Product Criteria Paper

Coffee Machines - with Focus on Espresso Machines

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The Project in brief

Topten.eu is part of the international euro-topten initiative supported by the European programme Intelligent Energy Europe and several national institutions (energy agencies, WWF, consumer associations, research institutes). On global level Topten is coordinated by TIG, the Topten International Group. The organization adheres to the Topten Charter, TIG statutes and TIG Rules of Procedure (www.topten.info).

On national level Topten is a service that supports the market for energy efficient products. It aims at making energy efficient products the first choice for consumers, by offering them a user friendly tool for product comparison and selection. Key element of topten.eu is an online information platform for consumers presenting the most energy efficient appliances currently available in various product categories, including household appliances, office equipment, consumer electronics and cars. Information on energy consumption and performance of products as well as several other characteristics (i.e. brand, model, price, picture) is provided. Product data is based on labels and standardized declarations as well as tests from accepted well known institutions. The service is independent of manufacturers and retailers.

Consortium

The project is co-ordinated by the Agence de l'Environnement et de la Maitrise de l'Energie (ADEME). The other 19 project partners are:

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Criteria Paper for Coffee Machines

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1 Introduction

The criteria papers are meant to help the national partners to collect and analyse data about a product and establish a national Topten selection. Once these selections are on-line, consumer oriented information on very efficient products will be available and publicised. Appropriate selection criteria and respective technical specifications are a crucial precondition for meaningful and well accepted Topten websites. The purpose of this criteria paper is to provide a common basis for the definition of technical specifications. Obviously the market offer differs significantly in European member States in terms of price level, configuration, energy classes and energy consumption corresponding to levels of purchasing power and behavioral aspects (mentality, customs, etc.).

Within the European wide Topten project, an aligned approach for technical specifications for all national Topten websites is aimed at, as far as possible. A high level of uniformity and congruency of the different national websites will enhance the awareness amongst manufacturers. Providing and publicising good quality data at national level allows to analyse the situation at European level and make policy recommendations which are shown on www.topten.eu.

Below is the product specification for Topten qualified Coffee Machines. A product should meet all identified criteria in Chapter 4 (as far as national context allows) in order to be a Topten.eu product.

2 Product Definition

This chapter provides an overview of Coffee Machines. It also gives a technical analysis of the product and explains EU and national relevant product and test standards.

2.1 Product Category

The stock of coffee machines in the European Union is estimated to be 100 million units, consuming 17'000 million kWh per year and causing electricity costs of about 2'500 Mio Euro (according to estimations by Topten). Roughly 20 million coffee machines are annually sold in Europe. There is a large variety of different products which can be defined as coffee machines (e.g. drip filter coffee machines, percolators, French Press). The main function of a coffee machine is the preparation of a coffee-based beverage.

Coffee machines with electricity supply can be categorized according to their pressure: machines with high pressure (> 800 kPa[1]), low pressure (< 800 kPa) and no pressure (see Table 1). For the preparation of a real "espresso" 1500 kPa are optimal. Therefore, machines with more than 800 kPa are synonymously called "espresso machines". Coffee prepared with low or no pressure tastes more like drip-filter-coffee.

Table 1 Types of coffee machines with electricity supply

Type	Pressure	Quality of Coffee	Synonym
Fully automatic machines	High	Espresso	Espresso machine
Portioned machines: Capsule machines	High	Espresso	Espresso machine
	Low (e.g. Tassimo)	Drip-filter-like	----
Portioned machines: Pad machines	Low	Drip-filter-like	----
Machines with piston lever (Semi-automatic portafilter coffee machines)	High	Espresso	Espresso machine
Drip-filter machines	No pressure	Drip-filter-like	----
Combi machines (Piston lever/Drip-filter)	High/Low	Espresso/Drip-filter-like	----

For comfort and quality reasons, there is a considerable trend towards fully automatic machines and an extremely strong trend towards espresso portioned machines (e.g. sales from 2006 to 2007: fully automatic machines + 5,5 % and espresso portioned machines +43.1%), while low-comfort machines - mainly traditional drip-filter machines - are losing market share[2] (although with 55% they still have the highest market share

1 Corresponding to 8 bar

2 Josephy, B. et al (2011): Super efficient coffee machines - best available technology and market transformation. EEDAL 2011.

of all coffee macines[3]).Therefore the following product categories for coffee machines for private household use are defined in this paper (detailed description chapter 2.2.1 and 2.2.2):

- Fully automatic coffee machines,
- Portioned machines for capsules
- Portioned machines for pads
- Semi-automatic portafilter coffee machines

These types of machines are automatic single-serve coffee makers. Compared to the traditional way of coffee making the advantage of these automatic coffee machines is - from the environmental point of view – that they brew just as much coffee as needed. Semi-automatic coffee machines like machines with piston lever are also single-serve coffee makers. The only difference is that the consumer has to grind the beans by himself and fill the coffee powder into the piston lever.

In comparison to filter drip machines, single-serve coffee makers help to save both energy and coffee (beans/powder) as less coffee is wasted. But most of the espresso/coffee machines sold so far have high power consumption. This is less due to the actual coffee-making process than to the stand-by consumption. Based on an average use of private households up to three quarters of electrical power is consumed in standby mode[4].

Not considered are filter coffee machines, combi-machines and (commercial) appliances with a permanent water supply.

The energy consumption of filter coffee machines is dominated by their keeping warm function. The power consumption for the coffee production is similar for all devices. A typical filter drip machine uses approximately 27 kWh per year (assumptinos: 30 minutes keeping warmfunction and 2190 cups). Filter coffee machines differ from devices mentioned above: they are not meant to brew coffee cupwise. For a good coffee quality they have to brew a certain quantity of coffee (2-3 cups). Due to this fact, the keeping warm function is not necessary for brewing additional cups but for keeping warm the brewed coffee. A thermal jug perfectly fulfills this function: it keeps the coffee hot and saves a lot of energy because the machine can be switched off directly after brewing. As a consequence the most efficient filter drip machines are the ones with thermal jug that do not need a keeping warm function.

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3 Source: Preparatory studies for Eco-design Requirements of EuPs- Lot 25: Non-Tertiary Coffee Machines" of 2011, task 2.

