



Domestic Refrigerated Appliances Actions and Assumptions: USA CEC Data

The aim of this document is to detail the actions and assumptions made in interpreting and processing the data specified above during the mapping and benchmarking of domestic refrigerated appliances. It is designed to be read in parallel with the “Summary Overall Mapping and Benchmarking Approach to Domestic Refrigerated Appliances”. Section numbers in each document should align.

1 Overview of the mapping and benchmarking outputs for domestic refrigerated appliances

No data specific actions.

2 The mapping and benchmarking process for domestic refrigerated appliances

2.1 Data Cleaning and Pre-processing

2.1.1 Data cleaning

- a. Removal of all models deleted or amended prior to 1996
- b. Allocation of model availability for any given year based on the “Add Date” and “Deleted or Amended Date”. Models with an "Add Date" more than 6 years prior to the given year are removed from the analysis.
- c. Combined the fields “Brand Name” and “Model Number” for each year and de-duplicated the list so that any unique “brand-model” combination only occurs once in any one year
- d. Volumes converted to litres (declared x 28.3168466)
- e. To revert to “as tested” unit energy consumption, reported chest freezer energy consumption has been multiplied by 1/0.7, and upright and compact freezer energy consumption has been multiplied by 1/0.85.

2.1.2 Pre-processing

The pre-processing of data:

- a. Allocation of US, Mapping and Benchmarking and EU product types. This allocation was based on the “refrig style” and “refrig defrost type” fields. Allocation for the Refrigerators, Freezers and Refrigerator Freezer Data sets as follows:

| File-Field-Field | USA type ¹ | Mapping and Benchmarking Category | EU type | Configuration |
|---|-----------------------|-----------------------------------|---------|----------------|
| CEC database of Refrigerator-Freezer models.xls-Refrig Style-Refrig Defrost Type | | | | |
| FF-Bottom Freezer w/Ice thru door-Automatic | 5A (assume 5) | Fridge Freezer | 7 | Freezer Bottom |
| FF-Bottom Freezer w/o Ice thru door-Automatic | 5 or 15 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Bottom Freezer w/o Ice thru door-Manual | 1 or 11 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Internal Freezer-Automatic | 3 or 13 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Internal Freezer-Manual | 1 or 11 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Internal Freezer-Partial Automatic | 2 or 12 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Kitchen Unit-Automatic | 3 or 13 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Kitchen Unit-Manual | 1 or 11 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Kitchen Unit-Partial Automatic | 2 or 12 | Fridge Freezer | 7 | Freezer Bottom |
| FF-Side-by-Side w/Ice thru door-Automatic | 7 | Fridge Freezer | 7 | Side-by-Side |
| FF-Side-by-Side w/o Ice thru door-- | 4 or 14 | Fridge Freezer | 7 | Side-by-Side |
| FF-Side-by-Side w/o Ice thru door-Automatic | 4 or 14 | Fridge Freezer | 7 | Side-by-Side |
| FF-Single Door-Manual | 1 or 11 | Fridge Freezer | 7 | Freezer Top |
| FF-Top Freezer w/Ice thru door-Automatic | 6 | Fridge Freezer | 7 | Freezer Top |
| FF-Top Freezer w/o Ice thru door-Automatic | 3 or 13 | Fridge Freezer | 7 | Freezer Top |
| FF-Top Freezer w/o Ice thru door-Manual | 1 or 11 | Fridge Freezer | 7 | Freezer Top |
| FF-Top Freezer w/o Ice thru door-Partial Automatic | 2 or 12 | Fridge Freezer | 7 | Freezer Top |
| FF-Upright Freezer-Manual ² | | | | |

¹ Note that a number of units have been allocated two potential “USA types”. In general this is where the unit may be “standard” or “compact”, but there is insufficient data available to differentiate. However, for the purposes of the mapping and benchmarking analysis, both standard and compact units are grouped with no differentiation; therefore the model is assumed to be “standard”. Where more than two types of product are shown, this relates to the potential combinations of products based on a defrost type or the presence of an ice maker which is unknown. In these cases, assumptions default to automatic defrost (which dominates the US market) and no ice maker. These types are shown in bold font in the table.

