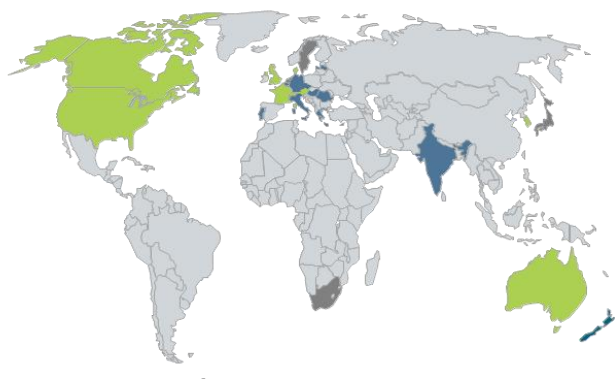


Technology: Standby Power



Participating countries:

Australia, Austria, Canada, Denmark, France, Republic of Korea, UK, USA

Other funding countries:

Netherlands, Japan, South Africa, Switzerland, Sweden

Other regions covered:

EU, India, New Zealand

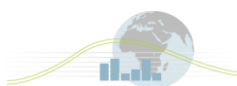
Benchmarking of the standby power performance of domestic appliances

Issue Date: July 2012

For further information refer to <http://mappingandbenchmarking.iea-4e.org/matrix>
or email operating.agent@mapping.iea-4e.org

Issue date: July 2012

The information and analysis contained within this summary document is developed to inform policy makers. Whilst the information analysed was supplied by representatives of National Governments, a number of assumptions, simplifications and transformations have been made in order to present information that is easily understood by policy makers, and to enable comparisons with other countries. Therefore, information should only be used as guidance in general policy - it may not be sufficiently detailed or robust for use in setting specific performance requirements. Details of information sources and assumptions, simplifications and transformations are contained within the document or the related Mapping Documents.



1 Summary for policy makers

This report describes trends in standby power for new product sales of ten household products, with a particular focus on televisions. It is the result of collaboration between the IEA 4E Annexes on Standby and on Mapping and Benchmarking.

The data set collated for this analysis covers samples of 156 different product types from 7 different projects or sources, including power measurements on over 26,000 new products. 75% of the measurements were made in shops. The top ten products/categories from that data set for which the most data are available account for over 70% of the total data set: Televisions, Home audio, Washing machines, Microwave ovens, DVD and Blu-ray players/recorders, Computer displays, Notebook PCs, External power supply (EPS), MFD (multifunction devices) and Set top boxes (STB).

The product category with most data is televisions with 9,600 products. The data show a consistent and significant reduction of average standby in new products from over 4W in 2000 to well under 1W by 2011. The countries and regions included represent around 45% of global television sales in 2011: Australia and New Zealand, USA, Republic of Korea, Canada, India and 13 countries of the EU. The Republic of Korea since 2001 and more recently the USA show consistently the lowest average standby power with between 20% and 50% lower than the average. Australia has the most consistent data which show that in 2007, two thirds of televisions had standby below 1W with the remainder ranging between 1W and 6W; by 2011, however, 99% were at or below 1W.

For eight of these ten products/categories average standby power has been less than 3W since 2007 in all countries for which data are available¹. The two higher standby power products are set top boxes (up to 25W) and home audio (up to 5W) for some countries in recent years.

Experts began warning of standby as a major energy issue on the late 1980s; the IEA formalised the challenge and policy options in 1999 with its 1 Watt plan. G8 ministers formally committed to address this challenge at their 2005 meeting at Gleneagles and thereafter followed a series of national plans, voluntary initiatives, labelling and regulatory measures applying to a rapidly expanding range of products.

The Republic of Korea government's early signaling of policy intent (2005 announcement of performance targets for some products set for 2010) and delivery of a comprehensive policy plan appears to have been highly successful. Furthermore, the failure of other markets to match this policy-driven improvement (although others may be improving thanks to more recent horizontal measures) implies that it is regulation, and the signaling of regulation, that

¹ Except 2008 average for TVs in India which was 6W.

has pushed this market further and faster than conventional commercial product development alone.

Policy approaches culminated in 'horizontal' measures applying to most electrical and electronic products in the EU in 2010 and expected in Australia from 2013 (not yet confirmed at May 2012). Following specific measures for the priority products, horizontal measures applicable to most or all other products appear the most appropriate approach now, given the proliferation of so many types of electrical and electronic goods that are constantly evolving.

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2 Introduction

This report describes evidence on standby power for samples of new products from several product categories gathered from 6 countries/regions of the world. It is the result of collaboration between the IEA4E Annexes on Standby and Mapping and Benchmarking. Analysis was carried out during late 2011 and early 2012.

Over 26,000 measurements of standby performance data were collated covering samples of 156 different product types, all being new products at the date of measurement. The majority arose from national and collaborative international projects and programmes to measure the power demand of products in shops. Around 40% of measurements came from an Asia Pacific Partnership project and around one quarter from the European SELINA project. This data was supplemented from a few other sources such as government databases for televisions in the Republic of Korea and the US state of California.

This report focuses on the top ten products/categories from that data set for which the most data were available. These together account for over 70% of the total data set (nearly 17,000 product measurements):

- Televisions
- Home audio
- Washing machines
- Microwave ovens
- DVD and Blu-ray players/recorders
- Computer displays
- Notebook PCs
- External power supply (EPS)
- MFD (multifunction devices)
- Set top boxes (STB)

3 Overview of data used and analysis process

3.1 Data sources

The data set collated for this analysis contains nearly 37,000 power measurements on over 26,000 products and came from 7 different sources:

1. Asia-Pacific Partnership (APP) standby project (11,000 products, see <http://www.energyrating.com.au/standbydata/app/Default.aspx>)
2. SELINA (EU project) dataset (6,000 products, see <http://www.selina-project.eu/>)
3. California Energy Commission televisions datasets (5,000 products, see <http://www.appliances.energy.ca.gov/QuickSearch.aspx>)
4. Standby data provided to Mapping & Benchmarking project (televisions only, 1,500 products, mostly for the Republic of Korea with some UK).
5. Indian data set from measurements in shops for 2010/2011 (1,070 products, supplied by the Indian government Bureau of Energy Efficiency, Ministry of Power)
6. Australian in-shop measurement data set from 2010/2011 (1,030 products, supplied by the Australian government Department of Climate Change and Energy Efficiency)
7. Canada CBEEEDAC² in-shop measurement project for 2011 (700 products, supplied by Natural Resources Canada)

The majority of data (75%) were measured in shops, with 24% from government databases and a small amount from an independent test house. The data spans 1999 to 2012 but 60% of measurements were from 2007 to 2010 inclusive.

3.2 Data by country

Data covers 19 separate countries with 34% of the data from Australia and New Zealand, 28% from EU and 20% from USA. Canada, Republic of Korea and India accounted for 7% or less each.

For the purposes of presentation in these graphs and analysis the 13 European countries were grouped together and labeled as “EU13”. The countries concerned were: Czech Republic, UK, Denmark, Latvia, Austria, Romania, Portugal, Belgium, Hungary, France, Germany, Greece and Italy.

Significant omissions in terms of major EU27 populations are Spain and Poland.

The countries/regions shown in Figure 1 are represented in the complete data set (some further detail in Table 24 on page 40).

² Canadian Building Energy End-use Data and Analysis Centre (CBEEEDAC), see <http://www.cbeedac.com/about/index.html>.

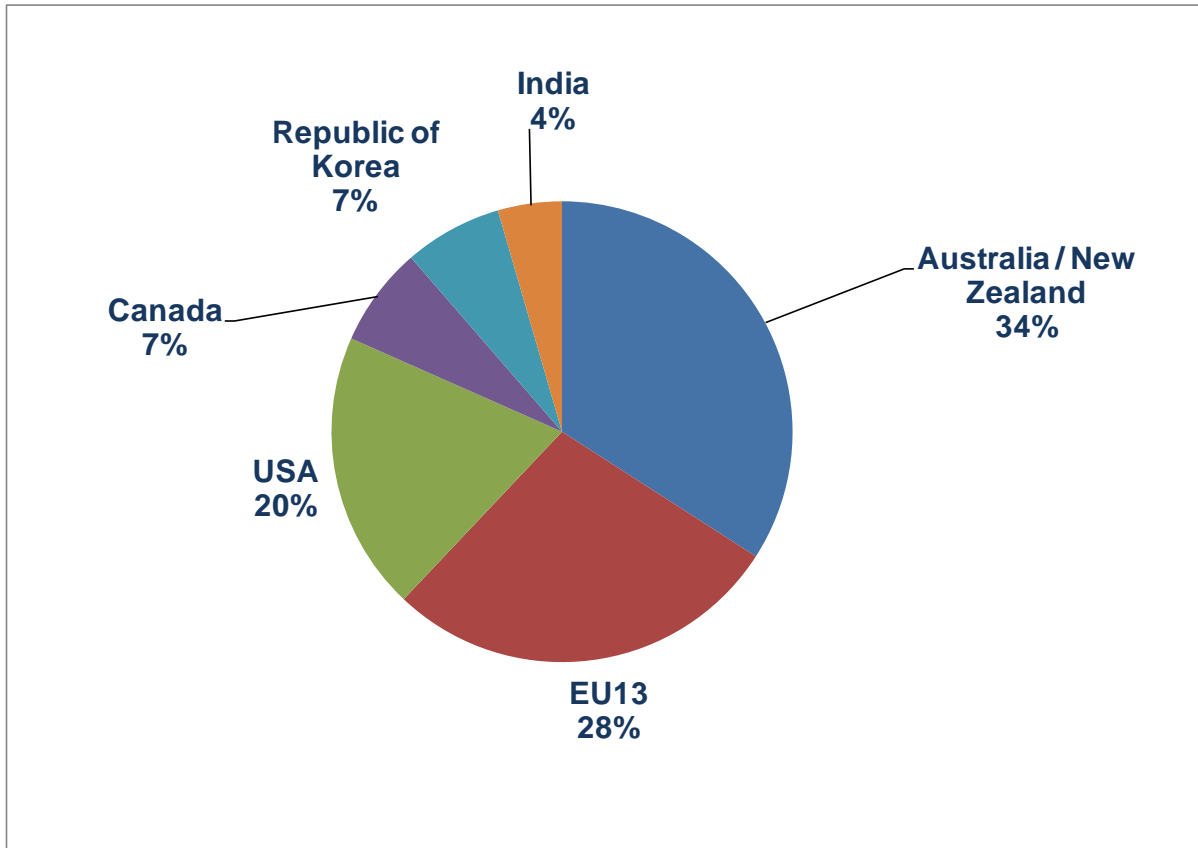


Figure 1. Sources of product data by country showing percentage of all products in the database.

Table 1. Summary of the data set sources for each country / region.

Country	Source(s)	Comments
Australia / New Zealand	<ul style="list-style-type: none"> APP data set (8,000 products) 2010/2011 in-shop measurements (1,000 products) 	
Canada	<ul style="list-style-type: none"> APP data set (1,100 products) CBEDAC 2011 in-shop measurements (700 products) 	
EU13	<ul style="list-style-type: none"> APP data set (Czech Republic and Hungary from 2008; 1,100 products) SELINA EC standby project (12 countries (not Hungary) from 2009 and 2010, 6,000 products) IEA 4E Mapping & Benchmarking data set on televisions (UK, 340 products) 	Czech Republic, UK, Denmark, Latvia, Austria, Romania, Portugal, Belgium, Hungary, France, Germany, Greece and Italy. (Missing large EU27 countries are Spain and Poland).
India	<ul style="list-style-type: none"> APP data set (2008 only, 120 products) India retail measurements (2010/2011, 1,070 products) 	

Country	Source(s)	Comments
Republic of Korea	<ul style="list-style-type: none"> APP data set (2007, 2008 and 2009, 430 products) IEA 4E Mapping & Benchmarking data set on televisions (1,200 products) Government database on home audio products (2006-2012, 260 products) 	
USA	<ul style="list-style-type: none"> APP data set (2008 only, 250 products) California Energy Commission database for televisions (2012 data set, 1,400 products) California Energy Commission database for televisions (historical data set 2005-2011, 3,600 products) 	California data set considered highly representative of whole USA for recent years; close match between APP and CEC averages for 2008.

3.3 Data by product and category

The main data set includes data on 156 different product (sub-)types, 26 of which account for 80% of the data. The top 20 product types by count of products included are listed in Table 2. For presentational purposes, these were grouped into 16 categories as shown in Figure 2. Full listings of product types included in the whole data set are shown in Table 25, Table 26, Table 27 and Table 28 starting on page 40. Only selected products and categories were analysed for this report – see section 3.4 *The selection process for priority products to present*.

Table 2. Top 20 product types ranked by count of products included (only a few of these were separately analysed, others combined into categories or not analysed).

