E3 Equipment Energy Efficiency

Refrigerator Energy Labelling and MEPS Compliance in the Australian Market

Prepared for the Equipment Energy Efficiency Committee
by Energy Efficient Strategies

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Disclaimer

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Executive Summary

Australia has a long history of regulating the energy efficiency of major consumer appliances. The benefits of this regulation are said to include lower running costs for consumers, increased security of energy supply and reduced environmental impact from reduced energy demand. This paper is about whether the claims of energy consumption of products regulated for energy efficiency are being met by equipment suppliers, using refrigerator data as a proxy for other regulated equipment types.

Any regulatory scheme carries a risk that some suppliers may inadvertently or intentionally breach the minimum energy performance standard or mandatory labelling rules. The risk of non-compliance is increased if the market perceives that regulatory agencies are not undertaking monitoring, verification and enforcement (also called compliance) activities. These activities measure whether supplier efficiency claims are being met and whether consumers are benefiting from lower energy bills, which should result from regulatory programs.

The Equipment Energy Efficiency (E3) Committee, on behalf of government regulatory agencies, has undertaken targeted checks of product compliance for more than a decade. These compliance checks are not based on a random selection of products on the market but are highly targeted towards products that are most likely to fail. The targeting of compliance testing is to ensure that limited public sector testing resources are used most effectively by examining the equipment most at risk of not complying. This targeted compliance activity, however, masks the actual level of compliance in the wider marketplace. In 2010, a public debate developed about what the overall compliance rate was for products regulated for energy efficiency in Australia. The targeted compliance testing program does not provide an answer to that question.

This report is an attempt to re-create a randomly selected sample of regulated whitegood products to better respond to this question using refrigerators, the longest regulated product within the program. The methodology behind the report is to create a more randomised sample from the data available. It documents how a “random” assessment of market compliance for refrigerators was created to draw conclusions about the possible overall marketplace compliance in the last decade.

To assess the level of compliance in the wider market place, a large random sample of test data is required. Usually it is not possible to retrospectively obtain a large set of energy tests on a random market sample of products. If such an exercise were planned in advance, it would be extremely expensive to obtain a sufficient number of tests over a period of time long enough to undertake such an assessment.

The Australian Consumers’ Association (ACA) however, via their testing facility Test Research, undertook and kept energy testing data on over 260 domestic refrigeration products measured against the relevant Australian Standard over the period 1997 to 2008. The results were published in CHOICE, the magazine of ACA, to inform consumers about the relative merits of those products. CHOICE selected refrigerators relatively new to the market and in most cases those likely to be large sellers. There was no sample bias in terms of selecting products because of their likelihood of failing testing. This sample can be said to represent a random selection of products offered on the Australian market over this period.

The cooperation of CHOICE staff in the provision of this data in electronic form and their agreement to support this evaluation is gratefully acknowledged by the E3 Committee. The value of that contribution goes well beyond the several million Australian dollars equivalent spent by CHOICE on testing. To add further credibility to this data, Test Research is National Association of Testing Authorities (NATA) accredited and is used by energy regulators to conduct compliance testing. The data supplied by CHOICE has been compared against the suppliers declared energy claims to establish the levels of compliance (and non-compliance) with the mandatory energy label and minimum energy performance standards, as they existed at the time. It is important to note that energy labelling was in force for the duration of the CHOICE testing analysed for this report. It also covers the introduction of two sets of Minimum Energy Performance Standards (MEPS) in 1999 and 2005.

The main findings from the analysis of the CHOICE data are that:

- The models tested by CHOICE each year cover about a third of refrigerators sold each year (representing approximately 300,000 to 350,000 units sold per year) providing a substantial sample size.
- Because CHOICE rotate the types of refrigerators tested from year to year to maximise their market coverage for their subscribers (i.e. they do not test the same models years after year) the market coverage of CHOICE testing could be as much as two thirds of the total refrigerator market when considered over a three or four year period.
- Around 16% of all models tested in the period 1997 to 2008 appeared to have a measured energy consumption that exceeds the accepted energy labelling tolerance (failing by more than 10% being the value which triggers regulatory action).
- When these models are mapped to appliance sales in the relevant year (to provide a sales weighted rather than model weighted analysis to reflect the number and type of units actually sold) the 16% of models drops to 10% of sales, over the period 2005 to 2008 where accurate total sales data is most readily available.
- When averaged across all models sold, the measured energy consumption is on average only 2% higher than the value shown on the energy label.
- If these 10% of sales for products that exceed the label claim by 10% are excluded from this analysis (on the basis that they should be found and de-registered) then the measured energy consumption is approximately equal to the label value when averaged over the remaining 90% of all refrigerators.

Analysis of the CHOICE data at a brand level indicates that many of the larger suppliers have measured energy consumption that has proven to be accurate, which is very encouraging. There are regrettably some suppliers that appear to systematically understate their energy consumption and arguably these should be subjected to closer ongoing scrutiny to eliminate this possible systematic non-compliance. Given that certain suppliers appear to have a history of non-compliance higher than their competitors, there is good reason to suggest that compliance might be improved by enforcement action targeted at suppliers with this poorer comparative compliance record or that a poor check testing record be used as the basis for developing more onerous compliance requirements into the future for those suppliers.

While a discrepancy of 2% on energy consumption between average claimed and actual measured energy across all models appears small, the magnitude of such non-compliance has a significant impact for Australian consumers and for complying suppliers. The value of energy consumed by refrigerators is about $AU1.3 billion per year. The value of 2% of this energy is about $AU25 million per annum. A level compliance playing field is critical to ensure program savings are achieved, consumer running costs are accurate and competition amongst suppliers is fair. Improved compliance could deliver significant consumer benefits.

Australian and New Zealand regulatory agencies maintain a shared database on the models that have been through the checktesting program. This was used to cross-compare the failures from the CHOICE tests. The following observations were made:

- The refrigerator checktest database reports a total of 157 refrigerator checktests that were conducted over the same time period as the Choice data. About 50 of these checktests resulted in models being de-registered, which is a raw failure rate of about 32%.
- About 35 of the refrigerator de-registrations over this period in the checktest database were either referred by CHOICE directly or picked up through regulator commissioned testing of models that were subsequently tested and failed.
- When the CHOICE records are removed from the checktest database, the rate of failure of the remaining checktests undertaken is about 19%. This is a marginally higher rate to that found using the CHOICE data to create a random sample. This shows that CHOICE testing has been a critical part of the successful checktesting program for refrigerators.

