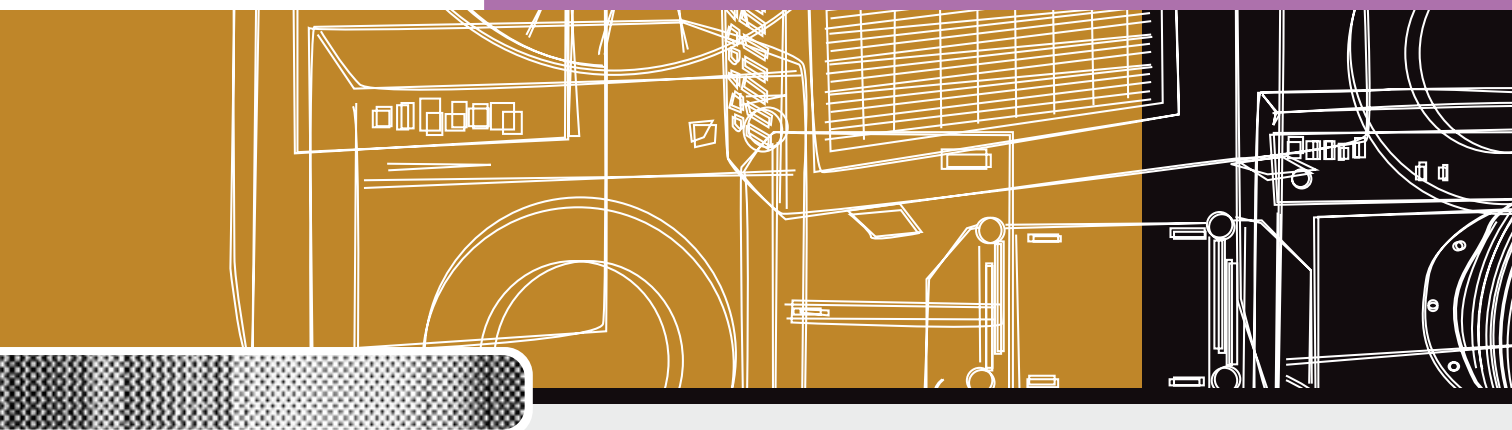


*NATIONAL APPLIANCE AND EQUIPMENT  
ENERGY EFFICIENCY PROGRAM*

*APPLIANCE STANDBY POWER CONSUMPTION:  
STORE SURVEY 2002*



*June 2002*

PREPARED BY ENERGY EFFICIENT  
STRATEGIES AND ENERGYCONSULT,  
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# CONTENTS

<b>Introduction</b>	<b>5</b>
Background	5
Definition of “Standby”	5
Aims & objectives	6
Research Methods	6
<b>Results</b>	<b>9</b>
Overview	9
Product Profiles	10
<b>References</b>	<b>52</b>

## INDEX OF TABLES

Table 1 – A summary of modes tested by appliance	7
Table 2 – A summary of air conditioner results	10
Table 3 – A summary of clothes dryer results	12
Table 4 – A summary of clothes washer/dryer results	13
Table 5 – A summary of dishwasher results	13
Table 6 – A summary of washing machine results	15
Table 7 – A summary of breadmaker results	16
Table 8 – A summary of dustbuster results	17
Table 9 – A summary of microwave results	20
Table 10 – A summary of computer results	21
Table 11 – A summary of computer monitor results	23
Table 12 – A summary of printers – inkjet: results	24
Table 13 – A summary of printers - laser results	25
Table 14 – A summary of scanner results	27
Table 15 – A summary of computer speaker results	28
Table 16 – A summary of television results	29
Table 17 – A summary of LCD TV results	32
Table 18 – A summary of projection TV results	32
Table 19 – A summary of TV/VCR results	34
Table 20 – A summary of VCR results	35
Table 21 – A summary of DVD player results	37
Table 22 – A summary of integrated stereo results	40
Table 23 – A summary of portable stereo results	42
Table 24 – A summary of amplifiers results	44
Table 25 – A summary of compact disc results	46
Table 26 – A summary of stereo receiver results	48
Table 27 – A summary of stereo tape deck results	49
Table 28 – A summary of stereo tuner results	49
Table 29 – A summary of surround sound amplifier results	50



# Index of Figures

Figure 1 – Power measurements for air conditioners: off mode	11
Figure 2 – Power measurements for clothes dryers: off mode	12
Figure 3 – Power measurements for dishwashers: off mode	14
Figure 4 – Power measurements for washing machines: off mode	16
Figure 5 – Power measurements for breadmakers: off mode	17
Figure 6 – Power measurements for dustbusters: active standby mode	18
Figure 7 – Power measurements for dustbusters: passive standby mode	18
Figure 8 – Power measurements for microwaves: passive standby mode	20
Figure 9 – Power measurements for computers: off mode	22
Figure 10 – Power measurements for monitors: off mode	23
Figure 11 – Power measurements for printers inkjet: passive standby mode	25
Figure 12 – Power measurements for printers inkjet: off mode	25
Figure 13 – Power measurements for printers - laser: passive standby mode	26
Figure 14 – Power measurements for scanners: passive standby mode	27
Figure 15 – Power measurements for televisions: in-use mode	29
Figure 16 – Power measurements for televisions: passive standby mode	30
Figure 17 – Power measurements for televisions: off mode	30
Figure 18 – Trends in passive standby for televisions	31
Figure 19 – Power measurements for projection televisions: in-use mode	33
Figure 20 – Power measurements for projection televisions: passive standby mode	33
Figure 21 – Power measurements for VCR: active standby mode	35
Figure 22 – Power measurements for VCR: passive standby mode	36
Figure 23 – Trends in passive standby for VCRs	36
Figure 24 – Power measurements for DVD players: active standby mode	38
Figure 25 – Power measurements for DVD players: passive standby mode	38
Figure 26 – Power measurements for DVD players: off mode	39
Figure 27 – Power measurements for integrated stereos: active standby mode	41
Figure 28 – Power measurements for integrated stereos: passive standby mode	41
Figure 29 – Power measurements for portable stereos: active standby mode	43
Figure 30 – Power measurements for portable stereos: passive standby mode	43
Figure 31 – Power measurements for amplifiers: in use mode	45
Figure 32 – Power measurements for amplifiers: off mode	45
Figure 33 – Power measurements for compact discs: active standby mode	47
Figure 34 – Power measurements for compact discs: off mode	47
Figure 35 – Power measurements for surround sound amplifiers: in use mode	50
Figure 36 – Power measurements for surround sound amplifiers: passive standby mode	51
Figure 37 – Power measurements for surround sound amplifiers: off mode	51

# INTRODUCTION

## Background

In recent years, the increase in energy consumption from appliances not being used for their primary purpose (or in “standby” mode) has become a major concern in terms of the potential contribution to greenhouse gas emissions.

In order to more accurately quantify the contribution “standby” power makes to greenhouse gas emissions in Australia, the Australian Greenhouse Office (AGO) and the National Appliance & Equipment Energy Efficiency Committee (NAEEEC) commissioned the report, *Quantification of Residential Standby Power Consumption in Australia* (Harrington and Kleverlaan, 2001). This study, conducted in late 2000, provides results of an intrusive survey where measurements on 2,500 appliances were undertaken in 64 houses in Melbourne, Sydney and Brisbane. The report also includes results of power measurements on 531 new appliances in retail outlets and results of a national telephone survey of 801 households in Australia which documents information on appliance ownership, age and usage patterns.

This research revealed that 11.6% of Australia’s household electricity consumption is attributed to energy used by appliances and electronic equipment when not performing their primary function (this figure includes some small continuous loads not traditionally classified as “standby”). This “standby” consumption was estimated in 2000 to be costing Australians more than \$500 million per year and generating more than 5 million tonnes of carbon dioxide per annum.

In addition to providing a more accurate estimation of the extent of power consumption from appliances in standby, the study revealed the need for ongoing research to monitor the change in standby consumption of new appliances.

NAEEEC has commissioned this survey of new appliances offered for sale in retail outlets to collect information on trends in standby power in Australia. Field work for this report was conducted in early 2002 and initial comparisons have been made with similar data collected in early 2001. NAEEEC has agreed to conduct similar surveys over the coming years to track industry progress in meeting standby targets.

## Definition of “Standby”

Appliances and equipment with a “standby mode” may include any household product which consumes power while not performing its primary function. A simple definition of “standby” is when an appliance is at its lowest power consumption when connected to mains power, even if the appliance is turned off (lowest power mode that can be influenced by the user). However, “standby” is better defined under various modes and for the purpose of this research, standby modes were defined as follows:

### OFF

When a product or appliance is connected to a power source but does not produce any sound or picture, transmit or receive information or is waiting to be switched “on” by the consumer. If the product has a remote control, it cannot be woken by the remote control from off mode. While the product may be doing some internal functions in off mode (eg memory functions, EMC filters) these are not obvious to the user.

### PASSIVE STANDBY

When a product or appliance is not performing its main function but it is ready to be switched on (in most cases with a remote control) or is performing some secondary function (eg has a display or clock). This mode also applies to power supplies for battery operated equipment (portable appliances which are intended to be used when disconnected from the base station) when the appliance is not being charged.

### ACTIVE STANDBY

Active standby is mostly applicable to VCRs and some stereo equipment where operating involves some mechanical drive (DVD and CD players, tape players). Active standby is when the appliance on but not performing its main function. For example, the VCR may be on but is not playing or recording. This mode also applies to power supplies for battery operated equipment (portable appliances) when the appliance is being charged (various sub-modes).



## Aims & objectives

The Australian Greenhouse Office (AGO) and the National Appliance & Equipment Energy Efficiency Committee (NAEEC) commissioned this research as part of its program to reduce the standby consumption of all electronic appliances to less than 1W. This research was primarily undertaken to monitor changes in standby power consumption from the results of research undertaken in 2001.

The main objectives of this survey were to:

- Quantify the magnitude of electricity used in standby mode by new appliances offered for sale in the Australian market in early 2002.
- Compare the results of this study with those from the 2001 in store survey in order to track the industry's progress in reducing standby power consumption.

Similar studies are proposed in future years to assess progress towards the 1 Watt target.

## Research Methods

### EQUIPMENT AND PREPARATION

The meter used for measuring appliance energy usage was a Yokogawa<sup>1</sup> digital power analyser Model WT200.

<sup>1</sup> Calibrated in February 2002. Fundamental power accuracy of 0.2%.

Two major Melbourne retail stores were approached to take part in the study, which allowed measurements of a large range of appliances, across a number of manufacturers to be taken. The metering device was systematically plugged into the floor stock across 27 appliances categories. There was no selection process, with all available stock on display in the store being measured. The reasons for some appliances not being measured as part of this survey were as follows:

- Appliance power cord missing;
- European or US power cord;
- Appliance difficult to access without disturbing the store display (this was particularly the case for some home cinema displays and plasma TVs);
- No display model available at the time;
- Appliance locked in cabinets for security reasons.

Appliance brand and model number were recorded to prevent duplication of measurements.

For each appliance, power consumption was measured while the appliance was in use, in standby (passive and/or active) and off, where applicable. Clearly for many appliances such as washing machines and dishwashers, it was impractical to measure the appliance in use. "In use" mode is covered adequately by the relevant Australian Standard for most of these products.



Other information recorded during measurements included power factor, crest factor and supply voltage.

Power factor traditionally means any phase shift between a sinusoidal voltage supply waveform and a sinusoidal current waveform (power factor is 1.0 when these are perfectly aligned). However, in the case of standby measurements where the current waveform is often distorted and non-sinusoidal in shape, the power factor is the ratio of the active power (Watts) to the average VA (volt-amps). The power factor is a measure of how much of the current is performing useful work (contributing to active power use). Values for power factor are low <0.5, moderate 0.5-0.8, high >0.8-1.0.

The crest factor is defined as the ratio of peak current to RMS current (or peak voltage to RMS voltage). For a pure sinusoidal waveshape the crest factor is 1.414, while for a pure constant DC load the crest factor is 1.0. The parameter of particular concern from a metering perspective for standby power is current and its waveform. During the measurement, it is critical that the crest factor available on the meter is greater than the actual crest factor of the load, otherwise the peak value of the current will be "lopped off". Note that the current crest factors for standby loads are typically 3 and can be as high as 10 in some circumstances. Crest factor is a measure of the level of distortion of the current waveform (and the difficulty in performing an accurate power measurement). Values for crest factor are low <2.5, moderate 2.5-4, high >4.

Table 1 – A summary of modes tested by appliance

Appliance List	In Use	Active Standby	Passive Standby	Off
Air Conditioner			✓	✓
Breadmaker		✓		✓
Computers				✓
Dishwasher				✓
Dryer				✓
Dustbuster *		✓	✓	
DVD Player		✓	✓	✓
Microwave			✓	
Monitor	✓			✓
Printer			✓	✓
Scanner			✓	✓
Stereo - Amplifier	✓		✓	✓
Stereo - CD Player		✓	✓	✓
Stereo - Integrated	✓		✓	✓
Stereo - Portable	✓		✓	✓
Stereo - Receiver	✓		✓	✓
Stereo - Tape Deck		✓		✓
Stereo – Tuner	✓		✓	✓
Surround Sound Amplifier			✓	✓
TV	✓		✓	✓
TV – LCD	✓		✓	✓
TV – Plasma	✓		✓	✓
TV – Projection	✓		✓	✓
TV/VCR	✓	✓	✓	✓
VCR		✓	✓	✓
Washer/Dryer				✓
Washing Machine				✓
Mode tested ✓				

Note \*: Battery operated appliance, passive = no battery charging, active = with battery charging.



As indicated in Table 1, appliances were measured in various combinations of in-use, in standby (passive or active, where applicable) and off mode. As previously mentioned it was not always practical to measure appliances in normal use during an in-store survey. The modes measured for each product type reflect the design and operation of the product. While some products types will have passive or active standby modes (eg a dishwasher can be switched on prior to the start of a program – this would be passive standby), not all of these modes were measured or are relevant to this study.

In total 635 products were measured resulting in 1136 measurements being recorded during the survey. These results were analysed and compared with outcomes from the 2001 in-store survey as far as possible. Comparisons with the previous survey are not possible for all groups as the number and type of appliances covered varied.

## **PROBLEMS ENCOUNTERED DURING DATA COLLECTION**

Not all products could be measured in all of the desired modes. For example, security reasons prevented many remote controls being displayed with items. As a result, appliances reliant on remote controls for operation into some modes were unable to be measured across all modes. Other problematic appliances included stereo units, such as integrated stereo equipment, where active standby power varied depending on the part of the unit “waiting to be used”. For example, active standby could be higher for some units when a CD was present (but not playing) within the unit. To overcome the variation in standby measurements for integrated stereo equipment, measurements were taken in CD mode when the unit had finished searching for the disc. In most units a “No Disc” message was displayed. For integrated stereo equipment without a CD player, measurements were taken with the unit set to tuner. Many stereo components did not appear to have an off mode.

## **ACKNOWLEDGEMENTS**

This study was undertaken by Energy Efficient Strategies (Victoria) and EnergyConsult (Victoria) for the National Appliance and Equipment Energy Efficiency Committee. The study was managed for NAEEEC by the Sustainable Energy Group of the Australian Greenhouse Office.

A number of organisations assisted with this project and their cooperation and assistance is gratefully acknowledged. Klaus Neuscheler of Test Research provided valuable advice on metering equipment. We would like to particularly thank management and staff of the following Melbourne stores:

- Myer Megamart, Sunshine;
- Newton's Retravision, Footscray.

The study was coordinated by Paula Kleverlaan of EnergyConsult with support from Lloyd Harrington of Energy Efficient Strategies. Melissa and Leo Damnics of EnergyConsult were responsible for undertaking field measurements on appliances and the recording of data. Paul Ryan of EnergyConsult was responsible for setting up the data collection instrument used in the field and subsequent data analysis software. Lloyd Harrington and Paula Kleverlaan conducted additional analysis of data from previous standby surveys. Melissa Damnics, Lloyd Harrington and Paul Kleverlaan were responsible for the preparation of the main report. Dianne Glass of EES formatted and typeset the final report.

Notwithstanding the many individuals and organisations that have assisted during this project, the content and form of this report, and all of the views, conclusions and recommendations expressed in it, are those of Energy Efficient Strategies and EnergyConsult.

# RESULTS

## Overview

The following 27 appliance types were tested during the 2002 in store survey:

- Air Conditioner
- Breadmaker
- Computers
- Dishwasher
- Dryer
- Dustbuster
- DVD Player
- Microwave
- Monitor - Computer
- Printers
- Scanner
- Speakers - Computer
- Stereo - Amplifier
- Stereo - CD player
- Stereo - Integrated
- Stereo - Portable
- Stereo - Receiver
- Stereo - Tape Deck
- Stereo - Tuner
- Surround Sound Amplifier
- TV
- TV - LCD
- TV - Projection
- TV/VCR
- VCR
- Washer/Dryer
- Washing Machine

The survey had also intended to measure CD writers, mobile phones and modems but found that for security reasons these items were displayed in locked cabinets and in the case of mobile phones, usually without chargers. Portable electric heaters were also to be measured, however these items are only stocked on a seasonal basis and were not in stores during the survey (summer).

The following sections details the results by appliance type.

## Product Profiles

### MAJOR APPLIANCES

#### AIR CONDITIONERS

A total of 20 air conditioner units were measured; 6 were window-wall models and the other 14 portable appliances. Seven of the portable units used evaporative cooling.

The in store survey measured air conditioners in off mode only. The majority of these appliances had an off switch on the unit, with very few having remote operation. The average power consumption in off mode was 0.4W with 1.9W being the highest and 0.0W the lowest. The units measured demonstrated low power factor and low crest factor with the averages measured at 0.37 and 1.66 respectively. The results for air conditioners are summarised in Table 2 below.

Figure 1 indicates that when in off mode a majority of air conditioners have zero energy consumption. Of the 40% shown to consume energy in off mode most were less than 1W.

Air conditioning units were not measured in the 2001 in store survey.

An important point to note regarding air conditioners is that the most popular type of air conditioners are split systems (many of this type use remote controls and will therefore have some standby) and almost all are “hard wired”, so in-store measurements were not possible. Lab measurements (e.g. during energy labelling and MEPS tests) will be necessary to collect data.

The intrusive survey in 2000 measured off mode data for 9 air conditioners installed in residential houses (most were window wall units – split systems were inaccessible). Average off mode power for these models was 0.1W.

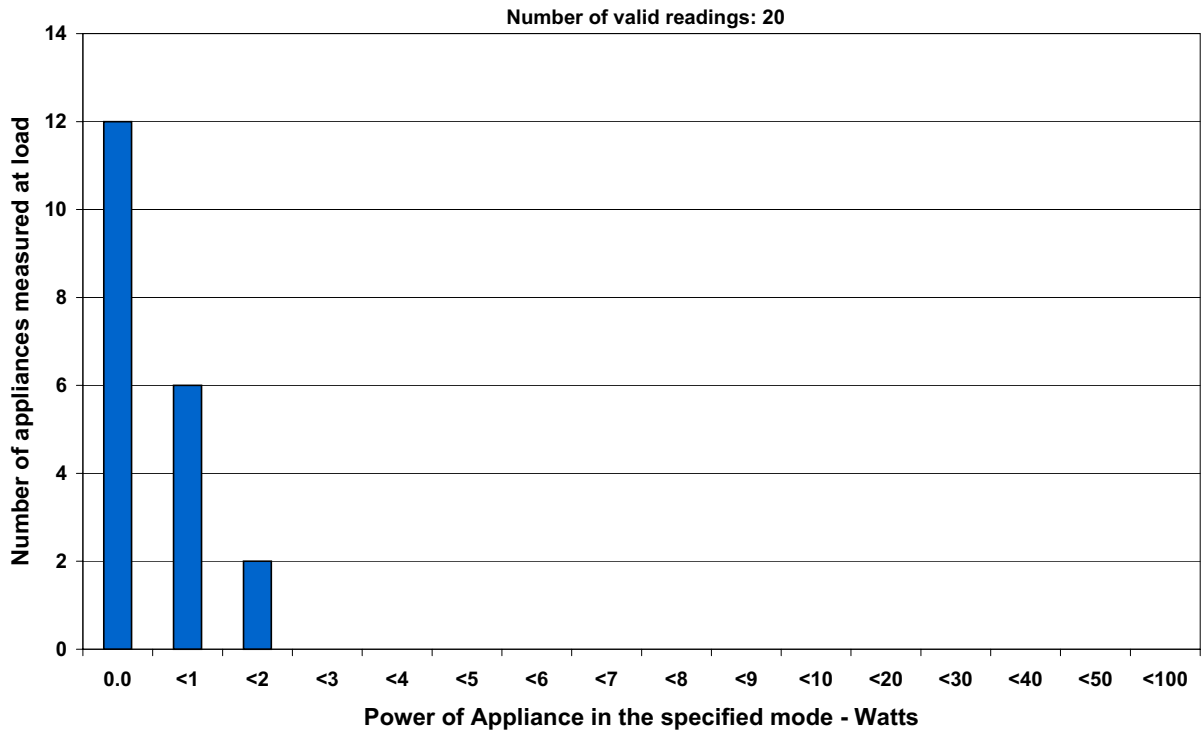
Table 2 – A summary of air conditioner results

Appliance: Mode	Air Conditioner Number of Measurements	Average Power (watts)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	20	0.4	0.37	1.66	1.9	0.0
<b>Total Number of Units</b>	20					

Unfortunately, in-store measurements were not possible for split system air conditioners



Figure 1 – Power measurements for air conditioners: off mode



Note: All histograms included in this report use the same bin definitions. The first bin indicates the number of units with no power consumption in the mode specified (i.e. equal to 0.0 Watts, or effectively less than 0.05 Watts in terms of metered data). The second bin is the number of appliances with >0.0 Watts but less than 1.0 Watts. The third bin is the number of appliances with greater than or equal to 1.0 Watts and less than 2.0 Watts and so on. Note that bin sizes for > 10 Watts are non linear.

