

Tuesday, 15:00 – 15:30, Session 2, Rheinlandsaal

## **Einsparpotentiale durch automatische Dosierung bei Waschmaschinen** ***Saving potentials by automatic dosage in washing machines***

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Tuesday, 15:30 – 16:00, Session 2, Rheinlandsaal

## **Comparison of resources used for laundry washing worldwide** ***Vergleich der weltweit zum Wäschewaschen verbrauchten Ressourcen***

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### **Abstract**

Washing laundry is one of the most widely spread homework in the world. Today washing machines are doing this work in many private households, using water, energy, chemical substances and process time. Although energy efficiency is in the focus of many regulations which have already achieved significant improvements, the question remains, how relevant these processes are in terms of the absolute impact of resources and whether there are possibilities to improve even further by looking abroad. This survey, which is based on published data, compares the energy and water consumption for automatic laundry washing in an average private household with the total energy and water consumption of private households in many countries of the world. The results of this work show that automatic laundry washing in private households is done with quite different amounts of electricity and water in different parts of the world both in absolute figures and relative to the overall household consumption. But due to additional factors influencing the achieved washing performance and resource consumption in the different global regions, the best practise in washing laundry in a most sustainable way can't be determined yet. Learning more about different homework and its environmental influence is necessary to understand how resources are used and can be optimised in private households in order to minimize energy and water consumption as well as environmental pollution.

### **Task**

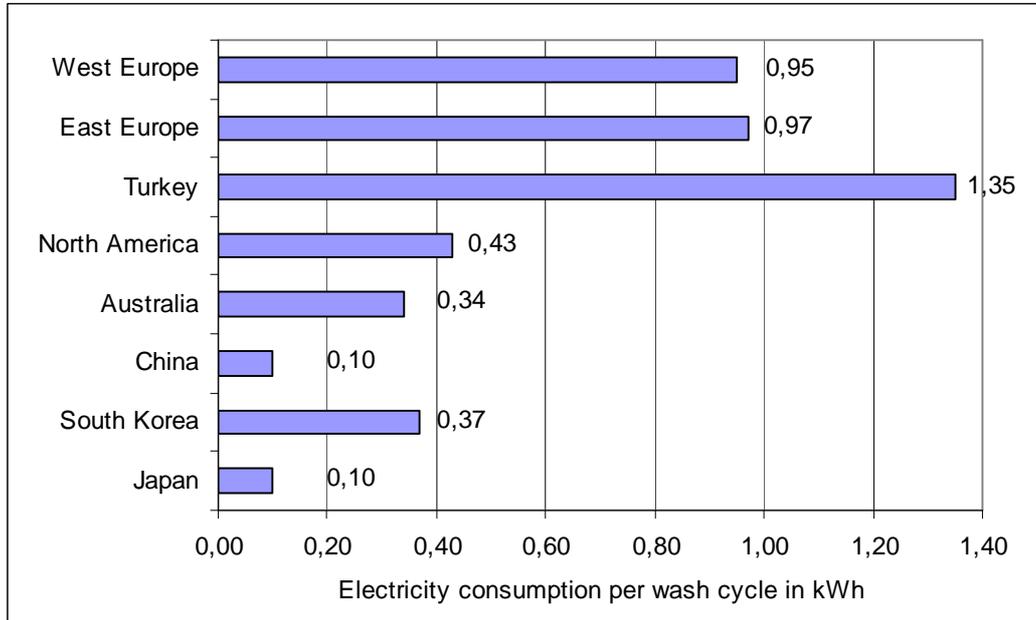
The main task of this work is the comparison of the electricity and water consumption for laundry washing by washing machine in relation to the total electricity and water consumption of households. As in some countries the market penetration of washing machines is low, in these countries about 30 % of the laundry is washed by hand. The report does not attempt to estimate the global resource consumption for laundry washing, but it might elucidate the relevance of automatic laundry washing in terms of the absolute impact on resources and show possibilities to improve automatic laundry washing even further by looking abroad.