Products	Count of products	% of all products
TV - LCD	3,699	14%
TV - unknown	3,601	14%
Washing machine	1,307	5%
TV - CRT	1,299	5%
Microwave	1,205	5%
Stereo - Integrated	931	4%
TV - Plasma	920	3%
DVD Player	798	3%
Computer display	748	3%
Notebook PC	690	3%
EPS	588	2%
Stereo - Portable	566	2%
Home Theatre System	499	2%
MFD	462	2%
Dishwasher	450	2%
Set Top Box	420	2%
AV Receiver	414	2%
Espresso Machine	330	1%
toaster	316	1%
Air Conditioner	301	1%
Other	7,055	27%
	26,599	100%

*AV Receiver is audio-visual amplifier and video signal router for home theatre.

Figure 2. Proportion of individual products included in the main product categories (details given in Table 3).

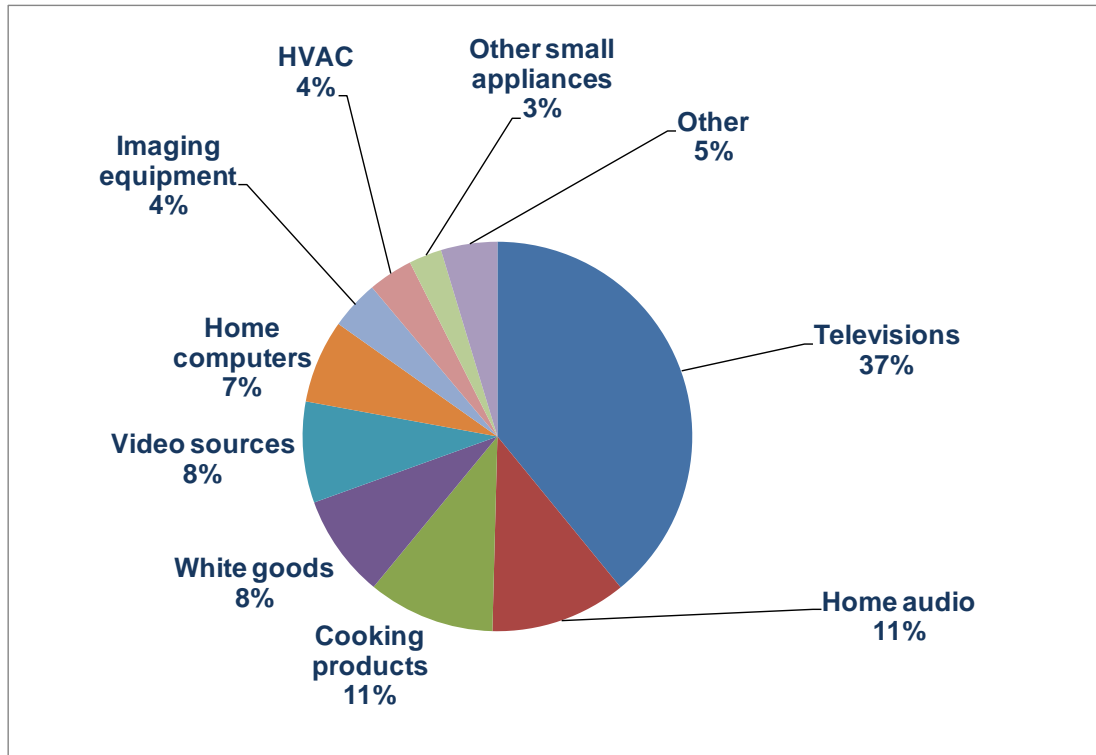


Table 3. Available product categories (only selected of these were analysed).

Categories	Number of product measurements	% of all product measurements	Products included
Televisions	9,763	37%	CRT, LCD, Plasma, LED and Projection screen types
Home audio	2,823	11%	18 types of audio players and sources (radios, CD/cassette decks, integrated stereo, home theatre, wireless speakers etc). Excludes portable products.
Cooking products	2,633	10%	44% of category is microwave ovens. Includes 39 types of cooking appliance that include a heating function (bread maker, grill, cook top, fondue, rice cooker, espresso machine, toaster etc)
White goods	2,132	8%	60% of category is washing machines; 22% dishwashers; 14% laundry dryers. Also includes some washer / dryers.
Video sources	2,094	8%	35% of category are DVD/Blu-Ray players; 21% Set Top Boxes. Also includes hard disk and DVD recorders, VCR.
Home computers	1,728	6%	Notebooks, desktops, displays
Imaging equipment	1,016	4%	Inkjet and laser printers, copiers, multi-function devices, scanners, fax machines.
HVAC	927	3%	Air conditioners, electric and gas heaters, dehumidifiers, humidifiers, range hoods and fans.
Other	3,482	13%	Other small appliances, External Power Supplies (EPS), Small kitchen appliances, Computing peripherals, Telephone, DIY, Games consoles, Other.
	26,599	100%	

3.4 The selection process for priority products to present

The main product types and categories (groups of similar products) for which data were available are summarised in section 3.3 *Data by product and category*.

The products selected for presentation of graphs in this report are actually a mix of individual product types and categories. These were chosen due to their combining:

- In or close to the ‘top ten products’ by count of product measurements, although MFDs and STBs had sparse data sets for which results should be treated with extreme caution (see section 3.6 for more on this subject)
- Extending over a period long enough to show medium-term trends
- Measurements from 3 or more countries, to make comparison worthwhile
- Some reasonable policy significance or other interest value as examples of standby power
- A reasonable consistency of results (i.e. not badly skewed by apparently spurious or inconsistent measurements or changes in the mix of product types included)
- A reasonably homogenous group of product types such that plotting an average had some policy significance.

On this basis the selected product types/categories for analysis were those listed in Table 4. NB In all cases the number of measurements analysed is less than the number of products measured; this is because either:

- The number of products in a category, region and year were too small or
- Data for the power mode selected for analysis was not available for that product.

See 3.7 Generic data analysis approach for all products and 3.8 About television data sets and their analysis for details.

Some graphs do show significantly varying averages for certain years or countries with no obvious explanation. Such cases could not be adequately investigated within the resources of this analysis.

Table 4. Products and categories prioritised for inclusion in this report.

Product	Percentage / number of all products	Number of measurements analysed
Televisions – LCD, Plasma, LED, CRT and ‘unknown’ screen technologies.	37% 9,800	9,277
Home audio includes integrated stereo music centres, radios, CD/cassette decks, home theatre, wireless speakers. Not portable	11% 2,800	2,104
Washing machines, top loading and front loading	5% 1,300	1,179
Microwave ovens	5% 1,200	1,058

Product	Percentage / number of all products	Number of measurements analysed
DVD and Blu-ray players/recorders: includes DVD and Blu-ray players and player / recorders, but not portable and home theatre	5% 1,200	1,025
Computer displays	3% 750	623
Notebook PC³	3% 690	535
External power supply (EPS)	2% 590	511
MFD (multifunction devices) - Imaging products combining scanner, printer and often fax for home and home office use.	2% 460	295
Set top box (STB)	2% 420	359
Total	72% 19,210	16,966

The small number of priority products shown in Table 4 account for the majority of the data in the whole data set. Of these, significantly more effort was exerted to analyse the televisions data, being by far the largest data set (see section 3.8 *About television data sets and their analysis*). Other types of printer had at least one third less product measurements than MFDs.

The remainder of the products account for just under 90% of the list of product types but only 28% (7,400) of the 26,300 total products included. None of these remainder products had more than 400 measurements each for all countries and all years; nearly three quarters of these product types had less than 100 measurements each; 40% of them had less than 10 measurements. In most cases this gives highly restricted trends or country/regional spread, often combined with low numbers of readings in each data bin. Analysis of these remainder products could possibly yield some meaningful results for specific policy research purposes but is unlikely to be of general interest and was not pursued for this report.

3.5 How representative of total standby consumption are the included products?

It has been estimated that the products in the whole data set account for at least 80% of the standby consumption of an average Australian home, based upon comparison with a home energy survey of 2005⁴ which is summarised in Table 5. By similar estimation, the products covered probably account for approaching 80% of the standby demand of a Korean home in

³ Notebook PCs were the focus of a separate benchmarking report which has analysed idle and sleep mode performance. See <http://mappingandbenchmarking.iea-4e.org/matrix>.

⁴ From 2005 Intrusive Residential Standby Survey Report, Prepared by Energy Efficient Strategies, March 2006 Report for E3 2006/02.

2011, as per Table 6. Note that all of these measurements relate to new products – not products in the stock.

Table 5. Contribution of major product type to household standby in 2005 from Australian intrusive survey⁵, also showing which of these are largely covered in the data set.

Product category	% of household standby accounted for by category	Covered in standby data set?	Implicit proportion of household standby covered by the available data set
Computers and peripherals	27.5%	Yes, well represented.	27.5%
Major appliances	11.5%	Yes - Washing machine, dishwasher and dryer, plus cooker(s) and HVAC.	11.5%
Televisions	6.5%	Yes.	6.5%
Set top boxes	3.5%	Yes.	3.5%
Other home entertainment	19.5%	Yes - home audio, other video sources, games consoles.	19.5%
Telephones and other office equipment	7.5%	Yes.	7.5%
Monitoring and continuous appliances ⁶	9%	No. Limited representation of some products.	-
External power supplies	3%	Yes.	3%
Other items with standby mode	4.5%	Yes – many other minor appliances are covered.	4.5%
(Unknown)	7.5%	-	-
Total	100%		83.5%

Table 6. Top ten sources of standby power demand in the Republic of Korea according to a 2011 household survey⁷.

Product	Percentage of total household standby	Covered in standby data set?
Boiler	17.4%	No
Set top box	9.4%	Yes
Rice cooker	9.2%	Yes, to a limited extent
Air conditioner	7.0%	Yes, to a limited extent
Microwave oven	6.9%	Yes
PC desktop	6.8%	Yes
Computer Modem	6.2%	Yes, to a limited extent
Television	6.0%	Yes
Wi-Fi system	4.1%	No
Washing machine	2.5%	Yes
Others	24.5%	Yes

⁵ From 2005 Intrusive Residential Standby Survey Report, Prepared by Energy Efficient Strategies, March 2006 Report for E3 2006/02.

⁶ This covered fish tank and pool equipment, remote doorbells, security systems, sensor lights etc.

⁷ Presentation made by representative of KERI to IEA 4E Standby Annex meeting, '2011 Standby Status of Korea: Did 1W policy work well in Korea?', Sydney 2011.

Total	100%
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3.6 Important cautions for interpreting and using mapping and benchmarking information

Considerable efforts have been taken to ensure the integrity of the data supplied and the subsequent data manipulation and analysis. To give readers an indication of the (relative) reliability of particular sets of data, a framework for quality grading of data has been developed that is used across all of this project's outputs. This generic approach is summarised in Annex 3 *Framework for grading mapping and benchmarking outputs* and is based on a scale consisting of Robust, Indicative and Illustrative.

The data in this study is based on sampling of very different numbers of products in differing numbers of shops with varying geographical distribution, combined with some variation in definition of modes etc. ***This makes data quality far more uncertain than with most products addressed so far in the Mapping and Benchmarking Annex.*** However, despite reduced confidence in the allocation, this report retains the 'robust', 'indicative' and 'illustrative' labels, while using an additional category of 'ungraded' in order to allow inclusion of some weaker data sets that may be useful to cross-compare with the main data sets.

For ***standby data only***, the following grading definitions have been applied for each product / country combination:

- **Robust:** Sales-weighted data with an average of at least 60 products in each data bin. None of these data sets are considered robust as none is sales-weighted.
- **Indicative:** Average count of products across those country / product / year data bins containing data is over 60. Shown on graphs as joined with dashed lines.
- **Illustrative:** Average count of products across those country / product / year data bins containing data is over 25. Shown on graphs as joined with dotted lines.
- **Not graded:** Average count of products across those country / product / year data bins containing data is between 6 and 25. These data sets are shown on graphs as individual points but not joined by lines.
- Not shown on graphs: Data bins containing 5 or less products.

These definitions can only be broad estimates but are based on assumptions about the size and variability of the product populations and the likelihood of skew in the samples.

When interpreting any graph, these gradings should be borne in mind along with the actual count of measurements per year shown in the tables accompanying each graph. The variation in count of products is particularly important when trying to judge the reliability of any apparent trend. Readers should not consider these gradings for standby data to be consistent with gradings shown in Mapping and Benchmarking Annex reports for other products.

The main cautions and sources of uncertainty relevant to all of the standby data sets considered are described below. No quantification of these uncertainties has been attempted:

- i. **None of the data in this analysis are sales weighted.** All are simply measurements from products appearing on certain retail shop floors or in government databases and so may not reflect actual country averages⁸.
- ii. Types of product measured may **not be representative of the full market** for any given product, year, country or combination. I.e. both the sample of retailers participating and the products selected within any shop may be skewed by price range, manufacturers included, quality, technology, style etc.
- iii. The **number of products** in each measurement sample varies significantly by product, by year and by country. Measurement counts of **less than 5 were ignored** (not plotted on the graphs) as being highly non-representative.
- iv. **Product mix varies from year to year.** Trends must be treated with caution as product categories may not have the same mix of products in each year (e.g. proportion of sub-types of home audio products will vary from year to year). Similarly the brands/styles etc. of products measured within any single product type will also vary from year to year. Both situations could mask or transform any real trend – ideally measurements would be from a product mix (or weighting) that was proportionate to market sales. (This problem was carefully minimised for televisions – see section 3.8 *About television data sets and their analysis*).

