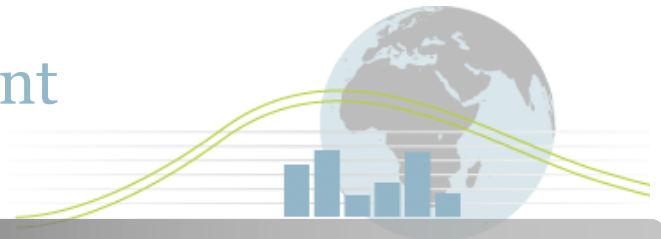


4E

Mapping Document



Country:	Denmark
Technology:	Washing Machines
Sub Category:	Domestic top and front loaders

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. Doing 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:

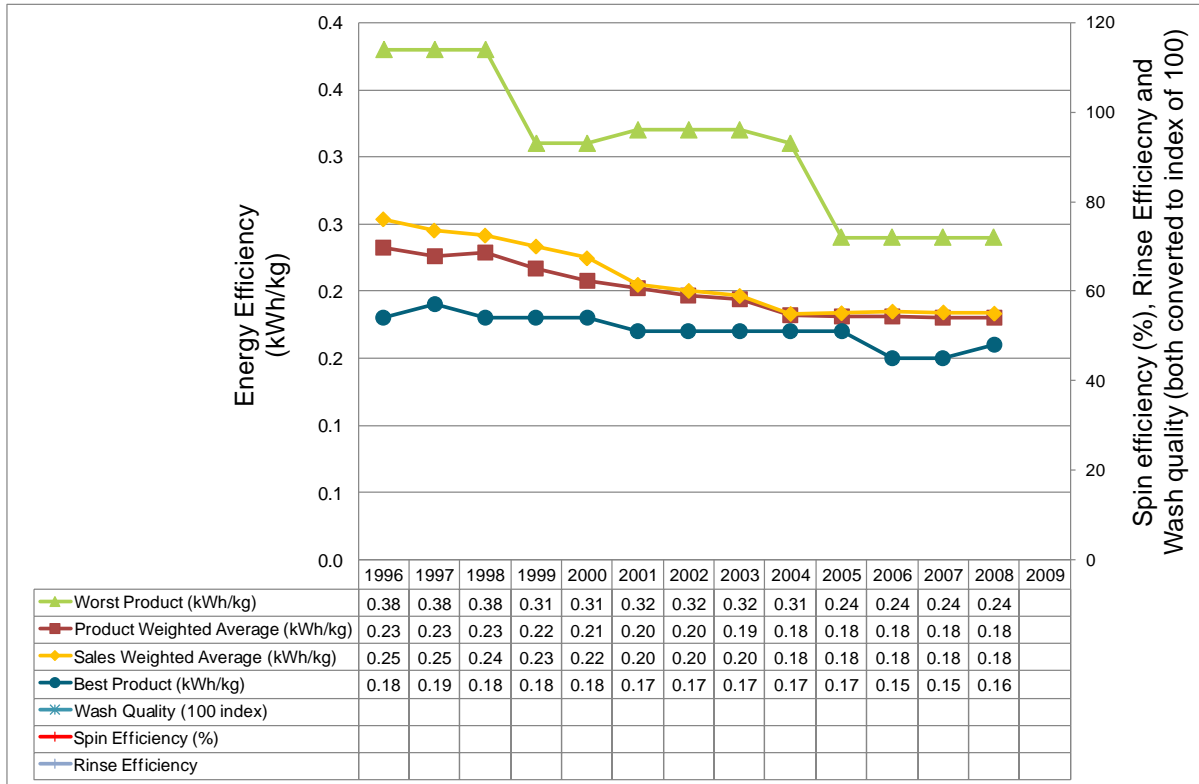
<p>Washing machines, defined as: <i>'An appliance for cleaning and rinsing of textiles using water which is principally designed for use within a domestic environment. The appliance may draw water from a cold and/or hot water supply and may also have a means of extracting excess water from the textiles.'</i></p> <p>Data will be analysed for the following types of washing machine :</p>		
Technology	User intervention	All Types - Automatic, semi-automatic and manual
	Orientation	All Types - Horizontal (front loaders) and Vertical Plane (top loader)
	Configuration	All Types - Drum, Impeller, Agitator, Nutators Exclude all types of Washer/Dryer
	Coin/Card Operation	All Types
	Water intake	All Types - Hot fill/cold fill
	Spin Speed	All Speeds
Other variables	Capacity	Consider only units between 1Kg - 13kg (Use kWh/Kg as metric)

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

<http://mappingandbenchmarking.iea-4e.org/matrix>

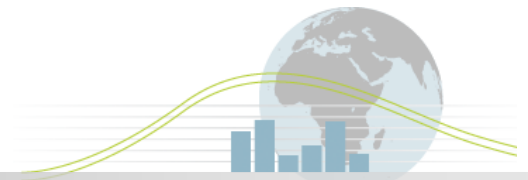


Energy Efficiency of New Washing Machines Denmark



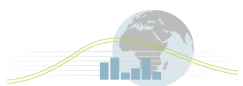
Key notes on Graph (see notes section 1)

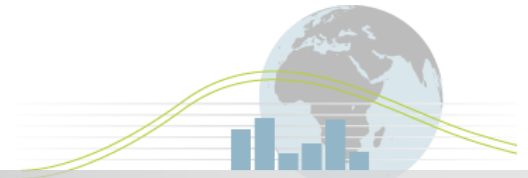
- Results for average efficiency are calculated from the sales of units and number of units by energy label classification (A, B, and other) and details of best, worst, an average consumption within each label classification. Total sales in years 1996 and 2000 based on market data but the proportion of sales by label in these years is model based.
- No data on wash quality, spin efficiency, and rinse efficiency was available to the Annex at the time of publication.



