

# Energy down the drain. The energy saving potential in water conservation

Diana Avasoo  
WSP Environmental  
Sweden  
diana.avasoo@wspgroup.se  
www.wspgroup.com

## Keywords

aerators, energy, energy saving, faucets, hot water, taps, showers, water, water saving, water conservation, water shortage, wastewater.

## Abstract

On national level, providing and using water consumes large amounts of energy. Energy production frequently uses or pollutes water. Most electricity production also contributes to global climate change, which is likely to have tremendous impacts on water availability and management. Yet energy and water issues are rarely considered together. A third of the world's population lives in water-stressed areas. By 2025, this is expected to rise to two-thirds.

Water is life – therefore water needs a summer study of its own to cover source and conveyance, treatment, distribution, end- use and wastewater treatment. In this paper we concentrate on water from an energy saving point of view. Studies show that new homes are using 12-60 % more water than their existing counterparts. At least 10-20 per cent of the overall water consumption can be saved with very simple measures in residential and in non-residential buildings. We are showing some examples that quickly can reduce the water and hot water consumption at a low cost.

## Prevent War – Save water

Is the purpose of this heading to create sensation? The authors answer is: Not at all. The importance of water is definitely worldwide. In history many wars were fought and many conflicts were created because of the desire for sovereignty of water.

Sunita Narain, editor of the CSE newsletter Down To Earth Magazine, India, wrote in July 2005: "Delhi has been waiting. For its neighbour, Uttar Pradesh (UP) to release water to its swank Sonia Vihar water treatment plant. The prime minister himself intervenes in the matter. He persuades up to release water. Only to be rebuffed by up political leaders, who say their farmers and cities need water first. Delhi is already water-spoilt, they say. Elsewhere, farmers in Tonk district of Rajasthan protest against a dam whose water, they say, is "reserved" for neighboring cities. They want that water. They take to the highway. Police open fire and farmers die."

In Africa and in many other countries, lack of water means hunger and hunger leads to war.

We cannot create water and prevent war but we can help countries towards a more rational use of water.

Lester Brown, chairman of World Watch Institute, predicts that around year 2025 1,8 billion people will live in areas with water deficit. Other studies show that by 2025, two-thirds of the world's population will live in water-stressed countries such as Spain, Jordan, China, Italy, Australia, Korea, Japan, France, UK, Greece and Israel. In the US, 36 states anticipate freshwater shortages in the next 10 years. Already now several countries in the Middle East and in North Africa belong to that category.

The past hot summers proved that water is not an endless source. At the same time water consumption is increasing rapidly around the world. In developed and developing countries alike, competition among water users is increasing. Tensions are particularly high in water-scarce areas where domestic, agricultural and industrial water needs are pitted against each other.



And if it was the last one?

Picture 1 Pamphlet from the city of Hyères-les-Palmiers in France

### Save energy – Save water

Water is consumed in many sectors of the society of which 30 per cent in the commercial-, industrial- and institutional sector. 50 per cent of this water is used for heating and cooling, which requires energy inputs. Other areas are agriculture and residential water use. Many politicians are worried about a coming climate change. The 29<sup>th</sup> of September 2006 I attended a seminar in which President Bill Clinton said: “We have alarming shortage of water. Greenland has 8 per cent of all the fresh water on earth. What happens if it melts?”

“British homes are using too much water” declared Tony Blair and the Chancellor, Gordon Brown, in a Treasury document published 27<sup>th</sup> of November 2006, in which they set out the long-term political challenges.

The average British home uses 150 liters of water per person per day, while the Germans, Belgians and Dutch - with similar living standards and climate - manage on 130 liters each or less. Mr. Blair and Mr. Brown want Britons to bring their water consumption down to European levels, and they warn that the Government may resort to “metering, price structures and demand management programmes” to ensure it happens.

Mr. Blair and Mr. Brown singled out water use and supply as one of the most important pressures on the UK's natural resources. Droughts that now occur once every 10 years are likely to happen every four or five years by the 2050s, and every two or three years by the 2080s.

1,16 kWh are needed to heat 1 m<sup>3</sup> water by one degree. The ground water temperature is 8 degrees in the middle of Sweden. To heat the ground water to comfort level, 40 degrees Celsius requires 46 kWh at 80 % boiler efficiency. 2/3 of the water consumption is hot water, often heated to 60 degrees.

### Water saving solutions for buildings

The water flow through an ordinary shower, handheld or wall fixed, is in average 16 liters per minute. According to a recently published study in Australia the average shower time is 7 minutes. Then they have not measured the time spent there by teenagers. Some persons tend to have more than one shower per



Picture 2 Water saving showers



Picture 3 Aerators

day. However, in our paper we calculate with an average shower time of 7 minutes per day for residential buildings.

