clothes Dryer Types



6.2 Energy Efficiency Trends – Main Findings

- The energy consumption of clothes dryers trended downwards at around -0.7% per annum. The old and new star ratings for clothes dryers increased at 0.3% and 2.3% per annum respectively. Table 4 summarises the key attributes from 1993 to 2005. A year by year breakdown of key performance characteristics is shown in Figure 27.

Table 4: Changes in Clothes Dryer Characteristics - 1993 to 2005

Characteristic	1993 Value	2005 Value	Change pa
Capacity (kg)	4.42	4.39	-0.1%
Program Time (minutes)	141	142	0.1%
Specific Energy (kWh/kg water removed)	1.10	1.12	0.2%
Energy (kWh/year)	240	219	-0.7%
Old SRI	2.40	2.49	0.3%
New SRI	1.2	1.59	2.3%
Price	\$339	\$407	1.5%

Note: The energy trend is affected by the share of timer and auto-sensing. The energy value reported above is based on the new algorithm of 52 uses/year introduced in 2000 (previously 150 uses/year).

Figure 27: Annual Trends in Key Performance Characteristics - Clothes Dryers

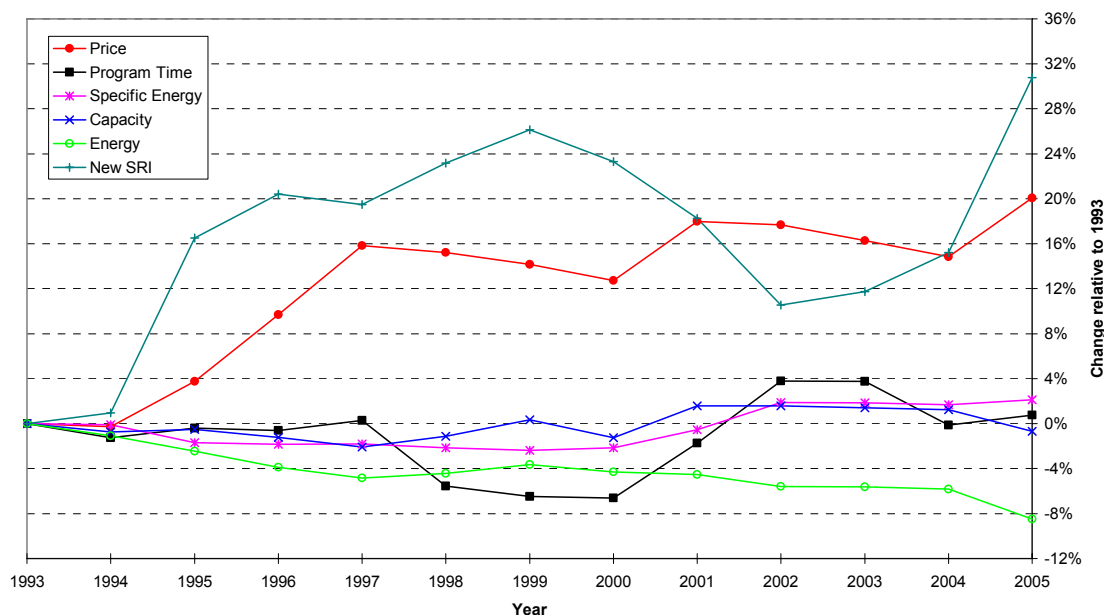


Figure 28 and Figure 29 show the national sales distribution of clothes dryer old and new star ratings for selected years from 1993 to 2005. Note that new half star ratings

(from 2000) have been amalgamated for this figure (e.g. 1 + 1.5 star share is shown as 1 star). The overall market trend in the old star rating was a reduction in the proportion of 2 star units sold and an increase in the proportion of 3 star units sold. Similarly, the overall market trend in the new star rating was a reduction in the proportion of 1 star units sold and an increase in the proportion of 2 star units sold. Given that 1 star represents a 15% difference in energy consumption for the 2000 energy labelling algorithm (for a given size), the energy efficiency range is quite narrow for this product.

Detailed information for energy and other characteristics for all years and types is available in the separate output tables (Appendix C).