4 Stratmann, B., Grießhammer, R. & Bush, E. (2009) PROSA highpressure coffee and espresso machines – developing the award criteria for a climate label. Freiburg 2009.

2.2 Product Types

2.2.1 Fully automatic coffee machines

Fully automatic coffee machines operate automatically at the touch of a button and contain a complete preparation system with mill and pumps. Coffee beans are grinded to coffee grounds and are then compressed. With a pressure of at least 900 kPa[5], the heated water (about 90°C) is pressed through the coffee powder. The coffee grounds are then automatically thrown into the pulp container and the brewed coffee goes directly into the provided cup/cups. Some automatic coffee machines even have an automated milk frothing, water filter and self-cleaning system. Most of the appliances can operate both with coffee powder and coffee beans.

Figure 1 Fully automatic coffee machine[6]

There are large differences in power consumption of the respective technologies: appliance without integrated auto power down function[7] could have an energy consumption of 196 kWh per year - due to the high power consumption in the machines' ready (keeping hot) and standby mode. The keeping warm function may consume up to 75 % of the total energy consumption per year, depending on user's switching off practice. High efficiency coffee machines with an auto-power-down function, a better insulation of boilers and low standby only have a consumption of about 34 - 44 kWh per year[8]. The price of a fully automatic machine ranges between 400 and 1300 Euros, with a lifetime of aout 10 years[9].

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5 Corresponding to 9 bar

6 Source: http://www.topten.eu/?page=super_automatics

7 Auto-power-down: automatic activation of the switch off after the machine has last been active or manipulated (factory setting).

8 Source: http://www.topten.eu/english/household/coffee_machines/super_automatics.html,

9 Source:"Preparatory studies for Eco-design Requirements of EuP – Tender TREN/D3/91-2007) LOT 25: Non-Tertiary Coffee Machines", task 4, p. 24

2.2.2 Portioned machines for capsules

Capsule machines work with high pressure of 800 kPa[10]. The hot water is pressed through small aluminium/plastic capsules filled with ground coffee. High efficiency capsule machines only have a consumption of even below 40 kWh per year (according to the measurement method of Euro-Topten/S.A.F.E.), whereas very energy inefficient machines need up to 200 kWh per year, similar to the automatic machines, due to their keeping hot and standby function. The price ranges between 80 an 250 Euros but in addition the running costs for these types of coffee machines are very high due to the costs of capsules. With an average price of 30 Cent per capsule in contrast to a portion coffee prepared by an automatic coffee machine with around 8 Cent per cup, the coffee costs are more than three times higher. The average lifetime of a capsule machine is 7 years (Market research in Germany , Juni 2011 and expert interviews of the Öko-Institut e.V.).

Figure 2 Capsule machine[11]

2.2.3 Portioned machines for pads

Using a filter pad machine, coffee is brewed cupwise by pressing hot water with low pressure (250 to 300 kPa) through small filter pads filled with ground coffee[12]. Their energy consumption is similar to the consumption of capsule machines. The price ranges between 40 and 210 Euros depending on their different functions. The running

[10] But there are also exceptions, e.g. the Bosch Tassimo capsule machine works with lower pressure (< 3 kPa) and it´s therefore – per definition –not an espresso machine (see Table 1).

[11] Source: http://www.topten.eu/?page=capsule_espresso_machiines

[12] An exception are the machines from Malongo: they brew with high pressure. http://www.malongo.com/uk/index.php

costs for these types of coffee machines are slightly lower than for capsule machines: their average price is 22 Cent per pad. The average lifetime of a pad machine is 7 years (Market research in Germany , Juni 2011 and expert interviews of the Öko-Institut e.V.).

Figure 3 Pad machine[13]

2.2.4 Semi-automatic portafilter coffee machines

A semi-automatic coffee machine works with high pressure of 800 kPa. The hot water is pressed through the portafilter which holds a filter and finely ground coffee and gets clamped to the espresso machine per hand (semi-automatic). The portafilter has one or two spouts which direct the coffee into the cup. High efficient machines only have a consumption of approximately 46 kWh per year (according to the measurement method of Euro-Topten/S.A.F.E.), whereas very energy inefficient machines need up to 140 kWh per year[14]. Their average price is about 200 Euros, it varies depending on their different functions. The average lifetime is 7 years (source: expert interviews of the Öko-Institut e.V.).

[13] Source: Senseo Press: http://www.senseo.de/Style%20Library/Senseo/Content/Presse/Umfrageergebnisse_Neue%20Kaffeepad-Generation/2011_07_06_neu_Senseo_Oyster_300dpi.jpg

[14] Source: http://www.topten.ch/deutsch/haushalt/kaffeemaschinen/kolbenmaschinen.html

Figure 4 Semi-automatic portafilter coffee machine[15]

2.2.5 Features

Following features are often used by coffee machines:

Auto-power-down (Auto-off): An auto-power-down function automatically terminates the heating of a machine after a certain time of inaction. This function can also be referred to as 'energy saving' in the instruction manual and the program menu. This has to be differentiated from an energy saving mode which reduces temperature (see below). In sales promotion the term 'automatic off' is also used for the comfort function regulating the coffee dispensing[16].

Auto-power-down Delay (Switch-off Delay): Delay to activation of the auto-power-down after the machine has last been active or manipulated. Usually different delay times can be programmed in the menu[16]. Source: Measuring Method and Calculation Formula for the Electrical Consumption of Coffee Machines for Houshold Use. Euro-Topten and S.A.F.E., 9th May 2009.

cup heating: some machines have a heating area for preheating the cups - not necessary and it needs also additional energy.

cup illumination: some fully automatic machines have a cup illumination.

Energy Saving Mode: Some coffee machines have a special energy saving mode or eco-mode which can be programmed in the menu or is factory set. This mode lowers the temperature of the heating element after a certain time (e.g. 20 minutes), e.g. to 60°C from 90°C. The machine then is no longer in the ready mode but requires some

15 Source: http://www.topten.ch/deutsch/haushalt/kaffeemaschinen/kolbenmaschinen.html

16 Source: Measuring Method and Calculation Formula for the Electrical Consumption of Coffee Machines for Houshold Use. Euro-Topten and S.A.F.E., 9th May 2009.

heating time before dispensing coffee. It takes less time however than when heating up from the cold state[16].

