Framework for Product Definition, Data Collection, Data Analysis and Outputs

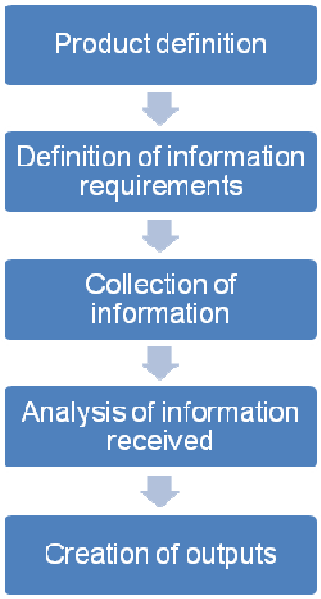
23rd June 2009

1. Introduction

The Mapping and Benchmarking Annex seeks to gather and analyse efficiency, and other data, on a range of products across a number of countries with the goal of presenting policy makers with clear and concise information on which to base effective policy decisions related to the efficiency of products (or at the very least, to allow policy makers to identify areas where further investigation is appropriate to enable these decisions).

Conceptually, the requirements of the mapping and benchmarking process are very straightforward as illustrated in Figure 1. However, when examined in detail, a large number of potential differences of input data, and complications in comparability of data between countries and between product types arise throughout this process. Hence, there is a need to create an overall framework detailing the approach that will be taken for the outputs, product definitions, data collection and data analysis methodologies. Such a framework will ensure transparency for all participating countries and will hopefully lead to:

Figure 1: requirements of the mapping and benchmarking Process



- Uniform expectations of outputs among participating countries
- Clear understanding of the information inputs required from participating countries resulting in improved compatibility of information collected from any one country with that from others
- Improved consistency in approach and ultimately improved clarity for users of resulting outputs, particularly potentially non-specialist policy makers
- Focused prioritisation of how best to use the available resources of the Annex to deliver appropriate and useful results. Fair and appropriate allocation of budget/analysis resources across countries, products and stages of the work.

Therefore this framework, while apparently quite simplistic, is far from it and requires the creation of an approach flexible enough to accommodate a wide range of potential products and their associated characteristics, while maintaining consistency, fairness, accuracy and transparency. This document seeks to define such a framework to be agreed upon by all participating countries and used throughout the life of the Annex.

2. Definition of Outputs

While clearly the requirements and formats of the outputs are the last element in the Mapping and Benchmarking process, they are the element that defines many of the requirements of the preceding elements and thus will be addressed first.

2.1. Mapping

Drawing from the Mapping and Benchmarking Strategy and Workplans document, the required outputs from the mapping process have been defined as follows:

- Worst efficiency new product
- Average efficiency new product (ideally sales weighted but where this is not possible stock weighted)
- Most efficient new product (BAT for an individual market and BNAT for all markets)
- Efficiency of installed stock
- Listing of main historical, current and planned policies that have affected, or are likely to affect, product efficiency over the period of the mapping
- Summary of main national cultural issues (house size, fuel price, etc) for a trial period[1]

Where possible, this information will be presented as a time series for individual countries to demonstrate changes in product performance over time thus giving policy makers an idea of the trend and possible impact of policies over that period. Also, on a trial basis[1] and where data is available, total stock energy consumption will be presented over the same time series to highlight whether overall consumption is moving in line with product efficiency[2].

In addition, it will be necessary to specify some additional information to ensure transparency to the policy maker, e.g. noting a change in testing methodology at some point in the time series[3] (that could not be normalised). Hence, in the simplest case, this would lead to summary product mapping outputs for policy makers similar to that shown in Figure 2

2.1.1 Mapping Complex Products

However, as will become clear in later sections, few products are 'simple' and in almost all cases, products will have some level of sub-categorisation e.g. by technology, functionality, capacity or some other performance criteria. When these sub-categorisations are important to the performance of the technology, they will be presented separately to maintain clarity for the policy maker. Hence for some products presenting all three categories could be relevant to the understanding of overall efficiency changes. Figure 3 shows examples of how these three sub-categories *could* be presented using different products as examples:

- Technology - TVs where information is displayed for LCD, Plasma, CRT or other technology
- Washing Machines where again information is limited to average efficiency only but with efficiency plotted against the other critical performance criteria of spin effectiveness, wash cleanliness and water consumption.
- Capacity/Size - Air-Conditioners where information is broken down by unit capacity (grouped to appropriate bands to enable understanding of the graphic)

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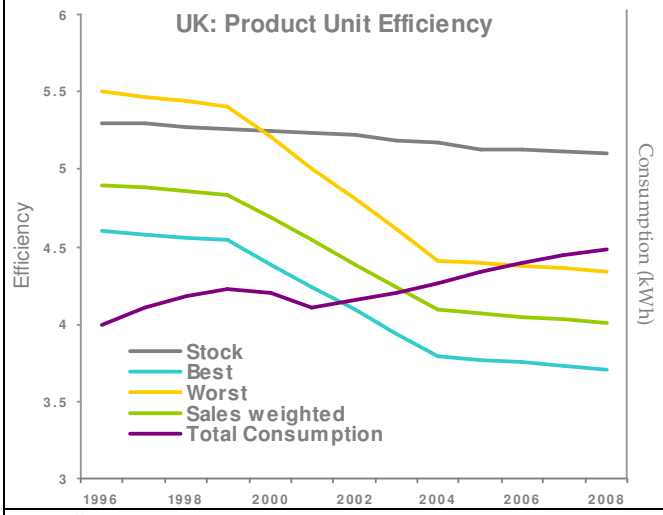
[1] The trial mapping of "cultural issues" influencing products within a market, and overall energy consumption for the product within the market, will be conducted for the first two products to be mapped. The total resources (in particular time) used to map cultural issues and consumption will be tracked and, in conjunction with the resulting outcomes, presented to the Korean Mapping and Benchmarking Management meeting for a decision on whether to continue analysing culture and consumption data for later products.

[2] Changes in individual product efficiency do not necessarily align with changes in consumption. It is easy to imagine a situation where the tested efficiency of new cold appliances is improving, but overall energy consumption of the stock is rising due to larger appliances being installed and/or on average more cold appliances being used per household.

[3] Note that it is not expected that the policy maker will necessarily understand the full implications of such additional information, but it is provided to make them aware that there may be some 'issues' with the information and consideration should be given to these issues prior to any decision making process.

Figure 2: Demonstration of summary mapping outputs for 'simple' products



Key Policies

- Announcement of MEPS in 1999.
- Introduction of MEPS in 2002.
- Planned procurement programme of best in market in 2009.

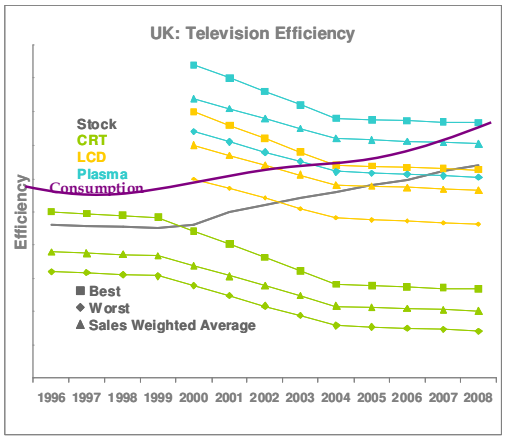
Additional Relevant Information

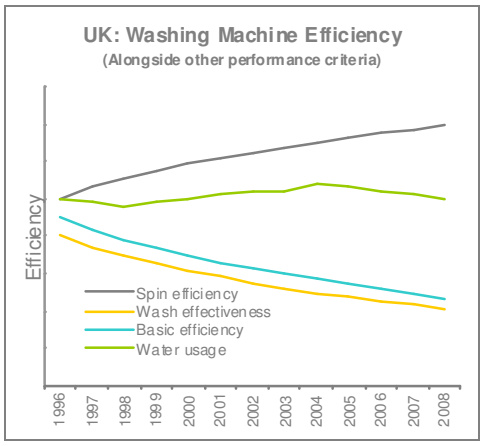
- Test methodology changed in 2002 to facilitate introduction of MEPS. Pre-2002 data corrected to 2002 methodology.
- 2007 and 2008 data provisional.

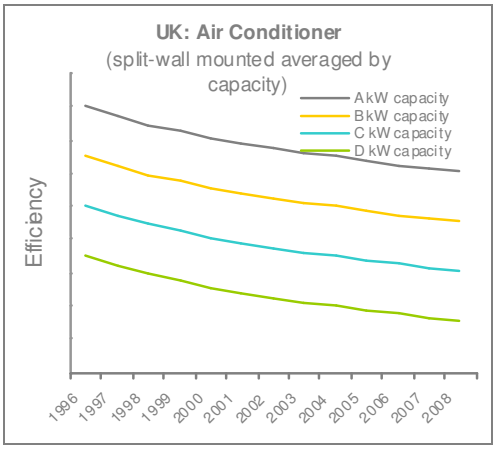
Data Set

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Best	4.6	4.6	4.6	4.5	4.4	4.2	4.1	3.9	3.8	3.8	3.8	3.7	3.7
Sales Weighted Average	4.9	4.9	4.9	4.8	4.7	4.5	4.4	4.2	4.1	4.1	4.1	4.0	4.0
Worst	5.5	5.5	5.4	5.4	5.2	5.0	4.8	4.6	4.4	4.4	4.4	4.4	4.3

Figure 3: Potential visual representations of efficiency depending on product type/characteristics







Provided it does not make the outputs difficult to interpret, this data will also be shown alongside Stock and Consumption data as shown in the TV example.