Figure 28: National Sales Distribution by Old Star Rating - Clothes Dryers

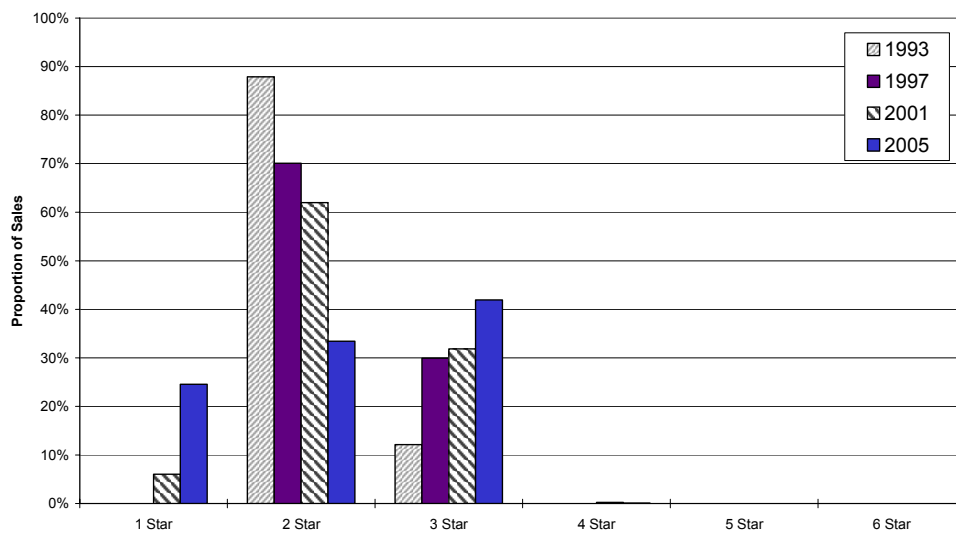
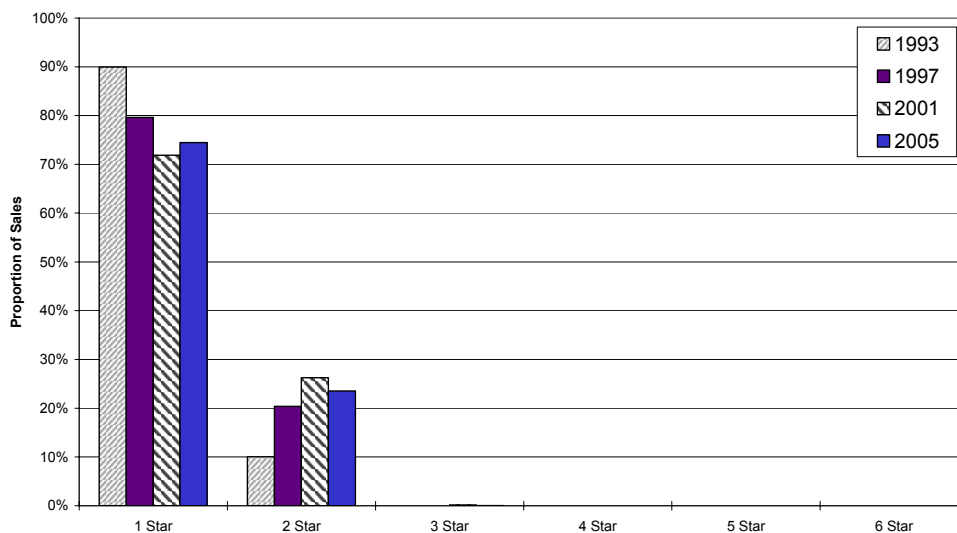


Figure 29: National Sales Distribution by New Star Rating - Clothes Dryers



7. Dishwashers

Energy labelling for dishwashers was introduced in 1988 and the labelling algorithm was revised in 2000. Voluntary water efficiency labelling commenced in the 1990's and mandatory water efficiency labelling commenced in July 2006.

7.1 Market Trends – Main Findings

In 2005, 289,535 unit sales were identified which made up nearly 100% of retail sales collected by GfK. The main findings were as follows:

- Total sales are continuing to increase with a growth of 5.4% per annum from 1993 to 2005 with sales of 289,618 units in 2005.¹¹
- The average place setting capacity for all dishwashers in Australia was 12.4 which is a slight decline in average capacity of 0.9% per annum since 1993.
- The vast majority of dishwashers sold in Australia are standard sized 600 mm wide units of 12 or 14 place setting capacity.
- Program times for dishwashers have increased from 69 minutes in 1993 to 103.7 minutes in 2005, a growth of 3.4% per annum.¹²
- The water consumption of dishwashers trended down at –4.0% per annum to 17.6 litres in 2005.
- The price of dishwashers increased at around 0.1% per annum in nominal terms which was well below inflation for the period. The average price in 1993 was \$927 compared to \$939 in 2005.¹³

7.2 Energy Efficiency Trends – Main Findings

The energy consumption of dishwashers trended downwards at -3.6% per annum from 1993 to 2005. The old star rating for dishwashers increased at 2.4% per annum while the new star rating increased at 3.4% per annum. Table 5 summarises the key

¹¹ It should be noted that the 2005 data set in the detailed output tables includes a number of new retail stores. The growth in dishwasher sales per annum has been corrected to take this change in base sample which has these new retailers excluded in for 2005.

¹² Program times appear to be increasing, however this is due to an ambiguity in the 2003 edition of the standard which does not differentiate between the end of program and end of cycle. Some models which have a large market share appear to now have a longer program time when this is being measured (usually because a fan is running after the program is complete, which is counted in the program time under the 2003 standard). The new standard published in 2005 has clarified the difference between cycle time and program time so that all units will be measured in the same way. This should appear as a program time decrease from 2007 as all products have to be registered to the new standard by early 2007..

¹³ Dishwasher price trends have varied since 1994 and were highest in 2001 when the average price was \$1,018. However, the dishwasher market has become highly competitive with a large proportion of components now being sourced from low cost countries (such as Asia and Eastern Europe) which has driven price downwards since 2001.



attributes from 1993 to 2005 using values obtained from analysis of the full data set. A year by year breakdown of key performance characteristics is shown in Figure 30.

Table 5: Changes in Dishwasher Characteristics - 1993 to 2005

Characteristic	1993 Value	2005 Value	Change pa
Place Settings	13.9	12.4	-0.9%
Program Time (minutes)	69	103.7	3.4%
Water Consumption (litres)	28.8	17.6	-4.0%
Energy (kWh/year)	494	317	-3.6%
Old SRI	4.07	5.40	2.4%
New SRI	1.88	2.80	3.4%
Price	\$927	\$939	0.1%