Hard-Off, Soft-Off: A hard-off switch disconnects a machine from the mains, so that power input is zero. With a soft-off switch a machine is switched off electronically and usually keeps up a minimal power input for supplying the electronic circuit. In some cases the type of switch cannot be identified easily, for instance if the machine is being disconnected from the mains by a relay while it is switched on with a smooth-running micro switch[16].

One-Touch-Function: operates automatically at the touch of a button milk-based coffee specialities such as Latte Macchiato, Cappuccino etc. [17].

Rinse, Rinse function: Many coffee machines automatically dispense a small amount of water after heating up, in order to clean and warm the dispensing canals. Possibly this function can be switched on or off in the program menu. In some cases the rinse function has to be confirmed by pushing a button after a request on the display[16].

2.2.6 Energy Consumption

The most energy using function of coffee machines is the permanently keeping hot of the water at 85°C to 90°C and strongly depends on the heating unit. Three types of heating units are common in coffee machines: boilers, thermo-blocks and flow-type heaters. The keeping warm function of a typical automatic /portioned coffee machine (excluding coffee brewing) may consume up to 170 kWh per year, depending on user's switching off practice. Further energy using functions are the production of a cup of coffee, standby, pumps and electric motors. Measures that strongly enhance the energy efficiency of coffee machines are the availability of an auto-power-down and a short delay time, insulation of hot parts, reduction of the thermal capacity of the heating unit; “energy saving mode”, reduced or zero standby consumption and low amount of water to be heated for hygienic and quality purposes (see chapter 2.2.6). (Josephy, B. et al. 2011).

2.3 Best Available Technology

On account of the high energy saving potentials, manufacturers have undergone various efforts to increase the energy efficiency of coffee machines in the last years. The key features that strongly enhance the energy efficiency of coffee machines thus are auto-power-down, good insulation of hot parts, reduction of the thermal capacity of the heating unit, “energy saving mode”, reduced or zero standby consumption and low amount of water to be heated for hygienic and quality purposes.

[17] The NESCAFÉ® Dolce Gusto®-System e.g offers capsules filled with 100% whole-milk powder (www.dolce-gusto.com).

The application of **flow-type heaters** is a current development towards super efficient coffee machines. These types of coffee machines currently represent the best available technology.

Table 2 shows the different properties of the three types of heating units in coffee machines. Flow-type heaters have the lowest thermal capacity (due to their very small thermal mass). The smaller the thermal capacity the less “heating up”-energy has to be supplied. The flow-type heater shows a small non-insulated surface. The huge energy saving potential compared to boilers and thermo-blocks is mainly due to the fact that it is heated only for 1 to 2 minutes whenever a cup of coffee is produced. They do not need autopower- down and have no ready mode losses, as they are activated only for coffee brewing and switched off immediately when the coffee production is finished. Heat losses during the brewing process are also low because of their little water content. (Josephy, B. et al. 2011).

Table 2 Properties of heating units for coffee machines: material contents and resulting thermal capacity at a temperature difference of 70°C (ambient 20°C, coffee production 90°C) (Josephy, B. et al 2011).

Type	Boiler	Thermo-block	Flow-type Heater
Water	200 g	10 g	10 g
Metal	400 g	650 g	120 g
Thermal capacity at $\Delta T = 70°C$	22 Wh	12 Wh	3 Wh

- **Availability of an Auto-Power-Down and Short Delay Time**

An auto-power-down function is the first and simplest measure to shorten the duration of the keeping hot state and thus to reduce the high energy consumption of the ready mode (keeping hot of the water). However, the duration of the delay time, or in other words, the time until the coffee machine switches from the ready mode into standby mode is important: the shorter the delay time the greater the impact of this feature. New water heater units that are designed as flow-type heaters do not need auto-power-down, as they are activated only for coffee brewing and switched off immediately when the coffee production is finished (see below).(Josephy, B. et al. 2011).

- **Insulation of Hot Parts**

Thermal losses of heaters are substantially lowered by (even thin) insulation of the hot parts of coffee machines such as thermo-blocks and water heaters of any kind. The insulation prevents the cooling effect of air ventilating the hot parts immediately. Even with flow-type heaters a small efficiency gain by insulation is to be expected. (Josephy, B. et al. 2011).

- **"Energy Saving Mode"**

Some coffee machines have an "energy saving mode" or "eco-mode" which is factory set or can be programmed in the menu. This mode lowers the temperature of the heating element after a certain time (e.g. 5 minutes), from standard 90°C to about 60°C (e.g.). The coffee machine then is no longer in a real ready mode, but requires some heating time before dispensing coffee. It takes less time however than heating up from the cold state. This type of "energy saving mode" allows good energy efficiency figures also with somewhat longer auto-power-down delay times. (Josephy, B. et al. 2011).

- **Reduced or Zero Standby Consumption**

The shorter the delay time of the auto-power-down the longer the machine remains in standby. The allowed energy consumption in standby is regulated by the Eco-design Regulation for standby and off mode consumption. As the use of a coffee machine requires pressing a button or another manipulation anyway, there is no need for a standby function as e.g. for TV sets, which are to be activated by a remote control. Therefore zero standby does not cause any technical problems for coffee machines and can be easily implemented. As most coffee machines afford an electronic control and soft switches, the extra costs of zero standby are small. (Josephy, B. et al. 2011).

- **Low Amount of Water to be Heated for Hygienic and Quality Purposes**

Most coffee machines heat up certain quantities of water for rinsing purposes when switched on or off, or they discard a small amount of coffee at the beginning of the brewing process, which might be not hot enough or not of sufficient quality. Decalcification and (automatic) cleaning also is an energy (and as chemicals are used also resources) consuming aspect in the life cycle of coffee machines. There might be an additional saving potential, e.g. by using lower water temperatures and volumes for these processes. (Josephy, B. et al. 2011).

