

Energy consumption of whitegoods - what is improving and what is not: analysis of 13 years of data in Australia

Paper 6.290 Final, 20 March 2007

Lloyd Harrington, Energy Efficient Strategies, Australia

Jack Brown, Energy Efficient Strategies, Australia

Keywords

Whitegoods, appliances, refrigerators, clothes washers, dishwashers, clothes dryers, energy consumption, trends.

Abstract

Australia has had an energy labelling program for white goods since 1986. Since 1993, market data on total sales for refrigerators, freezers, clothes washers, clothes dryers and dishwashers have been purchased from a commercial data collection agency. Sales volume and price for each model number provided and this has been cross matched with detailed attribute data which is contained in the mandatory government registration system.

This paper explores the changes in efficiency that have occurred in these white goods over 13 years. In this period the market for refrigerator-freezers has moved from being dominated by manual defrost freezers to being totally frost free. The energy consumption has continued to decline at around 3% per annum despite increases in frost free share and increases in volume. The impact of stringent new minimum energy performance standards introduced in 2005 is spectacular for both refrigerators and freezers with nearly a 30% reduction in energy over a 2 year period.

In the case of clothes washers, there has been a dramatic shift from vertical axis to European style drum machines (horizontal axis) over the past 3 years, mainly driven by water efficiency rebates and water efficiency labelling.

For dishwashers, the energy and water consumption has continued to decrease at an amazing 4% per annum over the study period. Dryers is a product where there has been little movement in product performance in recent times.

Introduction

This paper/poster 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 covers 2.45 million appliances sold in 2005 with a total retail value of EURO 1.2 billion, with comparable data in each previous year back to 1993. Generally, there has been a significant improvement in the energy efficiency for all products as a result of mandatory energy labelling, except for clothes dryers. In the case of refrigerators and freezers, additional improvements have occurred as a result of Minimum Energy Performance Standards (MEPS) which were initially introduced in 1999 and subsequently upgraded in 2005.

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

The Base Data

In 1995, Energy Efficient Strategies (EES) was first commissioned to undertake an analysis of appliance retail sales data purchased by the Australian Government in order to track energy efficiency trends of major appliances which were regulated for energy efficiency (energy labelling only at that time). As additional information has accumulated over time, it has been possible to determine trends in product attributes and energy efficiency to a very high degree of certainty. This paper summarises 13 years of appliance efficiency trends. It is proposed to continue the purchase annual data for the foreseeable future so the data set will be extended from year to year.

From 1993 to 2000 a data set that covered approximately 75% to 90% of total appliance sales in Australia was provided. From 2001, sales data for all models was supplied for each appliance, covering up to 99% of sales.

This study covers five major household electrical appliances: refrigerators, freezers; dishwashers; clothes washers; and clothes dryers.

It is hoped that air conditioner sales can also be included within the scope of the project in the future. However, the large number of specialist suppliers for air conditioners makes the market data for this product more fragmented and less complete than for whitegoods. It is also proposed to add televisions from 2006.

The methodology used is to match the brand and model details for each product listed in the data sets provided to the national registration database. The data contained in the energy labelling registration database is much more detailed and accurate than the limited information provided with the sales data for each model. In recent years sales data for around 1000 models for each product type have been provided.

A separate sales database is then 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. An analysis database imports the relevant sales weighted information 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. Detailed results are available in EES (2006). The key elements are included below.

Refrigerators

The energy label for refrigerators (which uses stars to indicate efficiency) 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.

Market Trends: Total sales increased at 2.6% per annum over the 13 year period to around 900,000 units in 2005. 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 total sales. Single door refrigerators with a short-term freezer compartment (Group 3) and two-door cyclic defrost refrigerator/freezers (Group 4 = European style refrigerator freezers) 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. There were no obvious price impacts from the introduction of MEPS in 2005.

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 (2000 system) increased from 1.76 in 1993 to 3.78 in 2005.

