



Bits to Energy Lab

→ **Saving polar bears in the shower –
developing technology to reduce
residential energy consumption**

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Agenda



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- Introduction B2E-Lab & Motivation



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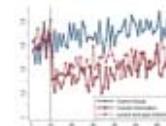
- *amphiro a1* smart shower meter



- Research questions and study design



- Results



- Implications



→ At the Bits to Energy lab, we combine IT and social science insights to motivate households to reduce their energy consumption.



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- Engineers, physicists, psychologists
- Develop technology for real-world applications
- Data collection in the field, data analytics, adjustments
- Transfer to practice in collaboration with organizations



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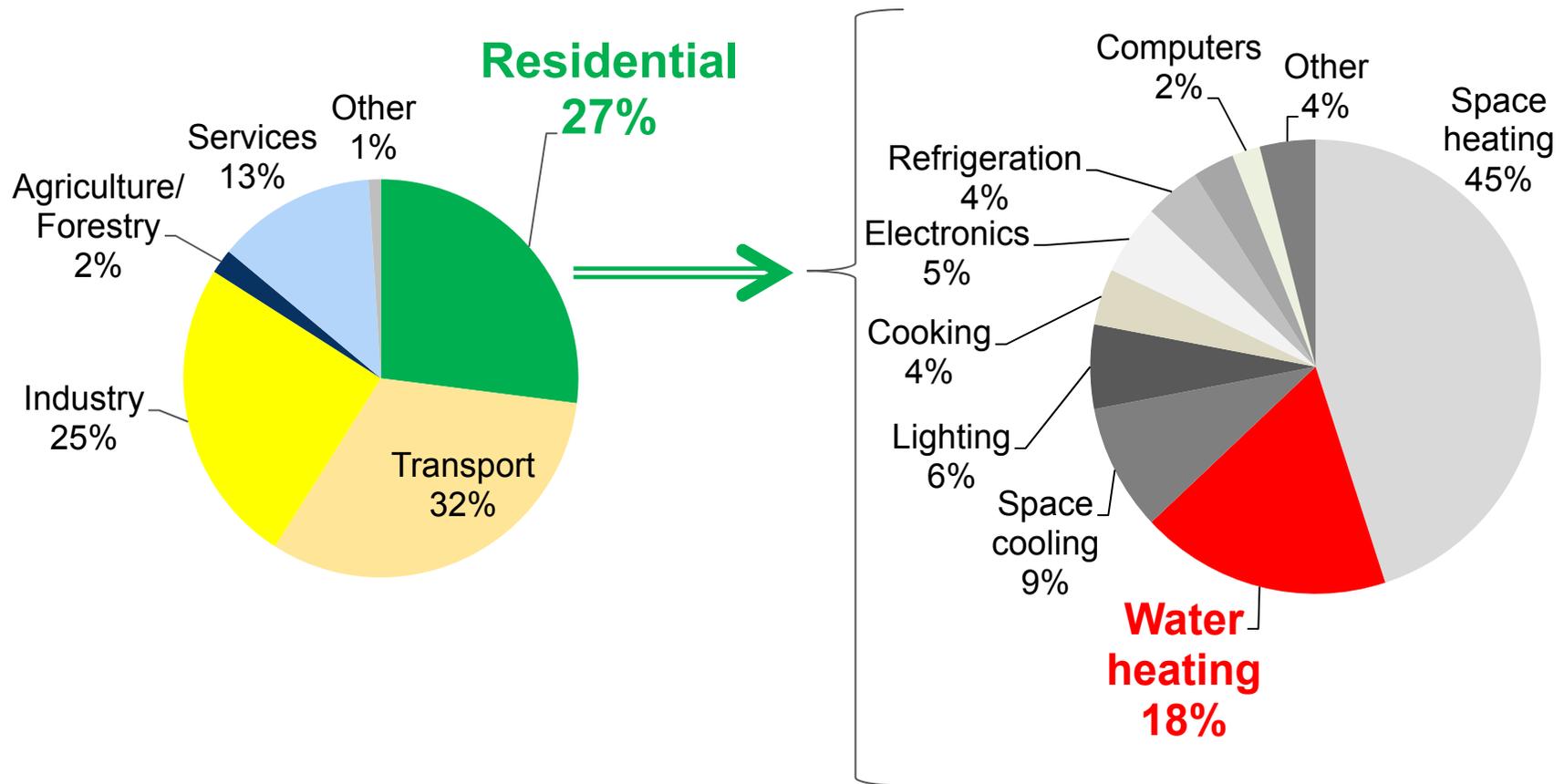


Hot water consumption is the 2nd largest end use in residential energy consumption, which accounts for 27% of the final energy use in the EU.



