

# CONSCIENTIOUS SHOWERERS TAKE SHORTER SHOWERS

People who track the amount of water and energy consumed during showers, thanks to a 'live' display on the shower head, shower sparingly. This is the main thrust of an empirical study by Dr. Verena Tiefenbeck at the Swiss Federal Institute of Technology (ETH) in Zurich. The study has implications beyond the actual subject matter: it supports the assumption that real-time feedback can make a significant contribution to more economical energy use.

Smart meters are modernized electricity meters. Thanks to smart meters, tenants and owners learn how much energy they consume at home. Many experts are convinced that such consumption indicators are an important tool for energy saving. This conviction, however, has recently been challenged by various studies. The savings achieved by consumption indicators are only on the order a few percent, the studies suggest, and are therefore comparatively low.

A new study by ETH Zurich commissioned by the Swiss Federal Office of Energy (SFOE), however, comes to a much more favorable conclusion. For the study, showers in 697 households in the Zurich region were equipped with mea-



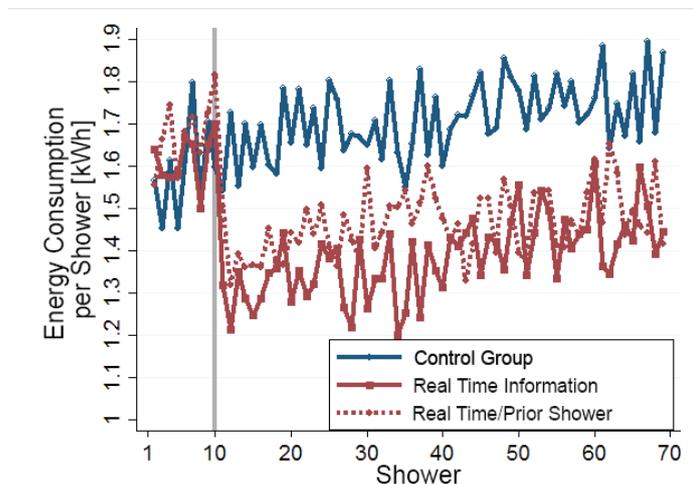
Dr. Verena Tiefenbeck with a shower indicator that was part of her study. Photo: B. Vogel

suring instruments. Anyone who took a shower in these households could 'live' track the amount of water they consumed and how much energy was required to heat the water. The astonishing result: in households, energy and water consumption during showering decreased by an average of 23%. This effect did not only last for two or three days, but remained constant over the two-month study period. Simply put, people - women and men - were no longer showering for four minutes, only three. Accordingly, the consumption

of 36- to 38-degree C water decreased, namely from 45 to 35 liters. Per shower, not only was water saved, but also 0.35 kWh of energy, which would otherwise have been required to heat the water.

### Not All Consumption Indicators are Alike

Why, however, is the energy savings from electricity meters (smart meters) only a few percent, whereas with shower indicators the savings equal almost a 25 percent? According to study author Dr. Verena Tiefenbeck: "The effects of the smart meter studies are not comparable with my investigation. This is real-time feedback that responds to the specific behavior of a person. Anyone who is in the shower and has the display in front of them can react immediately. During the process, significant behavioral changes can be achieved," she says. Smart meters in the forms used today did not achieve this goal. They show consumption in an entire home, but not for a single device. This motivates the homeowner less to affect a direct behavioral change. Smart meters also show power consumption in kWh—a unit less suitable for laymen than an indicator showing liters used during showering and an effect visualized by a polar bear (see p. 4).



Primary result of the ETH study: The energy consumption (in kilowatt hours) during showering with a consumption indicator (red) is significantly lower than without a consumption indicator (blue). During the first ten shower sessions, the displays did not provide any information on consumption - the energy consumption of the study group hardly differs from that of the control group. A subgroup (red, dotted) received not only information about consumption, but also learned how much energy the prior person had consumed during showering. This supplementary information about prior showerers did not noticeably influence their energy consumption. Graphic: Tiefenbeck

## Energy Efficiency Classification

A	0 Wh - 700 Wh
B	700 Wh - 1,225 kWh
C	1,225 kWh - 1,750 kWh
D	1,750 kWh - 2,275 kWh
E	2,275 kWh - 2,800 kWh
F	2,800 kWh - 3,325 kWh
G	Over 3,325 kWh

If you have a maximum of two minutes in the shower and use less than 20 liters of hot water, it consumes less than 0.7 kWh of energy. This fulfills the criteria for the energy efficiency class A. Those who shower about four times as long, and thus use more than 80 liters, reach only energy efficiency class G. Table: Amphiro

Given this background, ETH Zurich researcher Tiefenbeck is convinced: behavioral control through consumption displays is very effective - if the facts presented on such displays are easily understandable and if the user can react immediately and if the user knows how to react. "Most are shocked at how much water they consume per shower," says Verena Tiefenbeck. "Once you are aware of your consumption, you are ready to consume less." She points to fuel consumption indicators in cars, which also tend to encourage drivers to spare fuel. The scientist is convinced that even with smart meters, better savings can be achieved if they are used correctly: "Feedback in intelligent electricity meters must become more concrete. They must be designed in such a way that a single action that reduces power consumption is directly reflected on the display."

