Topten Product Criteria Paper on

Washing Machines

Marcus Hofmann

AEA – Austrian Energy Agency

AUSTRIAN ENERGY AGENCY

23.06.2011

Supported by

Supported by INTELLIGENT ENERGY EUROPE

Coordinated by

ADEME

Agence de l'Environnement et de la Maîtrise de l'Energie

The Project in brief

Topten is part of the international Euro-Topten Plus 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. This association promotes to the Topten Charter, TIG statutes and Rules of Procedure (www.topten.eu).

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. The key element 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:

Project Partner	Country
Austria : Austrian Energy Agency	AT
Belgium: World Wide Fund for Nature – vzw/asbl	BE
Belgium: WWF European Policy Office	BE
Czech Republic: SEVEn, o.p.s	CZ
Finland: Motiva Oy	FI
France: WWF Fonds Mondial pour la Nature	FR
Germany: dena, Deutsche Energie-Agentur	DE
Germany: Oeko-Institut e.V.	DE
Germany: Wuppertal Institute	DE
Germany: ICLEI, European Secretariat	DE
Greece: WWF Greece	GR
Italy: WWF Italia Onlus	IT
Lithuania: LNCF, consumer federation	LT
Luxemburg: Oeko-Zenter, asbl	LU
Norway: Norges Naturvernforbund	NO
Poland: FEWE Polish Foundation for Energy Efficiency	PL
Portugal: Quercus	PT
Romania: ICEMENERG	RO
Spain: ADENA / WWF, Asociacion para la defensa de la natureza	ES

Contact

Therese Kreitz (project leader)
500, routes des Lucioles
F-06560 Valbonne
France
+33(0)493957984
therese.kreitz@ademe.fr

Sophie Attali
20 place de la Chapelle
75018
Paris
+331 8394 8209
so-phie.attali@topten.info

Eric Bush
Rebweg 4
7012 Felsberg
Switzerland
+41 81 252 63 64
info@topten.info

Marcus Hofmann
Mariahilfer Strasse 136
1150 Vienna
Austria
T: +43 1 586 15 24 - 143
mar-cus.hofmann@energyagency.at

Topten Product Criteria Paper on Washing Machines

Contents

1 Introduction 4

2 Product Definition 5

2.1 Energy Consumption 5

2.2 Product Types 5

2.2.1 Loading Methods 6

2.2.2 Load Capacity 7

2.2.3 Features 8

2.3 Current Developements 9

2.4 Legislations and Labels 10

2.4.1 European Label 10

2.4.2 European Regulation on Energy Related Products (ERP Directive) 14

2.4.3 Comments on regulation and label 16

2.5 Requirements by The Blue Angel, the EU Ecolabel 18

2.6 Test Standards 19

3 Economic and Market Analysis 21

3.1 Sales and Stock data 21

3.2 Manufacturers and Distributors 25

3.2.1 List of Manufacturers 25

4 Selection Criteria 26

4.1 Product classes 26

4.2 Topten Selection Criteria 26

4.3 Recommendation for value setting 26

4.4 Topten product information 27

5 Additional Considerations 29

6 Bibliography 30

1 Introduction

Criteria papers provide a central tool for the Euro-Topten Plus partners to collect and analyse product data and to establish a national Topten selection. Appropriate selection criteria and 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 range of products differs significantly in European member States in terms of price level, configuration, energy classes and energy consumption corresponding to levels of purchasing power and behavioural aspects (mentality, customs, etc.).

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

This paper contains the product specification for Topten washing machines. Currently topten.eu already list the most efficient washing machines starting from a 7kg capacity. This paper presents a suggestion for an update of the selection criteria. A product should meet the criteria described in Chapter 4 in order to be listed on www.topten.eu as a Best Available Technology.

In an ideal situation, criteria are based on international or European standards. In some cases widely accepted and strictly defined standards are missing – (e.g. for products in the consumer electronics segment). Within the methodology of WP3, it was intended to use the implementation measures of the Ecodesign directive as a basis for the criteria definition. The information in this criteria paper is therefore mainly based on the "Preparatory studies for Eco-design Requirements of EuPs – (Tender TREN/D1/40-2005) LOT 14: Domestic Washing Machines and Dishwashers" and the corresponding implementing measure.

2 Product Definition

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

2.1 Energy Consumption

The washing process uses energy, which can be subdivided into heating, mechanical action and pumping. The amount of energy used for heating is influenced by the amount of water, the wash load, the temperature of the cold water inlet and the temperature to be reached (i.e. the final ΔT). The energy used for mechanical action depends on the total wash time. The energy use for pumping is in general fixed in the wash programme. The following figure shows the relative share of the components of the energy consumption of a 60°C cotton cycle in 1993.

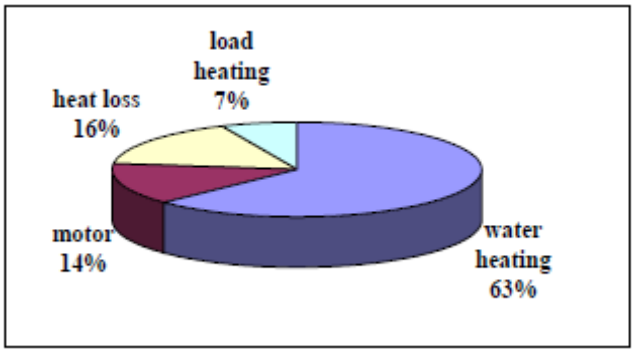

Figure 1 Relative energy consumption for the different components of the washing cycle in 1993[1]

During the washing process the energy used to heat the water also flows to other parts of the machine, for example the steel drum, the glass door and the wash load, and part is lost to the environment. The amount of energy that is lost to the environment depends on a number of variables, among which the insulation of the machine, the duration of the cycle, the ambient temperature and the temperature of the heated water. Future energy savings are expected through efficient motor technology, lower washing temperature, increased load capacity, rinsing phase optimisation and sophisticated electronic controls.