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Glossary

ACA	Australian Consumers Association (publishers of CHOICE magazine)
DCCEE	Department of Climate Change and Energy Efficiency
DEWHA	Department of the Environment, Water, Heritage and the Arts
E3	Equipment Energy Efficiency Committee
EES	Energy Efficient Strategies P/L
GWA	George Wilkenfeld and Associates
MEPS	Minimum Energy Performance Standards
RIS	Regulatory Impact Statement
TTMRA	Trans Tasman Mutual Recognition Arrangement (between Australia an New Zealand)

1. Introduction and Aim

Australia has a long history of regulating the energy efficiency of major consumer appliances. The most important of these regulations are the mandatory Minimum Energy Performance Standards (MEPS) that products must meet or exceed to be lawfully sold and the energy labelling of products at the point of sale.

The energy savings from these programs are significant. The 2005 MEPS regulatory impact statement (RIS) for refrigerators for example, suggested that it would deliver energy savings of almost 1 TWh/year by 2015. An ongoing evaluation study suggests though that the savings could be even larger, at almost 2 TWh/year by 2020 (Lane & Harrington, 2010).

Regulators need to be confident that efficiency claims being made by suppliers are being realised in practice. Therefore, the compliance component of an effective MEPS and labelling program is critical. This includes verification that claims are accurate and the commencement of enforcement action where suppliers are found to be making inaccurate claims.

The MEPS and labelling program in Australia, operated by the E3 Committee, allocates a significant proportion of its ongoing budget to verification activity (or checktesting). Generally checktesting is undertaken in accredited third-party laboratories, though some exceptions do apply where this is not possible.

Checktests are undertaken on a biased sample of the market. Testing is highly targeted and the program selects products that are at risk of failing to meet their declared values. The selection criteria for products at risk include:

- The test history of the supplier, model or test laboratory.
- Market intelligence and information from consumers or competitors.

The benefit of this kind of targeting is that program resources can be maximised by targeting the products most at risk of failing. To date over 1000 appliances have been checktested by the E3 Program.

The checktesting procedure and criteria for selection of models at risk is set out in the E3 Program's Administrative Guidelines available at www.energyrating.gov.au.

All products that undergo checktesting are entered into a checktest database, which provides a record accessible to all government regulators and DCCEE staff administering the compliance program.

In addition to the models selected for checktesting using the selection criteria, the database also records referrals from third parties, for example CHOICE or supplier competitors, where a test report to the relevant standard shows a failure to meet MEPS requirements or efficiency claims.

A key performance indicator of the improved effectiveness of the checktesting program is to increase the proportion of failures within models selected for checktesting, through better targeting of non compliant products. Checktesting of products that comply with all requirements might be considered a waste of the E3 Program's limited resources. However, as the overall level of compliance in the marketplace improves, finding non-compliant products becomes increasingly difficult.

Over the period from 1997 to 2008, the period covered by this report, a total of about 50 refrigerators out of a total of 157 checktested have failed Stage 2 checktesting (about 32%).

This report has been prepared to answer a number of important questions regarding the compliance of products with energy efficiency regulations:

- What is the underlying level of non-compliance in the market place?
- What is the impact on energy use of this non-compliance?

- Has there been any apparent change in the level of non-compliance over the study period (in particular through changes brought about by more stringent MEPS)?
- Are there ways that the product selection criteria could be improved to increase the likelihood of targeting non compliant products?

CHOICE magazine, published by the Australian Consumers Association, also undertakes detailed performance and energy tests on popular models of household refrigerators for their members. Selection of models for these tests however, is based on a random sample of popular new products, not targeted towards a likelihood of failing declared energy values. The basis for selection is that the models are likely to be popular with their members, generally the highest selling products and models that are relatively new to the market. The data from the CHOICE testing provides a clearer indication of the true level of compliance with MEPS and energy labelling, due to the more randomised selection of products for testing.

CHOICE have provided the detailed refrigerator data of over 260 models, tested during the period 1997 to 2008 and published in their magazine, for the purposes of this evaluation. The coverage tends to focus mostly on domestic refrigerator-freezer models.

For this report, the data was subjected to further analysis to assess the level of non-compliance that may be occurring in the general market place. The analysis included a review of the general level of claimed versus measured energy consumption for an assessment of any apparent systematic under reporting, or even over-reporting, of energy consumption on the energy label and an in depth assessment of any units that failed to meet MEPS requirements.

The assumption is that any measured information reported by CHOICE is subject to rigorous scrutiny from the relevant suppliers who are generally given the opportunity to explain any anomalous results. Also, any appliances that are found by CHOICE to be "faulty" are assumed to be repaired or replaced under warranty as would occur during a normal purchase, so the assessment in this report does not seek to include any assessment of quality control or the level of faulty products that may enter the market place[1].

While this analysis uses data measured and reported by CHOICE for individual models, the compliance evaluation and reporting in this report of the overall results is mostly general in nature. Data from individual models which have been extracted from CHOICE articles are not all reproduced in this report (although the data could be manually collected by a third party from published material should they wish to do so). Systematic non-compliance at a brand level, and any significant failures to comply, are noted in this report.

1 The assumption is that genuinely "faulty" products will be repaired or replaced under warranty by the supplier. However, a test laboratory is able to make a much more detailed assessment of product performance in comparison to a normal consumer, so there may be some instances where Test Research had products "repaired" but where a normal consumer would not necessarily be able to detect that a fault was present in the same product. This effect is thought to be small.

2. Background

Australia's appliance energy efficiency policy extends back to 1986, with energy labels being introduced for refrigerators and freezers in NSW, then Victoria via state based legislation. This was expanded to include other states after 1990, with the effective start of national requirements generally considered to be in 1992. This was followed by the introduction of MEPS in 1999, with more stringent requirements being mandated in 2005. A redesign of the energy label was introduced in 2000 together with a regrading of the energy label star rating. The star rating system was again regraded in 2010 and a number of important adjustments were made to the technical details for labelling and MEPS. This is summarised in Table 1 below.

Energy efficiency policy is the responsibility of the Ministerial Council on Energy (MCE) made up of Ministers with responsibility for energy from the Australian Government, each of the states and territories, and the New Zealand Government. Assessing any energy using product for possible regulation and advising the MCE on efficiency implementation measures is the responsibility of the Equipment Energy Efficiency (E3) Committee, made up of representatives of the Australian Commonwealth, state and territory governments and New Zealand government agencies.

Energy labelling and MEPS regulations are set out in the relevant state legislation. These specify offences and penalties for non-compliance. While some of the details vary at a state level, the following offences are typically contained in state regulations.

