University of St.Gallen

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Bits to Energy Lab

→ Self-powered Water Meter for Direct Feedback

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Conserving water is conserving energy

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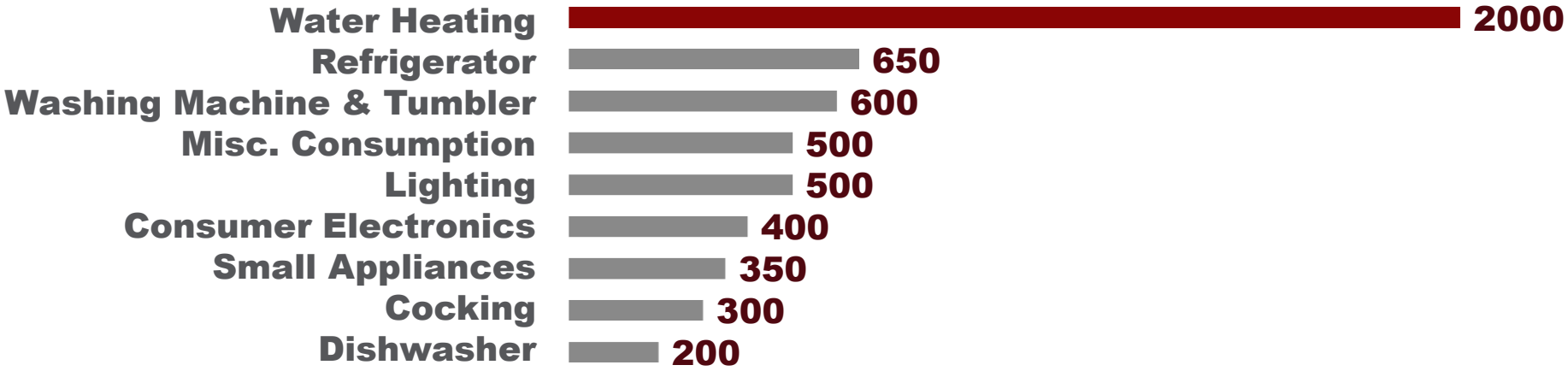
- In Switzerland, 1/3 of all households use electricity for water heating.
- One household uses on average 2.000kWh per year (2.2-person-houshold).
- For hotels and public buildings, the hot water demand constitutes a key cost factor.



Source: Bulletin SEV/VSE 19/2007

Why water?

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- **Perceived control**
- **Immediacy of feedback**
- **Possibility for Direct Feedback application**
- **Considerable saving potential**

- **Study objectives**
  - User acceptance rate
  - Technology acceptance
  - Overall savings

No behavioral approaches for water consumption

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	Automatic saving products	Behavioral
Electricity		
Water		

Study design

- 200 Swiss households received a water meter and a wirelessly connected display
- Duration 3 months, 9 showers per user as base line
- The device provided users with direct feedback of their water consumption for showering
- 3‘164 shower sessions recorded