2.2 Product Types

Washing machines can be classified according to the following features:

- Loading methods

[1] Source: "Preparatory studies for Eco-design Requirements of EuPs – (Tender TREN/D1/40-2005) LOT 14: Domestic Washing Machines and Dishwashers", p 483.

- Load capacity
- Features

2.2.1 Loading Methods

Two basic loading methods exist for washing machines, front loading and top loading.

Top loading washing machine: In this washing machine the clothes are loaded from the top of the washing machine. There is a cover at the top that helps loading and unloading of clothes in the round vessel that performs the function of the washer as well as the rinser and drier in the fully automatic washing machine. Top loading machines normally have lower purchase costs, but they are not the most economical choice.

Figure 2 Top loading washing machine[2]

Front loading washing machine: In this machine the clothes are loaded from the front side. The studies have shown that the front loading washing machines consume less electric energy, water and detergent and also give better washing results compared to the top loading washing machine. Front loading washers may cost a bit more at the store, but they are more energy efficient.

Figure 3 Front loading washing machine[3]

[2] Source: http://www.consumerreports.org/cro/appliances/laundry-and-cleaning/washing-machines/washing-machine-buying-advice/washing-machine-types/washing-machine-types.htm

[3] Source: http://www.consumerreports.org/cro/appliances/laundry-and-cleaning/washing-machines/washing-machine-buying-advice/washing-machine-types/washing-machine-types.htm

In the European markets the market share of the front loading washing machines is ~90%, while of the top loading washing machines is mere 10%. In contrast, the US has market share of ~65% for top loading and ~35% for front loading washing machines.

2.2.2 Load Capacity

Another important aspect of a washing machine is its load capacity. The larger the capacity, the fewer loads will be needed and the more energy and water could be saved. However the capacity should match the size of the houshold. As a rule of thumb, averagely single people wash less than 5kg per load, a couple without children between 5 and 5.5kg, a family with two children around 6.1 to 7kg and a family with 3-4 children 7.1kg and more.

The following figure shows what the different capacitys mean in terms of clothing. Water and energy use per kilogram of washing are often lower for big washing machines – but only when they are full loaded.

Washing machines: What size drum do you need?

Size	 6kg	 7.5kg	 10kg
Capacity	6 small towels 2 pillowcases 6 T-shirts 2 sheets 2 pairs of jeans 14 socks	6 small towels 2 pillowcases 10 T-shirts 2 sheets 4 pairs of jeans 14 socks	8 small towels 5 pairs of jeans 30 socks 4 pillow cases 3 sheets 15 T-shirts
Verdict	A 6kg load is usually large enough for most households	7.5kg provides an opportunity to squeeze in an extra pair of jeans or two	10kg is over double what a Which? member would do in one go[a]

Figure 4 Laundry sizes[4]

The trend to an increased load capacity is not desired by the consumer but driven through the manufacturers. Increased load capacity will lead to a better energy class rating according to the energy label. It is importand to know that the efficiency of the appliance is strongly related to the load. Therefore it is always less efficient to make two half loads than one full load. This should be underlined in the selection and recommendation pages of the national websites.

[4] Source: Source: http://www.which.co.uk/home-and-garden/laundry-and-cleaning/reviews/washing-machines/page/features-explained/

2.2.3 Features

Further classification can be made through different features. There are a lot of different features available but not all of them make sense concerning energy efficiency. Here are the washing machine features to consider:

Load Auto-Sensor: There are washing machines available that use sensors to determine the size of a load of dirty clothes, and then add the appropriate amount of water to the washing machine. This allows the user to save on the energy used for the water pump. Due to the trend towards larger washing machines (6 to10 kg) as well as the related problem of filling washing machines only partially, it is important that the washing machine has a load sensor. An effective load sensor positively influences the energy efficiency and in particular is meaningful for larger-sized washing machines (> 6kg), which are rarely fully loaded. The reduction with load sensors might be about 20%.

Automatic temperature control: It adjusts the water to the correct temperature for the cycle you are using. Most machines mix hot and cold water in preset proportions. An automatic temperature control adjusts for especially cold incoming water.

Automatic dispensers: Automatic dispensers for bleach, detergent, and fabric softener release powder or liquid at the appropriate time in the cycle; bleach dispensers also prevent spattering.

Spin speeds: Faster spin speeds will result in lesser moisture and shorter drying times. Standard models usually spin clothes around 630 revolutions per minute (rpm), whereas advanced models will spin up to 2000rpm.

Fuzzy Control: This category has load sensors, which indicates the water and detergent amount that is required and determines the wash cycle that is based on the load of wash. Also, it allows the individual to save more detergent, water, and electricity, at the same time the washing machine estimates the best time of wash automatically.

Neuro Fuzzy Control: It features sensors that automatically detects the fabric type and determine the detergent and water needed and the wash time accordingly.

Allwater washing machines: Washing machines which can be operated with a hot water supply, rain water or ground water. To connect a washing machine to the hot water supply makes sense if the installation of the water pipes is effective and the hot water is heated over 50% from renewable energy (solar collectors, heat pumps, wood) or district heating (from renewable energy or waste heat).

Energy saving function: At lower temperature and extended washing time the same washing results are achieved as with high temperature.

Automatic dosage of detergent: The optimum detergent dosage depends mainly on the used detergent formulation (liquid, pearls, tabs, compact powder or traditional powder) and chemical composition, the water hardness, the user selected washing temperature, the amount of laundry and the amount of soil on it. Consumers tend to overdose the detergent thinking to achieve a better washing performance.

Availability of 20°C program: The lion's share of washing machine electricity consumption is for heating water from the pipe temperature up to 30°C, 40°C, 60°C or even 90°C. Washing at lower water temperatures (max. 20°C) requires up to 70% less electric energy compared to 60°C. The availability of a 20°C program is a requirement of the Ecodesign implementing measure. A reduction of temperature clearly leads to a higher energy efficiency although there is no standard to measure the washing efficiency in the 20°C programs.

