

# Topten ACT Criteria Paper

## Washing machines

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Barbara Josephy

Bush Energie GmbH

barbara.josephy@topten.eu



**Topten ACT** aims at transforming the European market of energy-using products towards higher energy efficiency.

Topten ACT identifies the top energy-efficient products in 16 European countries, and makes this information available to consumers and large buyers on tailored national websites. The most energy efficient models in different product categories (such as household appliances, lighting, office equipment, consumer electronics, cars) are presented with comprehensive product information based on official labels and standardized declarations. Topten works with manufacturers and thus increases both market offer and consumer demand of high energy efficiency products. Topten is strictly neutral and independent from manufacturers and retailers, its selection criteria are always published online.

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More information and access to all national websites on the European site: [www.topten.eu](http://www.topten.eu)

WP2 European Product Analysis, Task 2.1 Determining energy efficiency criteria, D 2.1 Periodic Criteria Papers (first set)

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## 1. Topten.eu: Washing machines - current selection criteria and products selected

### Scope

Topten.eu presents the most energy efficient household washing machines available on the European market of the three following categories:

- Washing machines with a capacity < 8 kg
- Washing machines with a capacity of 8 kg
- Washing machines with a capacity > 8 kg

### Technical criteria

In order to qualify for Topten.eu, washing machines must meet the following criteria:

- Energy efficiency class: A+++ according to the EU energy label [1]
- Spin-drying efficiency class: A according to the EU energy label [1]
- Available in at least one European country.
- In addition, suppliers have to provide Topten with the following data:
  - Energy Efficiency Index (EEI)
  - Energy consumption per cycle in kWh for the 60°C programme at full load, the 60°C programme at half load and the 40°C programme at half load
  - Programme time for the 60°C programme at full load, the 60°C programme at half load and the 40°C programme at half load
  - Power in left-on-mode and off-mode
  - Maximum spin speed
  - Availability of a water protection system (Aqua Stop, waterproof, water control system etc.)
- Suppliers who are not able to provide the values cannot claim to have their appliances presented on Topten.eu.

Numbers of washing machine models currently on Topten.eu (September 2015). Similar models have not been counted if from the same brand.

	<b>Washing machines</b>
<b>&lt; 8 kg</b>	9
<b>8 kg</b>	17
<b>&gt; 8 kg</b>	9
<b>Total</b>	35

On the Topten.eu product lists there are 35 washing machine models of 13 different brands available: AEG (2), Bauknecht (6), Blomberg (2), Bosch (1), Candy (1), Electrolux (4), Gorenje (1), Hoover (4), Merker (1), Miele (6), Schulthess (1), Siemens (1) and V-Zug (2).

## 2. Expected selection criteria in 2016

In 2016 the Topten.eu selection criteria for washing machines will presumably be the same as in 2015 (see box above: A+++/A).

The EU energy label and Ecodesign regulations currently are under revision. This will lead to several modifications. The 2<sup>nd</sup> stakeholder meeting takes place in November 2015. Topten is involved in the process and will set appropriate criteria for washing machines as soon as more details are known.

### 3. Technical background

The most significant environmental aspects of washing machines are energy and water consumption in the use phase [2].

Key to reduce the energy (and water) consumption of the washing (and drying) process are:

- An effective load sensor to reduce the energy and water consumption when washing at lower loads than at full load.
- Programme duration: The cleaning process is based on the four factors known as the Sinner circle: temperature, mechanics, chemistry and time. These factors can, to a certain degree, be exchanged by each other to achieve the same washing result. Prolonging the time of a cycle's duration helps to save energy.
- Best spinning performance with only few remaining moisture content to reduce the drier's subsequently energy consumption.
- The availability of a cold wash programme, (which nowadays is mandatory according to [2]), and especially its usage in our everyday life. The energy savings of washing at 20°C is about 60% compared to 40°C.
- Hot water supply («hot fill»): In many countries more and more households use solar energy. Several machines offering this option are available on the European market.
- Automatic dosage systems prevent users from over-dosing detergents. Correct dosage of detergents raises the rinsing quality and reduces the amount of chemicals released to the environment.