Technology – specifications of the sensor unit

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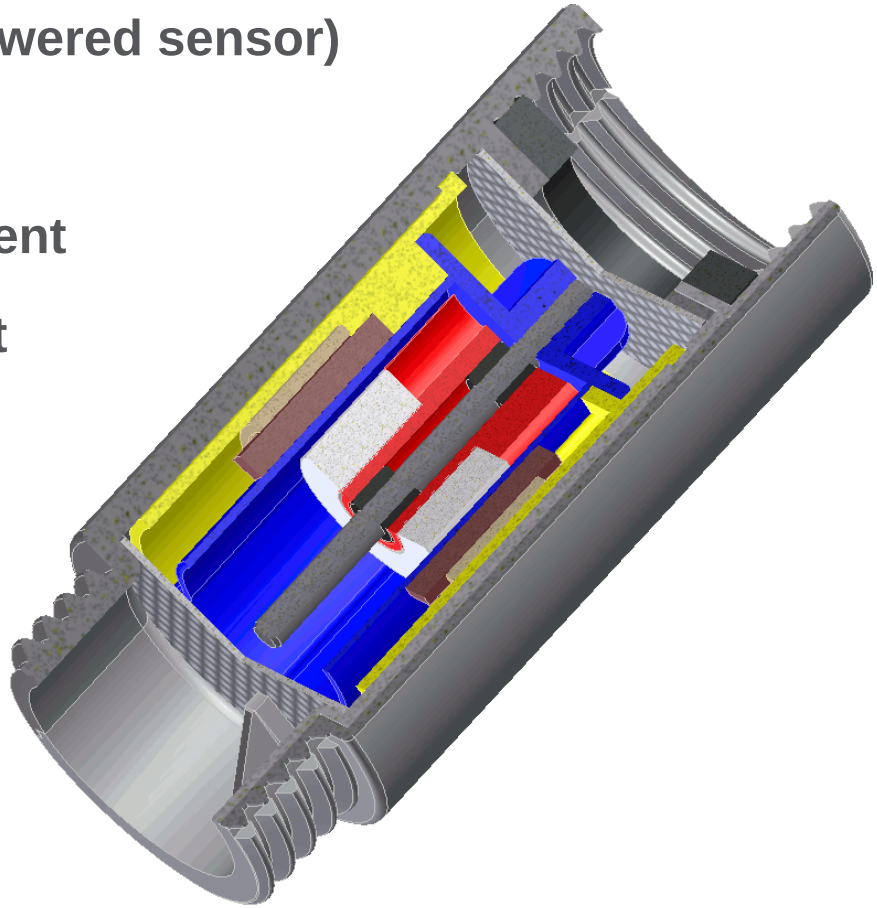
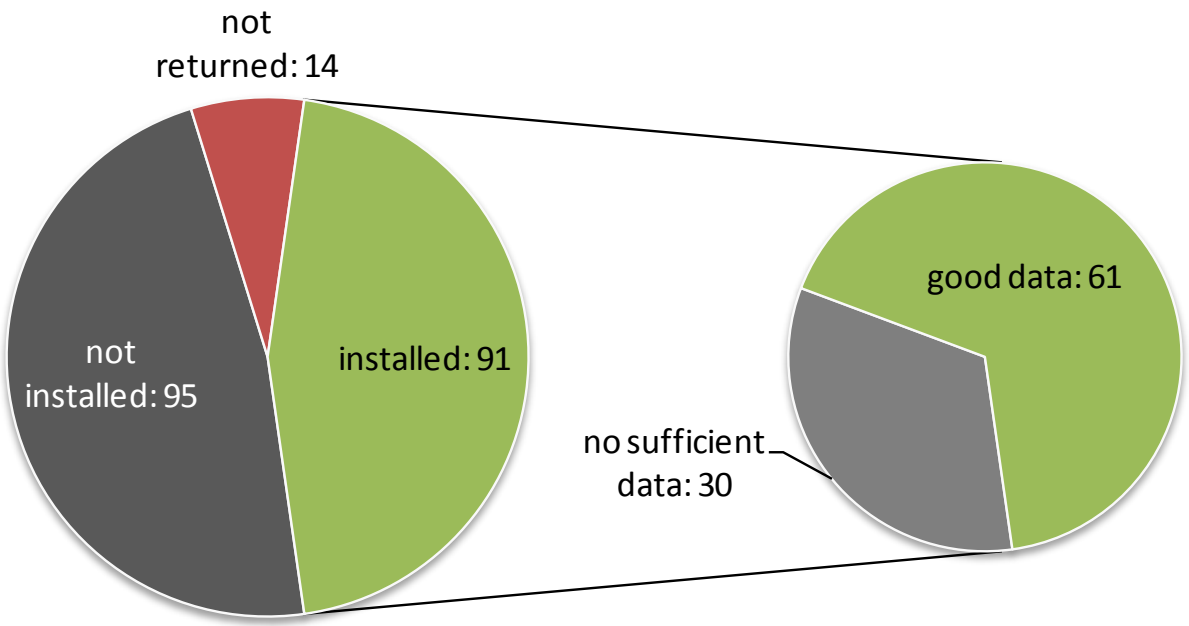
- Energy harvesting (self-powered sensor)
- Rectification
- Water flow-rate measurement
- Temperature measurement
- Wireless communication