Highly efficient coffee machines feature the above discussed efficiency technologies in an optimal combination. Presently, comparable measurement results of a broad selection of coffee machines are not available because measurement methods are not yet harmonised (see 2.5.1.2). The analysis of many results (FEA/CECED-forms) and Topten measurements suggest that several coffee machines – portioned as well as

fully automatics – are very nearby the theoretical "Best Available Technology". (Josephy, B. et al 2011).

2.4 Legislations and Labels

2.4.1 International

- **Australia's Standby Power Strategy 2002-2012**[18]

Australia implemented a National Standby Strategy, which aims to meet a power of 1 Watt in 2012 for numerous appliances, including espresso coffee machines. The National Appliance and Equipment Energy Efficiency Committee advised the Ministerial Council of Energy to target off mode of 1W by 2007, and 0.5W with 1 hour power down by 2012.

- **Switzerland – Energy Label (voluntary energy label)**[19]

The new voluntary EtiquetteEnergie (energy label) for non-tertiary espresso machines was developed under the guidance of the Swiss Association of Manufacturers and suppliers of electrical appliances (FEA) and in close collaboration with the Swiss manufacturer of coffee machines and the European Council of Equipment Manufacturers (CECED). It was created for use in Switzerland voluntarily since September 2009 and it is based on the FEA/CECED measuring method (see 2.5.1.1).,. The label has been designed for consumers to spot energy efficient machines in stores easier. It can show at a glance if a machine is among the models saving electricity (efficiency class A: green arrow) or not (efficiency class G: red arrow). The current annual consumption of the machine (according to the FEA/CECED measuring method) is also shown on the label.

- **Korea - Eco-Label**[20]

The Korean Eco-labelling programme is a voluntary certification programme which helps consumers to choose eco-products that reduce consumption of energy and resources and minimise the generation of pollution throughout the production process. The programme is applicable to electric kettles and electric coffee machines for private use, with effective power 2.0kW or less. For electric coffee machines the main criteria include a maximum of energy efficiency, a maximum of Wh of energy consumption for heating 1.0 l of water, criteria for material composition, information for consumers etc.

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18 Standby product profile – Espresso coffee machines, Australia's standby power strategy 2002 – 2012, www.energyrating.gov.au/library/pubs/sb200408-espresso.pdf (download 31-08-2009)

19 http://www.bfe.admin.ch

20 "Electric Kettles and Electric Coffee Makers EL408" Korea Eco-Products Institute www.koeco.or.kr

- **Russia - GOST 20888-81 Standard**[21]

The Russian standard GOST 20888-81: 2001 – "Methods for measuring the performance of electric household coffee makers" is a test and safety standard. But as it includes also MEPS, it is relevant as a legislative international standard. It limits the electricity consumption per unit of cooked coffee by different coffee machines: compression, percolating, filtration, vacuum.

2.4.2 European

There is no specific legislation on energy efficiency or energy consumption of coffee machines in Europe. As electrical products, coffee machines are under scope of many European Directives. The most relevant legislation and its scope are presented in the following table.

Table 3 Relevant European legislation and its scope[22]

Scope	Legislation
Environmental legislation	
European Regulation on Energy Related Products (ERP Directive) for Non-tertiary coffee machines (lot 25)	Under development see chapter 2.4.2.2
Entire product	Waste Electrical and Electronic Equipment Directive 2002/96/EC (category 2. Small household appliances)
	Restriction of the use of certain Hazardous Substances in electric and electronic equipment Directive 2002/95/EC (category 2. Small household appliances)
	REACH Regulation No 1907/2006/EC
Energy legislation	
Standby and off-mode power consumption	Commission Regulation (EC) No 1275/2008 of 17 December 2008

21 http://www.gost.ru/wps/portal/pages.en.StandartCatalog

22 Source:"Preparatory studies for Eco-design Requirements of EuP – Tender TREN/D3/91-2007) LOT 25: Non-Tertiary Coffee Machines", task 1, p. 44

Scope	Legislation
Legislation related to safety	
Entire product	General Product Safety Directive 2001/95/EC
	Low Voltage Equipment Directive 73/23/EEC
	Materials and articles intended to come into contact with foodstuffs – Directive 89/109/EEC
	Electromagnetic Compatibility (EMC) Directive 89/336/EEC

The low voltage and electromagnetic compatibility Directives, as well as the Regulation on standby and off mode power consumption (see below), are the most relevant to coffee machines that apply to electrical and electronic equipment.

2.4.2.1 Standby and off-mode power consumption - Commission Regulation (EC) No 1275/2008 of 17 December 2008

Since January 2010 the Eco-design Regulation for standby and off mode consumption[23] is in force and requires coffee machines to have a standby consumption of no more than 1.0 W (with display 2 W) [24]. The maximal delay from the last activity is not yet defined. From 2013 the limits will be 0.5 W (with display 1 W) and the products must have a power management function switching to a standby or off mode “after the shortest possible period of time appropriate for the intended use of the equipment”. For non-tertiary coffee machines, auto-power-down will therefore be a need. Topten.eu requires a maximal delay time (factory setting) of 30 minutes for portioned machines (high and low pressure), 60 minutes for fully automatic machines and semi-automatic portafilter coffee machines and 60 minutes for drip-filter machines without thermos jug.

2.4.2.2 European Regulation on Energy Related Products (ERP Directive)

In 2005, the Energy Using Products (EuP) Directive, sometimes also called the Ecodesign-directive was adopted (2005/32/EC)[25]. A major goal of the directive is to

[23] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:en:PDF

[24] For non-tertiary coffee machines there is no need to display any information in standby mode. This was one of our statements made in the EEDAL-paper 2011. I’m not sure whether all manufacturers would share this oppinion.

[25] DIRECTIVE 2005/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and

improve the energy efficiency of energy using products (EuPs) and thereby contribute to efforts to reach European targets for climate protection. The directive, however, does not only cover the energy use of products but rather aims to reduce the overall negative environmental impact of the products under consideration. In 2009, the EuP Directive 2005/32/EC was replaced by a new Directive (2009/125/EC)[26]. The most important amendment concerns the Directive's scope, which has been extended from "energy-using" to so-called "energy-related" products.

Since mid of 2009, the preparatory study on non-tertiary coffee machines Lot 25[27] is being carried out by BIO Intelligence Service (Paris) for the European Commission DG ENER in the context of the Eco-design Directive. The preparatory study follows the Methodology for Eco-design of Energy-using Products (MEEuP), which is mandatory for all Eco-design preparatory studies, comprising 8 tasks.