### Even Environmental Agnostics Save Money

One- and two-person households participated in the ETH study. The participants were slightly younger and somewhat better educated compared to the general population. However, it was not environmental-freaks who were simply waiting to prove their 'green' attitudes in the shower. According to Tiefenbeck, the participants, on the contrary, had a slightly below-average environmental awareness than the Swiss general public. At the beginning, the students were asked whether they were willing to reduce energy consumption. Interestingly enough, those who answered 'no' to this question generally took shorter showers than before the study.

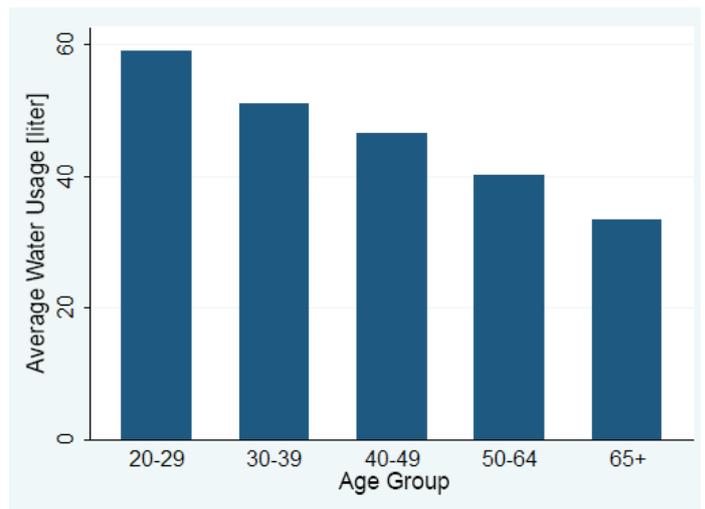
Tiefenbeck adds: “Even the environmental agnostics saved, though less than the average.”

This amazing result was achieved with a simple device, which was screwed between the end of the shower hose and the shower head. A built-in generator, driven by the flowing water, supplies the current for the indicator. Anyone who is showering can read the water temperature and the amount of water consumed (in liters) on the display. After completion of the shower, the energy consumed (in kilowatt hours /kWh) is displayed. In order to make energy consumption comprehensible to everyone, consumption is also expressed in letters, from A (very low) to G (very high), analogous to the energy efficiency classification system for household appliances. Frugal showerers see a polar bear on the display that can comfortably settle on a large ice floe. After long showers, the polar bear must make do with a small ice floe melted by climate change.

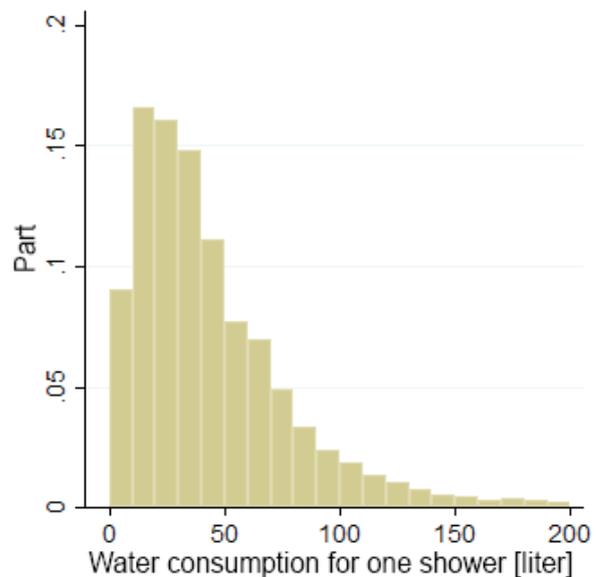
### Long-Lasting Savings Effect

The savings achieved thanks to the shower indicator are also astonishing because the students were not asked to achieve a specific savings goal. When they saved, they saved from their own usage. There is, however, an alternative theory: were the students so frugal because they knew they were taking part in a study and wanted to present themselves in the best light—as environmentally-conscious showerers? Another part of the study suggests not, because a third of the households were equipped with a shower indicator that displayed the water temperature, but neither consumption nor consumption reduction. In this control group consumption did not decrease (it even increased slightly).

According to Verena Tiefenbeck, the study could also prove that the savings are not due to the fact that the students wanted present themselves well to the other people living in the same household. To show this, the study group was divided into two subgroups: one subgroup saw only current consumption on the indicator display, the other subgroup could also see the consumption of the previous person. In both subgroups, the reduction in consumption was the same, so peer pressure was not significant. The savings effect observed by Verena Tiefenbeck lasted over the entire study period of two months. The study author deduced that the savings effect will persist over the long term. “According to psychologists, a new behavior becomes practiced behaviour after two months,” says Tiefenbeck.