The count of measurements for in each data bin varied from zero in many up to an overall maximum of 1,200 for televisions in 2011 for USA. The average for televisions across 1999 to 2012 for 6 countries/regions was 113 measurements per country per year; the next most populous category, home audio, averaged only 36 measurements per country per year. Washing machines (next most populous product type after LCD and ‘unknown’ televisions) averaged 20, varying between 0 and 250 per bin.

⁸ Although TV values were weighted by market proportion for each screen type i.e. LCD, plasma or CRT. See 3.8 About television data sets and their analysis

3.7 Generic data analysis approach for all products

The following generic steps were taken to clean and analyse the data which were used to derive the graphs in this report. Some additional steps and observations specific to televisions (which were analysed in more detail than other products) are described in section 3.8 *About television data sets and their analysis*.

1. Nomenclature (product / category name) was standardised across the datasets.
2. Products were grouped into categories appropriate for type of service provided to the user and similarity of basic function/components (see Table 3). For example, this resulted in a television category being composed of LCD, CRT, plasma and 'unknown' screen types.
3. Data from each project source were collated under a standardised set of operational mode headings: Passive standby; Off mode; Active mode; In use mode; Delayed start mode; Network standby mode. In each case, the closest match in definition was used. See section 4 *Test methodologies and metrics*.
4. For each prioritised product/category a decision was taken on which power mode would be the main focus of analysis – see section 4 *Test methodologies and metrics*. In each case, this was the mode for which the most readings were available for analysis.
5. For any given product, if the mode selected for analysis contained no data (blank entry) that item was ignored for the purposes of graphs and an average. If a zero was entered then this was counted in the calculation of average performance⁹.
6. Data bins (i.e. data for a particular product, country and year) that would require calculating an average consumption for 5 or less products were considered highly unreliable and discounted from the graphs and analysis.
7. No normalisation adjustments have been carried out. It is assumed that all measurements were taken using a power meter whilst the product under test was in the relevant mode and so no methodological differences should exist. Also, the majority of standby consumption involves only electronic controls and so supply voltage differences should have limited impact and not require normalisation. All readings were therefore assumed inherently comparable.

⁹ This approach was endorsed by the APP project managers who confirmed that a zero entry meant that the reading was lower than could be registered on the power meter used.

3.8 About television data sets and their analysis

Televisions have been and are currently a focus for standby power policy development in a number of countries/regions. The data on performance of televisions shown in this report were selected as the strongest sub-set and had particular focus in the analysis process to ensure best use of the data. The count of products by country and year is shown in Table 10 and the analysis process described in more detail below.

Figure 3 is based upon measurements from over 9,500 televisions. Averages for USA, EU13, Republic of Korea and Australia / New Zealand are based on over 1,100 measurements each; the data for India are based on around 450 measurements; those for Canada on 340 measurements. These countries and regions represent around 45% of global television sales in 2011¹⁰.

Most power data were separately recorded by screen technology (CRT, LCD, plasma). Rather than simply averaging the mix of CRT/LCD/plasma that happens to have been measured in each country/year, the datasets are weighted by sales of each technology type in each country/region (see step 3. below).

Three quarters of television measurements were taken in shops as part of government sponsored research projects using a comparable methodology, with one quarter from government databases (USA and Republic of Korea).

The following steps were taken to analyse the televisions data, over and above the steps already described in section 3.7 *Generic data analysis approach for all products*:

1. Passive standby was chosen for analysis and plotting of graphs for televisions. This is defined as when the television is not displaying an image but it is ready to be switched on (in most cases with a remote control). If no passive standby figure was available for that product (blank cell) then it was ignored; if zero entered it was counted as zero.
2. The 'televisions' category was composed of LCD, CRT and plasma screen televisions. LED and projection televisions had insufficient representation in the data sets (nor in the world market) to merit inclusion.
3. In calculating an average standby power for televisions, averages were first calculated for each screen type and country/year individually (e.g. for CRT televisions in USA for 2002 etc). Then the average power demands for each screen type were weighted in approximate proportion to market share of that screen type to arrive at an average for televisions for each country and year. For example, the proportions of global sales shown in Table 7 were used to sales-weight separate averages by

¹⁰ North America and Europe account for around 17% of global sales each in 2011, plus Australia and Republic of Korea and India adding another 11% approximately (DisplaySearch 2011 and Park, Phadke, Letschert et al. TV Energy Consumption Trends and Energy-Efficiency Improvement Options, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, International Energy Studies Group, July 2011 p17).

screen type for EU, USA, Canada and Australia; national market share data were sourced for other countries.

4. In general, if no data (or less than 5 measurements) were available for any of the main screen technologies of the time, a market-weighted average could not strictly be calculated and the data bin was dropped from the graph. However, for screen technologies that constitute only a small proportion of the market at that time (for example CRT televisions in later years; plasma in earlier years), their influence on the average is small and these products are less likely to be selected for measurement anyway. To avoid wasting data bins that are reasonably representative of the market, despite lacking data for one or more screen types, those types that constitute less than 10% of sales in that country/year were not required to have measurements included.

Note: on advice from a product specialist, it was concluded that 81 products recorded as “LED screen televisions” must have been LED back-lit LCD screen televisions¹¹. These have been reclassified as LCD TVs.

Table 7. Proportion of global television sales by screen type¹². Data for 1999 to 2004 (in italics) were extrapolated backwards from sourced data for 2005 to 2011.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CRT %	<i>100%</i>	<i>100%</i>	<i>100%</i>	<i>97%</i>	<i>94%</i>	<i>89%</i>	83%	69%	54%	41%	24%	16%	11%
LCD %	<i>0%</i>	<i>0%</i>	<i>0%</i>	<i>2%</i>	<i>3%</i>	<i>5%</i>	11%	22%	39%	51%	68%	78%	83%
Plasma (PDP) %	<i>0%</i>	<i>0%</i>	<i>0%</i>	<i>0%</i>	<i>0%</i>	<i>2%</i>	3%	4%	6%	7%	7%	6%	6%
Other screen types %	<i>0%</i>	<i>0%</i>	<i>0%</i>	<i>2%</i>	<i>3%</i>	<i>5%</i>	3%	4%	1%	1%	1%	0%	0%
total %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.8.1 Uncertainties specific to television data

These are the main cautions and sources of uncertainty specific to televisions:

- i. **Data for weighting by screen technology market share** for each country and each year are based on extrapolations and interpolations of incomplete market data. No sales data were available for some countries and sales were estimated by proportioning the sales from another country based on relative populations. See Table 7.
- ii. **Data for USA is mostly derived from a California state database** (California Energy Commission). Whilst this is not from measurements in shops as for most other

¹¹ Only two limited edition models of true LED screen TVs were on the market in 2009/2010, (personal communication, November 2011).

¹² DisplaySearch, Total LCD TV Shipments to grow to 188M Units in 2010, to surpass 260M Units by 2014, 29 June 2010, accessed 13 October 2010. Scaled from published graph.

datasets, the average for 2008 is highly comparable with US data that was derived from in-shop measurements. Discussion with a US consumer electronics expert confirmed that the Californian television market is highly representative of the whole US market, at least in recent years. Californian data has therefore been included in the graphs and analysis as 'US data'.

iii. **Data for the Republic of Korea is derived from a government database** of manufacturer's declared data not measurements in retail stores. The data are, however, subject to government surveillance and quality control.

4 Test methodologies and metrics

The majority of data collated for this study was measured in retail stores using a fairly sophisticated power meter. There are harmonised test methodologies for measuring standby power under laboratory conditions¹³ but their detail was not followed for this data. Of more significance is which operational mode the product was in during the measurement.

The definitions used in each source project (data set) are given in *Annex 1 Power mode definitions from each data set*. The definitions from the APP project (Table 21 on page 37) were adopted as the default and the basis of the standardised set of operational mode headings for this analysis:

- Passive standby
- Off mode
- Active mode
- In use mode
- Delayed start mode
- Network standby mode

In each case, the closest match in definition from the project source was used.

For each prioritised product and category a decision was taken on which power mode would be the focus of analysis. In each case, this was the mode for which the most readings were available for analysis – see Table 8. Many products had power measurements for more than one mode; for context, the total number of measurements in each mode are shown in Table 9.

Table 8. Mode of operation analysed for the priority products/categories.

Product	Mode analysed, with notes on definition
Televisions	Passive standby for which no image is showing but product is ready for re-activation by remote control
Home audio	Passive standby: no sound emitted or source actively running but ready to start playing on remote or mechanical switch; display and/or clock may be on
Washing machines	Off mode. Note increased uncertainty for WM due to existence of extra standby modes (passive standby / off / delayed start timer / left on mode after completion of wash) – extra risk of misallocation.
Microwave ovens	Passive standby: clock or display on, but no cooking or timing occurring.
DVD and Blu-ray players/recorders	Passive standby: off but ready to be switched on remotely; clock or display may be on
Computer displays	Off mode: no picture displayed, with manual switch to off position/status. Can only be switched on by manual intervention
Notebook PC¹⁴	Off mode: the lowest power mode that cannot be influenced by the user and is the

¹³ A significant example is BS EN 50564:2011, Electrical and electronic household and office equipment. Measurement of low power consumption.

¹⁴ Notebook PCs were the focus of a separate benchmarking report which has analysed idle and sleep mode performance. See <http://mappingandbenchmarking.iea-4e.org/matrix>.

Product	Mode analysed, with notes on definition
	closest comparable state to most other products included in this report.
External power supply (EPS)	Passive standby: product is connected to power but not providing power to the device (which may be attached or not)
MFD (multifunction devices)	Off mode: Product is connected to power but display is off, can be woken by network signal or manual switch.
Set top box (STB)	Passive standby: product is not providing video signal; display may be showing clock or other status; can be switched on by remote control or signal from network/cable (e.g. for data download).
All other products	Off mode (66% of these products had off mode power recorded versus only 29% with passive standby).

Table 9. Count of measurements for each mode of operation for all products.

Mode	Count of entries with figure (including zero)	% of all products with a figure for that mode
Power - Passive standby(W)	16,932	64%
Power - Off mode (W)	10,247	39%
Power - Use mode (W)	2,567	10%
Power - Active mode (W)	6,417	24%
Power - Delayed start mode (W)	952	4%
Network standby mode (W)	112	0%
Total	37,227	

5 Time series graphs by product / category

5.1 Televisions

Figure 3. Average passive standby power for Televisions (CRT, LCD and plasma) measured in Watts.

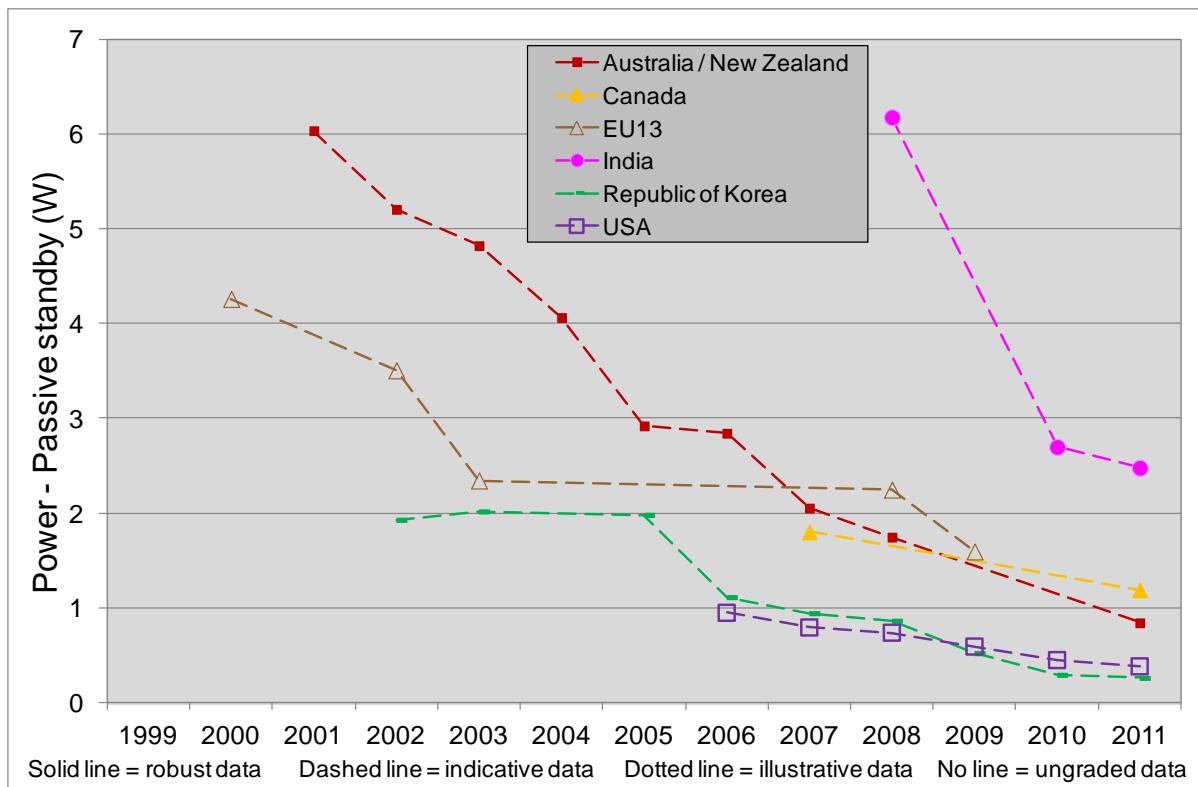


Table 10. Television data availability by country / region and by year, showing combined total number of models for CRT, LCD and plasma screens with data quality grading (see section 3.6).