To ensure consistency of outputs, efforts will be made to 'normalise' efficiency data to take account of performance, technology and/or size variations between products and for changes in test methodology over time. This will also facilitate the creation of the simplified graphic shown in Figure 2 for policy makers (with more complex material supplied in the following notes section - see below). It should be noted however, that this simplification is unlikely to be possible or appropriate for a large proportion of products. Where this is the case, information will be presented showing either average efficiency by size/capacity, performance and/or technology as appropriate to the product OR where there are multiple performance criteria (average efficiency by size/capacity, performance and/or technology) that are directly related to the unit efficiency they will be plotted on the same graph without combining the factors.

2.1.2 Supporting information for mapping outputs

Underlying these summary policy-maker outputs will be a comprehensive set of supporting 'notes' which, assuming the information is available from the source material provided by participating countries, will include:

- Sources of all material used (source material will be placed on the website whenever legally permissible)
- Test methodology(ies) used within the specific country to define efficiencies (and potential other product performance information)
- Electricity supply data including voltage, potentially energy mix of the country, etc
- Explanations of all data transformations/analysis undertaken to 'normalise' data, e.g. to one voltage, to one performance level or to one test methodology.
- Additional graphics/information on best and worst products on the market, stock efficiencies, etc. where these cannot be included in the main document.

See Attachment1 for an example Mapping output.

2.2. Benchmarking

The outputs from the benchmarking process have been defined as comparisons between countries/region based on the following:

- Average efficiency new product (ideally sales weighted)
- Best and worst new product
- Most efficient new product (BAT) for across all markets
- Most efficient (known) product close to market (BNAT – best not yet available technology)

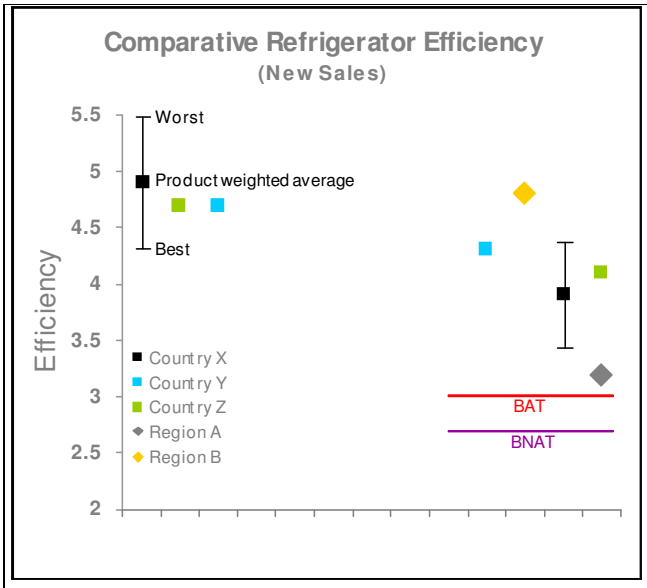
Where possible, this information will be presented as two points for each country/region, thus providing policy makers with some indication of relative efficiency movements between countries over time. The two data points will represent the earliest year and most recent year mapped (if a reliable set of early data is not available, only the most recent data point will be plotted). Further trend data for individual countries can be found by reverting back to the mapping data.

Further, where possible, reasons for differences in performance will be highlighted (e.g. possible cultural differences, differences in the types of policies initiated, etc.). However it

must be recognised that such isolation of causal links may be limited and is likely to be based on expert opinion rather than outcomes of detailed analysis.

Hence, in the simplest case, this would lead to summary product benchmarking outputs for policy makers similar to that shown in Figure 4.

Figure 4: Demonstration of summary benchmarking outputs for 'simple' products



Key Policies

- Countries adopting and enforcing MEPS appear to have products 20% more efficient than countries not using this policy
- Countries using fiscal and voluntary measures appear to have had little impact relative to their peers who have taken mo major policy actions.

Additional Relevant Information

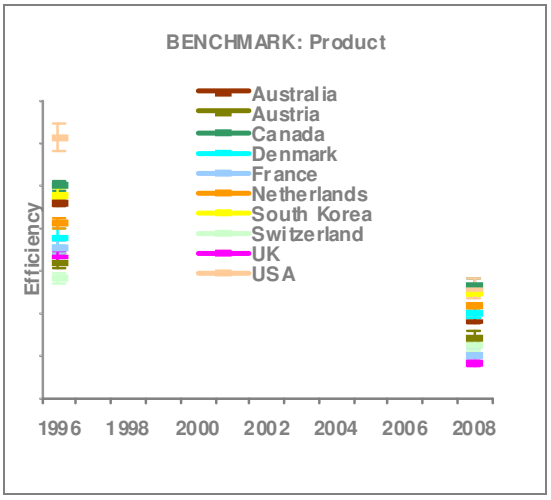
- BAT based on products available in country Z in 2008.
- BNAT based on report of product development in country Y in 2007.
- Significant data transformations have been necessary for country Y to make comparison with other countries possible resulting in some uncertainty in accuracy.

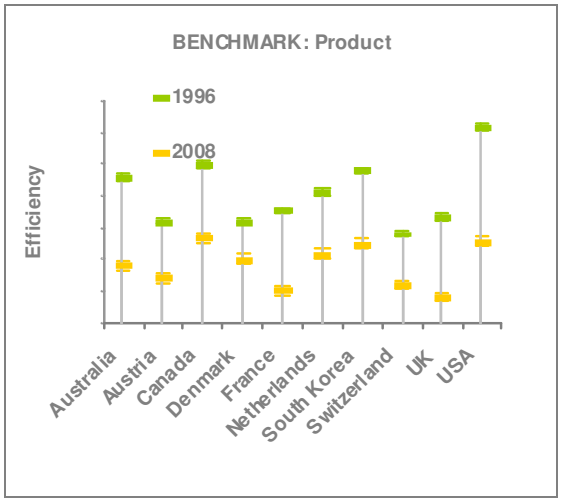
As noted in the Mapping section, outputs become more complex where there are technology/performance/capacity differences between products. These will be dealt with on a case by case basis, but as much consistency as possible will be maintained between products. Figure 5 gives some possible output formats

Again, underlying these summary policy-maker outputs will be a comprehensive set of supporting 'notes' which will include:

- Explanations of all data transformations/analysis undertaken to move from information reported in individual country mapping reports to overall benchmarking outputs including:
  - Corrections for differing electricity supply (voltage/frequency)
  - Corrections for differing test methodologies
- Data points for individual countries following data transformations

Figure 5: Potential visual representations of benchmarking data dependent upon process used in the mapping activities





3. Product Definition

As part of the strategy development process, participating countries have agreed that the products to be addressed in the first year are as follows:

Initiate in first 6 months:

- Domestic cold appliances (refrigerators, freezers and combinations)
- Televisions
- Domestic laundry appliances (including dryers)
- Domestic air conditioners
- Laptop computers

Initiate in second 6 months:

- Integrated home networks (to be defined)
- Waterheaters (to be defined)
- Domestic lighting
- Computer displays
- AC motors (if not addressed directly by the Motor Annex)

This selection of products is sensible given their overall high levels of electricity consumption and/or contribution to peak load, and the likelihood of availability of sources of information from which to conduct the analysis. However, these product definitions were drawn from Nordman and Sanchez [4] and, as recognised in the strategy and workplan development phase, in a number of cases these are not simply products, but more accurately product categories. For example, depending on how defined, there are potentially 288 sub-categories of air-conditioners as shown in Figure 6.

[4] Nordman, B. and Sanchez, M.C. (2006). '*Electronics come of age: Taxonomy for miscellaneous and low power products*'. Lawrence Berkeley National Laboratory, University of California

Air conditioners								
Cooling capacity	<12kW			12-45 kW			45-100kW	
Heat rejection	Air cooled				Water cooled			
System	Split			Multi-Split			Packaged	
Operation	Cooling only				Reverse cycle			
Mounting	High wall	Floor mounted	Cassette	Ceiling suspended	Built in horizontal	Built in vertical	Roof top	Window

Figure 6: The five product parameters for air conditioners in this example table from the Eurovent Certification scheme result in 288 possible sub-types of product.[5]

Given that the anticipated focus is domestic air-conditioners, the potential number of products may be halved simply by removing water cooled units, which are principally for commercial and industrial use. Nevertheless the number of sub-categories is still large and it would not lead to sensible and useable outputs to, for example, group window systems and split systems together. Thus, a number of the sub-categorisations have to be treated as 'separate products'.

Clearly this has implications for the resources available to both participating countries for the data collection (and product championing/review), and the operating agent for data collection, analysis and presentation.