Needless to say that according to the manufacturers the washing performance at max. 20°C is at the utmost satisfying for slightly dirty clothes, takes very long and partly needs more chemicals. Therefore it would be misleading for consumers to make them believe that the washing performance in the 20°C programs is equal to the one of the programs with higher temperature.

Paradoxical environmentally friendly detergents designed for low water temperatures (cold wash max. 20°C) became a standard for producers within a very short time and are recognised as an innovation by the whole laundry industry sector.

It can be concluded therefore that cold wash should be recommended at least slightly dirty clothes.

Hot Water Supply: Hot water supply ("hot fill") for washing machines can be both economically and ecologically reasonable provided that the hot water is heated efficiently (e.g. by renewable energy sources, heatpump-heating or district heating (e.g. from renewable energy sources or waste heat)) and that it is possible to appropriately install a warm water pipe. If the "hot fill" hot water is heated to 100% by an electric water heater, this (of course) does not bring any energetic benefits compared to direct warming in the machine. Thetechnology is available on the European market, however, its practical use strongly differs within the European countries.

2.3 Current Developements

Main technical characteristics of washing machines on the market in 2010 dealing with energy/water consumption and noise are:

- Quantity control: reduction of energy demand and water demand at half load by 25 % (30 °C 7 40 °C / 60 °C)

- Noise operation mode for washing: ≤ 52 dB;
- Noise operation mode spinning: ≤ 75 dB
- Rinsing phase: Rinsing performance of washing machines often is dissatisfying. Unfortunately at the moment there is no standard available that would allow the measurement of the rinsing performance. In order to give reasonable advice to consumers in fact both parameters should be achieved: low water demand and good rinsing performance.
- Water recovery and waste water heat recovery: Washing machines with a water recycling system reuse wash water from the previous rinse cycles for the next batch, decreasing the amount of new hot water required. Therefore, water from all cycle stages like prewash, main wash cycle etc. is collected for re-use in the next cycle.
- Polymer pellets: This washing process is expected to come to market for 2010/2011 in professional appliances. The pellet system is not compatible with conventional washing machine technology: new designs or modifications to existing designs are needed before the polymer bead system can be introduced.
- Ozone: This technology is available as a bolt-on in professional laundry machines. Ozone works as bleach at low temperatures and furthermore shortens wash time cycles so that potential energy savings are possible. Heating is still required.

2.4 Legislations and Labels

2.4.1 European Label

In 2011 will be a transition phase between the old label EU Directive 92/75/EC and the new label EU No 1061/2010 which will apply from 20 December 2011. During this transition period of one year, the old and the new EU energy labels can coexist. As manufacturers are already allowed to use the new label on their product, these two labels may be available at the same time in the shops.

There are different possibilities to deal with the fact that until the end of 2011 two labels are on the market! In case of topten.eu only products are listed which refer to the new label. In Austria we followed a different approach. We also have products in our list according to the old label. We rank them automatically after the products according to the new label. Additionaly we explain the circumstances of the new old label difficulty in a footnote at the bottom of the page. The ranking of the old products is based on the energy consumption of a washing cycle at 60 °. The measurement of this energy consumption has not changed in comparison to the new label.

2.4.1.1 Future Label

In September 2010, the Regulatory Committee updated the energy labelling directive for washing machines: COMMISSION DELEGATED REGULATION (EU) No 1061/2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines. It shall apply from 20 December 2011.

The energy efficiency class of a household washing machine shall be determined on the basis of its Energy Efficiency Index (EEI). The calculation of the EEI varied significantly in comparrison to the old label. The most important changes of the calculation in the EU energy label and as well in the Ecodesign implementing measure are:

- the EU energy label will in the future refer to 40°C and 60°C programs with full and half load. As in the old label only the 60°C standard program is included at full load, this change will give a completely new picture of the market concerning the EU energy label classification of washing machines!

- the unit of the index is not kWh/kg anymore but kWh/year of a set number of washing cycles per year (220 cycles/ year).

- Consumption of the left-on mode (wahsing finished but machine not shut down) and off-mode are included in the yearly consumtpion

- the wahsing performance information will not be indicated on the label anywmore because class A will be mandatory (see specific ERP requirements below)

The calculation is explained in detail in the labeling directive.

The new complexity of the calculation method has an impact on the verification of the appliances. It is not possible anymore to do a crosscheck of the appliances or verify the information given by the manufacturers through information provided on the label.

The new energy classes are set out in following table. The current situation in EU-27 is that almost all appliances are A in terms of the energy efficiency class (we will have to see if it changes with the new label, but we don't think so):

Table 1: Energy efficiency classes

Energy efficiency classes

Energy efficiency class	Energy Efficiency Index
A+++ (most efficient)	$EEI < 46$
A++	$46 \leq EEI < 52$
A+	$52 \leq EEI < 59$
A	$59 \leq EEI < 68$
B	$68 \leq EEI < 77$
C	$77 \leq EEI < 87$
D (least efficient)	$EEI \geq 87$

The spin-drying efficiency class of a household washing machine shall be determined on the basis of the remaining moisture content (D) as set out in following table. The curent situation in EU-27 is that almost all appliance are from A to C in terms of the spin-drying efficiency class:

Table 2: Spin-drying efficiency classes

Spin-drying efficiency classes

Spin-drying efficiency class	Remaining moisture content (%)
A (most efficient)	$D < 45$
B	$45 \leq D < 54$
C	$54 \leq D < 63$
D	$63 \leq D < 72$
E	$72 \leq D < 81$
F	$81 \leq D < 90$
G (least efficient)	$D \geq 90$