Energy Efficiency of New Top Loader Washing Machines Denmark

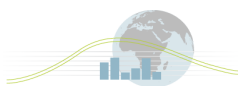
No data on the energy efficiency of new top loader washing machines was available to the Annex at the time of publication.

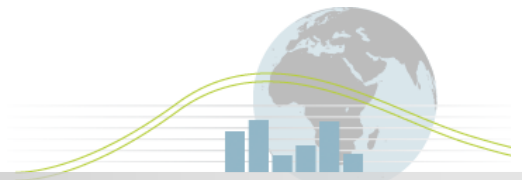




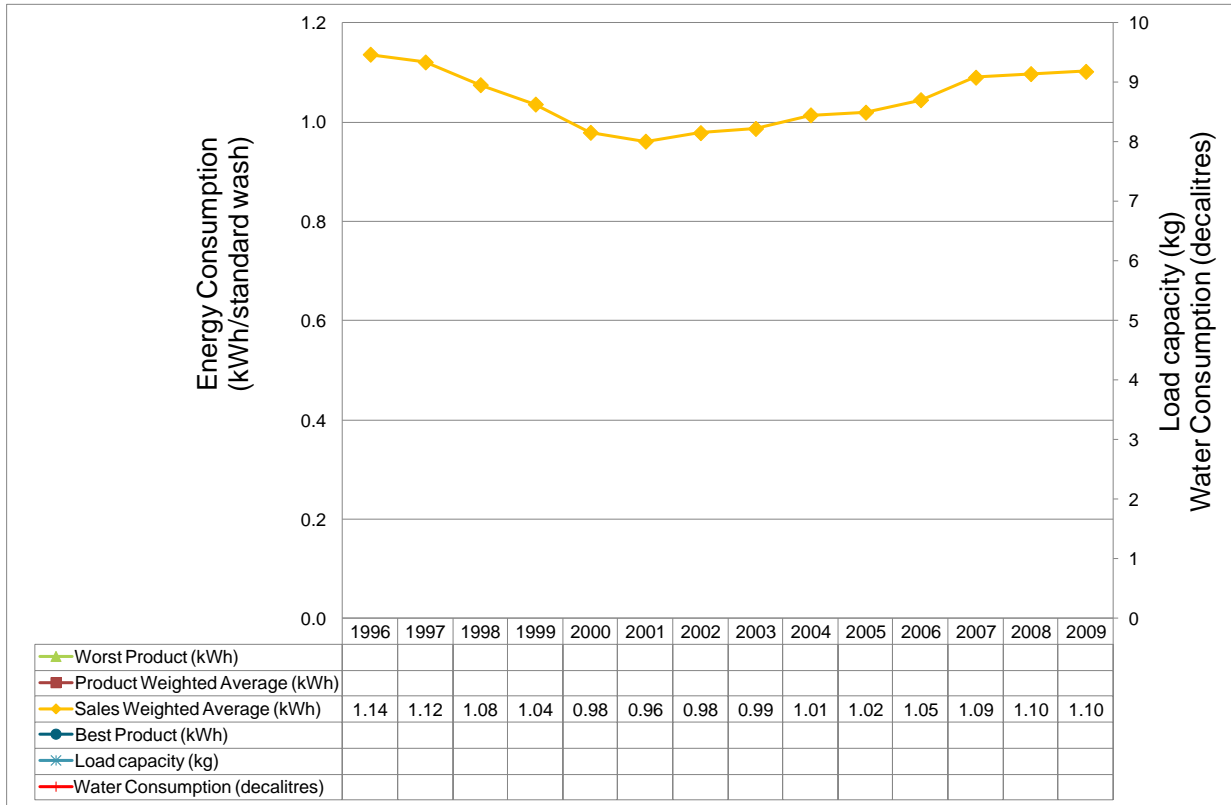
Energy Efficiency of New Front Loader Washing Machines Denmark

No data on the energy efficiency of new front loader washing machines was available to the Annex at the time of publication.



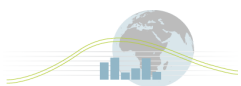


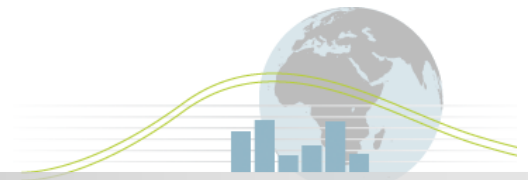
Energy Consumption of New Washing Machines Denmark



Key notes on Graph (see notes section 1)

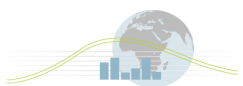
- Sales weighted energy consumption data is based on actual sales of products in the different energy classes, provided by BFE (Danish retailers organization) combined with energy consumption of new products in the given energy classes (ELDA) and assumed number of washes per year from the stock data model.

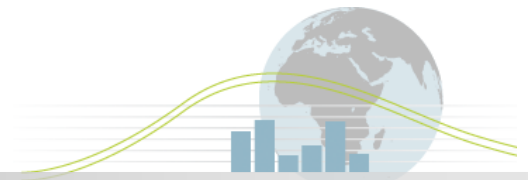




Energy Consumption of New top loader Washing Machines Denmark

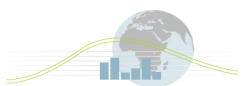
No data on the energy consumption of new top loader washing machines was available to the Annex at the time of publication.