Study Results

User acceptance

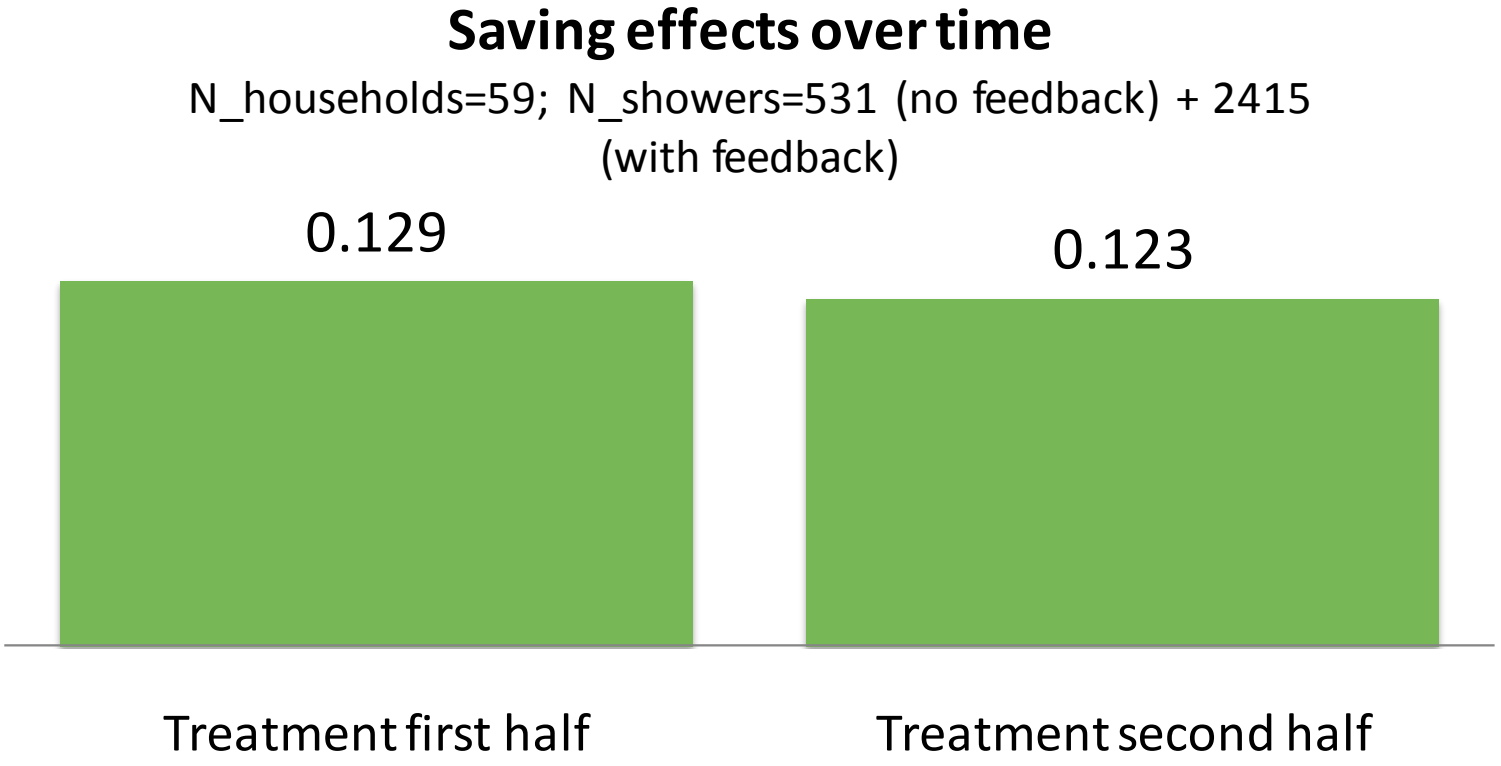
- 51% of the participants did not install the device
- 58% of the users reported good or very good user experience
- 32% of the participants produced good data



Overall savings

- 12.9% household average overall
  - 210 kWh per household & year
  - 6400 l per household & year
- 18.6% household average of above average user
- **Total water consumption reduced by 22.2% (baseline vs. display)**

The effects remain surprisingly stable over time



Effects persistent over time

Dependency on user group

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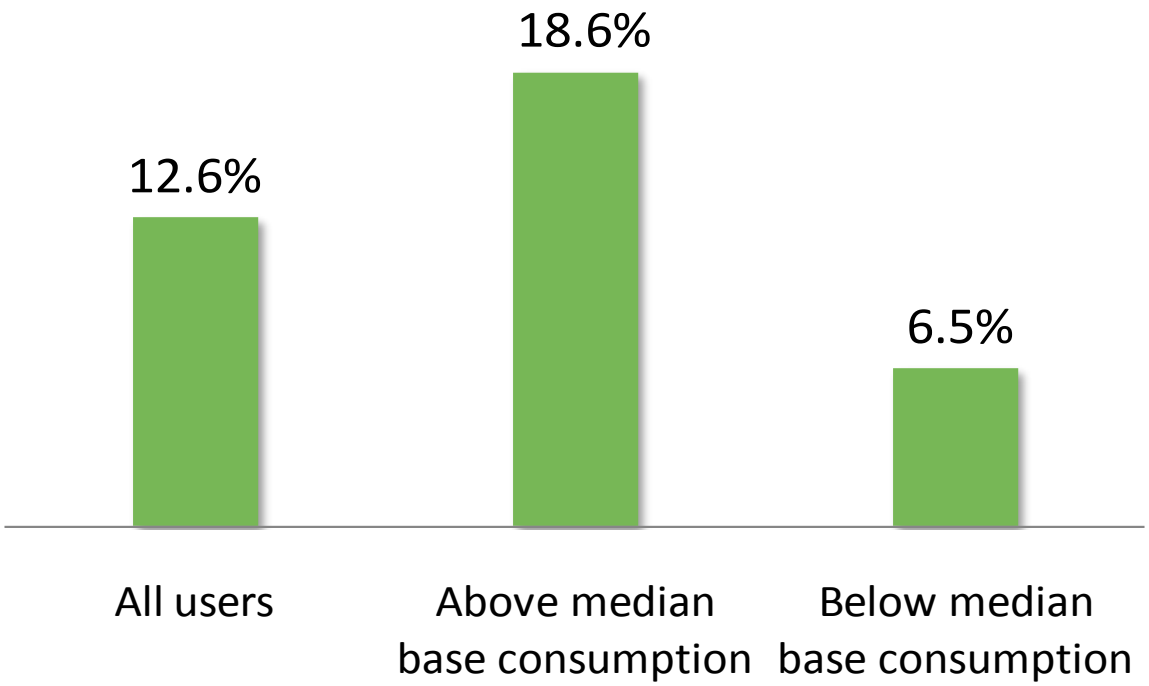
Energy savings of different user groups

