Water saving tips, peer pressure, and gamification: long-term behavior change and rebound effects from a long experimental trial

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THE sH2O PROJECT

GOAL Study, understand and modify consumer behavior to achieve quantifiable water savings by raising consumer awareness and by the design and implementation of customized feedback, peer pressure mechanisms and water saving tips, thus also improving the operational efficiency of water utilities.

CONCEPT Developing an ICT platform to improve the management of urban and peri-urban water demand. The SmartH2O ICT platform enables water managers and utilities to close the loop between actual water consumption levels and desired targets, through:

. understanding and modeling water consumers' behaviour, based on historical and sub-daily water usage data
. modelling how the consumer behaviour can be influenced by various Water Demand Management Strategies, such as customized feedbacks
. raising users' awareness to pursue water use efficiency in the residential sector

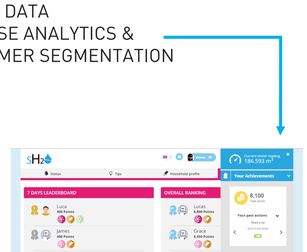
CORE ELEMENTS Sub-daily water consumption readings, interaction with customers for information sharing and socio-psychographic data gathering, data-intensive modelling, gamification.

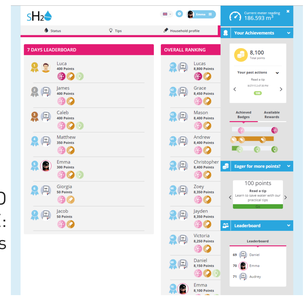
THE sH2O PLATFORM

SINGLE-POINT Smart meters: data acquisition and consolidation

Water consumption readings
DATA REPOSITORY
• Privacy
• Security

WATER DATA
END-USE ANALYTICS &
CUSTOMER SEGMENTATION





CONSUMER PORTAL: awareness feedbacks

ENGAGEMENT AND BEHAVIOURAL CHANGE: personalized tips, rewards

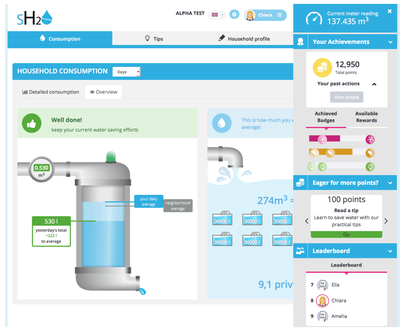
USE CASES

LONDON | UK
Thames Water water supply utility
15 million customers served

LOCARNO | CH
Società Elettrica Sopracenerina
multi-utility, 80 thousand customers served

VALENCIA | ES
Global Omnium water supply utility
2 million customers served

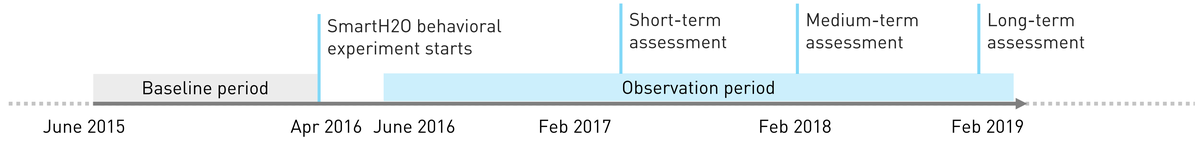
GAMIFICATION

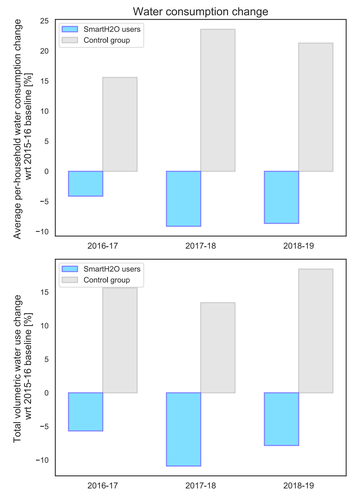


Water consumption is visualized with user-friendly visualizations and peer-comparison.

The SmartH2O user awareness portal includes a smartphone app and gamification mechanisms to promote water conservation behaviors.

SHORT- & LONG-TERM BEHAVIOR CHANGE OUTCOMES IN VALENCIA





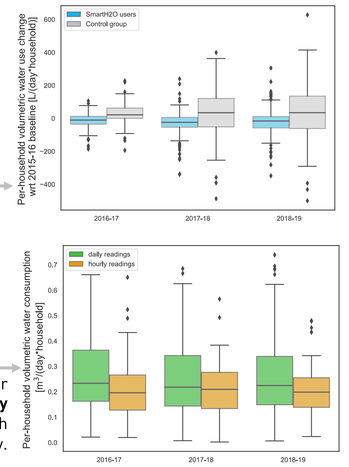
Behavioral experiment groups:
. SmartH2O users: **226** households
. Control group: **112** households

SmartH2O users decreased their water consumption with respect to the baseline period (i.e., pre-SmartH2O) **by approx. 5%** per household in 2016-17. Conservation efforts are even increased to about **8% in the medium- and long-term**. Conversely, users in the control group increase their water consumption, on average, by more than 15%, in the observation period.

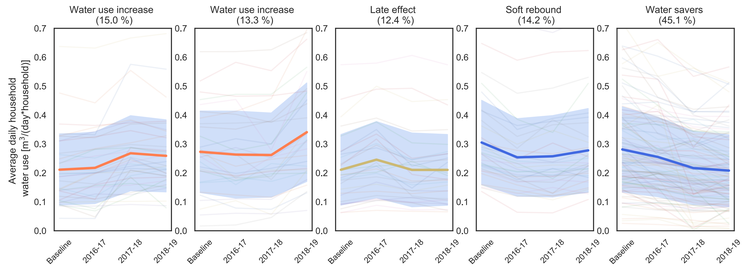
The range of water consumption change in the control group increases in the medium- and long-period. On average, SmartH2O users showed a more stable water usage behavior that results in reduced water consumption.

The **volumetric** water usage **difference** between the **SmartH2O users** and the **control group** is approximately between **20-25%**.

Water consumers with **smart meters** reading their household water consumption with **1-hour frequency** showed **better water conservation** than those with readings recorded with 1-day frequency.



CUSTOMER SEGMENTATION ANALYSIS



Among the SmartH2O users, we identified 5 clusters of water users by means of data-driven hierarchical clustering based on correltion distance. From the left, in the figure:

. **Water use increase** (clusters 1 and 2): no water conservation effects are visible

. **Late effect** (cluster 3): water conservation slightly starts in the medium-/long-term, but it is not very evident

. **Soft rebound** (cluster 4): water conservation in the first period, followed by a rebound period with water consumption going back to pre-treatment levels

. **Water savers** (cluster 5): water conservation starts early in the observation period and even improves in the medium- and long-term. These are the **majority**, approx. **45%** of all users.

TAKE-HOME CONCLUSIONS

. SmartH2O has demonstrated to be effective in the short-term: the SmartH2O users conserved more water than the users in the control group and used less water than before the start of the SmartH2O program.

. Medium- and long-term water conservation effects persist for the majority of users (~45%), while rebound effects are visible for about 14% of the users.

Related literature

Cominola, A., Nguyen, K., Giuliani, M., Stewart, R. A., Maier, H. R., & Castelletti, A. (2019). Data mining to uncover heterogeneous water use behaviors from smart meter data. Water Resources Research, *in press*.

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