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver.	Data Grade
EU13	72	15	71	46	42	131	798	175	1,350	169	Indicative				
India								44	242	161	447	149	Indicative		
Australia / New Zealand	134	102	176	146	107	65	179	58	56	16	140	1,179	107	Indicative	
USA						807	498	823	882	615	1,242	4,867	811	Indicative	
Republic of Korea	5	41	59	50	112	205	225	265	223	Aver*	Aver*	1,187	132	Indicative	
Canada								156				185	341	171	Indicative
Total	72	139	158	306	196	265	1,077	1,100	1,321	1,959	1,048	1,728	9,369		

* Average data quoted from a report, not calculated by the Operating Agent from individual product data.

Passive standby is the metric used, for which no image is showing but product is ready for re-activation by remote control.

Figure 3 shows a consistent and significant reduction of average passive standby power from over 4W in 2000 to well under 1W by 2011.

The Republic of Korea shows consistently the lowest average standby power throughout this period with between 20% and 50% lower than the average. These levels are matched closely by US performance from 2006 onwards. There appears a likely link between the beginning of the Korean standby campaign in 2005 and the resulting consistent and rapid reduction in standby power, achieving or matching the lowest average of nations surveyed. Similarly the significant drop in standby for the EU in 2009 could be attributed to the introduction of MEPS in that year.

In Figure 3, the relatively high average for India in 2008 at just over 6W probably reflects product type variations (some anecdotal evidence suggests that many televisions in India have built in sub-woofers), or of technology in the products that has been displaced from other markets reviewed. This includes the persistence of CRT screens in India, which has been sustained much longer than in many other countries: India had 95% CRT screen sales in 2008¹⁵ which had reduced to 60% in 2011 (compared to global averages of 41% and 11% respectively – see Table 7). The data shows a significant improvement to less than 3W in 2010 and 2011.

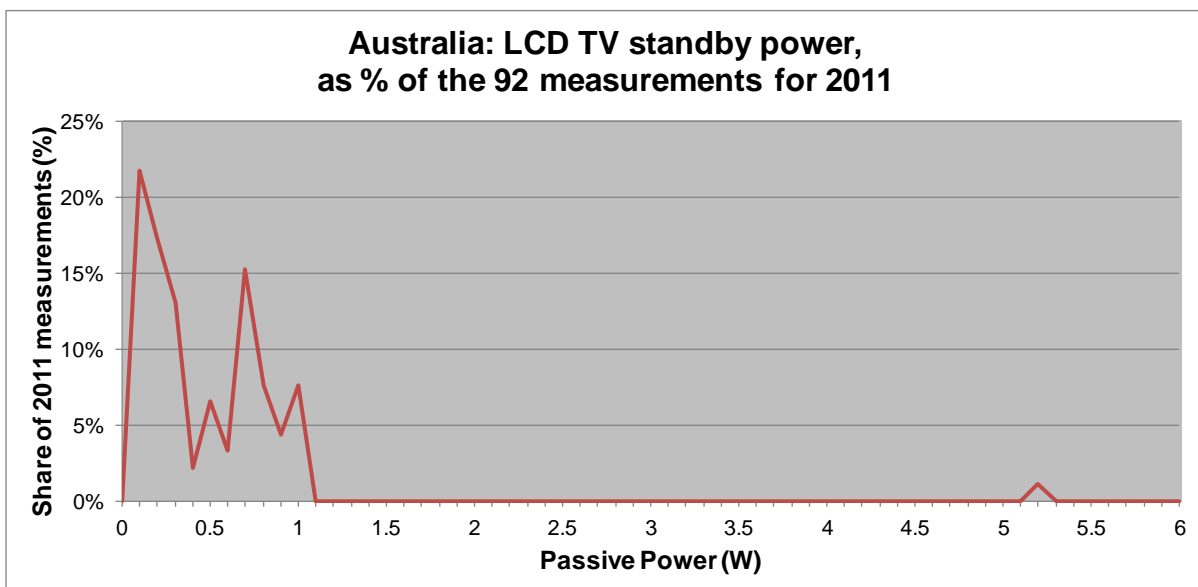
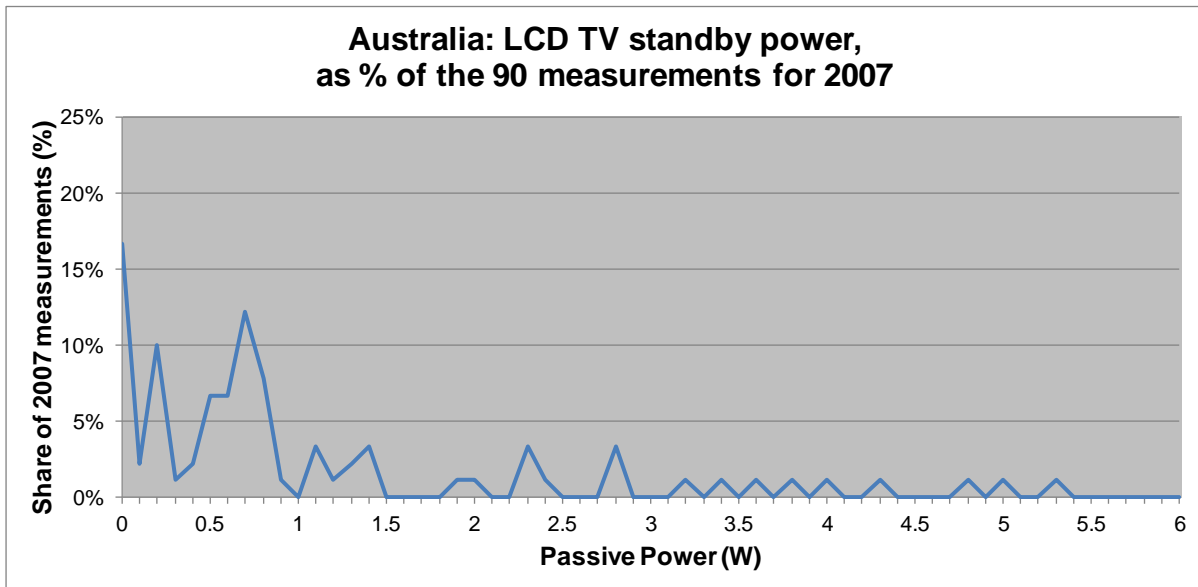
The graph (Figure 3) shows simply an average for each data bin, but the spread of standby power demand within each data bin has also changed over time. The upper histogram of Figure 4 shows that whilst many televisions in 2007 in Australia had standby power less than 1W, around one third ranged between 1W and 6W. The 2007 data set also contains three products between 6W and 20W. By 2011, however, 99% were at or below 1W. The 2011 set does include one isolated product at 5W.

Note that IEA 4E Mapping and Benchmarking Annex published a benchmarking report on televisions in 2010¹⁶. That document includes some limited standby analysis, but has its main focus on on-mode consumption.

¹⁵ TV Energy Consumption Trends and Energy-Efficiency Improvement Options, Young et al., LBNL, Environmental Energy Technologies Division, International Energy Studies Group (commissioned for the SEAD initiative), July 1 2011, Fig 2-10 (quoted from DisplaySearch, 2009).

¹⁶ IEA 4E Mapping and Benchmarking Annex, Benchmarking Document: Televisions, October 2010, see <http://mappingandbenchmarking.iea-4e.org/matrix>

Figure 4. Histogram of passive standby power for Australian LCD televisions, normalised as a percentage of the dataset in 2007 (upper chart) and 2011 (lower chart). 2007 data included 3 televisions above 6W; 2011 had none above 6W.



5.2 Home audio

Figure 5. Average passive power for home audio products, measured in Watts.

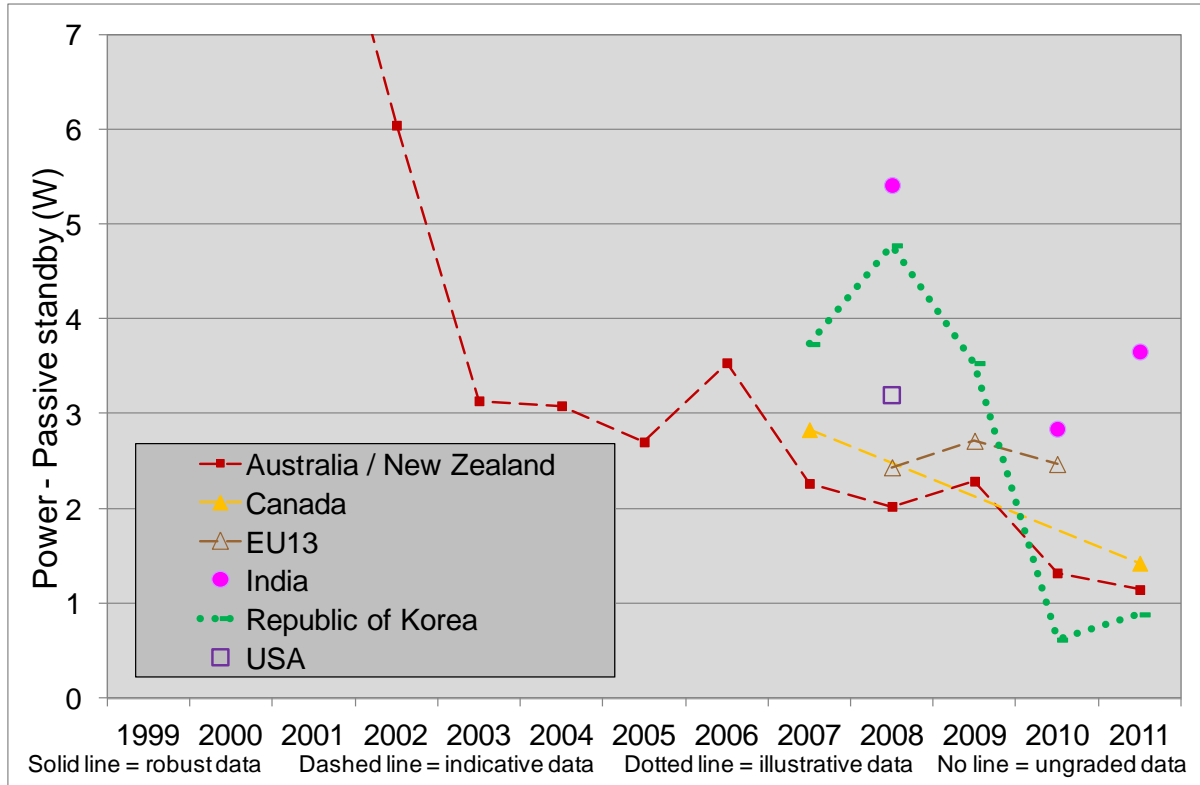


Table 11. Home audio products data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver.	Data grade
EU13								77	529	170		776	259	Indicative
India								11		44	14	69	23	(ungraded)
Australia / New Zealand	89	78	222	184	223	161	198	52	77	38	98	1,420	129	Indicative
USA								22				22	22	(ungraded)
Republic of Korea						2	9	17	19	105	93	297	41	Illustrative
Canada							120					119	239	Indicative
Grand Total	89	78	222	184	223	163	327	179	625	357	324	2,823		

Passive standby is the chosen metric: no sound emitted or source actively running but ready to start playing on remote or mechanical switch; display and/or clock may be on. This product group includes 18 types of audio players and sources (radios, CD/cassette decks, integrated stereo, home theatre, wireless speakers etc). It excludes portable products which would have lower power demands. Australian data shows an average of just over 9W for 2001 (off the scale of this Figure, constrained to be consistent with other figures).

It is difficult to discern a clear and robust trend for any other than the Australian data set, which is heading down from over 6W in 2002 to approaching 1W by 2011.

5.3 Washing machines

Figure 6. Average off mode power for washing machines, measured in Watts.