Regulations determine that:

- A person must not offer to supply a "specified" article which is not registered for energy labelling or MEPS (as applicable), or where the registration has been cancelled.
- An energy label must not be obscured.
- Other information must not be shown near the label that conflicts with data on the energy label.
- A person shall not make a false or misleading declaration.

Table 1: Summary of main household refrigerator policies in Australia

Measure	Summary
Labelling 1986	Introduced by NSW and Victoria, other states followed over time after 1990. Coverage considered national by 1992.
MEPS 1999	MEPS study in 1993 (GWA 1993). MEPS levels for refrigerators and freezer adjusted and finalised in 1996 and introduced nationally in October 1999. RIS GWA (1999).
Label revision 2000	Algorithm revised to take into account MEPS 1999 and overall improvement in product efficiency over time. RIS GWA (1999).
MEPS 2005	Stringent new MEPS levels introduced to align with USA MEPS requirements for 2001. RIS GWA (2001).
Label revision 2010 and MEPS adjustment	New labelling algorithm to take account of impact of MEPS 2005. Mandates new test method AS/NZS4474.1-2007. Adjustment to MEPS levels to take into account change in definition from average to maximum energy. Label validity margin decreased to 7.5%. RIS EES (2008).

- Registration holders must notify the regulatory authority of any change of contact details.
- Registration holders must supply a sample for testing on the request of the regulatory authority.
- Registration holders may be liable for costs of check testing by the regulatory authority if tests show that the model does not comply.

Full details and links to state regulations can be found on: www.energyrating.gov.au

The E3 national checktesting program purchases appliances from retail outlets and tests them in accredited independent laboratories. This activity is co-funded by the Australian, State and Territory governments and the New Zealand Government and is currently managed by the Australian Government on behalf of E3 members.

The E3 Committee spends a significant proportion of its budget on compliance activity, and publicises the results via its newsletter and in its annual report available on www.energyrating.gov.au.

2.1 Process of declaring energy information on energy labels and MEPS

Manufacturers who wish to offer household refrigeration appliances for sale in the Australian and New Zealand markets need to register their products with a state regulator[1]. Products can be registered in any state but all registrations are centrally recorded on the Energy Rating registration database. The declaration provided is a self certification, using data provided by the supplier. For refrigerators and freezers, three separate units have to be tested by suppliers in order to satisfy the registration requirements. Suppliers are required provide test reports for three units to the regulator during the registration process. However, these test reports may be provided from in-house laboratories. Test reports provided by laboratories that have a history of supplying test report for products that have failed checktesting may be deemed as unacceptable by regulators. The energy label values and MEPS compliance are verified in a laboratory under standard conditions specified in the relevant test standard.

The E3 Program's Administrative Guidelines set out the validity criteria for the range of appliances and equipment regulated for MEPS and/ or labelling. Information on validity criteria are also set out in the relevant standard which in the case of refrigerators and freezers is AS/NZS4474.2.

For a declared energy value on the energy label, a tolerance of 10% has been permitted within a checktest before it is considered to be a "failure". The 10% value allows for a wide range of factors such as production variability, measurement tolerance and laboratory reproducibility. Once the measured energy consumption exceeds 10% of the label claim, statistical analysis suggests that the likelihood of this being a result of random factors is very low and the product is usually required to go to 'Stage 2' check testing. The statistical basis for this tolerance is set out in the paper by Harrington and Bartels (2004) titled *Statistical Basis for the Determination of Check testing Validity Criteria*, which is available on www.energyrating.gov.au.

It is important to note that all registrations to the latest edition of AS/NZS4474.2-2009 have an energy labelling tolerance of 7.5%, rather than previous 10% figure which applied up to 2009. The 10% figure is applicable to the dataset examined in this report.

No formal tolerance is specified for MEPS compliance other than the measurement uncertainty for energy consumption (nominally 2%). The MEPS definition up to 2010 (i.e. prior to AS/NZS4474.2-2009) requires the model average energy to be less than the MEPS level. From a

1 State registrations are recognised in NZ. NZ registrations are recognised by Australian states under the TTMRA if the product is manufactured in NZ or imported through NZ prior to export to Australia.

sampling and statistical perspective, it can be difficult to accurately estimate the model average energy consumption, especially where there is some variability from unit to unit. Technically, under the previous MEPS definition (as applicable to the data analysed for this report), 50% of the production could be worse than the MEPS target energy consumption limit as long as the average was at or below the MEPS limit. This means that a single sample that is found to exceed MEPS by a small margin does not provide a definitive indication of non compliance with respect to MEPS. This made enforcement of the previous MEPS requirements difficult in marginal cases.

It is important to note that the MEPS definition under AS/NZS4474.2-2009 has been altered such that nominally all units of a particular model are now required to meet the specified MEPS levels. The levels in the 2005 standard were adjusted up by 6.1% to move the requirement from an average to a nominal maximum permitted value. This new definition is not applicable to the dataset examined in this report.

2.2 Checktesting program

The E3 checktesting program follows a strict process. The procedure for determining MEPS and energy labelling compliance for a refrigerator and freezer (and other whitegoods) is set out in the following steps:

1. A screen test (Stage 1) is conducted usually on a single selected unit.
2. If the Stage 1 measured energy consumption exceeds the Stage 1 screening criteria, the supplier may accept the Stage 1 result and the product registration is cancelled. Otherwise the supplier can elect to proceed to Stage 2, where three additional randomly selected units are checktested. The supplier may elect to test more than three units in the Stage 2 checktest.
3. The results for Stage 2 are evaluated against the MEPS and energy labelling validity criteria. In Stage 2 the test result from Stage 1 is not considered.
4. In specified special cases, the manufacturer may elect to test not less than five additional randomly selected units to demonstrate MEPS compliance (Stage 3). The same general MEPS compliance criteria apply to these additional Stage 3 units. Note that this requirement is not specified in products registered to AS/NZS4474.2-2009 (nominally supplied to the market from 2010).

A more detailed description and administrative guidance detail, including a discussion on statistical issues can be found at www.energyrating.gov.au.

In order to maximise the benefit of the checktesting program, products selected for checktesting by E3 are selected on the basis that they are at greatest risk of non-compliance.

All products that are checktested are listed in the national check test database. While many of the products in this database are selected by E3, a substantial number of products also enter the checktest database by other mechanisms. When a potential failure is identified by a third party, such as CHOICE or through competitor testing, the product may also be entered into the checktest database. In these cases the probability of a Stage 2 failure is already very high. It is self evident that third parties do not refer examples of complying tests onto regulators – so there is likely to be a large amount of testing by third party sources that is never reported to regulators because all requirements are met.

When these checktest product selection criteria are considered together with the process of third party referrals, it is clear that the products in the checktest database are not likely to be representative of the general level of non-compliance in the market place.