On the basis of this preparatory study the European Commission will develop a Working Document with draft Implementing Measures, i.e. requirements for the environmental performance of the coffee machines. The next step is then a so-called Consultation Forum, where feedback from representatives of the member states and selected stakeholder parties to the draft implementing measures is possible. The Implementing Measure is then subject to an impact assessment and interservice consultation before being presented for vote to an assembly of EU member states representatives, known as the Regulatory Committee. The EU parliament has the opportunity to intervene before the Implementing Measure enters into force.

2.4.2.3 Relevant National Criteria

- **France – NF Environment**[28]

There is a voluntary certification mark in France: the NF Environnement mark. For coffeee machines it is only applicable to filter coffee machines ("NF397 Electric Filter Coffee Machines for Domestic Use"). Certified characteristics comprise energy consumption in standby mode, off mode, as well as for coffee preparation, with threshold levels for each mode. It also requieres a hard on/off switch. The NF Environment mark is issued by AFNOR Certification by the Central Laboratory of Electrical Industry (LCIE) and it is the official French ecological certification logo for products with a reduced effect on the environment.

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amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council

[26] DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast)

[27] Ecodesign of EuP. Non-tertiary coffee machines lot 25. BIO Intelligence Service, Paris. www.ecocoffeemachine.org

[28] Référentiel de certification "Cafetières électriques à filtre pour usage domestique" AFAQ AFNOR Certification, www.marque-nf.com, France

- **Germany – Blue Angel**[29]

Prticularly energy-efficient and climate-friendly products are awarded by the well-known German Eco-label The Blue Angel[30]. For its new label for coffee machines the Blue Angel has overtaken the energetical criteria developped by Topten.eu (see chapter 4). The Blue Angel label "Espresso Machines /Coffee machines with high pressure – RAL-UZ 136" covers espresso/coffee machines using a pump pressure of at least 8 bars (brew an "Italian-style" coffee) for private household use[31]. These are Fully automatic coffee machines, Single-serve coffee machines for pads (automatic pad coffee machines) and Portafilter espresso/coffee machines.

Overall, the goal for establishing the label is to encourage manufacturers to enable coffee machines to:

- Feature a low power consumption
- Be durable goods
- Avoid the use of environmentally damaging substances

The criteria for the label are divided into four sections:

- Power consumption – the appliance should have an auto-off function with factory-set delay of less than 1 hour for automatic coffee machines and 30 minutes for pod types, stand-by power consumption shall not exceed 1.0 W, off mode power consumption shall not exceed 0.3 W; the energy consumption in "ready-to-use" mode until automatic switch off shall not exceed 35 Wh for fully automatic machines and portafilter machines and 30 Wh for pod coffee makers (these values base on the measurements according to the Topten/S.A.F.E. measuring method).
- Longevity – all repair and service parts shall be guaranted in continous production for at least 10 years after end of production;
- Material requirements – no carcinogenic, reprotoxic, mutagenic, persistent, bio-accumulative, or toxic materials shall be used in the construction of the product. Parts in contact with water or milk shall be in accordance with the German Food code, and shall avoid the release or leeching of toxic materials (maximum 2 mg Pb / litre H_2O and 50 mg Ni / litre H_2O brewed);

29 http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=471

30 For more information see: http://www.blauer-engel.de/en/index.php

31 See http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=471

- Consumer information – A comprehensible and detailed Operating Instructions and Product Information Manual in a printed form with a detailed description of the energy-saving functions shall be enclosed with the product complying with DIN EN 62079.

- **Current Topten.eu Criteria for High Efficient Coffee Machines:**

See chapter 4

- **EcoTopTen – Criteria (Germany):**

An additional criteria which has to be met by EcoTopTen (Germany) (www.ecotopten.de) is at least a "good" rating from Stiftung Warentest if a quality test exists. The absence of a test result does not lead to devaluation.

2.5 Test Standards

At present there are no European countries that regulate the energy efficiency of coffee machines and there are no standards at the European level (CEN) related to the performance (energy efficiency) of coffee machines. Currently most European standards that concern coffee machines address measurement standards and safety issues of electrical household appliances. These standards fall under EU directives such as the Low Voltage Directive (LVD).

Currently there is one European approach improving the existing methods presented in the next table. This approach will revise the IEC 60661 Standard and it is in development in a collaboration with CECED, manufacturers, Topten and S.A.F.E. (see 2.5.1.2).

Table 4 gives a summary of main test standards relevant for coffee machines.

Table 4 Main test standards relevant for coffee machines[32]

Reference	Title and *Content*
EN 13248:2002	"Cookware - Coffee makers for domestic use with an independent heat source - Definitions, requirements and test methods" *Contents: Scope, Normative references, Terms and definitions, Requirements, Tests, Marking and labelling, Instructions for use and maintenance*
EN 60661:2005 (IEC	"Methods for measuring the performance of electric

[32] Source:"Preparatory studies for Eco-design Requirements of EuP – Tender TREN/D3/91-2007) LOT 25: Non-Tertiary Coffee Machines", task 1, p. 40

Reference	Title and *Content*
60661)	household coffee makers" *Defines the main performance characteristics which are of interest to the user and describes the standard methods for measuring these characteristics.*
ANSI[33]/AHAM[34] CM-1-2007	"Method for Measuring Performance of Household Coffee Makers" *Establishes a uniform, repeatable procedure for measuring specified product characteristics of household electric coffee makers.*
CECED / FEA	"Measurement method for the determination of the energy consumption of Espresso machines" *Applicable to all manual and automatic espresso and multipurpose hot beverage machines characterised by the fact that they are based on high pressure (> 5 bar maximum working pressure) espresso technology and on a cup by cup system.*
Topten (2005, latest update May 2009)	"Measuring Method and Calculation Formula for the Electricity Consumption of Coffee Machines for Household Use." *Describes a measuring method for most types of household coffee machine and a calculation scheme for the yearly energy consumption. Adopted by The Blue Angel and approved for several years for the evaluation of appliances presented e.g. on www.Topten.ch and www.Topten.eu*