### CLOTHES DRYERS

The survey measured 16 clothes dryers in total. These appliances were measured in off mode only. The average power consumption was 0.3W with the maximum reading being 2.6W and the minimum zero. The average power factor was a low 0.2 and the average crest factor was also low measured at 1.8. Table 3 below summarises the results for clothes dryers.

The 2001 in store survey found clothes dryers to have an average consumption of 1.2W compared with 0.3W in 2002. In 2001, the range of results was

similar with measurements occurring between 0.0W to 2.9W and 2002 spanning 0.0W to 2.6W. However it would be unrealistic to make any assertions regarding trends when comparing results due to the small sample (7 units in 2001 and 16 units in 2002). The results have not been sales weighted for brand share.

The intrusive survey in 2000 measured off mode data for 35 clothes dryers installed in residential houses. Average off mode power for these models was 0.4W. There is no obvious trend when this data is considered with store data.

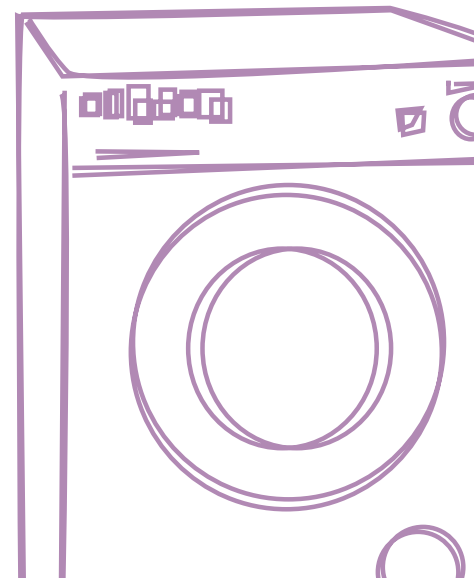
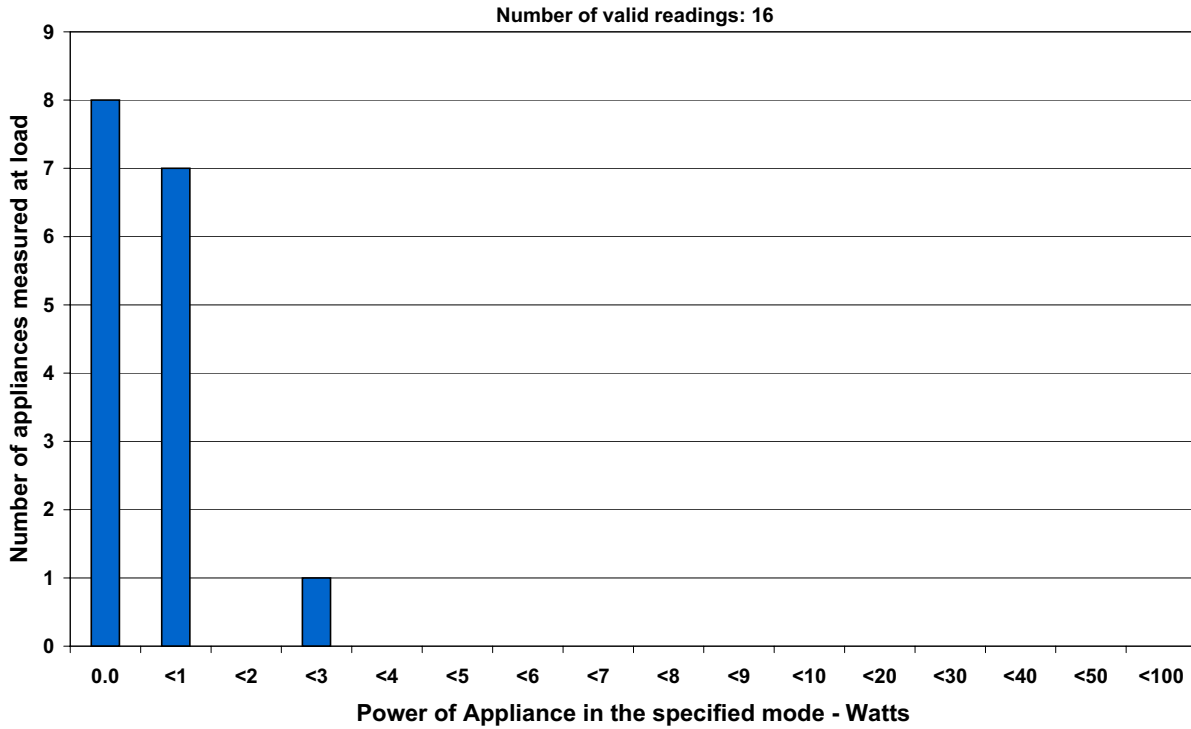


Table 3 – A summary of clothes dryer results

Appliance:	Dryer					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	16	0.3	0.23	1.81	2.6	0.0
<b>Total Number of Units</b>	16					

As presented in Figure 2 below the vast majority of clothes dryers consume less than 1W in off mode. 50% of units measured consume zero energy when in off mode and only one model consumed greater than 2W.

Figure 2 – Power measurements for clothes dryers: off mode



## CLOTHES WASHER/DRYERS

Clothes washer-dryers are units that are capable of both washing and drying clothes in single or separate cycles. A total of 2 washer-dryers from different manufacturers were tested in this survey. Both models were front loaders with a power on/off switch. They were tested in off mode only. Both machines recorded 0.1W power consumption when in off with a low average power factor of 0.02 and a low average crest factor of 1.3. A summary of these results can be found in Table 4.



Table 4 – A summary of clothes washer/dryer results

Appliance:	Washer/Dryer					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	2	0.1	0.02	1.30	0.1	0.1
<b>Total Number of Units</b>	2					

## DISHWASHERS

During the survey 42 dishwashers were measured. The operating controls on the dishwashers varied, with some having mechanical dials while others had soft touch electronic controls. A small minority of units did not have a power on/off button.

These appliances were measured only in off mode. Power consumption ranged from 0.0W to 11.3W with the average being 0.8 W. The dishwashers displayed a low average crest factor of 1.7 and a low average power factor of 0.2. Table 5, below summarises the in store results for dishwashers.

Table 5 – A summary of dishwasher results

Appliance:	Dishwasher					
Mode	Number of Measurements	Average Power (watts)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	42	0.8	0.22	1.72	11.3	0.0
<b>Total Number of Units</b>	42					

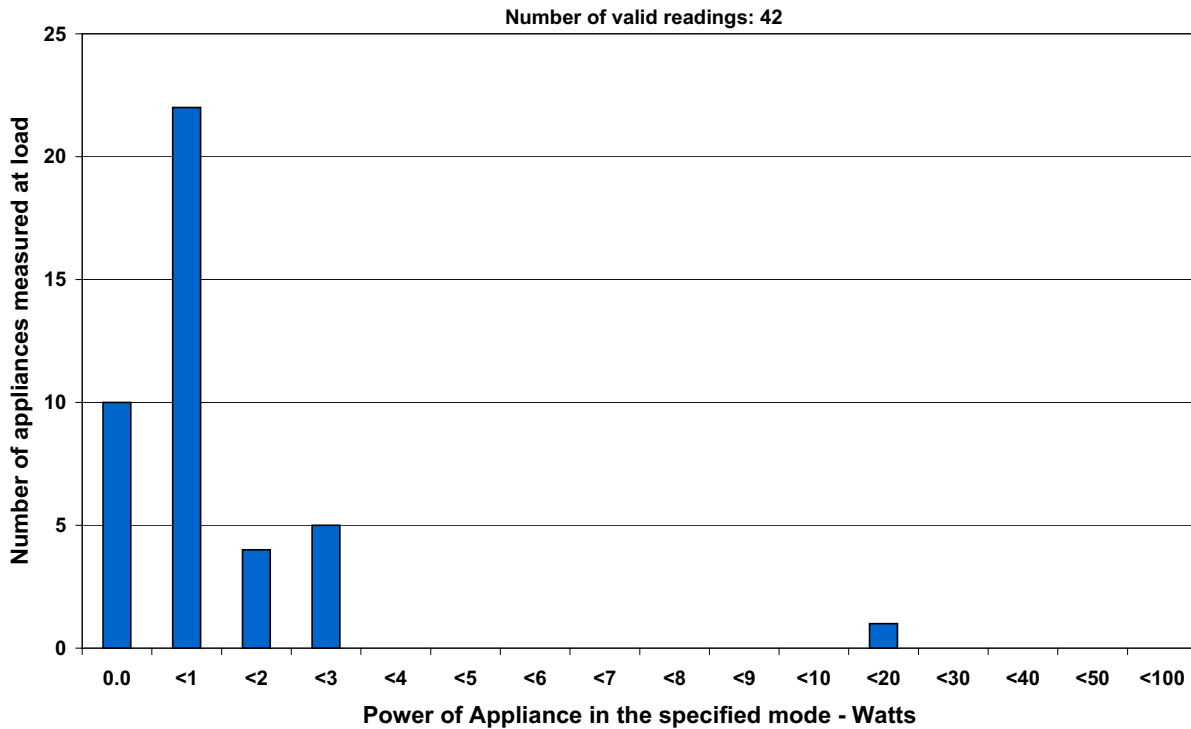
Figure 3 indicates that a large majority of dishwashers use less than 1W when in off mode with a quarter of these recording zero power consumption. While the maximum power consumption recorded was 11.3W, this single unit was the only one greater than 3 watts. With so many dishwashers recording consumption of less than 1W it is reasonable to expect that the higher standby models could be performing better.

Dishwashers were not included in the 2001 in store survey, therefore it is not possible to determine if there are trends occurring in standby power consumption. The results have not been sales weighted for brand share.

The intrusive survey in 2000 measured off mode data for 9 dishwasher installed in residential houses (ownership was higher, but most were very difficult to access when installed in homes as the power outlet is usually behind the machine or in a cupboard). Average off mode power for these models was 0.5W. There is no obvious trend when this data is considered with store data (small intrusive sample size).



Figure 3 – Power measurements for dishwashers: off mode



## WASHING MACHINES

The washing machine category includes both top loading models and front-loading machines. The machines also varied in their rated capacity and some machines had power on/off switches.

In total, 77 washing machines were tested in the store survey. All machines were measured in off mode only. Some machines recorded 0.0W consumption while the maximum power consumption recorded was 25.9W<sup>2</sup>. The average for all the machines was 1.7W. Both average power factor and average crest factor were low at 0.25 and 2.12 respectively. For a summary of these results see Table 6.

As demonstrated in Figure 4 the overwhelming majority of washing machines consume less than 1W when in off mode, with 36% recording zero consumption. These results indicate that the 27% of models that recorded higher consumption, especially those over 7W, should be able to decrease consumption when in off mode.

When compared with the 2001 store survey the average power consumption of washing machines has significantly reduced from 3.8W to 1.7W. However, the 2002 sample is biased towards lower standby models, so the data may be providing a false indication. The results have not been sales weighted for brand share. Care is required when examining this trend as the 2002 sample was nearly 50% front loaders which have generally had a low off mode consumption (typically 0.15W); however front loader sales are less than 15% of total sales. A very large selling brand had a standby of around 9W for all models and this brand was well under-represented in terms of display stock versus known total retail sales.

The intrusive survey in 2000 measured off mode data for 60 clothes dryers installed in residential houses. Average off mode power for these models was 2.0W. The trend appears to be towards increasing standby when the stock and the sales share of the in store surveys are taken into account.

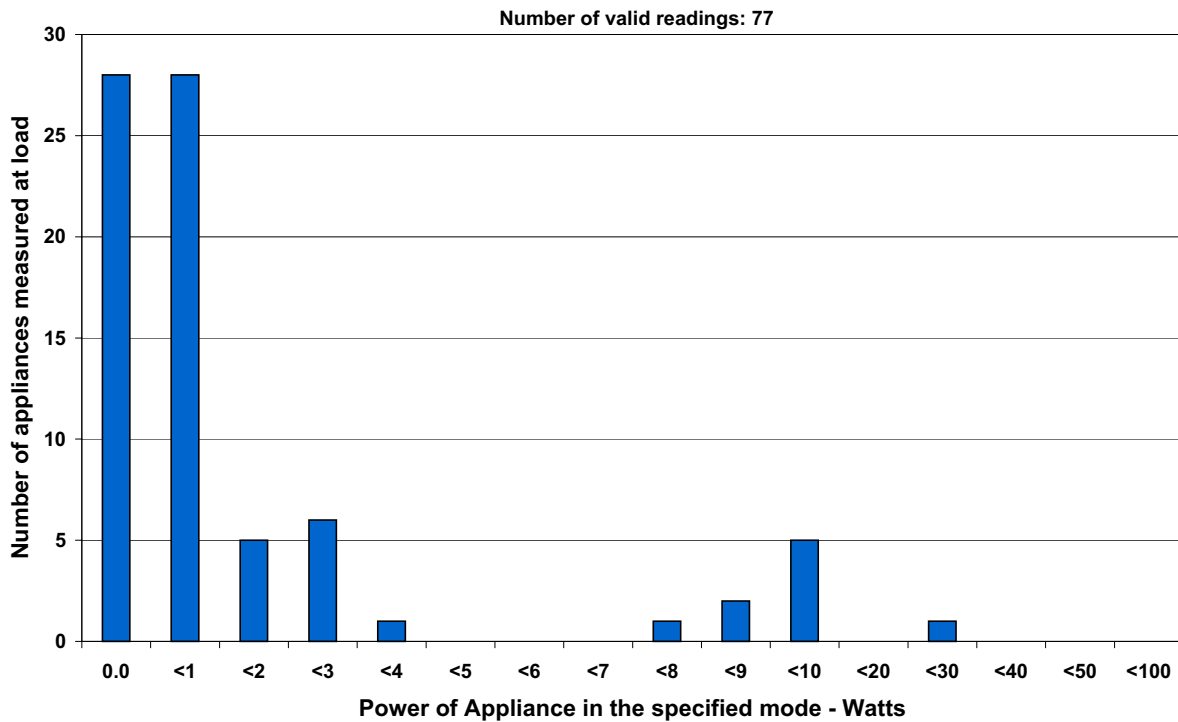
Table 6 – A summary of washing machine results

Appliance:	Washing machine					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	77	1.7	0.25	2.12	25.9	0.0
<b>Total Number of Units</b>	77					

2 This unit had a European plug and was being powered through some kind of inverter/transformer, so is non typical. It is unclear whether this unit would meet electrical safety requirements.



Figure 4 – Power measurements for washing machines: off mode



## SMALL APPLIANCES

### BREADMAKERS

The store survey measured 14 different breadmakers. Most breadmakers are either off or operational (active standby/on) with only one unit having a power on/off button. The units were measured in off mode only. The average power used by breadmakers in off mode was 1.5W with a low of 1.1W and a high of 2.6W. The average crest factor was a low 1.74 with the power factor a low 0.48. Table 7 below summarises the results for breadmakers.

In the 2001 survey the average power consumption recorded for 14 breadmakers was 1.63W in off mode. This indicates that the power consumption for this appliance has remained stable when compared with 1.5W in 2002.

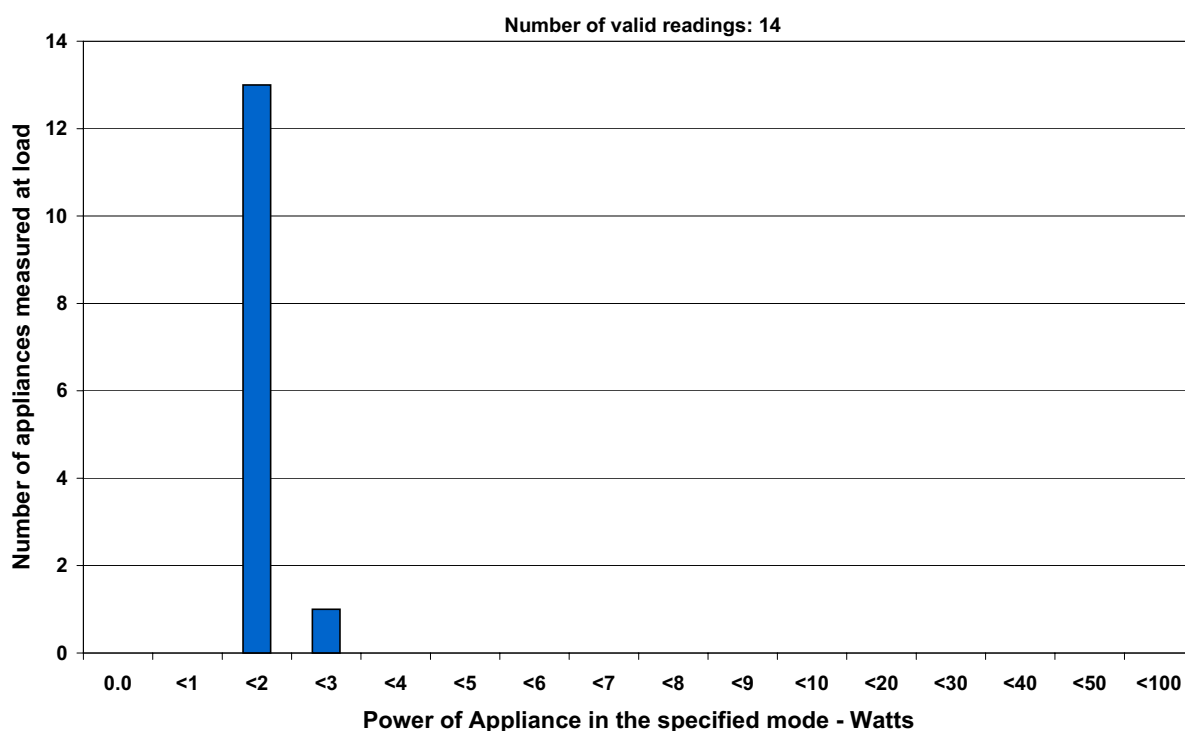
The intrusive survey in 2000 measured off mode data for 11 breadmakers installed in residential houses. Average off mode power for these models was 1.6W. The trend in off mode power consumption appears to be stable.

Table 7 – A summary of breadmaker results

Appliance:	Breadmaker					
Mode	Number of Measurements	Average Power (watts)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	14	1.5	0.48	1.74	2.6	1.1
<b>Total Number of Units</b>	14					

Figure 5 shows the breadmakers measured, excepting one consumed <2W but more than 1W.

Figure 5 – Power measurements for breadmakers: off mode



## DUSTBUSTERS

A total of 9 dustbusters were measured during the in-store survey. The most obvious differences that exist between models are based on size and whether the unit can vacuum wet as well as dry.