Further complicating the product definition issue and the associated resource requirements is the inherent inter-dependence between efficiency and performance of some products. For example, while the focus of the Annex is comparison of product efficiency, it is somewhat meaningless to compare energy performance of laundry units within or between markets without consideration of the effectiveness of laundry cleansing, the effectiveness of spin cycles and the water consumption of the units (i.e. it is not reasonable to compare the efficiency of a machine that washes well, uses limited water and spins effectively with a unit that washes poorly, uses large quantities of water and leaves laundry very wet at the end of the cycle).

Therefore, to optimise the allocation of resources in the Annex, some mechanism has to be developed whereby products can be sub-categorised into sensible groupings that give consistent and meaningful outputs for policy makers in a resource efficient way. Selecting these sub categorisations and presenting them alongside an analysis of the resources required to undertake the mapping and benchmarking process for each sub-group is a critical part of the Annex. It will allow the Annex Management Committee to make a decision on which product sub-categories they wish to address with a full understanding of:

- Why the product has been split into subcategories and
- The relative resources that are expected to be required for each product subcategory

[5] Source: Quoted from the ECODESIGN Lot 10 Draft of chapter 1 – '*Preparatory study on the environmental performance of residential room conditioning appliances (aircon and ventilation)'*, March 2008.

3.1. Initial Product Sub-Categorisation

Unfortunately Nordman and Sanchez's product definitions are quite coarse and do not help in product sub-categorisation. Further, as far as we have been able to ascertain, there is no authoritative and consistent source of product sub-categorisation which covers the broad range of product groups that may be addressed over the life of the Annex. Country specifics (e.g. cold vs. hot wash cycles) and fast-moving technologies including the availability of additional functionalities also mean that this task represents a challenge over time and borders. Therefore, we have defined a separate mechanism for product classification.

This mechanism is fundamental to the development of the annex and will play a central role in the process of selecting and analysing products. It is therefore described below alongside a working example for laundry units. ***(Note: the laundry example used is for demonstration purposes only and does not represent a proposed product selection for this technology. The methodology used will be applied to all products to be addressed in the first year.)***

3.1.1 Product sub-category selection process

The process for selecting product sub-categories will be based on the following 4 stages:

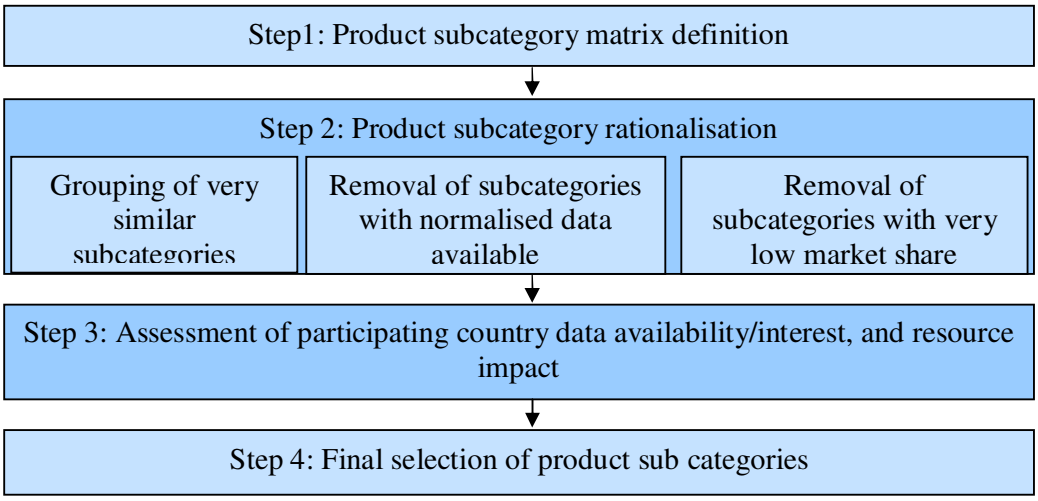


Figure 7: Product subcategory selection process

Step 1 - Product subcategory matrix definition:

Broadly speaking, products may be sub-categorised by one, or more, of the following:

- **Functionality** - where products broadly fulfil the same purpose, but have some peripherals or applications that result in different operational uses. For example, refrigerators with ice boxes, ice making facilities, drinks chillers, etc.
- **Technology** - where products may fulfil the same function, but have a fundamentally different technology solution. For example, top loader/front loader laundry units or LCD, Plasma or CRT TVs.
- **Size/capacity** - where a product performs differently depending on its size or capacity. For example, large electric motors are fundamentally more efficient that smaller motors.

To capture all the potential sub-categorisations and relevant performance parameters, a product matrix will be created to illustrate all potential technology, functionality, capacity and performance options. To ensure these align with existing market classifications, and hence

likely data availability within participating countries, breakdowns will primarily be based on existing classifications within:

- Test Methodologies
- Supplier categorisations
- Standard Industry Classifications (SIC)
- Existing market studies (e.g. EuP)

Where such breakdowns do not exist, e.g. for rapidly evolving technologies, such as set top boxes, expert opinion will be sought to establish most appropriate classifications.

Washing machines							
Technology	Front Loader			Top Loader			
Functionality	Washer			Washer/dryer			
Capacity	Small			Large			
Wash Quality	A	B	C	D	E	F	G
Spin efficiency	A	B	C	D	E	F	G
Water usage	Litres used						

Figure 8: Example Product sub-category matrix for washing machines with 392 permutations

Step 2 – Product subcategory rationalisation

Following the creation of the full matrix, an analysis will be conducted (primarily based on expert opinion) to rationalise the number of individual matrix elements by eliminating some elements entirely and grouping others where possible and appropriate.

This rationalisation process will be based on the following principles:

1. Grouping of products where functionality has little impact on efficiency/performance
2. Removing subcategories where testing methodologies have normalised for such functionality variations
3. Removing sub-categories with very little known market share in participating countries

Washing machines		
Technology	Front Loader	Top Loader
1. Functionality	Note: washer/washer dryer has little impact on performance	
2. Capacity	Note: test methodologies normalize for capacity	
3. Wash Quality	Note: All sub-categories have Wash Quality >B	
3. Spin efficiency	Note: All sub-categories have Spin efficiency >B	
Water usage	Litres used	

Figure 9: Example Product sub-category matrix for washing machines following Product subcategory rationalisation Reduces permutations to 2

Where a large number of sub-categories remain, expert opinion will be sought to reduce the number to a smaller number which will provide policy makers with products that are *representative* of the majority of the market.

Step 3 – assessment of product analysis process

The resulting simplified matrix will then be distributed to participating countries, with a detailed explanation of how the rationalisation has been undertaken. Countries will be asked to review the appropriateness of the rationale leading to product sub-categorisation and rationalisation and raise any objections within a designated/limited timeframe. Countries will then be asked to complete the matrix for each subcategory identifying whether they have data available (and in what form) and whether they have an interest in that analysis.

Technology	Variable	Data	Interest
Top loader	Efficiency		
	Water usage		
Front loader	Efficiency		
	Water usage		

Figure 10: Example simplified matrix for washing machines sent to assess participating country data availability and interest

Alongside the simplified matrix will be an estimate of resources required to gather and analyse the data for each subcategory (assuming all countries have data and are interested and taking into account the opportunities to collect and process data in parallel for similar product sub-categories).

	Number of Technologies				
# of variables		1	2	3	…
	1	1	1.3	1.5	…
	2	1.2	1.4	1.7	…
	….	…	…	…	…

Figure 11: Demonstrative resource estimation for a given rationalised product matrix

The aim will be to distribute the matrix, the explanation of the rationalisation approach and the estimate of resources required to analyse each subcategory for several products at the same time. This will allow participating countries to make a comparative assessment of their relative interest in each sub-category and the associated resource requirement.

Step 4 – assessment of product analysis process

The resulting feedback will allow creation of a list of subcategories prioritised by availability of data from participating countries and each individual country's level of interest in gaining Mapping and Benchmarking outputs for each sub-category. A recommendation will then be presented to the Annex Management Committee for final selection of the sub-categories to be addressed in the Mapping and Benchmarking process with a final resource estimate revised to take account of the availability of data and level of interest of participating countries.

Technology	Variable	Data	Interest	Resource
Top loader	Efficiency	2 countries	3 countries	0.3 products
	Water usage	1 countries	2 countries	
Front loader	Efficiency	4 countries	7 countries	0.5 products
	Water usage	3 countries	5 countries	

Figure 12: Demonstrative recommendation - rationalised washing machine matrix

4. Data Specification and Collection

Information will be sought for each sub-category from participating countries, known sector experts and regional representatives selected by the Annex Management Committee. Information sought will be from secondary sources only (i.e. information that is already available and requires no primary research or data collection).