2.5.1 Methods to Measure the Energy Consumption of Coffee Machines

2.5.1.1 Presently Used Measuring Methods

As mentioned above, the existing standard IEC 60661 (see Table 4) does not include a method for measuring the energy consumption of coffee machines. Therefore two initiatives have developed each a measuring method. Both methods are applied in Europe in parallel at present:

- **Topten /S.A.F.E.-Method**[35]

[33] American National Standards Institute

[34] Association of Home Appliance Manufacturers

[35] Measuring Method and Calculation Formula for the Electricity Consumption of Coffee Machines for Household Use. Euro-Topten and S.A.F.E., 9th May 2009. Download: www.topten.eu

This method was developed by Topten and S.A.F.E.. Its year of implementation was 2007 and last update May 2009[36].It is applied by Topten for “Best Products of Europe” and for national Topten-sites (e.g. www.topten.ch), by The Blue Angel (for RAL-UZ 136), by manufacturers to have their high efficient coffee machines presented on Topten websites and by Swiss electrical utilities and Swiss communities for rebate programmes based on Topten lists. The measurement is along a “coffee period” and it has simple proceeding irrespective of “energy saving modes”. However, coffee production is not measured but is taken into account with a standard value of 20 kWh per year.

- **FEA/CECED-Method**

This method was developed in 2008/2009 by the Swiss Association of the Domestic Electrical Appliances Industry FEA with the contribution of CECED. It is applied by manufacturers to get the voluntary Swiss energy label (class A to G, introduced in autumn 2009, see chapter 2.4.2). The measuring method was adopted by CECED. In contrast to the other method, it measueres the preparation of coffee and the steaming function but impact of auto-power-down delay and “energy saving modes” is not adequately considered.

2.5.1.2 Future Test Standard: Revised IEC 60661

As the existing standard IEC 60661 does not include a method for measuring the energy consumption of coffee machines and because the presently used measuring methods have their benefits and drawbacks as described above, one revised European approach improving the existing methods validated by CENELEC is in development in a collaboration with CECED, manufacturers, Topten and S.A.F.E. (working group TC59X_WG15).

The revised IEC 60661 will contain two measuring procedures: one for coffee machines with pressure (high and low pressure) and one for drip-filter machines (no pressure). Currently, the proposal is in discussion with the Technical Board. After that, the proposal will be sent to the National Committee.Topten and The Blue Angel already declared that they will adopt the revised IEC 60661 standard as soon as possible.

[36] Presented at EEDAL 2009: Bush E., Nipkow J., Josephy B.; Heutling S., Griesshammer R. Strategies to Enhance Energy Efficiency of Coffee Machines. Topten International Group TIG, Swiss Agency for Efficient Energy Use S.A.F.E., German Federal Environment Agency, Oeko-Institute, EEDALConference, Berlin 2009, Download: www.topten.eu

3 Economic and Market Analysis

The following information is based on the "Preparatory studies for Eco-design Requirements of EuPs- Lot 25: Non-Tertiary Coffee Machines" of 2011 if no other source is cited.

3.1 Stock, Sales and Market Trends

The stock of coffee machines in Europe is estimated at 100 million units (according to Topten). As shown inTable 5, annually more than 18 million coffee machines are sold in Europe (data of 18 European countries, according to GfK).

Table 5 Total sales figures of coffee machines of 18 European countries[37]

Sales (1 000s)	2006	2007	Increase
Filter	10.076	10.072	0,0%
Portioned machines (pad)	3.546	3.410	- 3,8 %
Portioned machines (espresso/hard cup)	1.647	2.356	43,1%
Espresso fully automatic	824	870	5,5%
Espresso piston hand-operated	1.358	1.246	-8,2%
Combi Espresso-Filter	312	284	-8,9%
All coffee machines	**17.763**	**18.238**	**2,7 %**
All Espresso- and Padmachines	**7.375**	**7.882**	**6,9 %**

[37] Nipkow, J. et al. (2010) Coffee machines: recommendations for policy design, Topten International Group TIG, Paris, www.Topten.info. Countries included are Austria, Belgium, Switzerland, Germany, France, Great Britain, Spain, Italy, the Netherlands, Portugal, Sweden, Denmark, Finland, Greece, Poland, Hungary, Czech Republic and Slovak Republic. Note that Switzerland is not an EU Member State but is included in the original dataset.

Drip filter coffee machines still have the highest market share (55%). Fully automatic coffee machines and espresso portioned machines have a market share of 43% and an important growth of 6.9%.

There is a considerable trend towards fully automatic machines (+5.5% in 2007 compared to 2006) and an extremely strong trend towards espresso portioned machines (+43.1%), while low-comfort machines are losing market share (machines with piston lever, machines with filter-coffee quality such as portioned machines for pads and combi machines).

The following trends have been estimated for capsule und fully automatic machines:

- Single-serve coffee machines for capsules: They are expected to have strong growth (12% per year) in the coming 3-5 years and are expected to continue to grow at a moderate pace in the longer term.

- Fully automatic coffee machines: Sales are expected to grow in coming years, though less dramatically than capsule machines.

3.2 Manufacturers and Distributors

3.2.1 List of Manufacturers

Table 6 List of important manufacturers

Brand	Country (headquater)	Website
Bosch	*Germany*	*www.bosch.com*
Cremesso	*Switzerland*	*www.cremesso.com*
Delizio	*Switzerland*	*www.delizio.ch*
DeLonghi	*Italy*	*www.delonghi.com*
Gaggia	*Italy*	*www.gaggia.com*
Jura	*Switzerland*	*www.jura.com*
Krups	*Germany*	*www.krups.com*
Martello	*Liechtenstein*	*www.martello-cafe.com*
Melitta	*Germany*	*www.melitta.de*
Miele	*Germany*	*www.miele.com*
Mocoffee	*Switzerland*	*www.mocoffee.com*
Nespresso (Koenig, Krups, Turmix)	*Switzerland*	*www.nespresso.com*
Nivona	*Germany*	*www.nivona.com*
Philips/Saeco	*Netherlands (Philips) / Italy (Saeco)*	*www.saeco.philips.com*
Rotel	*Switzerland*	*www.rotel.ch*
Rowenta	*France*	*www.rowenta.com*
Satrap	*Switzerland (home brand of Coop)*	*www.satrap.ch*
Siemens	*Germany*	*www.siemens.com*
Tchibo	*Germany*	*www.tchibo.com*

4 Selection Criteria

According to the Topten concept, each country has to develop its specific Topten lists which depend on the products available on the national market. Thus, the specific thresholds for Topten lists depend on the products offered at national level and will be more or less stringent depending on the number of efficient products available. The intention of this paper is to provide some recommendations regarding the criteria to be considered in Topten product listings and to give an idea of the efficiency of products currently offered on the market.