The dustbusters were measured in active standby, that is, plugged in and charging, and in passive standby, with the base station plugged in but not charging the portable unit. One unit could not be measured in active standby, as it is also reliant on an internal battery to recharge. This internal

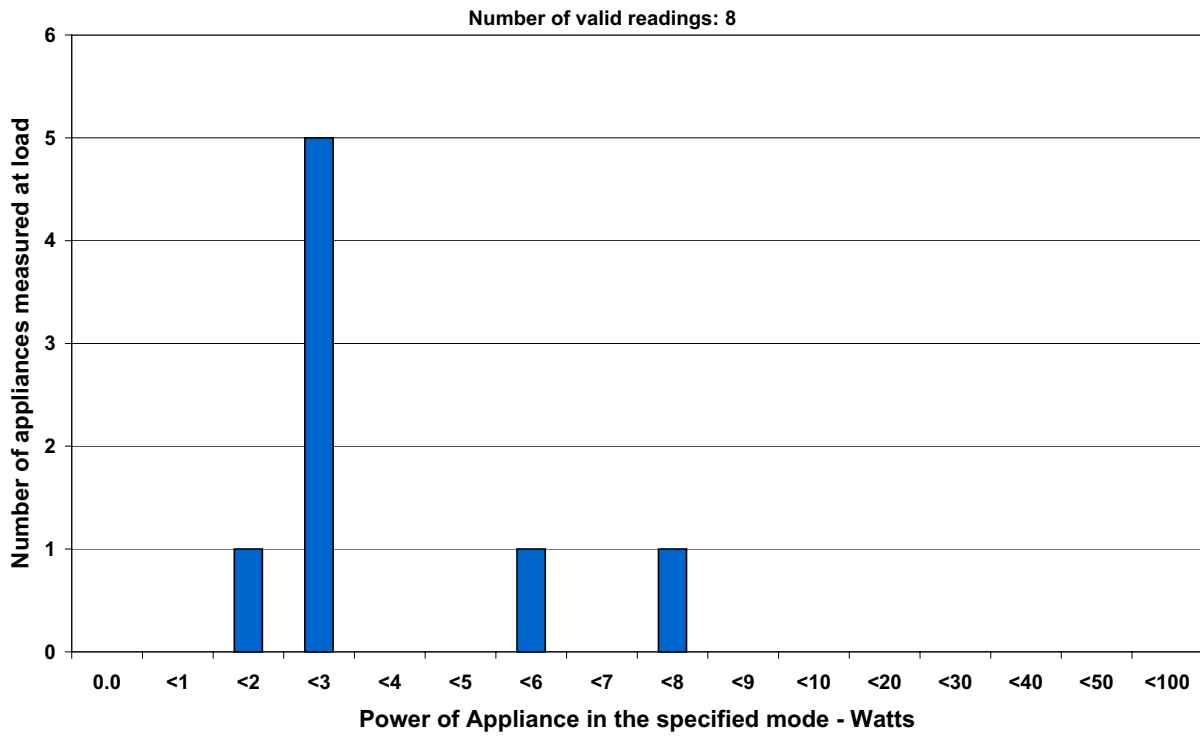
battery was flat. On average the units were found to consume 3.3W when charging, with the maximum consumption of 7.9W and a minimum of 1.1W. In this mode a moderate average power factor of 0.6 and a low crest factor of 1.9 was recorded. When in passive standby the units recorded an average power consumption of 0.9W with a low of 0.7W and a high of 1.5W (standing losses of the low voltage power supply – typically a transformer). Both average power factor and average crest factor were low at 0.27 and 2.0 respectively. These results are summarised below in Table 8.

Table 8 – A summary of dustbuster results

Appliance:	Dustbuster					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	8	3.3	0.61	1.91	7.9	1.1
Passive	9	0.9	0.27	2.01	1.5	0.7
Off	0	NA	NA	NA	-	-
<b>Total Number of Units</b>	9					

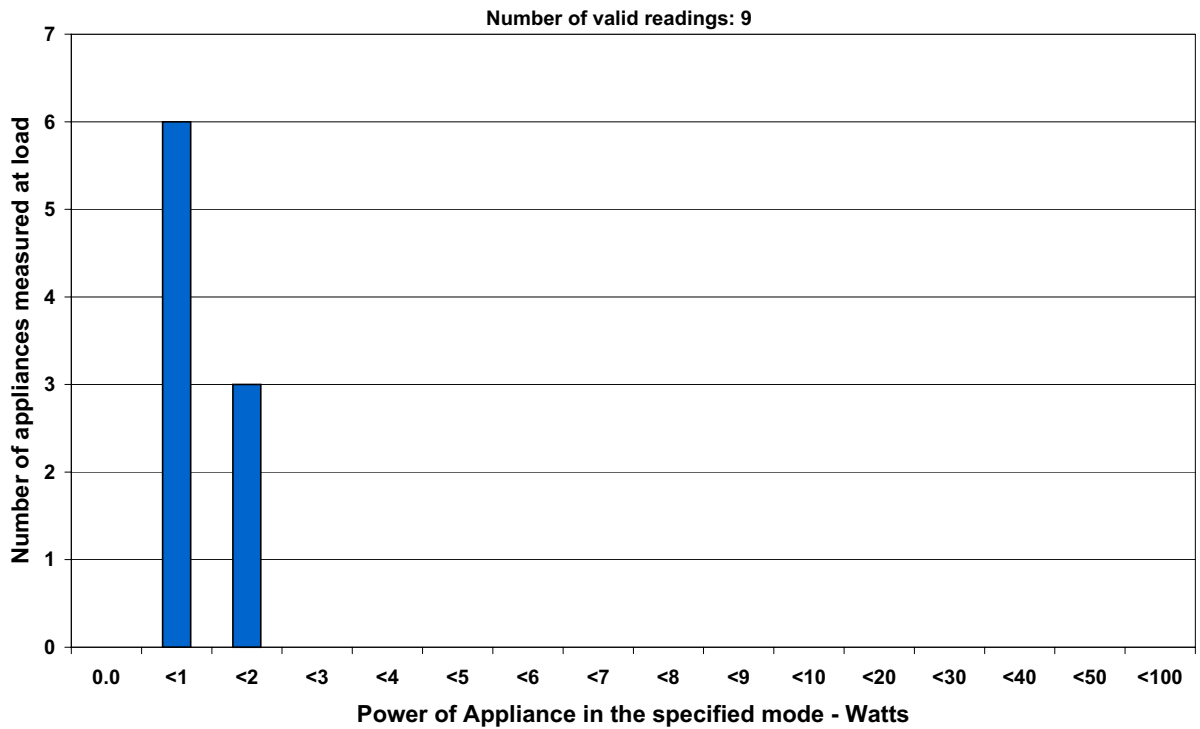
Figure 6, below demonstrates that the majority of dustbusters use less than 3W when in active standby. The two units greater than this consume 5.4W and 7.9W respectively.

Figure 6 – Power measurements for dustbusters: active standby mode



In passive standby mode most dustbusters consumed less than 1W with only 3 units in the less than 2W range. These results are reflected in Figure 7 below.

Figure 7 – Power measurements for dustbusters: passive standby mode



The 2001 in store survey also measured nine dustbusters. The average recorded for active standby was 3.6W and for passive standby was 1.0W. Given the small sample, these figures are very consistent with the 2002 figures indicating the average standby for dustbusters continues to be stable.

The intrusive survey in 2000 measured off mode data for 29 dustbusters installed in residential houses. Average passive standby mode power for these models was 1.3W while the active standby power was 3.3W. The trend in passive and active standby mode power consumption appears to be stable (possibly a slight decline in passive standby).



## MICROWAVE OVENS

A total of 60 microwave ovens were measured during the survey. The majority of microwave ovens had a digital clock display and electronic controls, however a small number relied totally on mechanical controls. The microwaves varied in size and included both combined convection/microwave and microwave only models.

Microwave ovens were measured in passive mode only (even though strictly models with mechanical controls should be classified as off mode). As demonstrated below in Table 9 the average power measured for microwaves was 2.7W with a minimum of 0.1W and a maximum of 6.5W. The average power factor was moderate at 0.56 with a low average crest factor of 1.86.

Figure 8 indicates that 78% of microwave ovens consume between 1W and 4W in passive standby

mode. The 3 ovens used less than 1W had mechanical switches and had no digital clock display.

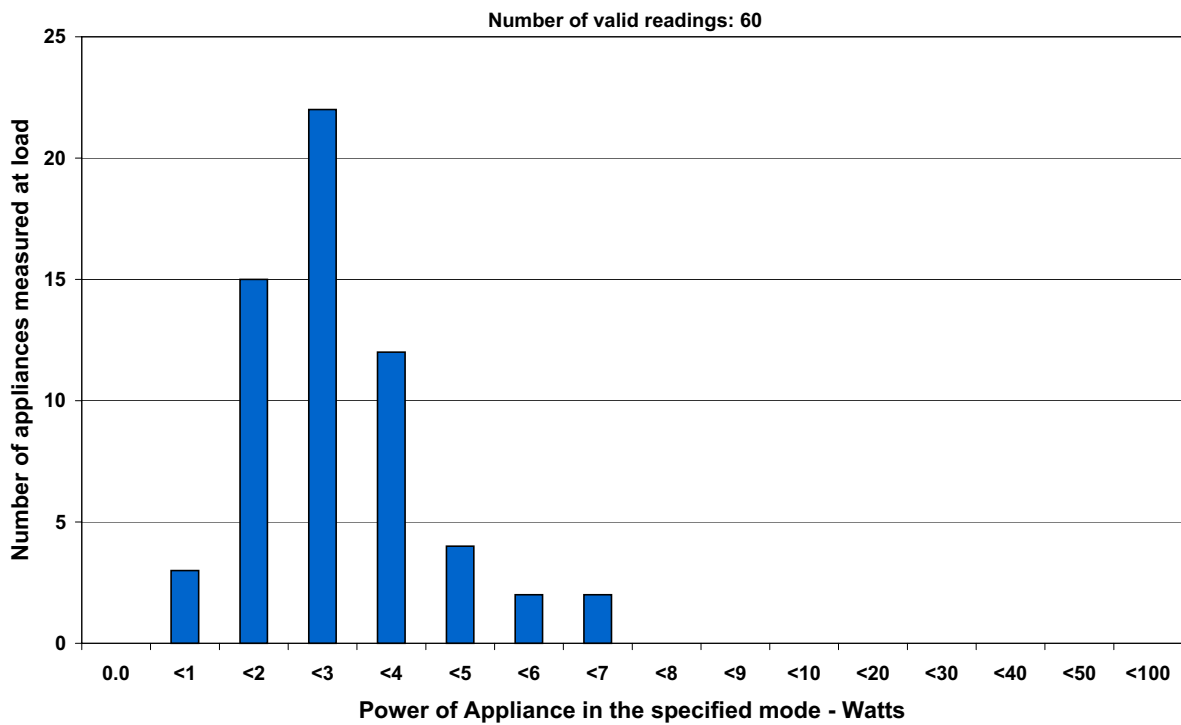
The 2001 store survey also took measurements for 60 microwaves in passive mode. The average power consumption is only slightly lower in 2002 at 2.7W compared to 3.5W in 2001. This would indicate that average passive standby for microwaves is stable (or decreasing slightly) and that there are still no strong trends.

The intrusive survey in 2000 measured off mode data for 44 microwave ovens installed in residential houses. Average passive standby mode power for these models was 3.9W. The trend in passive standby mode power consumption appears to be fairly stable (possibly a slight decline when considering store data with intrusive data).

Table 9 – A summary of microwave results

Appliance:	Microwave					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	60	2.7	0.56	1.86	6.5	0.1
Off	0	NA	NA	NA	-	-
<b>Total Number of Units</b>	60					

Figure 8 – Power measurements for microwaves: passive standby mode



## COMPUTERS AND PERIPHERALS

### COMPUTERS

A total of 14 computers were included in the in store survey. The measurements included only the hard drive/CPU box with peripherals such as monitors and printers measured separately. No portable/ laptops were measured.

Computers were measured in off mode only as active and passive operating modes for computers are complex and are dependent on hardware and software settings. In addition, these modes are adequately covered by existing standby related programs such as Energy Star.

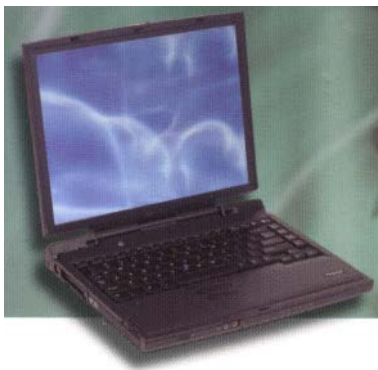
The average off mode power consumption was 3.1W with the highest consuming unit using 5.2W and the lowest using 1.9W. Crest factor and power factor were both low at 2.3 and 0.26 respectively. These results are summarised in Table 10 below.

The 2001 in store survey did not measure computers so no comparison can be made. However it was recognised during the 2001 study that due to an increasing number of computers with a hot key start, standby in off mode in computers may be increasing. Keeping in mind the small sample size, the 2002 results seem to reflect this, with all computers consuming more than 1W in off mode.

The intrusive survey in 2000 measured off mode data for 74 computers installed in residential houses. Average off mode power for these models was 2.0W. This survey covered products that ranged in age from 1 year to 10 years – most of the older products appeared to have 0.0W power consumption on off mode while newer ones tended to have some off mode consumption. The trend in off mode power consumption appears to be increasing when considering the characteristics of the installed stock and the fact that all new models appear to all have off mode power consumption.

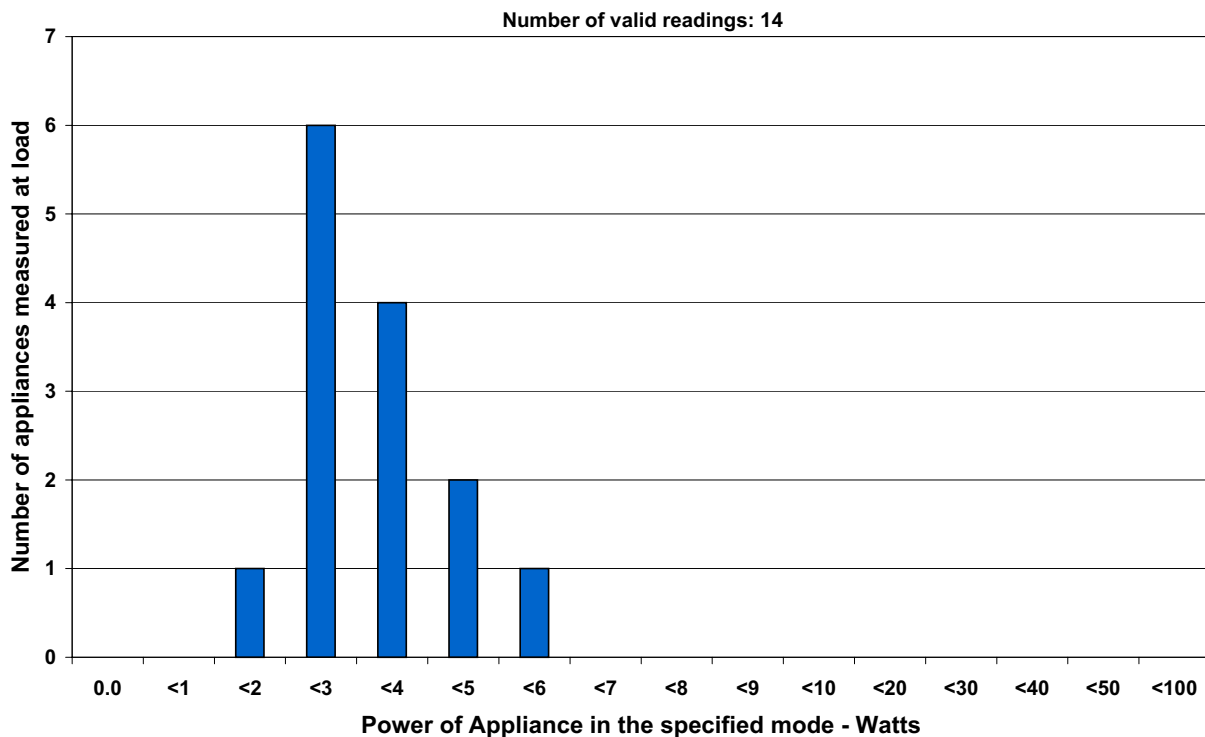
Table 10 – A summary of computer results

Appliance:	Computers					
Mode	Number of Measurements	Average Power (watts)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	14	3.1	0.26	2.27	5.2	1.9
<b>Total Number of Units</b>	14					



As illustrated in Figure 9, the majority of computers consume between 2W and 4W. Only one unit was identified as using less than 2W.

Figure 9 – Power measurements for computers: off mode



### COMPUTER MONITORS

The survey measured 8 computer monitors in off mode only. The average power consumption was 1.2W with a minimum of 0.1W and a maximum of 3.6W. The average power factor was low at 0.3 as was the crest factor at 2.15. The results for computer monitors are summarised in Table 11 below.

Figure 10 indicates that all monitors were found to consume energy in off mode with most consuming less than 1W.

No monitors were tested in the 2001 in-store survey and with the small numbers of monitors tested it is not possible to make comparisons or suggest any definite trends.

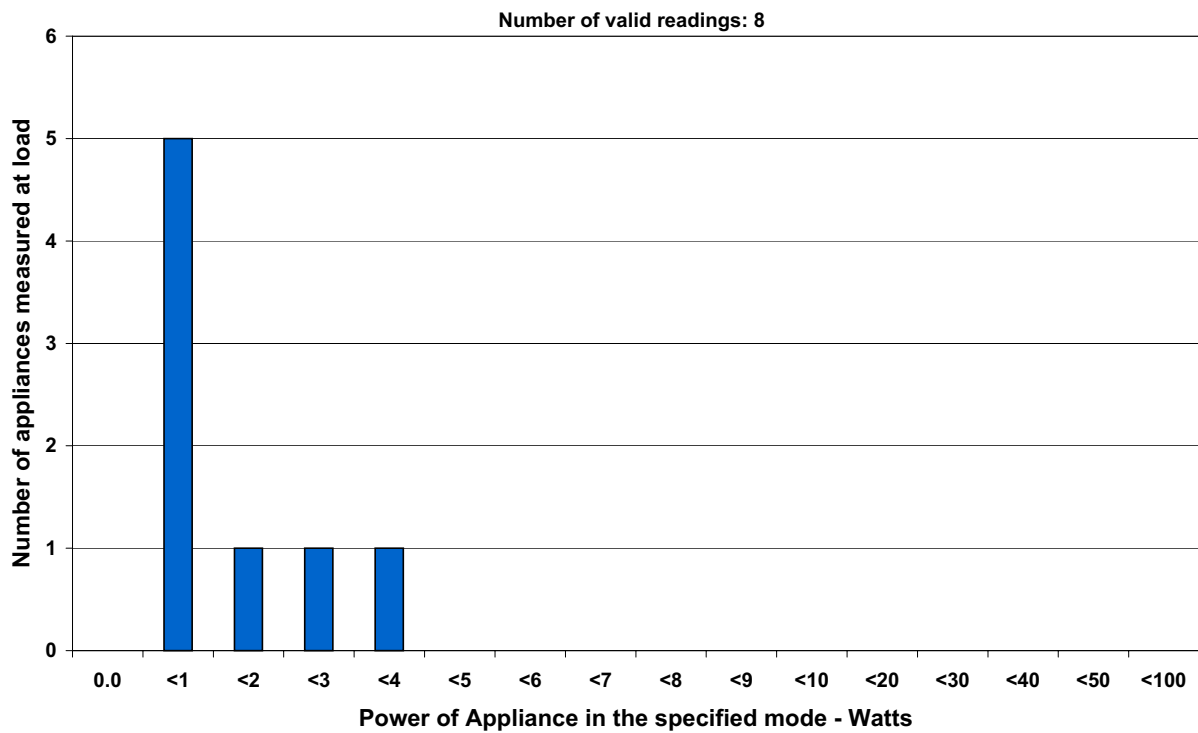
The market trend towards LCD screens (which usually have an external switched mode power supply with a no load power consumption of 1W to 3W) will mean that off mode power consumption is likely to increase for monitors.

The intrusive survey in 2000 measured off mode data for 37 monitors installed in residential houses. Average off mode power for these models was 1.2W. As for computers, off mode consumption for monitors was rare for those units purchased prior to 1995. The trend in off mode power consumption appears to be increasing when considering the characteristics of the installed stock and the fact that all new models appear to have some off mode power consumption (even traditional CRT monitors). The reasons for this are unclear.

Table 11 – A summary of computer monitor results

Appliance:	Monitor					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	8	1.2	0.30	2.15	3.6	0.1
<b>Total Number of Units</b>	8					

Figure 10 – Power measurements for monitors: off mode



## PRINTERS – INKJET

A total of 20 inkjet printers were tested during the in-store survey. The units were differentiated by the quality of print they were able to produce and the speed at which they could print.

During the survey inkjet printers were measured in off mode and in passive mode - that is, switched on ready to print (but not printing). Three models did not have a power on/off switch so no off mode could be recorded. When in passive standby the average power consumption was 5.5W. However the highest power consumption was 14.6W and the lowest was 1.5W. In off mode the average power was 3W with a maximum of 14.6W and a minimum of 0.4W. For both passive and off mode a low average power factor was recorded at 0.46 and 0.37 respectively. Average crest factor was moderate for both modes being 3.7 for passive and 3.8 in off. Table 12 summarises these findings.

The power measurements for inkjet printers in passive mode are displayed in Figure 11. While most printers consumed less than 6W in passive standby mode, only 10% consume less than 2W. Nearly a quarter of those units measured use more than 8W.

Figure 12 presents the power consumption results for inkjet printers in off mode. Over half the models

consumed more than 3W, while approximately a quarter of models consumed less than 1W. All models tested consumed energy when in off mode, indicating that inkjet printers generally have a very poor standby profile in off mode.

There were no printers tested during the 2001 in store survey.

The intrusive survey in 2000 measured off mode data for 50 inkjet printers installed in residential houses. Average off mode power for these models was 3.0W. The trend in off mode power consumption appears to be stable when considering the characteristics of the installed stock.