2.4.1.2 Label Scheme

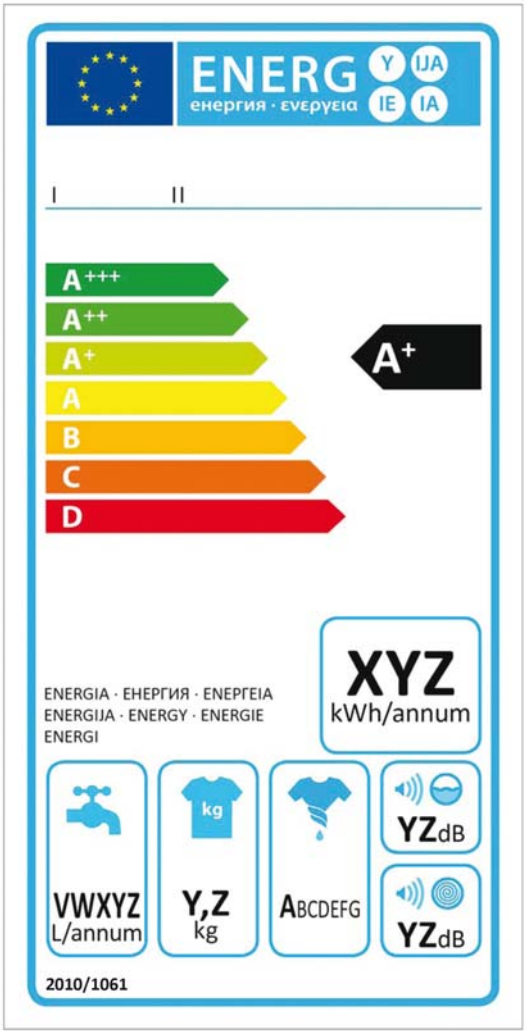

Figure 6: New Label Scheme[5]

I. supplier's name or trade mark;

II. supplier's model identifier, meaning the code, usually alphanumeric, which distinguishes a specific household washing machine model from other models with the same trade mark or supplier's name;

III. the energy efficiency class determined in accordance with point 1 of Annex VI; the head of the arrow containing the energy efficiency class of the household washing machine shall be placed at the same height as the head of the arrow of the relevant energy efficiency class;

IV. energy consumption in kWh per year, rounded up to the nearest integer in accordance with Annex VII;

V. water consumption, in litres per year, rounded up to the nearest integer in accordance with Annex VII;

[5] COMMISSION DELEGATED REGULATION (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines

VI. rated capacity, in kg, for the standard 60 °C cotton programme at full load or the standard 40 °C cotton programme at full load, whichever is the lower;

VII. the spin-drying efficiency class as set out in point 2 of Annex VI;

VIII. airborne acoustical noise emissions, during the washing and spinning phases, for the standard 60 °C cotton programme at full load, expressed in dB(A) re 1 pW, rounded to the nearest integer.

2.4.2 European Regulation on Energy Related Products (ERP Directive)

The ERP Directive serves as a basis for the Labeling Directive. Its intention is to set minimum ecodesign requirements for energy related products whereas the Labeling Directive aims to push the market to more efficient products.

The following information refers to COMMISSION REGULATION (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for household washing machines.

There are generic and specific ecodesign requierments given in the regulation. These requirements shall apply according to a timetable which is stated in the regulation.

2.4.2.1 Generic Ecodesign Requirements

- For the calculation of the energy consumption and other parameters for household washing machines, the cycles which clean normally soiled cotton laundry (hereafter standard cotton programmes) at 40 °C and 60 °C shall be used. These cycles shall be clearly identifiable on the programme selection device of the household washing machines or the household washing machines display, if any, or both, and indicated as ‘standard 60 °C cotton programme’ and ‘standard 40 °C cotton programme’.

- The booklet of instructions provided by the manufacturer shall provide:

- the standard 60 °C and 40 °C cotton programmes, referred to as ‘standard 60 °C cotton programme’ and ‘standard 40 °C cotton programme’, and shall specify that they are suitable to clean normally soiled cotton laundry and that they are the most efficient programmes in terms of combined energy and water consumptions for washing that type of cotton laundry; in addition, an indication that the actual water temperature may differ from the declared cycle temperature;

    - the power consumption of the off-mode and of the left-on mode;

- indicative information on the programme time, remaining moisture content, energy and water consumption for the main washing programmes at full or partial load, or both;

- recommendation on the type of detergents suitable for the various washing temperatures.

- Household washing machines shall offer to end-users a cycle at 20 °C. This programme shall be clearly identifiable on the programme selection device of the household washing machines or the household washing machines display, if any, or both.

2.4.2.2 Specific Ecodesign Requirements

From 1 December 2011:

- for all household washing machines, the Energy Efficiency Index (EEI) shall be less than 68 (corresponds to class A of the label)

- for household washing machines with a rated capacity higher than 3 kg, the Washing Efficiency Index (I_w) shall be greater than 1,03 (equivalent to Class A)

- for household washing machines with a rated capacity equal to or lower than 3 kg, the Washing Efficiency Index (I_w) shall be greater than 1,00 (equivalent to Class A)

- for all household washing machines, the Water Consumption (W_t) shall be:

$W_t \leq 5 \times c + 35$

where c is the household washing machine's rated capacity for the standard 60 °C cotton programme at full load or for the standard 40 °C cotton programme at full load, whichever is the lower.

From 1 December 2013, the requirement will be tighter

- for household washing machines with a rated capacity equal to or higher than 4 kg, the Energy Efficiency Index (EEI) shall be less than 59 (corresponds to class A+ of the label)

- for all household washing machines, the water consumption shall be,

W t ≤ 5 × c ½ + 35

where c ½ is the household washing machine's rated capacity for the standard 60 °C cotton programme at partial load or for the standard 40 °C cotton programme at partial load, whichever is the lower.

2.4.3 Comments on regulation and label

For the old label (regulation EU-Regulation 95/12/EG) the energy efficiency classes were set by measuring the energy consumption per kg (kWh/kg laundry). For the new regulation the energy efficiency classes are set through a calculated energy efficiency index. This fact makes a comparison between old and new products almost impossible. A first product data from the manufacturers received in Austria based on the new regulation has shown that virtually all products achieve an energy efficiency class of A ++ to A+++. It seems that the Commission standards are very soft.