### 4. Policy measures, standards and labels

#### **Preliminary note: Energy label and Ecodesign regulations currently are under revision**

The EU Energy label regulation [1] and Ecodesign regulation for washing machines [2] are currently being revised. The Joint Research Center (JRC) will publish a preparatory study around end of 2015.

In the framework of these preparatory studies, Topten regularly provides input to the Commission. For details see the Topten-recommendations:

[http://www.topten.eu/english/recommendations/washing-machines-3.html&fromid=.](http://www.topten.eu/english/recommendations/washing-machines-3.html&fromid=)

Some points of discussion are:

- Measurement and testing: shall the most efficient programme (standard programme, as now) be tested or the most used programmes?
- Energy efficiency index (EEI): calculation according to which formula? The current one makes it easier for high capacity-machines to reach a good efficiency class.
- Programme duration: shall a cap (e.g. 3 h) be required for the tested programmes and/or its declaration on the Energy label?
- At which temperatures shall cycles be measured? 60°/40°C (as now) or 40°/30°C?
- At which load shall cycles be tested and in which proportions? Full load/half load (as now) or full load/small load or full load/average load? 3:2:2 (as now) or what else?
- Declaration of the energy and water consumption: annually (as now) or per cycle?
- Spin-drying efficiency: Introduction of requirements and if yes, what minimum requirements (class A or B)?
- Rinsing performance: Introduction of requirements?
- Washing performance of the (mandatory) 20°C cycle: Introduction of requirements?
- Washing performance of the tested programmes: mixed value (as now) or for each tested programme separate? Re-introduction of the indication on the label or still minimum requirements (MEPS)?
- Hot fill: yes or no-declaration on the Energy label?
- Measurement of capacity: introduction of a standard?

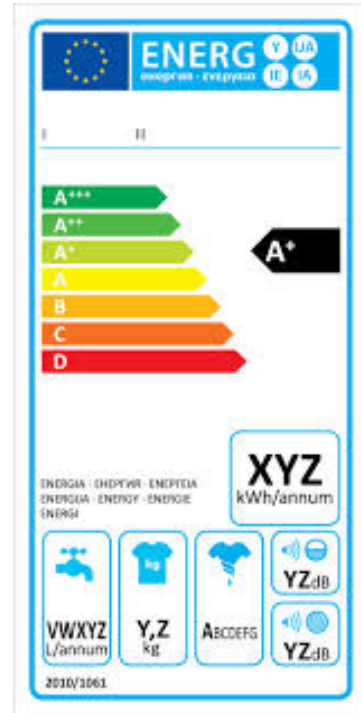
- Washer-dryers: how and under which product category shall they be regulated?

### Current EU Energy Label for washing machines

The current Energy label (Regulation No 1061/2010 [1]) entered into force in December 2010 and became – after the transition period of one year – mandatory in December 2011.

The label introduced the Energy Efficiency classes A+, A++ and A+++ . Note: The label classes now range from class A+++ to class D. The four classes A, B, C and D are still shown on the Energy Label, although they are prohibited on the market since December 2011 and December 2013 respectively (see table 2 and Ecodesign requirements [2]).

The calculation of the Energy Efficiency Index (EEI) is based on annual energy consumption for 220 so called «standard cycles», including low power modes (left-on and off-mode). A «standard cycle» consists of testings at 60°C full load (3x), 60°C half load (2x), 40°C half load (2x). Testing at half load was introduced in order to better reflect the real use of washing machines in homes.



Furthermore the label informs about annual energy consumption (kWh/a), annual water consumption (litres/a), capacity (kg), spin-drying efficiency (class A to G) and sound power level during washing and during spinning.

Not anymore indicated on the current Energy label is the washing performance (which was declared on the former label). It now is regulated by the Ecodesign regulation [2] instead: the washing efficiency index has to be class A (for a «standard cycles»).

In the Energy label fiche, additionally the energy consumption of the «standard cycles», programme time of the «standard cycles», power in off and left-on modes, and duration of the left-on mode are declared.