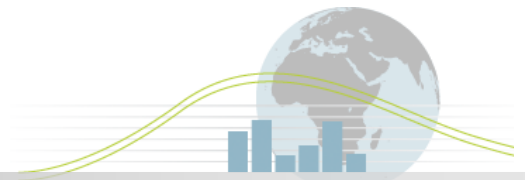




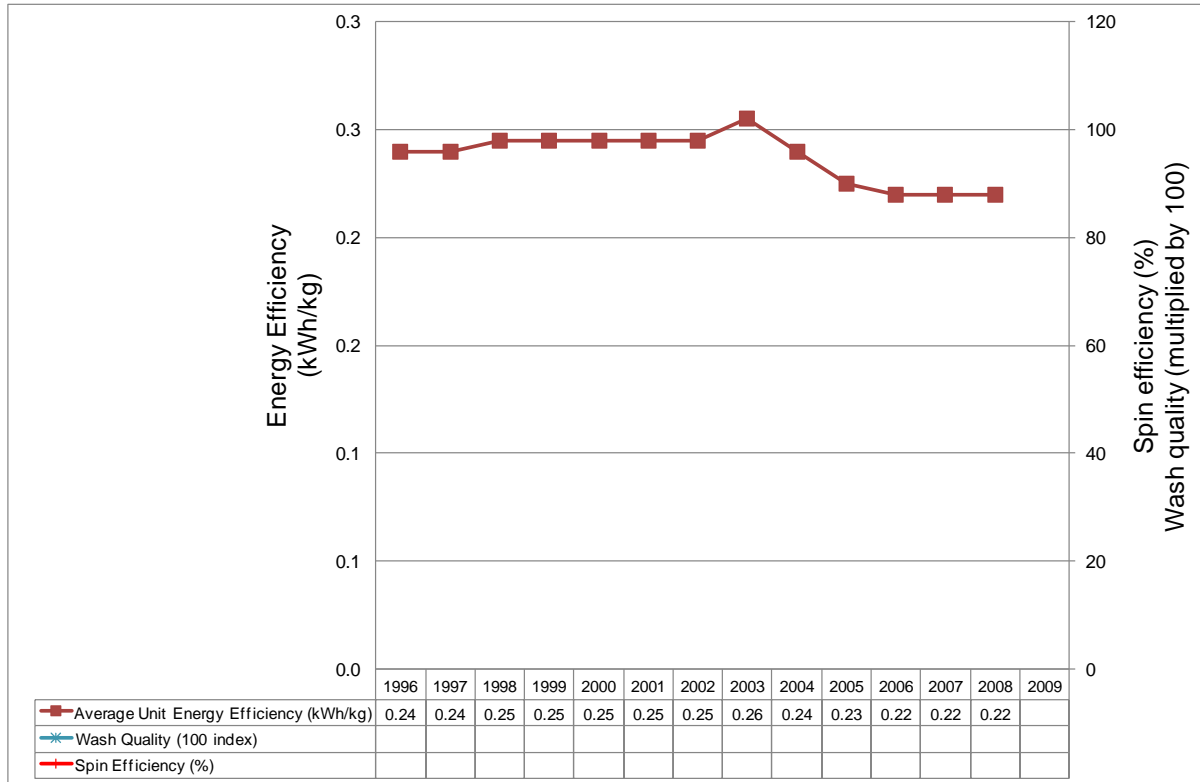
Energy Consumption of New front loader Washing Machines Denmark

No data on the energy consumption of new front loader washing machines was available to the Annex at the time of publication.



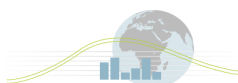


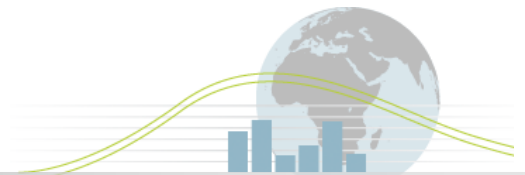
Unit Energy Efficiency of Washing Machines Installed in the Stock - Denmark



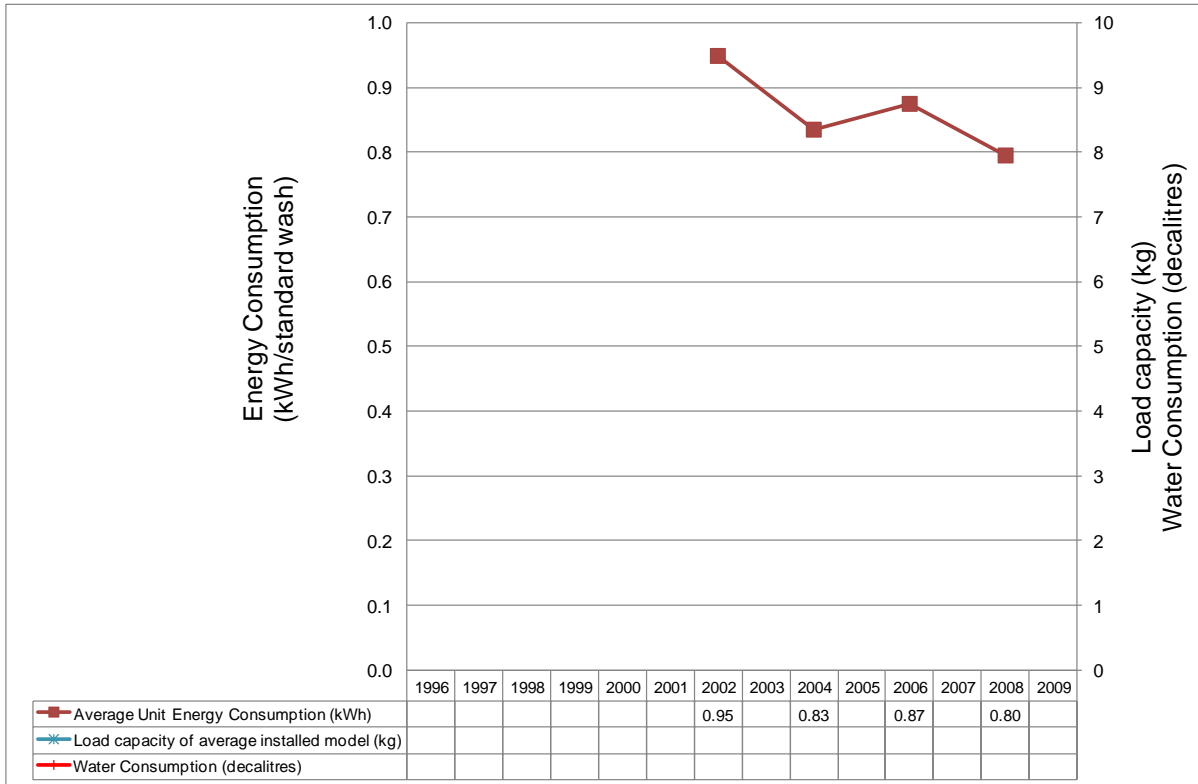
Key notes on Graph (See notes section 2)