A good part of the efficiency potential seems not to be used by the new labeling scheme for washing machines. The new energy efficiency classes are too weak, it is necessary to revise the EU energy label as soon as possible to facilitate further improvements. The top classes then should be held empty for future technical developments.

It is recommended to revise the Eco-design Requirements for Washing Machines as soon as possible, in particular to strengthen the requirements on the Energy Efficiency Index. Additionally it is key that Minimum Energy Performance Standards (MEPS) shall also be set for the spin-drying efficiency (A is recommended). Drying laundry by tumble driers consumes far more energy than the washing itself and spinning is much more efficient than tumble drying.

2.4.3.1 Current Label (until december 2011)

Commission Directive 95/12/EC implements council directive 92/75/EEC with regard to the energy labelling of household washing machines. Directive 96/89/EC amends Commission Directive 95/12/EC. On December 1999 the Commission adopted the criteria valid until December 1st 2002. These criteria were then prolonged to November 30th 2005 (Decision 2003/240/EC).

The energy label contains information on

- total energy consumption per cycle
- energy performance
- washing performance - with a class from A to G
- spin drying performance - with a class from A to G

- maximum spin speed
- the total cotton capacity in kg
- water consumption per cycle in litres
- noise in the washing and spinning cycles dB(A)

The label also sets energy efficiency classes through the calculation of an energy efficiency index. The claculation method is explained in detail in the regulation. The following tabel shows the energy classes acording to the energy efficiency index. Through a voluntary agreement the definition of a A+ class was also established but is not mentioned in this table.

Table 3: Washing machine classes with the energy efficiency index

Washing Machines	
Class	**Energy Efficiency Index (kWh per kg of laundry)**
A	<0.19
B	<0.23
C	<0.27
D	<0.31
E	<0.35
F	<0.39
G	>0.39

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

Table 4: Washing performance class of an appliance

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	$0{,}88 \geq P$

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

Table 5: Drying efficiency class of an appliance

A	D < 45 %
B	45 % ≤ D < 54 %
C	54 % ≤ D < 63 %
D	63 % ≤ D < 72 %
E	72 % ≤ D < 81 %
F	81 % ≤ D < 90 %
G	90 % ≤ D

2.5 Requirements by The Blue Angel, the EU Ecolabel

Besides the Eco-design requirements outlined above, The Blue Angel and the EU Ecolabel (both environmental endorsement labels) set voluntary minimum criteria for washing machines.

The Blue Angel

Particularly energy-efficient and climate-friendly products are awarded by the well-known German Eco-label The Blue Angel[6]. The award criteria for washing machines are described in RAL-UZ 137 and can be summarized as follows:

- Energy Efficiency Index: < 52 (which corresponds to A++ and better according to the new EU energy label)
- Left-on mode: max. 3.0 Watt; Off mode: max. 0.5 Watt
- Water Consumption: max. 9 litres/kg
- Washing Efficiency Index: > 1.03 (which corresponds to A according to the Eco-design requirements)
- Spin-drying efficiency: B or better
- Further requirements are made on the availability of a 20°C-programme, noise, the availability of (most important) spare parts, materials, water safety and instruction manuals.

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

EU Ecolabel

The European Ecolabel is a voluntary scheme that today covers a wide range of services and products[7]. The Ecolabel for washing machines is currently under revision. Criteria will be set for:

- Energy Efficiency Index
- Water Consumption
- Washing Efficiency Index
- Spin-drying efficiency
- Further requirements are made on noise, flame retardants and heavy metals, prevention of excess use of detergents, appliance design, design for disassembly, user instructions, life time extension, information appearing on the Ecolabel and biocides.

2.6 Test Standards

The current test standards used for testing the performance of washing machines are shown below in the following table.

[7] For more information see http://ec.europa.eu/environment/ecolabel/

Table 6: Test Standards for Washing Machines

Test Standard name	Date in force	Description	Comments
BS EN 60456 Clothes washing machines for household use - Methods for measuring the performance	2005	The test standard contains a number of methods for measuring the various performance characteristics of washing machines. The tests that are relevant to Government Standards are: cleaning performance, energy consumption, water consumption, spin extraction performance and spin speed.	The tests form the basis of the EU Energy Label – see BNW14 EU Energy Labelling of washing machines http://www.mtprog.com/spm/download/document/id/587 The EU Ecolabel also uses this test method. EuP will require a revised version of the test standard that includes methods for half loads.
BS EN 50229 Electric clothes washer-dryers for household use – Methods for measuring performance	2001	The test standard contains a number of methods for measuring the various performance characteristics of washer driers. The tests that are relevant to Government Standards are: cleaning performance, energy consumption, water consumption, spin extraction performance and spin speed.	The tests form the basis of the EU Energy Label – see BNW14 EU Energy Labelling of washing machines http://www.mtprog.com/spm/download/document/id/587

The EN ISO 60456:2005 ‘Clothes washing machines for household use – Methods for measuring performance’ was published in 2005 and was updated and published by CENELEC in July (EN 60456:2011). Some normalisation work are has been done include describing proceedures to test half loads, 40°C loads (full and half), and also rinsing efficiency (because consumer organisations protest that in order to be well rated and not heat too much water, the machines do not rinse well).

A test method has been published for noise measurements in July 2001 – IEC 60704-2-4, edition 2 ‘Household and similar electrical appliances – Test code for the determination of airborne acoustical noise Part 2-4: Particular requirements for washing machines’. The method covers single unit electrically driven machines, the washing and spinning function of combined appliances for household and similar uses and spin driers. For the test, the same standard test load is used as in IEC 60456 (the standard as EN 60456).

3 Economic and Market Analysis

The following information is based on the "Preparatory studies for Eco-design Requirements of EuPs – Lot 14: Domestic Washing Machines and dishwashers" of 2005.

3.1 Sales and Stock data

This chapter presents some market data of washing machinges. The data given by the preperatory study are for the years 2002 and 2004 which are too old for a description of the current situation for which, in summary one can say that nearly all washing machines are A-rated

The following table Table 7 show the washing machines sales repartition by energy efficiency classes for the years 2002 and 2004.. The A+ class results from a voluntary agreement between CECED manufacturers only (non-regulatory).