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Final energy consumption by sectors (EU-27, 2010)



Source: European Commission: Energy Efficiency Status Report 2012

Source: DoE Buildings Energy Data Book 2011



amphiro a1 displays shower data in real time and stores data of up to 500 showers.

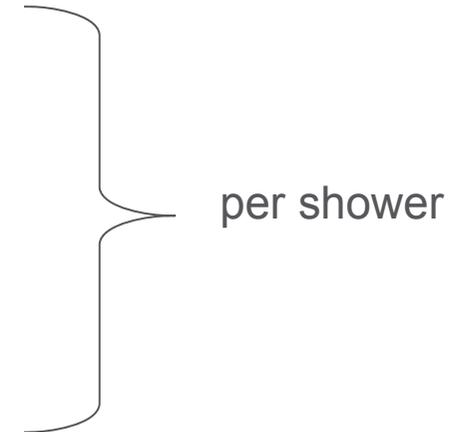


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Display and stores

- Water volume
- Energy consumption
- Temperature
- Energy efficiency class
- Polar bear animation



per shower

Deployed in >10.000 households

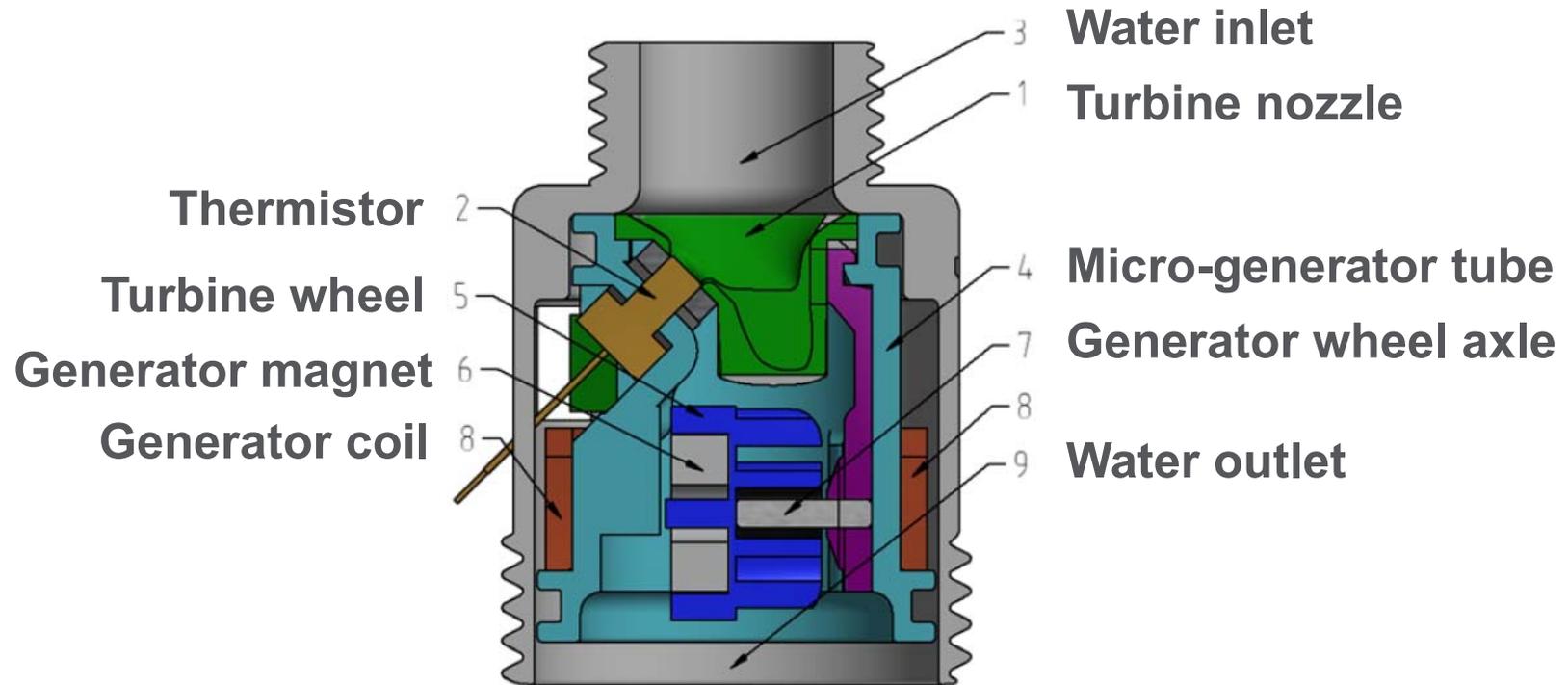
- Mainly in Switzerland
- 2-month study with 700 households
- Long-term study still ongoing