- Energy efficiency results were based on ELMODEL-boligdata.
- No information on spin efficiency and wash quality in the stock was available to the Annex at the time of publication.



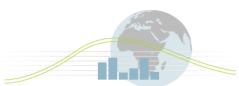


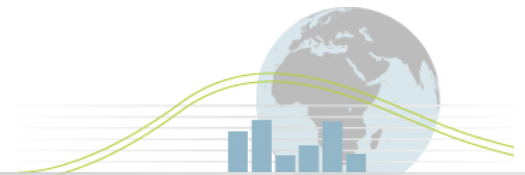
Unit Energy Consumption of Washing Machines Installed in the Stock - Denmark



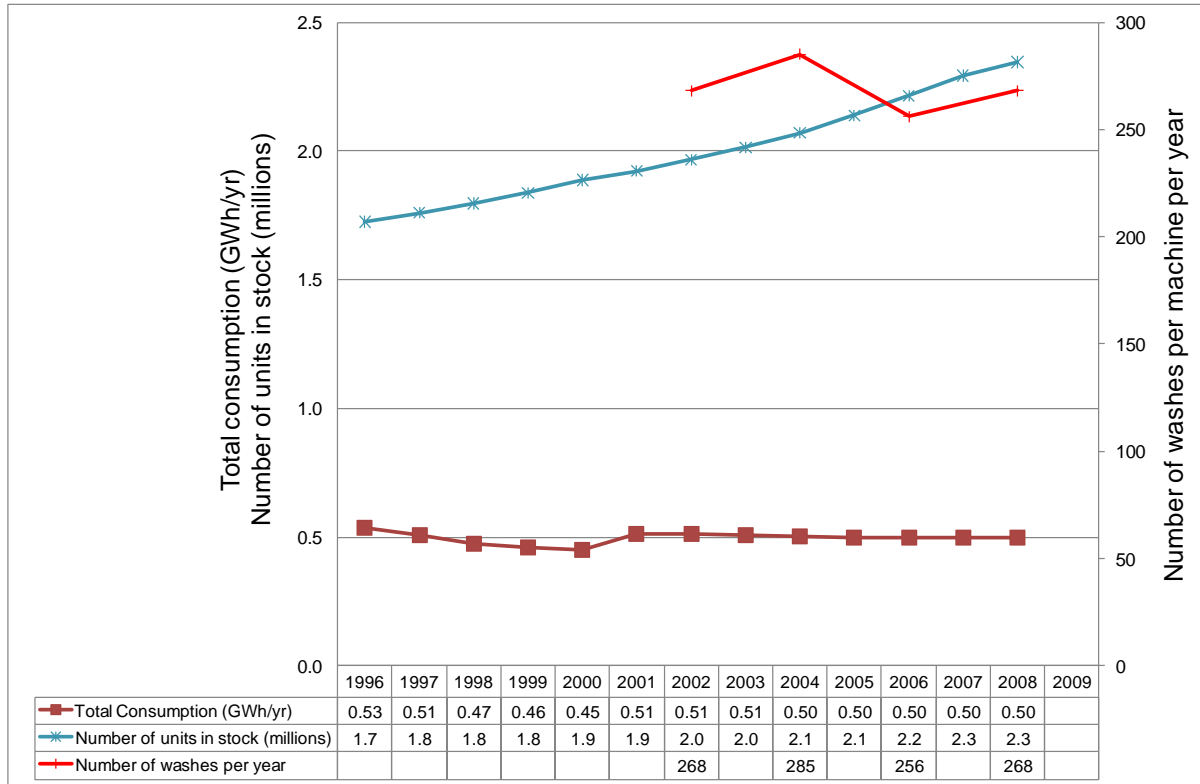
Key notes on Graph (See notes section 3)

- Energy consumption results are based on ELMODEL-bolig data.
- No information on load capacity and water consumption in the stock was available to the Annex at the time of publication.



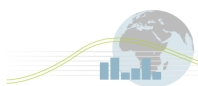


Energy Consumption of the total stock of Installed Washing Machines - Denmark



Key notes on Graph (See notes section 4)

- Energy consumption results are based on ELMODEL-bolig data.



Major Policy Interventions (See notes Section 5)

Primary policy interventions related to washing machines can broadly be divided into two groups, those developed and implemented at a pan-European level (although often through national legislation mandated through the EU), and those developed and implemented at the national level only.