Given the nature of the information sought and the likely formats of data submission, there is little value in creating a 'questionnaire'. However, specific detailed data requests will be made for individual products and will normally include the following:

- For each subcategory, new product information on best, worst, (sales weighted) average efficiency and know BNAT
- Product specific normalisation information (e.g. climate class)
- Overall (and ideally sub-category specific) stock efficiency, total number in stock and other product specific information required to identify overall consumption
- Test methodologies used within each subcategory and their relationship to known international standards (e.g. clone, clone with amendments X Y and Z, etc.)
- Summary of all major policy actions (in place or planned)
- Summary of major cultural issues specific to a country or region
- Country specific information on electricity voltage and frequency, etc. (note that this information will only be collected once, unless additional product specific information is required).

Information will be sought from 1996 to the most recent data set available, ideally on an annual basis (in many cases this will allow for 10 years of data to be collected – with some countries not having early data and others yet to gather data on more recent years).

To increase the ease of the data analysis process, and to increase the reliability of the resulting outputs, information will be sought from (in priority order with Option 1 being a significant preference for integrity of results):

1. Original data sets, i.e. raw or processed data on a product or sub-sector level
2. Analysis reports based on original data sets
3. Other sources e.g. meta-analysis, expert opinion etc.

5. Data Analysis

Data analysis for the Mapping and Benchmarking will follow the methodology shown in Figure 13 below.

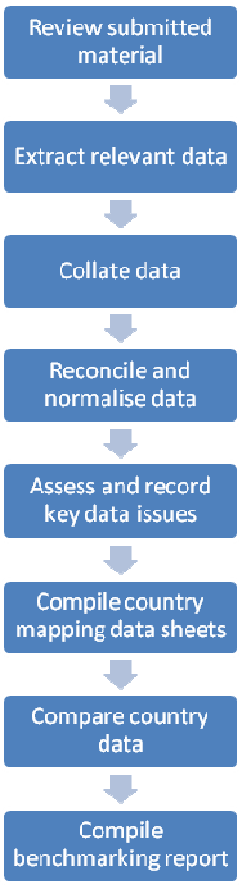


Figure 13: Methodology for data analysis

This methodology will be conducted using the following principles:

- **Data manipulation** - where possible, the amount of data manipulation carried out will be minimised so as reduce distortion and retain the qualities and reliability of the original data. In all cases, where data manipulation of any kind occurs, full disclosure and description will be made in the 'notes' section of the relevant mapping or benchmarking document.
- **Conversion factors** - where conversion factors are used to normalise various data sets to 'correct' for differing electrical supplies, variations in test methodology, product performance variations, etc., these will be based on known/widely accepted factors. Where correction factors are not available, expert opinion and dialogue with industry will be sought to propose factors. The source of any conversion factor will be transparent. If no reliable conversion factors can be found or developed, data will be reported separately
- **Selection and reporting of data** sources - where separate data sources for the same period provide non-constant data, efforts will be made to identify the most robust data set. Where this is not possible, both data sets will be reported
- **Changes in basis of data source** - where single data sets vary over time (e.g. due to a change in test methodology), data will be converted to the most recent data basis when an appropriate methodology can be identified
- **Representation of missing data** - where data is only available for intermittent periods, data points with three or less years' separation will be interpolated based on best fit. For periods in excess of three year, data will be reported separately with no interpellation. No extrapolation with be made beyond the earliest and latest data points
- **Confidence levels and data quality** - given the nature of much of the source material expected, no effort will be made to report confidence levels but all data sources will be clearly detailed.

6. Other Relevant Issues

6.1. Geographical Coverage

The strategy document suggests the geographical coverage of the mapping and benchmarking will be extensive. However, given the limited resources available, the two product pilot phase of the mapping and benchmarking activities will be restricted to participating countries *plus* the EU, China, India, Japan and Russia where data is readily available[6]. During this time, detailed records of resource expenditure will be kept on each stage of the mapping and benchmarking process. The management committee will then be presented with a breakdown on the actual resource expenditure involved in each task and can then make an informed judgement on which of the geographical areas beyond participating countries should receive priority within the available resources.

[6] South Africa and Brazil may also be included where information is easily sourced, but overall these countries are being treated with a lower priority.

6.2. Allocation of resources

The time taken to gather data, and the quality of the data received, from individual countries will have a major impact on the overall quality of outputs from any analysis. To ensure transparency and fairness, equal resource will be given by the Operating Agent to each individual participating country and the non-participating countries/regions. Hence the quality of analysis on each country will be directly related to the quality of and ease of access to data, and the in-kind contribution given by individual countries in the analysis review phase. Assuming data is available from all participating countries and non-participating countries/regions for a specific product, this allocation of resources for a standard product[7] per country or region is expected/estimated to be:

Mapping:

• Individual follow-ups of data requests and posting of source material	0.25 days
• Provisional Mapping	0.30 days
• Comments, corrections and report issue	0.15 days

Benchmarking:

• Provisional benchmarking and additional data sourcing	0.25 days
• Identifying Policy Best Practice and draft reporting	0.20 days
• Comments, corrections and report issue	0.15 days
Total	**1.30 days**

[7] A standard product is defined as where the sub-categorisation and selection process has resulted in section of choices where resources equates to those identified in the workplans, ie 14 days for mapping and 7 days for benchmarking

Attachment 1:
Example Country Mapping Information

IMPORTANT NOTE

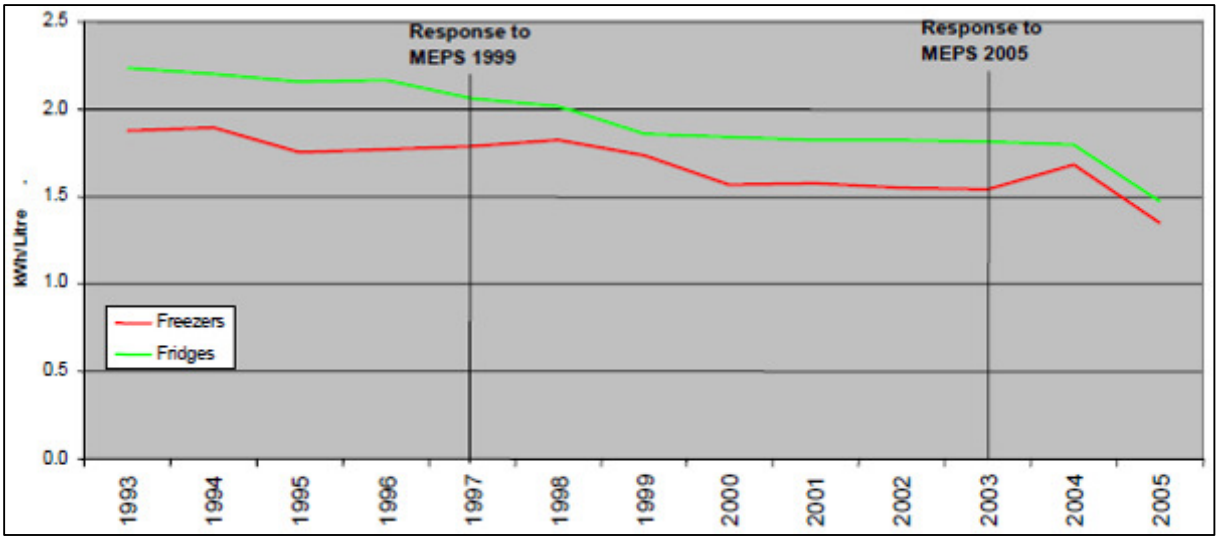
The following Mapping Example is based on Australia. However, it should be noted that the review used only publicly available information sources (ie reports without the primary data on which they were based) and requested only limited assistance from the Australian representative for the Annex.

Such an approach has been taken to demonstrate that the ability to Map a country's current and historic position, and consequential benchmark against others, is highly dependent on the quality and type of source data received. Even where countries such as Australia have a significant body of published material available, this material may not be provided in a form that allows full comprehensible and transparent results.

Higher quality information is available for Australia, and additional support is available and will be will be used during the formal mapping process. Therefore the material presented here should not be cited.