Table 12 – A summary of printers – inkjet: results

Appliance: Mode	Printer - Inkjet Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	20	5.5	0.46	3.74	14.6	1.5
Off	17	3.0	0.37	3.81	5.5	0.4
<b>Total Number of Units</b>	20					

Figure 11 – Power measurements for printers inkjet: passive standby mode

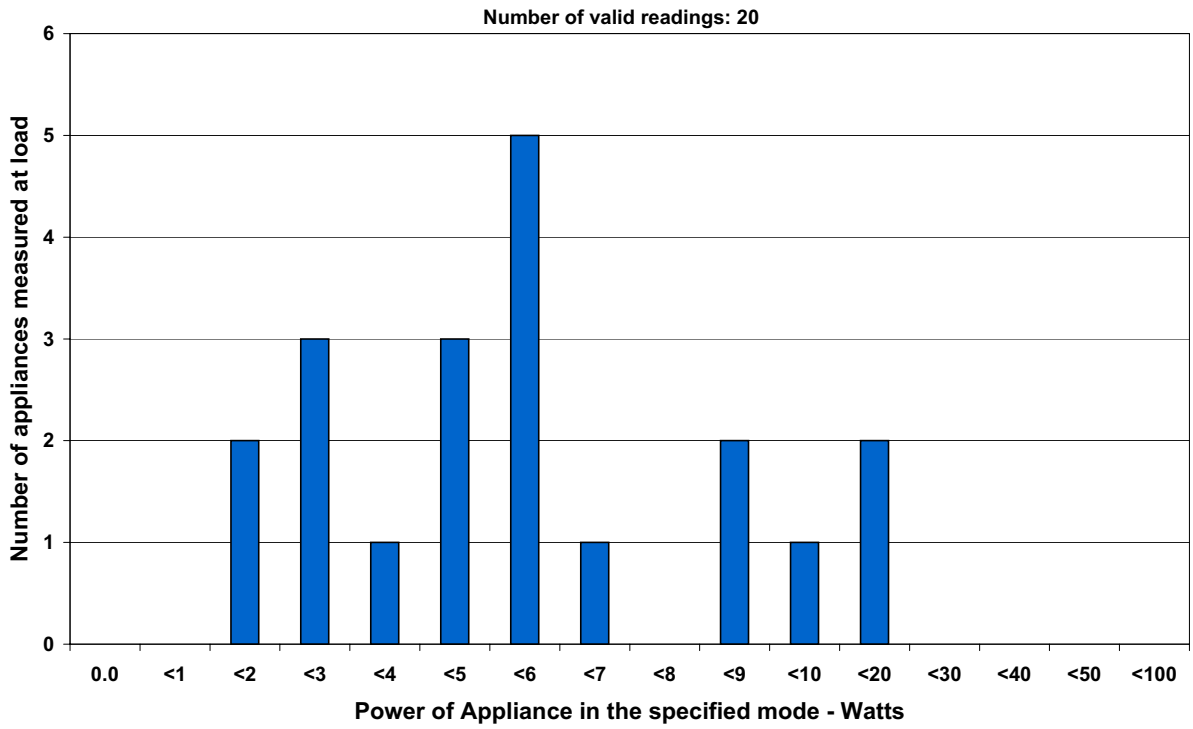
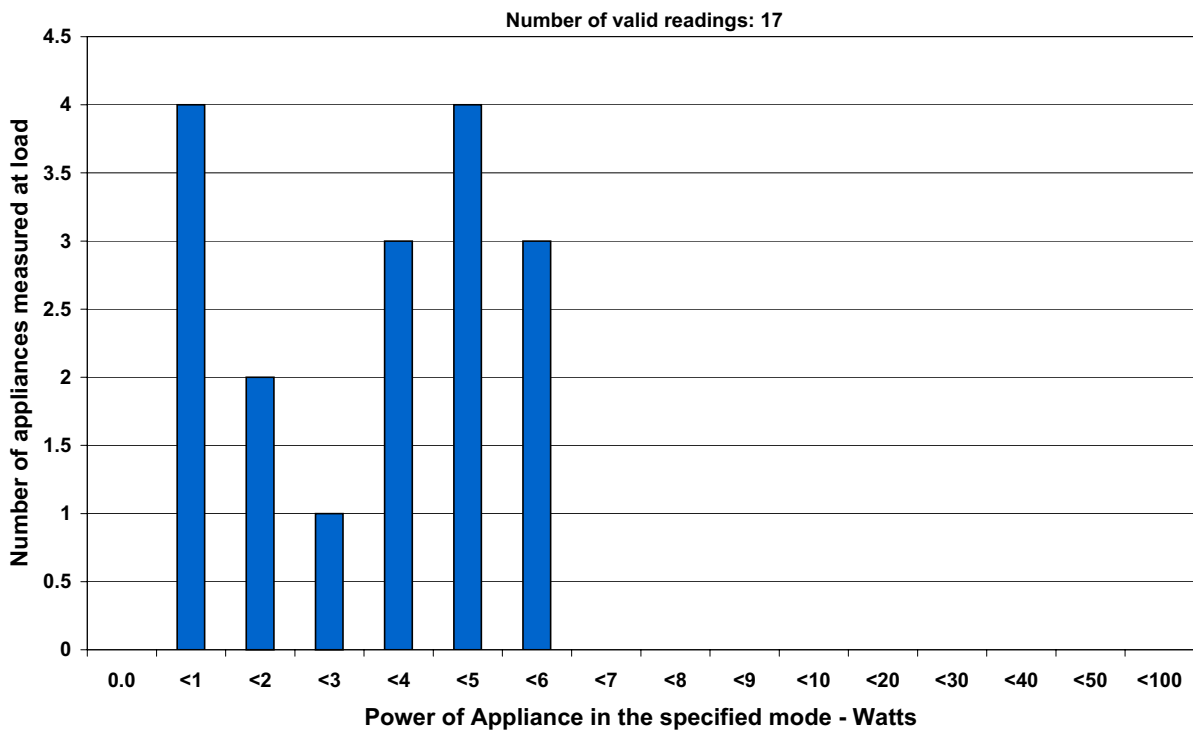


Figure 12 – Power measurements for printers inkjet: off mode



## PRINTERS – LASERS

Only 5 laser printers were tested during the survey. These printers were tested in passive standby and in off mode. One printer had no power on/off switch and therefore could not be tested in off mode. The average power consumption in passive standby mode was 6.1W with a maximum of 8.1W and a minimum of 3.3W. A low average power factor of 0.45 and a moderate average crest factor of 2.95 were detected in this mode. In off mode all laser printers recorded zero consumption.

Figure 13 shows that all five laser printers fell into a different power consumption range.

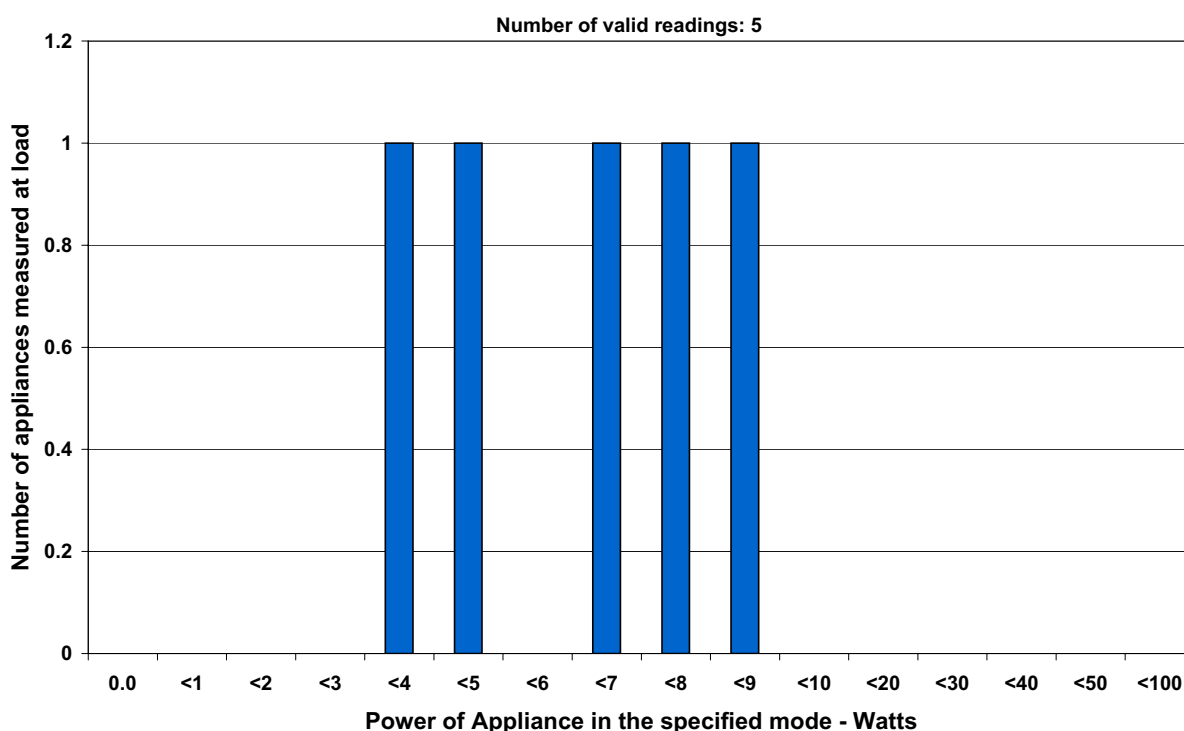
No comparison can be made as laser printers were not included in the 2001 store survey.

The intrusive survey in 2000 measured off mode data for 8 laser printers installed in residential houses. Average off mode power for these models was 0.1W, with most units having 0W in off mode. The trend in off mode power consumption appears to be stable when considering the characteristics of the installed stock.

Table 13 – A summary of printers - laser results

Appliance: Mode	Printer - Laser Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	5	6.1	0.45	2.95	8.1	3.3
Off	4	0.0	0.37	1.83	0.0	0.0
<b>Total Number of Units</b>	5					

Figure 13 – Power measurements for printers - laser: passive standby mode



## SCANNERS

A total of 6 computer scanners were measured. A noticeable feature of the scanners was only one had a power on/off switch; the others were all in passive standby mode once plugged in.

The average power consumption for scanners in passive mode was 7.5W with the maximum being 12.9W and the minimum being 3W. Moderate average power factor and average crest factor were detected at 0.5 and 3.45 respectively. The one scanner recorded in off mode consumed 0.8W with a low power factor of 0.18 and a low crest factor of 2.3. Care is required in interpreting this figure as some scanners may take some time to get to their lowest passive standby power consumption.

As is to be expected with a small sample, Figure 14 shows the passive mode power measurements for the scanners are spread evenly across the range of results.

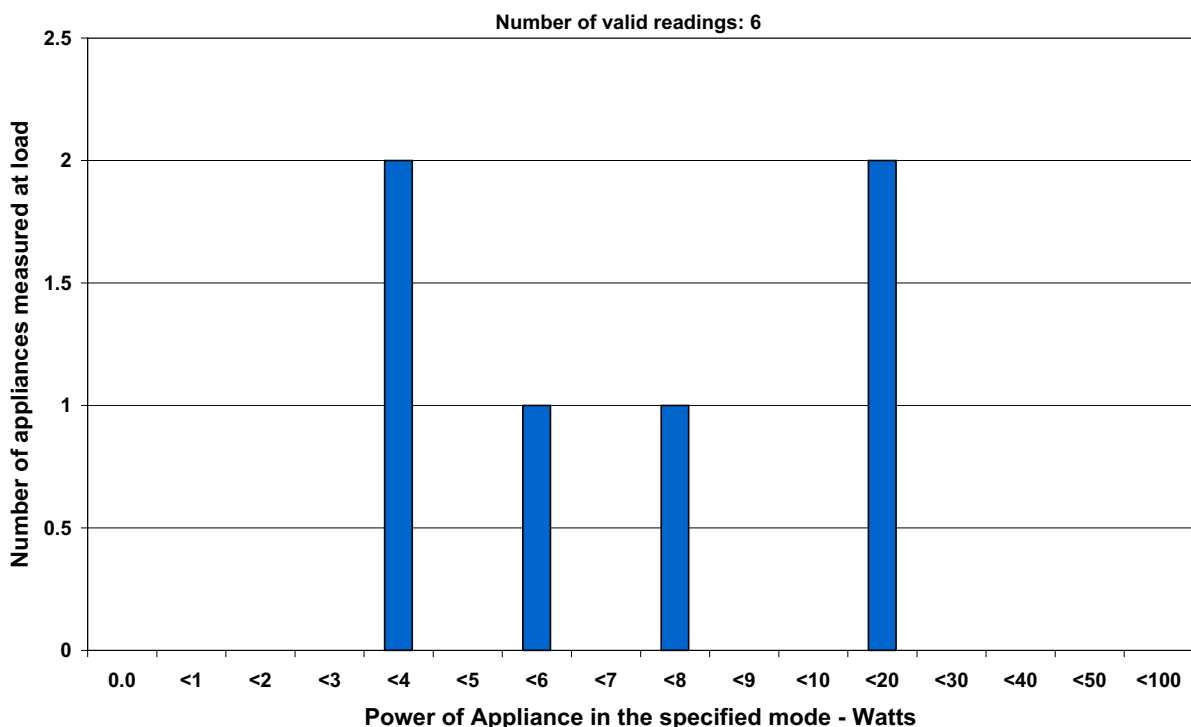
No comparison can be made with 2001 data as scanners were not included in the in store survey.

The intrusive survey in 2000 measured off mode data for 18 scanners installed in residential houses. Average off mode power for these models was 0.9W (for the 6 units that appeared to have an off mode), while average passive standby mode power for these models was 10.4W. Given the small sample size, it is difficult to draw clear conclusions regarding trends from this data.

Table 14 – A summary of scanner results

Appliance:	Scanner					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	6	7.5	0.50	3.45	12.9	3.0
Off	1	0.8	0.18	2.30	0.8	0.8
<b>Total Number of Units</b>	6					

Figure 14 – Power measurements for scanners: passive standby mode



## COMPUTER SPEAKERS

Only two computer speakers could be measured during the in-store survey. They recorded a power consumption of 2.6W and 2.4W in off mode. They had a low average power factor and crest factor at 0.32 and 1.95 respectively. Table 15 reports these results.

The intrusive survey in 2000 measured off mode data for 39 computer speakers installed in residential houses. Average off mode power for these models was 2.1W. Given the small sample size, it is difficult to draw clear conclusions regarding trends from this data but there appears to be no substantial change.

Table 15 – A summary of computer speaker results

Appliance:	Speakers Computer					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	0	NA	NA	NA	-	-
Passive	0	NA	NA	NA	-	-
Off	2	2.5	0.32	1.95	2.6	2.4
<b>Total Number of Units</b>	2					

## HOME ENTERTAINMENT EQUIPMENT

### TELEVISIONS

A total of 98 Televisions were measured during the survey. This category covers standard cathode ray tube models for UHF and VHF reception and excludes those models with LCD, plasma or rear projection screens as well as those with in built VCRs. While all models had remote control operation it was not possible to access this for all models. The televisions ranged in size from 34cm to 108cm, with the average size on display being 62cm. All of the units tested were colour sets.

Televisions were tested in 3 modes: in-use, passive standby and off. One unit could not be measured in use as the remote could not be located and it had been left in passive standby mode. The average power consumption for a television in use was 97W with the maximum being 196W and the minimum being 35.5W. The average crest factor (2.92) and average power factor (0.62) were both

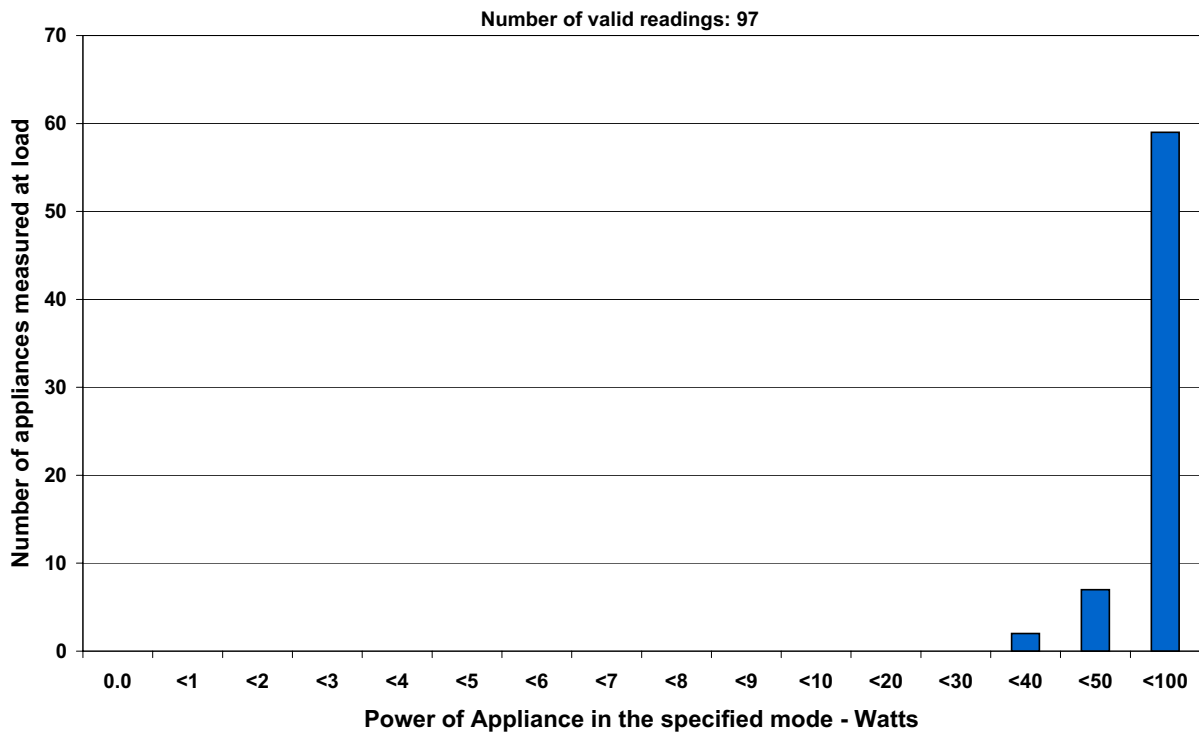
moderate. Only 87 televisions were measured in passive standby mode due to remote controls not being available and the units not have a manual standby function. In this mode the average power consumption was 5.1W with a maximum of 39W and a minimum of 0.3W. Low average power factor was recorded at 0.33 with a moderate average crest factor of 3.83. All televisions could be measured in off mode with the average consumption recorded at 0.0W. The highest reading was 0.3W. Both average power factor and average crest factor were low at 0.28 and 2.05 respectively. Table 16 summarises these results.

Figure 15 shows the power measurements for televisions when in use. Most of the televisions (59) used between 50W and 100W with only 9 models using less than this. For the most part larger consumption was recorded for models with larger screen size however, it should be noted that there were some mid size units that registered some of the higher readings.

Table 16 – A summary of television results

Appliance:	TV					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	97	88.4	0.62	2.92	196.0	35.5
Active	0	NA	NA	NA	-	-
Passive	87	5.1	0.33	3.83	39.0	0.3
Off	98	0.0	0.28	2.05	0.3	0.0
<b>Total Number of Units</b>	98					

Figure 15 – Power measurements for televisions: in-use mode



In passive standby mode nearly a quarter of the models had a power measurement less than 1W. The rest of the units were spread across the 1W to 40 W range as is displayed in Figure 16. There appears little correlation between the size of the television and the power consumption in passive

standby. Each size range contains a broad range of measurements. These results suggest that there could be a substantial decrease in the energy consumed by televisions in passive standby. Figure 16 shows these results.