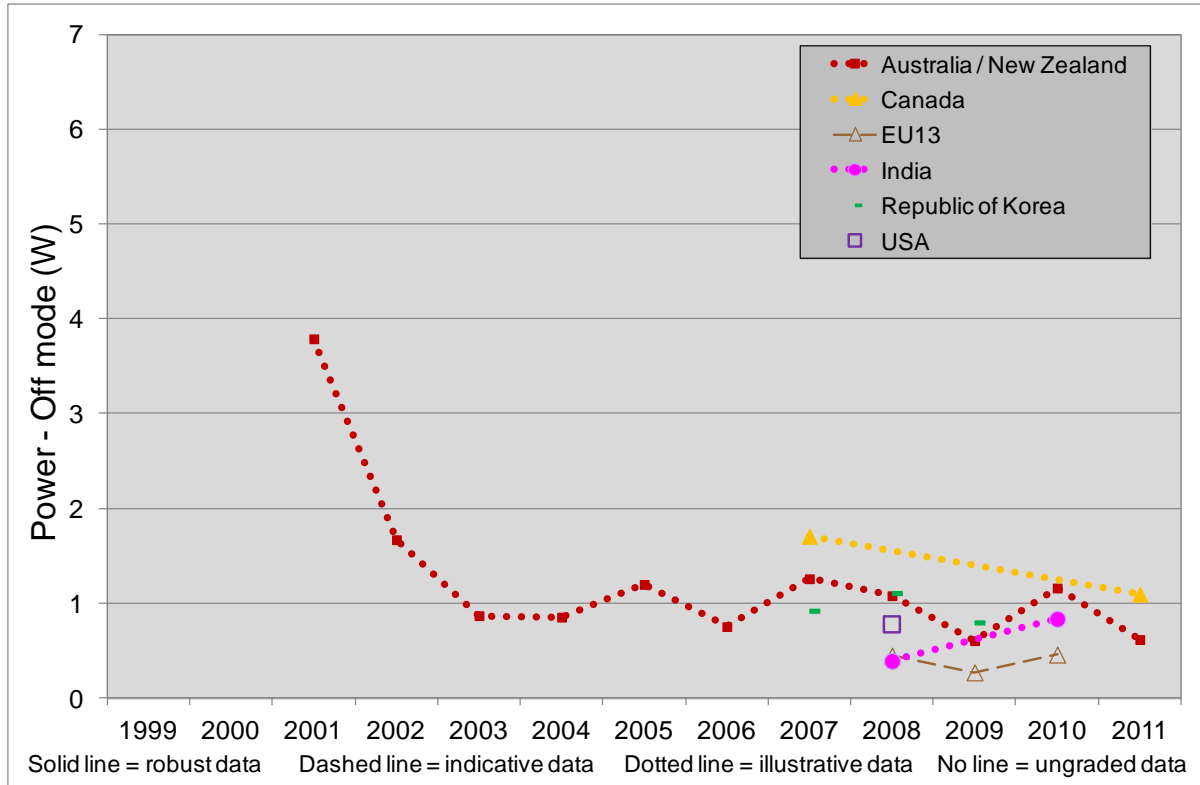


Table 12. Washing machine data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13							86	251	78			415	138	Indicative
India								10		65		75	38	Illustrative
Australia / New Zealand	36	77	115	96	54	22	82	28	48	19	80	657	60	Illustrative
USA								12				12	12	(ungraded)
Republic of Korea							30	12	24			66	22	(ungraded)
Canada							11				71	82	41	Illustrative
Total	36	77	115	96	54	22	123	148	323	162	151	1,307		

Off mode is the chosen metric. Note that there is increased uncertainty for washing machines due to the existence of additional standby modes for this product (passive standby / off / delayed start timer / left on mode after completion of wash). There is therefore additional risk of misallocation. This product group includes front-load and top-load washing machines of all sizes.

Recent data from all regions is at or below 1W by 2010 / 2011.

5.4 Microwave ovens

Figure 7. Average passive standby power for microwave ovens, measured in Watts.

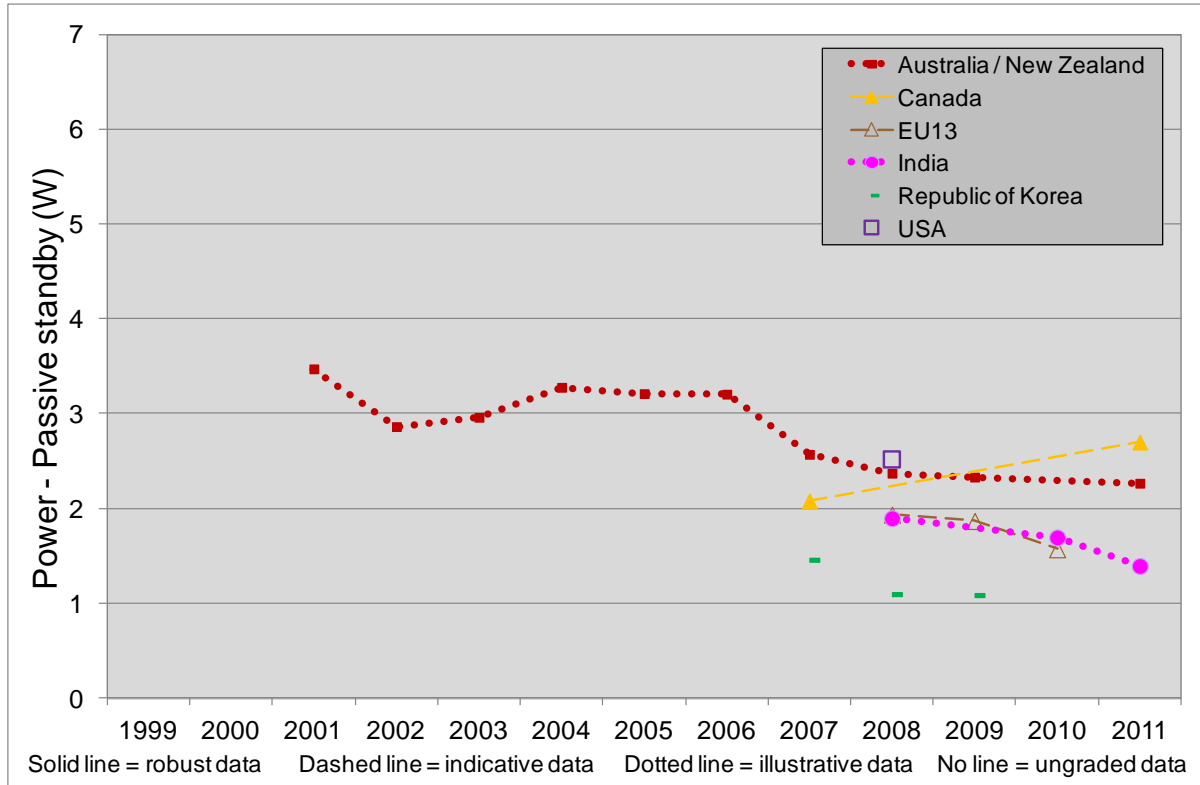


Table 13. Microwave oven data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								59	222	49		330	110	Indicative
India								23		75	40	138	46	Illustrative
Australia / New Zealand	60	60	83	76	58	64	51	24	31		24	471	53	Illustrative
USA								17				17	17	(ungraded)
Republic of Korea							13	15	17			45	15	(ungraded)
Canada							39				105	144	72	Indicative
Total	60	60	83	76	58	64	103	138	270	124	169	1,145		

Passive standby is the chosen metric: clock or display on, but no cooking or timing occurring.

Performance has shown little change 2007 to 2011 and persists around the 2W mark except for the Republic of Korea which has achieved 1W average.

5.5 DVD and Blu-ray players/recorders

Figure 8. Average passive standby power for DVD and Blu-ray players/recorders, measured in Watts.

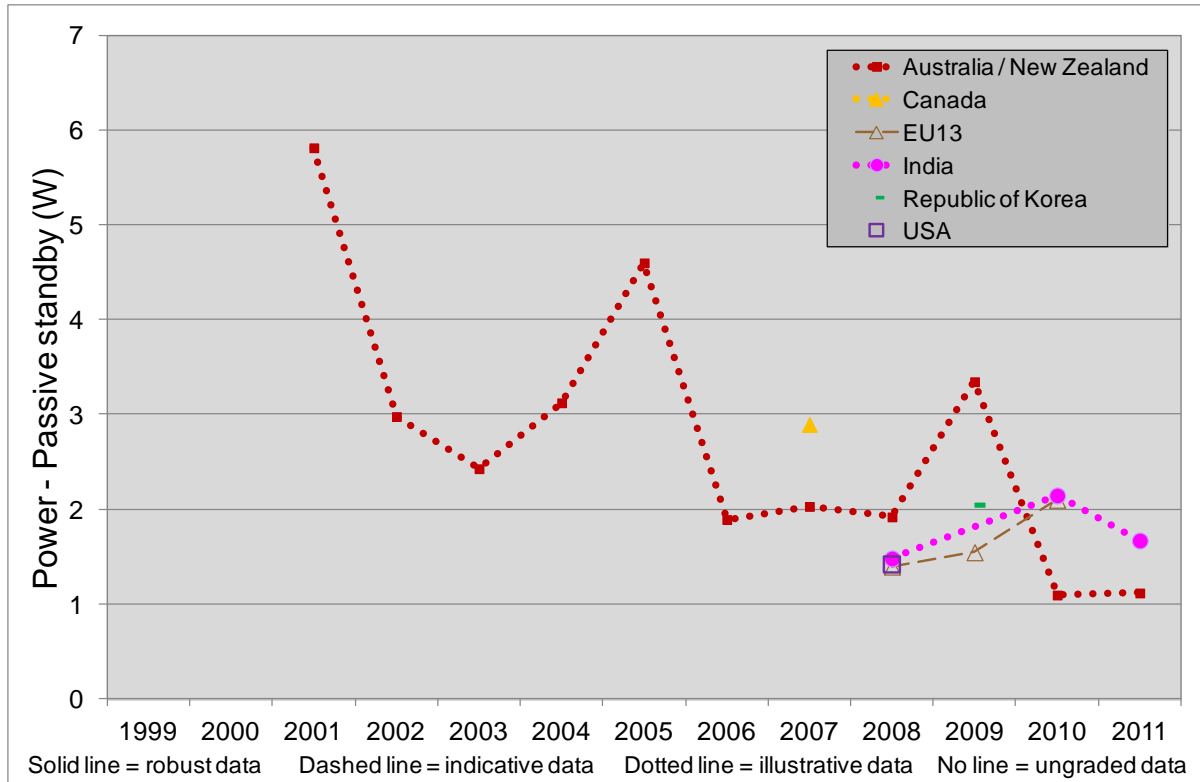


Table 14. DVD and Blu-ray players/recorders data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								69	167	84		320	107	Indicative
India								21		58	32	111	37	Illustrative
Australia / New Zealand	30	44	101	95	128	38	92	34	34	30	25	651	59	Illustrative
USA												23	23	(ungraded)
Republic of Korea									12			12	12	(ungraded)
Canada							82				13	95	48	Illustrative
Total	30	44	101	95	128	38	174	147	213	172	70	1212		

Passive standby is the chosen metric: product is off but ready to be switched on remotely; clock or display may be on. Performance persists at around 2W except for Australia at 1W. Possible reasons for the variation in standby for Australia and New Zealand include:

- The division of data for this analysis into calendar years (for simplicity) instead of into financial years used in the projects has distorted the planned product sampling (part of one batch collected in calendar year 2004 would be split from the remainder collected in early 2005).
- Recording and playing devices are bundled together although their standby power is different. The spike in 2004/2005 is when recording devices first appeared.

5.6 Computer displays

Figure 9. Average off mode power for computer displays, measured in Watts.