Figure 30: Annual Trends in Key Performance Characteristics - Dishwashers

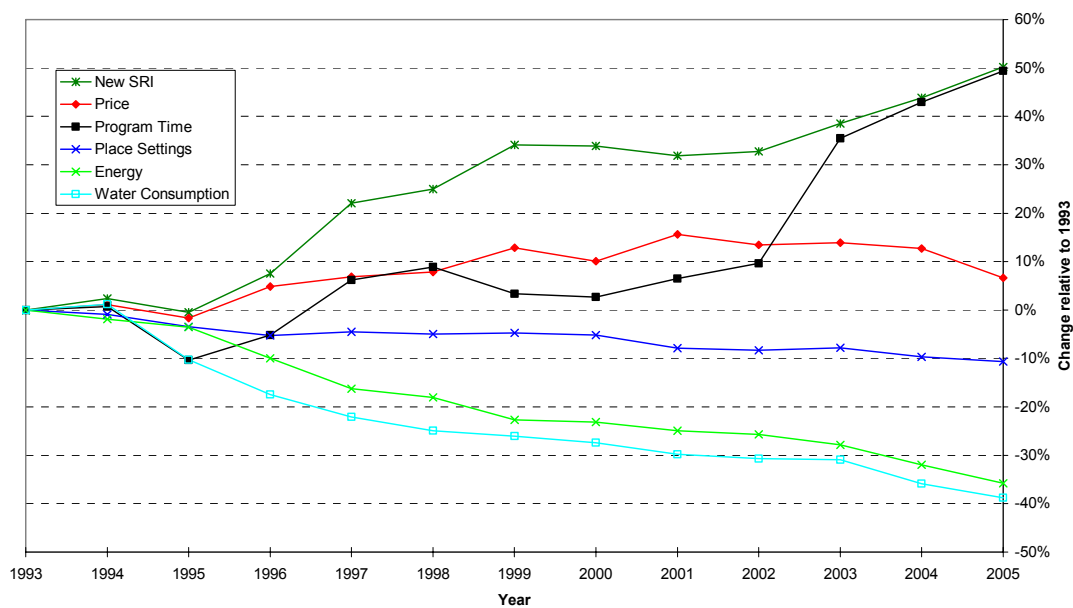


Figure 31 shows the improvements in energy and water consumption of dishwashers since 1993. The graph demonstrates the ongoing effectiveness of the energy labelling program which was introduced in 1988. Water efficiency labelling was introduced in the 1990's although the market penetration was quite low during this period. Water consumption sharply declined between 1994 and 1998 before levelling off prior to another decline after 2003. Mandatory water efficiency labels for dishwashers were introduced in 1 July 2006.



Figure 31: Sales Weighted Trends in New Dishwasher Energy and Water Consumption

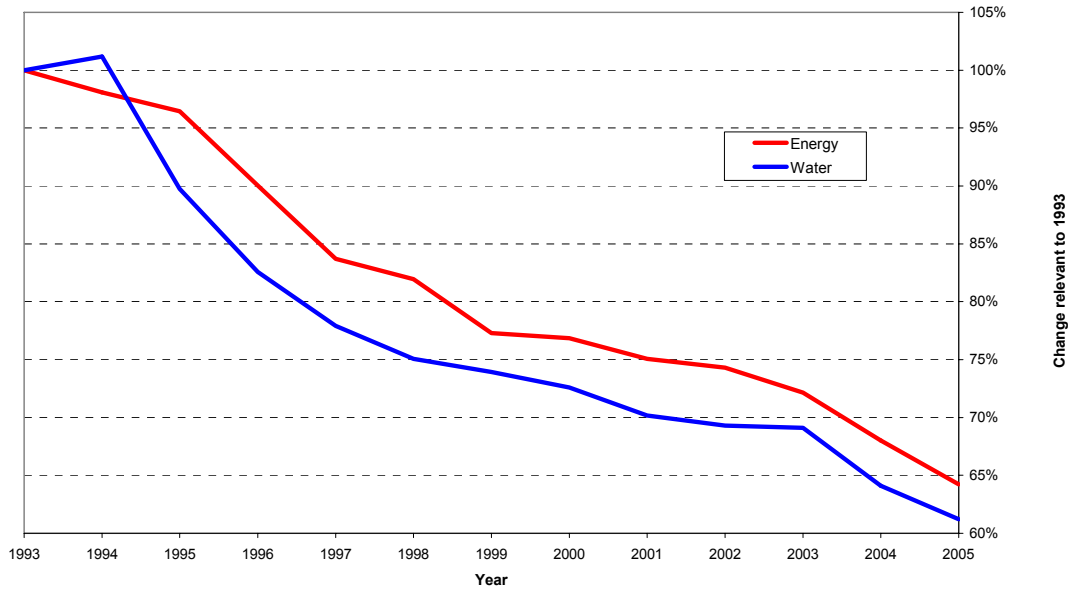


Figure 32 and Figure 33 show the sales distribution of dishwasher old and new star ratings for selected years from 1993 to 2005. Note that new half star ratings (from 2000) have been amalgamated for this figure (e.g. 1 + 1.5 star share is shown as 1 star). The overall market trend in the old star rating is a reduction in the proportion of 3 and 4 star units sold and an increase in the proportion of 5 and 6 star units sold. The overall market trend in the new star rating is a reduction in the proportion of 1 star units sold and an increase in the proportion of 2, 3 and 4 star units sold.

Detailed information for energy and other characteristics for all years is available in the separate output tables (Appendix D).