Country	**Australia**
Product Group	**Cold Appliances**
Sub-Category	**All Cold Products**

Product Efficiency (See Notes Section 1)



Sales weighted average efficiency of all refrigerators and freezers, 1993 to 2005

Summary Data Set: Refrigerators (kWh/adjusted litre)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Best Product	No data at present												
Worst Product	No data at present												
Average	2.13	1.96	1.94	1.84	1.73	1.76	1.74	1.74	1.95	1.63			
Sales Weighted Average	No data at present												

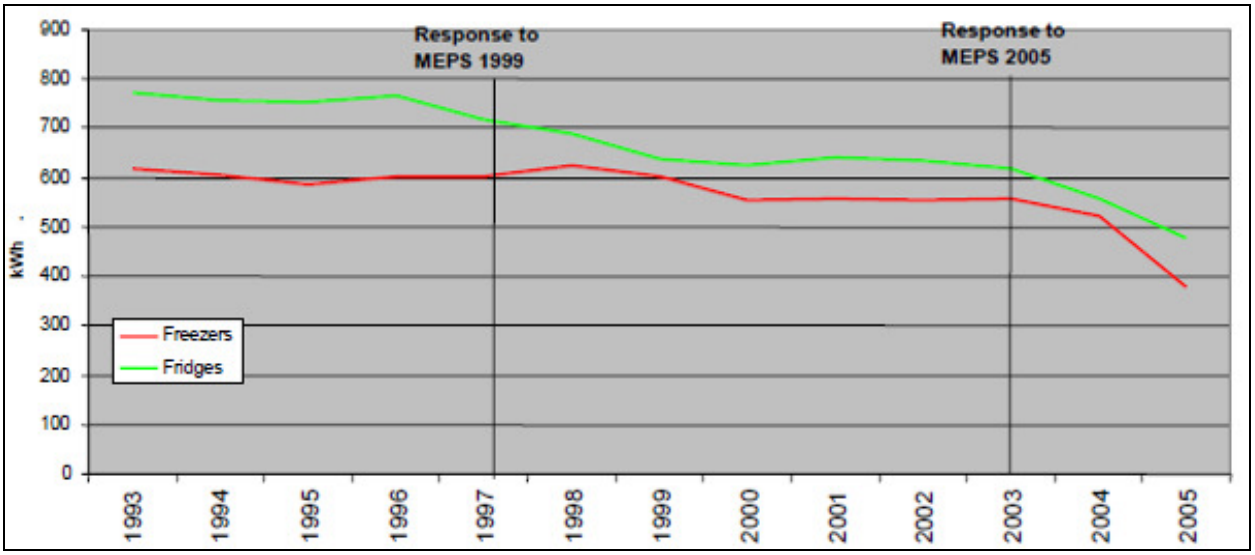
Summary Data Set: Freezers ((kWh/adjusted litre)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Best Product	No data at present												
Worst Product	No data at present												
Average	1.68	1.75	1.67	1.56	1.51	1.57	1.56	1.59	1.67	1.31			
Sales Weighted Average	No data at present												

Key Notes on Data

1) Graphic provides sales weighted average, data provides product weighted average. Currently unable to match data sources
2) Test methodology changes through time frame (unclear if source corrects data for changes in methodology)

Product Consumption (See Notes Section 2)



Sales weighted average energy consumption of all refrigerators and freezers, 1993 to 2005

Summary Data Set: Refrigerators (kWh/year)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Best Product													324
Worst Product													868
Average	780	723	640	606	579	630	609	589	541	480			542
Sales Weighted Average	No data at present												

Summary Data Set: Freezers (kWh/year)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Best Product													241
Worst Product													868
Average	640	628	649	614	555	564	565	570	560	410			414
Sales Weighted Average	No data at present												

Key Notes on Data

1) Graphic provides sales weighted average, data provides product weighted average. Currently unable to match data sources
2) Average energy consumption of individual units calculated as defined in the standard and may not represent actual consumption in operation
3) Test methodology changes through time frame (unclear if source corrects data for changes in methodology)
4) 2008 best, worst and average data are calculated values based on a different data set to the 1996 to 2005 average figures

Efficiency of Stock (See Notes Section 3)

No data at present

Summary Data Set: Refrigerators

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Products	No data at present												
Stock Efficiency	No data at present												

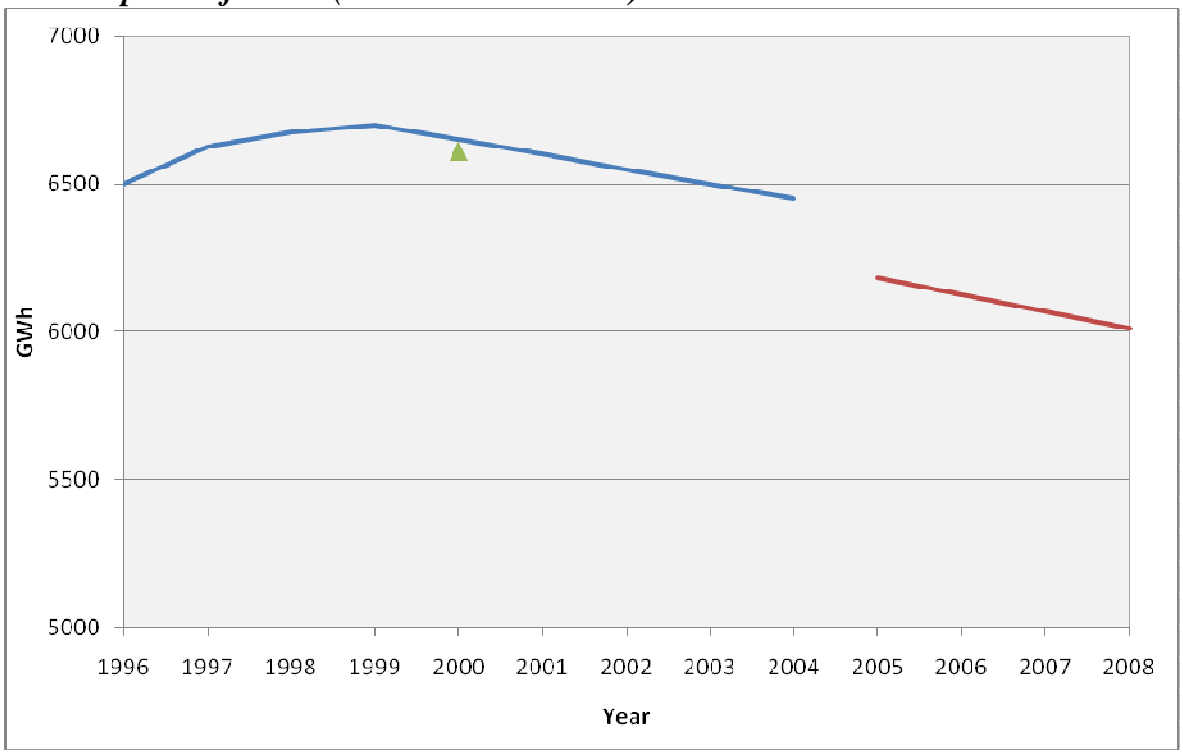
Summary Data Set: Freezers

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Products	No data at present												
Stock Efficiency	No data at present												

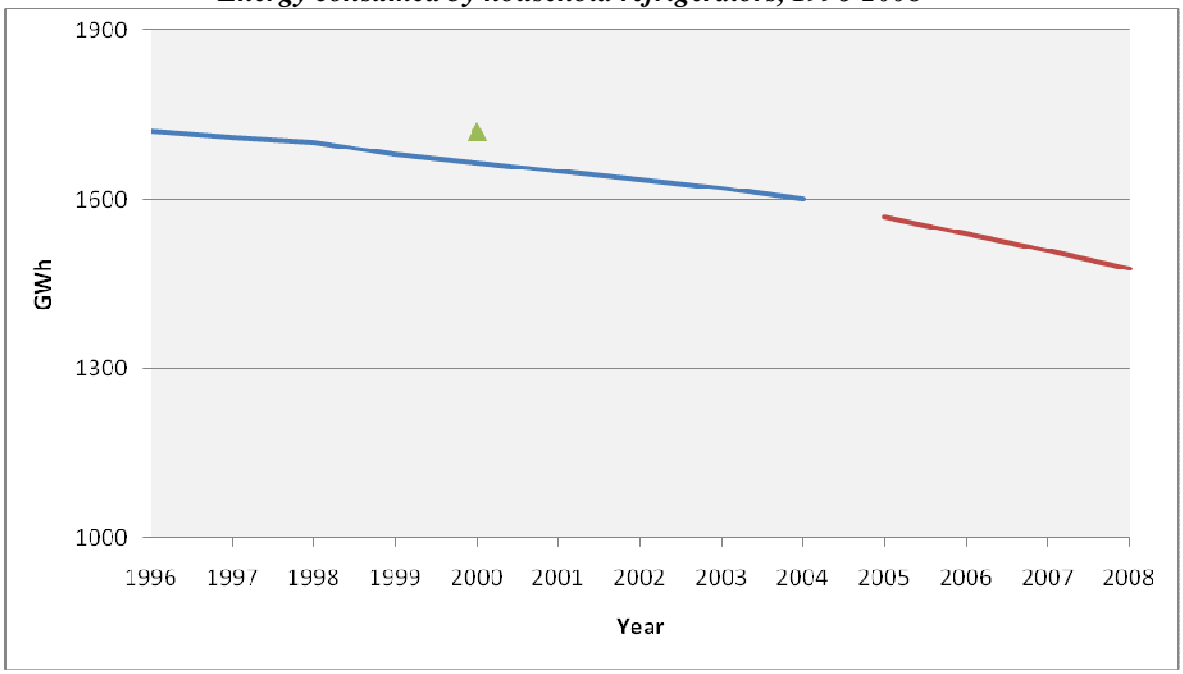
Key Notes on Data

1)

Consumption of Stock (See Notes Section 4)



Energy consumed by household refrigerators, 1996-2008



Energy consumed by household freezers, Australia 1996-2008

Summary Data Set: Refrigerators

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Products (millions)									9.6				
Consumption of Stock (GWh)	*6500*	*6625*	*6675*	*6700*	*6650*	*6600*	*6550*	*6500*	*6450*	6184	6128	6070	6011