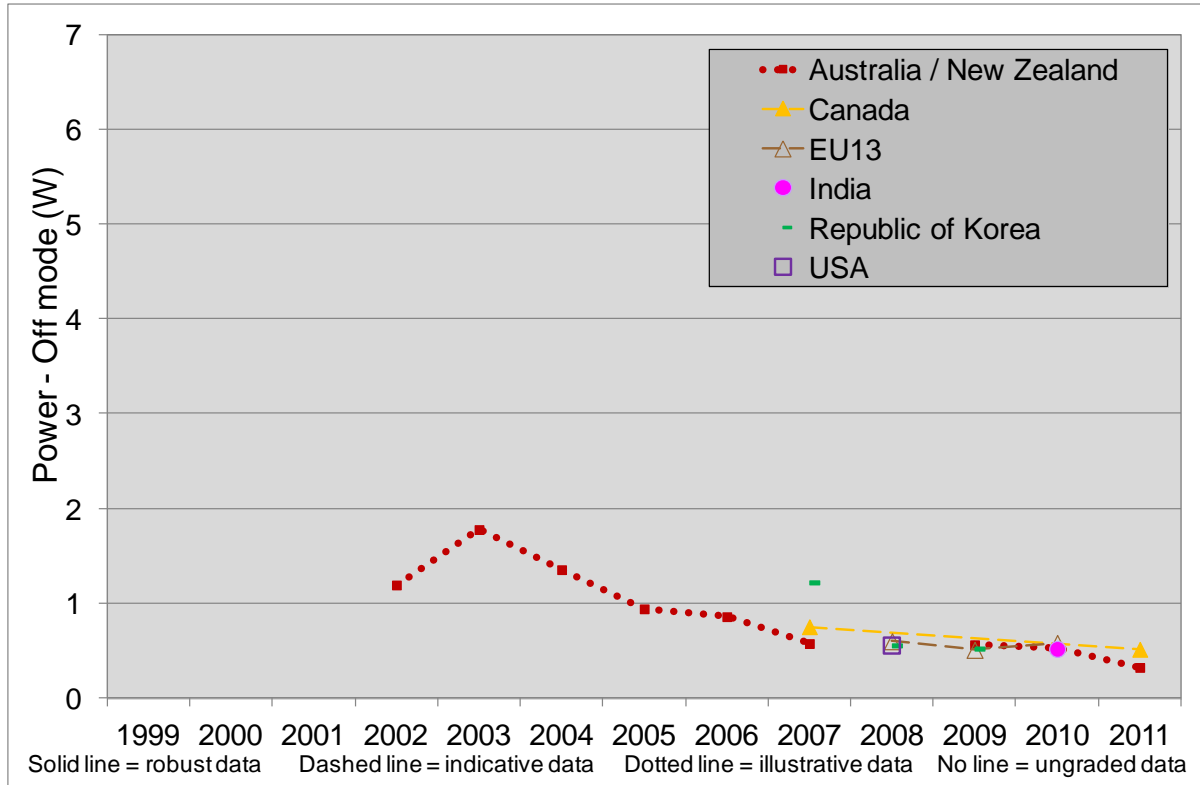


Table 15. Computer display data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								56	131	48		235	78	Indicative
India										20		20	20	(ungraded)
Australia / New Zealand		7	51	59	48	20	50		14	12	21	282	31	Illustrative
USA								20				20	20	(ungraded)
Republic of Korea							12	13	12			37	12	(ungraded)
Canada							81				69	150	75	Indicative
Total		7	51	59	48	20	143	89	157	80	90	744		

Off mode is the chosen metric: no picture displayed, with manual switch to off position/status. Can only be switched on by manual intervention.

Performance is extremely uniform at around 0.5W for all regions examined, and has been less than 1W since at least 2008.

5.7 Notebook PCs

Figure 10. Average off mode power for notebook PCs, measured in Watts.

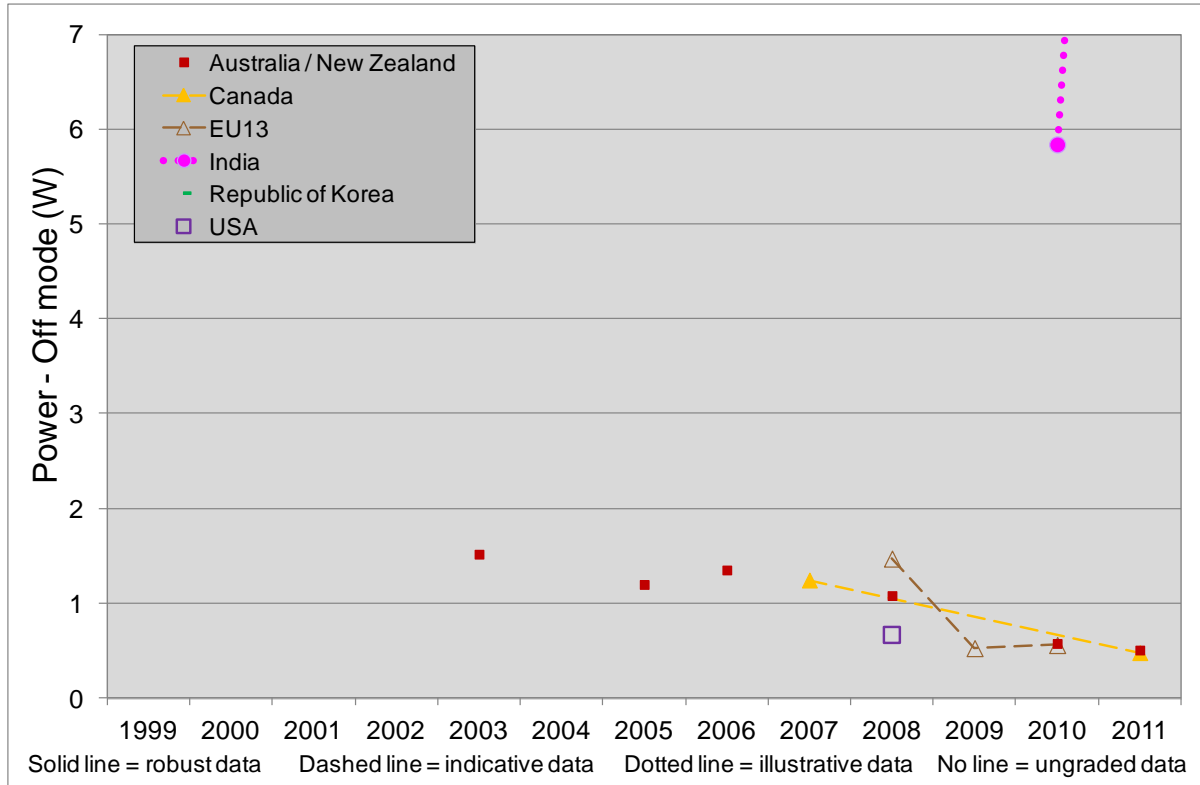


Table 16. Notebook PC data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								51	203	81		335	112	Indicative
India										45	13	58	29	Illustrative
Australia / New Zealand			27		7	8		20	11	29	21	123	18	(ungraded)
USA								11				11	11	(ungraded)
Republic of Korea														-
Canada							61					99	160	80 Indicative
Total	0	0	27	0	7	8	61	82	214	155	133	687		

Off mode is the chosen metric: the lowest power mode that cannot be influenced by the user and is the closest comparable state to most other products included in this report.

Product data for India is significantly out of step with other countries, at 5.8W (2010) and 18.5W (2011), but the sample size is not small. One possible explanation (backed up by anecdotal observation) is that the notebooks were not fully charged at time of measurement and so battery charging has inadvertently been included in the measurement. All other countries appear to have achieved close to or below 1W by 2009.

5.8 External power supplies (EPS)

Figure 11. Average passive standby power for EPS, measured in Watts.

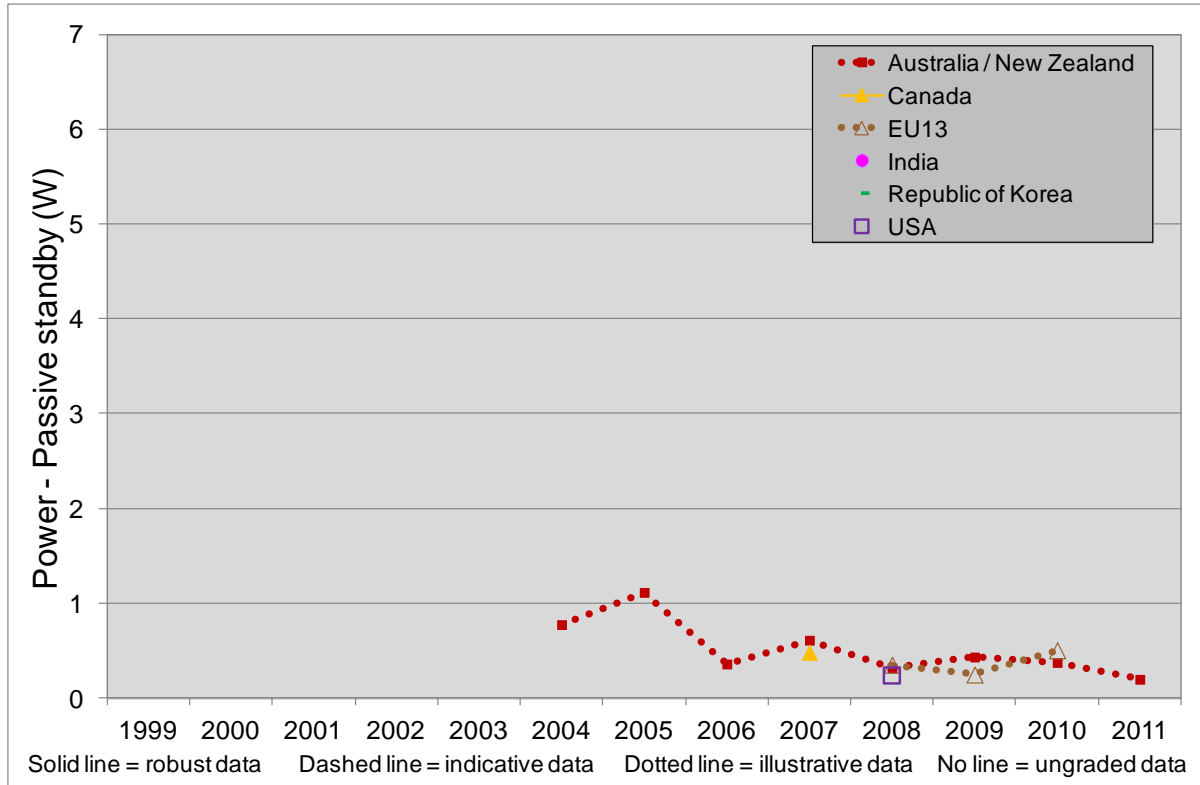


Table 17. EPS data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								50	79	50		179	60	Illustrative
India														-
Australia / New Zealand				11	34	25	22	26	19	42	44	223	28	Illustrative
USA								25				25	25	(ungraded)
Republic of Korea														-
Canada							159					159	159	Indicative
Total	0	0	0	11	34	25	181	101	98	92	44	586		

Passive standby is the chosen metric: product is connected to power but not providing power to the device (which may be attached or not).

Each region examined has achieved an average of below 1W since 2007.

Data for India has been removed due to fewer than 5 products measured in each of 2 years.

5.9 MFDs (multi-function devices)

Figure 12. Average off mode power for MFDs, measured in Watts.

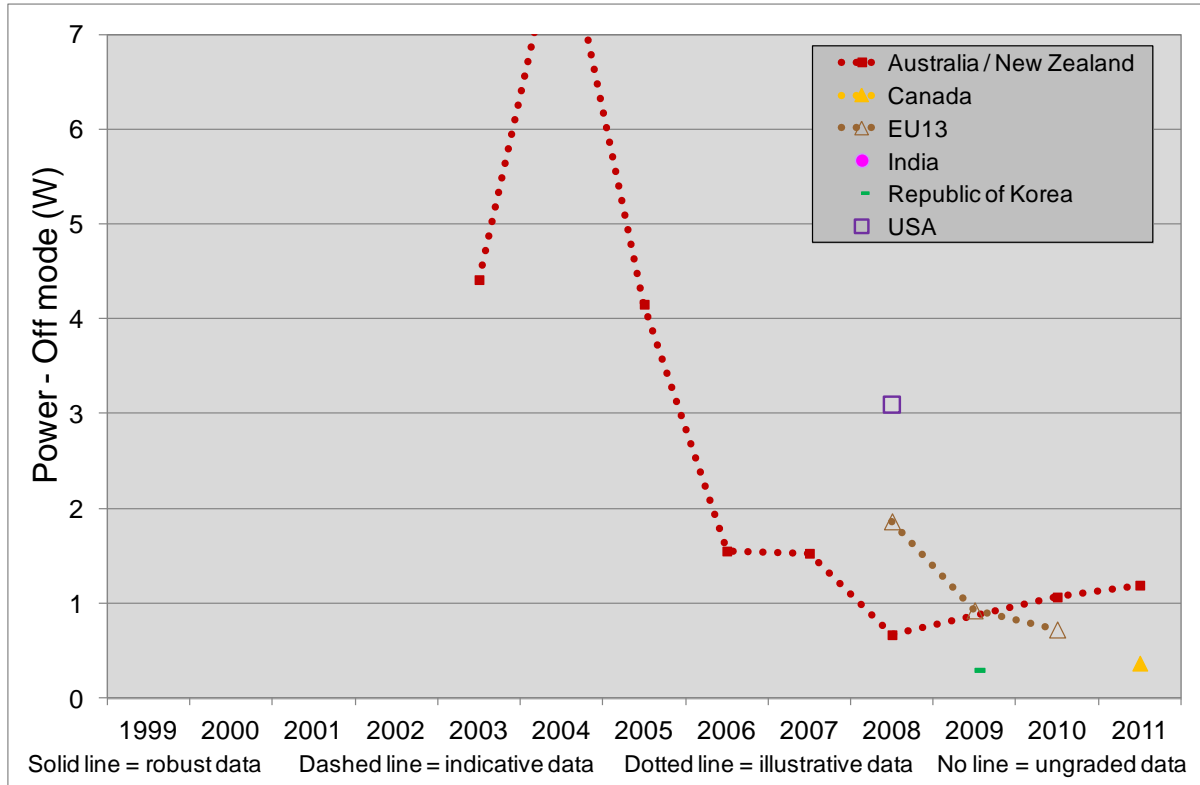


Table 18. MFD data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								50	26	27		103	34	Illustrative
India														-
Australia / New Zealand			25	20	56	36	50	7		22	23	239	30	Illustrative
USA								19				19	19	(ungraded)
Republic of Korea									8			8	8	(ungraded)
Canada							46				36	82	41	Illustrative
Total			25	20	56	36	96	76	34	49	59	451		

Off mode is the chosen metric: Product is connected to power but display is off, can be woken by network signal or manual switch.