Following criteria shall be fullfilled for high efficient coffee machines by fully automatic coffee machines, portioned machines for capsules and pads and semi-automatic portafilter coffee machinesmachines with piston lever to be listed on Topten.eu – Best Products of Europe (not considered are filter coffee machines, combi-machines and (commercial) appliances with a permanent water supply).

4.1 Energy Efficiency Criteria

In order to be displayed on topten.eu, coffee machines must meet the following technical criteria:

- Auto-power-down function switching off the permanent heating of the water after a certain time lag to standby or off
- Time lag of the auto-power-down, factory setting:
  - max. 1 hour: fully automatic, semi-automatic portafilter coffee machines
  - max. 30 minutes: portioned machines
- Power consumption in standby (or sleep) following the auto-power-down: max.1 W
- Electricity consumption for ready mode[38]:
  - max. 35 Wh: fully automatic, semi-automatic portafilter coffee machines
  - max. 30 Wh: portioned machines

[38] The energy consumption for ready mode during the whole coffee period, incl. heating up, according to the Euro-Topten/S.A.F.E. measuring method.

Machines with flow-type heater do not have a ready mode or “keeping warm function”. They switch off immediately after coffee production. Therefore they comply with the Electricity consumption criterion anyway. Because there is no ready mode that can be measured, this type of machines is measuered according to point 5 of the Euro-Topten/S.A.F.E. measuring method (Measuring of Machines without Regular Ready Mode in “Measuring Method and Calculation Formula for the Electricity Consumption of Coffee Machines for Household Use”; Euro-Topten and S.A.F.E., 9th May 2009 (see chapter 2.5.1.1)).

The appliance must be available in at least one European country. Relevant values have to be provided by the suppliers. Suppliers who are not able to provide these values cannot claim to have their appliances displayed on topten.eu. All declarations can be verified by random measurements. The data sources are declarations by producers and suppliers, national data-bases and topten-sites (e.g. www.topten.ch, www.topprodukte.at) and measurements by test laboratories (e.g. www.salt.ch).

The products can be ranked according to their electricity consumption (www.ecotopten.de) or to their their electricity costs (www.topten.eu) during 1 or 10 years.

4.2 Quality related product features

In addition to the energy criteria other quality information could be useful for the consumer. Therefore Ecotopten (www.ecotopten.de) in Germany requires a further quality criterion:

- at least a “good” rating from Stiftung Warentest has to be achieved if an quality test exists. (The absence of a test result does not lead to devaluation.)

4.3 Recommendation for value setting

Availability of an auto-power-down function
The coffee machine must have an auto-power-down function.

Time lag of the auto-power-down, factory setting:
We recommend a maximal delay time (factory setting) of 30 minutes for portioned machines (high and low pressure) and 60 minutes for fully automatic machines and semi-automatic portafilter coffee machines.

Power consumption in standby (or sleep) following the auto-power-down:
As for non-tertiary coffee machines there is no need to display any information in standby mode, we recommend max. 1 W in standby mode.

Electricity consumption for ready mode[39]:

- max. 35 Wh: fully automatic, semi-automatic portafilter coffee machines
- max. 30 Wh: portioned machines

Annual energy consumption[40]:

- ≤ 45 kWh/year: fully automatic, semi-automatic portafilter coffee machines
- ≤ 35 kWh/year: portioned machines

4.4 Topten product information

The following information can be shown on the Topten websites (in the tables) to ensure that the consumer gets sufficient information also on quality criteria other than energy efficiency:

- Purchase price
- Annual energy costs
- Energy (kWh/year)
- Global warming potential in kg CO_{2eq} per year
- Pressure
- powerconsumption in standby-mode in Watt
- Switch-off delay in minutes
- Others functions, e. g. availability of an automatic cleaning and descaling function

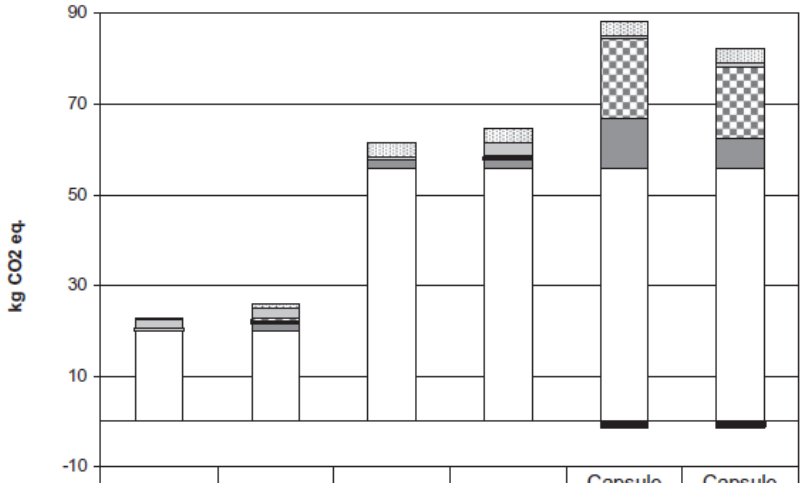
39 The energy consumption for ready mode during the whole coffee period, incl. heating up, according to the Euro-Topten/S.A.F.E. measuring method.

40 According to the Euro-Topten/S.A.F.E. measuring method

5 Additional Considerations

Policy measures are needed to realise the high electricity saving potential of coffee machines. The Eco-design Regulation for standby and off mode consumption is relevant for coffee machines, but the delay-time for the auto-power-down is not yet defined. Furthermore, as for non-tertiary coffee machines there is no need to display any information in standby mode, thereforelower values should apply (max.0.5 W). Nevertheless, zero standby represents BAT and helps manufacturers to get a better energy class. Minimum Energy Performance Standards MEPS and an EU energy label for coffee machines should be established.