Pan-EU Policy

Policy name	Period in force	Description
EU Energy Label ¹	1996 - 2010	Required labelling of all new washing machines. Defines A to G classes for energy efficiency, wash performance and spin performance. Gives maximum spin speed information and water consumption.
EC Ecolabel	1999 - ongoing	Voluntary declaration for resource efficiency. For the standard 60°C cotton programme: energy consumption equal to or lower than 0.17 kWh/kg, water consumption equal to or lower than 12 litres/kg.
Industry voluntary commitments	1996 – 2002 and 2002 – 2010	Removed EU Energy Label energy classes E, F and G by 1999. Removed class D by 2003. New Labelling category introduce A+ (EEI > 0.17) introduced at the end of 2002 Set target for efficiency of sales weighted ("fleet") average efficiency of 0.2 kWh/kg by 2008. Promotes models with 0.17 kWh/kg and A rated wash performance.
Early replacement	2007 - ongoing	Industry promotion to consumers to encourage consumers to replace older appliances with more efficient new ones.

Note: it is anticipated that the European Commission will be publishing new energy labels and the ecodesign requirements for washing machines. The efficiency figure for both the MEPS and the label will be based on a different calculation than the current labels, i.e. the calculation will take into account "standby" and off mode and will also take into account the 40 °C cotton cycle. Also for the label additional classes will be introduced (A+, A++, A+++). More details can be found in the Washing Machine Mapping Document for the EU, and the proposed regulatory document (current at the time of publication). Both documents can be found in the Washing Machine area of the Mapping and Benchmarking website – see <http://mappingandbenchmarking.iea-4e.org/matrix>.

¹ See notes section 1.1.2

Cultural Issues (See Notes Section 6)

In single family houses the ownership levels have been high for many years – almost one machine per house on average. A trend the last 4-6 years is that flats and weekend cottages are also beginning to have high ownership levels for washing machines, though the frequency of use is still lower for families in these dwelling types.

In earlier years it was normal in multifamily houses to have common washing facilities in the basement areas. This is slowly being replaced by machines in each of the flats, typically the top-loaded, smaller models that can be plugged to a normal water tap, using the sink as drain.

The washing habits are also changing, but only slowly. In recent years washing powders utilising enzymes and the like, have been on the market, enabling people to wash at 20-30 degrees with same results as washes at 40-60 degrees earlier on. This also cuts many minutes of a standard wash cycle. But the acceptance and belief in the capabilities of the new washing powder types is only vaguely moving forward. It is planned though, to include a new degree category in the next questionnaire, annotated “Below 20 degrees”. Also the use of, and knowledge about, special washing powders will be addressed.

Notes on data

Section 1: Notes on Product Efficiency

1.1 Test methodologies and Performance Standards

1.1.1 Test methodology

From 1 Jan 2007 EN 60456: 2005 (derivative IEC 60456:2003)

Previously EN 60456: 1999 + A11:2001 + A12:2001 + A13:2001. Primary difference with preceding method is the allowance of 3 methods to condition the load prior to test.

1.1.2 Key Testing Parameters and Regulatory Requirements

Overview of test method

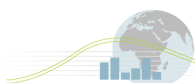
The test standard EN 60456 contains a number of methods for measuring the various performance characteristics of washing machines. The key relevant tests are: cleaning performance, energy consumption, water consumption, spin extraction performance and spin speed. All these tests are performed using the rated capacity cotton load and a 60°C cotton programme nominated by the manufacturer. The cleaning performance of a washing machine is measured by using it to wash a set of standard soiled test strips together with a base laundry load. Each soiled test strip consists of five fabric squares, soiled with carbon black / mineral oil, blood, chocolate and milk, red wine, with the fifth square left unsoiled. The different soils challenge the various cleaning characteristics of the washing machine such as mechanical action, mixing and distributing the wash liquor, and wash temperature control. After washing, drying, and ironing, soil removal is assessed by measuring the reflectance of the test strips. Cleaning performance is calculated from the reflectance values.

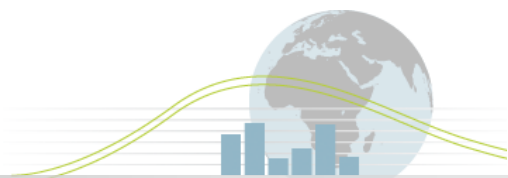
The energy and water consumption are measured during the cleaning performance test. If the machine draws hot water rather than cold, the energy associated with the hot water is added to the electrical energy used to give the total energy consumption. The spin extraction performance is assessed after the cleaning performance test by weighing the base load. Comparing the wet load weight with the dry load weight²

Specific Test Details

Voltage	230V +/- 1V, 50Hz +/- 1Hz
Test Cycle	60°C Cotton Cycle (without pre-wash) in accordance with the manufacturer's instructions. At least 5 complete cycles should be completed with new soil strips added before each new cycle commences.
Ambient Temperature	23°C +/- 2°C
Load	Rated Kg
Detergent	Type A* as defined in Annex F of IEC 60456.

