www.bre.co.uk

Study of Over-Consuming Household Cold Appliances

Energy consumption of cold appliances scheduled for recycling

Prepared for: Penny Dunbabin
Date: 25th August 2015
Report Number: HPR187-1001

BRE
Watford, Herts
WD25 9XX

Customer Services 0333 321 8811

From outside the UK:
T + 44 (0) 1923 664000
F + 44 (0) 1923 664010
E enquiries@bre.co.uk
www.bre.co.uk

Prepared for:
Penny Dunbabin
DECC,
3-5 Whitehall Place,
London,
SW1A 2AW

Prepared by

Name Judith Evans & Jack Hulme

Position Director, RD&T and Principal Consultant, BRE

Date 25 August 2015

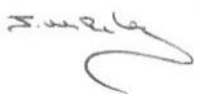
Signatures 

Authorised by

Name John Riley

Position Director

Date 25 August 2015

Signature 

Summary

This report presents the findings of research into the performance of working cold appliances which were due to be recycled. The research was undertaken by RD&T in their laboratory in Bristol.

In total, 100 domestic cold appliances were examined to determine why they were being recycled. Following a series of tests (outlined in the 'Inspection of 100 appliances due for recycling' report), 28 of these were considered suitable for re-use. The 28 appliances were tested (using a method that closely followed the BS EN 62552:2013 test standard) to compare:

1. The energy used by the appliances compared to their original energy consumption when new.
2. The performance of the tested appliances against current day appliances.

Data on the energy used by the appliances when new was obtained from the manufacturer's reported consumption figures. This data was only available for 22 of the appliances. Comparing the energy consumption when tested with the original manufacturers' reported figures demonstrated that:

- 18 appliances used more energy than the manufacturers measured when new;
- 1 appliance used almost identical energy and;
- 3 appliances used less energy than the manufacturers measured when new.

Compared to current appliances, only one of the fridges, two of the freezers and two of the fridge-freezers that were tested were better than or equal to a current A rated appliance. None of the appliances tested were better than a current A+ appliance.

The results highlighted that:

1. The energy used by freezers (compared to other appliance types) tended to increase less over time.
2. Some appliances consumed at least double the energy that they used when new.
3. Few of the recycled appliances could achieve the energy efficiency of modern appliances.
4. The appearance of an appliance was not an especially good indicator of its energy performance.
5. If recycled appliances were to be re-used, care should be taken to identify the appliances that are more energy efficient. This can probably only be achieved through an operation test of the appliance.

Contents

1 Background

Previous work by RD&T and BRE had examined 100 appliances due for recycling (see 'Study of Over-Consuming Household Cold Appliances - Inspection of 100 appliances due for recycling' report). In total, 28 of the refrigerated appliances examined were considered suitable for re-use (i.e. were functioning / needed only superficial repairs). Although these appliances were considered suitable for re-use, two questions remained:

1. Whether the appliances used more energy than they did when they were manufactured (i.e. had their performance had reduced over time)?

2. Whether the energy currently used by the appliances was higher than a new equivalent sized refrigerator (i.e. were the older appliances significantly less efficient than new appliances)?

This piece of follow-on research considers these questions and implications for the suitability for re-use of older appliances sent to be recycled.

2 Methodology

The energy used by the 28 appliances considered suitable for re-use was assessed using a method that closely followed BS EN 62552:2013 (Household refrigerating appliances - Characteristics and test methods) test standard. The methodology was designed so that a number of appliances could be tested cheaply and relatively rapidly to provide a good estimate of the energy used by the appliances.

The testing differed from a full BS EN 62552:2013 in the following respects:

1. Testing booths were not used; however, appliances were lined up against the test room walls to simulate a similar environment to testing booths.
2. Energy data from the two tests carried out to determine energy used at a defined temperature was generally interpolated (as described in the standard), but occasionally, when this was not possible, the data was extrapolated.
3. When testing freezers, some test packs that were below the maximum temperature pack were removed before the final test as these were not relevant to the overall test result.
4. The power meters used measured cumulative power only, however, their accuracy was checked and was within that required by the standard.
5. Only a single ambient measurement was taken for each cabinet as opposed to the two prescribed in the standard.

The tests carried out determined:

1. **Energy used by the appliances:** Energy use was obtained from two tests at the set point temperatures required in BS EN 62552:2013. Energy use was calculated by interpolating (or in a few cases extrapolating) between the two tests to provide the energy use at the exact temperature stipulated in the standard (for that particular appliance type).