Table 2: Energy efficiency classification scale of the current Energy label for washing machines

Energy Efficiency Class	Energy Efficiency Index (EEI)
A+++	EEI < 46
A++	46 ≤ EEI < 52
A+	52 ≤ EEI < 59
A	Phased out since Dec 2013
B	Phased out since Dec 2011
C	
D	

## Current EU Ecodesign requirements for washing machines

Summary (for details see Commission Delegated Regulation (EU) No 1061/2010 [2])

- Energy Efficiency Index (EEI): washing machines with A+, A++ and A+++ are allowed on the EU market. Washing machines with A to D are banned from the EU market.
- Washing Efficiency Index: has to be > 1,03, which corresponds to class A according to the former EU energy label.
- Water consumption:  $W_t \leq 5 \times c/2 + 35$ , which – translated into litres – means:

Capacity (c)	Annual water consumption ( $W_t \times 220$ )	Water consumption per cycle (average)
6 kg	$\leq 11'000$ litres	$\leq 50.0$ litres
7 kg	$\leq 11'550$ litres	$\leq 52.5$ litres
8 kg	$\leq 12'100$ litres	$\leq 55.0$ litres
9 kg	$\leq 12'650$ litres	$\leq 57.5$ litres
10 kg	$\leq 13'200$ litres	$\leq 60.0$ litres
11 kg	$\leq 13'750$ litres	$\leq 62.5$ litres

- A 20°C-programme (cold wash-programme) for cotton has to be offered by each washing machine entering the EU market.
- The test programmes «standard 40°C cotton» and «standard 60°C cotton» shall be clearly identifiable on the washing machine.
- Various requirements on the booklet of instructions provided by the manufacturer.

The standby regulation No 1275/2008 [3] horizontally regulates the washing machines' maximum allowed energy consumption in standby.

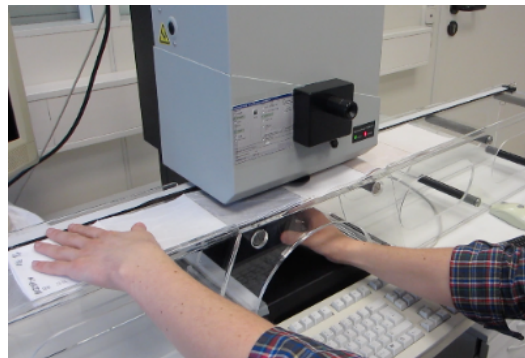
The electricity saving potential until 2025 is estimated to be around 2.7 TWh [4].

### Measurement standards

Washing machines are tested according to the European standard EN 60456: Clothes washing machines for household use. Methods for measuring the performance. All details are described in [5].

The whole testing is standardised such as:

- the type of laundry, existing of cotton towels, pillowcases and sheets
- the number of laundry pieces for full load and half load
- the test strips, which are soiled with five standardized stains
  - sebum / pigment
  - mineral oil / black carbon
  - blood
  - chocolate / milk
  - red wine
- the detergent
- the water
- etc.



The Washing Efficiency Index is defined by measuring the reflectance of the five standard stains by a spectral photometer (see photo) and referencing it with the reflectance of a reference machine at 60°C.

## 5. Market analysis

The following sections are a summary of the Topten-paper «Monitoring the washing machines market in Europe», which was presented at EEDAL 2015 [6], and of the market monitoring report by Topten [10].

### Sales: about 15 millions per year

From 2004 to 2007, sales of washing machines increased in EU-21 from 13.5 million to 15.1 million units. Since then, sales fluctuated around 15 million units per year. In 2014, 15.2 million washing machines were sold in EU-21.

### Energy efficiency: around 50% of the sold washing machines are in class A+++

Between 2004 and 2010 – at the time before the current Energy label for washing machines officially introduced the «plus»-classes A+, A++ and A+++ in December 2010 – manufacturers had no official possibility to market their energy efficient innovations. They helped themselves with expressions such as «A-10%» or «A-20%». Based on a voluntary agreement between the Commission and CECED, some manufacturers officially labelled these products also as «A+».

In 2011 – the transition year of the new Energy label from entering into force to getting mandatory – already 14% of the sold washing machines in the EU were labelled with the then new introduced top class A+++.