Figure 32: National Sales Distribution by Old Star Rating - Dishwashers

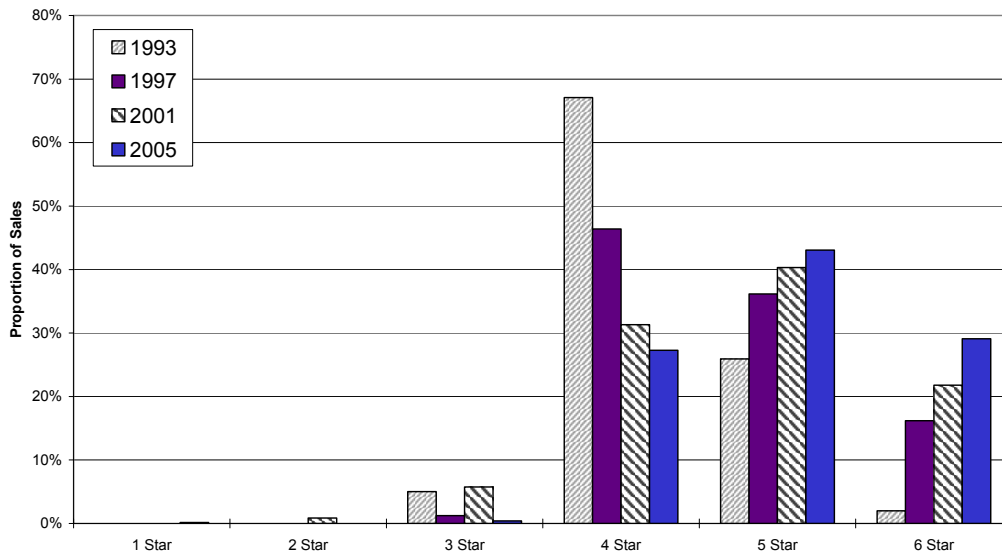
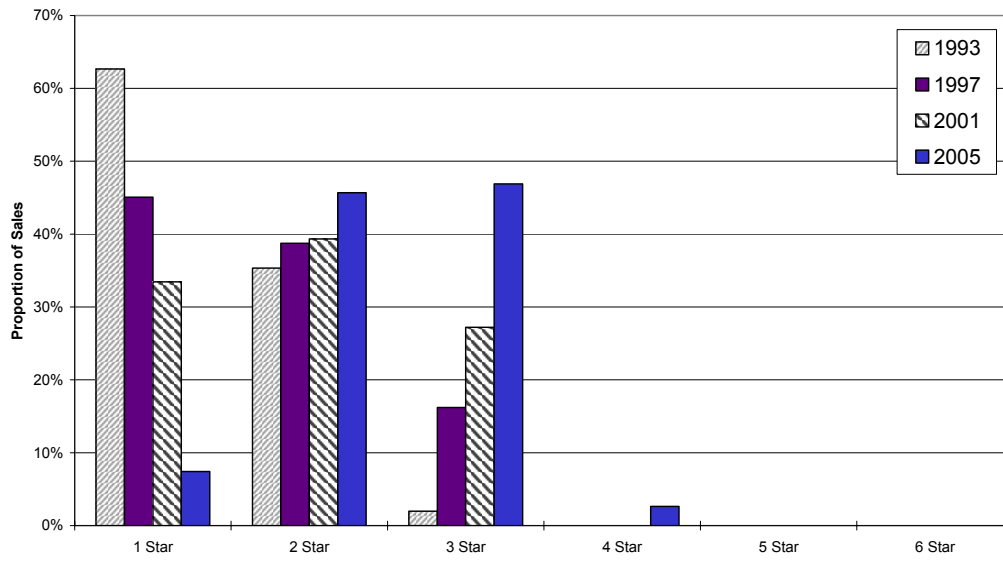


Figure 33: National Sales Distribution by New Star Rating – Dishwashers



Annex A: Source Data, Methodology and Notes on Data

Source Data

The information provided by GfK was in the form of national sales data plus sales data for five state groupings (NSW+ACT, QLD, WA, SA+NT, VIC+TAS). The appliance lists show the largest selling models for each of the main appliance categories. For 2001 and for subsequent years GfK have provided full sales lists for all models. Models tagged as exclusive have some performance information but they do not show the model and may not show the brand. In some cases the model can be identified and matched with an energy label registration – where this is the case the model is listed as identified. However, from 2001 to 2005 all exclusive models had no price information. So exclusive models have been excluded from average price calculations by product type (even where the model has been identified). Typically exclusive models are either significantly cheaper or more expensive than the average, so these need to be separated to give an more accurate price indicator by product type.

For years up to 2000 the sum of the state sales for a particular model does not necessarily equal the national sales for that model, as not all models listed at the state level are necessarily listed at the national level and vice versa. However, the total state sales add up to total national sales. From 2001 all models were identified in all states. However there were many models that appeared to have multiple entries at a state and national level.

GfK claim to cover more than 95% of total retail appliance sales in Australia in 2005 for the products covered by this report. It is still unclear what proportion of total appliance sales would occur outside the retail system (possibly some large institutional buyers or other large direct wholesale purchases). This is probably most significant for refrigerators but also possibly for some dishwashers which are often included in the total price of a newly built home.

A number of new retail chains have been included in the GfK data collections since 2003, together with a “rest of market” estimate, which increased the sample size and value by 30% to 40% for the data sets provided from 2004 to 2005. The data sets used in the report do not include these new sales in 2003 or 2004 but they are included in the 2005 data set. For reference, the figures with and without these additional sales are shown in the following tables.



Table 6: Sample sizes NOT including new retail chains & “rest of market” estimate

	2003		2004		2005	
	Units	Value	Units	Value	Units	Value
Dryers	201,205	79,204,936	188,714	74,447,173	201,636	84,049,721
Dishwashers	199,292	199,513,453	203,291	206,821,123	209,801	203,060,075
Freezers	102,539	67,975,409	131,046	79,360,237	153,264	86,468,148
Refrigerators	539,673	553,167,839	625,403	629,946,540	648,594	669,536,946
Washing Machines	476,570	370,331,489	502,677	381,665,556	521,890	400,292,020

Note: Shaded cells indicate the data reported in the data tables in Appendices A to D.

Table 7: Sample sizes including new retail chains & “rest of market” estimate

	2003		2004		2005	
	Units	Value	Units	Value	Units	Value
Dryers	272,880	104,522,137	268,148	102,782,142	278,811	113,347,280
Dishwashers	285,764	275,586,027	292,397	286,770,313	289,618	271,971,818
Freezers	133,050	85,821,014	170,884	102,713,539	198,257	113,829,153
Refrigerators	772,456	778,681,610	897,521	893,404,208	885,935	904,945,468
Washing Machines	659,159	499,407,209	696,336	516,337,608	722,950	542,391,281

Note: Shaded cells indicate the data reported in the data tables in Appendices A to D.