Summary Data Set: Freezers

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Products (millions)									3.2				
Consumption of Stock (GWh)	*1720*	*1710*	*1700*	*1680*	*1665*	*1650*	*1635*	*1620*	*1600*	1568	1539	1508	1477

Key Notes on Data

1) Consumption of stock data derived from two main sources. The 2005 to 2008 data is thought to be more reliable. A third data set (consisting of one data point for 2000 is also plotted). This is considered to be more accurate than the equivalent data point in the 1996 to 2004 data set. At this time, it is not possible to reconcile the data sources.
2) Data set and graphic based on same data sources

Major Policy Interventions (See Notes Section 5)

Energy Labels

- **December 1986**: Mandatory energy labels introduced in the State of New South Wales.
- **February 1987**: Mandatory energy labels introduced in the State of Victoria.
- **1991 to 1994**: Mandatory energy labels progressively introduced in all other Australian States.
- **1991**: First extensive review of the energy labelling programme in Australia was conducted (GWA 1991). It reviewed the technical basis for all labelled appliances and marked the start of a coherent national energy labelling program in Australia, especially with regard to test procedures.
- **1996**: The first cost benefit evaluation of the labelling program was undertaken (GWA 1996).
- **1997**: Further review of the technical basis of the energy efficiency labelling programme commenced, which included within its scope revision of the energy efficiency labelling algorithms for all labelled appliances as well as the energy label design itself.
- **1998**: NAEEEC recommended the introduction of new energy labelling algorithms (equations used to calculate the 'star' rating) to provide expanded scope for improvements in energy efficiency (5+ star rated units were regraded to become 3 – 3.5 star units).
- **2000**: Energy labelling algorithm revised and it became compulsory for all display stock to carry these labels from 1 October 2000.

Minimum energy performance standards

- **1992 to 1993:** A study conducted into the feasibility of minimum energy performance standards (GWA 1993).
- **October 1999:** MEPS for refrigerators and freezers first introduced
- **1 January 2005:** New stringent MEPS levels (based on US 2001 levels) introduced.

NOTES ON DATA

Section 1: Notes on Product Efficiency

1.1 Test Methodologies Performance Standards and Labelling Requirements

1.1.1 Current Test Methodology

Standard	AS/NZS 4474.1:2007, 'Performance of household electrical appliances - Refrigerating appliances - Energy consumption and performance' (available from www.saiglobal.com)
Equivalence	Unknown at present
Scope	Standard specifies the method for determining the performance characteristics of electric refrigerating appliances intended for household and similar use. Appliances covered by this Standard include refrigerators, refrigerator/freezers and freezers. Appliances such as multi-fuel refrigerating appliances, extra low voltage units (including d.c.) and mobile or portable units are not included in the scope of this Standard.
Historical Information	• First published in Australia as AS B116-1956. • Second edition 1967. • Revised and redesignated AS 1430-1973. • Second edition 1976. • Third edition 1986. • AS 2575.2 first published 1986. • Second edition 1989. • First published in New Zealand as NZS 6205:1982. • Revised and redesignated in part as NZS 6205.2:1988. • Second edition 1989. • AS 1430-1986, part of AS 2575.2-1989 and part of NZS 6205.2:1989 jointly revised, amalgamated and redesignated AS/NZS 4474.1:1997. • Second edition 2007.
Impact of incremental changes	Unknown at present

1.1.2 Current Performance Standards and Labelling Requirements

Standard	AS/NZS 4474.2:2009, 'Performance of household electrical appliances - Refrigerating appliances - Energy labelling and minimum energy performance standard requirements' (Available from www.saiglobal.com)
Equivalence	Unknown at present
Scope	This Standard specifies the energy labelling and minimum energy performance standard (MEPS) requirements for vapour compression refrigerating appliances that can be connected to mains power and which are within the scope of AS/NZS 4474.1:2007. Such refrigerating appliances that are used in the commercial sector are included within the scope. Separate stand alone wine storage cabinets are not specifically within the scope of this Standard. In particular, this Standard specifies the following: a) Projected annual energy consumption (PAEC). b) Adjusted volume. (c) Comparative energy consumption (CEC). c) Star rating. d) Performance criteria for energy label validity. e) Some of the requirements for energy label validity. f) Minimum energy performance standards (MEPS) for refrigerating appliances for MEPS 2010 requirements. g) Test report format and printing requirements for refrigerating appliance energy labels.
Historical Information	• First published in Australia as AS 2575-1982. • AS 2575.2 first published 1986.

	• Second edition 1989. • AS 2575-1982 revised and redesignated as AS 2575.1-1989. • First published in New Zealand as NZS 6205:1982. • NZS 6205:1982 revised and redesignated as NZS 6205.1:1989 and NZS 6205.2:1989. • AS 2575.1-1989 and NZS 6205.1:1989 and parts of AS 2575.2-1989 and NZS 6205.2:1989 jointly revised, amalgamated and redesignated as AS/NZS 4474.2:1997. • Second edition 2000. • Third edition 2001. • Fourth edition 2009.
Impact of incremental changes	Unknown at present

1.2 Product Classifications

(Source: AS/NZS 4474.1:2007)

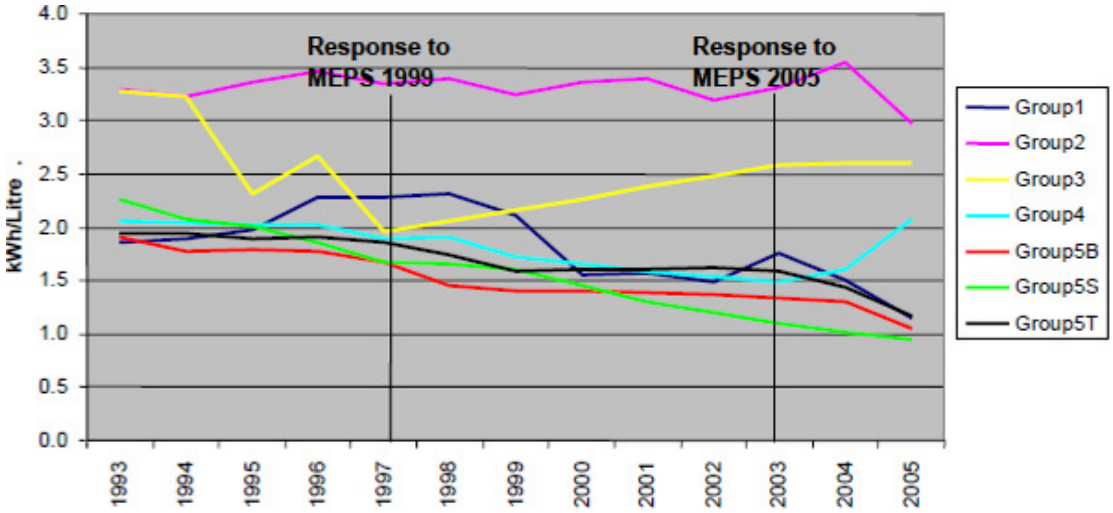
Group	Description
Group 1	Single door, all refrigerator, no internal frozen space
Group 2	Single door, all refrigerator, with an internal ice making sub-compartment
Group 3	Single door, all refrigerator, with short-term internal frozen food sub-compartment
Group 4	Two door, cyclic defrost refrigerator, with separate freezer section/compartment
Group 5T	Two door, vertical refrigerator, frost free, with freezer compartment at top
Group 5B	Two door, vertical refrigerator, frost free, with freezer compartment at bottom
Group 5S	Two door, vertical refrigerator, frost free, with freezer compartment at side
Group 6C	All freezer - chest type
Group 6U	All freezer - vertical cabinet type manual defrost
Group 7	All freezer - vertical cabinet type frost free

1.3 Product Efficiency Graphic

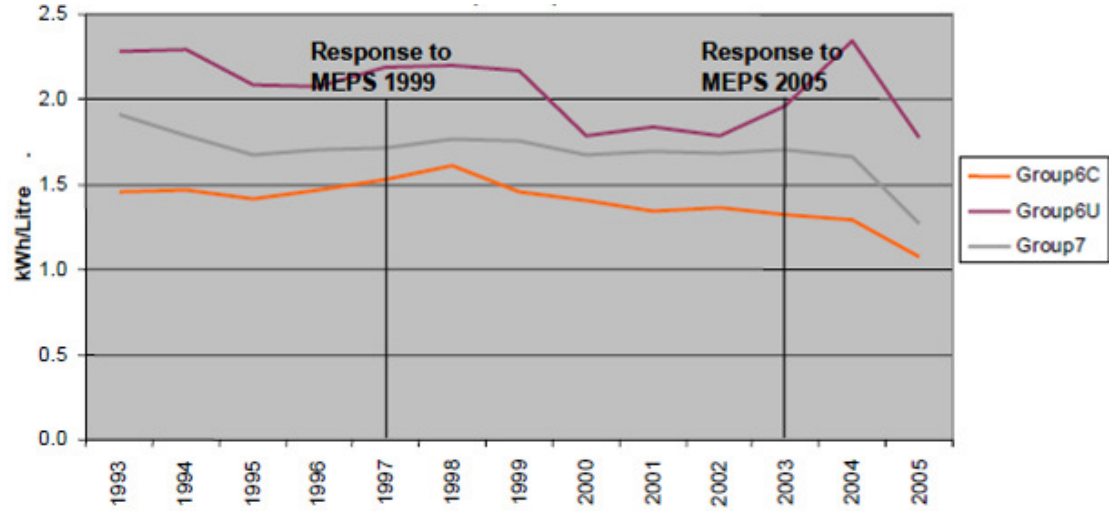
(Source: *'Retrospective analysis of the impacts of energy labelling and MEPS: refrigerators and freezers'*, October 2006 for Australian Greenhouse Office by EnergyConsult PTY Ltd)

Sales weighted average annual energy per unit of adjusted storage volume. Note source does not detail source material or methodology used to reach sales weighted figures. Also, test methodology changes through time frame and it is unclear if source corrects data for changes in methodology.