In 2014, three years later, already 43% of the sold washing machines across the EU were labelled in the top class A+++! (see Fig. 1)

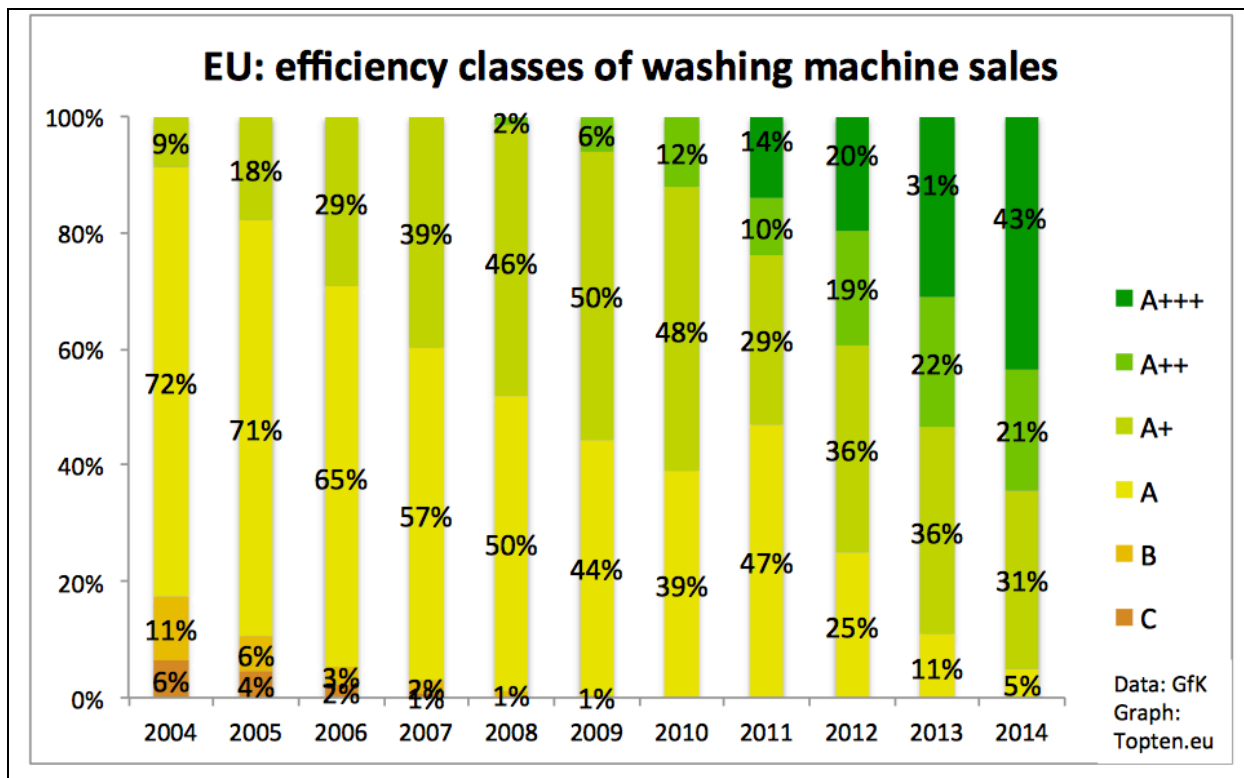


Fig. 1: The most sold efficiency class has improved from A to A+++ in ten years

However, popularity of the efficiency classes varies considerably on the national markets. In France for example only 31% of the sold washing machines in 2014 were class A+++. In Portugal the sales share of A+++-washing machines was 47% (2014), in Switzerland is already was (2013).

**BAT – Best Energy Efficiency Index (EEI): 22.8**

In September 2015, the best Energy Efficiency Index (EEI) reached by a washing machine was 22.8. Due to an integrated heat pump this value exceeds the A+++-threshold (< 46) by more than 50% (see [www.topten.eu](http://www.topten.eu), model: V-Zug Adora SLQ-WP, 8 kg).

**Energy consumption: in average 185 kWh per year**

In 2014, the annual energy consumption of the sold washing machines in the EU-21 was in average 185 kWh per year. However, Figure 2 shows up, that the differences regarding the energy consumption are not so large between the energy efficiency classes.