### **Methodology**

The report is based on published data. Demographic figures about the number of households, the household size and the total electricity and water consumption of the residential sector are provided by national statistical offices of most countries, by the European Commission and also by OECD. With these figures the total electricity and water consumption per household could be calculated. The resource consumption for automatic laundry washing depends on the washing machine technology and traditional consumer habits and practices, like the number of wash cycles

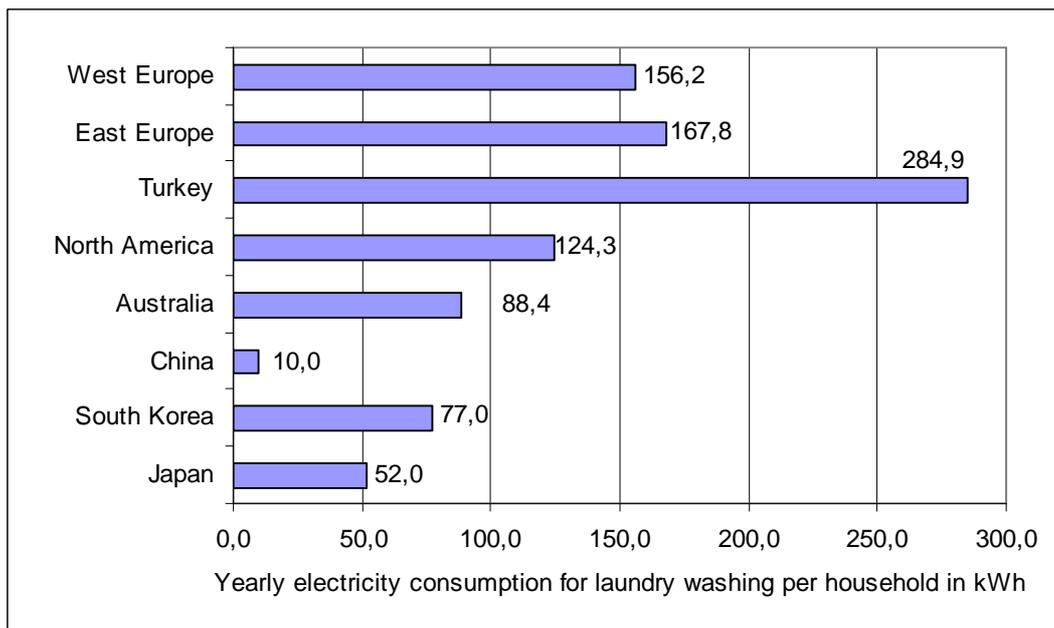
run per year and the chosen wash program. For many regions worldwide this information is available from reports on consumer habits and practices. On basis of the published figures the energy and water consumption for automatic laundry washing has been calculated and put in relation to the total electricity and water consumption of households.

## Results



**Fig. 1:** Electricity consumption per wash cycle  
Source: University of Bonn based on published data

The electricity consumption for laundry washing mainly depends on the average washing temperature. In North America, Australia, China, South Korea and Japan vertical axis machines are widely spread which use cold water or warm water from the tap which is not heated by the washing machine furthermore (Figure 1).