² DENMARK MTP Briefing Notes: See www.mtprog.com





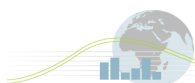
Water Supply	Cold Water: 15°C +/-2°C Hot Water (for use in units without heating elements): 60°C +/-2°C (or as directed by manufacturer)
Reference Unit	As defined in Annex A of EN60456
Water Test Temperature	60°C
Energy Consumption	Consumption of unit under test corrected for energy in water as follows: Total Energy = Tested Energy + Cold Water Correction + Hot Water Correction, where: Cold Water Correction = (volume of cold water x (cold water inlet temp - 15))/860 and Hot Water Correction = (volume of hot water x (hot water inlet temp - 15))/860 Average of 5 cycles TOLERANCE: Not greater than 15% greater than manufacturer claim (for one unit) or 10% greater than manufacturer claim (if average of 3 units)
Cycle Efficiency	TOTAL Energy of Model under test divided by rated load (kWh/cycle/kg).
Measurement of Water Volume	Complete volume of water used during energy consumption test (litres). Average of 5 cycles TOLERANCE: Not greater than 15% greater than manufacturer claim (for one unit) or 10% greater than manufacturer claim (if average of 3 units)
Spin Extraction Ratio	Section 9: EN60456 - Moisture remaining in base load after spinning relative to the conditioned mass of the same load. (Mass of Base Load after Spin - Mass of conditioned base load)/Mass of conditioned base load. Average of at least 5 cycles TOLERANCE: Not greater than 15% greater than manufacturer claim (for one unit) or 10% greater than manufacturer claim (if average of 3 units)
Rinsing Index	Section 9: EN60456 - Based on alkalinity of detergent in base load following normal cycle. Value of 2-5 cycles (1st cycle after normalising not to be used)
Wash Quality Index	Section 9: EN60456 - As a ratio of average reflectance measured (compared with reference unit). At least 5 cycles from series.
Spin Speed	The lowest speed achieved during highest spin speed variation which runs continuously for 60 seconds. TOLERANCE: Not greater than 10% or 100 rpm greater than manufacturer claim (if average of 1 or 3 units)

Regulatory Requirements based on:

1995 95/12/EC implementing directive³ implementing 92/75/EEC with regard to energy labelling of washing machines. (see also policy in Notes Section 5)

1.2 Product Efficiency Graphics

³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1995L0012:20070101:EN:PDF>



1.2.1 Data Source:

Efficiency data: BFE (Danish retailers organization).

Consumption data: BFE (Danish retailers organization) combined with energy consumption of new products in the given energy classes (ELDA).

1.2.2 Data Clarifications

Original Data Limitations

Results for average efficiency are calculated from the sales of units and number of units by energy label classification (A, B, and other) and details of best, worst, an average consumption within each label classification. Total sales in years 1996 and 2000 based on market data but the proportion of sales by label in these years is model based.

An example of the data provided is given in the table below:

	A	A	A	A	
		Mid.	Max.	Min.	
Date	Number of models	Efficiency	Efficiency	Efficiency	Sales-A
31/12/1996	11	0.19	0.19	0.18	4146
31/12/1997	25	0.19	0.19	0.19	8922
31/12/1998	38	0.19	0.19	0.18	18349
31/12/1999	89	0.19	0.19	0.18	36289
31/12/2000	121	0.19	0.19	0.18	75000
31/12/2001	182	0.19	0.19	0.17	114214
31/12/2002	217	0.19	0.19	0.17	135409
31/12/2003	297	0.19	0.19	0.17	170722
31/12/2004	350	0.18	0.19	0.17	193438
31/12/2005	311	0.18	0.19	0.17	188275
31/12/2006	354	0.18	0.19	0.15	199014
31/12/2007	429	0.18	0.19	0.15	209522
31/12/2008	323	0.18	0.19	0.16	195368

Proportion of data set excluded

Not applicable.

Additional Specific Data Cautions

None.

1.2.3 Key calculations undertaken:

Declared Unit Load Capacity: Unit load capacity in kg is defined by local regulations and declared by manufacturers (Unit kg).

(Note: This capacity is defined using the mixture of materials defined in the local regulations which is not necessarily in line with the mixture of material used elsewhere (for local load mix, refer to Section 1.1 on “Notes on Data”).

Model Energy Consumption: Model Energy Consumption is the energy consumed by the unit to complete one wash cycle as defined by local test conditions (Unit: kWh/wash).

Sales Weighted Energy Consumption of New Models: Value calculated by [Sum of (Model Energy Consumption multiplied by sales volume of Model in year) for all Models] divided by [Sum of (sales volume of all Models in year)]. Unit kWh/wash.

Model Weighted Consumption of New Models: Value calculated by [Sum of (Model Energy Consumption for all models sold in year)] divided by [Sum of (Number of Models sold in year)]. Unit kWh/wash.

Model Energy Efficiency: Value calculated by dividing Model Energy Consumption by Declared Unit Load Capacity (kWh/Kg/Wash).

Sales Weighted Energy Efficiency of New Models: Value calculated by [Sum of (Derived Model Energy Efficiency multiplied by sales volume of Model in year) for all Models] divided by [Sum of sales volume of all Models in year]. Unit kWh/kg/Wash.

Model Weighted Energy Efficiency of New Models: Value calculated by [Sum of Model Energy Efficiency for all models sold in year] divided by [Number of Models sold in year]. Unit kWh/Kg/Wash.

Spin Efficiency: The efficiency of removal of water from the test load as defined in local test conditions (refer to Section 1.1 on “Notes on Data”).

Wash Quality: The efficiency of cleansing of test load as defined in local test conditions (refer to Section 1.1 on “Notes on Data”).

Rinse Efficiency: The efficiency of removal of detergent, softener or other additive from the test load as defined in local test conditions (Unit: comparative percentage).

Spin Speed: The highest spin speed attainable by the unit (Unit: revolutions per minute – rpm).

Section 2: Notes on Product Consumption

2.1 Test methodologies and Performance Standards

Refer to section 1.1

2.2 Product Consumption Graphic

Refer to section 1.2

Section 3: Notes on the Efficiency and Consumption of units in the installed Stock

3.1 Unit Stock Efficiency Graphic

3.1.1 Data Source

Source: ELMODEL-bolig

3.1.2 Data Clarifications

None

3.2 Unit Stock Consumption Graphic

3.2.1 Data Source

Please refer to section 3.1.1

3.2.2 Data Clarifications

None

Section 4: Notes on Consumption of Stock

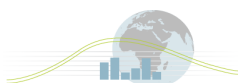
4.1 Stock Consumption Graphic

Data Source

Please refer to section 3.1.1

4.1.1 Data Clarifications

None



Section 5: Notes on Policy Interventions

5.1.1 Data Source

1995 95/12/EC implementing directive⁴ implementing 92/75/EEC with regard to energy labelling of washing machines

5.1.2 Requirements of 1995 95/12/EC implementing directive implementing 92/75/EEC with regard to energy labelling of washing machines.