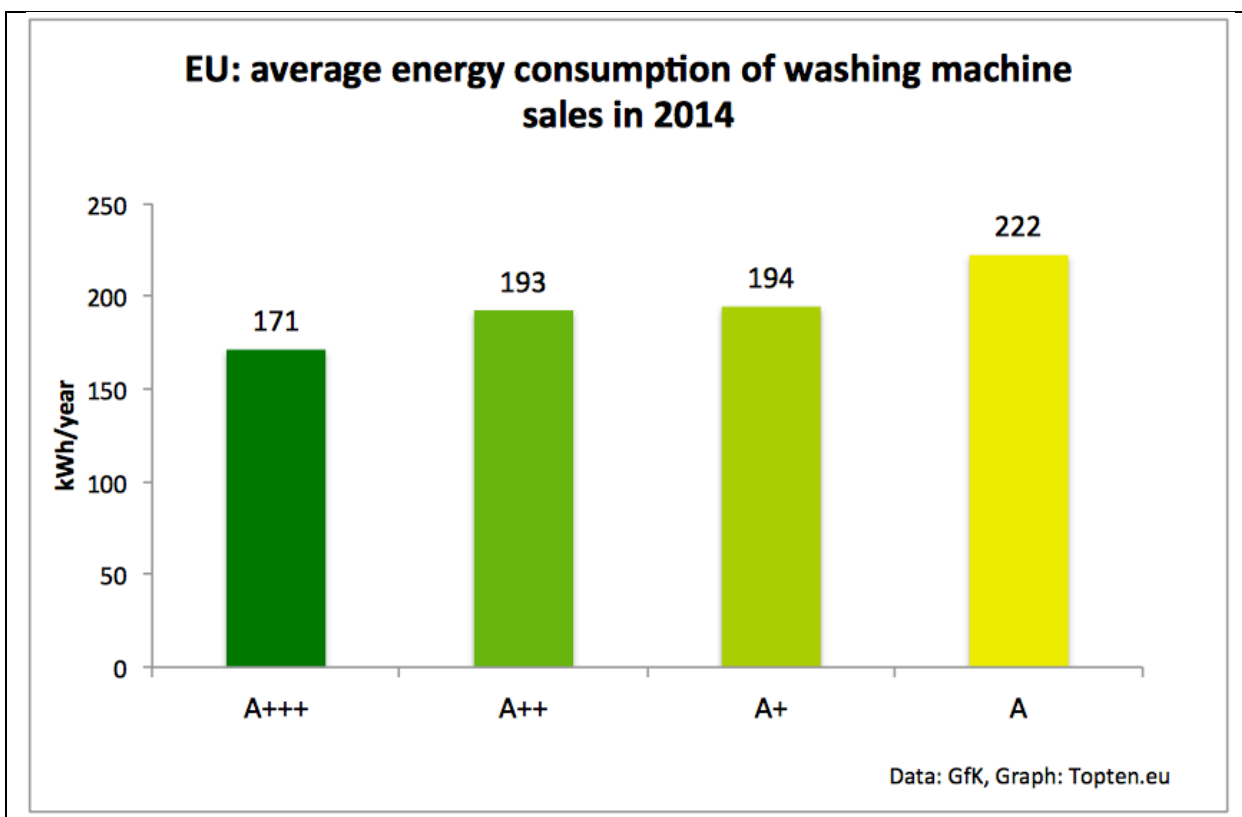


Fig. 2: Small differences of the energy consumption between the energy efficiency classes

**Capacity: strong trend towards larger capacities**

Ten years ago, nearly all washing machines were designed for 6 kg of laundry and less. Since then, a strong trend towards larger capacities started. The biggest ones available on the European market have a capacity of 13 kg.

In 2014, more than 50% of all sold washing machines were designed for 7 kg laundry and more (see Fig. 3). It however seems that the trend towards large washing machines is rather coming from the changed market offer and not from the side of the consumers. Washing habits of the consumers with all probability have not changed so quickly over these few years towards washing larger loads, especially against the background that the average household size is declining and average wash-loads are to be about 3 kg.

