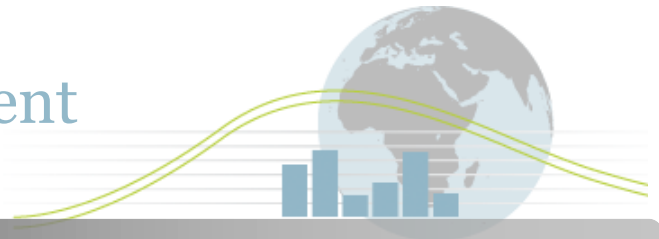


4^E

Mapping Document



Country: The European Union*

Technology: Dishwashers

Sub Category: with a capacity of between six and sixteen place settings

* Austria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Poland, Slovakia, Spain, Sweden, and the United Kingdom

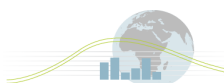
Introduction

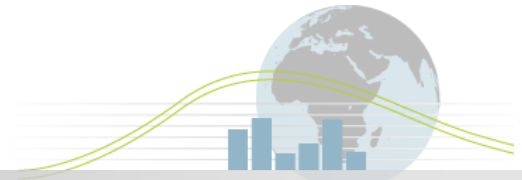
The first stage in the Mapping and Benchmarking process is the definition of the products, i.e. clearly setting the boundaries that define the products for use in data collection and analysis. This ensures that comparison between the participating countries is done against a specific and consistent set of products. The summary definition for this product is:

M&B Category	Description
Definition and Scope	<p><i>A machine which cleans, rinses, and dries dishware, glassware, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal, and/or electric means, normally through the use of water and detergent. The machine may or may not have a specific drying operation at the end of the programme.</i></p> <p>The scope is to primarily include:</p> <ul style="list-style-type: none">• Single door built-in (this includes freestanding units in European definitions), portable and drawer-type dishwashers;• Both non-soil-sensing and soil-sensing unit. <p>The scope will <i>exclude</i>:</p> <ul style="list-style-type: none">• Table top dishwashers (with fewer than 6 place settings)
Rated Capacity	6-16 place settings
Other characteristics to be noted	Wash Cycle Time Cleansing Performance Drying Performance Standby Functionality and Power Levels (Delayed Start, End of Cycle and Off) Load Type

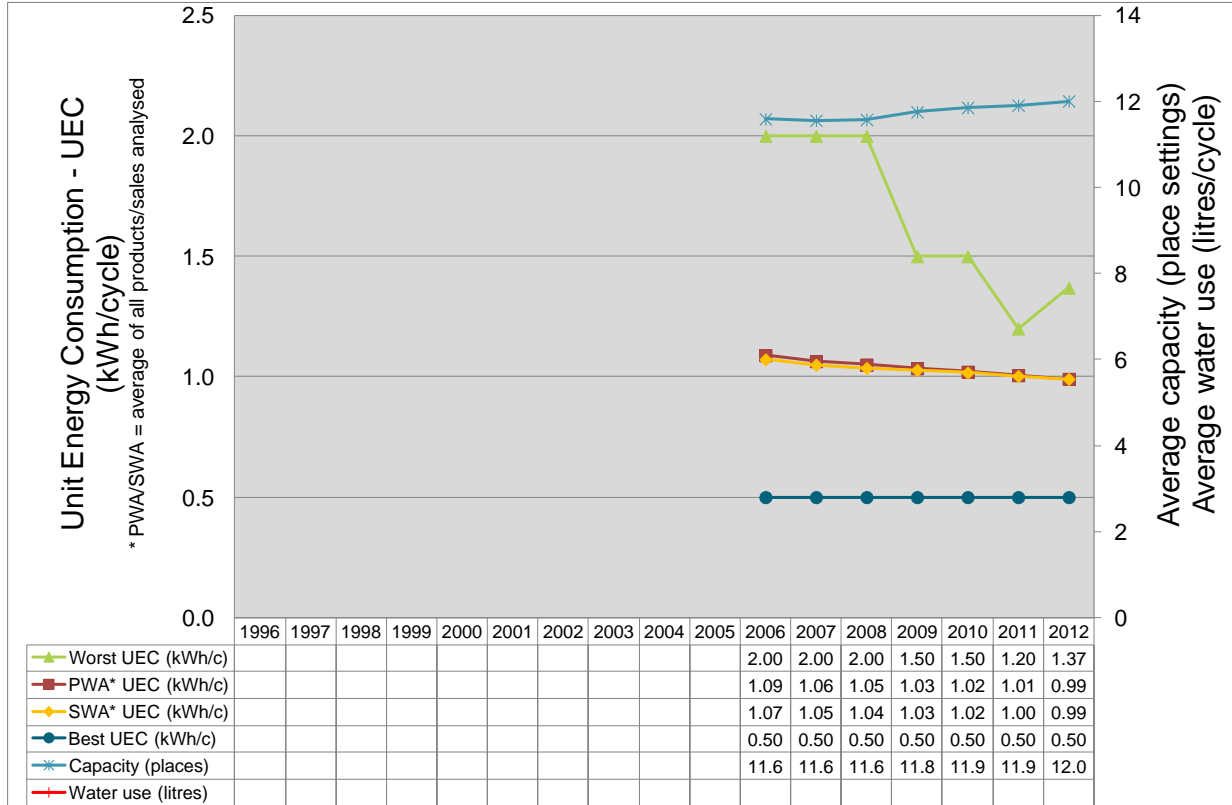
The detailed product definition can be found at the Annex website:

<http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=11>





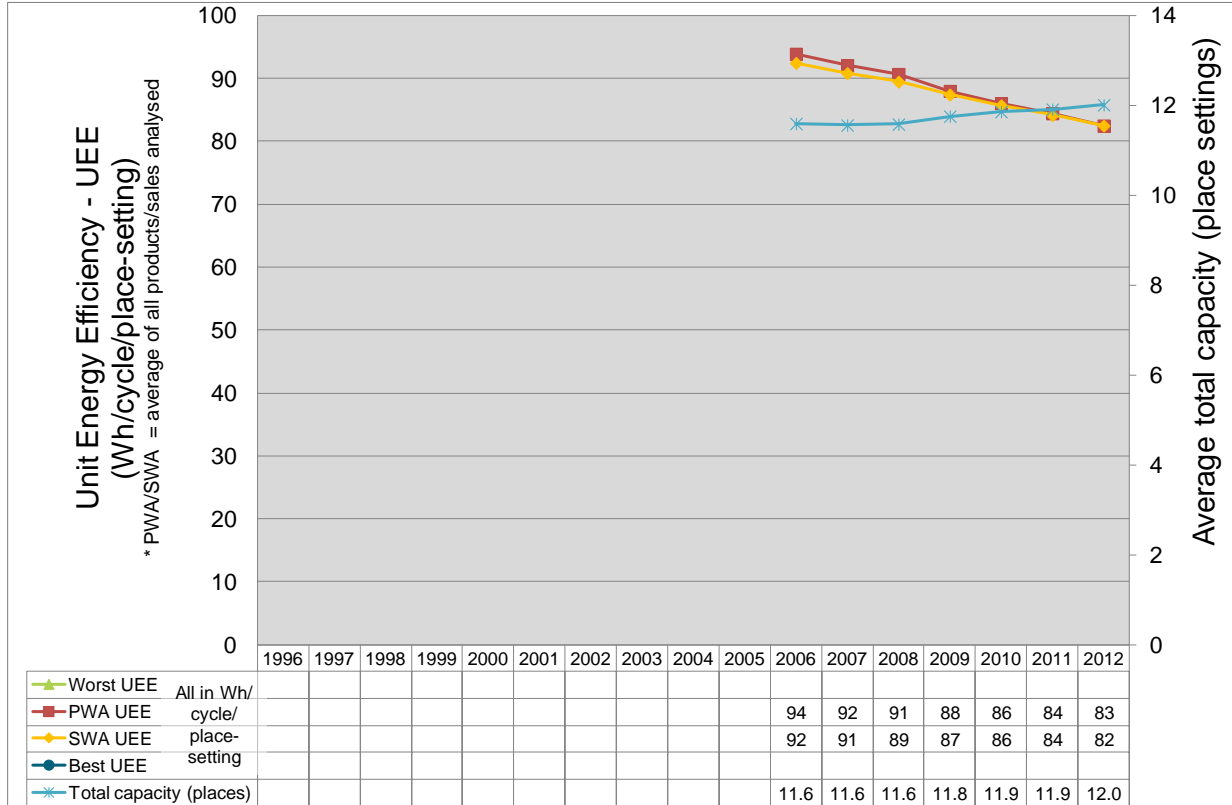
Unit Energy Consumption (UEC) of dishwashers in the EU



Key notes on Graph (see notes section 1)

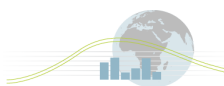
- Data was supplied to the Annex as market averages from a dataset that covers approximately 88% of sales in the market.
- All capacities shown are sales weighted averages.
- Best and worst values are limited to those models with >0.1% of market sales.