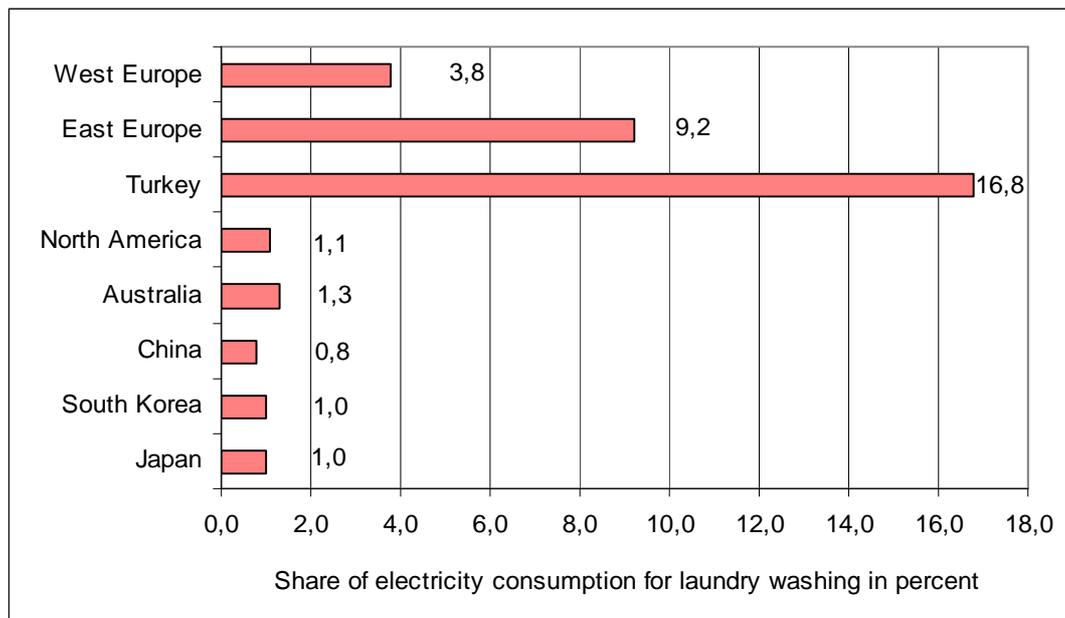


**Fig. 2:** Yearly electricity consumption for laundry washing per household  
Source: University of Bonn based on published data

Due to the larger household size and thus higher number of wash cycles in East European countries, the electricity consumption is slightly higher than in West European countries. The

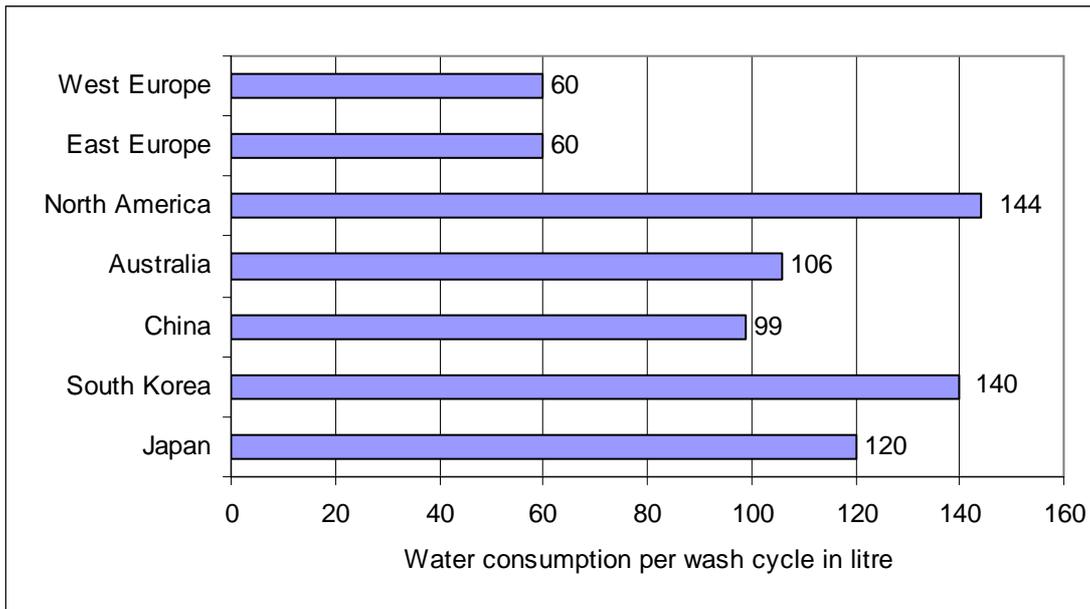
extremely high value for Turkey is caused by the large household size and frequently used high washing temperatures and thus high energy consumption per wash cycle (Figure 2).