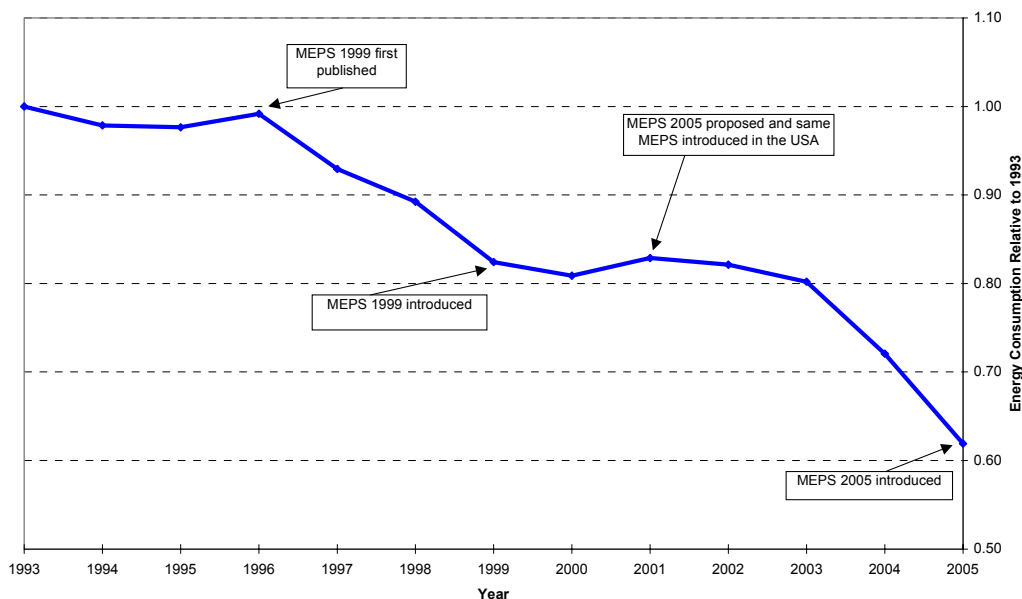


Figure 1. Energy Consumption of Refrigerators

In 2003, 88% of refrigerators sold did not pass 2005 MEPS levels while in 2005 only 6% of models sold failed to meet 2005 MEPS¹. At the time of their development in 2000, no models registered met the 2005 MEPS levels.

¹ Under the Australian regulatory system for MEPS, products that were manufactured or imported prior to the MEPS implementation date can continue to be sold for an indefinite period. Non-complying sales in 2005 represent clearance of pre-MEPS models from the retail distribution system.

The spectacular decrease in energy from 2003 to 2005 (23% reduction over 2 years, sales weighted) is in response to stringent MEPS levels introduced in on 1 January 2005. The energy savings from MEPS 1999 are more than originally estimated and savings from MEPS 2005 are in line with the estimated savings in the original Regulatory Impact Statement in 2001. It has been separately estimated that an average refrigerator sold in 2005 consumes less than 40% of an average refrigerator sold prior to the commencement of energy labelling in 1986 (EnergyConsult, 2006). As expected, the impact of energy labelling appears to be somewhat diminished when mandatory MEPS levels drive energy efficiency at a rate faster than would normally occur from information programs alone.

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.

Market Trends: Total sales grew at an average of 4.8% per annum to a total of 200,000 units in 2005, 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. Chest freezer (Group 6C) sales constitute nearly 50% of the market and their share has 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 new star rating system (2000) increased from 1.48 in 1993 to 3.4 in 2005. Interestingly, the CFC phase-out in 1995 had a negative impact on energy efficiency of freezers prior to the introduction of MEPS in 1999. Energy labelling appeared to be ineffective after the introduction of MEPS in 1999, but closer examination indicates that only vertical manual defrost freezers deteriorated during this period (for reasons which remain unclear) while other groups improved slowly.