Unit Energy Efficiency (UEE) of dishwashers in the EU

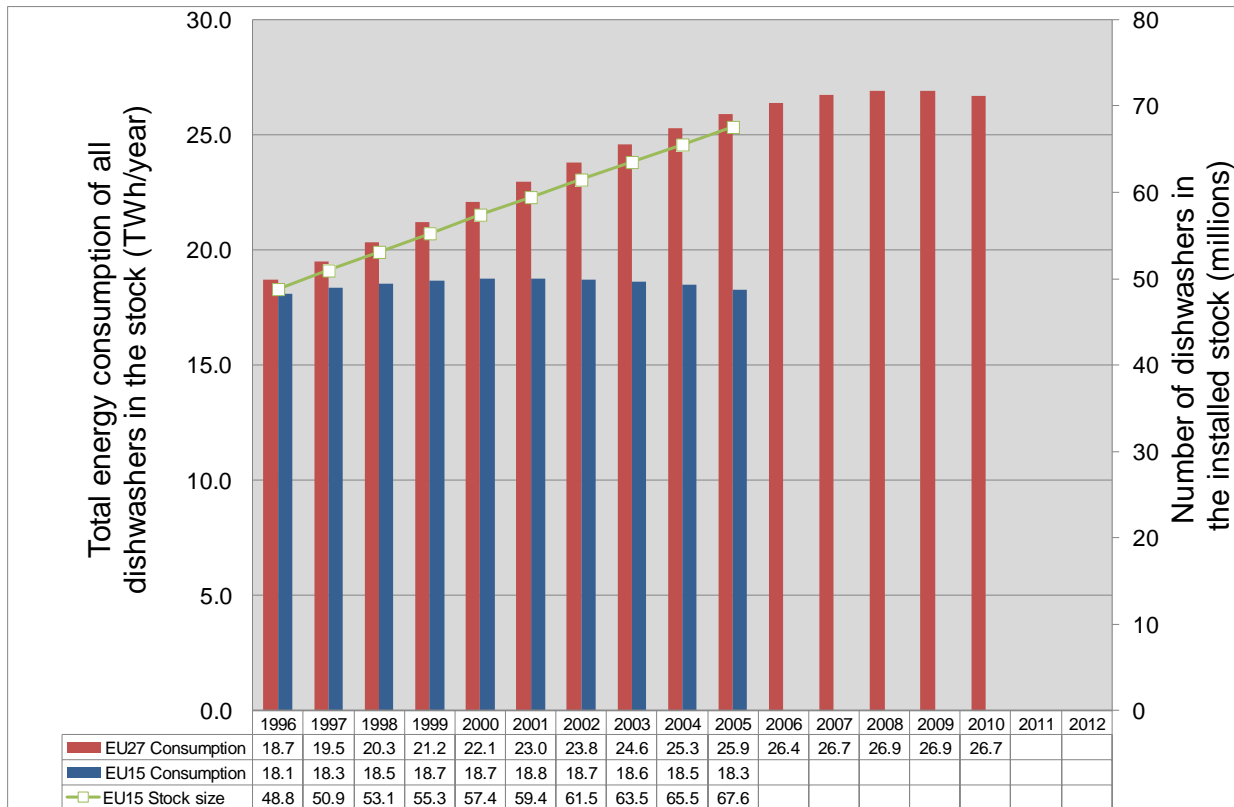


Key notes on Graph (see notes section 1)

- All UEE values are estimated from the average Unit Energy consumption (UEC) and the average capacity by year.
- UEC and capacity data was supplied to the Annex as market averages from a dataset that covers approximately 88% of sales in the market.
- This approach does not allow best or worst values for UEE to be reliably estimated.



Energy Consumption of the installed stock of dishwashers in the EU

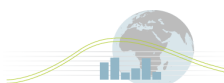


Key notes on Graph (see notes section 2)

- No data was available on the same combination of EU countries presented in the new product UEC and UEE graphics. Data is presented from the Eco-design analyses and covers the EU15¹ and EU27² regions.
- EU15 data is extracted from the stock model for the Eco-design preparatory study for dishwashers.
- EU27 data is extracted taken from the Eco-design impact assessment future scenario model for dishwashers.

¹ Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom

² EU15 plus Poland, Czech Republic, Cyprus, Latvia, Lithuania, Slovenia, Estonia, Slovakia, Hungary, Malta, Bulgaria, Romania



Major Policy Interventions (see notes section 3)

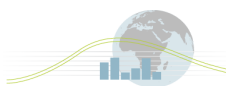
The European Union has two primary EU wide regulations related to dishwashers:

- **Minimum Efficiency Performance Standards (MEPS):** the Commission Regulation (EU) No 1016/2010 of 10 November 2010 defined a two-tier minimum Energy Efficiency Index (EEI) requirement of 71 for "*large*" units and 80 for "*small*" units. These minimum requirements are strengthened from 1st December 2013 to 63 and 71 respectively with and EEI of 63 applying to all units from 1st December 2016. A two-tier minimum requirement for drying efficiency also comes into force on 1st December 2013.
- **Mandatory Labelling:** current EU labelling requirements were established by Commission Delegated Regulation (EU) No 1059/2010 of 28 September 2010. They show Energy Efficiency Index (EEI) by label categories A+++ through to a lowest level of D. The EEI boundaries do not align with previously used method of measured energy consumption for a full cycle corrected for water usage.

In November 1999, the European Committee of Domestic Equipment Manufacturers entered into a voluntary agreement³ with the Commission with an overall target to reduce the specific energy consumption of household dishwashers by 20% until 31 December 2002 related to the base case figures of 1996. This included a two-stage programme to phase out less efficient units by stopping the import and production of '*large*' E and all F-G rated units by the end of 2000 and all D-E units by the end of 2003. The voluntary agreement with CECECED was not continued due to the introduction of the Ecodesign measures for dishwashers.

In addition there are a large number of regional, national and local policy interventions used within the European Union.

³ See http://www.ceced.org/ifede/easnet.dll/GetDoc?APPL=1&DAT_IM=20DAAB



Cultural Issues (see notes section 4)

Due to the extremely diverse range of cultures within countries the EU (eg household sizes, building types and sizes, national and local income levels, etc), it is impossible to provide any meaningful cultural information other than large scale observations:

- Household numbers are rising in almost all member states, but the number of individuals within households is falling.
- Average buying power of households rose in all member states between 1996 and 2008.
- Dishwasher sales across the whole EU are increasing from approximately 6 to 7 million between 2006 and 2012.
- There is evidence from the Denmark dataset (and anecdotally elsewhere) that that longer cycle times are becoming more common during testing and this may be contributing to the improvement in dishwasher efficiency. Any energy savings from these longer cycle times will not be delivered if consumers do not use the same cycle as the manufacturers used during the test. This is being addressed in the new ecodesign measure (Regulation 2010/1016/EU) for dishwashers which requires in Annex I, under point 1(1), that the standard cycle shall be clearly identifiable on the programme selection device of the dishwasher.

Section 1. Unit Energy Consumption and Unit Energy Efficiency Graphics

1.1 Test methodologies

1.1.1 Regulations

The testing methodology summarised below refers to EN 60436:2008 (and the associated national derivatives). This methodology is largely based on IEC 60436:2004 with some additional specific direction/ clarification added for application related to the EU directive requirements.