In off mode all televisions consume less than 1W with zero consumption recorded for the vast

Figure 16 – Power measurements for televisions: passive standby mode

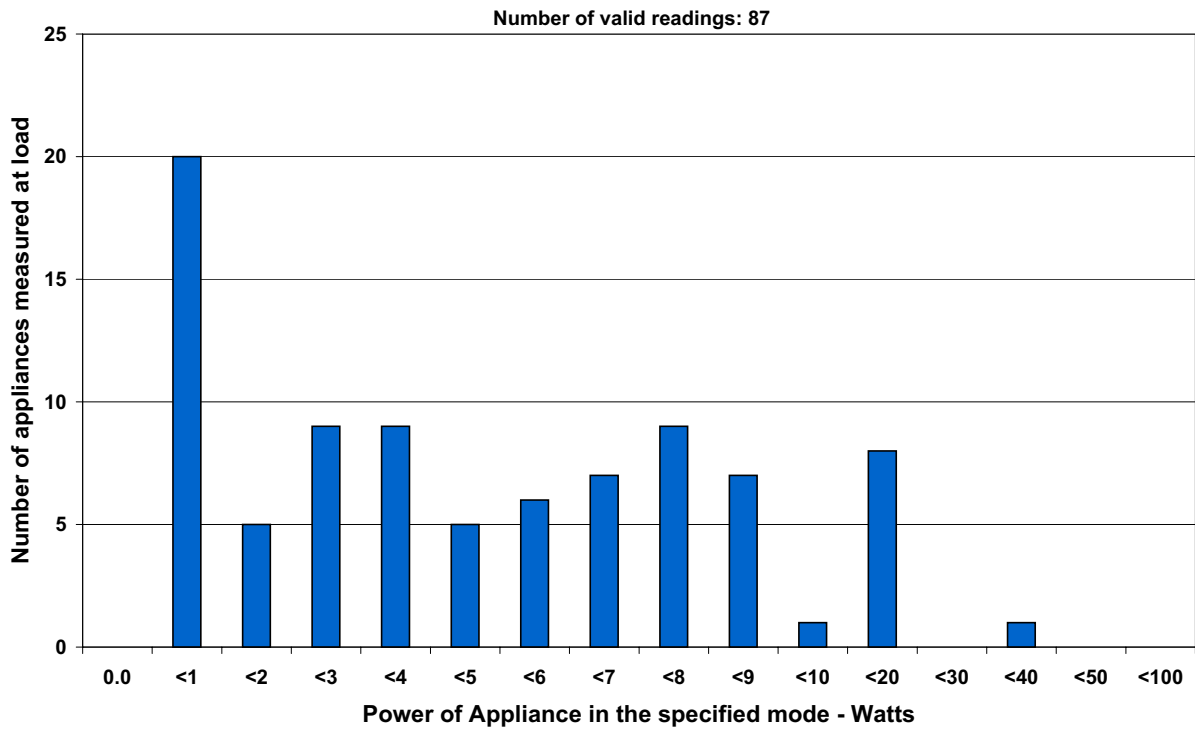
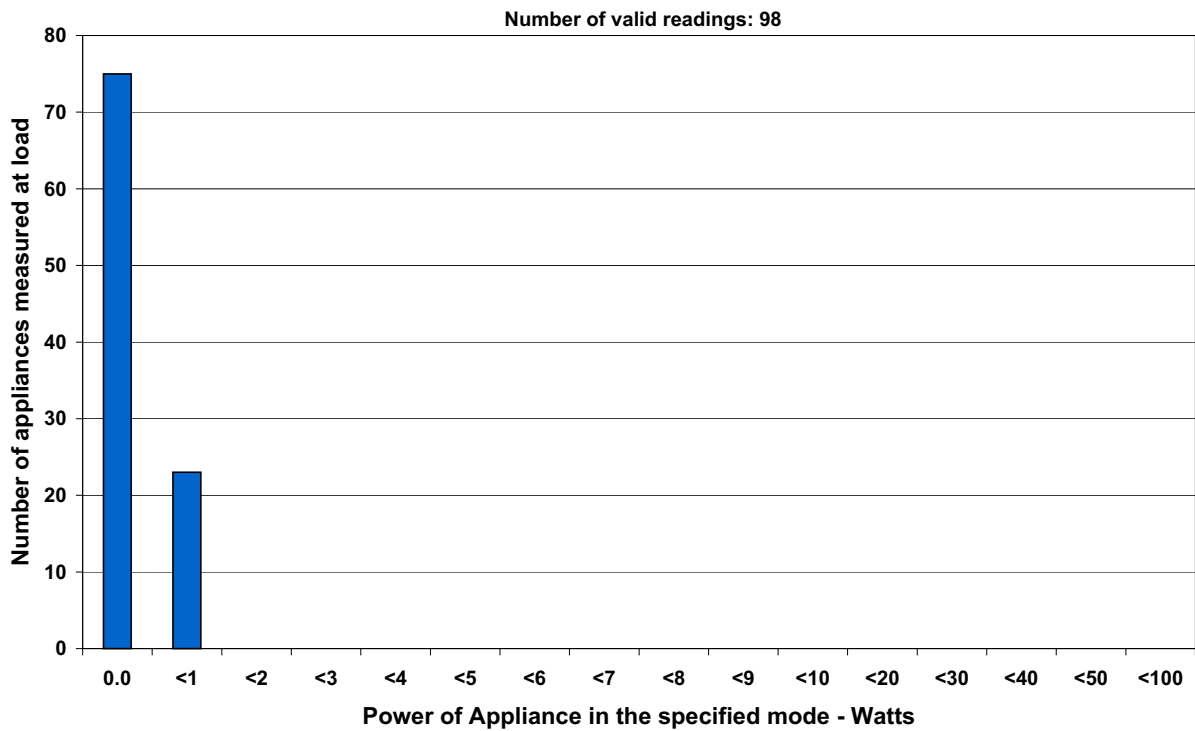


Figure 17 – Power measurements for televisions: off mode



majority. This is illustrated in Figure 17.

In the 2001 store survey 157 televisions were measured. The average power consumption both in use and passive standby demonstrates a similar but slightly lower result in 2002 with the average consumption for televisions in 2001 at 93.7W in use and 5.9W in passive standby. In 2002 there is an increase in the proportion of models registering some power consumption in off mode with only one model registering >0W power consumption in off mode in 2001. However the average consumption has only risen from zero in 2001 to 0.1W in 2002.

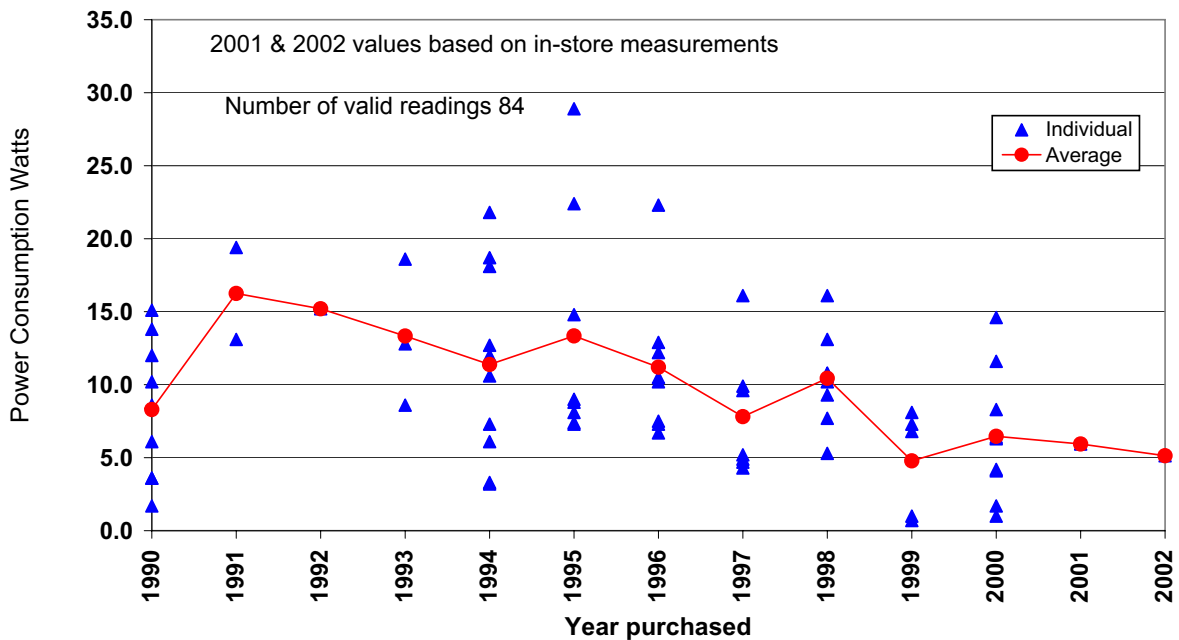
The intrusive survey in 2000 measured off mode data for 116 televisions installed in residential houses. Average off mode power for these models was 0.2W, while average passive standby mode power for these models was 9.5W and average in use consumption was 67.4W. There appears to be an ongoing downward trend in passive standby consumption when the year of purchase is examined as illustrated in Figure 18. A significant number of older televisions (pre 1990) did not have remote controls or a passive standby mode, so data

in this mode prior 1990 is of little significance. For older appliances there is a tendency for respondents to estimate the purchase year (these tend to cluster around 5 and 10 year intervals – eg 1990 is over represented).

While the passive standby power consumption for TVs is still high, there have been substantial improvements over the past 10 years. The apparent decline in recent years is only moderate.



Figure 18 – Trends in passive standby for televisions



## LCD TELEVISIONS

Only 2 LCD (liquid crystal display) televisions were measured during the in store survey. One model was 100cm screen and the other was 109cm. Both units had remote control operation. When in use one unit measured 168W with the other registering 155W resulting in an average of 161.5W. Both average crest factor (3) and average power factor

(0.59) were moderate. There was a large difference between the 2 units when in passive standby with the maximum being 8.6W and the minimum being 1.1W. Average power factor was low at 0.27 with average crest factor a moderate 2.9. In off mode both units consumed 0.1W with low average power factor of 0.1 and low average crest factor of 1.5. Table 17 summaries the results for LCD televisions.

Table 17 – A summary of LCD TV results

Appliance:	TV – LCD					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	2	161.5	0.59	3.00	168.0	155.0
Active	0	NA	NA	NA	-	-
Passive	2	4.9	0.27	2.90	8.6	1.1
Off	2	0.1	0.01	1.50	0.1	0.1
<b>Total Number of Units</b>	2					

## PROJECTION TELEVISIONS

A total of 11 projection televisions were measured. Projection televisions are made as either a front or rear projection type. The models measured in the survey mostly had 109cm screens however they ranged upward to 145cm.

Projection televisions were measured when in use, passive standby and off. When in use the average power consumption was 153.9W with a maximum of 201W and a minimum of 105.6W. The highest and the lowest consumers both have the

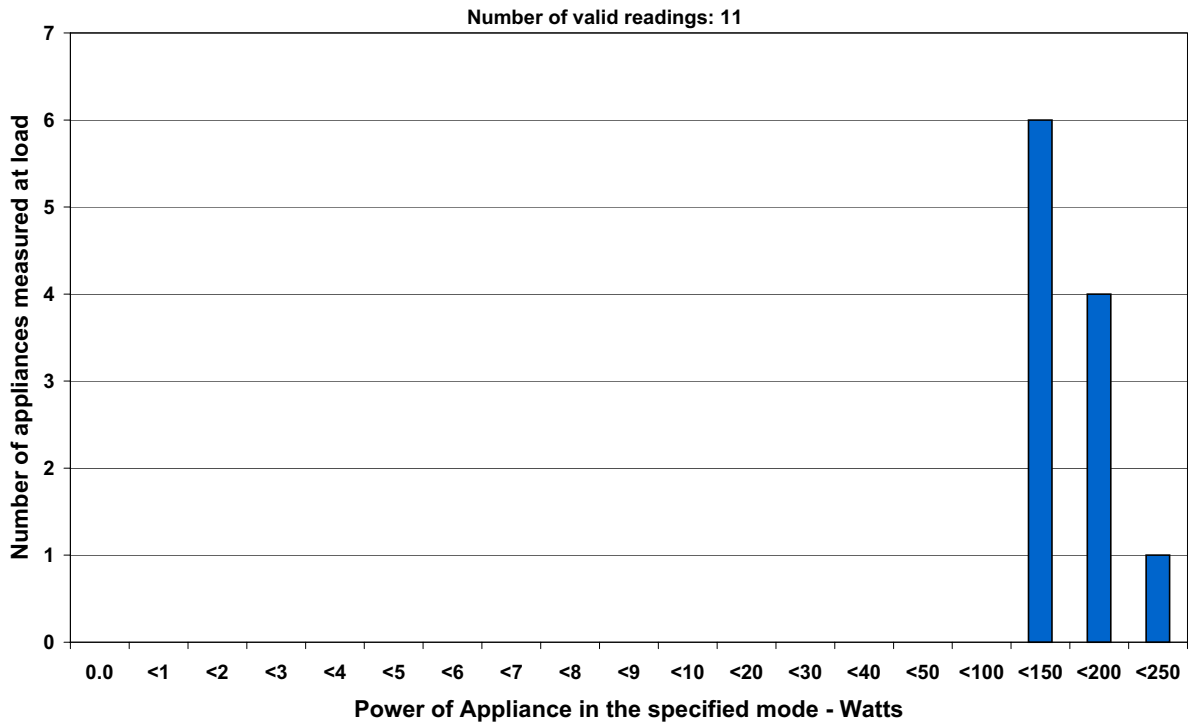
same screen size. The average power factor and average crest factor were both moderate at 0.64 and 2.67 respectively. When in passive standby the range of consumption extended from 0.3W to 10.8W producing an average of 2W. The average power factor (0.22) and average crest factor (2.45) were both low. In off mode the average power consumption was 0.1W with a maximum of 0.2W and a minimum of 0.1W. Again the average power factor and average crest factor were both low at 0.09 and 1.86 respectively. These results are summarised in Table 18.

Table 18 – A summary of projection TV results

Appliance:	TV – Projection					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	11	153.9	0.64	2.67	201.0	105.6
Active	0	NA	NA	NA	-	-
Passive	11	2.0	0.22	2.45	10.8	0.3
Off	11	0.1	0.09	1.86	0.2	0.1
<b>Total Number of Units</b>	11					

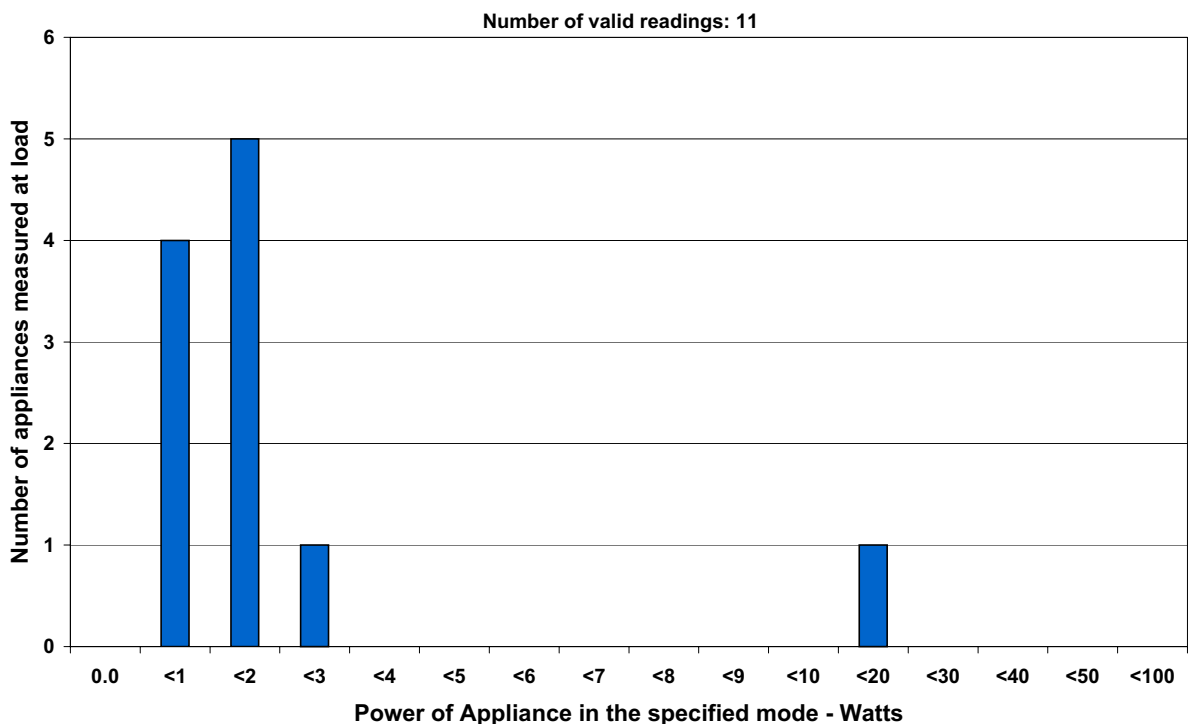
Figure 19 presents the power measurements for projection televisions when in use. Most projection televisions (6) used between 100W and 150W when in use, with the remaining models all recording higher consumption.

*Figure 19 – Power measurements for projection televisions: in-use mode*



As presented in Figure 20 most projection televisions consume less than 2W when in passive standby indicating the few units consuming more than this should be able to make efficiency improvements. All projection televisions consume less than 1W when in off mode, however there were no models with zero consumption.

*Figure 20 – Power measurements for projection televisions: passive standby mode*



## TV/VCR

A TV/VCR is a standard television with a built-in video recorder. Only 2 models were measured in the survey with one having 34cm screen and the other a 48cm screen. When in use power consumption was almost identical with one model measured at 69.7W the other at 67.4W. Average power factor and crest factor were moderate at 0.59

and 3.35 respectively. In passive standby the units recorded similar readings of 9.8W and 7.2W with a low average power factor (0.46) and a high average crest factor of 4.2. Power consumption in off mode was measured at 0.4W for one unit and zero for the other. Both average power factor and average crest factor were low at 0.37 and 1.8 respectively. Differences could not be attributed to screen size. The results are summarised in Table 19.

Table 19 – A summary of TV/VCR results

Appliance:	TV/VCR					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	2	68.6	0.59	3.35	69.7	67.4
Active	0	NA	NA	NA	-	-
Passive	2	8.5	0.46	4.20	9.8	7.2
Off	2	0.2	0.37	1.80	0.4	0.0
<b>Total Number of Units</b>	2					

## VCRs

All VCRs in the study had remote control operation. None of the models could be turned off and all had some type of clock display always active. The VCRs were measured in active standby that is, on but not playing and in passive standby, that is, ready for remote operation and still displaying clock.

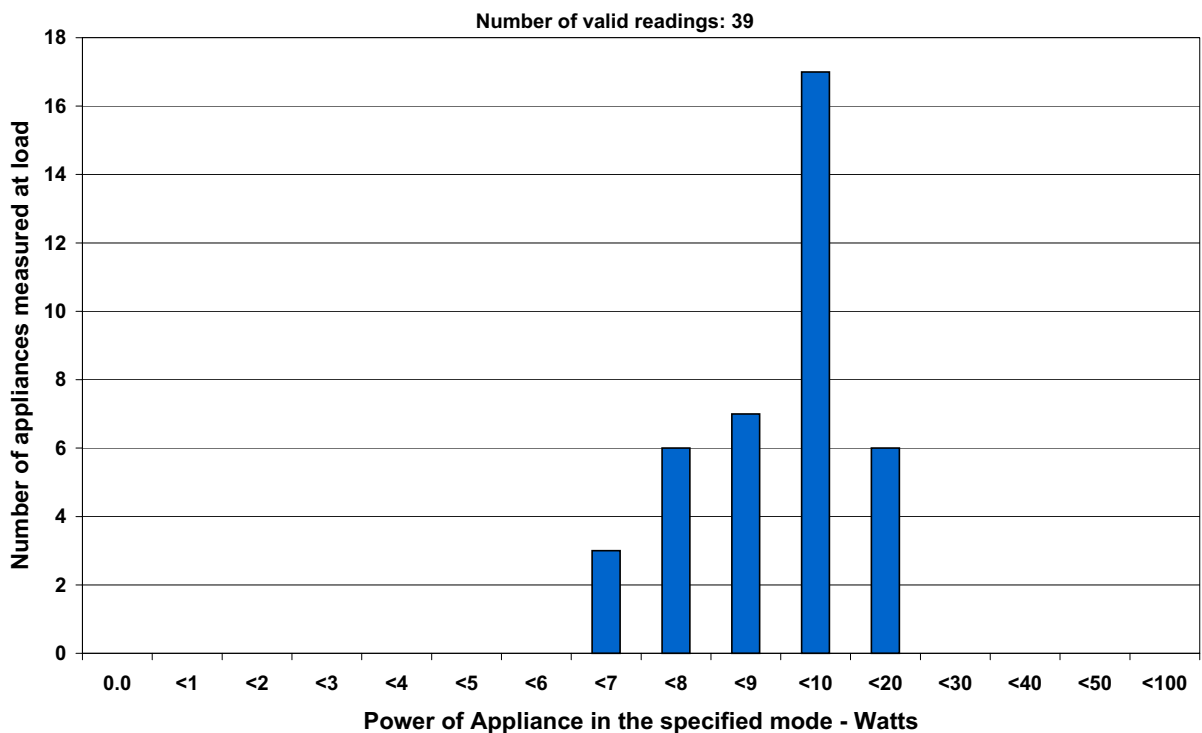
A total of 40 models were tested, however one model could not be measured in active standby as it functioned only by remote control and this could not be located. The average active standby mode power consumption was 9W with a maximum of 12.3W and a minimum of 2W. The average power factor was low at 0.49 while the crest factor was a moderate 3.69. In passive standby the average power consumption dropped to 3.5W with the minimum being 2W increasing to a maximum of 5.6W. The average power factor was a low 0.4 and the average crest factor was high at 4.57. Table 20 summarises these results.

The most common consumption recorded for VCRs in active standby was between 9W and 10W. However 41% of models were consuming less with the best being less than 7W. This indicates that there is the possibility that active standby consumption could be reduced in many units. Figure 21 illustrates these findings. Care is needed in the interpretation of this result, as most VCRs will go to “sleep” when left in active standby mode without playing a tape for some period (typically 20 minutes). For practical reasons it was not possible to make this measurement during the in store survey (as the power has to be re-connected to make a power measurement). Experience indicates that a VCR which is left on but allowed to go to “sleep” will consume less than active standby but more than passive standby (typically sleep mode consumption will be about an average of active and passive standby). This “sleep” mode would be a common mode in normal use in households.

Table 20 – A summary of VCR results

Appliance:	VCR					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	39	9.0	0.49	3.69	12.3	6.7
Passive	40	3.5	0.40	4.57	5.6	2.0
Off	0	NA	NA	NA	-	-
<b>Total Number of Units</b>	40					

Figure 21 – Power measurements for VCR: active standby mode



No VCRs were found to consume less than 1W in passive standby mode. Most models consumed between 2W and 4W with only a few units above this range. These results are presented in Figure 22.