2. **Temperature control of the appliances:** Freezers were loaded with standard Tylose test packs and M-packs (measurement packs with a calibrated t-type thermocouple in the geometric centre). Chilled compartments were loaded with brass cylinders with a t-type thermocouple in their geometric centre which were placed in the measurement positions stipulated in BS EN 62552:2013

The measured energy consumption for each of the appliances tested was compared with:

1. The manufacturer's reported energy consumption figures for each appliance when new (this information was obtained from the GfK Etilize dataset).

2. The energy used by a new A, A+, A++ and A+++ appliance of similar type and size.

From this information it was possible to assess whether the electricity consumption of the recycled appliances was any higher than when they were new (i.e. if there was a falloff in performance over time) and if they used substantially more energy than current appliances. This information could then be used to help decide if it would not be beneficial to recommend that older appliances are re-used rather than recycled.

One cabinet out of the 28 was removed from the tests as it was found to no longer work when tested. Manufacturer data associated with eight appliances was not available on the GfK Etilize database, but data on three appliances was found by searching websites. Manufacturer consumption data could not be found for the remaining five appliances and so these appliances were not be included in the analysis.

3 Results

3.1 Measured energy consumption compared to manufacturer's figures

Figure 1 shows the manufacturer reported annual energy consumption of all the appliances tested, and compares it to the energy consumption in the tests carried out. Of the 22 appliances tested, 18 (82%) of the appliances used more energy than was claimed when they were manufactured. Three (14%) of the appliances used less energy than claimed, and one appliance (5%) used almost identical energy to that claimed when new. Table 1 shows the number and percentage of appliances that used more than, or less than, the energy use claimed when new by the manufacturer.

The results were divided by appliance type: freezer; fridge (sometimes referred to as chiller); fridge with an ice-box; or fridge-freezer, and the results are presented in Figure 2. Only one ice-box appliance was included in the analysis and therefore there were insufficient data points to provide any meaningful results. The energy consumed by the freezers tested tended to be more similar to the original energy claimed by manufacturers than was found for fridges or fridge-freezers. This may be because freezers are used less and moved less frequently, and so are less likely to exhibit problems such as a loss of refrigerant that would not have been identified in the original stage 1 checks. One fridge used considerably more energy than claimed by the manufacturer. It was possible that the appliance had lost some refrigerant as the compressor operated 100% of the time and the minimum temperature achieved in testing was 8 °C (which is higher than would be considered 'normal').

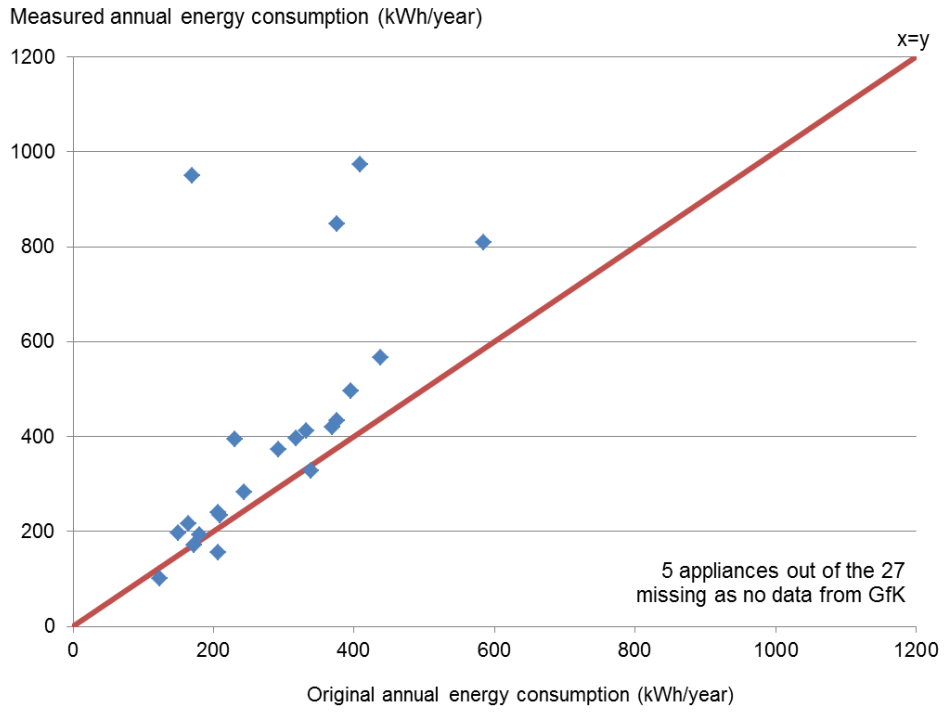


Figure 1. Energy consumption of the appliances when new (manufacturer data) and when tested