EN 60436:2008 supersedes EN 50242:1999 which was withdrawn on 1 September 2010. However, these standards are very similar with the following exceptions:

- 1) EN 60436:2008 includes methodologies to measure standby power
- 2) EN 60436:2008 introduces the option for use of the AHAM defined load (although this is excluded from use in the EU labelling process)
- 3) EN 60436:2008 includes methodologies for the measurement of units using non15°C inlet water (although this is excluded from use in the EU labelling process)
- 4) Introduces additional options for detergent specification

Performance and Labelling Requirements:

The performance and labelling requirements prior to 30 November 2011 are set out in COMMISSION DIRECTIVE 97/17/EC of 16 April 1997 implementing Council Directive 92/75/EEC with regard to energy labelling of household dishwashers

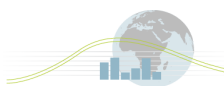
For machines entering this market after 1 December 2011, they must comply with:

- For labelling: the requirements established by COMMISSION DELEGATED REGULATION (EU) No 1059/2010 of 28 September 2010
- Minimum performance standards for energy and cleaning efficiency (and from 2013 drying efficiency): the requirements established by COMMISSION REGULATION (EU) No 1016/2010 of 10 November 2010 implementing DIRECTIVE 2009/125/EC. (Note that this regulation also sets increasingly stringent performance requirements that come into force in 2013 and 2016, with a mandatory review no later than 2014).

Summary details of both the test methodology and the performance and labelling requirements are included below:

1.1.1.1 Test Conditions:

General approach: The test methodology defines how to establish the energy consumption (including standby power consumption); the washing and drying performance, and the water consumption of the dishwasher.



The specification requires at least 5 cycles to be performed on a single machine with the average of resulting values used for declarations.

Note that the requirement to measure standby power was only introduced in regulation 1059/2010 and inclusion of standby power in product declarations was not required until 2011.

Rated Capacity: The rated capacity of the dishwasher is defined as the whole number of place settings together with the serving pieces stated by the manufacturer, which can be cleaned and dried when loaded in accordance with the manufacturer's instructions.

A place setting (a set of crockery, glass and cutlery for use by one person) and the associated serving pieces are defined .

Test load: The test load consists of the whole number of complete place settings plus the corresponding serving pieces which together comprise the manufacturer's rated capacity. While the test methodology specifies two load options (referred to Annex A and Annex B which correspond to the "IEC" and "AHAM" loads), for compliance with the EU labelling requirements, only the Annex A IEC load can be used in the test.

(NOTE The reference machine always uses a 12 piece IEC load irrespective of the load used on the test machine).

Soiling Agent: The make-up of the soiling agents includes the following:

The following soiling agents are required:

Dinner plates: Quarter sections of egg yolk, mashed potatoes, ground beef/tomato paste mix, and red raspberry preserves with coffee grounds

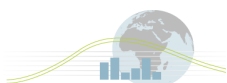
- milk
- tea
- minced meat
- egg;
- oat flakes

The standard prescribes the specific preparation of these material, and method of application and drying.

Cycle, Programme and Time: A cycle is defined as a complete washing, rinsing, and drying process consisting of a series of operations as defined by the programme selected

The test the programme to be used is the programme recommended by the manufacturer for a normally soiled load (a programme for normal use, using normal table ware, excluding cooking utensils).

The cycle time is broadly defined as the time measured from the initiation of the program (excluding any user programmed delay) until all activity ceases. Activity is considered to have ceased when the power consumption reverts to a steady state condition that persists indefinitely without user intervention. If there is no activity after the end of the program, the cycle time is equal to the program time.



Cleansing Performance: The test method for cleansing performance of the dishwasher under test is based on a comparison of the performance of the unit under test with the performance of the reference unit, and is conducted in conjunction with the energy performance test. Algorithms are provided to allow the calculation of an index for the measurement of wash performance (PC).

Under Directive 97/17/EC wash quality was required to be declared on an A-G scale on the product label.

The table below gives the A-G rating for a given wash performance index from Directive 97/17/EC.

Table 2

Cleaning performance class	Cleaning performance index P_c as defined in the harmonized standards referred to in Article 1 (2), using a standard cycle
A	$P_c > 1,12$
B	$1,12 \geq P_c > 1,00$
C	$1,00 \geq P_c > 0,88$
D	$0,88 \geq P_c > 0,76$
E	$0,76 \geq P_c > 0,64$
F	$0,64 \geq P_c > 0,52$
G	$0,52 \geq P_c$

However, under the more recent delegated regulation 1059/2010, there is no longer a requirement to declare the wash quality on the energy label, but Regulation 1016/2010 requires a minimum “cleaning efficiency index” (redefined and denoted by I_c) of 1.12 (equating to A performance under the previous labelling requirements).

Drying Performance: The drying performance test is conducted separately from the wash performance/energy test/water consumption test but uses the same cycle and load size. An unsoiled load is used for the drying test.

The drying performance⁴ is calculated (as an index) based on the number and size of droplets of water remaining after the test relative to the reference machine. An algorithm is then used to determine drying index to be declared.

The calculation methodology and declaration requirements remain unchanged between Directive 97/17/EC and delegated regulation 1059/2010. Both require drying performance to be declared on an A-G scale on the product label (although the actual label differs). The table below gives the A-G rating for a given drying performance index.

⁴ Note that both 2010 regulations define drying performance as a “drying efficiency” defined by a value I_D . However, the methodology for calculating I_D is identical to that for calculating the preceding drying performance index P_D and the actual labelling bands remain identical.