2.3 CHOICE and ACA

CHOICE is an independent publisher of consumer information, and is the public face of the Australian Consumers' Association (ACA), with over 200,000 subscribers. Its aim is to provide independent advice across a range of goods and services. It does this by undertaking in-house reviews of consumer products that are of interest to its members. For household refrigeration products this includes making use of its own NATA accredited testing facility, Test Research. The test laboratories allow for a detailed independent assessment of manufacturer declarations. Further information about CHOICE and ACA are available at their website: www.choice.com.au

Typically, twice a year CHOICE randomly selects and tests a range of popular refrigerators and freezers. CHOICE generally conducts full energy tests to the relevant published test procedure AS/NZS4474.1, which provides a sound basis for verification of the labelling and MEPS claims. In addition, they also conduct a range of other in-house tests to assess a range of factors such as temperature control and stability, performance across a range of ambient temperatures, processing capacity, ease of use and other aspects not specified in the standard. As a general rule, they tend not to conduct other performance tests which are mandatory for energy regulation in Australia and New Zealand (e.g. temperature operation test, pull down test). They publish a summary of their results in CHOICE magazine. The data they have collected over the period 1997 to 2008 provides the basis for the analysis in this report.

3. Methodology

The methodology used for the analysis in this report can be summarised as follows:

- A dataset was compiled from published CHOICE articles from 1997 to 2008 collating information on brand, model, claimed energy (energy label value) and the measured energy value.
- Each model was then cross-matched to the energy labelling registration details record (including details of the energy label reportedly affixed to the product) to verify the published information (i.e. that the claimed energy label is legitimate and accurate and the registration is valid for the stated brand and model).
- Each model was then matched to the sales database from GfK (for every year from 1997 to 2008) in order to assess the market share of each model tested by CHOICE (note that there was incomplete market share of models prior to 2001).
- Each brand was matched to the sales database from GfK (for every year from 1997 to the present) in order to assess the market share of each brand tested by CHOICE.
- An assessment was made of the labelled energy versus tested energy consumption for each model (including an assessment of the relevant validity criteria).
- An assessment was made of the level of non-compliance with 1999 and 2005 MEPS for each model.
- An attempt was made to trace every non-compliant model identified by CHOICE to see if it was in the checktesting database.
- Using sales-weighted data, an overall market assessment of the level of compliance with energy labelling and MEPS requirements was made.

4. Review of Data Collected

CHOICE has published data at a model level on declared consumption values and the measured values from their independent tests on over 260 models from 1997 through to 2008[2]. For this report these were matched to data in the registration database to generate a clean dataset for further analysis.

The dataset includes the information listed in Table 2.

Using information provided by GfK, sales from across the study period have been matched for each specific model tested. It is quite normal for the same model to have a number of registrations with the same or different energy consumption, but otherwise with the same underlying performance characteristics. A search through the GfK sales database was undertaken to identify all of the models identical to the one tested by CHOICE and sold throughout the period.

In addition, the total volume of sales by year (1997-2008) has been included to estimate the total coverage of the products tested. Market sales data for 2009 have not yet been received/ processed, so are not included in the aggregate statistics.

Table 2: Structure of (CHOICE) data set developed for analysis

Variable	Unit	Comment
Model		Brand, name, number
Measured energy consumption	kWh/year	Test Research NATA lab to AS/NZS4474.1
Declared energy consumption	kWh/year	Energy on the label affixed to the product
Registration number		To uniquely identify model in EnergyRating database
Year bought in shops	Year	Usually six to nine months before publication of results in CHOICE magazine
MEPS-1999 target energy value	kWh/year	Calculated for each model
Pass/Fail 1999 MEPS	Yes/No	
MEPS-2005 target energy value	kWh/year	Calculated for each model
Pass/Fail 2005 MEPS	Yes/No	
Model-Sales- [year]		Sales for specific model from GfK sales database
Brand-Sales- [year]		Sales for specific brand from GfK sales database

2 Some data for 2009 were provided by CHOICE but these included only separate freezers, which were quite a different product group, so these products were not generally included in the analysis for this report.

5. Analysis of Data

5.1 Analysis of registration compliance

When collating the analysis dataset, the label information noted by CHOICE as affixed to the product at the time of purchase was compared to the models listed in the registration database at the time of purchase. This sub-section provides an assessment of the level of compliance with respect to the mandatory registration requirement. This is an element of process evaluation, rather than a direct impact on energy consumption.

Out of the 261 tests, at least eight models may have been registered incorrectly at the time of purchase by CHOICE. A couple of these have very small discrepancies that may be typing or data entry errors in CHOICE publication (less likely) or in the registration record. However, there are 5 discrepancies that appear to be genuine issues worth noting:

- The NEC 3D cooling (FR-405) did not register the energy consumption reported by CHOICE. It appears to have the same technical details as a DAEWOO model, which is probably supplied from the same OEM factory. (1998)
- The Centrex CTF210A was never registered successfully and its attempted registration was returned. The company went bankrupt when regulatory action was commenced after identification of the Stage 1 check test failure by CHOICE. (2007)
- The General Electric TFG20JAWW and the Kelvinator N500BD were registered but not with the stated energy consumption values recorded by CHOICE.
- The Jenn-Air JCB-20-BDS was bought and tested in 2004 however it was not registered until 2005.

Overall, the level of compliance with mandatory registration requirements was found to be very high. Only 4 products out of a total of 261 models were found with registration discrepancies (better than 98.5% compliance).

Another effective mechanism for assessing registration compliance is the labelling and registration audits conducted by the Australian Refrigeration Council (ARC) for E3. A 2009 survey of 24,851 whitegoods found the national average rate of registration was 99.4%. This is broadly consistent with the Choice data over a long period.

A complementary assessment of the level of registration compliance can be obtained from an analysis of GfK sales data covering some 1,500 models and claimed market coverage of approximately 95% of all retail sales in Australia. Sales data in 2009 found that about 80 models of refrigerator recorded by GfK remained "unmatched" based on a cross match of the model numbers supplied with the registration database. These models only made up about 0.8% of sales in 2009. However, in all likelihood this is probably a substantial overstatement of the number of unregistered models as many of the GfK listings would appear to have typographical errors in them, which makes accurate cross matching difficult in the first instance. A deeper investigation would probably reveal that many of these "unmatched" models are covered by existing registrations. Spending a lot of time on such investigations is not warranted from a sales weighting analysis perspective (as these constitute less than 1% of sales), but it may yield some useful data in terms of compliance. The number of unregistered models recorded by GfK is likely to be around 30, which is 2% of the models recorded by GfK. This is slightly higher than the values reported by Choice and the Australian Refrigeration Council store surveys, but this could be explained with consideration to the following:

- Some uncertainty regarding correct model details recorded by GfK.
- Inclusion of some products by GfK that are not regulated (eg non vapour compression, non-main power models – it can take some research

to establish the attributes of each model from third party sources and make an assessment on whether it is within the scope of the program).