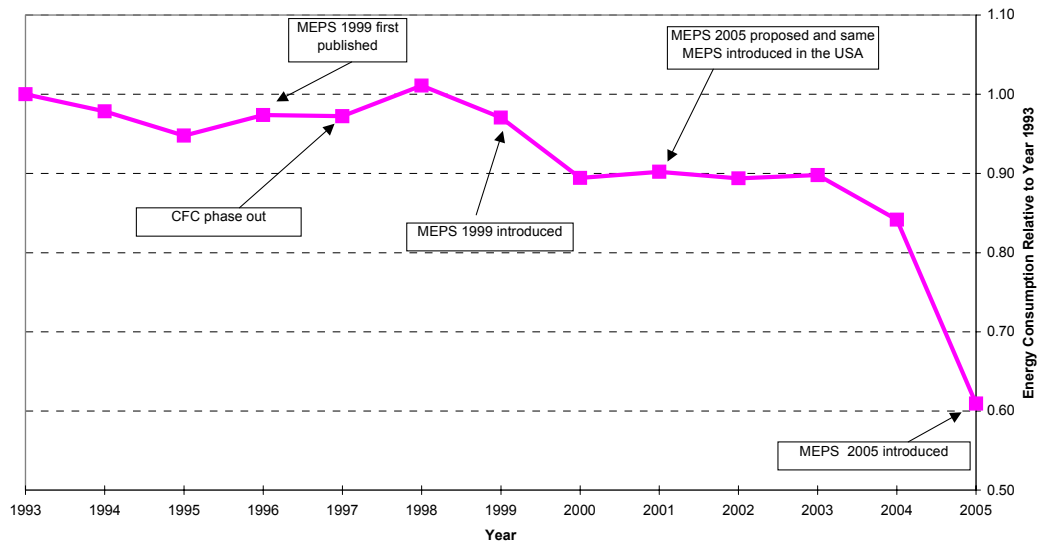


Figure 2. Energy Consumption of Freezers

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.

Market Trends: Total sales increased at 2.2% per annum over the analysis period to a total of 725,000 units in 2005. Front loading machines have been dramatically increasing their market share in recent years and constituted 30.9% of all machines sold in Australia in 2005 (see Figure 3). 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. 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 within top loading and front loading machines has shown little change over the past 10 years. However, the overall average energy for clothes washers has been declining as a result of increased market share of front loaders. Average water consumption decreased by 2.8% per annum since 1993. The average star rating under the new star rating system (2000) increased from 1.28 in 1993 to 2.4 in 2005.

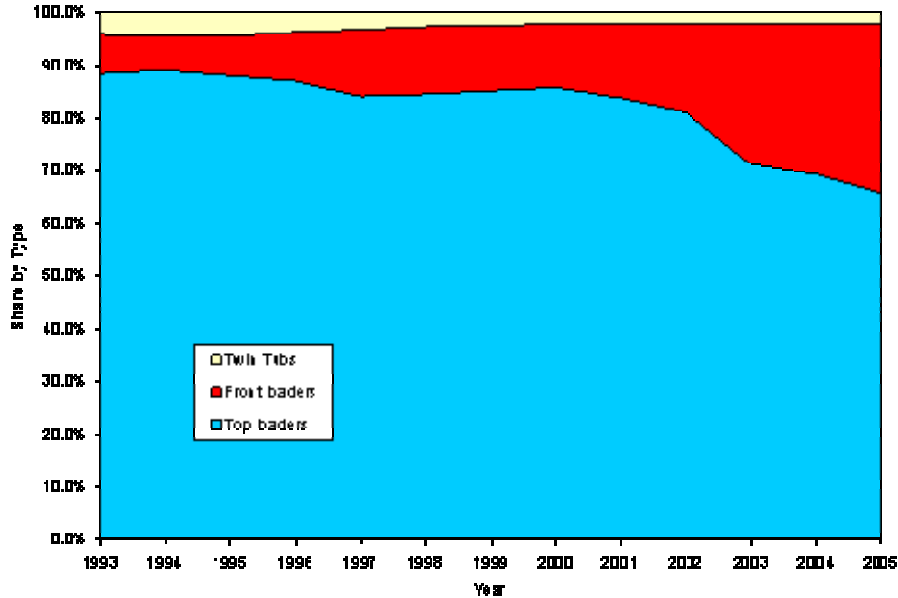


Figure 3. Share of Clothes Washer Type

Clothes Dryers

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

Market Trends: Total sales increased at an average of about 4% per annum from 1993 to 2005 to a total of 280,000 in 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 rated 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. Condenser dryers only account for a few percent of the market. Combination washer-dryers increased significantly in 2005 to 6%, with the largest market share from Korea. Water consumption during drying for combination washer-dryers is becoming an issue.

Energy: Energy consumption decreased at an average of 0.7% per annum from 1993 to 2005. 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 new star rating system (2000) 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 with no real improvement in the fundamental efficiency of the products. Despite this, industry is supportive of the program and has proposed an increase in mandatory spin performance requirements for clothes washers in order to decrease dryer energy. While the energy label is not improving energy consumption of dryers, the regulatory program is probably ensuring that very low cost, low efficiency and poorly performing products are kept from the market.