The 2001 in store survey measured 39 units, which resulted in similar readings. Average active standby in 2001 was recorded at 9W compared to 10.9W in 2002 while passive standby was 3.8W in 2001 and 3.5W in 2002. The 2001 survey did find four units that had an off mode resulting in an average consumption of 1.3W. These results indicate little change in standby power consumption for VCRs.

The intrusive survey in 2000 measured off mode data for 88 VCRs installed in residential houses. Average passive standby mode power for these models was 7.8W. There appears to be an ongoing downward trend in passive standby consumption when the year of purchase is examined as illustrated in Figure 23. While the passive standby power consumption for VCRs is still high, there have been substantial improvements over the past 10 years. The apparent decline in recent years is only moderate.

Figure 22 – Power measurements for VCR: passive standby mode

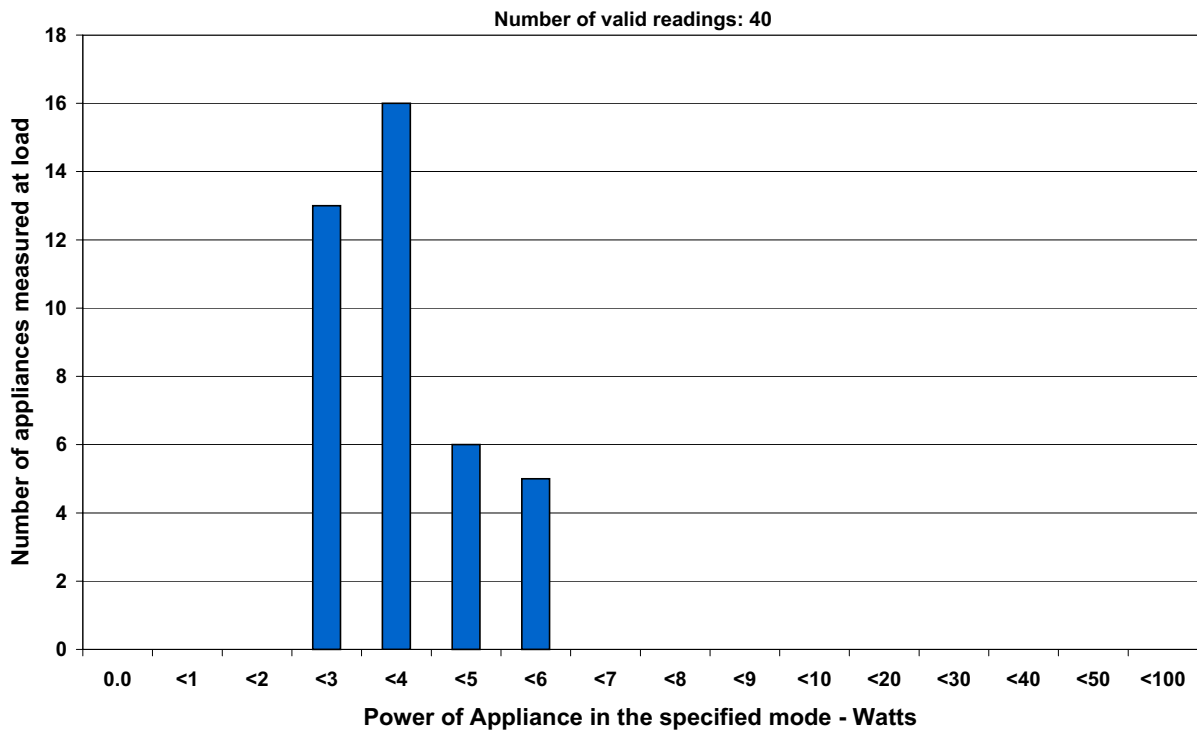
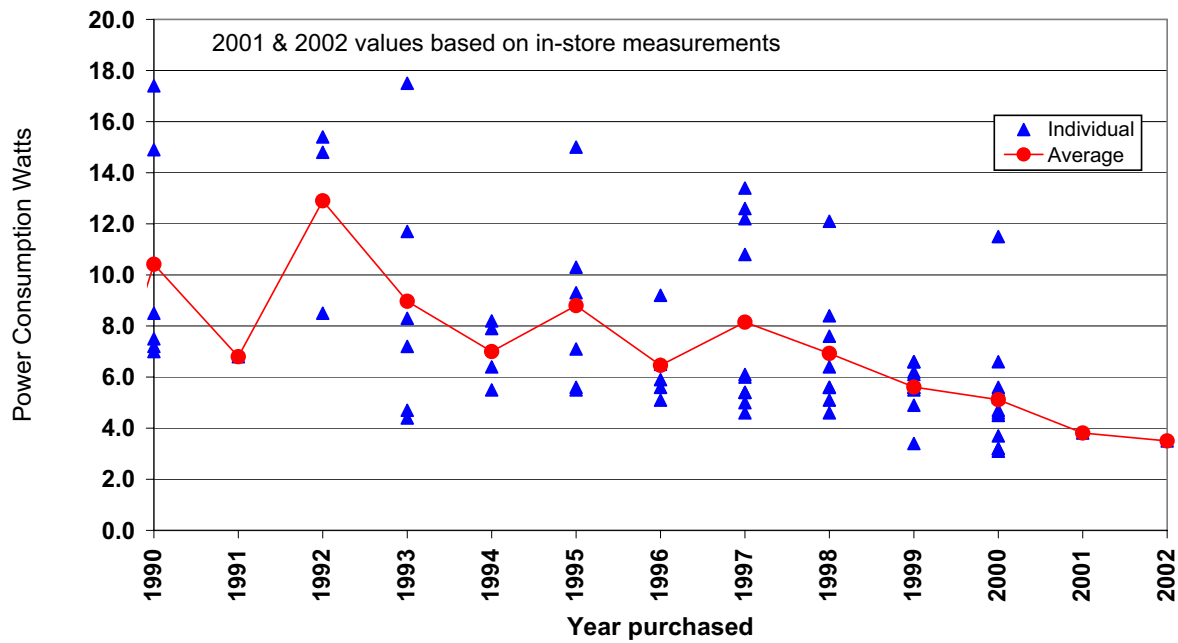


Figure 23 – Trends in passive standby for VCRs



## DVD PLAYERS

The in store survey measured 44 DVD players. Most of the units had remote operation, although access to these controls was not available for all the players during testing. Many models do not have an off switch and are always ready for remote activation (passive standby only).

DVDs were measured in 3 modes: active standby, that is, ready to play a disc, passive standby, that is, ready to be activated and off (where present), that is, powered down but not able to be activated by a remote. All 44 units could be measured in active standby with the average consumption being 13W. The range varied from a minimum of 7.2W to a maximum of 52.6W. The average power factor of 0.5 and the average crest factor of 3.7 fall into the moderate range. The passive standby could be measured on only 37 units as in stores remote controls were not always available and because some units do not have a remote function. The average power consumption was found to be 3W in passive standby with a minimum of 0.3W and a max of 15.2W. The average power factor was low at 0.32 while the average crest factor was high at 4.39. Approximately one third of DVD players had a power

on/off control providing a total of 16 measurements for the off mode. The average power consumption was 0.1W with results ranging from zero to 0.7W. The average power factor and average crest factor were both low at 0.26 and 2.4 respectively. For a summary of these results see Table 21 below.

Overwhelmingly most DVD players had an active standby power consumption of between 10W and 20W. However, as can be seen in Figure 24 lower energy usage is possible with 27% of DVD units using less than 10W. There was only a small number (5) using more than 20W.

Figure 25 indicates that most DVD players have a power consumption less than 3W when in passive standby mode. Around 21% are actually consuming less than 1W. Power consumption for the remaining models (approximately a quarter) is spread from 3W to 20W. This would indicate that these models should be able to decrease power consumption in passive mode.

Only 16 of the DVD units tested had an off mode. As can be seen in Figure 26 most of these recorded zero power consumption. The remaining four models were measured as using less than 1W.

Table 21 – A summary of DVD player results

Appliance:	DVD Player					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	44	13.0	0.50	3.72	52.6	7.2
Passive	37	3.0	0.32	4.39	15.2	0.3
Off	16	0.1	0.26	2.40	0.7	0.0
<b>Total Number of Units</b>	44					



Figure 24 – Power measurements for DVD players: active standby mode

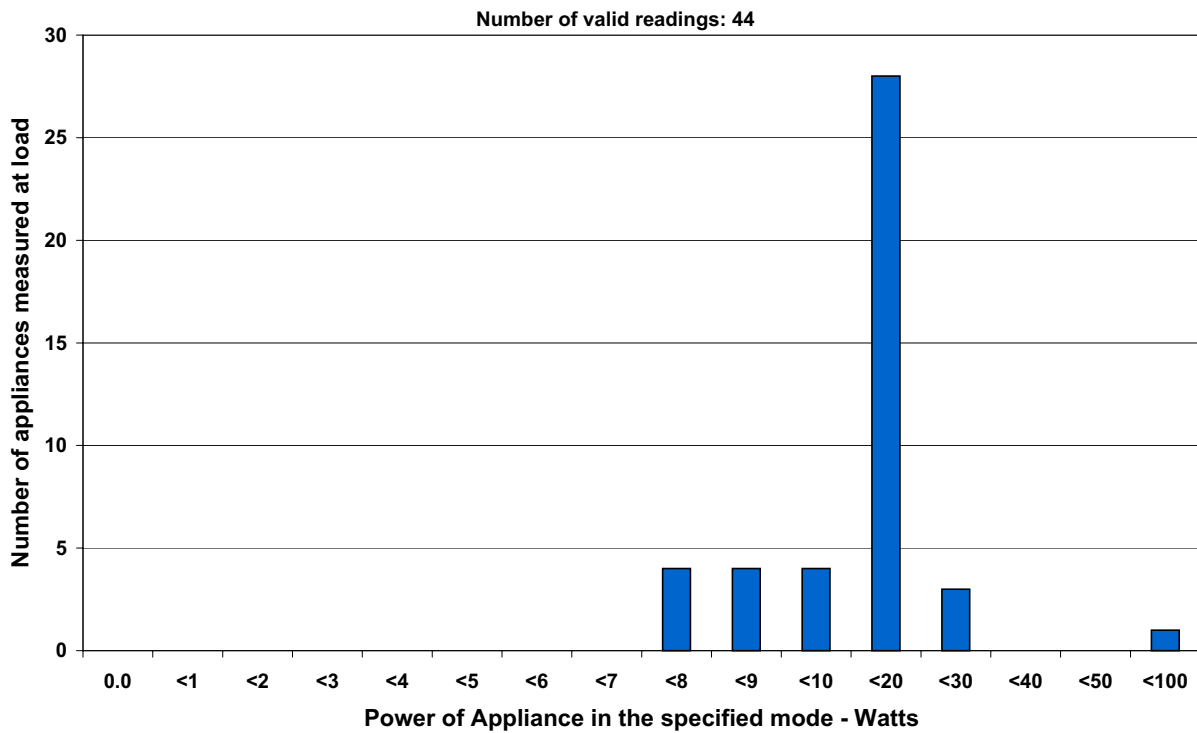


Figure 25 – Power measurements for DVD players: passive standby mode

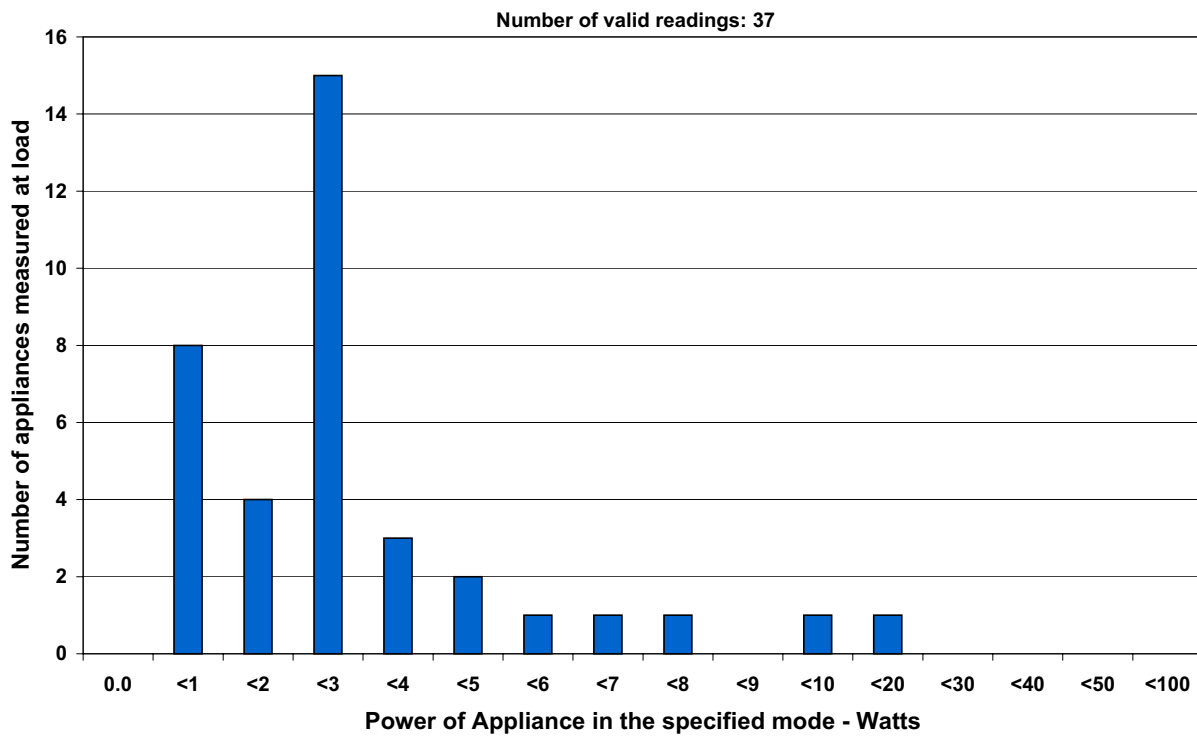
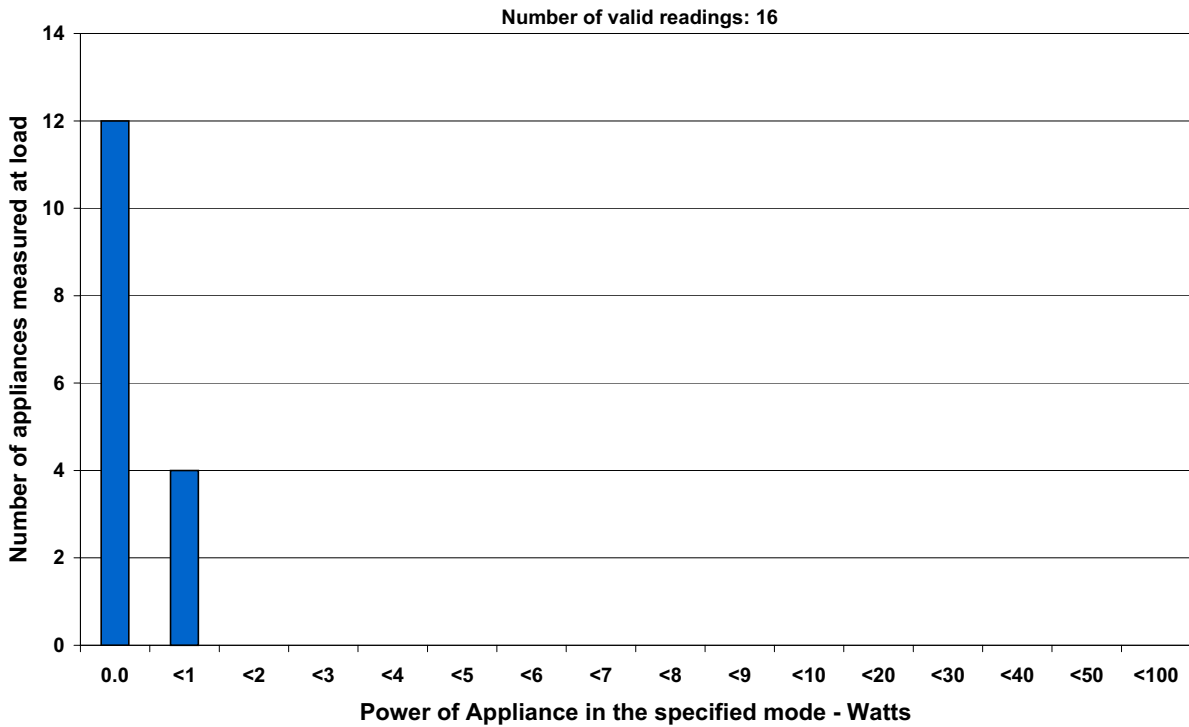


Figure 26 – Power measurements for DVD players: off mode



Comparing the survey with the 2001 in store survey, the average power consumption for DVD players is marginally less in 2002. In 2001 the active standby average was 17.4W compared to 13W in 2002. Passive mode was 5.8W compared to 3W in 2002 and off mode was 0.8W in 2001 compared to 0.1W in 2002. The number of appliances measured in 2001 was 31 compared to 44 in 2002.

The intrusive survey in 2000 measured passive and active standby data for 8 DVD players installed in residential houses. Average passive standby mode power for these models was 11.2W while active standby was 13.2W. Given the small sample size, it is difficult to draw clear conclusions regarding trends from this data but there appears to be no substantial change in active standby and a possible decrease in passive standby.



## INTEGRATED STEREOS

Integrated stereos are single units that perform more than one function such as CD player, tuner, tape deck, amplifier etc. The survey measured 51 of these appliances. Most units had remote control as well as manual operation. Variants included CD capacity, presence of a tape deck, and digital displays.

Integrated stereos were measured in 3 modes: active standby, that is, ready to play a disc; passive standby, that is, ready to be activated and off, that is, powered down but not able to be activated by a remote. In active mode there was a large variation in power consumption with an average of 20.4W and a maximum of 48W and a minimum of 7W. Average power factor was moderate at 0.7 and average crest factor was low at 2.0. Only 50 stereos could be measured in passive mode as one model was a demonstration unit that always operated in active standby. The average power consumption for passive mode was 7.9W with a maximum of 25W and a minimum of 0.3W. Again there was a moderate power factor (0.59) and a low crest factor (2.13). Off mode was only available on 3 units resulting in an average power of 1.1W with a 1.2W maximum and a 0.9W minimum. The average power factor was low at 0.4 as was the average crest factor at 2.07. These results are summarised in Table 22.

Figure 27 indicates that most integrated stereos consume between 10W and 30W in active standby. Only 5 models were able to achieve energy consumption less than 10W and only 6 consumed more than 30W.

When in passive standby most integrated stereos consume either less than 1W or more than 10W. This would seem to indicate that changing from active to passive standby does not alter energy consumption in many units. The fact that 30% (15) of units use less than 1W would suggest that those units with power measurements more than 10W (38%) could be improved so that consumption is decreased. These findings are represented in Figure 28.

Only 3 units had an off mode resulting in power measurements of 0.89W, 1.08W and 1.19W respectively. All 3 models had a passive standby consumption over 10W and active standby measurements over 20W. Indicating that using the off mode has significant benefits in terms of energy savings.

In 2001 88 integrated stereos were measured with an active standby of 23.9W, passive standby of 9.3W and off mode at 3.5W. These figures, while slightly higher, are in the same range as the 2002 results suggesting that standby power trend for this product is stable.

The intrusive survey in 2000 measured passive standby mode data for 53 integrated stereo units installed in residential houses. Average active standby was 9.4W. Given the small sample size, it is difficult to draw clear conclusions regarding trends from this data but there appears to be no substantial change in passive standby mode power consumption.