- Better coverage by GfK of some small retail outlets and models with very low sales that may not be common in mainstream retail outlets and therefore could be under-reported by Choice and the Australian Refrigeration Council store surveys.

A comprehensive approach to compliance would be to chase up each of the relevant suppliers recorded by GfK to verify with them the registration status of any “unmatched” model numbers and to approach GfK to have errors in their database corrected where identified.

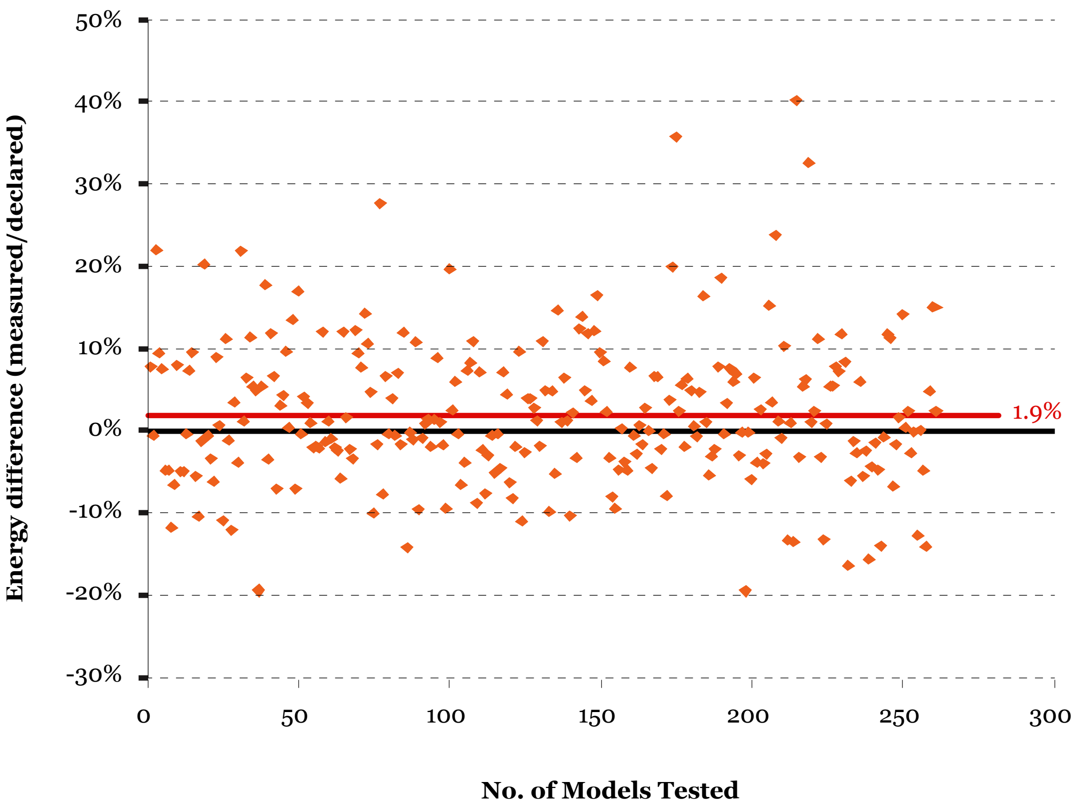
5.2 Comparison of measured versus declared energy consumption label values

The main focus of the analysis in this report is an assessment of the accuracy of energy label claims (kWh/year) on household refrigeration equipment and to gain insights into the general level of compliance of products offered to the market.

The measured data are based on a single test of products by CHOICE using the appropriate testing standard (AS/NZS4474.1). Additionally, the analysis used the label energy consumption CHOICE reported as affixed to the product at the time of purchase.

When comparing the measured with declared/labelled values tested by Choice, 42 of the models show a difference of more than 10%. This is normally sufficient to trigger a Stage 2 checktest

***Figure 1*: Comparison at model level (% difference between measured versus declared/label)**



but of the 42 models about 8 did not proceed to stage 2 testing. These failures date back to 1997 and regulators would have had difficulty sourcing those models from the market place. In the event, regulators were able to test 33 models.

In initial analysis of the data, a simple plot of models was performed for all the data over all years (1997 to 2008). Figure 1 shows the percentage difference between the measured and claimed energy use, minus 100%. At a model level, the difference between measured and declared data (label value) shows quite a scatter, with values ranging from -20% to +40%. The Y axis of this chart shows the number of models tested from 1 to 261. The left side of the chart is 1997 while the right hand side of the chart is 2008 (so effectively the X axis is a rough proxy for time from 1997 to 2008).

The simple average of the measured/declared 'difference' for all models is 1.9% (with a standard deviation 8.8%). This means that on average, the declared (labelled) energy consumption is around 2% lower than the value as measured in the laboratory (or the measured energy consumption is systematically 2% higher than the declared value). This suggests on average that manufacturers are not significantly understating their claims of energy consumption on the energy label, which suggests a good level of overall compliance. The scatter is effectively random around the zero difference line with no statistically significant slope over the years.

This data is summarised in Table 3.

The above analysis is based on the model data only. It is possible to weight the models according to the number of sales of that product. For the average difference the sales-weighted figures is 1.9%, which is the same as the models-weighted difference.

It is possible to repeat the above analysis, but excluding models that exceed the validity thresholds (i.e. those with a measured energy that exceeds 10% of the label claim). Once the products which exceed +10% difference are removed, the average difference was found to be almost zero. This illustrates that 1.9% difference between measured energy and labelled energy for all products is primarily driven by the relatively small number of products that fail to comply with regulatory requirements.

Table 3: Overview of models data (measured and declared/label)

Aspect	Output
Number of models	261
%Difference – average	1.9%
%Difference - Standard deviation	8.8%
%Difference - Number greater than +10%	42
%Difference – Percentage greater than +10%	16%

Note – these statistics are models-weighted (not sales weighted)

It is interesting that the scatter of products is fairly evenly distributed around the zero difference line. Of most interest are the products that exceed -10% and +10%.