The Energy label might be at least partly responsible for the trend towards larger machines, since it is easier for large machines to reach a good efficiency class due to the current

calculation formula. Even if oversized washing machines are labelled A+++, they do not contribute to energy savings at all. In case that most of the wash cycles run with low loads (e.g. 2-3 kg in a 8 kg-machine) energy and water are wasted because lower loads usually do not cut energy and water consumption linearly (e.g. half load uses only about 20% less energy and water instead of 50% less).

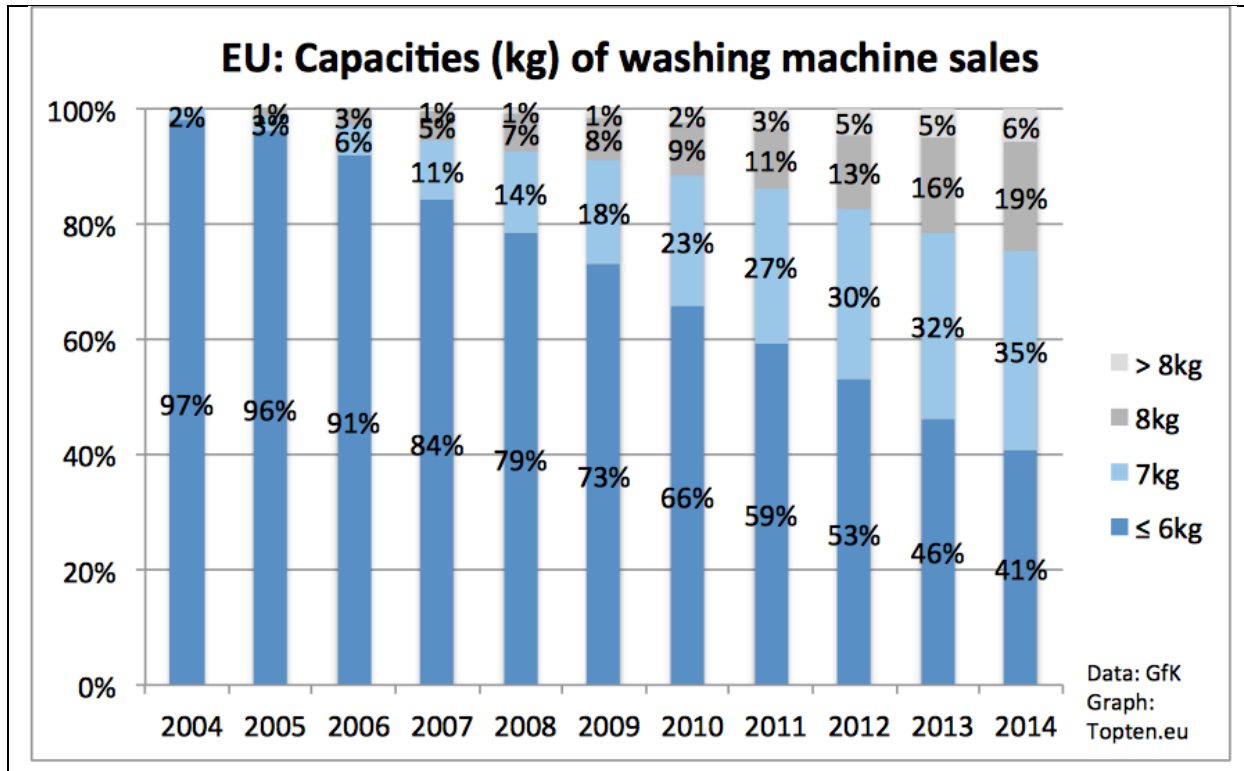


Fig. 3: There can be observed a strong trend towards larger capacities

### Prices: decline since 2004

Across the EU-21, the average real price for a washing machine has declined by 8% from 459 Euros in 2004 to 368 Euros in 2014 – despite higher efficiency and larger capacities. However, in the prices level differ on the national markets.

In 2014, A+++-washing machines cost on average 69% more than A+-washing machines. Since more efficient washing machines are also larger, this price premium is linked to energy efficiency as well as to size.