The Australian figure for 2004 is 8.3W (off the scale of this figure; axis is constrained to be consistent with other product figures). No explanation for the high 2004 (or perhaps low 2003) value is apparent.

Overall performance is close to or below 1W for all countries with recent data.

5.10 Set top boxes (STB)

Figure 13. Average passive standby power for STBs, measured in Watts. (Note different vertical axis range compared to most other graphs).

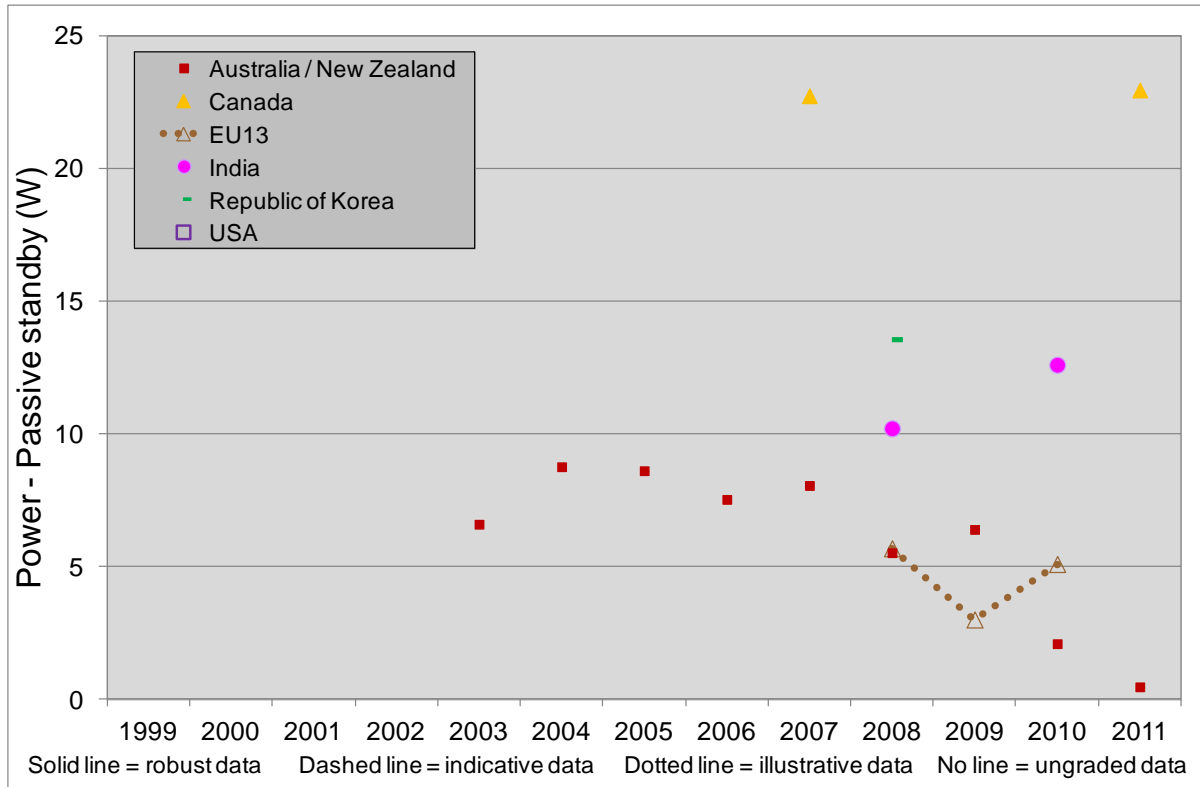


Table 19. STB data availability by country / region and by year with data quality grading (see section 3.6).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Aver	Data Grade
EU13								24	80	73		177	59	Illustrative
India										6		6	6	(ungraded)
Australia / New Zealand			16	43	44	21	34	16	12	7	20	213	24	(ungraded)
USA														-
Republic of Korea														-
Canada							7				8	15	8	(ungraded)
Total			16	43	44	21	41	40	92	86	28	411		

Passive standby is the chosen metric: product is not providing video signal; display may be showing clock or other status; can be switched on by remote control or signal from network/cable (e.g. for data download).

This product group showed very large variation in average performance (note that the power axis extends to 25W, not 7W as for other products). Canada’s average is just under 23W for 2007 and 2011; India has an average of 10W (2007) and 13W (2010); Republic of Korea at 14W. The reasons for this have not been investigated, but could (for example) be due to differences in functionality inherent in each market. Australia on the other hand appears to have achieved an average performance of below 1W by 2011.

6 Standby Policies

6.1 Overview of standby policies around the world

Table 20 summarises important policy milestones in addressing standby power demand around the world.

Experts began warning of standby as a major energy issue in the late 1980s; the IEA formalized the challenge and policy options in 1997 with its 1 Watt plan. The IEA 1 Watt plan provided a global policy approach template and is described in section 6.2 The IEA's 1W plan. G8 ministers formally committed to address this challenge at their 2005 meeting at Gleneagles and thereafter followed a series of national plans, voluntary initiatives, labelling and regulatory measures applying to a rapidly expanding range of products. Policy approaches culminated in 'horizontal' measures applying to most electrical and electronic products in the EU in 2010 and expected to take effect in Australia in 2013 (not yet confirmed at May 2012).

The Republic of Korea has perhaps implemented the earliest and most comprehensive policy plan, with undeniable success. It began with the launch of the 'Standby Korea 2010' roadmap in 2005 that laid out the problem and how the government, working with industry, planned to address it. Voluntary measures from 2005 lead to mandatory warning labels by 2008 and an expanding range of MEPS by 2009.

The EU began early with its voluntary code of conduct in 2001 and achieved the global first of a mandatory 'horizontal measure' in 2010.

In most countries, ministerial "messaging" to industry expressed the need to address standby power by design and was signaled several years in advance of regulatory measures, encouraging industry leaders to respond.

Horizontal measures applicable to most or all products are becoming established as the most effective means to tackle standby as the types of electrical goods available proliferate. Whilst there is a need for vigilance that measures are not undermined by evolving product functionality (such as rapid start standby for televisions), networked standby is emerging as the next significant issue for policy to address. The nature and implications of 'networked standby' are now being thoroughly investigated under several initiatives including the IEA 4E Standby Annex¹⁷, the SEAD initiative¹⁸ and in a European ecodesign preparatory study¹⁹. Possible mitigating measures include minimum standards are under consideration in Europe.

¹⁷ See <http://standby.iea-4e.org/>

¹⁸ Super-efficient Equipment and Appliance Deployment (SEAD) initiative, see <http://www.superefficient.org/>.

¹⁹ See <http://www.ecostandby.org/>.

Table 20. Chronology of key events and policies addressing standby²⁰, in particular relating to televisions.

Year	Policy or event	Comments
1986	First identification of standby as a significant energy issue	
1992	First ENERGY STAR specification addresses standby	Desktop computers, 30W limit (60W for integrated computers)
1997	European manufacturer voluntary agreement with the European Commission on standby for colour televisions and VCRs.	Standby <10W and sales weighted average <6W for each signatory by 2000 ²¹ .
1999	IEA 1-Watt plan	
2001	EU establishes voluntary code of conduct on standby for consumer electronics products	Covers set top boxes and external power supplies.
2001	IEA publishes study on the sources and scale of the standby challenge	<i>'Things that go blip in the night - Standby power and how to limit it'</i>
2002	Australia publishes standby plan	
2003	European manufacturers establish voluntary commitment for CRT and non-CRT televisions ²² .	Sales weighted <3W in 2005; <1W by 2007 for signatories
2005	Republic of Korea publishes 1-Watt plan	Roadmap 'Standby Korea 2010'
2005	International measurement methodology for standby ²³	IEC 62301.
2005	G8 leaders endorse the IEA 1-Watt target	In the 2005 Gleneagles Plan of Action
2006	California introduces 3W TV standby requirement	
2008	Republic of Korea – mandatory standby warning label for televisions in force	Expanded to further 6 products in 2009 plus 12 more in 2010.
By 2009²⁴	Standby MEPS in place in Australia and New Zealand, China, EU, Republic of Korea, USA. Standby labels in place in each of these plus Brazil and Japan	Cover various products, mainly consumer electronics.
2010	'Horizontal' MEPS at 1W in force in EU covering most electrical appliances for home and office use. Specific regulations for external power supplies and televisions	First major horizontal measure. 1W limit (2W if display is included) via the ecodesign directive.
2011	European Commission preparatory study into networked standby published	
2012	Standby MEPS in place in Canada for Compact Audio, Video and TV devices	
2013	EU MEPS require 0.5W standby. 'Horizontal' MEPS in Australia expected to require 1W standby.	EU: 0.5W limit (1W if display is included).

²⁰ General sources: Ellis presentation, India 2008; EU ecodesign Directives; IEA STANDBY POWER POLICY SUMMARY.

²¹ Voluntary agreement between EACEM and EC, as reported in 'Things that go blip in the night - Standby power and how to limit it', IEA, 2001, p42.

²² Industry Self-Commitment To Improve The Energy Performance Of Household Consumer Electronic Products Sold In The European Union, 1st July 2003

²³ IEC 62301 Household electrical appliances - Measurement of standby power

²⁴ Source: Gadgets and Gigawatts, Policies for Energy Efficient Electronics, IEA, 2009.

6.2 The IEA's 1W plan²⁵

In 1999, the IEA proposed that all countries harmonise energy policies to reduce standby power use to no more than one watt per device. The proposal contained 3 elements:

- Participating countries would seek to lower standby to below 1 watt in all products by 2010
- Each country would use measures and policies appropriate to its own circumstances
- All countries would adopt the same definition and test procedure

Follow-up processes to the G8, APP, APEC and CSD Marrakech accord have all called on Governments to make a greater commitment to the IEA 1-Watt standby target and other programs to tackle standby power.

As the number of products with a standby power component increases, dealing with each product separately is becoming less cost effective and it is growing more difficult to define products individually. The solution proposed by the IEA was to apply a uniform standby power requirement to all products (such as the 1-Watt target) – the so-called “horizontal approach”. This ensures that all devices are included by default, unless specifically excluded. No products should be permanently excluded; instead, a postponement would be granted, with an interim level set in the meantime. The EU became the first major region to enforce such a horizontal measure in 2010.

An IEA guiding principle²⁶ is that all devices should have the ability to automatically move to the lowest power needed for required functionality.

²⁵ From IEA Fact Sheet: Standby Power Use and the IEA “1-watt Plan”, April 2007

²⁶ IEA G8 Recommendation, 2007.

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6.3 Policy implications for televisions

Due to its much larger data set, trends for televisions have been analysed in detail; little analysis has been done for other products. The following policy implications have been identified:

- a) The success of the Korean early signalling and delivery of a comprehensive policy plan stands out in Figure 3 on page 21. The failure of other markets, except California, to match this policy-driven improvement implies that it is regulation and the signalling of regulation that has driven markets further and faster than conventional commercial product development alone.
- b) In overview, it appears that high level international commitments can have real and lasting impacts on policy and carbon emissions. An important example being the commitment by G8 ministers at Gleneagles in 2005. This appeared to cement the market improvements that followed the earlier IEA 1-Watt challenge.
- c) The lower part of Figure 4 on page 23 (for 2011) shows why regulation is still required despite the trend and average achieving under 1W in that 1% of products appear to be failing to comply. Regulation must protect the investment made by the majority of suppliers that comply and ensure a level playing field. This helps guarantee that energy savings are not undermined by non-compliant suppliers.

Annex 1 Power mode definitions from each data set

Note: Since the project work that generated the data in this analysis was completed, the IEC has published IEC 62087-BD ed. 3.0 *Methods of measurement for the power consumption of audio, video and related equipment*. This is the new harmonised global standard for standby measurements for audio / video equipment and is the methodology of choice for future work in this area.