There is a fairly straightforward explanation for products that have measured energy that is as low as 10% below the energy label claim. It is quite common for manufacturers to make ongoing improvements to a model design through tweaks to designs and components. Some of these may improve the energy consumption by several percent and some may be made for other non energy reasons. After these energy improvements, the manufacturer is entitled to re-register the product with a lower energy consumption level. However, the time and cost to register (with the requirement for new test reports which themselves represent a significant cost) is considerable and this may not be warranted until an additional half star is clearly earned. For reference, in refrigerators an extra half star can be earned with a reduction of energy of about 12%. If the existing registration is close to a half star threshold, the incentive to re-register without gaining an additional half star is minimal. This is likely to explain many of the tested

Table 4: **Overview of models data (average difference between measured and declared/label)**

Exclusion of models with the declared/measured difference (>%)	Estimated average difference (%)	Comment
50%	1.9	All products included
40%	1.7	Due to one product above 40% difference
30%	1.6	
20%	1.2	
10%	-0.2	This is the level which would trigger a Stage 2 test
0%	-1.9	

Note – this is for sales-weighting of the measured product

values in the range 0% to minus 10%. There is no clear explanation for the presence of models with performance better than minus 10%.

Another way to examine the data is to aggregate all models for each year and show the average for each year as an annual plot over time. Note that since

***Figure 2*: Energy comparison of averages for each year (measure/declared)**

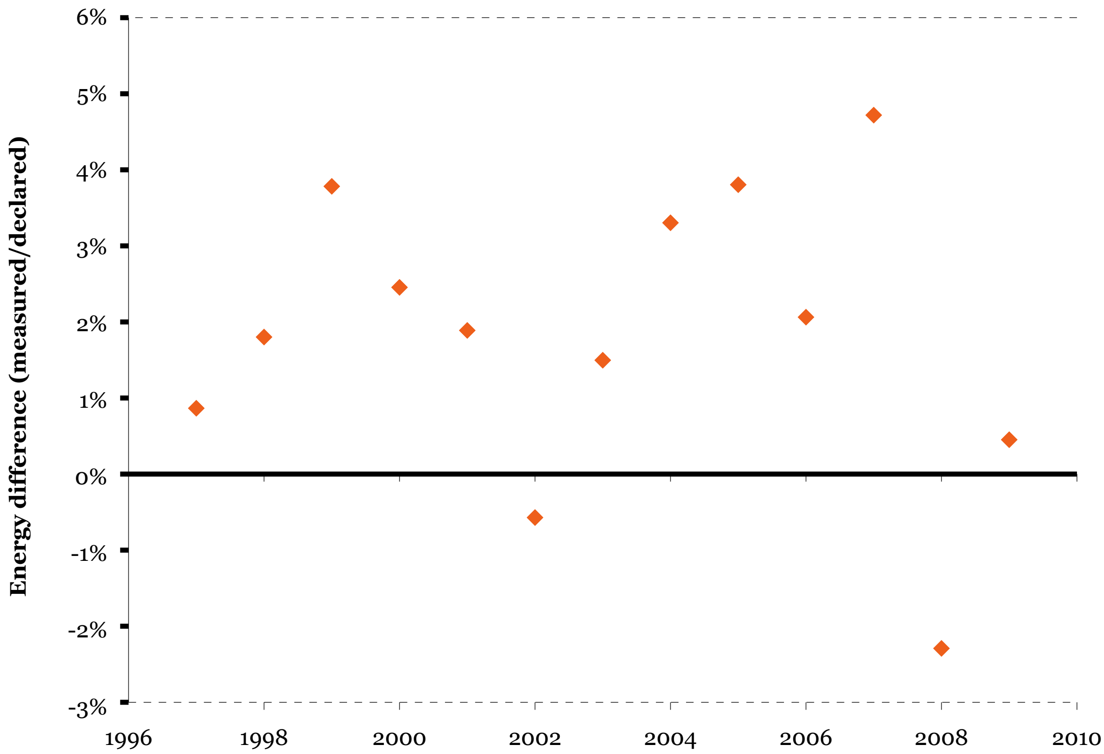


Table 5: **Models-weighted average difference between measured and declared/label values by year**

Year	Average	Std Dev	Minimum	Maximum	Count
1997	1%	9%	-12%	22%	17
1998	2%	10%	-12%	22%	14
1999	4%	8%	-19%	18%	23
2000	2%	7%	-6%	14%	18
2001	2%	9%	-14%	28%	29
2002	-1%	7%	-11%	11%	23
2003	1%	7%	-11%	15%	16
2004	3%	8%	-10%	16%	20
2005	4%	9%	-8%	36%	24
2006	2%	9%	-20%	24%	24
2007	5%	12%	-14%	40%	23
2008	-2%	8%	-17%	14%	24
2009	0%	10%	-14%	15%	6
Grand Total	**2%**	**9%**	**-20%**	**40%**	**261**

there are a reduced number of models for each year (when compared to the aggregate analysis) there will be a larger variance (confidence interval) on the plotted points. It is interesting to note that in some years (2002, 2008) the average of the measured data is lower than the average of the declared data. However, these data confirm that the overall difference between declared and measured energy consumption is about 2% on average and that there is no significant trend over time.

The models-weighted analysis for each year illustrated in Figure 2 is defined in Table 5.

Another way of examining the data is to see whether there is any systematic difference between the measured and labelled values by brand. A table which shows the results for all brands tested by CHOICE is set out in Appendix A. This indicates that at a brand level many of the larger mainstream suppliers have a measured energy consumption that is close to equal the declared energy value on their energy labels. There do however appear to be some suppliers who systematically understate their energy consumption. Of the brands with more than 10 products tested, LG, Kelvinator, NEC, Mitsubishi and Westinghouse had a model weighted difference of 2% or more. These should be subjected to closer scrutiny to understand the significance and any implications of any brand bias. Note that data for brands with a sample size of less than 5 might not be statistically representative.

5.3 Comparison of measured versus declared MEPS levels

It is also interesting to see how the measured products compared with any MEPS values in place at the time (MEPS were introduced in October 1999 and upgraded in January 2005).

***Table 6*: List of appliances that failed screen testing**

Brand	Model No	Label	Measured	Measured / label	Published	Approx (start/buy)	MEPS 2005	Fail Margin	Fail margin
		(kWh/ yr)	(kWh/yr)	(%)	(yyyy-mm)	(yyyy-mm)	(kWh/yr)	(kWh/yr)	(%)
CENTREX	CTF210A	403	565	40.2%	2007-11	2007-04	412	153	37%
CONIA	CF330	420	570	35.7%	2006-05	2005-10	422	148	35%
TOSHIBA	GR-M55ADA	557	689	23.7%	2007-05	2006-10	568	121	21%
HITACHI	R480ET5X	540	640	18.5%	2006-11	2006-04	542	98	18%
HITACHI	R-550ET5	575	662	15.1%	2007-05	2006-10	576	86	15%
WHIRLPOOL	6WRI27N	406	472	16.3%	2006-05	2005-10	421	51	12%
SMEG	FAB32	348	461	32.5%	2007-11	2007-04	419	42	10%
BOSCH	KSU445216W	484	580	19.8%	2006-05	2005-10	528	52	10%
DAEWOO	FR-4501W	495	550	11.1%	2008-05	2007-10	506	44	9%

Note: These are based on one test and only constitute a prima facie screen test failure.