Table 3

Drying performance class	Drying performance index P_D as defined in the harmonized standards referred to in Article 1 (2)
A	$P_D > 1,08$
B	$1,08 \geq P_D > 0,93$
C	$0,93 \geq P_D > 0,78$
D	$0,78 \geq P_D > 0,63$
E	$0,63 \geq P_D > 0,48$
F	$0,48 \geq P_D > 0,33$
G	$0,33 \geq P_D$

From 1 December 2013, delegated regulation 1059/2010 places a minimum drying efficiency requirement of 1.08 for units with rated capacity of 8 settings or above and 0.86 for units with rated capacity of less than 7 settings.

Stand-by: The performance and labelling requirements set out in 97/17/EC do not require the measurement or declaration of any aspect of stand-by power.

However, regulation 1059/2010 requires the measurement of two stand-by power modes:

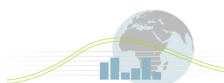
- **off-mode:** a condition where the household dishwasher is switched off using appliance controls or switches accessible to and intended for operation by the end-user during normal use to attain the lowest power consumption that may persist for an indefinite time while the household dishwasher is connected to a power source and used in accordance with the supplier’s instructions; where there is no control or switch accessible to the end-user, ‘off-mode’ means the condition reached after the household dishwasher reverts to a steady-state power consumption on its own;
- **left-on mode:** the lowest power consumption mode that may persist for an indefinite time after completion of the programme and unloading of the household dishwasher without any further intervention by the end-user

Both modes are then incorporated in the energy consumption and efficiency calculation.

However, the measurement of neither mode is specified in EN 60436:2008 and the regulation 1059/2010 simply requires that they “shall be obtained by reliable, accurate and reproducible measurement methods, which take into account the recognised state-of-the-art measurement methods”. However, EN50564 (the EU version of IEC standby measurement standard) can be used for this purpose.

Water consumption: The measurement of total water consumption is taken during the energy consumption test. For labelling regulations, all water consumption is based on cold water supply.

Declaration of annual water consumption is required on the energy label (where annual consumption = cycle consumption x 280 cycles per Annum).



Embodied Water Energy/ Nominal Water Inlet Temperature: While the test methodology provides for several water inlet temperatures, in the European energy labelling test, the nominal cold water inlet temperature is 15 °C. Adjustments for embodied energy in the water are made for supplies that vary from this temperature.

Water Hardness: For energy label purposes only water of 2,5 +/- 0,5 mmol/l shall be used.

Detergent/ Rinse Agent/Water Softener: The quantity and formula of the detergent, rinse aid and (if required) water softening salt is proscribed.

Noise: Airborne acoustical noise measurement is required for declaration under both new and old regulations. However, two further standards are referenced for measurement (EN 60704-2-3) and determination (EN 60704-3).

Ambient Temperature: The ambient temperature and the relative humidity measured during the tests shall be reported in the test report.

- Ambient temperature of the room: (23 ± 2) °C
- Relative humidity: (55 ± 5) % RH

Order of Tests: The methodology specifies that cleaning performance test is performed first, followed by the drying performance. The determination of energy, water and cycle/program time is done in conjunction with a cleaning performance test.

No specification is yet included on how or when the standby consumption is measure.

Energy Consumption:

Total energy consumption for a cycle is the sum of electrical consumption for the full cycle, plus embodied water energy (pre 2011, this value was referred to as C, but now referred to as E_t)

The energy consumption and water consumption are measured for each complete cycle.

Energy consumption and declarations are then calculated as follows:

From 1 March 1999 to 30th December 2010.

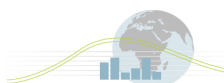
Total energy consumption to be declared is as per cycle.

Calculation of label class E_t is:

$$E_t = C/Cr$$

Where

$$Cr = 1.35 + (0.025 * \text{place settings}) \text{ [for 10 or more place settings]}$$



$$Cr = 0.45 + (0.09 * \text{place settings}) \text{ [for 9 or less place settings]}$$

Labelling class is then defined from the following table:

Table 1

Energy efficiency class	Energy efficiency index E_i
A	$E_i < 0,64$
B	$0,64 \leq E_i < 0,76$
C	$0,76 \leq E_i < 0,88$
D	$0,88 \leq E_i < 1,00$
E	$1,00 \leq E_i < 1,12$
F	$1,12 \leq E_i < 1,24$
G	$E_i \geq 1,24$

From 1st January 2011.

E_i = Measured energy consumption for a full cycle corrected for embodied water energy

The Annual Energy Consumption (AE_c) is calculated by:

$$AE_c = E_i \times 280 + \frac{\left[P_o \times \frac{525\,600 - (T_i \times 280)}{2} + P_l \times \frac{525\,600 - (T_i \times 280)}{2} \right]}{60 \times 1\,000}$$

Where:

- 280 washes is the assumed washes/year.
- P_l is standby “left-on mode”
- P_o is standby “off mode”
- T is cycle time

(note that there is a separate but similar algorithm for units with a power management system).

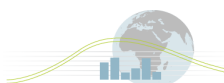
The standard energy consumption (SAE_c) is

$$SAE_c = 378 + (7 * \text{place settings}) \text{ [for 10 or more place settings]}$$

$$SAE_c = 126 + (25.2 * \text{place settings}) \text{ [for 9 or less place settings]}$$

The Energy Efficiency Index (EEI) is the derived by

$$EEI = (AE_c / SAE_c) \times 100$$



The labelling category is then allocated based on the following table (NOTE. The new label introduces three new bands, A+, A++ and A+++ with the lowest level being D. *EEI* values used in new regulations do not align with the previously used E_t values).