Also the production of capsules and pads should be taken into account and an ambitious timetable for the implementation of accordant criteria should be set up. The capsule production is likely to (over-) compensate the somewhat lower energy consumption of portioned machines for a coffee period (see Table 7). As the energy and resource expenses of capsules cannot be influenced by the buyers after the decision to buy a certain coffee machine, a declaration of the eco-balance of capsules and pads in order to support the buying decision should be discussed.



	French Press	Filter drip coffee maker	Fully automatic coffee	Pad filter machine with credit	Capsule machine (PP+Alu) with credit	Capsule machine (100% Alu) with credit
Manufacturing of the coffee makers	0.3	0.8	3.2	3.0	3.0	3.0
Production of the packaging of the filter pads/capsules/coffee	2.1	2.1	0.6	2.9	1.0	1.0
Production of the filter pads/capsules	0.0	0.8	0.0	0.3	17.4	15.9
Disposal of the packaging of the filter pads/capsules	0.4	0.4	0.1	0.6	-1.3	-1.3
Disposal of the filter pads/capsules/coffee ground	0.02	1.7	2.1	2.2	11.3	6.8
Use of the coffee makers	20.1	20.1	55.5	55.5	55.5	55.5

Table 7 Global warming potential of different preparation methods for coffee. Functional unit: 2000 cups of coffee. (Brommer et al., 2011)

Considering the overall environmental impacts of one cup of coffee, the CO_2e-emissions from the use phase of coffee (grinding and purchasing, preparation, disposal) represent one of two significant hot spots in the lifecycle of coffee with a share of 36% of the overall emissions. Actually, 30% of these impacts attributed to the use phase are caused by coffee preparation (grinding and purchasing: 4%, disposal: 2%). The second hot spot is the cultivation of coffee beans (cultivation, including therewith connected upstream processes such as production of pesticides and fertilizers) with a share of 55% of the CO2e emisisons. Concerning the use phase, research shows that environmental impacts vary significantly depending on the preparation method used by the consumer[41]. Capsule machines have the highest GWP of between 81 and 87 kg CO2e. The production of the capsules as well as their disposal cause significant greenhouse gas emissions that impair the overall result of the capsule machines. It must be added that the assumptions made concerning the disposal favoured the recycling of the capsules; worse scenarios may be possible in real life.

Furthermore consumers have the possibility to influence the environmental impacts of their coffee machine not only by purchasing an efficient appliance but also by using it efficiently. Smart user behaviour may save a lot of energy. If the coffee machine has an automatic power down function, this should be set to 1/2 to 1 h. Note: the automatic power down function is usually set to 1 to 2 h by factory setting.With the proper setting, not only energy can be saved but also seals and pumps remain in good condition for a longer time, not being hot all of the time. Coffee machines without an automatic power down function should directly be switched off after use. For appliances with an energy saving mode (lowering the temperature of the thermo block), consumers should consult the manual or check the menu in order to verify that this function is activated. If necessary, the energy saving mode must be activated.

Consumers may obtain further information at Internet platforms such as www.topten.eu that contain a number of well-grounded recommendations concerning the choice of efficient appliances. Also promotion programs are important to increase the market share of high efficiency coffee machines. Possibilities are rebate programs, information campaigns, or bonus-malus systems addressing producers.

[41] Source: CASE STUDY TCHIBO PRIVAT KAFFEE RARITY MACHARE BY TCHIBO GMBH undertaken within the PCF Pilot Project Germany. http://www.pcfprojekt.de/files/1232962944/pcf_tchibo_coffee.pdf

6 Bibliography

Measuring Method and Calculation Formula for the Electrical Consumption of Coffee Machines for Houshold Use. Euro-Topten and S.A.F.E., 9th May 2009. Download: www.topten.eu

IEC 60661 Ed. 2.2 (2006 – 02). Methods for measuring the performance of electric household coffee makers.Bush, Eric, Jürg Nipkow, Barbara Josephy, Susanne Heutling, Rainer Griesshammer (2009). Strategies to Enhance Energy Efficiency of Coffee Machines. Topten International Group TIG, Swiss Agency for Efficient Energy Use S.A.F.E., German Federal Environment Agency, Oeko-Institute. EEDAL-Conference, Berlin 2009.

Josephy, Barbara, Eric Bush, Jürg Nipkow, Adelmo Pilone (2011). Super efficient coffee machines – best available technology and market transformation. EEDAL-Conference, Copenhagen 2011.

Nipkow, J. et al. (2010) Coffee machines: recommendations for policy design, Topten International Group TIG, Paris, www.Topten.info. Countries included are Austria, Belgium, Switzerland, Germany, France, Great Britain, Spain, Italy, the Netherlands, Portugal, Sweden, Denmark, Finland, Greece, Poland, Hungary, Czech Republic and Slovak Republic. Note that Switzerland is not an EU Member State but is included in the original dataset.

Nipkow, Jürg et al. (2010) Coffee machines: recommendations for policy design, Topten International Group TIG, Paris,

Nipkow, Jürg, Eric Bush (2006). Energy label for coffee machines. S.A.F.E.. EEDAL-Conference, London 2006.

Brommer, E.; Stratmann, B.; Quack, D..Environmental impacts of different methods of coffee preparations. International Journal of Consumer Studies ISSN 1470-6423. Öko-Institut e.V./Institute for Applied Ecology, Freiburg, Germany 2011.

The Blue Angel: RAL-UZ 136: Vergabegrundlage für Umweltzeichen Espressomaschinen / Kaffeemaschinen mit hohem Druck. June 2009. http://www.blauer-engel.de/en/products_brands/search_products/produkttyp.php?id=471

Ecodesign of EuP. Non-tertiary coffee machines lot 25. BIO Intelligence Service, Paris. www.ecocoffeemachine.org

Ecodesign regulation for standby and off mode consumption: Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the

European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment.

www.topten.eu - Best Products of Europe

www.topten.info – International Platform for Best products