Table 7: Washing machinges sales for the years 2002-2004 (units)[8]

	TOTAL WEST		TOTAL EAST		TOTAL EAST
	January 2002 – December 2002	January 2004 – December 2004	January 2002 – December 2002	January 2004 – December 2004	January 2004 – December 2004
Grand Total	11.198.889	12.166.433	1.253.348	1.579.762	1.621.560
A++	0	2	0	0	0
A+	9.699	929.225	30	24.816	19.060
A	6.749.547	8.549.715	556.986	1.243.710	1.265.422
B	2.235.786	1.441.018	365.304	184.230	200.284
C	1.412'140	909.048	214.610	55.020	54.044
D	150.126	88.656	16.280	6.327	11.326
E	25.926	15.649	2.347	296	361
F	52.447	56.923	79	13	0
G	5.744	1.438	8	0	0
Unknown	557.472	174.759	97.704	65.350	71.065

In 2007 when the preperatory study was written, in EU 25 nearly all households own at least one washing machine, more precisely 91 %. 70% of them own a washing machine of class A. Table 8 illustrates the stock, total stock energy consumption and unitary stock energy consumption of washing machines, in a 5 years periode, beginning with 1995.

[8] Source: Preparatory Studies for Eco-design Requirements of EuPs – Lot 14 Domestic Washing Machines and Dishwashers, p. 125

Table 8: Washing machines EU 25: Stock, total stock energy consumption and unitary stock energy consumption for the years 1995, 2000, 2005[9]

Year	Washing machines Stock	Total stock Energy Consumption	Unitary stock Energy Consumption
	thousand	*GWh/year*	*kWh/year*
1995	140.886	66.563	472
2000	156.629	58.611	374
2005	167.333	51.272	306

More up to date data is given through the DEFRA study "Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe" in June 2009. The graphs below show the 2008 (10 months, from January to October) sales share and the number of models available by energy class. For the comparisons between countries, the numbers given are those of 2007.

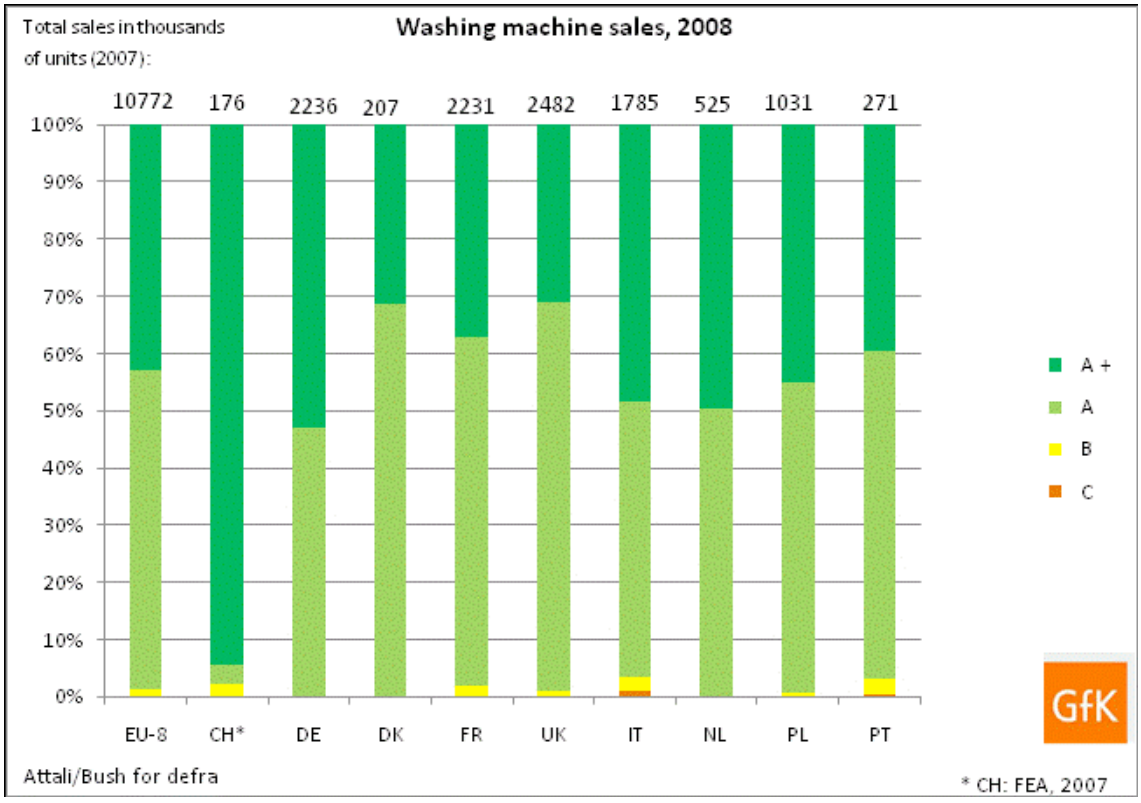

Figure 5 Washing machine sales,2008[10]

[9] Source: Preparatory Studies for Eco-design Requirements of EuPs – Lot 14 Domestic Washing Machines and Dishwashers, p. 146

[10] Source: DEFRA study "Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe", in June 2009, page 16.