The appliance sales data is collected by GfK from all major retailers of appliances. GfK estimate that about 80% of this sales data is from retailers with full census information in 2005 (via computerised listings at a model level), while the model breakdowns in the remaining 20% is estimated on the basis of sampling from selected stores in the various retail chains. It should be noted that the total sales figures (number sold and total value) for each appliance type will be accurate - only the market share by model is estimated by GfK by the use of sampling. The breakdown between census and sampling estimates was closer to 50%/50% for the data sets provided in the early 1990's.

Since 2001, GfK have supplied a full data set for each appliance. In past years, data for approximately 75% to 90% of total sales for each of the appliance groups was provided. The data included a list of models with the largest sales in order of decreasing sales. The analysis in this report is based on the full data set and Annex B of this report provides a comparison with the full and cut down versions for selected attributes for 2001 to 2005. This analysis concludes that the reduced data set used in earlier years does not unduly affect estimates of the key appliance parameters. The main improvement from the full data set is better identification of product types that have a small market share. This is particularly evident in clothes dryers (eg no condenser types were identified prior to 2001 due to low sales per model) and for clothes washers, where front loader and twin tub models were numerous but sales per model were generally fairly small and so were not included prior to 2001. Fortunately



for clothes washers, GfK separately provided cross tabs for all clothes washers by type for all years except for 2001 (where author estimates have been made based on trends). Data in the main report on share by clothes washer type are based on these primary cross tabs.

For all appliances covered, GfK provided the following data for each model listed, both at the national and state levels:

- brand
- model number
- energy label consumption (CEC)
- star rating
- unit sales
- average selling price
- maximum price

The GfK data for star ratings in years 2000 to 2002 were only a general guide as there were a mixture of old and new star ratings recorded.

For refrigerators and freezers, the following additional data was provided for each model:

- nominal total gross volume
- number of external doors
- defrost type (manual, frost free, auto, push button)
- refrigerator type (standard, all refrigerator, upside down, side by side - or chest/upright for freezers)

For clothes washers, the following additional data was provided for each model:

- tub – single/double/drum (double = twin tub)
- loading type - top/front
- load capacity

For clothes dryers, the following additional data was provided for each model:

- control – electronic or timer (most were recorded as “unidentified”)
- load capacity

For dishwashers, the following additional data was provided for each model:

- freestanding or built in (integrated)
- mechanical or electronic control



GfK commenced data collections in February 1993, so no data is available prior to this date. GfK have recently converted their databases to align with a new international format within the company so data sets prior to 2003 are no longer available. Data sets provided to EES from GfK are still held.

Initially data was collected in 2 monthly periods, so the closest period which corresponded to a full Calendar year is from February one year to January the next year. These periods have been used as nominal years for this analysis. Data has been received and analysed for each of the yearly periods from February 1993 - January 1994 (nominal year 1993) to January 1999 (nominal year 1998). From 1999 GfK collected data monthly and from 1999 true calendar years have been used from 1999.

One issue that has created analysis issues is multiple records with seemingly the same appliance attributes (but usually a different price). Some manual adjustment of the data set within any single year is required in order to make each of these records unique for each state and the national sales listing. GfK have indicated that for 2006 each model will have a unique record identifier which will speed the cross matching process in subsequent years and make the compilation of the data simpler.

Analysis Methodology

In earlier years, the first step in the process was to compile all of the state based registers into a single complete listing of all models for each appliance that have ever been registered for labelling. This step has now been superseded as the national appliance database has been used as the primary data source for all models. Where data for particular fields was required for the analysis but was missing from an old registration record, this was obtained from related registrations where available, or from labelling brochures where these contained the relevant information. In a few cases, inquiries were made with the state which held the registration and test report for the relevant model, or with the manufacturers themselves.

For each model listed in the GfK hit lists for each period, the correct national database registration number was identified then entered into a separate database together with the GfK data on sales and price for each model (national and state data). From 1999 GfK have supplied electronic lists which made cross matching much faster and more streamlined. The data contained in the energy labelling registration database is much more detailed and accurate than the limited information collected by GfK for each model. The analysis for years from 2001 was slower as the number of models in the full model listing was typically 3 to 4 times larger than the hit lists provided prior to 2001 (of the order of 300 to 1000 models per product).

A separate sales database has been created for each appliance type and for each year. The appliance attributes which are required for analysis in these yearly sales databases are imported from the master registration database which has been checked for completeness for each record used in the analysis. The yearly sales database then calculates the sales weighted attributes of interest that are tracked in



the analysis. Where corrections to the master database are required (incorrect data or missing data) this is coordinated with the relevant regulator.

An analysis database imports the relevant sales weighted information from each of the single yearly sales databases and compiles sales weighted information of interest for each year. This data is available at the national and state level. National trend data for all the years analysed is then compiled onto a single listing for further analysis.

A data issue which is also related to analysis is the attributes that GfK report for a particular model. Typically GfK obtain information such as capacity and type from manufacturers or wholesalers which is then recorded against a particular model in the GfK system. In subsequent years the same attributes are reported against that particular model number into the future. The reality in the market, however, is that models are often re-registered for energy labelling (and/or MEPS in the case of refrigerators and freezers). So newer registrations (and the attributes of appliances shipped into the market) in the current year may have different energy attributes to previous models with the same number which may have been recorded in the past by GfK (this can also apply to other attributes as well). In these cases, the GfK information usually provides a good check regarding the model details, but for the analysis in this report the most recent energy labelling registration for that model in the current year is used to perform the sales weighted analysis for that year.

Further Notes on Data

The data in this report relies on energy labelling registration data which is based on Australian Standards and test procedures relevant to each product group and it is useful to be aware of some of the issues related to these standards if extrapolating data and/or information from this report. They are outlined for each product group below.