Energy efficiency classes

Energy efficiency class	Energy Efficiency Index
A+++ (most efficient)	$EEI < 50$
A++	$50 \leq EEI < 56$
A+	$56 \leq EEI < 63$
A	$63 \leq EEI < 71$
B	$71 \leq EEI < 80$
C	$80 \leq EEI < 90$
D (least efficient)	$EEI \geq 90$

Regulation 1016/2010 requires units to meet the following minimum efficiency levels:

From 1st December 2011.

- a) Units with rated capacity of 10 settings and a width equal to or less than 45cm are required to have an EEI of less than 80
- b) All units not specified in a) above are required to have an EEI of less than 71

From 1st December 2013.

- a) Units with rated capacity of 10 settings and a width equal to or less than 45cm are required to have an EEI of less than 71
- b) Units with a rated capacity of 11 settings or greater, or with 10 settings and a width greater than 45cm are required to have an EEI of less than 63

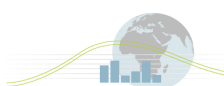
From 1st December 2016.

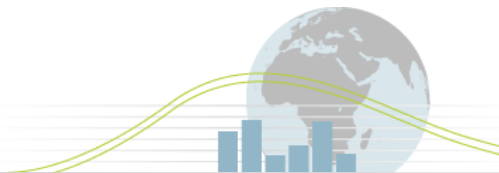
Units with rated capacity of 8 or 9 settings, and units with a rated capacity of 10 settings and a width equal to or less than 45cm, are required to have an EEI of less than 63.

1.2 Product Classifications

The test methodology applies to electric dishwashers for household use that are supplied with hot and/or cold water (although only the cold water supply can be used within the context of EU MEPS and labelling).

Definition





A dishwasher machine which cleans, rinses, and dries dishware, glassware, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal, and electric means. A dishwasher may or may not have a specific drying operation at the end of the programme.

The MEPS regulations apply only to units designed for domestic use.

1.3 Data sources

Sources: Data is sourced from GfK data. All data was provided as market averages in the from shown in the table below:

Metric	Year
Product Weighted Energy Consumption [kWh per cycle]	
Sales Weighted Energy Consumption [kWh per cycle]	
Best Energy Consumption* [kWh per cycle]	
Worst Energy Consumption* [kWh per cycle]	
Coverage %	
Sales split by Place Setting Group [Thousand Units]	
Sales split by Energy Label [Thousand Units]	

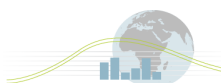
*minimum market share 0.1%

The datasets submitted are reported to cover approximately 88% of sales in the European Market in the most recent year in which coverage data was available as shown here.

Country Year	Coverage	Population
AT 2012	85%	8,489,000
CZ 2012	84%	10,519,000
DK 2011	90%	5,612,000
FI 2011	76%	5,436,000
FR 2012	94%	63,821,000
DE 2012	89%	80,557,000
GB 2012	90%	64,231,000
HU 2012	100%	9,894,000
IT 2012	83%	59,787,000
NL 2012	88%	16,795,000
PL 2012	87%	38,548,000
SK 2012	94%	5,413,000
ES 2012	87%	1,283,000
SE 2011	78%	9,593,000
Average/population weighted average:	87.5%	88.5%

The number of models and sales analysed by product category are presented in the tables below.

	2006	2007	2008	2009	2010	2011	2012
Sales in dataset	6,116,704	6,415,571	6,551,474	6,552,705	6,854,728	7,043,561	6,978,476
Sales analysed	6,095,520	6,398,797	6,537,664	6,543,200	6,843,717	7,027,195	6,961,588
% Sales included	99.7%	99.7%	99.8%	99.9%	99.8%	99.8%	99.8%



1.4 Data manipulations and specific limitations

1.4.1 Overview of the mapping and benchmarking process

There are essentially 4 stages to the mapping and benchmarking process for dishwashers as detailed below:

Stage:	Description
1. Data Cleaning and Pre-processing	<ul style="list-style-type: none"> • Removal of duplicate entries • Pre-processing to align all terminology and reported test values to be consistent between countries • Assigning of local, mapping and benchmarking and EU categories • Etc
2. Production of mapping outputs	<ul style="list-style-type: none"> • Production of mapping outputs based on local test methodologies
3. Normalisation of test data	<ul style="list-style-type: none"> • Calculation of full cycle Unit Energy Consumptions • Normalisation for test temperature differentials
4. Production of Benchmarking outputs	<ul style="list-style-type: none"> • Post processing of benchmarking results • Production of benchmarking report

The details of this process are described in two supporting documents that accompany this mapping report:

1. The **product definition** describes the exact characteristics of the product being analysed; the energy metrics that will be calculated; the technological, usage and other characteristics that will be considered; and any other policy or cultural information that will be collected
2. The **summary of approach** provides an overview of the mapping and benchmarking process for analyzing dishwashers for all countries and regions.

These documents can be found at the annex website:

<http://mappingandbenchmarking.iea-4e.org/matrix?type=product&id=11>

Aspects of the EU analysis that are specific to the local dataset or regulations are described below.

1.4.2 Specific cautions for the EU data

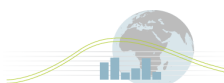
1.4.2.1 Data cleaning

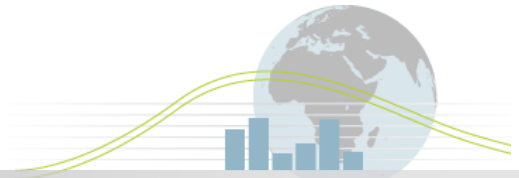
No data cleaning was undertaken.