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.

Market Trends: Total sales are continuing to increase with a growth of 5.4% per annum from 1993 to 2005 to a total of 290,000 units in 2005. Average capacity (place settings) has been stable since 1996 although there has been a slight decline since 2000. 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 4). Water consumption decreased by 4.0% per annum since 1993. The average star rating under the new star rating system (2000) increased from 1.88 in 1993 to 2.8 in 2005.

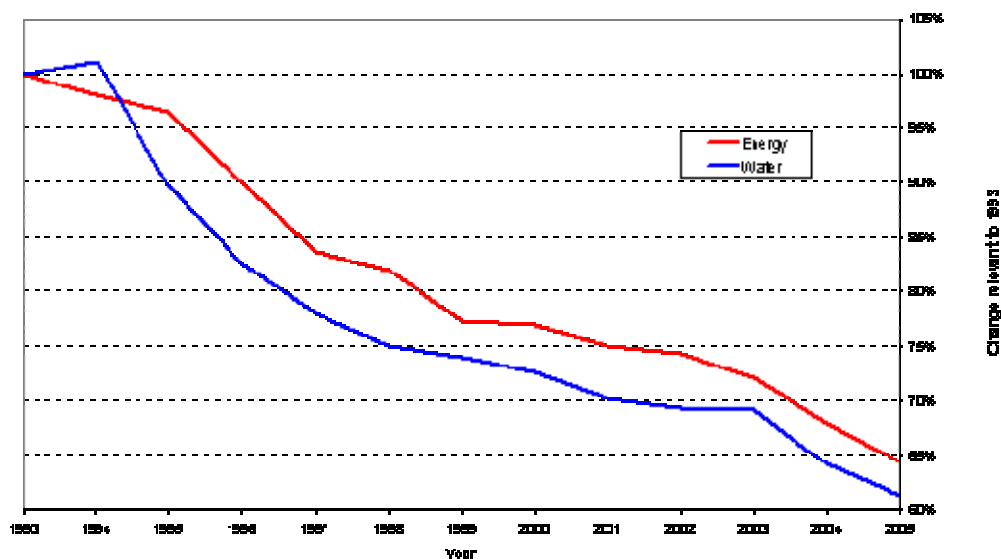


Figure 4. Energy and Water Consumption of Dishwashers

Conclusions

All white goods covered by the mandatory energy labelling scheme, apart from clothes dryers, have shown a substantial and persistent ongoing improvement in energy consumption and other attributes such as water consumption. This is despite, in many cases, increases in appliance capacity or size over the study period. In addition, the impact of the stringent Minimum Energy Performance Standards (MEPS) for refrigerators and freezers in early 2005 is substantial and resulted in an acceleration in the reduction in energy to around 12% per annum for the 2 years preceding its commencement. The impact of MEPS was substantially larger than labelling alone.

The price of virtually all product types tracked for this study showed a decrease in real prices over time, despite increases in energy efficiency. Ongoing collection of detailed sales data is a valuable tool in the assessment of delivered energy savings to the market place.

The data in this paper relies on energy labelling registration data which is based on Australian and New Zealand Standards and test procedures relevant to each product group. While the values reported are useful and reflect general improvements in product performance, care is required if using this data to estimate the energy consumption of the products in the home due to factors such as climate and consumer usage patterns. More details for all products covered above can be found in EES, 2006.

References

- EES, 2006. Greening Whitegoods - A report into the energy efficiency trends of Major Household Appliances in Australia From 1993 to 2005. Prepared by Energy Efficient Strategies on contract to the Equipment Energy Efficiency Committee. Copy available from www.energyrating.gov.au in the electronic library.
- EnergyConsult, 2006, Retrospective Analysis of the Impacts of Labelling and MEPS: Refrigerators and Freezers. Prepared by EnergyConsult on contract to the Equipment Energy Efficiency Committee. Copy available from www.energyrating.gov.au in the electronic library.
- Lane et al, 2007. Evaluating the impact of energy labelling and MEPS - a retrospective look at the case of refrigerators in the UK and Australia, paper by Kevin Lane (AEA Technology, UK), Lloyd Harrington (Energy Efficient Strategies, Australia) and Paul Ryan (EnergyConsult, Australia), presented to the ECEEE Summer Study, France, June 2007.