To check that the 261 models tested have passed the 1999 and 2005 MEPS, a threshold kWh value was estimated for the particular model (based on product group and volumes). Clearly models on the market before these MEPS introduction years do not have to attain these target threshold levels. These threshold values have been compared against the measured data.

From this analysis, none of the models on the market from end of 1999 onwards fail the MEPS 1999 levels.

However, 25 models analysed fail the nominal 2005 MEPS levels. Even though CHOICE usually purchases current models, some of these may still be market-legitimate models since they may have been manufactured or imported before the 2005 MEPS commencement date, and therefore could still have been legally sold from 2005 onwards without complying with that requirement. On closer examination, the failure margin is very small (<25 kWh and <5%) for about half of the models that would have nominally failed. As previously noted, MEPS in 2005 was defined as a requirement for a model average and thus 50% of the production can legitimately have an energy value that is higher than the MEPS target energy consumption value.

Of the 25 that failed MEPS, 9 fail by a significant margin (9% to 37% above the MEPS target energy consumption level) and were followed up with further investigations and regulatory action. These products are listed in the following table. In addition to failing the nominal MEPS 2005 levels, virtually all of these products failed the 10% screening criteria for labelling in any case.

A single unit that fails the MEPS 2005 levels in this analysis does not mean that products were illegally on the market. They could be considered to have failed Stage 1 of the checktesting process. The requirement at the time was that the average of the models on the market is less than the MEPS level, so some products above the MEPS level are permitted, although large margins are unlikely to pass these requirements.

5.4 Data coverage, model share and brand share

In terms of the models tested by CHOICE, it is useful to see what proportion of the total market the products they tested represented. To do this, the models tested by CHOICE were cross matched with sales recorded by GfK. This was completed for the primary registration identified for the CHOICE tests. In addition, other registrations for exactly the same models (but registered in other years) have also been identified and matched from GfK sales data to provide a better indication of coverage over time (secondary registrations). It is important to note that many of these registrations for the same model will have the same specifications, but some may have different energy values.

In terms of national sales statistics, Column S1 in Table 7 provides the actual sales data where individual model details are known. Up to 2004, the known or identified models was significantly less than the total market as shown in Column S2 (as reported by GfK) because many models in their sales database were hidden or could not be traced in the registration system[3]. It is also important to note that the market coverage by GfK increased in 2005 and the way the data was provided allowed all models to be identified in the data set. The

3 GfK have a policy of not identifying sales (and value) of models that are sold through a single retail chain – so called Tradebrands or Private Label models. Since 2005, it has been possible to attribute approximate sales within these groups of models through an improved process of sales allocation and more complete data from GfK.

***Table 7*: Annual sales coverage of models measured by CHOICE**

	Sales (S1)	Sales (S2)	Reg1 Sales	(% S1)	(% S2)	Reg1-5 Sales	(% S1)	(% S2)
1997	582,515	807,506	74,545	13%	9%	159,093	27%	20%
1998	614,410	851,889	136,983	22%	16%	258,564	42%	30%
1999	604,106	837,875	180,158	30%	22%	315,043	52%	38%
2000	591,583	819,933	93,323	16%	11%	406,529	69%	50%
2001	588,343	815,330	121,455	21%	15%	486,151	83%	60%
2002	584,502	809,016	124,296	21%	15%	492,708	84%	61%
2003	642,211	888,842	146,703	23%	17%	529,714	82%	60%
2004	756,449	1,045,924	167,622	22%	16%	527,043	70%	50%
2005	1,084,192	1,084,192	375,282	35%	35%	749,553	69%	69%
2006	1,199,955	1,199,955	427,412	36%	36%	783,168	65%	65%
2007	1,162,760	1,162,760	320,312	28%	28%	743,215	64%	64%
2008	1,201,470	1,201,470	362,068	30%	30%	600,878	50%	50%

Notes: The retailer base changed in 2005 with the inclusion of 3 new retail chains, so that total market size appears to increase significantly. S1 are GfK sales where models are explicitly known. S2 are total market sales (S1 plus Tradebrand models). Reg1 is the exact registration as reported by Choice. Reg1-5 is all related registrations for the same model.

Source: Based on GfK data

proportion of the registration sales covered by the models in the current analysis is given in Table 7 by year.

The explanation for this change is that prior to 2001, only sales of models greater than 800 units were provided in the GfK data purchased, representing around one third of models and 75% of all sales. Post 2001 there was a better estimate of total coverage by GfK as a more complete data set was provided with sales data available down to each unit by model. In the period 2001-2004 every model was listed but there was not sufficient information to identify the correct energy registration for some of the so called Exclusive Models (or Tradebrands) which were sold through a single retailer. From 2005 onwards more data were provided which effectively allowed sales to be allocated to groups of Exclusive Models with the same specifications. Thus, to interpret Table 7, from 2005 onwards, S1 column provides the most representative data and is the best estimate for the likely of coverage of the CHOICE tests.

This suggests that the CHOICE data represents direct coverage of the exact registrations of around one-third of the sales of products on the market (ie approximately 350,000 models sold each year in recent years). When the same models tested by CHOICE are considered across all years, then the coverage increase to around 65% of the total market. This can be regarded as a legitimate (although less robust) figure as a spot check on the model energy consumption though the CHOICE test can be considered as indicative of the same model characteristics through time.

If the primary model registration is used (Reg1), then these products already represent a significant proportion of the market. However, if other registrations for the same models are included (Reg1-5 = secondary registrations for the same model), then the proportion rises significantly, especially in the early years.

5.5 Comparing 'failure' rates: ACA data set and checktest database

The failure rate of models detected under E3's targeted checktesting program can be adjusted to see what the failure rate is without accounting for those models which have ended up in the regulatory system as a result of CHOICE tests. This is a useful analysis to understand how effective targeting using E3's selection criteria has been.

As noted earlier, the products selected for checktesting are from a targeted sample where products that have a higher likelihood of failing are selected for testing. A summary of the outcome of check testing is usually given in the annual E3 Achievements report, published at www.energyrating.gov.au. The total number of checktest failures of all refrigerator models recorded in the checktest database over the study period (same period covered by the Choice data) is 32% (about 50 in 157).