² Product discarded as associated product information corrupted.

| File-Field-Field | USA type ¹ | Mapping and Benchmarking Category | EU type | Configuration |
|---|-----------------------|-----------------------------------|---------|-----------------|
| CEC database of Refrigerator-Freezer models.xls-Refrig Style-Refrig Defrost Type | | | | |
| F- Chest Freezer-Automatic | 10 or 18 | Freezer | 9 | Chest Freezer |
| F- Chest Freezer-Manual | 10 or 18 | Freezer | 9 | Chest Freezer |
| F- Single Door-Manual | 1 or 11 | Freezer | 8 | Upright Freezer |
| F- Upright Freezer-Automatic | 9 or 17 | Freezer | 8 | Upright Freezer |
| F- Upright Freezer-Manual | 8 or 16 | Freezer | 8 | Upright Freezer |
| R-Chest Refrigerator-Manual-Freezer vol <14L | 1 or 11 | Refrigerator | 5 | Not Applicable |
| R-Chest Refrigerator-Manual-Freezer vol >or= 14L | 1 or 11 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Double door-Automatic-Freezer vol <14L | 3 or 13 | Refrigerator | 5 | Not Applicable |
| R-Double door-Automatic-Freezer vol >or= 14L | 3 or 13 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Drawer Unit-Automatic-Freezer vol <14L | 3 or 13 | Refrigerator | 5 | Not Applicable |
| R-Drawer Unit-Automatic-Freezer vol >or= 14L | 3 or 13 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Internal Freezer-Automatic-Freezer vol <14L | 3 or 13 | Refrigerator | 5 | Not Applicable |
| R-Internal Freezer-Automatic-Freezer vol >or= 14L | 3 or 13 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Internal Freezer-Manual-Freezer vol <14L | 1 or 11 | Refrigerator | 5 | Not Applicable |
| R-Internal Freezer-Manual-Freezer vol >or= 14L | 1 or 11 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Kitchen Unit-Automatic-Freezer vol <14L | 3 or 13 | Refrigerator | 5 | Not Applicable |
| R-Kitchen Unit-Automatic-Freezer vol >or= 14L | 3 or 13 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Kitchen Unit-Manual-Freezer vol <14L | 1 or 11 | Refrigerator | 5 | Not Applicable |
| R-Kitchen Unit-Manual-Freezer vol >or= 14L | 1 or 11 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Single Door-Automatic-Freezer vol <14L | 3 or 13 | Refrigerator | 5 | Not Applicable |
| R-Single Door-Automatic-Freezer vol >or= 14L | 3 or 13 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Single Door-Manual-Freezer vol <14L | 1 or 11 | Refrigerator | 5 | Not Applicable |
| R-Single Door-Manual-Freezer vol >or= 14L | 1 or 11 | Refrigerator with Freezer | 5 | Not Applicable |
| R-Single Door-Partial Automatic-Freezer vol <14L | 2 or 12 | Refrigerator | 5 | Not Applicable |
| R-Single Door-Partial Automatic-Freezer vol >or= 14L | 2 or 12 | Refrigerator with Freezer | 5 | Not Applicable |

- b. In a small number of cases, it was unclear whether freezer units were upright or chest. Where there was doubt, products have been assumed to be upright. In cases where this assumption was incorrect, this will only affect the

calculation of EEI., with the calculated EEI being slightly lower than the true model value (i.e. the product EEI will indicate the unit is slightly more efficient than is actually the case). It is believed the overall effect on the market average is minimal, but the specific impact is unknown.

The pre-processing of data:

- c. Compartments within the various US unit types were allocated to one of the mapping and benchmarking compartment categories based on the table below (note this table also gives the assumed test temperatures for each compartment for each product type under US test conditions).

| EU Categorisations | Fresh Comp Temp | Frozen Comp Temp | Compartment Allocations for Fresh, Frozen and "Other Compartment" Volumes (T=degC) | | | | | |
|-----------------------------|-----------------|---------------------|--|------------|-------|-------------|---------------|----------------|
| | | | 14 > T > 5 | 5 >= T > 0 | T = 0 | 0 > T => -6 | -6 > T => -12 | -12 > T => -18 |
| Refrigerators | 3.33C | -9.44C ³ | | Fresh | | | Frozen | |
| Refrigerators with Freezers | 7.22C | -9.44C | | Fresh | | | Frozen | |
| Fridge Freezers | 7.22C | -15C | | Fresh | | | | Frozen |
| Freezers | | -17.77C | | | | | | Frozen |

