Product Definition: Domestic Cold Appliances
Final: 30th July 2009

1 Matrix Definition

While various standards use differing definitions, domestic cold appliances can be broadly categorised by the matrix in Figure 1.

Figure 1: Matrix Definition of Cold Appliance Sub-Categorisation

A)	**Technology**	**Cooling Method**	Compressor			Absorption					
B)	**Functionality**	**Types**	Refrigerator			Refrigerator Freezer			Freezer		
C)		**Type Configurations**	Under Counter	Upright	Refrigerator with freezer (ice) compartment	Side-by-Side	Freezer top/ Refrigerator bottom	Refrigerator top/ Freezer bottom	Chest	Under Counter	Upright
D)		**Freezer Temperatures** [1]	0 - ≥-6C			-6 to ≥-12C		-12 to ≥-18C		≤-18C	
E)		**Defrost**	Manual			Cyclical			Automatic		
F)		**Temperature Control**	Single Control			Dual Compartment Control			Multiple Compartment Control		
G)		**Peripherals**	Ice Makers/Water Coolers/Anti-condensate heaters								
H)	**Other Variables**	**Capacity**	Compartment Capacity								
I)		**Installation**	Built in/Free Standing							Built in/Free Standing	
J)		**Climate Class**	10-32C			16-32C		16-38C		16-43C	

[1] *No differentiation of refrigerator temperatures is made as the vast majority of units, irrespective of type, fall into the 0-5C category*

2 Product Sub-Category Rationalisation

2.1 Technology

Matrix Row A): Cooling Method

Absorption cooling is extremely rare in domestic environments with compressor based technology being the dominant driver for the cooling system.
Agreed Approach: Consider only compressor driven units

2.2 Functionality

Matrix Row B) and C): Types and Configurations

Attempting to reduce the number of type and associated configurations is problematic as detailed definitions of each vary between international standards and associated regulatory definitions within countries. However, *in general:*

i) Test methodologies/regulatory specifications have various methodologies for taking account of, and "correct" for, small freezer/ice compartments within refrigerator units (normally related to the temperature of the freezer "box". However, the sub-variations are large and inconsistent and each sub-variation is anticipated to have very low individual market share (although as a group they may be significant in some markets). Therefore, although causing a potentially significant impact on the efficiency of the differing units, a simple division is proposed between refrigerators without freezer boxes and those with freezer boxes (irrespective of box temperature)

Agreed Approach: Treat individual refrigerator units with and without small freezer/ice making compartments as separate categories, but do not sub-divide between temperatures within the freezer "box".

ii) Test methodologies/regulatory specifications almost always account for differences in volume, and although a few countries categorise upright and under-counter individual refrigeration units separately, most do not. Therefore the differentiation of upright and under-counter individual refrigerator and individual freezer units may be removed.
Agreed Approach: Treat upright and under the counter refrigerator and freezer units as one category.

iii) Similarly, many countries categorise upright and chest freezers as one group. However, most regulatory specifications treat upright and chest freezers differently given the (generally) significant difference in external surface area which impacts significantly on unit efficiency. Nevertheless, in the context of the mapping and benchmarking annex, where the aim is to inform policy makers of the difference in efficiency to deliver a particular level of service, it appears reasonable to treat chest and upright/under counter freezer units as one category
Agreed Approach: Treat upright, under the counter and chest freezers as one category.

iv) The differentiation between whether the refrigerator or freezer unit is on the top or the bottom in combined refrigerator/freezer units does have a slight impact on efficiency, but expert opinion indicates that this is minor, with the majority of variation caused by the relative size of the compartments (which is dealt with by most test methodologies/regulatory specifications). However, due to the significantly different thermal characteristics of side-by-side units compared with top and bottom units, the impact on comparable efficiency is larger. Nevertheless, as noted above, the aim is to inform policy makers of the difference in efficiency to deliver a particular level of service. As both side-by-side units and top and bottom units deliver fundamentally the same service they should be considered as one grouping. However, where possible data on the number of each type of unit (ie side-by-side or top/bottom) should be captured for use with the "cultural" analysis of potential differences between markets
Agreed Approach: Treat all refrigerator/freezer combination units as one group irrespective of configuration. Where possible, capture information on the relative proportions of each unit in the various markets.

Matrix Row D): Freezer Compartment Temperature

Freezer compartment temperature in both individual freezer units and fridge/freezer combination units has a fundamental impact on unit efficiency. However, indications are that most freezers operate at -12C or lower, with the vast majority built for a target -15C. Therefore, other freezer temperatures can be ignored
Agreed Approach: Consider only units with freezer design operation temperature between -12C and -15 C.