The water flow through a kitchen tap is in average 12 liters per minute and for bathroom taps 9 liters per minute.

An engineering practice for individual water users is the installation of indoor plumbing fixtures that save water and still maintain a high comfort level. These can either be totally new products, such as water saving taps, or installation in existing taps, such as aerators. Tap aerators installed in existing taps cut the water consumption by up to 70 %. The technology, mixing air into the water, provides good comfort and energy savings.

Showers account for about 20 percent of total indoor water use. By replacing standard showerheads/handheld showers with water saving showers, up to 70 percent of the water and hence the warm water will be reduced. New technologies mix air into the water and provide increased pressure and comfort with only half of the water quantity.

There are shower hoses specially designed to reduce water consumption when installed with water saving showers.

Other water saving solutions in existing installations are water pressure valves fitted between shower mixers and hose. Because flow rate is related to pressure, the maximum water flow from a fixture operating on a fixed setting can be reduced if the water pressure is reduced.

### Water consumption in buildings

50 per cent of homes that will exist in year 2030 have not yet been built. Studies are showing that new homes are using 12-60 per cent more water than their existing counterparts. Several showers a day, Rain-forest-showers etc contribute to high water and particularly high hot water consumption.

The water consumption in different buildings in Belgium, France, Cyprus and Sweden was measured by various energy companies and organizations (Energy 21 in France, WSP Environmental in Sweden, Avasoo Consulting and ODE Vlaanderen in Belgium, Avasoo Consulting in Cyprus). We concentrated on consumption areas that are possible to control and measure accurately. We measured water flows from taps and showers in two types of building, hotels and residential buildings.



Picture 4

The water consumption in hotels varies between 200-500 liters per guest night. In residential buildings the consumption varies between 120-400 liters per capita. This wide span leaves room for 50 % reduction in water and hot water savings.

**RESIDENTIAL BUILDINGS**

In Sweden, two areas with one-family houses were studied. The water consumption per capita per day varied between 140 liters in areas with individual measuring up to 221 liters in areas without individual measuring of water consumption. Another study carried out by the Swedish National Testing Institute covering multi storey buildings showed an average consumption of 391 liters per capita. The figures above are only for tap water, shower/bath and WC flush.

It is difficult to compare figures per capita from other studies and from other countries as these sometimes include dishwashers and cloth washers and some again include water use in garage and garden. Water bills include hidden water leakage and water consumption related to behavior.

The figures above are based on figures obtained from manufacturers, previous studies, statistics provided by building owners and hotel managers. The energy and water prices vary very much from country to country depending on energy source for water heating and availability of water. For instance most of the hot water in Cyprus is from solar collectors. Due to limited water availability, the cold water prices are very high. The energy figures are based on 9 degrees ground water temperature (Northern and central Europe), 40 degrees hot water temperature, 80 % efficiency for the boiler and 0,1 euro per kWh. This adds up to 44,95 kWh/m<sup>3</sup>. The cold water price is based on 3,0 euros per m<sup>3</sup>.

The City of Stockholm carried out Technology procurement in year 2000-2001 for water saving taps. Laboratory studies and studies in existing multi storey buildings were carried out. The estimated energy and water saving potential in residential buildings was, according to obtained results, 300-375 kWh per person/year and 14,6 m<sup>3</sup> of water per year. That was for one new tap with 20 % lower water consumption compared to the existing tap. Our figures are based on two water efficient taps and one shower.

**HOTELS**

Energy consumption in hotels is much higher than in most of the European residential buildings, measured in kWh/m<sup>2</sup>. We have collected energy indicators from approximately 200 hotels. Tourist hotels have 1,8 guests per room and an occupancy rate of 60-80 %. Business hotels have 1,2 guests per room and an occupancy rate of 80 %.

One international hotel chain installed water saving devices, showers and aerators, in it hotel in Sweden in 2001. We collected data for the years 2002-2004 and the results are a reduction by 94 liters per guest night, 5200 m<sup>3</sup>/year, minus 31 %. The energy saving was 212,5 MWh per year in average.

Another studied European hotel chain has in average 72 000 guest nights per hotel and a water consumption of 3300 m<sup>3</sup> per hotel. They run 100 hotels. Their energy consumption is between 400 and 550 kWh/m<sub>2</sub>. The amount of water varies between 200 and over 1000 liters per guest night. Their most energy conscious hotels reduced the energy consumption by 11 per cent between 2001 and 2005. At the same time their water consumption increased by 3 per cent. It is not much but it is a negative trend and also means that they focused on energy saving in other areas than by reducing the water consumption.