Younger study participants consume significantly more water than the elderly during showers. The ETH study explains that elderly people were educated to be thrifty at a young age. Graphic: Tiefenbeck



The graph shows how much water the students used for a shower before a consumption indicator was installed. Graphic: Tiefenbeck

### Considerable Savings Potential

Showering is an effective lever in reducing energy consumption: Hot water is the second most important energy eater in the household after heat; the consumption share is 12 to 18%, but in a passive house the consumption share can reach 45%. Showering uses the largest share. “Hot water has a much greater significance for energy savings than the standby consumption of electrical appliances or lighting,” says Verena

Tiefenbeck. Given this context, the ETH researcher advocates a comprehensive introduction of shower indicators. In a two-person household, an average of 8500 l of water and 440 kWh of heat energy can be saved per year, based on the empirical findings of this study. With 10% of Swiss households equipped with shower indicators, 170 GWh of thermal energy could be saved. This corresponds to the amount of energy consumed by 18,400 Swiss citizens in their homes per year.

The ETH study shows that there is an energy saving potential that can be realized without legal requirements, without

active financial incentives, and even without consumption targets set from above (see text box below). Rather, many people are motivated 'from the inside' (intrinsically) to reduce consumption. This is also reflected in the fact that every second participant voluntarily set a personal consumption target within the framework of the study. In addition to this very optimistic finding, the ETH study also contains a note worthy of reflection: the collected data suggest that 20 to 29-year-olds are consuming 2,7 times more energy during showers than the 64-year-olds, likely because the latter group grew up in a culture of thrift. Verena Tiefenbeck: "Our data indicate that within one generation the consumption of resources

## SHOWER INDICATORS WANT TO CONQUER HOUSEHOLDS

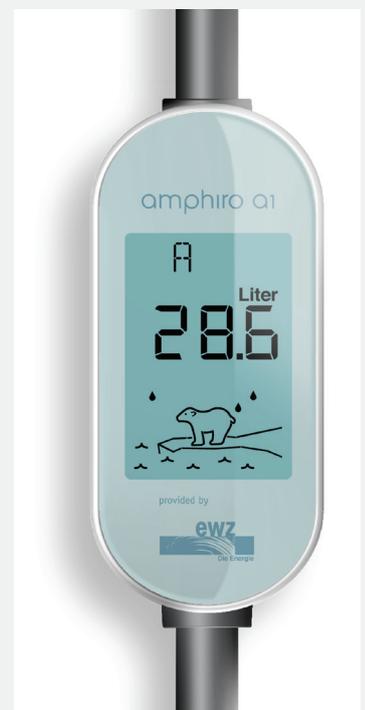
The shower indicator display, which Verena Tiefenbeck has investigated in her study, is available on the market. The display is produced by Amphiro AG, a spinoff of ETH Zurich. The company, which was founded in 2009, has set itself the goal of equipping every tenth shower fixture in Switzerland with a shower indicator by 2020. By mid-2016, the company had sold 35,000 shower indicators.

An Amphiro indicator is currently priced at CHF 80. The purchase price is amortized within six to eight months thanks to electricity savings, according to manufacturers. The indicator is screwed onto the shower hose or firmly anchored in the shower enclosure.

"Amphiro is addressing a broad spectrum of people interested in the environment and technology," says Thorsten Staake, professor of energy-efficient systems at the University of Bamberg and co-founder of Amphiro AG. Staake has set up the 'Bits to Energy Lab' at the Department of Management, Technology and Economics at ETH Zurich, where the idea for the device was developed. This is also the department in which Dr. Verena Tiefenbeck works as a researcher and in which she carried out her study together with Prof. Lorenz Götte from the University of Lausanne.

To further develop their technology, Amphiro launched a crowdfunding campaign. Through the platform Clickstarter, the company invested a total of 30,000 British pounds with 232 supporters in November and December of 2014 to co-finance a new version of the shower indicator. The new product variant Amphiro b1 enables the transfer of consumption data from the shower via Bluetooth to an Internet-capable device – typically a mobile phone. Amphiro also developed an app. With this, smartphone users can compare consumption values, display historical consumption, participate in competitions and activate an acoustic signal, which informs users when they exceed a self-chosen water or energy consumption limit. Furthermore, the new product variant makes it possible to compensate for personal energy consumption using "CO<sub>2</sub> credits." The new version of the shower indicator display was launched in the first quarter of 2016. BV

[www.amphiro.com](http://www.amphiro.com)



has more than doubled during showering. There is therefore a risk that changes in life might erode the savings that can be achieved with the use of shower indicators.”

- The **final report** on the project can be found at: <http://www.bfe.admin.ch/dokumentation/energieforschung/index.html?lang=en&publication=11283>
- For **further information** on the project, please contact Dr. Anne-Kathrin Faust ([anne-kathrin.faust@bfe.admin.ch](mailto:anne-kathrin.faust@bfe.admin.ch)), Head of the SFOE Research Program ‘Energy-Economy-Society.’
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