2.2 Production of Graphical Mapping Outputs

Local adjusted volume test methodology used:

$$Total\ Adjusted\ Volume = Volume\ fresh + n * Volume\ frozen$$

³ US regulations do not specify a standardized compartment temperature for the freezer compartment of an "all-refrigerator" units, therefore the actual temperature during tests could vary. However, a nominal temperature of -9.44 has been allocated based on the freezer temperature of "refrigerators" to enable benchmarking with other countries. This is *likely* to lead to a slightly lower unit energy consumption per litre in comparison with other countries.

Where

| USA Classification | n |
|---|----------|
| Refrigerators (excluding all refrigerators) | 1.44 |
| Fridge-Freezers | 1.63 |
| Freezers | 1.73 |
| All Refrigerators | 1 |

2.3 Normalisation

2.3.1 Normalisation Overview

No data specific actions.

2.3.2 Allocation of declared UEC to compartments

The adaptation of the EU methodology used in this analysis requires knowledge of compartment defrost type. It is also possible that we will use information on climate class, whether or not the unit is built in and whether or not the unit has an ice maker in a separate specific piece of benchmarking analysis. These characteristics of each model were allocated based on the declared values where available and on the “File-Filed-Field” description when not explicitly stated. Allocation based on product type was as follows:

| File-Field-Field | Defrost Type | Built-in | Ice maker |
|---|-----------------------------|-----------------|------------------|
| CEC database of Refrigerator-Freezer models.xls-Refrig Style-Refrig Defrost Type | | | |
| FF-Bottom Freezer w/Ice thru door-Automatic | All Compartments Automatic | No | Yes |
| FF-Bottom Freezer w/o Ice thru door-Automatic | All Compartments Automatic | No | No |
| FF-Bottom Freezer w/o Ice thru door-Manual | All Compartments Manual | No | No |
| FF-Internal Freezer-Automatic | All Compartments Automatic | No | Unknown |
| FF-Internal Freezer-Manual | All Compartments Manual | No | Unknown |
| FF-Internal Freezer-Partial Automatic | Fresh Compartment Automatic | No | Unknown |
| FF-Kitchen Unit-Automatic | All Compartments Automatic | Yes | Unknown |
| FF-Kitchen Unit-Manual | All Compartments Manual | Yes | Unknown |
| FF-Kitchen Unit-Partial Automatic | Fresh Compartment Automatic | Yes | Unknown |
| FF-Side-by-Side w/Ice thru door-Automatic | All Compartments Automatic | No | Yes |
| FF-Side-by-Side w/o Ice thru door-- | Unknown | No | No |
| FF-Side-by-Side w/o Ice thru door-Automatic | All Compartments Automatic | No | No |
| FF-Single Door-Manual | All Compartments Manual | No | Unknown |
| FF-Top Freezer w/Ice thru door-Automatic | All Compartments Automatic | No | Yes |