Table 21. APP project definition of standby modes²⁷

Mode	Definition appearing in the APP Standby project guidance notes
Active Standby	Active standby is when the appliance is on but not performing its main function. For example, the DVD may be on but is not playing or recording. This mode is usually only present in devices (a) where there is a mechanical function which is not active (e.g. DVD drive or motor) but where power circuits are on, or (b) where a device has a battery and the device is charging or (c) where a device is in a quiescent power state (audio amplifier with no audio signal) or (d) the device is downloading data (STB or TV updating Electronic Programme Guide or software)
Passive Standby	When a product or appliance is not performing its main function (sleeping) but it is ready to be switched on (in most cases with a remote control) or is performing some secondary display function (e.g. has a display or clock which is active in this mode). This mode also applies to external power supplies for battery operated equipment (portable appliances)
Network Standby	TBA
Off Mode – Off	The product must have a power switch located on the product. Off mode is 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 – it can only be activated via the power switch on the product. No display should be active in off mode. While the product may be doing some internal functions in off mode (e.g. memory functions, EMC filters) these are not obvious to the user. An LED may be present to indicate off mode.
Delay Start or other Mode	Delay start is becoming common place on many major appliances. Essentially the appliance can be programmed to begin functioning at a later time; in some cases up to 24 hours later. Appliances left in this mode are in neither active nor passive standby and therefore this mode is measured as a separate category. (Note this is different to sleep mode where the timer is used to stop in use operation after a set period)

²⁷ Table copied from *Appliance Standby Survey Product Guide, Detailed Instructions of the International Standby Basket of Products Survey*, prepared for: Department of Climate Change and Energy Efficiency Australia, 13 April 2010, Prepared by: EnergyConsult with assistance from the SELINA Project. Version: Appliance Instructions V1.7.doc.

Table 22. Indian project definition of standby modes²⁸

Mode	Definition for that project
Active standby	[Not defined/used]
Passive standby	[Not defined/used]
Network standby	[Not defined/used]
Off mode	The energy using products is connected to a mains power source and is not providing any standby or active mode function. This situation may persist for indefinite time.
Delay Start	[Not defined/used]
Standby mode	The energy using product is connected to a power source and offers one or more of the following user oriented or protective functions which may continue for an indefinite period: ability to activate other modes (including active mode) by remote switch (including remote control), internal sensor, time; continuous function: information or status displays including clocks; continuous function: Sensor-based functions.
In use power	The power consumed by an appliance when it was on full or partial function.

²⁸ From Standby Power Basket: Report, Prepared by the students of TERI University, under the Summer Internship Project for Bureau of Energy Efficiency, New Delhi & Asia Pacific Partnership, July 2011.

Table 23. Canadian project definition of standby modes for specific products²⁹. Initial definitions were based closely on the APP project definitions³⁰, but the variations by product were defined as in this table.

Mode ref. no.	In use			Active standby			Passive standby			Off***		Delay start
	1.0	1.1	1.2	2.0	2.1	2.2	3.0	3.1	3.2	4.0	4.1	
Microwaves				Door open	Fan on / low	Fan high	Door closed	Duplicates door closed				Timer
Clothes Washers				On, not running						Off		Timer
Other appliances	In use			On, not running			Off, with light or clock			Off, no light or clock	Off, with hard off	Timer
Coffee Machines				On, not running			Off, display clock			Off, no clock		Timer
Printers				On, not printing						Off		
Computers	Disk playing			On, not running	On, disk inside		Sleep	Sleep with disk	Hibernate	Off	Off, with hard off	
Monitors	On and displaying			On, no signal						Off		
Laptops	Disk playing			On, not running	On, disk inside		Sleep	Sleep with disk	Hibernate	Off		
Audio systems	Playing radio	Playing from disk	Playing from other source	On, not playing			Off, display clock	Off, no clock**			Off, with hard off	Alarm set
Video systems	Playing video			On, not running	On, disk inside		Off, no disk	Off, disk inside				
Televisions	On and displaying			On, no signal			Off				Off, with hard off	

²⁹ Table copied from table 'Mode Type: Codes and Description of Modes' in data spreadsheet titled 'All Standby Power 2011 data Revised.xlsx' provided to the Operating Agent on 2 April 2012.

³⁰ From report Measurement in retail stores of standby power consumption of household electrical appliances, prepared by: Canadian Building Energy End-use Data and Analysis Centre, for Natural Resources Canada; Lucie Maruejols and David L Ryan, May 2011, CBEEDAC 2011-RP-06, page 5.

Annex 2 Tables characterising the data set

These tables show the count of products in the data sets. They do not necessarily reflect the count of products for which usable data is available (i.e. products counted here may not all include the necessary operational mode data for analysis). Actual number of products analysed for graphs etc will be lower than these numbers in many cases.

Table 24. Data availability for countries and regions represented on graphs for all products, covering over 150 products.

Regions	Count of products	% of all products	Notes
Australia / New Zealand	9,070	34%	96% Australia, 4% NZ
EU13	7,433	28%	13 of EU27 are represented; significant omissions are Poland and Spain.
USA	5,210	20%	
Republic of Korea	1,863	7%	
Canada	1,829	7%	
India	1,194	4%	
Other	-	0%	
Total:	26,599	100%	

Table 25. List of product types with over 100 products included in the data set, ranked by count (44 product types which account for 24,141 products).

Rank by data count	CLEANED PRODUCT TYPE	Count of products	% of all products	Cumulative % of all products
1	TV - LCD	3,699	14%	14%
2	TV - unknown	3,601	14%	27%
3	Washing machine	1,307	5%	32%
4	TV - CRT	1,299	5%	37%
5	Microwave	1,205	5%	42%
6	Stereo - Integrated	931	4%	45%
7	TV - Plasma	920	3%	49%
8	DVD Player	798	3%	52%
9	Computer display	748	3%	55%
10	Notebook PC	690	3%	57%
11	EPS	588	2%	59%
12	Stereo - Portable	566	2%	61%
13	Home Theatre System	499	2%	63%
14	MFD	462	2%	65%
15	Dishwasher	450	2%	67%

Rank by data count	CLEANED PRODUCT TYPE	Count of products	% of all products	Cumulative % of all products
16	Set Top Box	420	2%	68%
17	AV Receiver	414	2%	70%
18	Espresso Machine	330	1%	71%
19	toaster	316	1%	72%
20	Air Conditioner	301	1%	73%
21	Desktop PC	290	1%	75%
22	Printer - Inkjet	290	1%	76%
23	Unknown	285	1%	77%
24	Laundry dryer	284	1%	78%
25	Heater - Electric portable	276	1%	79%
26	Subwoofer	275	1%	80%
27	Radio	269	1%	81%
28	Hard Disk Recorder	260	1%	82%
29	TV - Projection	241	1%	83%
30	Home Entertainment Other	218	1%	84%
31	VCR	198	1%	84%
32	Printer - Laser	181	1%	85%
33	DVD/BR, players	178	1%	86%
34	DVD Recorder	177	1%	86%
35	Juicer	176	1%	87%
36	Handheld vacuum	167	1%	88%
37	Cordless Phone Base Station	161	1%	88%
38	Breadmaker	153	1%	89%
39	Computers - Speakers	148	1%	89%
40	Cooktops	132	0%	90%
41	Digital photo frame	125	0%	90%
42	Mobile Phone	121	0%	91%
43	Oven	108	0%	91%
44	Hair dryer	107	0%	92%
45	Coffee maker	105	0%	92%
	Total	24,469		

Table 26. List of product types with between 50 and 100 products included in the data set, ranked alphabetically (15 product types which account for 1,117 products).

Product type	Count of products in data set
Blender	100>x>50
Computer - Speakers	
Facsimile	
Fan	
Food processor	
Hair Straightener	
Hand mixer	
Heater - Electric	
Heater - Gas	

Iron	
Projector	
Range Hood	
Stand mixer	
Unknown	
Washer/Dryer	

Table 27. List of product types with between 10 and 50 products included in the data set, ranked alphabetically (33 product types which account for 854 products).

Product type	Count of products in data set
Air cleaner	
Barbecue grill	
Battery charger	
CD Player	
Clock Radio	
Coffee grinder	
Cordless Phone Outpost	
Deep Fryer	
Dehumidifier	
Digital camera	
DVD/BR, recorders	
DVD/VCR	
Electric cooking pan	
Electric Grill	
Electric toothbrush	
Electric water Boiler	
Food slicer	
Games Consoles	50>x>10
Gas Water Heaters	
Hair Curler	
Hand-held blender	
Kettle	
Lighting, Lamp/transformers	
Modems, Routers (cable or wireless connection)	
Rice Cooker	
Shaver	
Shredder	
Speaker, powered	
Steam cooker	
Steam iron station	
Toaster Oven	
TV/VCR/DVD	
Vacuum cleaner	

Table 28. List of product types with less than 10 products included in the data set, ranked alphabetically (64 product types which account for 229 products).

Air Compressor, air cooler (humidifier), Answering Machine, Automatic griddles, Can opener, Cassette Deck, Chocolate Fountain, Chocolate maker, Circular saw, Computer/TV, Computing peripherals, Copier, Crock Pot, Drill, DVD Player - Portable, egg boiler, electric blanket, Electric chain saw, Electric Griddle, Electric knife, Electronic controllers for central heating/cooling, Epilator, Equalizer (audio), Fondue, Food Dehydrator, Fruit press, garage door openers, Headphones (wireless base station), hot air gun, Hot plate (kitchen), Humidifier, Ice cream maker, Ice Crusher, Ironing Press, Jigsaw, Kneader, knife sharpener, Massage device, Multi-socket extension, Oven + cooktop, PDA, Pop corn machine, Pressure Cooker, Printer - Dot Matrix, Projector, projector slide, Raclette, Sander, Scanner, Sensor(Light), sewing machine, Speakers - Wireless, Steam Cleaner, Treadmill, Tuner, Turn table, TV - portable, TV, antenna, Typewriter, Video Splitter, Waffle maker, Water dispenser, Water purifier, Wine Chiller, wireless audio transmitter,

Annex 3 Framework for grading mapping and benchmarking outputs

In order for the Mapping and Benchmarking Annex to provide transparency regarding the degree of 'reliability' that can be attributed to the results produced by the Annex, a framework has been developed that allows the *grading* of benchmarking outputs. This grading is based on a three part 'scale' of robust, indicative and illustrative. This grading is applied to both the initial data input and any manipulations that are required to present the data in a consistent form in the country mappings, and to the subsequent manipulations of that data in order to make it comparable with datasets from other countries/regions during the benchmarking process. While expert opinion is used to formulate the specific grading allocated to individual datasets or outputs, this expert opinion is formed with the following framework.

Grading of data/mapping outputs

Robust – where typically:

- The data are largely representative of the full market and
- The data include at least a significant element of individual product data and
- The data are from known and reliable sources and
- Test methodologies are known and reliable and
- Any data manipulations are based on solid evidence and should not unduly distort results.

Conclusions from such datasets are as reliable as reasonably possible within the boundaries of the Annex operation.

Indicative – where typically:

- Datasets may not be fully representative of the markets (but do account for a majority, ideally a known and understood majority) and/or
- Any data manipulation used includes some assumptions or unavoidable approximations that could unintentionally reduce accuracy.

Accuracy is, however, judged such that meaningful but qualified conclusions could be drawn.

Illustrative – where typically:

- One or more significant parts of a dataset is known to represent less than a majority of the full market or
- Test methodologies used to derive data are not known or
- Test methodologies used to derive data are known but could lead to significant differences in outcome or
- Data manipulations for the analysis contain an element of speculation or significant assumption or
- Conflicting and equally valid evidence is available.

Rather than being rejected completely, perhaps because the flaws in the data are at least consistent, such data could provide some insight into the market situation and so are worth reporting, but results must be treated with caution.

Grading of comparison between country outputs (benchmarking)

Robust – where typically:

- The data sources being compared are each largely ‘robust’ and
- No data manipulations for benchmarking were necessary; or if manipulations were used they were based upon solid evidence and should not distort results.

Conclusions from comparisons within and between such datasets are as reliable as reasonably possible within boundaries outlined above.

Indicative – where typically:

- Datasets being compared are themselves only ‘indicative’ and/or
- Any data manipulation used for benchmarking includes some assumptions or unavoidable approximations that could unintentionally reduce accuracy and/or
- For any other reason(s) subsets of the data may not be strictly comparable which leads to some distortion.

However, accuracy is such that meaningful but qualified conclusions could be drawn.

Illustrative – where typically:

- One or more significant parts of the datasets are themselves ‘illustrative’ and/or
- Data manipulations for the benchmarking process contain an element of speculation or significant assumption.

Rather than being rejected completely, perhaps because the flaws in the data are at least consistent, such data could provide insight into the market situation and so are worth reporting, but results must be treated with caution.

Annex 4 Document change log

19 April 2012: First full draft completed for internal review.

24 April 2012: Minor updates; ready for circulation to participants as Version 1.0.

29 June 2012: Added home audio data for the Republic of Korea; updated data statistics tables in line; minor edits following feedback on V1.0.

27 July 2012: Assimilated comments from participant: Deleted section 5.11 with graph and table showing all products as this is potentially misleading as data are inconsistent over time and between countries. Minor presentational and wording clarifications.