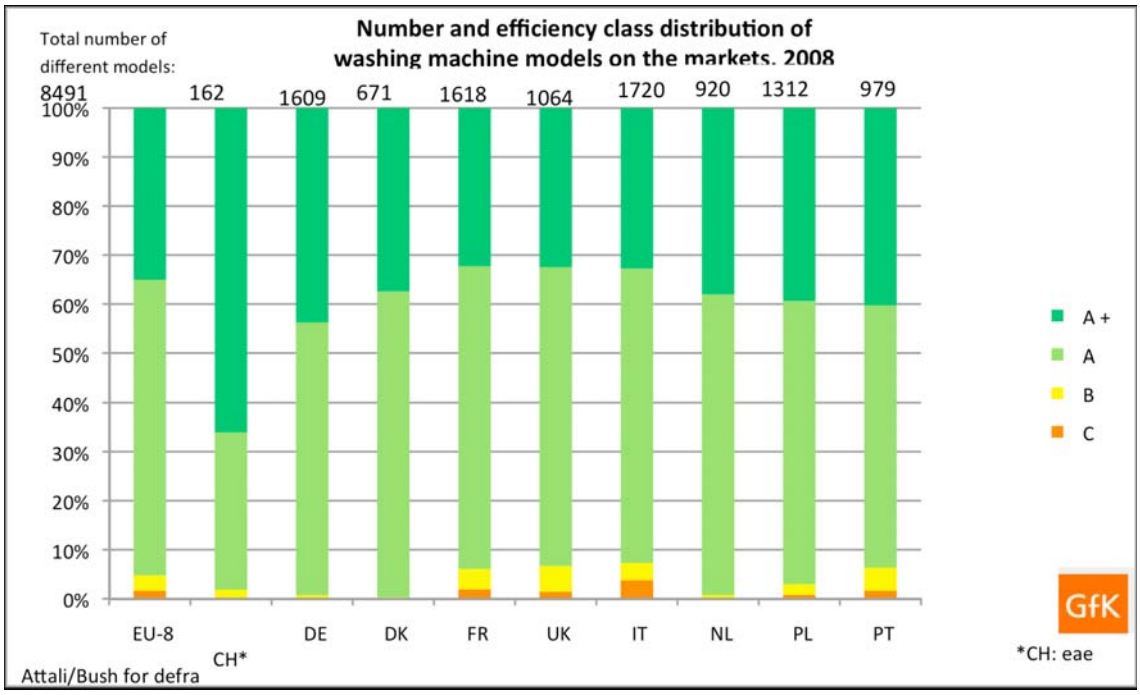

Figure 6 Efficiency class distribution, 2008[8]

Although the nine countries studied are governed by the same basic legislation on energy labelling and minimum energy performance standards, and are supplied by the same manufacturers, there are marked national differences in the market share of efficient models. This is caused mainly by brand policy (identical models with different names or vice versa), or by country (same models may have different reference names). Therefore information on the range or variety of products must be viewed with caution.

The spinning efficiency of washing machines has an impact on the energy consumption used for drying indoors.

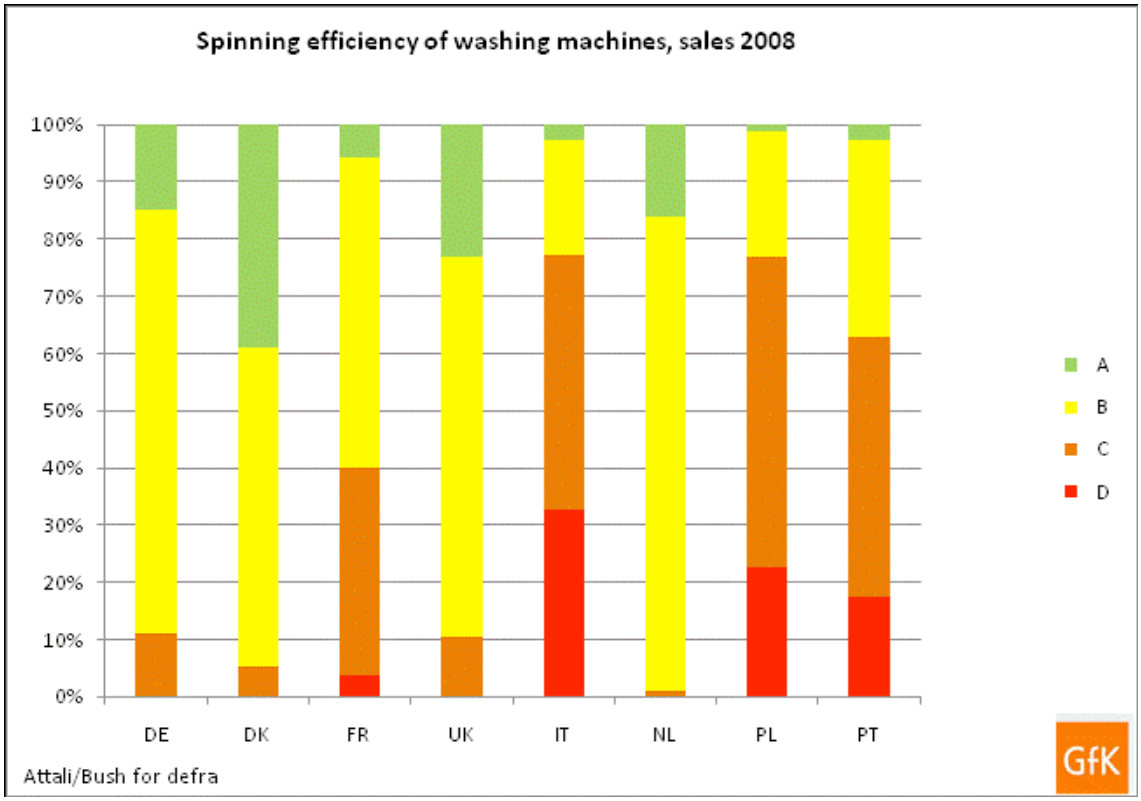

Figure 7 Spinning efficiency of washing machines, sales 2008[11]

[11] Source: DEFRA study "Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe", in June 2009, page 17.

3.2 Manufacturers and Distributors

3.2.1 List of Manufacturers

Brand	Website
AEG	www.aegworldwide.com
Beko	www.beko.co.uk
Bosch	www.bosch.com
GE	www.ge.com
Gorenje	www.gorenje.com
Haier	www.haiereurope.com
Hoover	www.hoover.co.uk
Hotpoint	www.hotpoint-ariston.com
Indesit	www.indesit.com/indesit
Kenmore	www.kenmore.co.uk
LG	www.lg.com
Miele	www.miele.com
Samsung	www.samsung.com
Siemens	www.siemens-home.com
Whirlpool	www.whirlpool.eu
Zanussi	www.zanussi.com

4 Selection Criteria

This chapter does not define specific target values to be met by Topten products in all Euro-Topten partner countries. 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. Currently www.topten.eu already list the most efficient washing machines starting from a 7kg capacity. This paper presents a suggestion for an update of the selection criteria.