Source also provides additional breakdown by product classification. Again note source does not detail source material or methodology used to reach sales weighted figures. Also, test methodology changes through time frame and it is unclear if source corrects data for changes in methodology.



Sales weighted average efficiency of refrigerators by groups, 1993 to 2005



Sales weighted average efficiency of freezers by groups, 1993 to 2005

1.4 Product Efficiency Summary Data

(Source: National Appliance and Equipment Energy Efficiency Committee Report 2006/06, '*Greening whitegoods: A report into the energy efficiency trends of major household appliances in australia from 1993 to 2005*', detailed output tables, June 2006)

Data presented is simple of average of data table from source (below) for refrigerator and freezer product categories.

Year	Group 1	Group 2	Group 3	Group 4	Group 5T	Group 5B	Group 5S	Group 6U	Group 6C	Group 7
1993	1.72	2.94	3.22	1.96	1.92	1.88	2.25	2.09	1.38	1.95
1994	1.77	2.85	3.15	1.97	1.91	1.76	2.09	2.10	1.41	1.82
1995	1.86	2.96	2.31	1.97	1.84	1.76	2.03	1.98	1.33	1.69
1996	1.92	3.07	2.53	1.97	1.85	1.73	1.86	1.97	1.36	1.70
1997	1.92	2.98	1.95	1.79	1.76	1.64	1.65	2.09	1.44	1.71
1998	1.88	3.02	1.84	1.67	1.44	1.64	2.11	1.52	1.76	1.73
1999	1.68	2.96	1.60	1.51	1.40	1.59	2.11	1.38	1.73	1.58
2000	1.48	3.00	1.51	1.52	1.39	1.45	1.74	1.32	1.65	1.55
2001	1.46	2.98	2.29	1.45	1.50	1.38	1.29	1.80	1.23	1.67
2002	1.39	2.88	2.42	1.41	1.53	1.36	1.20	1.75	1.26	1.66
2003	1.44	2.93	2.57	1.34	1.50	1.31	1.10	1.89	1.21	1.67
2004	1.40	3.10	4.08	1.43	1.33	1.29	1.01	2.20	1.19	1.63
2005	1.05	2.67	2.60	2.03	1.11	1.04	0.94	1.73	0.99	1.22

Specific energy consumption (kWh/Adjusted litre), 1993 to 2005

Section 2: Notes on Product Consumption

2.1 Test Methodologies Performance Standards and Labelling Requirements

Refer to section 1.1

2.2 Product Classifications

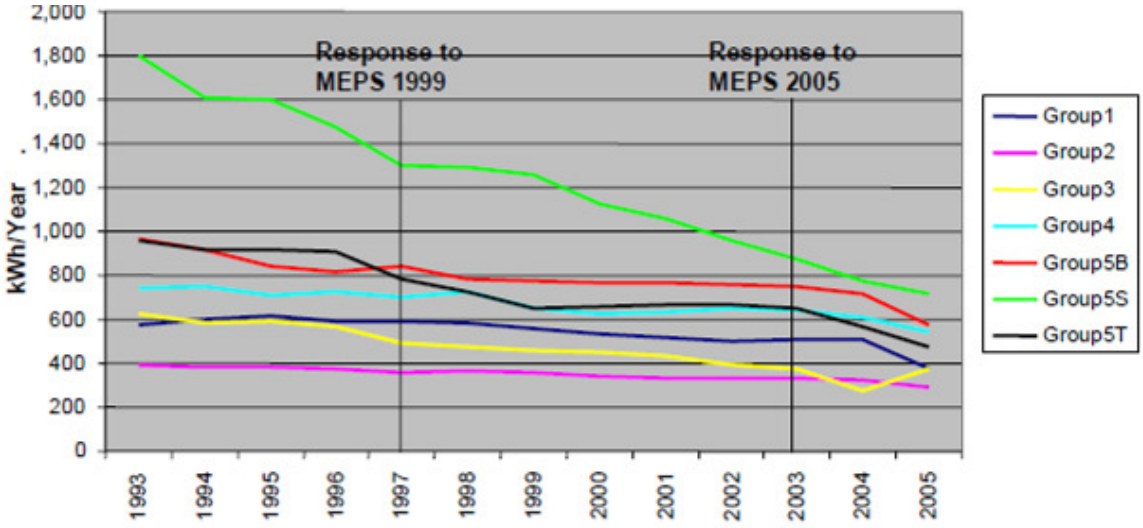
Refer to section 1.1

2.3 Product Consumption Graphic

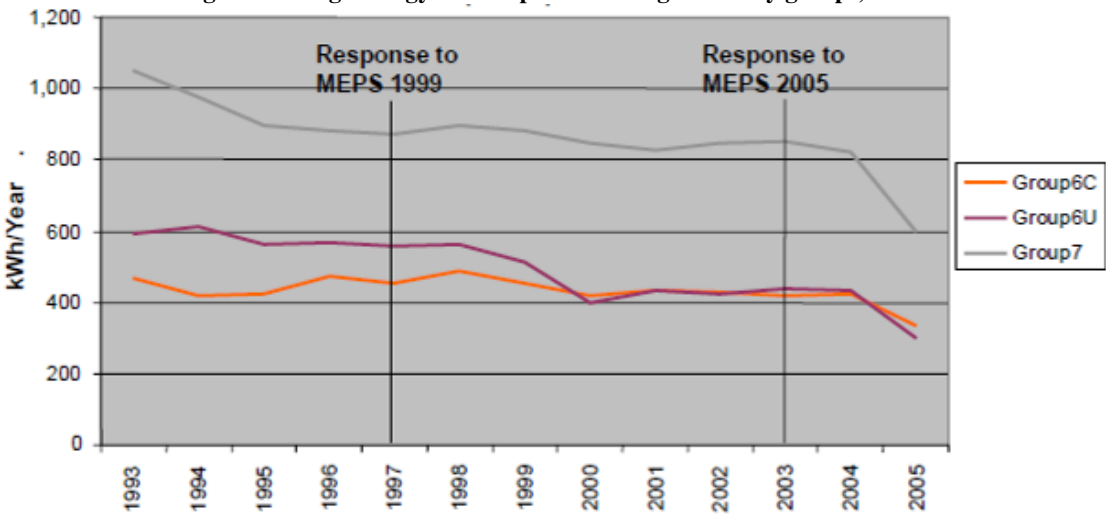
(Source: 'Retrospective analysis of the impacts of energy labelling and MEPS: refrigerators and freezers', October 2006 for Australian Greenhouse Office by EnergyConsult PTY Ltd)

Sales weighted average annual energy consumption per unit. Note source does not detail source material or methodology used to reach sales weighted figures. Also, test methodology changes through time frame and it is unclear if source corrects data for changes in methodology.

Source also provides additional breakdown by product classification. Again note source does not detail source material or methodology used to reach sales weighted figures. Also, test methodology changes through time frame and it is unclear if source corrects data for changes in methodology.



Sales weighted average energy consumption of refrigerators by groups, 1993 to 2005



Sales weighted average energy consumption of freezers by groups, 1993 to 2005

2.4 Best and Worst Product Performance

2.4.1 2008 data

(Source: Derived from products registered on www.energyrating.gov.au website at 17 April 2009)

Refrigerators				Freezers			
Group	**Best**	**Worst**	**Average**	**Group**	**Best**	**Worst**	**Average**
1	180	698	359	6C	182	840	363
2	183	387	323	6U	231	739	324
3	293	573	357	7	310	1024	556
4	312	819	518				
5	452	1150	759				
5B	358	940	613				
5S	478	1356	891				
5T	335	1018	516				
Average	**324**	**868**	**542**	**Average**	**241**	**868**	**414**

2.5 Product Consumption Summary Data

(Source: National Appliance and Equipment Energy Efficiency Committee Report 2006/06, 'Greening whitegoods: A report into the energy efficiency trends of major household appliances in Australia from 1993 to 2005', detailed output tables, June 2006)

Data presented is simple of average of data table from source (below) for refrigerator and freezer product categories

.