Cross-section of the device: A built-in generator harvests energy from the water flow.



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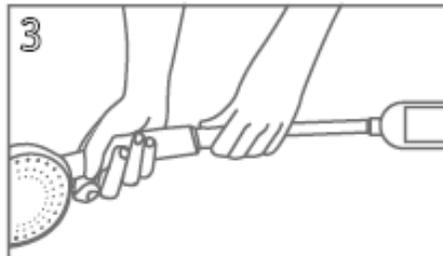
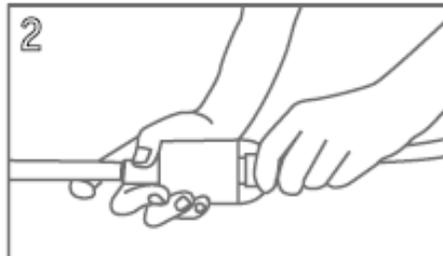
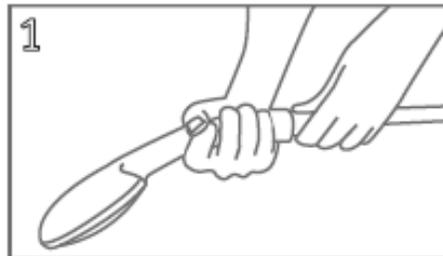
**Amphiro a1 harvests its energy from the water flow.
Its electronic components are optimized for intermittent energy supply.**



Users can install the smart water meter *amphiro a1* in three simple steps.



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Our study addresses different research questions in the context of behavioral feedback.



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- **Main effect: Impact of real-time feedback on energy and water consumption in the shower**
 - Impact on a large scale?
 - How: Time? Temperature? Interruptions? Flow Rate?

- **Contextual factors**
 - Environmental attitudes?
 - Demographics?
 - Personality?
 - Household size?
 - Income?





For our 2-month field trial with 700 households, the devices were reconfigured to customized operation modes.