N_households=59; N_showers=531 (for baseline) + 2415 (for intervention)



Cost efficiency

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- **Cost efficient “negative energy”:**
  - Device cost: 50 USD
  - Device in operation: 3 years
  - 50 / (210kWh * 3) = 0.079 USD per kWh saved
  - 50 / (6.4*3) = 2.60 USD per m^3 saved
  - Higher savings for above average consumers!
- **Much stronger effects than for smart metering for electricity**

Key findings

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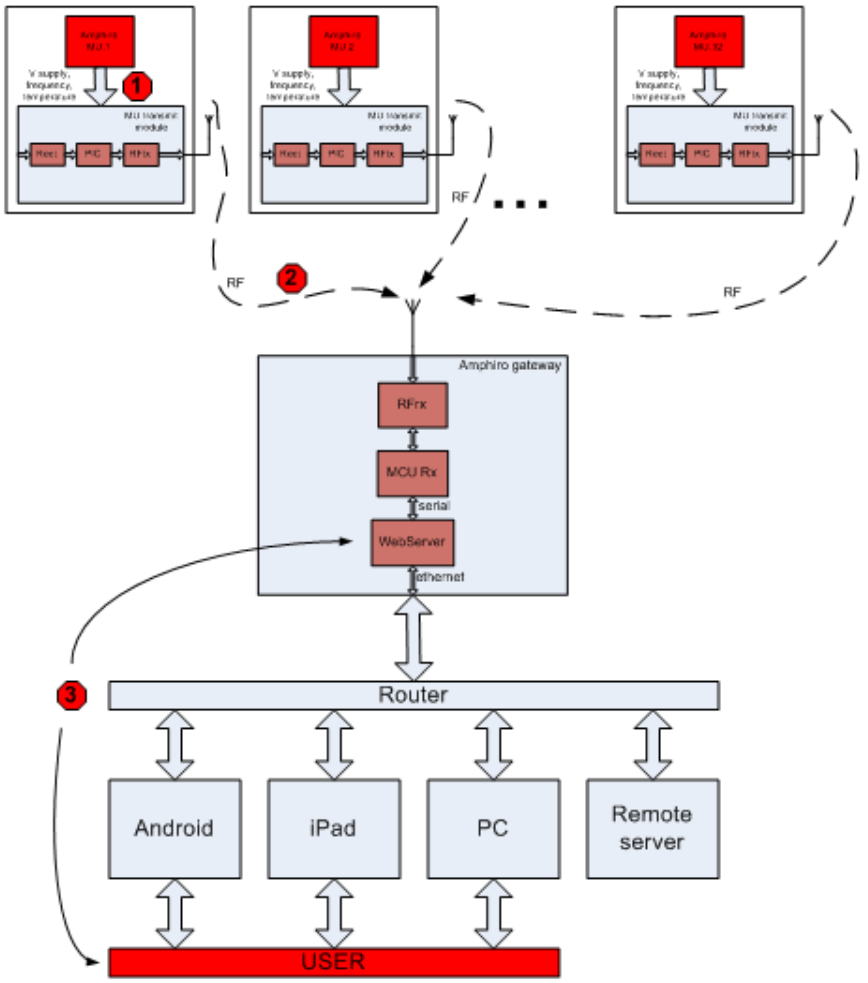
- Direct feedback for hot water conservation is a cost-efficient means to conserve energy.
- Let consumers decide if they want to use it. A mandatory distribution would probably lead to a high share unused devices.
- Efficiency gains much stronger than for electricity. Possible explanation: perceived control, immediacy of feedback, ease of “information consumption”.

Next steps

- Powering display
- Wireless connectivity
- Harnessing social networks



Thank you very much.

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