Year	Group 1	Group 2	Group 3	Group 4	Group 5T	Group 5B	Group 5S	Group 6U	Group 6C	Group 7
1993	577	391	624	743	959	970	1,802	590	468	1,049
1994	600	380	587	748	918	914	1,606	614	421	978
1995	616	384	590	710	917	838	1,596	565	426	896
1996	588	376	570	725	912	815	1,473	566	476	879
1997	590	357	490	697	785	838	1,303	559	454	870
1998	580	367	-	728	726	787	1,294	561	488	898
1999	554	356	-	652	653	772	1,258	512	451	880
2000	530	343	-	628	659	764	1,129	401	420	845
2001	518	336	432	635	666	766	1,056	433	434	824
2002	498	332	389	653	670	762	959	421	429	845
2003	507	329	373	639	649	753	872	437	421	851
2004	509	324	275	612	570	717	778	434	423	824
2005	378	295	376	543	476	574	719	296	334	599

Specific energy consumption (kWh/Adjusted litre), 1993 to 2005

Section 3: Notes on Efficiency of Stock

None at present

Section 4: Notes on Consumption of Stock

4.1 Number of Units

4.1.1 2004 data

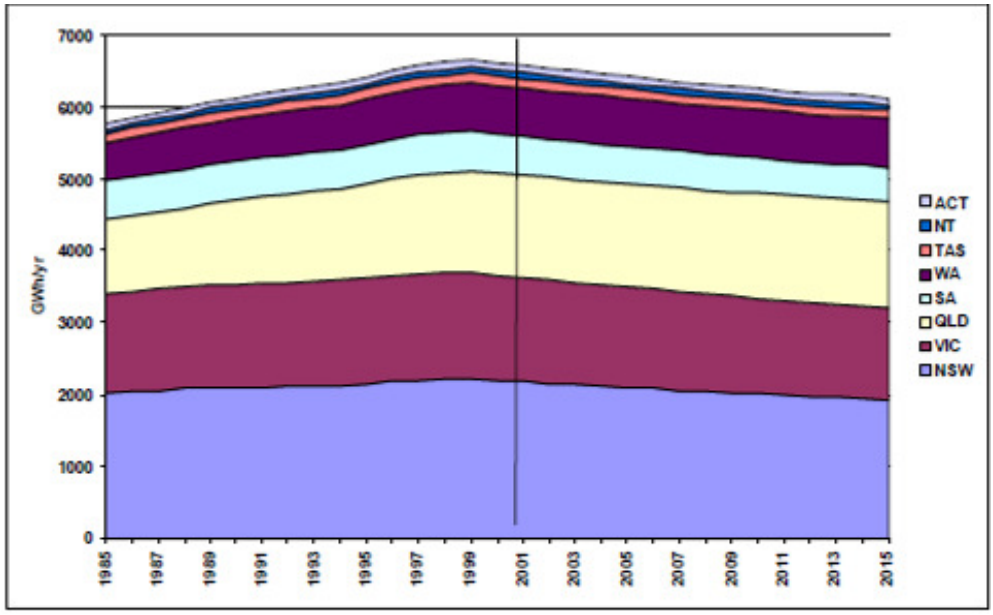
(Source: National Appliance and Equipment Energy Efficiency Committee Briefing Paper: Domestic Refrigeration)

4.2 Consumption of Stock

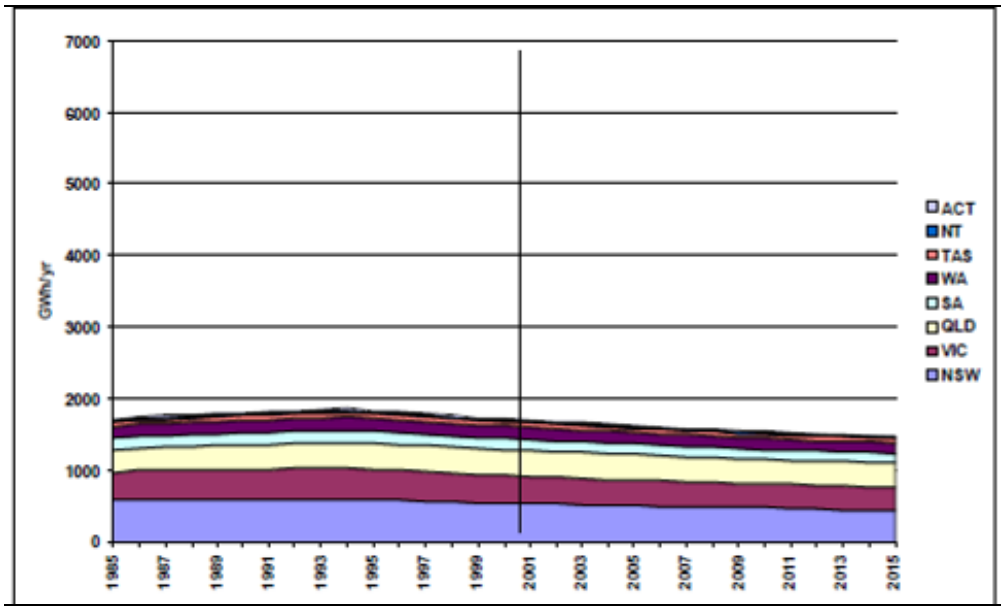
Year	Fridges			Freezers		
	Data set 1	Data set 2	Data set 3	Data set 1	Data set 2	Data set 3
1996	6500			1720		
1997	6625			1710		
1998	6675			1700		
1999	6700			1680		
2000	6650		6610	1665		1720
2001	6600			1650		
2002	6550			1635		
2003	6500			1620		
2004	6450			1600		
2005		6184			1568	
2006		6128			1539	
2007		6070			1508	
2008		6011			1477	

4.2.1 1996 – 2004 data (data set 1)

*(*Source: Values estimated from graphs in '*Regulatory impact statement: Revised minimum energy performance standards for household refrigerators and freezers',* draft for public comment, August 2001)



Energy consumed by household refrigerators, Australia 1985-2015



Energy consumed by household freezers, Australia 1985-2015

4.2.2 2005 – 2008 data (data set 2)

(Source: '*Consultation regulatory impact statement of proposed revisions to the method of test and energy labelling algorithms for household refrigerators and freezers'*, June 2008)

Table 87: BAU and Expected Impact Costs and Benefits for Australian Refrigerators

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	6184	6184	0	$0.0	0	$0.0
2006	6128	6128	0	$0.0	0	$0.0
2007	6070	6070	0	$0.0	0	$0.0
2008	6011	6011	0	$0.0	0	$0.0
2009	5952	5949	2	$0.4	2	$2.4
2010	5887	5880	7	$1.1	7	$4.6
2011	5826	5812	14	$2.3	13	$6.9
2012	5768	5744	24	$3.8	22	$9.2
2013	5713	5680	34	$5.4	30	$9.2
2014	5664	5621	44	$7.1	38	$9.1
2015	5622	5569	54	$8.7	46	$9.1
2016	5587	5523	64	$10.4	54	$9.1
2017	5560	5486	74	$12.0	61	$9.1
2018	5541	5456	85	$13.7	68	$9.1
2019	5533	5438	95	$15.4	74	$9.2
2020	5536	5430	106	$17.1	80	$9.2

Note: Energy saving from products installed to 2020 continue to accrue to 2045

Table 88: BAU and Expected Impact Costs and Benefits for Australian Freezers

Year	BAU (GWh/yr)	Expected (GWh/yr)	Energy Savings (GWh/yr)	Savings Value ($m)	Emissions Savings (kt CO2-e)	Additional Appliance Cost ($m)
2005	1568	1568	0	$0.0	0	$0.0
2006	1539	1539	0	$0.0	0	$0.0
2007	1508	1508	0	$0.0	0	$0.0
2008	1477	1477	0	$0.0	0	$0.0
2009	1445	1445	0	$0.0	0	$0.2
2010	1412	1411	1	$0.1	1	$0.3
2011	1379	1378	1	$0.2	1	$0.4
2012	1347	1344	2	$0.4	2	$0.5
2013	1314	1311	3	$0.5	3	$0.5
2014	1283	1279	4	$0.6	3	$0.4
2015	1251	1246	5	$0.8	4	$0.4
2016	1220	1215	6	$0.9	5	$0.4
2017	1190	1183	6	$1.0	5	$0.4
2018	1159	1152	7	$1.2	6	$0.4
2019	1129	1121	8	$1.3	6	$0.4
2020	1100	1091	9	$1.4	7	$0.4

Note: Energy saving from products installed to 2020 continue to accrue to 2045

4.2.3 2000 data (data set 3)

(Source: '*Regulatory impact statement: Revised minimum energy performance standards for household refrigerators and freezers',* draft for public comment, August 2001

Section 5: Notes on Major Policy Interventions

5.1 Energy Labels

(Source: National Appliance and Equipment Energy Efficiency Committee Report 2004/05, '*Energy Label Transition – The Australian Experience: Main Report*', July 2004)

5.2 Minimum Energy Performance Standards

(Sources: National Appliance and Equipment Energy Efficiency Committee Report 2004/05, '*Energy Label Transition – The Australian Experience: Main Report*', July 2004; Paper 6.290, '*Energy consumption of whitegoods - what is improving and what is not: analysis of 13 years of data in Australia*', March 2007)