| File-Field-Field | Defrost Type | Built-in | Ice maker |
|---|-----------------------------|-----------------|------------------|
| CEC database of Refrigerator-Freezer models.xls-Refrig Style-Refrig Defrost Type | | | |
| FF-Top Freezer w/o Ice thru door-Automatic | All Compartments Automatic | No | No |
| FF-Top Freezer w/o Ice thru door-Manual | All Compartments Manual | No | No |
| FF-Top Freezer w/o Ice thru door-Partial Automatic | Fresh Compartment Automatic | No | No |
| Chest Refrigerator-Manual-Freezer vol <14L | All Compartments Manual | Unknown | No |
| Chest Refrigerator-Manual-Freezer vol >or= 14L | All Compartments Manual | Unknown | No |
| Double door-Automatic-Freezer vol <14L | All Compartments Automatic | Unknown | Unknown |
| Double door-Automatic-Freezer vol >or= 14L | All Compartments Automatic | Unknown | Unknown |
| Drawer Unit-Automatic-Freezer vol <14L | All Compartments Automatic | Unknown | Unknown |
| Drawer Unit-Automatic-Freezer vol >or= 14L | All Compartments Automatic | Unknown | Unknown |
| Internal Freezer-Automatic-Freezer vol <14L | All Compartments Automatic | Unknown | No |
| Internal Freezer-Automatic-Freezer vol >or= 14L | All Compartments Automatic | Unknown | No |
| Internal Freezer-Manual-Freezer vol <14L | All Compartments Manual | Unknown | No |
| Internal Freezer-Manual-Freezer vol >or= 14L | All Compartments Manual | Unknown | No |
| Kitchen Unit-Automatic-Freezer vol <14L | All Compartments Automatic | Yes | Unknown |
| Kitchen Unit-Automatic-Freezer vol >or= 14L | All Compartments Automatic | Yes | Unknown |
| Kitchen Unit-Manual-Freezer vol <14L | All Compartments Manual | Yes | Unknown |
| Kitchen Unit-Manual-Freezer vol >or= 14L | All Compartments Manual | Yes | Unknown |
| Single Door-Automatic-Freezer vol <14L | All Compartments Automatic | Unknown | Unknown |
| Single Door-Automatic-Freezer vol >or= 14L | All Compartments Automatic | Unknown | Unknown |
| Single Door-Manual-Freezer vol <14L | All Compartments Manual | Unknown | Unknown |
| Single Door-Manual-Freezer vol >or= 14L | All Compartments Manual | Unknown | Unknown |
| Single Door-Partial Automatic-Freezer vol <14L | Fresh Compartment Automatic | Unknown | Unknown |
| Single Door-Partial Automatic-Freezer vol >or= 14L | Fresh Compartment Automatic | Unknown | Unknown |
| Chest Freezer-Automatic | Automatic | Unknown | Unknown |
| Chest Freezer-Manual | Manual | Unknown | Unknown |
| Single Door-Manual | Manual | Unknown | Unknown |
| Upright Freezer-Automatic | Automatic | Unknown | Unknown |
| Upright Freezer-Manual | Manual | Unknown | Unknown |

Whilst installation type is not listed in the data for all models, the table below⁴ shows that majority of models in the USA market are freestanding.

| Sum of Domestic Unit Shipments Combined DOE Product Class | B, Free Stand | Year | | |
|--|---------------|-------|-------|-------|
| | | 2005 | 2006 | 2007 |
| 1 and 2 | B | 0.0% | 0.1% | 0.0% |
| | F | 0.6% | 0.3% | 0.2% |
| 4 | B | 0.9% | 0.8% | 0.7% |
| | F | 0.9% | 0.9% | 0.7% |
| 5 | B | 0.0% | 0.0% | 1.3% |
| | F | 0.0% | 0.0% | 16.7% |
| 5 and 19 | B | 1.1% | 1.7% | 0.0% |
| | F | 2.6% | 16.3% | 0.0% |
| 7 | B | 1.0% | 1.8% | 1.5% |
| | F | 61.7% | 55.3% | 51.5% |
| 8 and 10 | F | 11.5% | 8.7% | 9.2% |
| | B | 0.1% | 0.1% | 0.2% |
| 9 | F | 11.5% | 9.4% | 8.8% |
| | B | 0.3% | 0.3% | 0.5% |
| 13 | F | 7.2% | 3.6% | 2.8% |
| | B | 0.1% | 0.1% | 0.1% |
| 14 and 15 | F | 0.0% | 0.1% | 0.0% |
| | B | 0.0% | 0.0% | 4.9% |
| 19 | B | 0.3% | 0.4% | 0.5% |
| | F | 0.2% | 0.1% | 0.4% |
| Wine Cooler | B | 0.3% | 0.4% | 0.5% |
| | F | 0.2% | 0.1% | 0.4% |

Market Share Product Class Data for Built-ins (Selected Product Classes)

2.3.3 Normalisation of “compartment EC” for test temperature variations and calculation of normalised UEC

The assumed test temperatures for each compartment for each product type are given in the table in section 2.1.2 b).

External test temperature is 32.2°C

2.3.4 Calculation of Normalised UEE

No data specific actions.

2.3.5 Calculation of normalised EEI

No data specific actions.

⁴ AHAM R-F shipment and efficiency data submission to DOE January 16, 2009