## 6. FAQ

### Washing at 20°C (Cold wash)

1) For detailed information on the topic «cold wash» see the following documents

- Washing at 20°C is Cool (Flyer for consumers) [7]
- Cold wash – Tests on the washing performance [8]
- Cold wash – Do prejudices impede high energy saving potentials? (paper at EEDAL 2013) [9]

2) Why cold wash?

Heating-up cold tap water to 30°C, 40°C, 60°C or even 90°C uses the lion's share of washing machines' electricity consumption.



«Cold wash» – washing at 15/20°C – saves about 60% electricity compared to a cycle at 40°C. Therefore it holds a tremendous energy saving potential. In the EU-27 «cold wash» can save up to 11 TWh per year, which equals 2'200 million Euros or the annual production of the nuclear power plant Emsland (assumptions and calculation details see [8]). This exceeds by far the estimated saving potential resulting of the Ecodesign measures (2.7 TWh, see above).

The EU Ecodesign Regulation requires washing machines to offer a washing cycle at 20°C and a variety of detergent designed for these temperatures are available in Europe. Despite all of this, prejudices and habits prevent most consumers from «cold wash» (details see [9]).

### 3) Good washing performance at 20°C is possible

Discussions on «cold wash» – especially on the washing performance – run often controversial and emotional arguments. To contribute to the debate with impartial and scientific facts, Topten arranged 24 test situations to measure and compare the washing performance and energy consumption at 40°C and 20°C. Factors influencing the washing result were systematically investigated such as detergent, pre-treatment of stains, washing machines and loading. The tests were carried out in collaboration with the VDE Testing and Certification Institute and with the support of the Elektrizitätswerke des Kantons Zürich and Stiftung Warentest in December 2014.

Good washing performance at 20°C is reached when using a good machine and good detergent. It is assumed that «cold wash» is absolutely appropriate for lightly and normally soiled laundry and that it is worthwhile to encourage consumers to try it out (details see [8]).

In the framework of the revision of washing machines' Ecodesign regulation it is relevant to introduce appropriate requirements regarding the washing performance at 20°C. Otherwise, if consumers do not trust that it washes well, even though it is a mandatory programme to be proposed by all machines, consumers will never use it.

### 4) How about hygiene when washing at 20°C?

Hygiene is an often noted concern and given argument against «cold wash». However, hygiene is a complex topic for itself, which should not be correlated only with temperature. One has to be aware that bacteria multiply most rapidly at warm temperatures and not as often feared at 20°C and that it is more relevant how well they get washed out. A research of the University of Bonn and Hochschule Rhein-Waal showed that energy saving washing programmes (the so called «standard programmes») remove due to their long programme time many germs from the laundry even at low temperatures. Bleach can also help. And those bacteria and fungi surviving at low temperatures even with bleach are assumed to be no danger for healthy people. However, it is recommended to frequently wash the laundry at 60°C for persons having a weak immune system, a contagious disease or an allergy on house dust mites.

### 5) How about the environment-friendliness of the detergent appropriate for cold wash?

In general all detergents – except some explicitly ecological ones, which however are niche products (e.g. "Held" by ecover in Switzerland or Germany) – do harm the environment. Think on all the optical bleachers etc.! All common detergents of all well-known detergent manufacturers nowadays are designed to wash in the temperature range of 15°C/20°C, 30°C, 60°C and sometimes even 90°C. Thus, it's one and the same detergent which is appropriate for all typical washing temperatures. To achieve good washing results at 15°C/20°C the detergent contains enzymes. These enzymes develop their enzymatic activity best at these low temperatures. High(er) temperatures destroyed them. These enzymes

usually are genetically-modified. The consumer has the choice: either to use these enzymes – which are in the detergent anyway – for the purpose they are made for (good washing results at 20°C!) or to destroy and not use them when choosing high temperatures.

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#### 5) How about getting biofilm when washing at 20°C?

Biofilm is a film of bacteria and fungi which multiplies in the humid environment of the washing machine and likes to settle especially on plastic parts, hard to reach areas and on the washing machine's drum.