Table 22 – A summary of integrated stereo results

Appliance: Mode	Stereo - Integrated					
	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	51	20.4	0.70	2.00	48.1	7.3
Passive	50	7.9	0.59	2.13	25.0	0.3
Off	3	1.1	0.40	2.07	1.2	0.9
<b>Total Number of Units</b>	51					

Figure 27 – Power measurements for integrated stereos: active standby mode

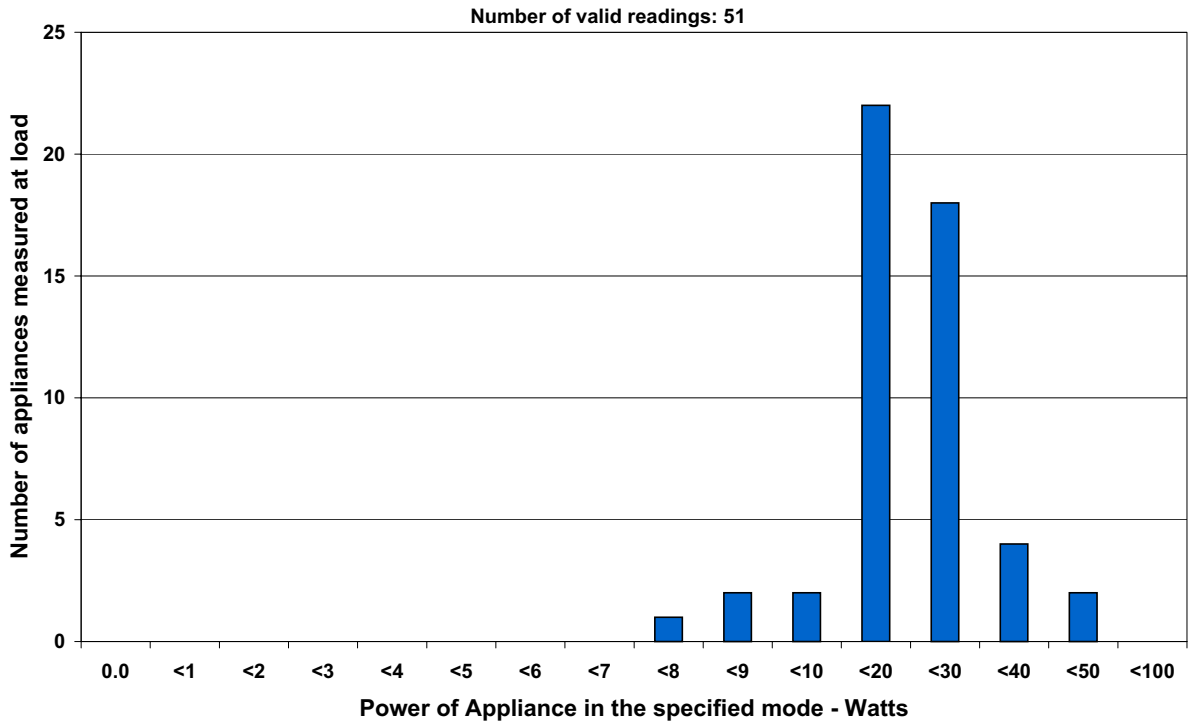
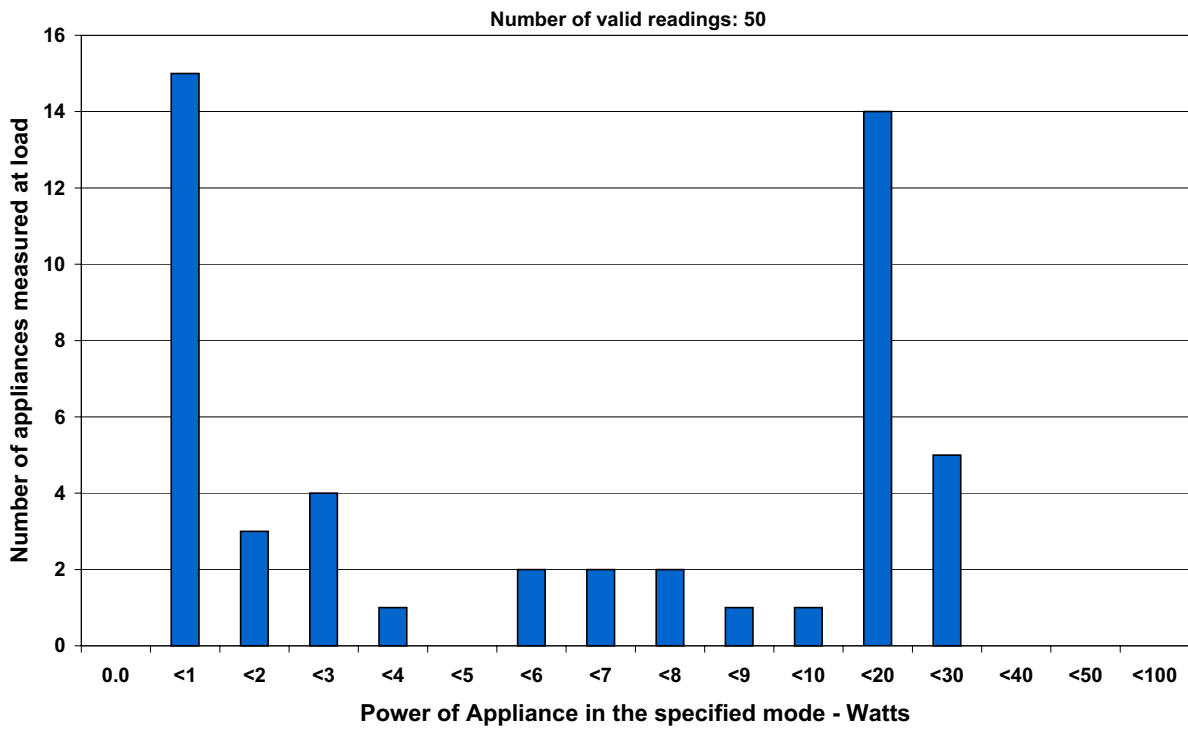


Figure 28 – Power measurements for integrated stereos: passive standby mode



## PORTABLE STEREOS

Portable stereos can be operated using mains power or batteries. They are mobile single units that can perform more than one function such as CD player, tuner, tape deck, etc. The survey measured 32 of these appliances. Some units had remote control as well as manual operation. Variants included CD capacity (multi-disk), presence of a tape deck, and digital displays. None of the products tested had an off mode.

These appliances were measured in active and passive standby. In active mode the average power was 5.2W with a moderate power factor of 0.64 and low crest factor of 1.69. The maximum power was 8.6 W with a minimum of 3.1W. Average power consumption in passive mode was 1.8W with moderate average power factor of 0.54 and a low crest factor of 1.92. The maximum power was 3.6W with a minimum of 0.8W. Table 23 presents these results.



Figure 24 demonstrates that 41% (13) of portables have a power consumption between 4W and 5W. Only 6 units fell below this level with the remainder having consumption spanning upward to 9W.

Power measurement for portable stereos in passive mode are represented in Figure 30. Most stereos reduced consumption substantially when changing from active to passive mode with 59% (19) using less than 2W and all but one unit using less than 3W.

In the 2001 survey 36 portable stereos were measured with an average consumption in passive mode of 2.8W. The 2002 result was almost 30% less than this at 1.8W for 32 units, indicating that there may have been some gains made in product design which has improved the standby profile of portable stereos.

The intrusive survey in 2000 measured passive and active standby mode data for 42 portable stereo units installed in residential houses. Average passive standby was 3.5W while average active standby was 5.6W. There appears to be no substantial change in active standby and a possible decrease in passive standby.

Table 23 – A summary of portable stereo results

Appliance:	Stereo – Portable					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	32	5.2	0.64	1.69	8.6	3.1
Passive	32	1.8	0.54	1.92	3.6	0.8
Off	0	NA	NA	NA	-	-
<b>Total Number of Units</b>	32					

Figure 29 – Power measurements for portable stereos: active standby mode

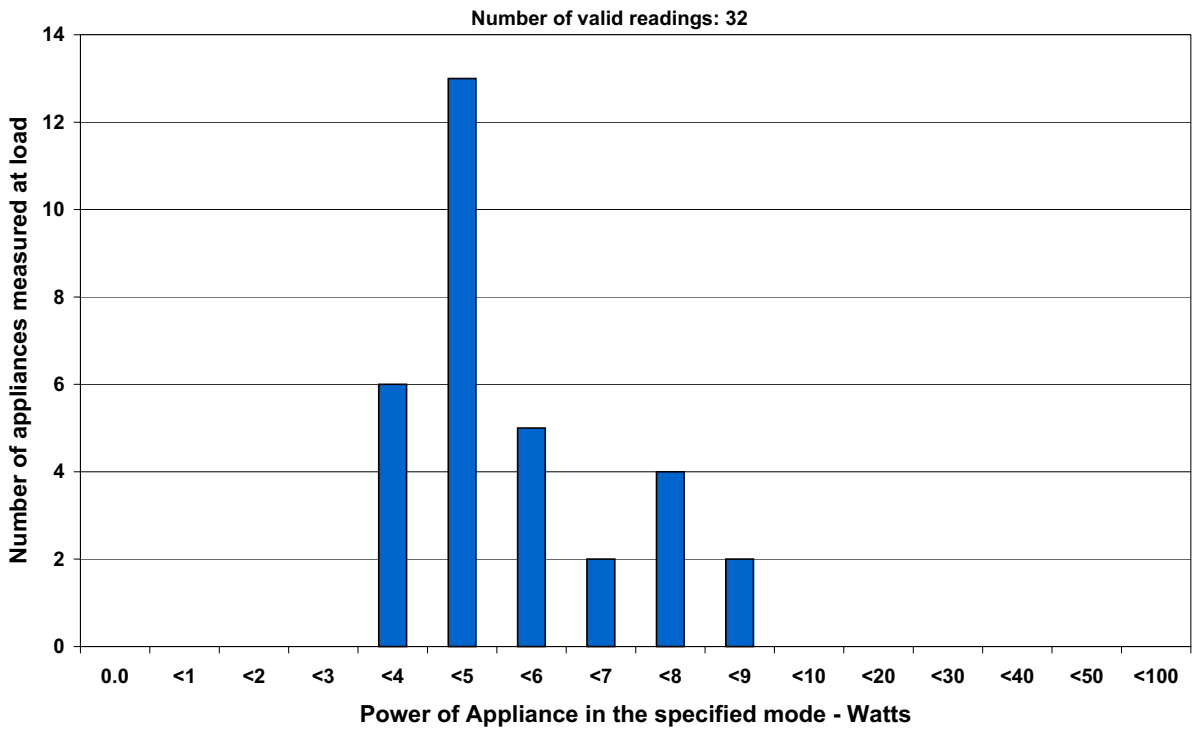
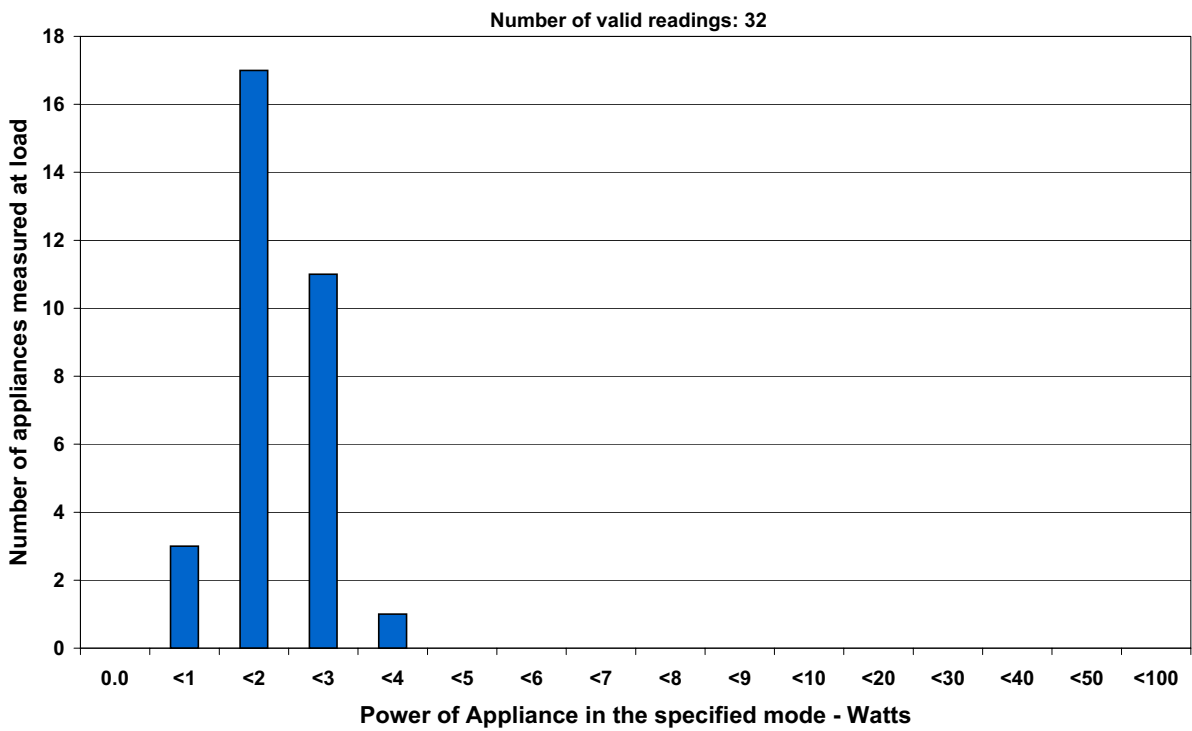


Figure 30 – Power measurements for portable stereos: passive standby mode



## STEREO – AMPLIFIERS

A total of 6 amplifiers were measured during the in store survey. Most had remote operation as well as power on/off switches.

Amplifiers were measured in 3 modes: in use, passive standby and off. There was a large variance in the power consumption of the amplifiers in in-use mode with a maximum consumption of 193.4W and a minimum of 16.5W. The average power was 54.8W with a moderate average power factor of 0.66 and a low average crest factor of 2.23. Two units had no standby feature so only four models were measured in passive mode. The average power was 1.2W with a maximum of 1.4W and a minimum of 1.1W. In contrast with the in-use results the spread of results in off mode was small with a maximum of 0.6W and a minimum of zero Watts. The average power consumption was 0.2W with the average power factor low at 0.29 and the average crest factor a low 1.66. Only five units were able to be powered off. These results are summarised in Table 24.

When in use 3 of the amplifiers consumed less than 20W, 2 between 30W and 50W and 1 at the maximum of 193.4W. These results are presented in Figure 31.

All of the four amplifiers tested in passive mode had a power consumption of between 1W and 2W. As can be seen in Figure 32 the five amplifiers measured in off mode were all below 1W with two having zero consumption.

Amplifiers were not measured in the 2001 survey.

The intrusive survey in 2000 measured off mode data for 23 amplifiers installed in residential houses. Average off mode power was 0.7W although this appears to be a mix of off mode and passive standby. The intrusive survey data has been recorded in a way that makes it difficult to determine whether there is any trend in this appliance.

Table 24 – A summary of amplifiers results

Appliance:	Stereo - Amplifier					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	6	54.8	0.66	2.23	193.4	16.5
Active	0	NA	NA	NA	-	-
Passive	4	1.2	0.79	1.78	1.4	1.1
Off	5	0.2	0.29	1.66	0.6	0.0
<b>Total Number of Units</b>	6					

Figure 31 – Power measurements for amplifiers: in use mode

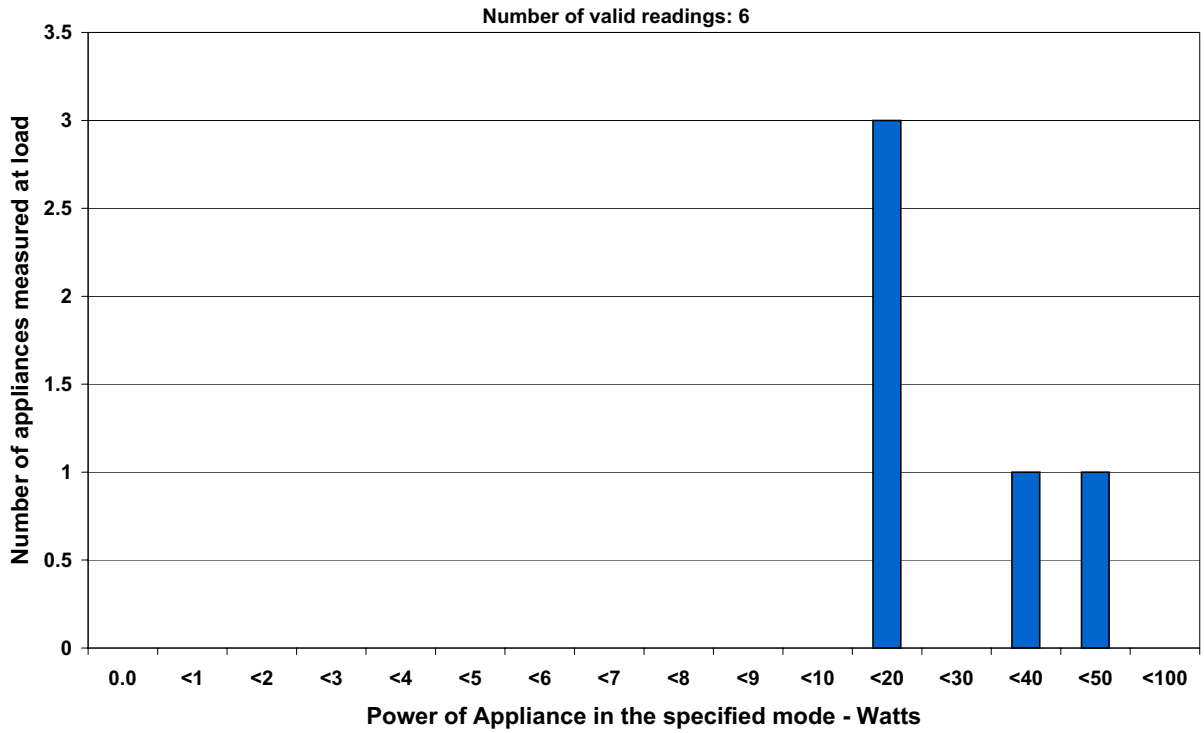
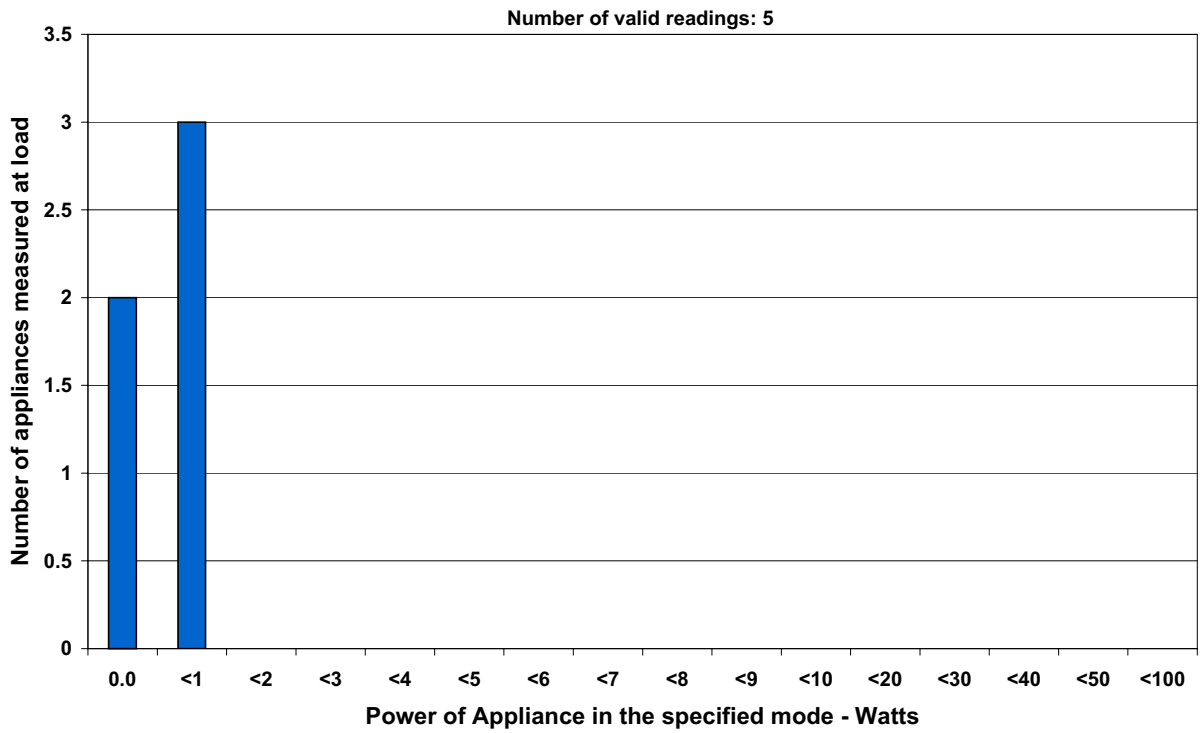


Figure 32 – Power measurements for amplifiers: off mode



## STEREO – COMPACT DISC

A total of 17 Compact Disc Players were measured during the survey. The CD players varied in the number of CDs that could be played ranging from 1 to 10. Most units had a power on/off button. Six units did not have a passive standby mode and for seven units passive standby was reliant on remote controls that were unavailable.

Compact disc players were measured in 3 modes: active standby, that is, ready to play a disc; passive standby, that is ready to be activated and off, that is, powered down but not able to be activated by a remote. In active standby the average power consumption was 8.2W with a minimum of 4.3W and a maximum of 17.1W. Moderate average power factor was present at 0.73 as was low crest factor at 1.97. Only 4 units could be measured in passive mode where average power was 2.9W with a maximum of 5.2W and a minimum of 1.1W. Again moderate average power factor (0.57) and low average crest factor (1.95) were present. Fourteen CD players could be measured in off mode with an average power of 0.1W. Consumption ranged from 1.5W to zero. The average power factor and crest factor were both low at 0.19 and 2.04 respectively. All these results are summarised in Table 25.

Power measurements for CD players in active mode are represented in Figure 33. While over half the appliances consumed less than 8W in-use 24% (4) used between 10W and 20W.

In passive mode 2 units consumed 1W, 1 unit consumed 4W and 1 unit consumed 5W. Figure 34 shows the power consumption for CD players in off mode. Overwhelmingly the majority of CD players have zero consumption when in off.