Limits for various labelling criteria are defined in the directive as follows (refer to policy table for criteria that are now no longer applicable due to the introduction of minimum standards or voluntary agreements):

ANNEX IV

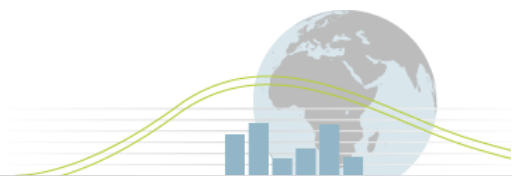
ENERGY EFFICIENCY CLASS

- The energy efficiency class of an appliance shall be determined in accordance with the following table 1:

Table 1

Energy efficiency class	Energy consumption 'C' in kWh per kg washed for standard 60 °C cotton cycle using test procedures of the harmonized standards referred to in Article 1 (2)
A	$C \leq 0,19$
B	$0,19 < C \leq 0,23$
C	$0,23 < C \leq 0,27$
D	$0,27 < C \leq 0,31$
E	$0,31 < C \leq 0,35$
F	$0,35 < C \leq 0,39$
G	$0,39 < C$

⁴ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1995L0012:20070101:EN:PDF>



2. The washing performance class of an appliance shall be determined by the following table 2:

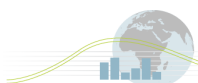
Table 2

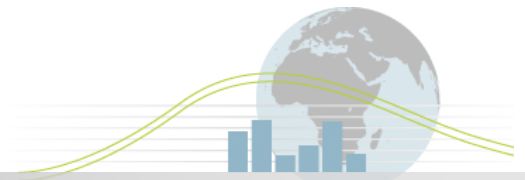
Washing performance class	Washing performance index P as defined in the harmonized standards referred to in Article 1 (2), using a standard 60 °C cycle
A	$P > 1,03$
B	$1,03 \geq P > 1,00$
C	$1,00 \geq P > 0,97$
D	$0,97 \geq P > 0,94$
E	$0,94 \geq P > 0,91$
F	$0,91 \geq P > 0,88$
G	$0,88 \geq P$

3. The drying efficiency class of an appliance shall be determined by the following table 3:

Table 3

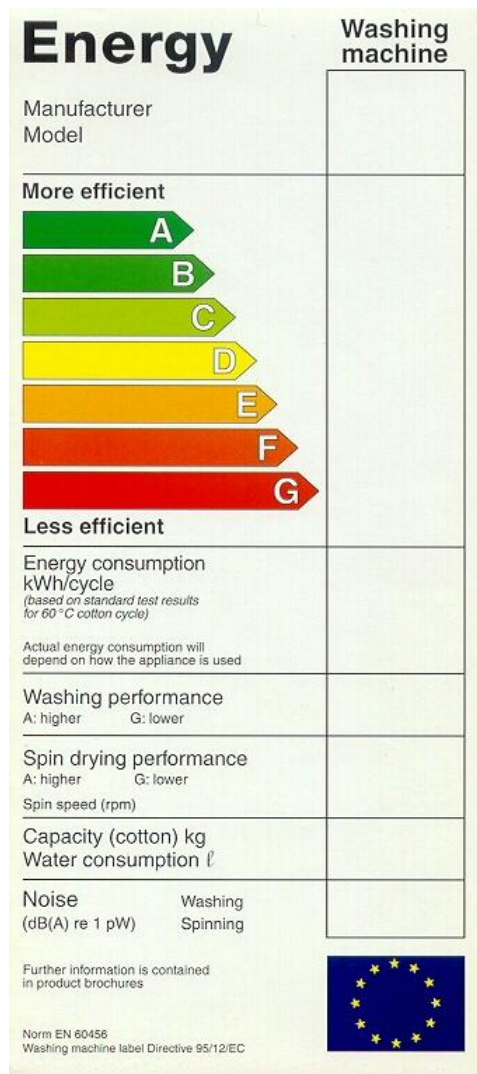
Spin drying efficiency class	Water extraction efficiency D as defined in the harmonized standards referred to in Article 1 (2), using a standard 60 °C cycle
A	$D < 45 \%$
B	$45 \% \leq D < 54 \%$
C	$54 \% \leq D < 63 \%$
D	$63 \% \leq D < 72 \%$



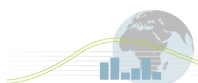


Spin drying efficiency class	Water extraction efficiency D as defined in the harmonized standards referred to in Article 1 (2), using a standard 60 °C cycle
E	72 % ≤ D < 81 %
F	81 % ≤ D < 90 %
G	90 % ≤ D

The label itself is shown below⁵



⁵ Source from: http://www.ceced.org/energy/Washer_energy_label.jpg



Note: it is anticipated that the European Commission will be publishing new energy labels and the ecodesign requirements for washing machines. The efficiency figure for both the MEPS and the label will be based on a different calculation than the current labels, i.e. the calculation will take into account "standby" and off mode and will also take into account the 40 °C cotton cycle. Also for the label additional classes will be introduced (A+, A++, A+++). More details can be found in the Washing Machine Mapping Document for the EU, and the proposed regulatory document (current at the time of publication). Both documents can be found in the Washing Machine area of the Mapping and Benchmarking website – see <http://mappingandbenchmarking.iea-4e.org/matrix>.