However, it can be avoided with simple measures such as taking the laundry as soon as possible out of the machine after washing, leaving the door of the washing machine and of the detergent compartment open so that the residual moisture can evaporate and running a load of laundry at 60°C with heavy-duty detergent occasionally (see also [7]).

#### *Why best spinning performance (A) is important?*

There is a strong trend towards drying the laundry using a tumble drier, while hanging up laundry outdoor is more and more decreasing. Drying laundry by a tumble drier consumes far more energy than the washing process itself and spinning is much more efficient than tumble-drying!

Hence, the better the laundry is spun in the washing machine, the less electric energy is needed to dry it in the tumble drier. Therefore best spin-drying efficiency of a washing machine is a relevant parameter when assessing the overall electric energy consumption of the laundry process.

Topten recommends to opt for best energy efficiency (A+++), and best spin-drying efficiency (class A), when buying a new washing machine.

#### *Why hot fill can be reasonable?*

The higher the washing temperature, the higher are the potential electricity savings from hot water supply (up to 70% less electricity consumption by the washing machine).

In many countries more and more households use solar energy, and «hot fill» thus can contribute to energy savings.

On the European market several washing machines are available offering the option for «hot fill» (see Topten.eu).

#### *Combined washer drier or separate washing machine and separate tumble drier?*

Washer-driers combine the functions of a washing machine and a tumble drier, in one drum. The appliance therefore can combine the processes «washing» and «drying» in one non-stop cycle (no interaction by the user is needed in between).

In the non-stop cycle the load capacity is the one of «only drying», which normally is smaller than the one for «only washing». If it is washed at full load, then a part of the washed load has to be taken out after spinning, and two separate drying cycles have to be run (one after another) in order to dry the complete load (e.g.: washing separately: 9 kg; non-stop cycle washing-drying: 6 kg; drying separately: 6 kg).

The advantage of washer-driers over a separate washing machine and a separate drier is not so much comfort, but space (only one appliance instead of two appliances) and the lower purchase price. However, running costs for electricity and water can be much higher, because a washer-drier usually is *per se* less efficient than a separate washing machine and



tumble drier. The energy consumption for washing plus drying when using Topten-models accounts for max 3.8 kWh, while inefficient washer-driers use > 6 kWh for this process.

Within the washer-driers product group, there are large difference in energy as well as in water consumption between high efficient models and inefficient ones.

Typically the water consumption of washer-driers is generally quite high as they not only use water for washing but additionally also (cooling) water for drying!

Topten.eu presents the most efficient washer-driers. In order to qualify for Topten.eu, washer-driers must meet the following criteria (September 2015):

- Energy efficiency: max. 0.5 kWh per kg laundry (full wash and dry cycle / washing capacity)
- Water consumption: max. 12 litres per kg laundry (full wash and dry cycle / washing capacity)

The Topten-criteria currently only are reached by appliances which are equipped with an integrated heat pump. Thanks to this technology these BAT-models consume 40% less energy than inefficient washer-driers.

Furthermore washer-driers with an integrated heat pump use no cooling water for drying. Therefore water only is needed for washing, which saves 30% of the water consumption compared to conventional washer-driers without heat pump.

(Topten-models: 69 litres / cycle; inefficient models: around 100 litres and more.)

## 7. References and links

### Useful links

Topten.eu washing machines product lists:

- < 8 kg:  
<http://www.topten.eu/english/household/washing-machines/8kg.html>
- 8 kg:  
<http://www.topten.eu/english/household/washing-machines/8kg-2.html>
- > 8 kg:  
<http://www.topten.eu/english/household/washing-machines/8kg-3.html>

Topten.eu washing machines selection criteria:

<http://www.topten.eu/english/criteria/washing-machines-2.html&fromid=>

Topten.eu washing machines recommendations:

- <http://www.topten.eu/?page=washing-machines-3&fromid=>
- [http://www.topten.eu/uploads/File/Topten\\_recommendations\\_Washing\\_machines.pdf](http://www.topten.eu/uploads/File/Topten_recommendations_Washing_machines.pdf)

Topten.eu washer driers product list and selection criteria:

- <http://www.topten.eu/english/household/washer-driers.html>
- <http://www.topten.eu/english/criteria/washer-driers.html&fromid=>

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