The intention is rather 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.

4.1 Product classes

We suggest the following product classes

- Household washing machines < 7 kg
- Household washing machines = 7 kg
- Household washing machines > 7kg

4.2 Topten Selection Criteria

The criteria for selection of the products shall be:

1. Energy efficiency class
2. Annual energy consumption kWh / y
3. Annual water consumption in litres / y
4. Spin drying efficiency class

4.3 Recommendation for value setting

We suggest the following minimum values for a capacity of < 7 kg:

- Energy Efficiency Class: A+++
- Annual energy consumption < 140 kWh / y
- Annual water consumption < 10000 litres / y
- Spin drying efficiency class: A

We suggest the following minimum values for a capacity of = 7 kg:

- Energy Efficiency Class: A+++
- Annual energy consumption < 165 kWh / y
- Annual water consumption < 11000 litres / y
- Spin drying efficiency class: A

We suggest the following minimum values for a capacity of > 7 kg:

- Energy Efficiency Class: A+++
- Annual energy consumption < 185 kWh / y
- Annual water consumption < 12000 litres / y
- Spin drying efficiency class: A

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. These information should not be used for the selection of the products and should be based on the new EU label which will be enter into force in December 2011.

Energy information:

- the energy efficiency class
- annual energy consumption in kWh per year
- the energy consumption for the standard 60 °C cotton programme at full load
- the energy consumption for the standard 60 °C cotton programme at half load (information only available on the product fiche)
- the energy consumption for the standard 40 °C cotton programme at half load (information only available on the product fiche)
- the spin-drying efficiency class
- the maximum spin speed attained for the standard 60 °C cotton programme at full load or the standard 40 °C cotton programme at partial load, whichever is the lower, and the remaining moisture content attained for the standard 60 °C cotton programme at full load or the standard 40 °C cotton programme at partial load, whichever is the greater
- the annual water consumption

- costs after 15 years (energy & water)
- availability of a load sensor
- availability of cold wash programme
- availability of rain water supply
- availability of automatic dosage system

5 Additional Considerations[12]

Future key parameters of washing machines will be energy and water consumption both for full and partial loads, spin-drying efficiency, availability of a 20°C-cycle and supply for hot fill.

The most significant environmental aspects of washing machines are energy and water consumption in the use phase. One measure to reduce the energy consumption is an effective load sensor. Further measures considerably reducing the energy consumption are the availability of a cold wash programme and hot water supply. Best spinning performance (with few remaining moisture content) is of high importance for the drier's energy consumption.

An effective load sensor reduces not only the energy consumption but also the water consumption. However, rinsing should be sufficient16. The common practice of users to over-dose detergents can be prevented by automatic dosage systems. Correct dosage of detergents raises the rinsing quality and reduces the amount of chemicals released to the environment.

The use of rainwater in washing machines can be an expedient and cost effective option. Depending on local water and sewage water tariffs and/or the water consumption of the washing machines, the water costs for washing machines may be as much as 50 to100% of the respective electricity costs.

[12] Washing Machines: Key Criteria for Best Available Technology BAT, Barbara Josephy, Eric Bush, Jürg Nipkow, Sophie Attali, Topten International Services (Paris, France), http://www.topten.eu/uploads/File/039_Barbara_Josephy_final_Washing.pdf

6 Bibliography

European Commission. Commission Regulation (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for household washing machines. In: Official Journal of the European Union, 11. 11. 2010.

European Commission. Commission Delegated Regulation (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines. In: Official Journal of the European Union, 30. 11. 2010.

"Preparatory studies for Eco-design Requirements of EuPs – (Tender TREN/D1/40-2005) LOT 14: Domestic Washing Machines and Dishwashers, 2007".

D 6.2 frm EurotoptenPlus Project, "Innovation goals for washing machines", Öko-Institut, 2010.

Preparatory Studies for Eco-design Requirements of Energy-using Products Lot 24: "Professional Washing Machines, Dryers and Dishwashers", Tender No. TREN/D3/91-2007, Draft Report, Part: Washing Machines and Dryers, Task 6: Technical Analysis Best Available Technologies, Öko-Institut, 2010.

ISIS, 2007, Preparatory Studies for Eco-design Requirements of EuPs (Tender TREN/D1/40- 2005) – LOT 14: Domestic Washing Machines and Dishwashers, www.ecowet-domestic.org

European Commission. Corrigendum to Commission Regulation (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for household washing machines (Official Journal of the European Union L 293 of 11 November 2010). In: Official Journal of the European Union, 16. 11. 2010.

www.topten.eu – Best Products of Europe

www.topten.info – International Platform for Best Products

Josephy B., Bush E., Nipkow J., Attali S., Werle R., Granda Ch. Changing washing machines and driers: Let's have a look at the laundry room. Paper for the 2011 Summer Study of the European Council for an Energy Efficient Economy. 6-11 June 2011.

Attali S., Bush E., Michel A. Factors influencing the penetration of energy efficient electrical appliances into national markets in Europe. Report for Defra / the Market Transformation Programme by SoWatt and Bush Energie GmbH, Paris, June 2009. 12

Bush E., Jürg Nipkow J. Energie- und Kostenoptimierungen bei Waschmaschinen und Geschirrspülern: Kriterien für Warmwasseranschluss. Im Auftrag des Amts für Hochbauten der Stadt Zürich, 2005.

Bush E., Nipkow J., Attali S. Josephy B. Washing Machines: Key Criteria for Best Available Technology BAT, Topten International Services (Paris, France), Report for EEDAL & eceee, 2011, http://www.topten.eu/uploads/File/039_Barbara_Josephy_final_Washing.pdf