About 65% of all failures recorded in the checktest database appear to either have been referred by CHOICE directly or have entered the system as a result of CHOICE tests and reporting. Where CHOICE test a product and identify a failure of the validity criteria, it can be assumed that in most cases the product will go on to fail stage 2 check testing. Therefore, a majority of all confirmed failures in the checktest database appear to have come directly or indirectly from CHOICE testing.

The underlying level of market compliance in the checktest database for products selected and tested independent of CHOICE intelligence can be calculated by removing the CHOICE referrals. When this is done the rate of failure is about 19% - a very similar rate to that found by CHOICE in their large random sample.

This broadly corroborates the underlying level of non-compliance estimated by the large random CHOICE sample over a 12 year period. However, it also suggests that better targeting of checktesting of products selected by E3 may be possible in order to increase the probability of failure of the products selected for checktesting which are not based on information from CHOICE.

When these models are mapped to appliance sales in the relevant year (to provide a sales weighted rather than model weighted analysis to reflect the number and type of units actually sold), the 16% of models drops to 10% of sales, over the period 2005 to 2008 where accurate total sales data is most readily available. When averaged across all models sold, the measured energy consumption is on average only 2% higher than the value shown on the energy label. While a discrepancy of 2% on energy consumption between the average claimed and actual measured energy across all models appears small and some might argue even acceptable, the magnitude of such non-compliance has a significant impact for Australian consumers and for complying suppliers. The value of energy consumed by refrigerators is about AU$1.3 billion per year and 2% of this figure is about AU$25 million per annum. This additional energy cost is paid by consumers and should be subtracted from the projected energy savings of the program. While it is impossible to eliminate all non-compliance, additional resources and improved strategic approaches may be able to improve this significantly.

A separate evaluation of energy savings from energy labelling and MEPS for refrigerators (Lane and Harrington 2010) found that annual savings from all program measures since the late 1990's are estimated to be worth about $300 million a year in 2009. The potential savings lost through non-compliance are relatively small, but if non-compliance could be eliminated, it would add as much as 8% to the annual savings from all program measures for refrigerators from the late 1990's.

A level compliance playing field is critical to ensure program savings are achieved, consumer running costs are accurate and competition amongst suppliers is fair. Improved compliance could deliver significant consumer benefits.

During 2010 there were a range of press reports that quoted results from the check test database as being the underlying level of non-compliance in the market (over 30% for refrigerators and considerably worse for some other products). However, analysis in this report has shown that the published checktesting results should never be used as an indicator of the underlying compliance rate as the database contains a heavily biased (non-representative) sample of products. As a key indicator, a higher proportion of failures in the checktest database really only means that selection processes targeting products for checktesting are highly effective and other techniques are required to assess the underlying compliance rate.

5.6 Conclusions

Product policy, such as energy labelling and MEPS, for refrigeration appliances are estimated to deliver considerable energy savings benefits to consumers and society in general. Monitoring the compliance levels of these policies is very important to ensure that these savings are being delivered and not being eroded by false or misleading claims. Verification and enforcement are key elements of any regulatory program.

Assessing the underlying level of compliance is not an easy task as it is difficult to get a large unbiased sample of measurement data, using standard testing procedures, on new products placed on the market. The CHOICE dataset is unique in this regard. Analysis of the CHOICE data has provided an excellent insight into the likely compliance levels in the Australian market place. The models tested by CHOICE cover a very high proportion of the sales in Australia, so can be considered a good surrogate of total market trends. While the market coverage varies by year, it averages at around 30% of models sold, though can be as high as 60% of the market when considering the same models sold in different years.

Analysis of the data on all models shows that on average the tested energy value is approximately 2% more than the declared value. The data at a model level suggests a small level of systematic overstatement of energy consumption by some suppliers. When models that exceed 10% difference are excluded from the analysis, there is virtually no difference between the claimed and measured energy.

Around 16% of all models tested by CHOICE in the period 1997 to 2008 appeared to have a measured energy consumption that exceeds the accepted energy labelling tolerance (failing by more than 10% being the value which triggers regulatory action). When these models are mapped to appliance sales in the relevant year (to provide a sales weighted rather than model weighted analysis to reflect the number and type of units actually sold), the 16% of models drops to 10% of sales over the period 2005 to 2008 where accurate total sales data is most readily available.

When the CHOICE records are removed from the checktest database, the rate of failure of the remaining checktests is about 19%. This is a marginally higher rate to that found using the CHOICE data to create a random sample. This shows that CHOICE testing has been a critical part of the successful checktesting program for refrigerators, but that improvements in model selection procedures should be examined.

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Appendix A: Brand Test/Declared Energy Values (%)

A simple model-weighted analysis of the brands of models tested by CHOICE is given in the following table.

***Table A1*: Difference between measured and declared/label energy (kWh) figures**

Brand	Average	Count	Min	Max
Amana	2%	4	-3%	7%
BOSCH	6%	4	1%	20%
CENTREX	40%	1	40%	40%
CONIA	36%	1	36%	36%
Daewoo	5%	3	1%	11%
Electrolux	-2%	9	-17%	9%
ELECTROLUX KELVINATOR	-2%	2	-6%	1%
Fisher & Paykel	1%	46	-10%	22%
GE General Electric	2%	6	-7%	22%
Haier	-3%	3	-14%	12%
HITACHI	13%	3	5%	19%
Hoover	4%	6	-3%	9%
JENN-AIR	2%	1	2%	2%
Kelvinator	-4%	16	-19%	5%
Kelvinator / Simpson	2%	2	-6%	9%
Lemair	15%	1	15%	15%
LG	3%	20	-14%	12%
Liebherr	3%	4	-20%	28%
Maytag	-1%	6	-13%	12%
MIELE	1%	2	0%	2%
MITSUBISHI	5%	10	-2%	13%
NEC	3%	12	-10%	18%
OMEGA	6%	1	6%	6%
Panasonic	5%	3	-4%	17%
Samsung	0%	21	-11%	14%
Sharp	2%	5	-16%	12%
SIMPSON	0%	6	-9%	6%

Brand	Average	Count	Min	Max
SMEG	14%	2	-4%	32%
TOSHIBA	13%	2	2%	24%
Vestfrost	2%	1	2%	2%
Westinghouse	2%	41	-13%	16%
Whirlpool	1%	17	-14%	20%
Grand Total	**2%**	**261**	**-20%**	**40%**

Note: Care is required in the interpretation of the results with a sample size of less

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