Matrix Row E): Defrost Type

Defrost cycle has a major impact on efficiency. While automatic defrost units now make up a large majority of the market, cyclical defrost still have a significant market share in many markets (manual defrost now seems to have limited market) and have a significant impact on efficiency. However, again as noted above, the aim is to inform policy makers of the difference in efficiency to deliver a particular level of service. As far as the consumer is concerned, automatic and cyclical defrost perform the same function and as such should be treated as one category.
Agreed Approach: Treat all defrost cycles as the same although collect data on defrost cycles in case it later found to be significant.

Matrix Row F): Temperature Control Method
Temperature controls impact efficiency in use. However, almost all data that will be available to the Annex will be based on laboratory test data, and almost universally the testing methodologies require the setting of controls to specific (rated or predetermined) levels. Therefore, temperature controls will have no impact on actual performance/efficiency and can be ignored.
Agreed Approach: Remove any categorisation for number of controls in the appliances

Matrix Row G): Peripherals
Ice-makers and water coolers make a major difference to the overall energy consumption of the unit in use, but also to the basic consumption of the unit even when not making ice/cooling. While most test methodologies require these peripherals to be turned off (or disabled) during the testing, there still appears to be an underlying addition to the consumption of the unit and therefore its inherent efficiency. Therefore data will be collected to differentiate units with/without icemakers/water coolers and efforts will be made to analyse/present separately.
Agreed Approach: Where possible, differentiate units with/without ice-makers/water coolers.

Anti-condensate heaters have a major impact on efficiency but are not differentiated in most test methodologies or local regulations. Further it is not normally possible to easily discern which products include anti-condensate heaters from those that do not.
Agreed Approach: Remove any categorisation for products which do or do not contain anti-condensate systems

2.3 Other Variables

Matrix Row H): Volume
All test methodologies and local regulations characterise products in terms of volume of the various appliance compartments. Therefore volume will be used as an input to the measurement metrics. However, the adjustments factors for volume vary significantly, therefore gross volume will be requested, or at least the adjustment factors used for a given market. Although unit size does have a significant impact on consumption, units will not be differentiated by overall unit or compartment volume as such a split would have to be made at an arbitrary point.
Agreed Approach: Use volume as an input metric (based on gross volume). Units will not be sub-categorised by volume.

Matrix Row I): Installation
Identification of built in units is generally not possible from data sets, although some markets provide a "correction factor" for this type of unit. From a policy point of view such units fulfil the same function as standalone units and should therefore be treated in the same way.
Agreed Approach: Remove any categorisation for type of installation, but ensure data on corrections for specific models are obtained and normalised to other data.

Matrix Row J): Climate Class
Climate class in itself has no impact on consumption. However, it is relevant to the test methodology used (external temperature settings and thus consumption at these conditions) and often allowances are made in local regulations for climate conditions. If such local variations testing variations and allowances can be identified within the data, it should be possible to normalise all data and ignore climate class as a sub-categorisation. Therefore it is proposed to not sub-divide by climate, but to seek data on local allowances for various climate classes, and climate class variations to the test methodology, hence facilitating normalisation of data between sources.
Agreed Approach: Do not differentiate between climate class but gather climate class data and test methodology information to allow for normalisation between data sources.

3 Revised Categorisation

Based on the proposals made, Figure 2 provides a rationalised version of the original Matrix Definitions. This rationalised matrix may then be rearrange to provide a simplified view of the product categorisations for which data should be sought, see figure 3.

Figure 2: Rationalised Matrix Definition of Cold Appliance Sub-Categorisation

A)	**Technology**	**Cooling Method**	Compressor			
B)	**Functionality**	**Types**	Refrigerator		Refrigerator Freezer	Freezer
C)		**Type Configurations**	Under Counter/ upright	Refrigerator with freezer (ice) compartment	Side-by-Side and Freezer top/ Refrigerator bottom and Refrigerator top/ Freezer bottom (Collect data on proportion of each type of unit in the market)	Chest/Under Counter/Upright (Collect data on proportion of each type of unit in the market)
D)		**Freezer Temperatures (1)**			-12 to ≥-15C	
E)		**Defrost**	All Defrost Cycles (Collect data on defrost method for each model where possible)			
F)		**Temperature Control**	All Controls			
G)		**Peripherals**	Do not differentiate between units with water coolers, ice makers and anti-condensate systems (Collect data on whether water cooler or ice maker installed in models (or proportion in market) where possible)			
H)	**Other Variables**	**Volume**	All Volumes			
I)		**Installation**	All types			
J)		**Climate Class**	All Climate Classes (Collect data on whether climate class of models (or proportion in market) where possible)			

4 Participating Country Requirements

Almost all participating countries that responded indicated very high levels of interest in mapping and benchmarking information for fridge/freezer combinations and for freezers. However, refrigerators proved to be of limited interest to participating countries. Therefore, full mapping and benchmarking will be conducted on fridge/freezer combinations and freezer units. Information will be collected on refrigerators (with and without freezer (ice) compartments) but mapping and benchmarking will not be conducted initially.