We have measured the water consumption in tourist hotels in Cyprus and France. After installation of water saving showers and aerators, we obtained an average energy saving of 1570 kWh and a water saving of 35 m<sup>3</sup> per room per year. These were ordinary rooms with modern showers and no cooking facilities. Some hotels had a water flow of 22 liters per minute from rather new showers.

**Energy saving potential from water conservation**

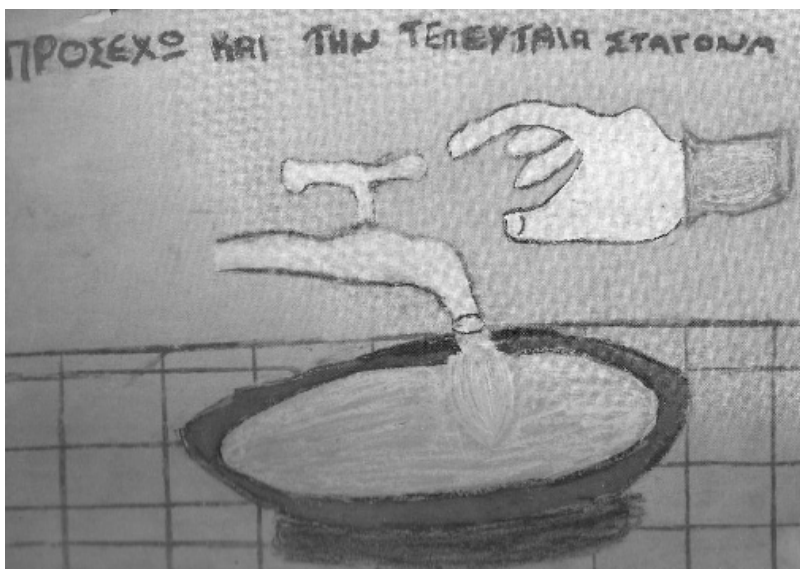
Based on the above figures, it is easy to make a simple calculation for any country.

Imagine 1 million people in residential buildings in each European member country (27) saving 2,9 MWh each. This adds up to 78,3 TWh in saved energy per year. The water saving would be 192 million m<sup>3</sup>. The individuals' economy would improve, releasing money to cover other costs or reduce the public costs for subsidies. The population within the EU-27 is approximately 500 million.

To calculate the energy saving potential in hotels, we take the previously mentioned European hotel chain with 100 hotels as an example. They have in total approximately 18 000 hotel rooms. If they invested in water saving only by replacing one tap aerator and one shower in all rooms, the energy saving potential would be 2,3 GWh and 630 000 m<sup>3</sup>. The average saving

Measured unit	Minutes/day	L/min before	L/min saving	SavingM3/year	Saving kWh/year*	Cost saving in euros*
Shower	7	16	8	20	899	
Kitchen	15	12	6	33	1483	
Washbasin	5	9	5	11	494	
		39	20	64	2876	480 euros per person

Figure 1. Potential savings in water and energy per person in residential buildings



Picture 5 The Greek phrase on the painting is: "We are careful with every drop!"

is 1,3 MWh per hotel room per year. The calculation is based on business hotels.

The energy saving potential in the whole world by reducing water consumption with small measures is enormous. Unfortunately very few are aware of this potential:

Saving energy by rational use of water, will have several positive impacts such as reduced CO<sub>2</sub> emissions and access to fresh water for more people.

The painting is presented in a calendar as a result from a competition conducted between children of the primary schools of Cyprus, with the purpose of the cultivation of Water Conscience in schools. It was made possible with the cooperation of the Water Development Department of the Ministry of Agriculture, Natural Resources and Environment and the Ministry of Education And Culture, [www.moa.gov.cy/wdd](http://www.moa.gov.cy/wdd).

## References

- A Sustainable Future for the Mediterranean. The Blue Plan's Environment and Development Outlook. Plan Bleu. Sophia Antipolice. [www.planbleu.org](http://www.planbleu.org)
- Miljöanpassning av befintlig bebyggelse (environmental friendly adaption of existing housing stock), John Peterson, University of Gothenburg, January 2003.
- Technology procurement for energy efficient taps. Various reports. Agneta Persson and Sten-Ivan Bylund, WSP Environmental, 2000-2001.
- Water and energy savings when replacing water taps. SP Swedish National Testing and Research Institute, Borås, Sweden, 2000. Report 00ETs PO 02310.
- Water Development Department of the Ministry of Agriculture, Natural Resources and Environment. Interviews.
- Cyprus Institute of Energy, Ministry of Commerce Industry & Tourism, Nicosia. Interviews.
- Energy 21, Serge Broch, France. [www.energy21-france.com](http://www.energy21-france.com).
- California Urban Water Conservation Council
- Avasoo Consulting, [www.avasoo.com](http://www.avasoo.com)