5.1.3 CECED Voluntary Agreements

There have been two voluntary agreements have been negotiated between the EU and CECED (the European Committee of Manufacturers of Domestic Equipment). The following description of the first agreement and outcome and detailing of the second agreement is drawn from: “*SECOND VOLUNTARY COMMITMENT ON REDUCING ENERGY CONSUMPTION OF DOMESTIC WASHING MACHINES (2002 - 2008)*”⁶

“The European Committee of Manufacturers of Domestic Equipment (CECED) represents the interests of domestic washing machines manufacturers in Europe. Its members are domestic appliances manufacturers and a number of national trade associations.

In April 1996 the European Committee of Manufacturers of Domestic Equipment (CECED) presented a first Commitment about energy saving to the European Commission. This Commitment was made on behalf of the European manufacturers of domestic washing machines and was aimed at a considerable reduction of energy consumption of washing machines. The proposal was negotiated with the EU Authorities and notified, in October 1997, to EC DG IV. The final approval followed on 9. December 1998, when the Commitment was published in the Official Journal. Exemption according to Art. 81 of the EU Treaty was granted by decision of the Commission for the period up to end of year 2001.

The overall saving target of this Commitment was to reduce the specific energy consumption of domestic washing machines by 20% in the period 1994 - 2000. Practically, this targeted at bringing the average consumption value of 0.30 kWh/kg1 down to 0.24 kWh/kg within 6 years. To achieve this goal, a catalogue of different technical and marketing related measures was set up, specifying so called “hard targets” and also “soft targets”.

In addition, CECED committed itself to monitor the progress and to report regularly - every year – to the European Commission on the basis of a notary report and the technical database of washing machines of CECED. The targets of the Commitment were achieved at the end of 1999. The specific energy consumption was then calculated and reported with 0,228 kWh/kg. That way a saving of 24% had been achieved - without regulative measures and without adverse market distortion.

⁶ http://ec.europa.eu/energy/efficiency/doc/agreements/2002_ceced_washing_machines.pdf

A recently completed study² came to the conclusion that in terms of energy efficiency of washing machines there is no real reason for a change in the present energy label. Other conclusions of this study have been taken on board in this proposal if considered as a support to contribute to energy savings in the future.

The successful fulfilment of this first Commitment prompted manufacturers to elaborate the possibility of a new - second - Voluntary Commitment, covering the period from 2002 to 2008. The proposal of this new Commitment is described thereafter.

This Industry Commitment is developed at Community level as it aims to ensure that free circulation of goods is not hampered by diverging practices at national level. Its logical reference could be ECTreaty article 95.

....

[In the second voluntary commitment, CECED members] commit to:

“Hard targets”:

- *By 31.12.2003⁴ participants will have stopped producing for and importing in the CommunityMarket domestic washing machines which belong to energy efficiency class D*

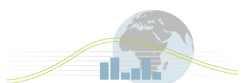
“Fleet target”:

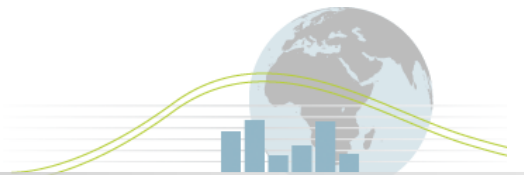
- *Each participant will commit himself to contribute to the Commitment overall objective ofachieving a European production weighted average of 0.20 kWh/Kg for the year 2008. Eachparticipant will provide to the CECED notary consultant, as specified in part B of this clause, andaccording to the procedure specified in annex 2; production weighted energy consumption data forthe previous calendar year.*

“Soft targets”:

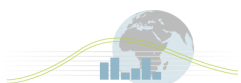
In addition to the above commitments, all participants commit themselves to strengthen their overall activities to achieve further energy savings and to educate consumer on the way to save energy, in particular, they commit to:

- *Support the introduction of a new 'quality mark' on the present energy label, identifying and promoting super efficient machines at a level of 0,17 kWh/kg by giving additional public awareness.*
- *Support at EU or national level, rebates schemes aiming at fostering the introduction of efficient washing machines, e.g. by replacing old and inefficient machines as long as the balance between energy and washing performance in maintained (minimum class B for washing performance)*





- *Co-operate preferably at national level in setting up targets and measures for achieving a high level of spinning efficiency for markets where tumble drying is relevant*
- *Inform in their brochures about the advantages of a high spin speed washing machine when tumble drying is preferred*
- *Promote the energy efficient use of washing machines by giving information in the user manual*
- *Co-operate with detergent industry on new energy saving detergents and promotion of an energy saving consumer behaviour*
- *Push the development of a new standard for testing washing machines taking into account the change of consumer behaviour towards lower wash temperatures and not using always full load. This development will be done in close co-operation with GENELEC and consumer organisations and testing institutes if actively supported by member states and/or the European Commission and is targeting to be used as a basis for a revised label in 2008. 4 Models of classes E,F and G were already eliminated by the first negotiated agreement Voluntary Commitment II - Washing Machines - 31.08.2002 7"*



Section 6: Notes on Cultural Issues

6.1.1 Data Source

Ownership levels and use patterns are collected every second year in a major questionnaire – some 46 pages of questions related to electricity consumption in houses – with more than 2000 respondents. Data are pooled in the framework called ELMODEL-domestic.

The questionnaire focuses on washing machines both as normal washing machines and as combined washers/driers. The use patterns are collected as number of washes per week, per temperature group, the groups being “below 30”, “30-40”, “40-50”, “50-60”, “60-70” and “above 70” degrees Celsius.

Information about washing machine models, their technical data etc. are collected from the Danish ELDA database, which contains producers data on their models collected from brochures, web-pages etc. Practically all known models on the Danish market is represented in the database, also dates for entering and leaving the market again, for each model.

Also the annual sales figures are known for washing machines, collected by the Danish organisation of white goods importers, FEHA. Sales figures are subdivided by energy class.