Table 1. Number and percentage of appliances using more or less energy when tested than when new

	% of appliances	No. of appliances
Used 20% or less energy than when new	5%	1
Used 15% or less energy when tested than when new	9%	2
Used 10% or less energy when tested than when new	9%	2
Used 5% or less energy when tested than when new	9%	2
Used less energy when tested than when new	**14%**	**3**
Almost identical energy to new when tested	**5%**	**1**
Used more energy when tested than when new	**82%**	**18**
Used 5% or more energy when tested than when new	82%	18
Used 10% or more energy when tested than when new	68%	15
Used 15% or more energy when tested than when new	68%	15
Used 20% or more energy when tested than when new	55%	12
Used 25% or more energy when tested than when new	45%	10
Used 30% or more energy when tested than when new	32%	7
Used 35% or more energy when tested than when new	23%	5
Used 40% or more energy when tested than when new	18%	4
Used 50% or more energy when tested than when new	18%	4
Used 60% or more energy when tested than when new	18%	4
Used 70% or more energy when tested than when new	18%	4
Used 80% or more energy when tested than when new	14%	3
Used 90% or more energy when tested than when new	14%	3
Used 100% or more energy when tested than when new	14%	3

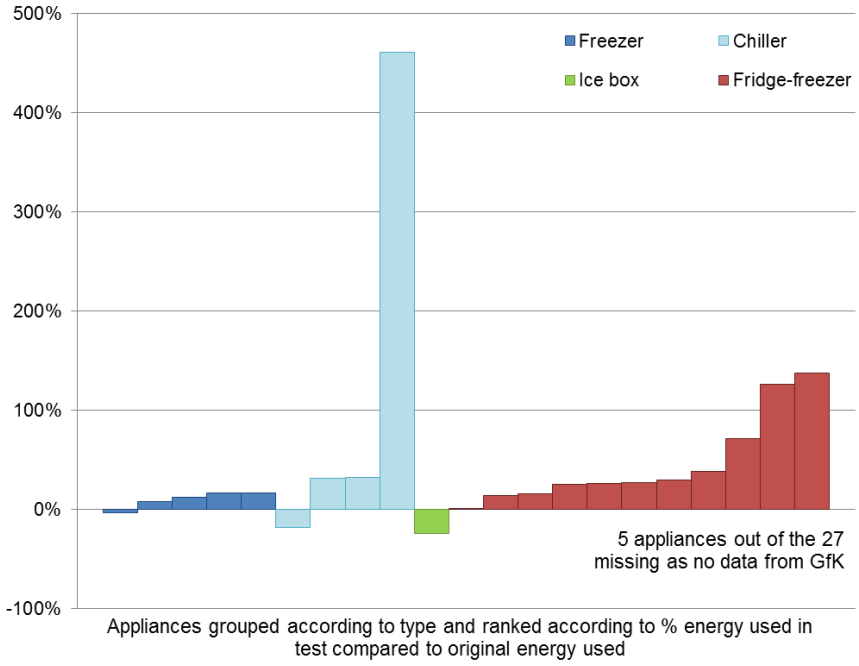


Figure 2. Comparison between the manufacturer reported energy consumption and in the test carried out by RD&T, split by appliance type

3.2 Measured energy consumption compared to current appliances

The energy consumed by tested appliances was compared to current appliances available on the market. This was achieved through calculating the AEC (Annual Energy Consumption) range for current A, A+, A++ and A+++ appliances for a given equivalent volume, which were then plotted against each other. The equivalent volume of the appliances tested and their AEC were then superimposed onto the graphs to compare current appliance performance with the appliances tested.

The equivalent volume (V_{eq}) of a household refrigerating appliance is the sum of the equivalent volumes of all compartments and is calculated using the following formula:

$$V_{eq} = \left[\sum_{c=1}^{c=n} V_c \times \frac{(25 - T_c)}{20} \times FF_c\right] \times CC \times BI$$

Where:

n is the number of compartments

V_c is the storage volume of the compartments

T_c is the nominal temperature of the compartments

FF_c, CC and BI are the volume correction factors for frost free, climate class (T or ST) and built in appliances respectively.