1.4.2.2 Data processing specific to the EU dataset

Unit Energy Efficiency (UEE) was calculated from the average consumption and estimated average capacity as follows:

$$\text{Product weighted average Unit Energy Efficiency} = \frac{\text{product weighted average Unit Energy Consumption}}{\text{sales weighted average capacity}}$$

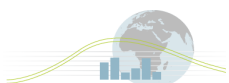




Sales weighted average Unit Energy Efficiency = sales weighted average Unit Energy Consumption / sales weighted average capacity

1.4.2.3 Test methodology details used in the analysis

The EU test methodology was used as the benchmarking methodology and so no normalisation was necessary.



Section 2. Energy Consumption of the installed stock of dishwashers graphic

EU15 Sources:

- EU 15 data is taken from the Preparatory Study for Eco-design Requirements for EuPs. (Tender TREN/D1/40-2005) Lot 14: Domestic washing machines and dishwashers. Final report tasks 1-2⁵.

EU15 Data:

Data was extracted from the following graphs on pages 148 and 150 of the report:

Figure 2.24 Dishwashers stock trend for EU 15 (1968 – 2005)

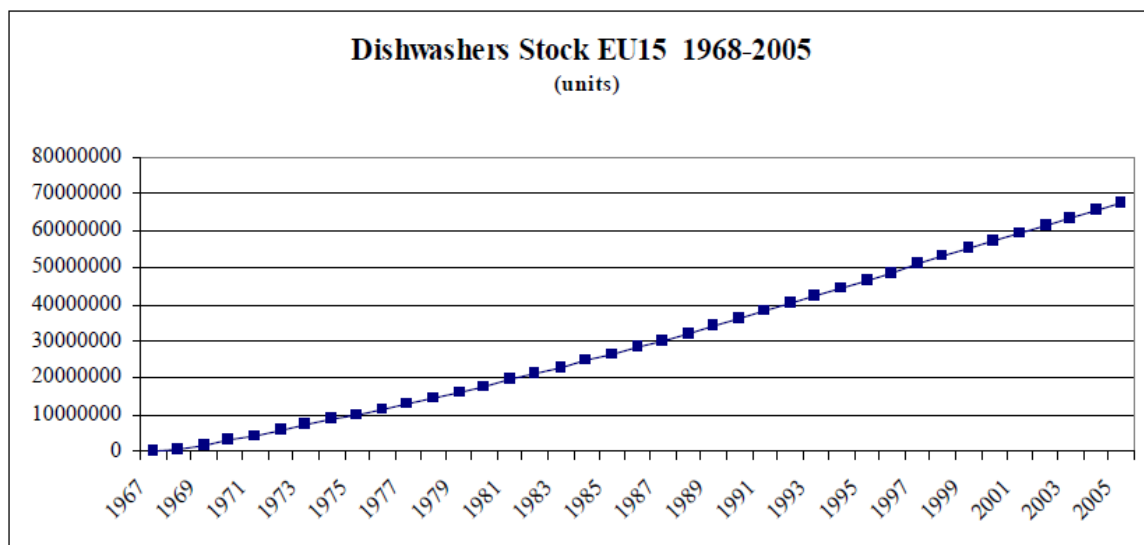
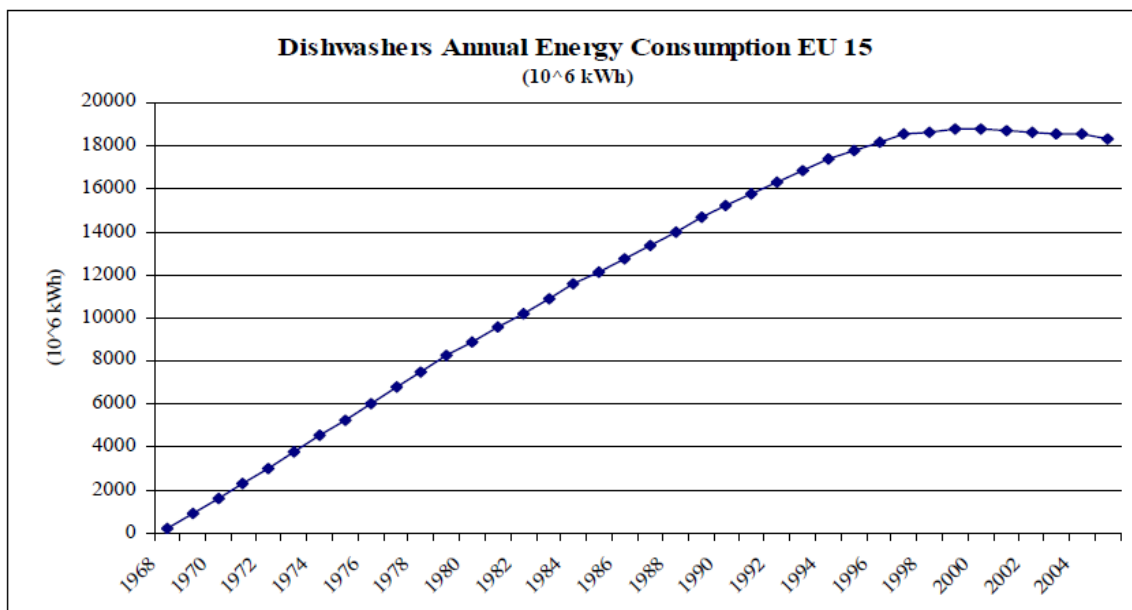
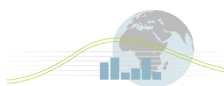