The large difference of the share between West European (3,8 %) and East European (9,2 %) households is caused by the much lower total electricity consumption of East European households. Due to the relatively high electricity consumption for laundry washing and a low total electricity consumption of only 1,7 MWh per household and year, on basis of our calculation Turkish households spent more than 16 % of their expenditures for electricity on laundry washing. But as the ownership rate of washing machines is only 63 % and the total electricity consumption refers to all households in Turkey, it might be that this share is too high (Figure 3).



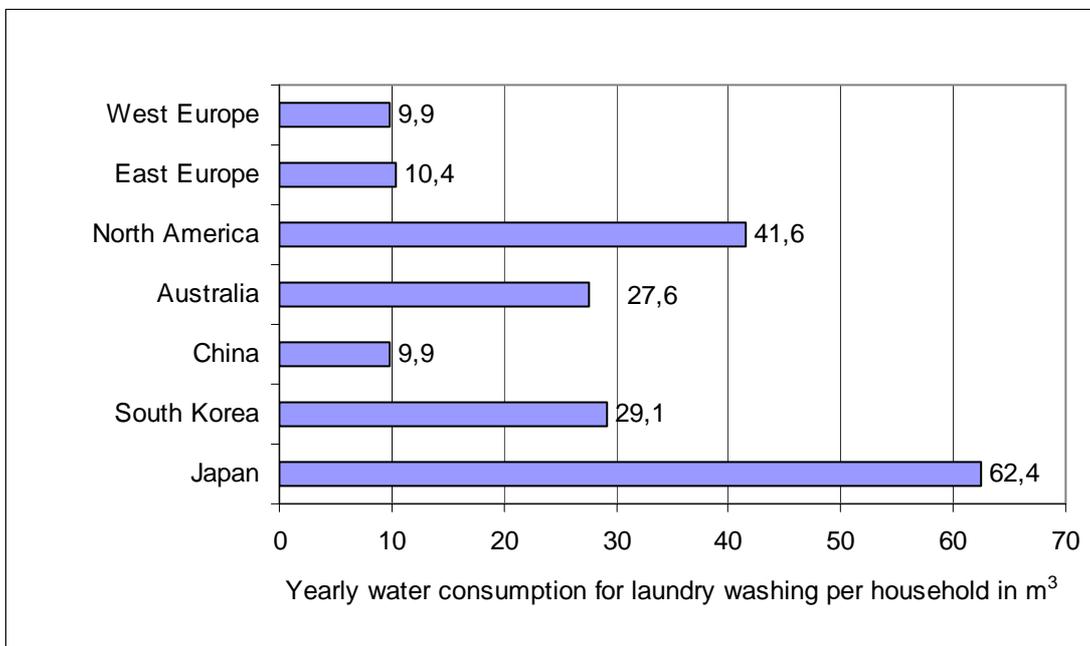
**Fig. 3:** Share of electricity consumption for clothes washing per household  
Source: University of Bonn

As well as the electricity consumption for laundry washing the volume of water consumption is influenced by the technical standard of the washing machine and by the behaviour of the user. European washing machines use less water per wash cycle than washing machines in America, Australia and Asia, which is caused by the fact that in Europe only horizontal axis machines are in use (Figure 4).