For the analysis the appliances were divided into fridges, freezers and fridge-freezers (which included the ice-box appliances) (Figure 3, Figure 4 and Figure 5 respectively). Only one of the fridges, two of the freezers and two of the fridge-freezers that were tested, were better than or equal to current A rated appliances. None of the appliances tested were better than a current A+ appliance.

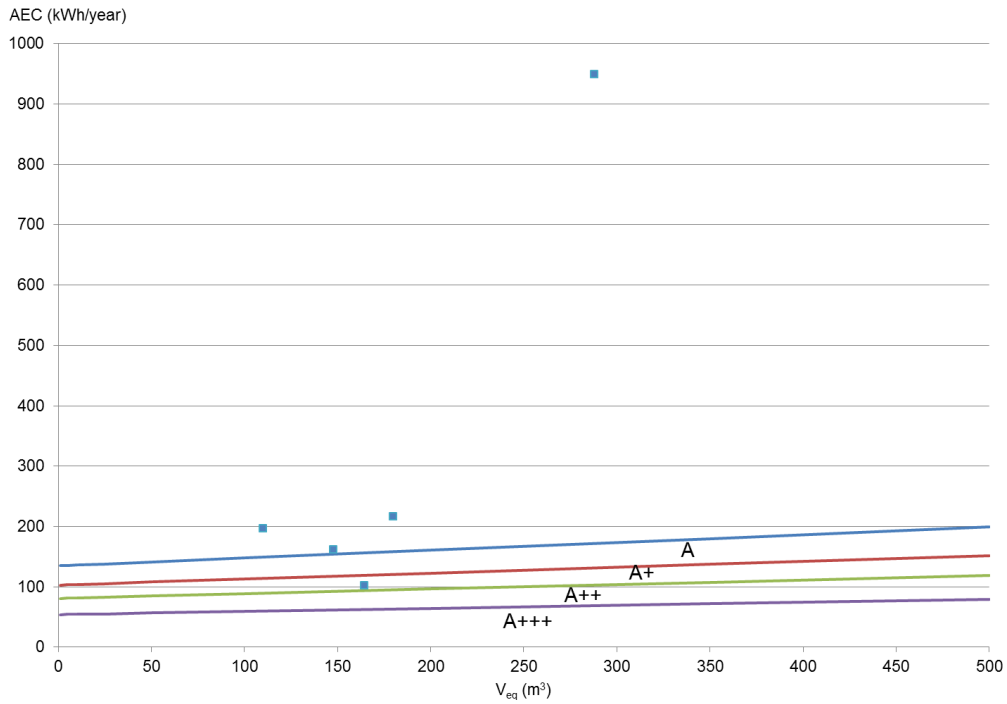


Figure 3. Equivalent volume against AEC for current A, A+, A++ and A+++ fridge appliances compared to the appliances tested

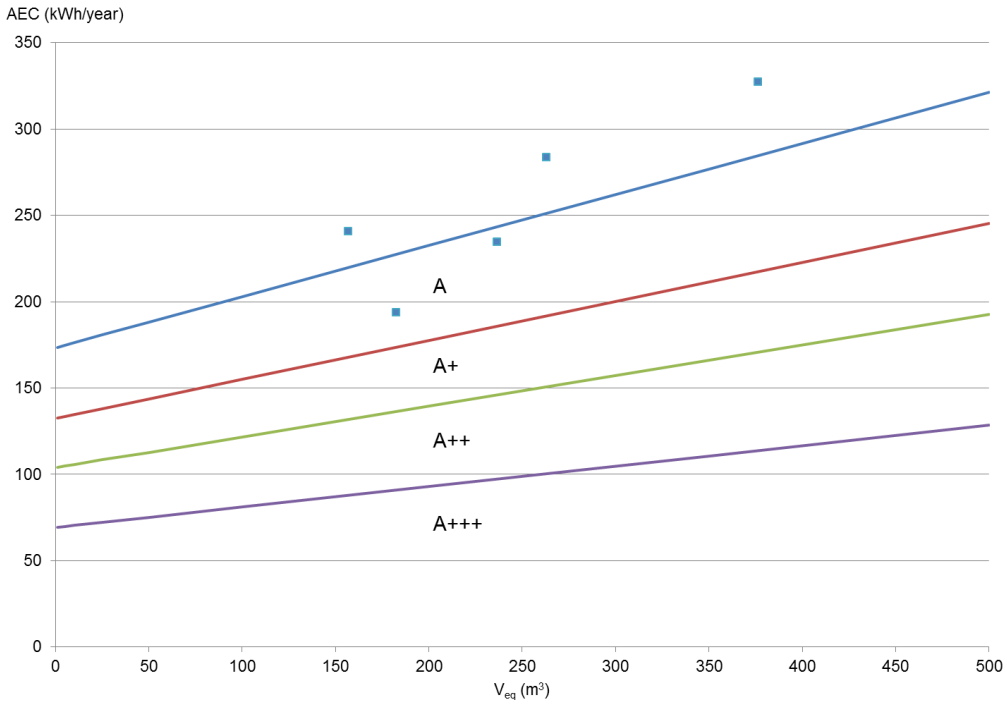


Figure 4. Equivalent volume against AEC for current A, A+, A++ and A+++ freezer appliances compared to the appliances tested