Clothes Washers – AS/NZS 2040

Despite the apparent lack of improvement in top loader energy consumption over the analysis period, there are other factors that have an important influence on clothes washer energy consumption during actual use in households. Firstly, there has been an ongoing trend towards cold water washing in Australian households. The Australian Bureau of Statistics (see www.abs.gov.au) reported that in 2005 some 69% of households wash in cold water (up from 61% in 1994) (ABS4602.0-2005 – Table 5.13). This is critical because the energy values analysed for this report are to AS/NZS2040 which specifies a warm wash for the purposes of energy labelling (nominal wash temperature of 40°C). The energy embodied in warm water for a clothes washer test constitutes typically more than 80% of the total energy consumption of clothes washers. Most top loaders are able to wash in cold water, so the in use energy consumption of top loaders will be considerably lower than stated on the energy label for households that use cold washing frequently. The new energy label now also shows cold water energy for clothes washers – for top loading machines this is an average of 75 kWh/year compared to an average warm CEC of



488 kWh/year for products currently registered. This value has not be included in this report.

Connection to cold water or hot and cold water will affect operating costs. Most top loaders have dual connection and use external hot water. In the 1990's, very few front loaders had dual water connection (and therefore heated water internally by electricity), although by 2005 about half the models registered had dual connection, presumably due to consumer demand.

A related issue for consideration with respect to energy consumption is the capability to undertake so called "cold washes" as reported by ABS above. Very few front loaders have programs that wash in temperatures less than 30°C and almost all have internal heaters to heat from cold or to boost wash temperatures if the fill temperature is too low during hot water intake. In contrast virtually all front loaders have dual water connections, no internal heater and can wash in "cold water" (noting that some have variations to cold wash such as the ability to control and mix water to achieve a wash temperature of around 20°C without internal water heating).

The other factor that will influence in use energy consumption for clothes washers is frequency of use. The energy label assumes a constant 7 washers per week for all models on the program recommended for a normally soiled load. Household sizes are continuing to decline while clothes washer capacity in recent years has increased. Presumably the total washing requirement per person is not increasing, so it is reasonable to assume in average households that either there are less loads per week washed or more loads are done at part of rated capacity.

The Australian Standard assumes all loads are at rated capacity. It is known that many consumers load their machines at somewhat less than rated capacity during normal use. The impact of this will depend on the ability of the particular machine to adjust its water and energy consumption to suit to reduced load. As a result of reduced loads and reduced wash temperatures, the resulting energy consumption is likely to be less than that stated on the energy label. However, the energy label remains an important comparative tool for consumers.

Clothes Dryers – AS/NZS 2442

Energy consumption for clothes dryers is based on the new energy labelling algorithm of 52 uses per year (introduced in 2000), so care is needed when comparing data in this report to values published in previous years (as this was based on 150 uses per year).

Overdrying is another factor in actual use and this varies between different consumer types. Auto-sensing machines will reduce the likelihood of this occurring under normal circumstances.

Another factor is actual load versus rated capacity (which is the basis of tests under the Australian Standard). It is known that many consumers load their machines at less than rated capacity during normal use. The impact of part loads will probably be small for auto-sensing dryers.



Dishwashers – AS/NZS 2007

Energy consumption for dishwashers is based on 365 uses per year at rated capacity on the program recommended for a normally soiled load. The frequency of use, the loading (full or partly full) and use of economy or Eco programs will all affect energy consumption, although few dishwashers adjust their water and energy consumption in response to consumer soil loads. Connection to cold water or hot and cold water will affect operating costs (although virtually no current models now have dual water connection). This is partly because fill volumes for dishwashers are now so small (typically of the order of 4 litres) that little if any hot water actually reaches the machine by the time the required intake has been reached, so much of this hot water energy is generally wasted.

Refrigerators and Freezers – AS/NZS 4474

Energy consumption for refrigerators and freezers is determined under steady state conditions at prescribed internal temperatures (eg +3°C for fresh food and -15°C for freezers). The ambient test temperature is +32°C but there are no external food loads or door openings during the test. The actual in use energy consumption in a consumer home is dependent on actual ambient temperature and the response temperature curve of individual refrigerators and freezers, which can be difficult to determine from test data and which will vary from model to model. The internal temperatures selected by the user and frequency and duration of door openings and warm food loads will all have some impact on energy consumption during normal use. Most data indicates that on average the energy label overestimates energy consumption by around 10% in temperature climates. This difference will be more in cooler climates and less in warmer climates.



Annex B: Comparison of Full & Reduced Data Sets for Selected Attributes

Summary

From 2001 GfK provided a full data set for each appliance. Prior to 2001, data for approximately 75% to 90% of total sales¹⁴ for each of the appliance groups was provided. In this report, trends and comparisons have utilised the full data sets provided since 2001. This Annex provides a comparison of the impact of using the full data sets and reduced data set (in a form that is equivalent to years prior to 2001) for the years 2001 to 2005.

This analysis concludes that the reduced data set from earlier years does not unduly affect estimates of the key parameters. The main improvement and benefit from utilisation of the full data set is better identification of product types that have a small market share. Comparison of full and cut down data sets will not be necessary in future editions of this report.

Refrigerators

Table 8 shows the key characteristics for refrigerators and the data for each of the years 2001 to 2005. Both the reduced and full data sets are shown and the proportional difference between the reduced and full data set for each year is noted. All parameters except freezer volume show only minimal differences of between -1% to 4% (i.e. the reduced and full data sets are closely matched). For freezer volume the full data set shows a slightly greater volume than the reduced data set in all years (between 6% and 8% greater), mainly due to the exclusion of side by side and bottom mount models which generally have small sales at a model level (and therefore are excluded from the reduced data set) but which have larger than average freezer compartments. Other parameters such as kWh/adjusted litre and star rating are not affected by this particular bias.