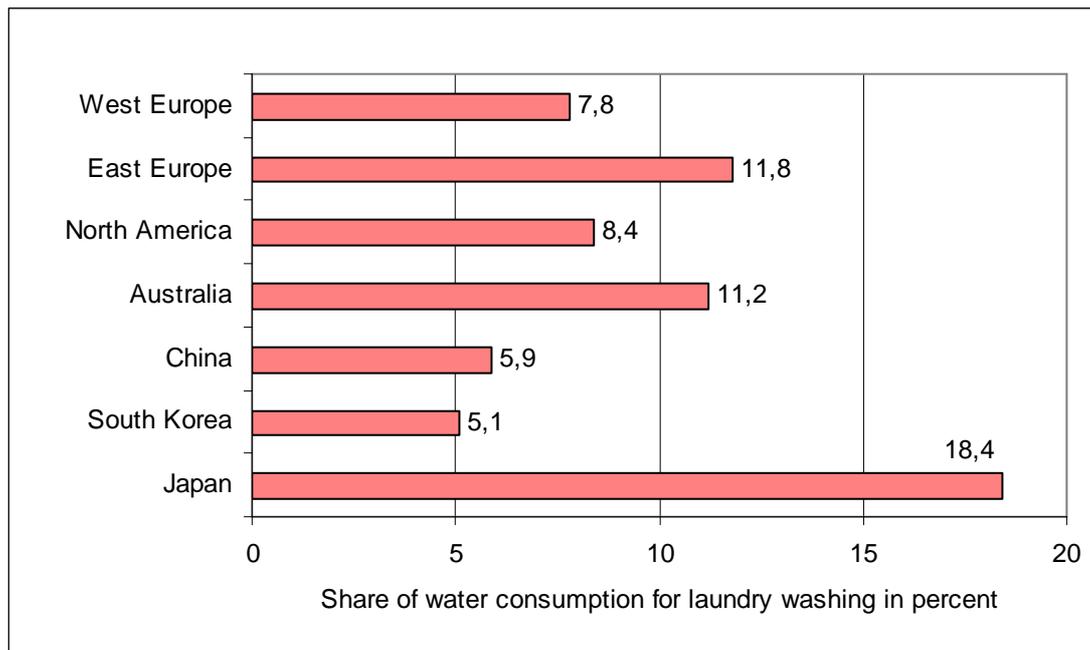


**Fig. 4:** Water consumption per wash cycle  
 Source: University of Bonn based on published data

Due to the economical water consumption of European washing machines households in Europe use less water for clothes washing per year than most other countries. Households in China consume as little water as European households because of their low number of wash cycles. In China manual laundry washing is quite common also in households that own a washing machine. The high water consumption shown for Japan is caused on one hand by the high number of wash cycles and on the other hand by the high water consumption of the vertical axis technology (Figure 5).



**Fig. 5:** Yearly water consumption for clothes washing per household  
 Source: University of Bonn based on published data



**Fig. 6:** Share of water consumption for clothes washing per household  
Source: University of Bonn

The share of water consumption for laundry washing varies between 5 % and 19 % and depends on the water consumption per wash cycle and on the total water consumption of the household. The volume of water used for laundry washing influences the total water consumption of households in all countries significantly (Figure 6).

## Summary

Huge differences regarding electricity and water consumption for automatic laundry washing do exist among the countries surveyed. Reasons for these variations are different numbers of wash cycles per year, different washing temperatures and different technologies like horizontal and vertical axis washing machines. The quantification of the electricity and water input is difficult as traditional wash habits and practices vary a lot.

To provide a complete picture on the resources used for laundry washing also the use of detergent (inside the washing machine, but also for manual washing and pre-treatment) should be considered. A selection of those countries as ‘world champion’ which have the lowest consumption is too premature, as it lacks the information on the achieved washing performance and additional resources used for washing processes of laundry outside the machine. But there are for sure plenty of opportunities to learn from each other in having the laundry process done in a most sustainable way.

## Literature

Australian Bureau of Statistics: Environmental Issues: Energy Use and Conservation, Canberra, 2008

Boudewijn et al: Energy Efficiency in Household Appliances. Proceedings of the First International Conference on Energy Efficiency in Household Appliances, Florence, Italy 1997

DEWHA: Equipment Energy Efficiency Programm. Dep. of the Environment, Water, Heritage and the Arts, Australia, 2008a

DEWHA: Energy use in the Residential Sector 1986 – 2020, 2008b

European Commission: Commission Directive 95/12/EC of 23 May 1995 implementing Council Directive 92/75/EEC with regard to energy labelling of household washing machines

European Commission: EuP Studies for Eco-design Requirements of EuP's (Tender TREN/D1/40-2005); <http://www.ecowet-domestic.org/>