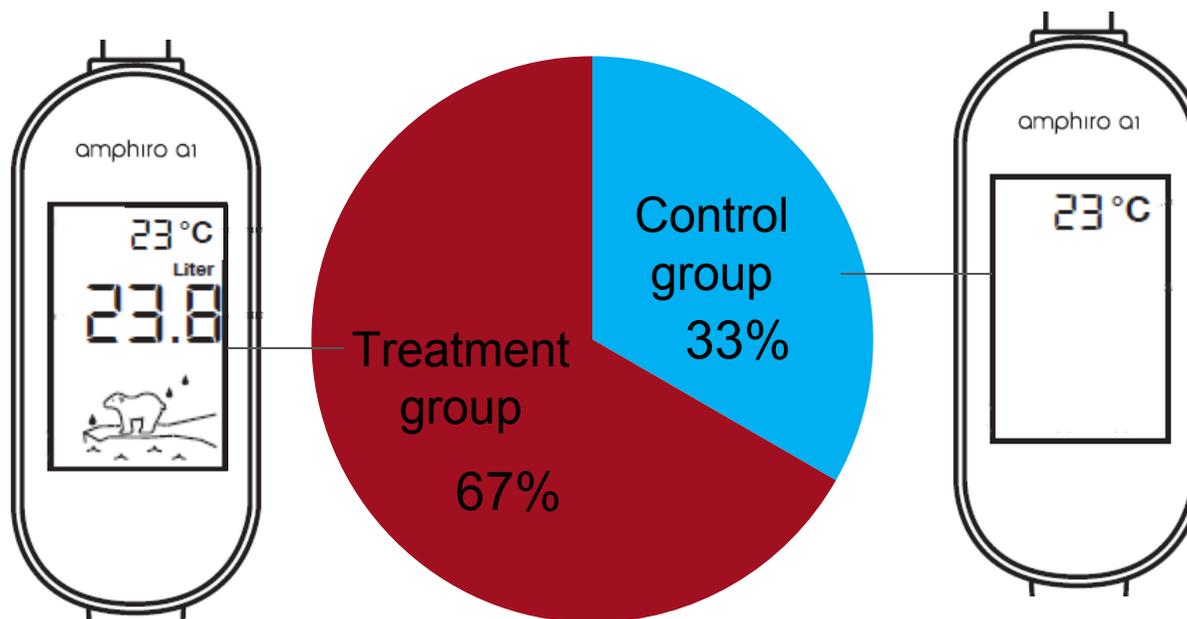
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- Generic software for all devices
- Random group assignment
- Baseline phase (only temperature displayed) for all



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE





For the visual data readout we built a readout terminal with a webcam.



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- 685 devices read out
- Data of 46'835 showers (T, vol, showertime, breaktime)
- Survey data (demographics, attitudes, personality)
- 629 complete datasets



Main effect: the device has a clear impact on energy and water consumption in the shower.



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- **The treatment group reduced their energy and water consumption by 23%**
 - Mainly by reducing shower time
 - No change in water temperature and flow rate
 - Some increase in shower interruptions (+12%), but still low percentage of users

- ***(Chart not available online)***



The smart shower meter reduces shower consumption by 23% – a much higher impact than electricity smart meters typically have.



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- **2-month study with 700 households**
 - **23% (!)** reduction
 - The impact exceeds electricity smart meters by far:

Reduction	Electricity smart meters	Smart shower meter
Energy – relative consumption change	3.2% of household electricity	23% of shower energy
Energy – absolute change	86 kWh	443 kWh
Water reduction per yr	/	8500 liters
Cost savings per year	15 CHF	96 CHF



The age of the study participants highly affected the baseline consumption, but (indirectly) also the treatment effect.

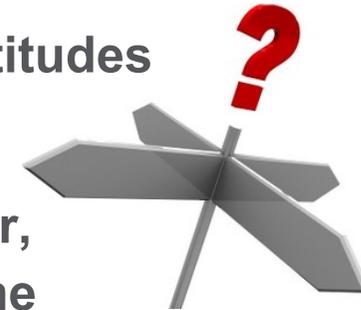


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- *(Charts and precise figures not available online)*
- **Young people take much longer showers than elder people**
 - Could be question of age, but...
 - More likely question of age cohort / transformation of conventions in the society
- **Age seems to have an impact on the treatment effect**
 - Stronger treatment effect on younger people
 - Spurious correlation (higher savings because high users)



- **Identifies primary target groups for interventions**
- **Reduction is independent of environmental attitudes**
 - Not driven by some green consumers
- **High impact of feedback on a specific behavior, concrete, individual, salient, simple, in real-time**
 - 23% reduction
 - 3-5 time the impact of displays to monitor electricity consumption
- **Quantifies impact of lifestyle transformation**
 - Part of a larger trend: HVAC, laundry,...
 - Possibly erodes energy efficiency gains of technological progress
 - Missing in energy demand forecasts





Key points, outlook and thank you for listening



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- Developed device for consumption feedback on hot water usage
- Energy-autarkic, easy to install, and mass-market compatible
- Deployed in >10.000 Swiss households
- Field study shows high impact: 23% reduction
- Long-term study ongoing (1 year)

Thank you very much for your attention.

Please support us on Indigogo!

www.igg.me/at/amphiro

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