5 Final Mapping and Benchmarking Specification

Combining the revised categorisation and participating country requirements, the simplified product matrix is now as follows:

Figure 3: Simplified Product Categorisation Matrix

Under Counter/ upright Refrigerators (Single Grouping – collect data only)	Refrigerator with freezer (ice) compartment (Single grouping – collect data only)	Side-by-Side and Freezer top/ Refrigerator bottom and Refrigerator top/ Freezer bottom (Collect data on proportion of each type of unit in the market)	Chest/Under Counter/Upright (Collect data on proportion of each type of unit in the market)
Where units are: • From all climate classes (but collect data on specific climate class that may be useful for later analysis) • Have freezer compartments with rated temperatures between -12 to ≥-15C (all temperature ratings to refrigerator with freezer (ice) compartment) • Differentiated (if possible) between units with peripheral water coolers and ice makers			
Do not differentiate between • Defrost Cycles including Manual/Cyclical/Automatic (although collect data in case normalisation is required) • Controls mechanisms including manual, automatic and cyclical • Built in and stand-alone units (but where differentiated in market, collect data to enable normalisation) • Volume (but collect data on gross volumes as base metric) • Climate class (but collect data on climate class in case future analysis required, plus data on related local test conditions for climate classes)			

6 Metrics

In line with almost all testing methodologies and regulations worldwide, it is proposed to define the energy consumed by a unit over one year as:

Unit Energy Consumption: *kWh/year (total consumption, not corrected for volume or other variants)*

Given the variants on local regulations (and in some cases test methodologies), it is also proposed that efficiency will be defined as:

Unit Energy Efficiency: *kWh/year/litre (corrected for only volume of individual compartments but no other variants)*

Some correction factor will be required for the comparative fridge/freezer compartments. However, at this stage it is proposed the correction factor will be developed once the available data can be evaluated.

7 Data requirements

To enable the most effective analysis of data and comparison between countries, we would like to collect the following data:

New Product Information

For all years available between 1996 and 2008 and for all categories as defined in Figure 3,

1. Ideally this will be in the form of **individual model information** including**:**
    a. Type of Appliance (using the definitions in Figure 3 or local efficiency class definitions)
    b. Annual Consumption kWh
    c. Type and volume of individual compartments (gross volume required, or net volume with details of correction factors used for model type)
    d. Annual sales volume
    e. Climate class
    f. Defrost cycle type (manual/cyclical/automatic)
    g. Whether the model has an ice maker or water cooler

h. If regulated locally and correction factor applied, is the model built in or free standing
i. Any information on models that are anticipated to enter the local market within two years that are more efficient than anything currently on the market

2. Where this is not possible, other information that allows the identification of best, worse and sales weighted average consumption of products within the market

Information on Stock

For all years available between 1996 and 2008 and for all categories as defined in Figure 3,

3. Ideally this will be full stock information that includes:
    a. Overall number of products installed in homes (or average number per household)
    b. Average volume of each product type and breakdown by average product type/volume if known
    c. Average annual energy consumption of each type (and if not direct multiple of test results, how this is calculated, eg assume actual usage conditions require additional 30% energy consumption than test conditions.
    d. Average product lifetime
4. Where this is not possible, other available information on stock, eg overall average energy consumption, number in stock, etc.

Additional Information Required for Data Processing

5. All test methodologies used within each subcategory and their relationship to known international standards (e.g. clone, clone with amendments X Y and Z, etc.). In particular it is necessary to provide information on external and internal test temperatures (and whether air temperatures of load temperatures)
6. Local regulations that define products (eg regulations that define product groups within efficiency bands and the associated algorithms that allow calculation of efficiency classes within those bands)
7. Total number of households in country/region
8. Total annual energy consumption for domestic cooling (ie by refrigerators/freezers NOT air-conditioning) within country/region (note while this will be calculated for the units where information is collected, it is useful to have an alternative value that will act as a cross check of the veracity of calculated results)
9. Local electrical supply information (voltage and frequency)

Additional Information Required for Other Analysis

10. Summary of all major policy actions over the period data is available including the times when policy were first considered, the time of formal announcement of the policy plans and the date when policy came into force
11. Summary of major cultural issues that are thought to affect this product at the local level