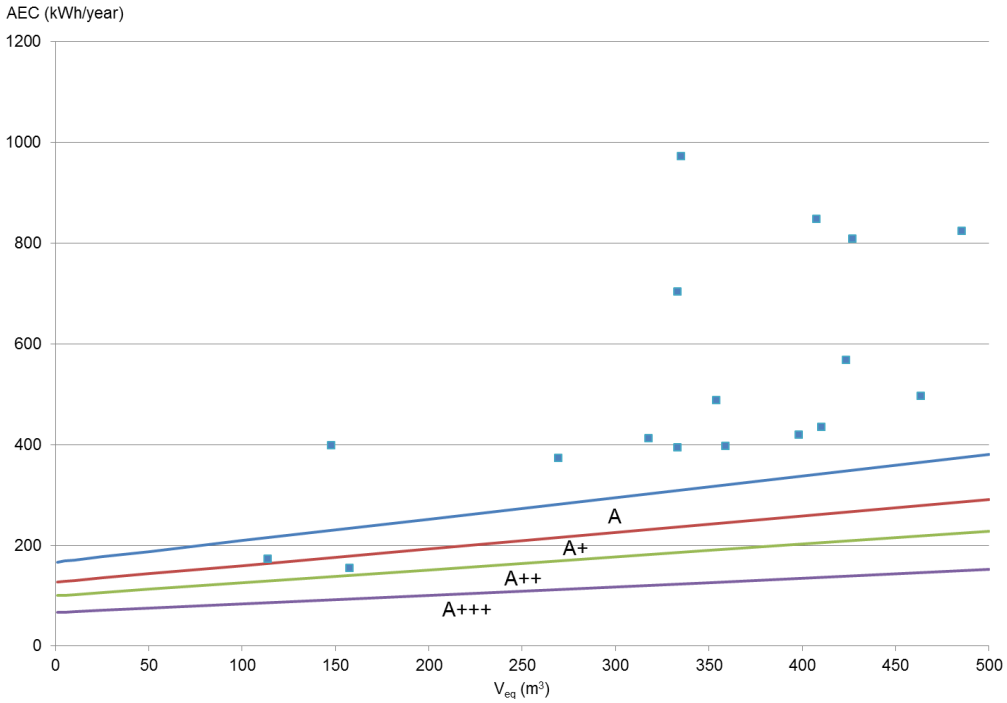


Figure 5. Equivalent volume against AEC for current A, A+, A++ and A+++ fridge-freezer appliances compared to the appliances tested

4 Conclusions

This project has examined cold appliances, originally scheduled for recycling, to determine how their current consumption compares to the declared consumption when they were new. It was possible to compare data from a total of 22 appliances. These were working appliances (and in principle suitable for re-use), with available consumption data from the manufacturer.

Of these 22 appliances:

- 18 appliances used more energy when tested than the manufacturer's reported data; one appliance used almost identical energy and three appliances used less energy.
- It appeared that the energy used by freezers (compared to other appliance types) tended to increase less over time.
- Some appliances consumed at least double the energy compared with the reported energy use by the manufacturer.
- Compared to current appliances only one of the fridges, two of the freezers and two of the fridge-freezers were better than or equal to a current A rated appliance. None of the appliances tested were better than a current A+ appliance.

From these investigations we are able to draw some potential policy implications relating to re-use of older appliances. In particular:

1) The investigations reveal the potential for some recycled appliances (even if apparently working, and in good condition) to consume significantly greater than their declared levels of consumption by the manufacturer.
2) The energy consumption of the recycled appliances is generally greater than the consumption of an equivalent new appliance.

It is recommended, therefore, that particular care is taken to identify potentially high consuming re-used appliances, and consideration should be given to the overall energy efficiency of re-used appliances. As these results indicate, it is generally not possible to do this simply from the general appearance of the appliance and an operational test of the appliance is likely to be required.