Figure 2.26 Dishwashers total stock energy consumption trend for EU 15 (1968 – 2005)



⁵ http://www.eceee.org/ecodesign/products/domestic_dishwashers



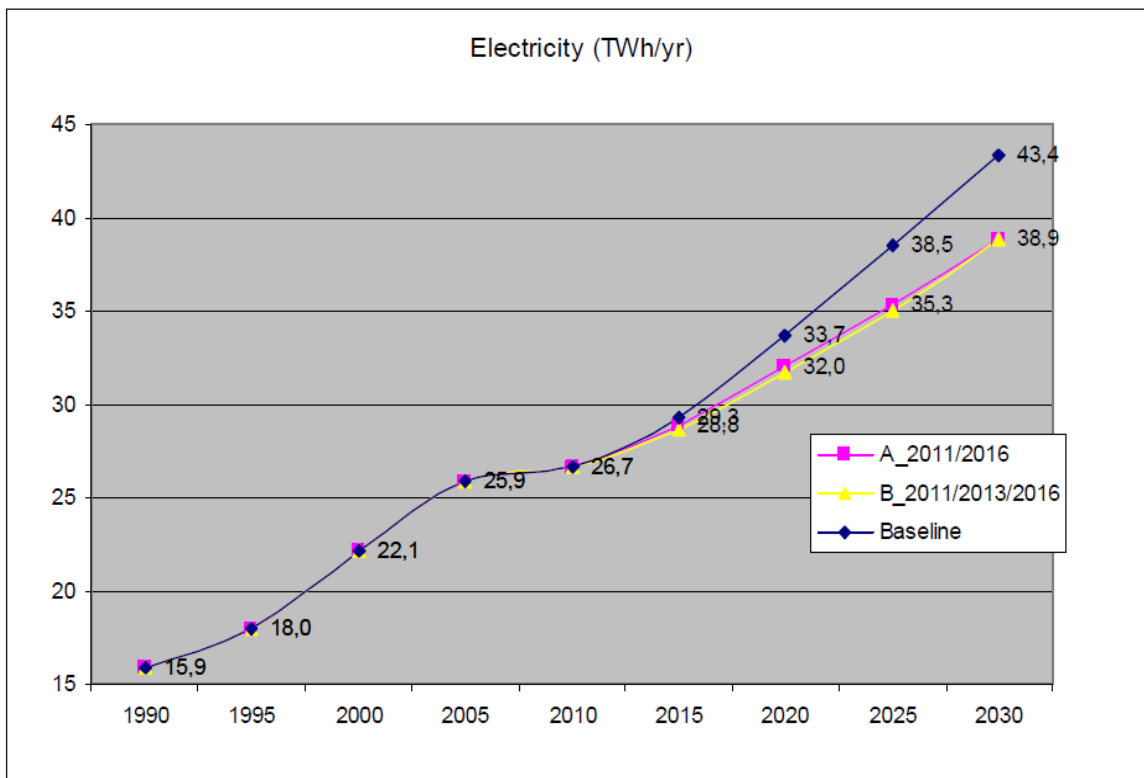
EU27 Sources:

- EU27 data is taken from the Commission Staff Working Document SEC(2010) 1356 final, Impact Assessment, Accompanying document to the Draft Commission Regulation implementing directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household dishwashers.

EU27 Data:

Data was extracted from the following graph on page 46 of the report:

Figure 10: Electricity consumption according the scenario's



Section 3. Major Policy Interventions

3.1 Minimum Energy Performance Standards

Regulation 1016/2010 requires units to meet the following minimum efficiency levels:

From 1st December 2011.

Units with rated capacity of 10 settings and a width equal to or less than 45cm are required to have an EEI of less than 80

All units not specified in a) above are required to have an EEI of less than 71

From 1st December 2013.

Units with rated capacity of 10 settings and a width equal to or less than 45cm are required to have an EEI of less than 71

Units with a rated capacity of 11 settings or greater, or with 10 settings and a width greater than 45cm are required to have an EEI of less than 63

From 1st December 2016.

Units with rated capacity of 8 or 9 settings, and units with a rated capacity of 10 settings and a width equal to or less than 45cm, are required to have an EEI of less than 63

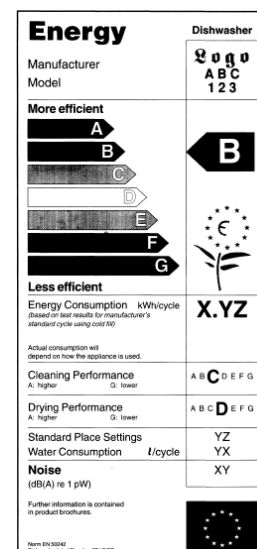
3.2 Mandatory Labelling

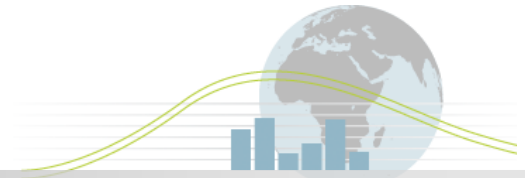


The labelling requirements is defined in the “Commission Delegated Regulation (EU) No 1059/2010 of 28 September 2010 supplementing Directive 2010/30/EU with regard to Household Dishwashers”

It requires that new dishwashers shall display labels at the point of sale that comply with the new regulations from 20 December 2011 (with some limited transitional arrangements not coming into effect until 20 April 2012). The defined label is shown to the left.

Previous labelling requirements are shown right (note the label itself is in colour).





Section 4. Cultural Issues

No additional notes.