Freezers

Table 9 below shows the differences in characteristics between the reduced and full data sets for freezers. The only significant difference between the full and reduced data set was for volume in 2001 and to a lesser extent in 2002 (this parameter also impacts on adjusted volume and kWh/adjusted litre). It is unclear why there was a bias in volume for these two years, but examination of the original data set for 2001 has confirmed that models included in the reduced data set (biggest sellers) tended to be smaller than the average for that year, so the effect is real. Other parameters such as kWh/adjusted litre and star rating are not affected by this particular bias.

¹⁴ Total sales implies total sales of appliances from the retail stores from which GfK collect data. GfK claim to cover more than 95% of total retail appliance sales in Australia for these products.



Table 8: Comparison of full and reduced data set for refrigerators – 2001 to 2005

Year	Fresh Food Volume (litres)	Freezer Volume (litres)	Other (litres)	Energy (kWh/year)	Adjusted Volume (litres)	kWh/adjusted litre	Old SRI (star rating)	New SRI (star rating)
2001 Reduced	255.8	91.6	2.0	622.5	404.7	1.5	4.3	2.7
2001 Full	262.9	98.2	2.0	639.5	422.5	1.5	4.3	2.7
Difference (%)	3%	7%	1%	3%	4%	-2%	2%	0%
2002 Reduced	252.5	92.1	2.5	621.3	402.9	1.5	4.3	2.7
2002 Full	259.8	97.8	2.5	633.7	419.3	1.5	4.3	2.7
Difference (%)	3%	6%	-1%	2%	4%	-2%	1%	0%
2003 Reduced	256.0	92.0	2.4	610.5	406.1	1.5	4.3	2.8
2003 Full	262.5	98.9	2.4	618.8	423.7	1.5	4.4	2.8
Difference (%)	3%	8%	2%	1%	4%	-3%	2%	2%
2004 Reduced	250.8	87.5	2.3	539.4	393.6	1.4	4.3	3.1
2004 Full	256.9	94.3	2.3	556.0	410.5	1.4	4.4	3.1
Difference (%)	2%	8%	1%	3%	4%	-1%	1%	0%
2005 Reduced	253.3	91.3	2.6	461.5	402.6	1.1	4.9	3.8
2005 Full	259.5	97.5	2.6	477.7	418.6	1.1	5.0	3.8
Difference (%)	2%	7%	-2%	4%	4%	0%	1%	-1%

Table 9: Comparison of full and reduced data set for freezers – 2001 to 2005

Characteristic	Freezer Volume (litres)	Energy (kWh/year)	kWh/adjusted litre	Old SRI	New SRI
2001 Reduced	217.0	550.3	1.6	4.7	2.0
2001 Full	232.1	558.3	1.5	4.8	2.0
Difference	7%	1%	-5%	1%	-1%
2002 Reduced	218.7	539.3	1.5	4.8	1.9
2002 Full	232.3	553.2	1.5	4.8	1.9
Difference	6%	3%	-3%	1%	0%
2003 Reduced	228.1	550.9	1.5	4.8	1.8
2003 Full	236.5	555.8	1.5	4.9	1.9
Difference	4%	1%	-3%	0%	1%
2004 Reduced	215.8	523.6	1.5	4.6	2.0
2004 Full	215.8	520.9	1.5	4.6	2.0
Difference	0%	-1%	-1%	1%	1%
2005 Reduced	193.4	371.9	1.2	5.2	3.4
2005 Full	198.1	377.0	1.2	5.2	3.4
Difference	2%	1%	-1%	0%	-1%



Clothes Washers

Table 10 shows the differences in characteristics of clothes washers for each year in the reduced and full data sets. The table shows that the reduced and full data sets are virtually the same for all characteristics barring New SRI which showed a small difference (3% to 4%) in the years 2001 and 2002.

Table 10: Comparison of full and reduced data set for clothes washers – 2001 to 2005

Characteristic	Capacity (kg)	Water Consumption (litres)	Spin Performance	Energy (kWh/year)	Old SRI	New SRI
2001 Reduced	6.2	134.9	0.8	583.7	3.9	1.8
2001 Full	6.2	133.6	0.8	576.4	3.9	1.8
Difference	0%	-1%	0%	-1%	1%	3%
2002 Reduced	6.2	134.3	0.8	547.0	4.0	2.0
2002 Full	6.2	132.5	0.8	537.3	4.0	2.0
Difference	0%	-1%	0%	-2%	1%	4%
2003 Reduced	6.3	122.6	0.7	490.9	4.2	2.3
2003 Full	6.3	121.9	0.7	488.7	4.2	2.3
Difference	1%	-1%	0%	0%	1%	2%
2004 Reduced	6.3	108.5	0.7	480.2	4.3	2.4
2004 Full	6.4	108.6	0.7	476.3	4.3	2.4
Difference	1%	0%	0%	-1%	1%	2%
2005 Reduced	6.5	104.1	0.7	492.8	4.3	2.4
2005 Full	6.5	103.8	0.7	488.1	4.3	2.4
Difference	0%	0%	0%	-1%	1%	2%

Clothes Dryers

Table 11 below illustrates that there is very little difference between the reduced and full data sets for clothes dryers. For analysis purposes, the two data sets can be considered virtually identical.

Dishwashers

Table 12 below illustrates that there is very little difference between the reduced and full data sets for dishwashers. For analysis purposes, the two data sets can be considered virtually identical.