In the 2001 store survey 14 CD players were measured, however active standby was not recorded. Average power consumption for passive standby and off modes in 2001 were somewhat higher than 2002. In passive mode it was 7.98W in 2001 and 2.9W in 2002 while in off mode, it was 2.16W in 2001 and only 0.1W in 2002. Additionally there were only 3 units (33%) with zero consumption in 2001 compared with 12 (85%) in 2002.

The intrusive survey in 2000 measured off mode and active standby mode data for 37 CD players installed in residential houses. Average off mode was 2.0W (this appears to be a mix of off mode and passive standby) while average active standby was 8.0W. There appears to be no substantial change or trend in active standby. The intrusive survey data for off mode has been recorded in a way that makes it difficult to determine whether there is any trend in this appliance.

Table 25 – A summary of compact disc results

Appliance:	Stereo – CD					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	17	8.2	0.73	1.97	17.1	4.3
Passive	4	2.9	0.57	1.95	5.2	1.1
Off	14	0.1	0.19	2.04	1.5	0.0
<b>Total Number of Units</b>	17					

Figure 33 – Power measurements for compact discs: active standby mode

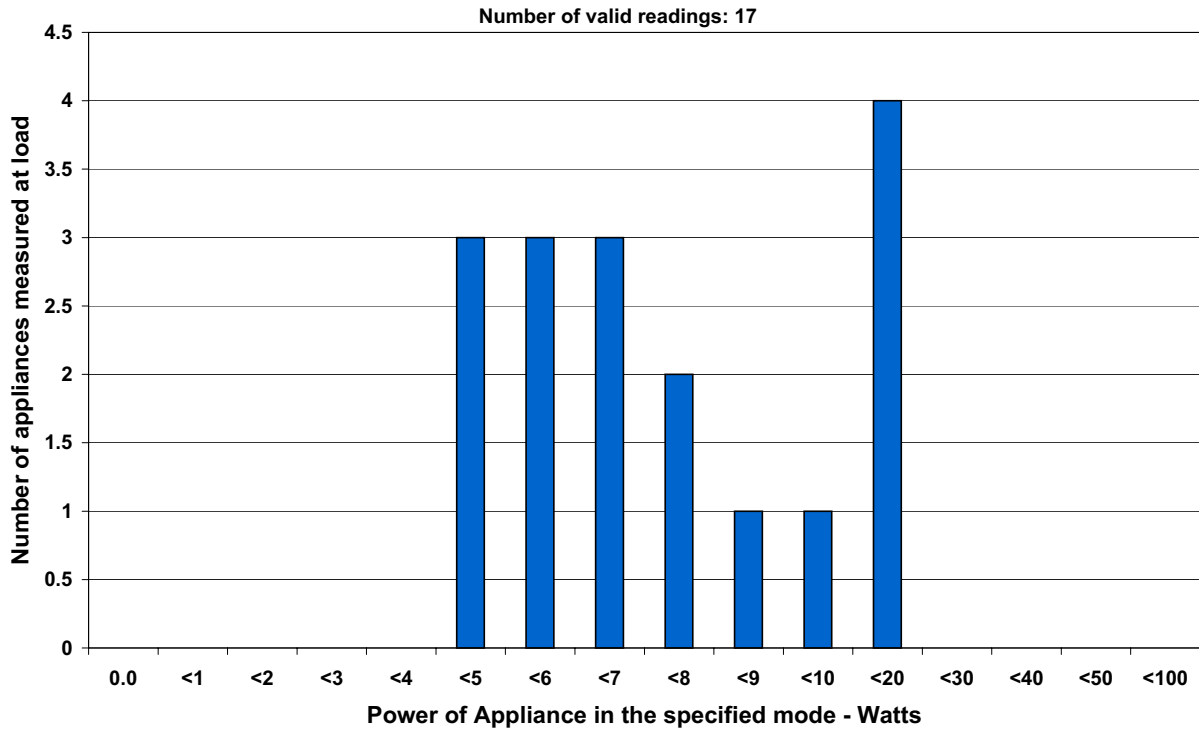
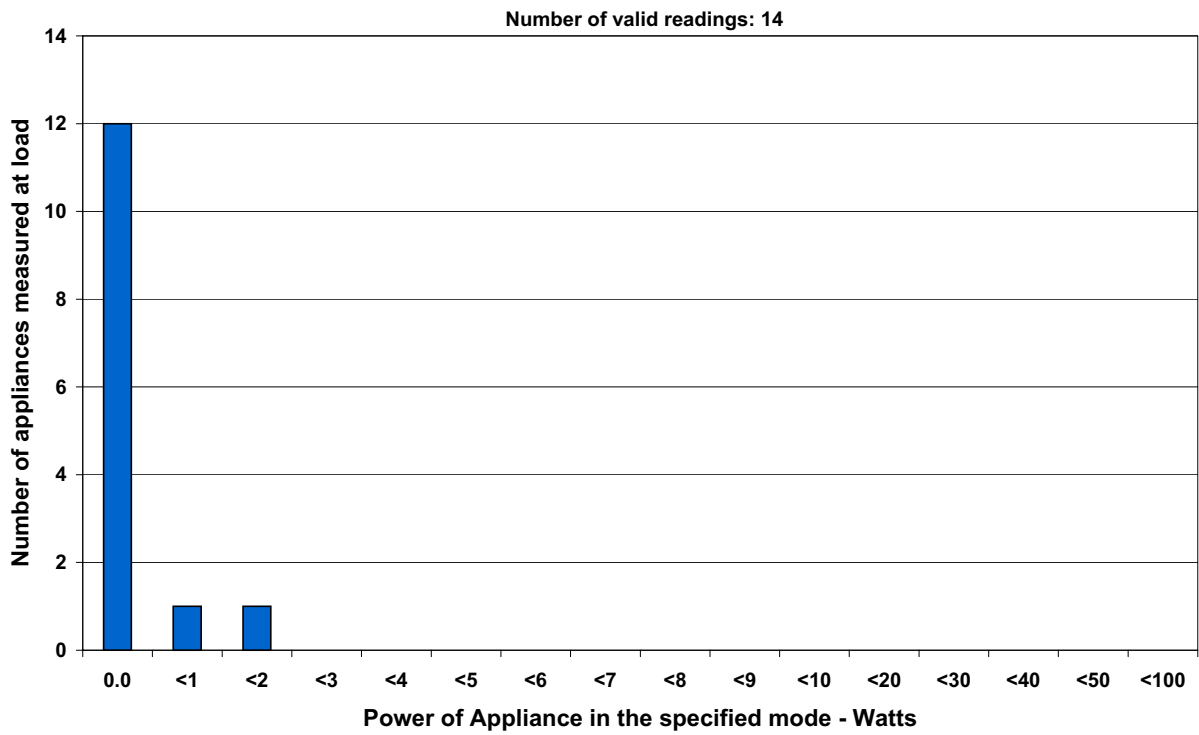


Figure 34 – Power measurements for compact discs: off mode



## STEREO RECEIVERS

Stereo receiver units contain an inbuilt tuner and an amplifier for use with other components such as CD players and tape decks. The units tested did not include units with audiovisual capacities such as those designed for home theatre. A total of 4 units were tested.

Stereo receivers were tested in 3 modes; in use - set to tuner, passive standby and off mode. When in use the average power was 19.3W with a moderate power factor of 0.68 and a low average crest factor of 2.4. The maximum consumption was 23.1W with the minimum at 15.8W with the other units

measuring 19W and 19.4W. In passive standby mode the average power was 1.4W. There was just under 1W difference between the 4 units at 1.9W, 1.5W, 1.2W and 1.0W. Average power factor was moderate at 0.54 and average crest factor was low at 2.18. Only 1 model had a power off mode and it recorded zero consumption in this setting. Table 26 summarises the results.

Although there were some receivers in the 2000 intrusive survey, these were recorded with other types of stereo equipment so this data cannot be separately analysed.

Table 26 – A summary of stereo receiver results

Appliance:	Stereo - Receiver					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	4	19.3	0.68	2.40	23.1	15.8
Active	0	NA	NA	NA	-	-
Passive	4	1.4	0.54	2.18	1.9	1.0
Off	1	0.0	0.02	1.50	0.0	0.0
<b>Total Number of Units</b>	4					

## STEREO TAPE DECK

A total of four tape decks were measured during the survey. Tape decks were measured in active standby and in off mode. When in active standby the tape decks had an average power consumption of 6.8W with a moderate power factor of 0.7 and low average crest factor of 1.8. Maximum power consumption was 10.7W and the minimum was 4.5W with remaining units at 4.7W and 7.1W. The units used substantially less in off mode with an average power of 1.1W. Two units had the maximum power consumption of 2.2W and the remaining two units were measured at zero. The

average power factor was 0.3 and average crest factor of 1.8 both being low readings. Table 27 summaries these results.

No tape decks were measured during the 2001 in store survey.

The intrusive survey in 2000 measured off mode and active standby mode data for 27 tape decks installed in residential houses. Average off mode was 1.0W while average active standby was 11.0W. There appears to be no substantial change or trend in off mode while there may be a decrease in active standby power, but the small sample in 2002 makes these trends rather uncertain.

Table 27 – A summary of stereo tape deck results

Appliance:	Stereo - Tape Deck					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	0	NA	NA	NA	-	-
Active	4	6.8	0.71	1.83	10.7	4.5
Passive	0	NA	NA	NA	-	-
Off	4	1.1	0.31	1.83	2.2	0.0
<b>Total Number of Units</b>	4					

## STEREO TUNER

Stereo tuners are the radio component of a sound system and have no built in amplifier. Only two stereo tuners were measured during the survey. The units were both measured in use, however one model had passive standby with no off mode and the other only had off mode. Both units measured 5.6W in use with a high average power factor of 0.83 and a low average crest factor of 1.85. The unit with passive standby only measured 3.8W with power

factor 0.78 and crest factor of 2.3. The model with off mode recorded zero consumption. These results are summarised in Table 28.

No tuners were measured during the 2001 in store survey.

Although there were some tuners in the 2000 intrusive survey, these were recorded with other types of stereo equipment so this data cannot be separately analysed.

Table 28 – A summary of stereo tuner results

Appliance:	Stereo - Tuner					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	2	5.6	0.83	1.85	5.6	5.6
Active	0	NA	NA	NA	-	-
Passive	1	3.8	0.78	1.80	3.8	3.8
Off	1	0.0	0.18	2.30	0.0	0.0
<b>Total Number of Units</b>	2					



## SURROUND SOUND AMPLIFIERS

Surround Sound Amplifiers are “home theatre” units that consist of a number of output channels suitable for both audio and visual (VCRs and DVDs) equipment. Most of the models tested had inbuilt tuners while the others were purely amplification units. Most of the models had remote operation.

Table 29 provides a summary of the results for the 26 surround sound amplifiers tested. When in use the average power consumption was 48.3W with a maximum of 88.2W and a minimum of 28W. The

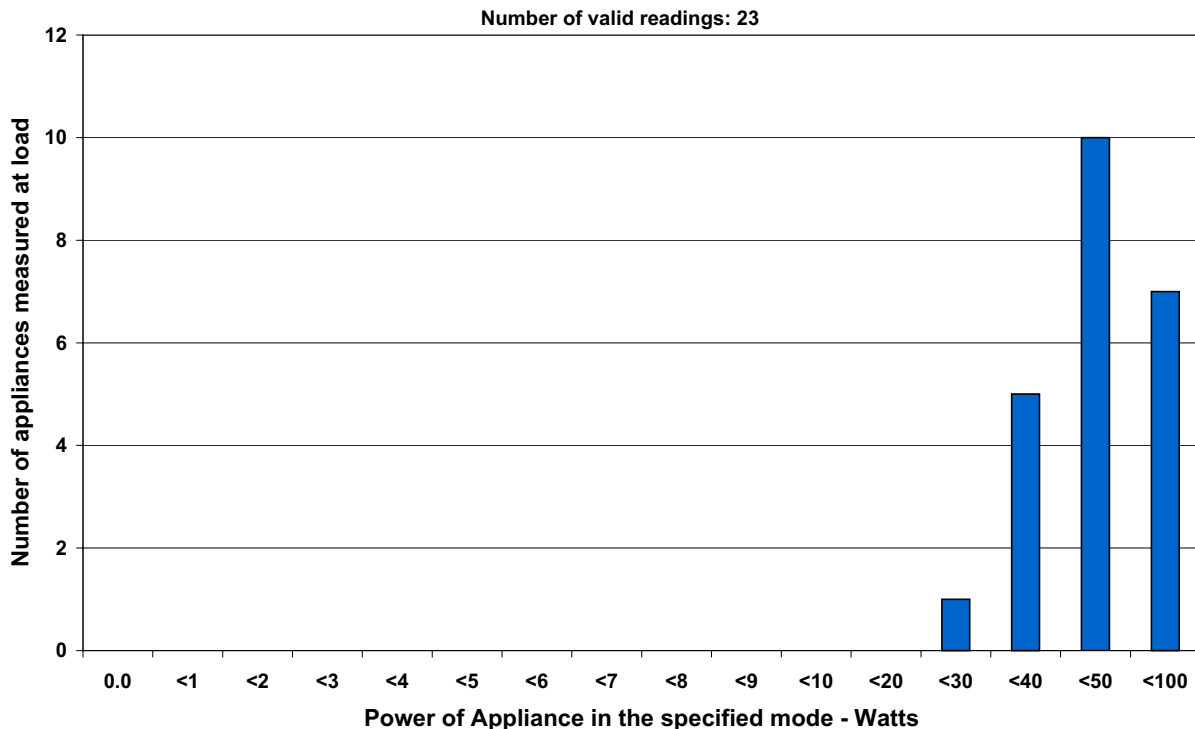
average power factor was moderate at 0.74 with a low average crest factor of 2.42. A total of 22 units had were able to be tested in passive mode with the average power being 2.1W. The highest consumption in the mode was recorded at 10.9W with the lowest 0.6W. Again the average power factor was moderate at 0.64 and the average crest factor was low at 1.87. Most surround sound amplifiers had an off mode with 19 units being tested in this status. The average power consumption was 0.2W with a high of 0.8W and a low of zero. Both average power factor and average crest factor were low at 0.26 and 2.31 respectively.

Table 29 – A summary of surround sound amplifier results

Appliance:	Surround Sound Amplifier					
Mode	Number of Measurements	Average Power (W)	Average Power Factor	Average Crest Factor	Power Max	Power Min
In Use	26	48.3	0.74	2.42	88.2	28.0
Active	0	NA	NA	NA	-	-
Passive	22	2.1	0.64	1.87	10.9	0.6
Off	19	0.2	0.26	2.31	0.8	0.0
<b>Total Number of Units</b>	26					

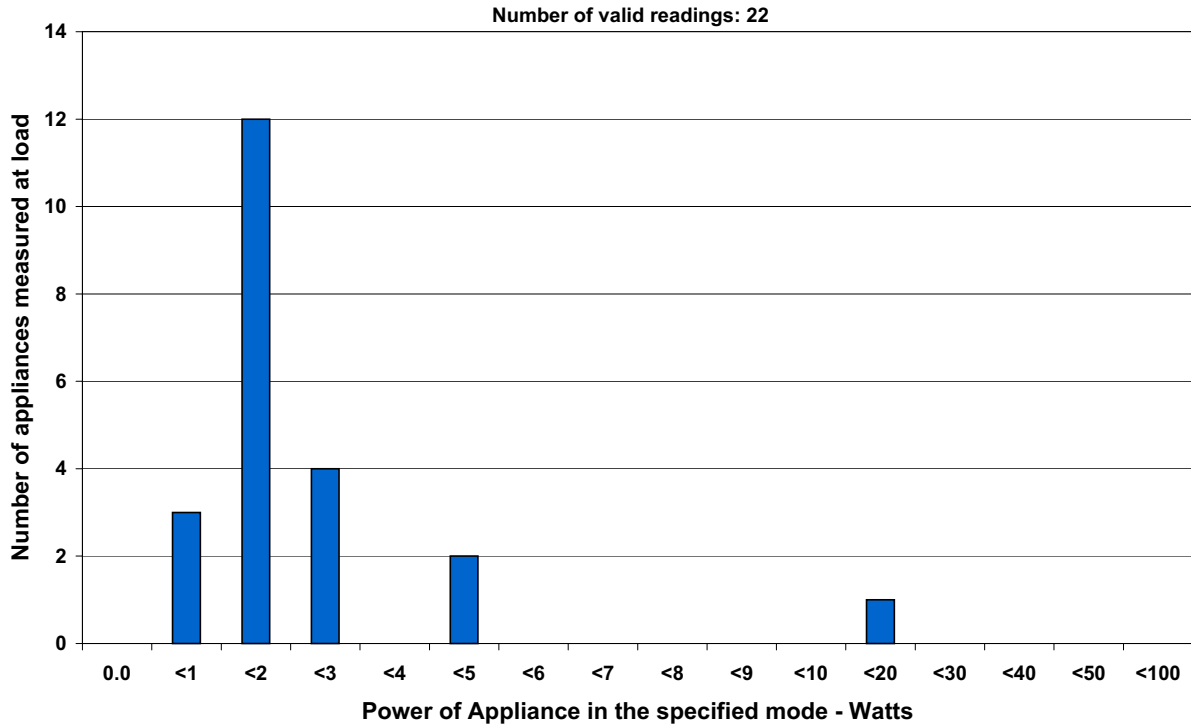
The range of in use power measurements for surround sound amplifiers is demonstrated in Figure 35. When in use most units (19) consumed more than 40W with only 2 models using less than 30W.

Figure 35 – Power measurements for surround sound amplifiers: in use mode



As set out in Figure 36 only 3 surround sound amplifiers recorded readings less than 1W in passive mode. However most models tested (12) consumed between 1W and 2W in this mode. This suggests that the higher consuming units especially the model that consumes more than 10W may be able to significantly improve their passive standby consumption.

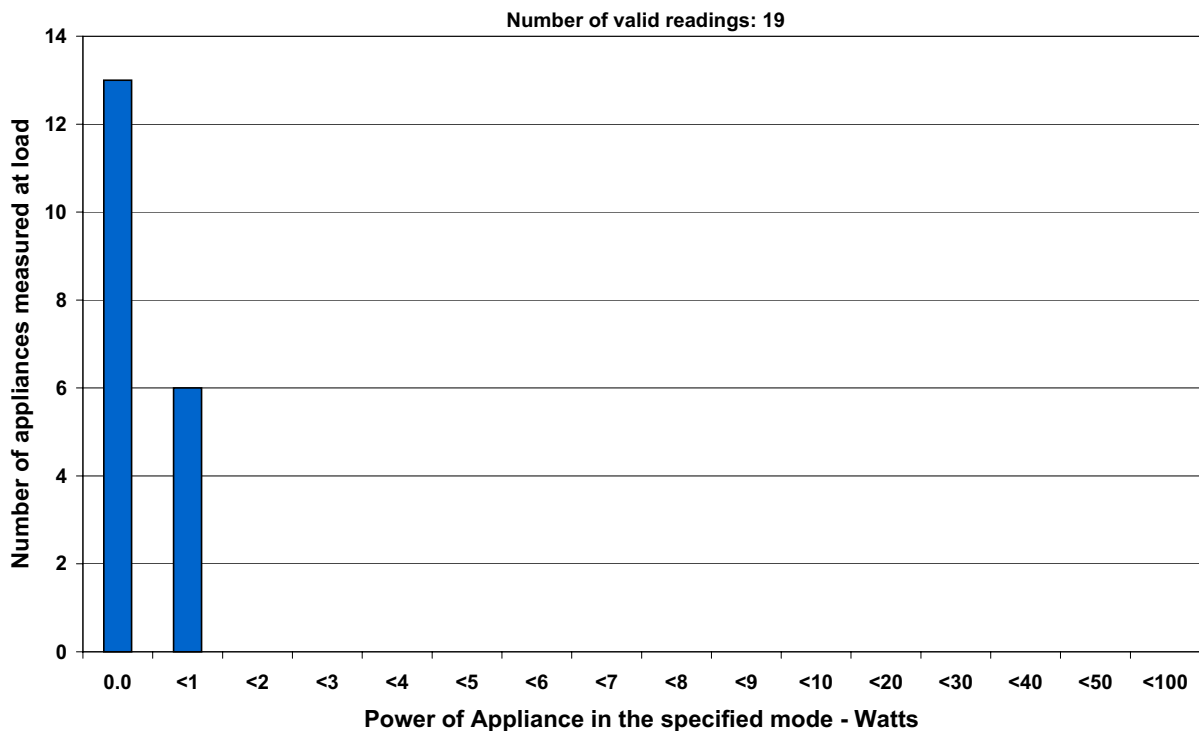
Figure 36 – Power measurements for surround sound amplifiers: passive standby mode



When in off mode all surround Sound Amplifiers consume less than 1W with the vast majority having no consumption. This is demonstrated in Figure 37.

Surround sound amplifiers were not measured during the 2001 in store survey.

Figure 37 – Power measurements for surround sound amplifiers: off mode



## References

Harrington and Kleverlaan, 2001 *Quantification of Residential Standby Power Consumption In Australia: Results of Recent Survey Work*, NAEEEEC.