- GIFAM: Le marché français des produits. 2005  
<http://www.gifam.fr/pages/lemarché/chriffrescles/gam-lavage-2005-2.html>. (accessed October 27<sup>th</sup>, 2006)
- Harrel, C. W.: The US Laundry Market. IEC SC 59D WG Meeting, Gaithersburg Oct. 13<sup>th</sup>, 2003. Procter & Gamble communication to IEC SC59D working groups (private communication)
- IBM: Aise Code of Good Environmental Practice: Final Report to the European Commission 1996 – 2001, Brussels, 2002
- Nakaoka, K.; Sudarsana, B.S.: Laundry in Japan. Procter & Gamble communication to IEC SC59D working groups (private communication), 2002
- National Statistics
- Adato Energia Oy: Electricity Consumption, Statistical Yearbook 2006, Helsinki 2006
- Eurostat: Europe in Figures. Yearbook 2005
- Eurostat: Statistik kurz gefasst, Thema 8, 13/2003
- Eurostat: [http://epp.eurostat.ec.europa.eu/portal/page?\\_pageid=1996,45323734&\\_dad=portal&\\_schema=PORTAL&screen=welcomeref&open=/&product=Yearlies\\_new\\_environment\\_energy&depth=4](http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/&product=Yearlies_new_environment_energy&depth=4) (accessed, November 2006)
- OECD Environmental Data 2004 – Compendium 2004, OECD 2005
- StatBank Denmark: Stat. Yearbook 2006, Copenhagen 2006 Household Size, 2001 Census.
- Statistisches Bundesamt Schweiz: Statistisches Jahrbuch 2006, Neuchâtel 2006
- Statistics Norway: Statistical Yearbook of Norway 2005
- Statistics Bureau Japan: Household and Household Members  
<http://www.stat.go.jp/english/data/handbook/c02cont.html>. (accessed November 3<sup>rd</sup>, 2006)
- Statistics Bureau Japan: Final Energy Consumption  
<http://www.stat.go.jp/english/data/handbook/c02cont.html>. (accessed November 3<sup>rd</sup>, 2006)
- Procter & Gamble: Laundry Habits and Practices in China 2002, India 2002, Philippines 2003.
- Procter & Gamble communication to IEC SC59D working groups (private communication)
- Rüdenauer, I; Griebhammer, R.: PROSA Waschmaschinen. Produkt-Nachhaltigkeitsanalyse von Waschmaschinen und Waschprozessen, Freiburg 2004
- Rüdenauer, I. et al: Ökobilanz und Lebenszykluskostenrechnung Wäschewaschen. Vergleich des Waschens bei durchschnittlichen Waschttemperaturen mit Waschen bei niedrigeren Waschttemperaturen, Freiburg/Hamburg 2006
- Stamminger, R. et al: Old Washing Machines Wash Less Efficiently and Consume More Resources. In: Hauswirtschaft und Wissenschaft 3/2005
- Stamminger, R. et al: Definition und Ermittlung verhaltensabhängiger Energieeinsparpotentiale beim Betrieb elektrischer Haushaltswaschmaschinen, Aachen 2007
- Stamminger, R.; Goerdeler, G.: Aktionstag Nachhaltiges Waschen –Was macht der Verbraucher? In: SÖFW-Journal 1/2-2007
- Togay, M.: Laundry in CEEMEA. Procter & Gamble communication to IEC SC59D working groups (private communication)
- US Federal Register: 10 CFR Section 430.23(j), i.e. Appendix J1 to Subpart B of Part 430, 2005
- Van Holsteijn en Kemna: Report on Energy Consumption of Domestic Appliances in European households, Brussels
- Wäschereiforschung Krefeld. [www.wfk.de](http://www.wfk.de), (accessed, December 2006)
- Wang, A.H.: Personal information Dr. Alexander H. Wang, Haier Group Corporation, Qingdao, China 2006
- Yang, H.: The total Energy and Water Consumption of Washing Machines in Korea. Samsung Electronics, 2006 (unpublished)
- ZVEI: Market saturation in Germany in percentage of households. Zentralverband der Elektrotechnik Industrie, Nürnberg, 2005