Table 11: Comparison of full and reduced data set for clothes dryers – 2001 to 2005

Characteristic	Capacity (kg)	Program Time (minutes)	Specific Energy (kWh/kg water removed)	Energy (kWh/year)	Old SRI	New SRI
2001 Reduced	4.4	139.5	1.1	225.3	2.6	1.4
2001 Full	4.5	138.8	1.1	228.7	2.6	1.4
Difference	2%	-1%	0%	1%	2%	2%
2002 Reduced	4.4	147.7	1.1	223.0	2.3	1.3
2002 Full	4.5	146.6	1.1	226.1	2.4	1.3
Difference	2%	-1%	0%	1%	3%	2%
2003 Reduced	4.4	147.6	1.1	223.8	2.3	1.3
2003 Full	4.5	146.5	1.1	226.1	2.4	1.4
Difference	2%	-1%	0%	1%	2%	2%
2004 Reduced	4.4	141.8	1.1	223.0	2.4	1.4
2004 Full	4.5	141.0	1.1	225.6	2.5	1.4
Difference	2%	-1%	0%	1%	2%	1%
2005 Reduced	4.3	142.0	1.1	217.2	2.5	1.6
2005 Full	4.4	142.3	1.1	219.2	2.5	1.6
Difference	2%	0%	0%	1%	1%	1%

Table 12: Comparison of full and reduced data set for dishwashers – 2001 to 2005

Characteristic	Place Settings	Program Time (minutes)	Water Consumption (litres)	Energy (kWh/year)	Old SRI	New SRI
2001 Reduced	12.8	73.4	20.3	369.0	5.1	2.5
2001 Full	12.8	74.0	20.3	370.8	5.1	2.5
Difference	0%	1%	0%	0%	0%	-1%
2002 Reduced	12.8	76.0	20.1	366.0	5.1	2.5
2002 Full	12.7	76.1	20.0	367.1	5.1	2.5
Difference	0%	0%	0%	0%	0%	-1%
2003 Reduced	12.8	94.3	20.2	354.2	5.2	2.6
2003 Full	12.8	94.0	19.9	356.5	5.2	2.6
Difference	0%	0%	-1%	1%	0%	-1%
2004 Reduced	12.6	98.8	18.5	330.9	5.3	2.7
2004 Full	12.6	99.2	18.5	336.0	5.3	2.7
Difference	0%	0%	0%	2%	-1%	-1%
2005 Reduced	12.4	103.0	17.7	314.3	5.5	2.9
2005 Full	12.4	103.7	17.6	317.3	5.4	2.8
Difference	0%	1%	0%	1%	-1%	-1%



Annex C: Monitoring and Reporting on the E₃ Program

The Equipment Energy Efficiency (E₃) Committee undertakes a range of activities to assess the effectiveness and impact of the mandatory energy labelling and MEPS measures, as well as the National Standby Power Strategy, for which it is responsible. More information on all of the programs listed below and other publications can be obtained from www.energyrating.gov.au

Monitoring Compliance

A targeted check testing program selects products available for retailer to verify their labelling and/or MEPS claims to help ensure that all products meet regulatory requirements. Details of products that fail check-testing are published in E₃'s annual Achievement Reports.

Store 'shadow shopping' surveys are undertaken from time to time to assess the level of compliance by the retail sector with respect to mandatory energy labelling (ensure that products are correctly labelled) and MEPS (ensuring that products are registered).

Monitoring Impact

A major survey of consumers and retailers was undertaken in 2005 to assess the awareness and influence of both electric and gas energy rating labels. These surveys are repeated on a regular basis. Results are reported in E₃ publications such as Achievements.

Since 2000 regular in-store surveys have been undertaken to measure the standby power characteristics of new electrical appliances offered for sale and to track trends in standby power consumption for a wide range of appliances and equipment used in the domestic sector. The results are reported in regular standby store survey reports.

In 2000 and 2005 detailed surveys of a sample of Australian households were undertaken which measured the standby power characteristics of all electrical appliances and equipment used in typical homes. These so called "intrusive" surveys have helped to identify major trends in standby power in the residential sector and quantify the magnitude of standby in Australia.

A retrospective study on the impacts of refrigerator labelling and MEPS was commissioned in 2005, and will be published early 2007.

This report, *Greening Whitegoods*, is updated annually and tracks the sales weighted energy efficiency trends of major whitegoods sold to the residential sector.



Impact Projections

Since 1998, the projected impacts of each new joint 3 year work plan published by E₃ has been published in a publicly available report. The latest edition is titled *When You Keep Measuring It, You Know Even More About It!* and was released in 2004.

A baseline study of residential sector end use energy consumption and greenhouse gas emissions with projections to 2010 was completed and published in 1999. This is being updated in 2006 with projections to 2020.

Achievements

Each year E₃ publishes an annual report titled *Achievements* which documents their activities and achievements for the previous calendar year. This report contains information on many of the latest monitoring and evaluation results that are commissioned by E₃ on an ongoing basis.

Acknowledgements

This report was prepared by Energy Efficient Strategies under contract to the Equipment Energy Efficiency Committee (E₃).

The data analysis for this paper, including record checking and review of historical data, was undertaken by Jack Brown with assistance from Lloyd Harrington. The report was updated by Paula Kleverlaan with editorial assistance from Lloyd Harrington and Jack Brown. Compilation of databases and cross matching of records was undertaken by Jack Brown and Dianne Glass.

Ian McNicoll of Sustainability Victoria provided detailed comments on the first draft.

EES would like to acknowledge the assistance provided by the state energy efficiency regulators and E₃ members during the preparation of this report and the data analysis:

- Office of the Chief Electrical Inspector Victoria and Sustainability Victoria;
- NSW Ministry of Energy & Utilities;
- South Australian Office of the Technical Regulator;
- Queensland Department of Industrial Relations; and
- Australian Greenhouse Office.

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 provided by GfK, the authors are not responsible for the source data or for any use or misuse of data and information provided in this report and the associated Appendices or any loss arising from the use of this data.

