



# Gamification for water utilities

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# Agenda

- Gamification and how it works
- Gamification as a strategy for water demand management
- Example SmartH2O project:
  - Overview of applied incentive model
  - First results

# Gamification & how it works

# Gamification

“The use of game design techniques and game mechanics to enhance non-game contexts”

S. Deterding, M. Sicart, L. Nacke, K. O’Hara, and D. Dixon,  
“Gamification. Using game-design elements in non-gaming contexts”

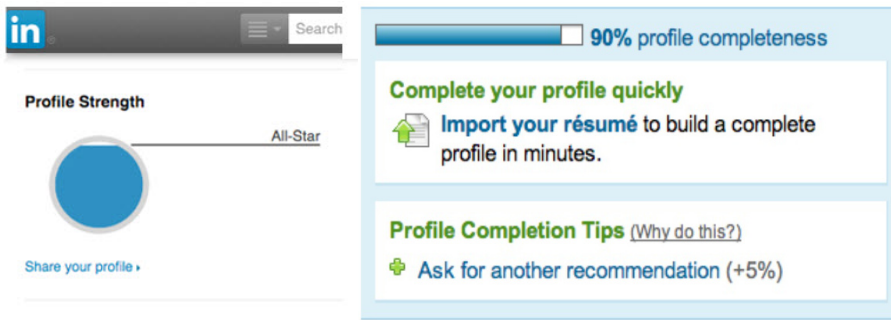
- Game-like elements should trigger specific behaviour (motivation to complete tasks)
- Motivation and feedback mechanisms are integrated into “serious contexts“
- Related concepts: Persuasive Games, Serious Games, Gameful Interaction Design, Games with a purpose (GWAPs)

Points

Leaderboards

Achievements and badges

# Examples of gamification



Source: LinkedIn



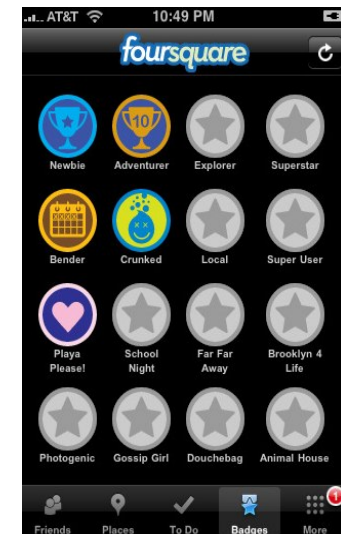
Source: Duolingo



Source: Nike+



Source: Khan Academy



Source: Foursquare

# Game-like elements

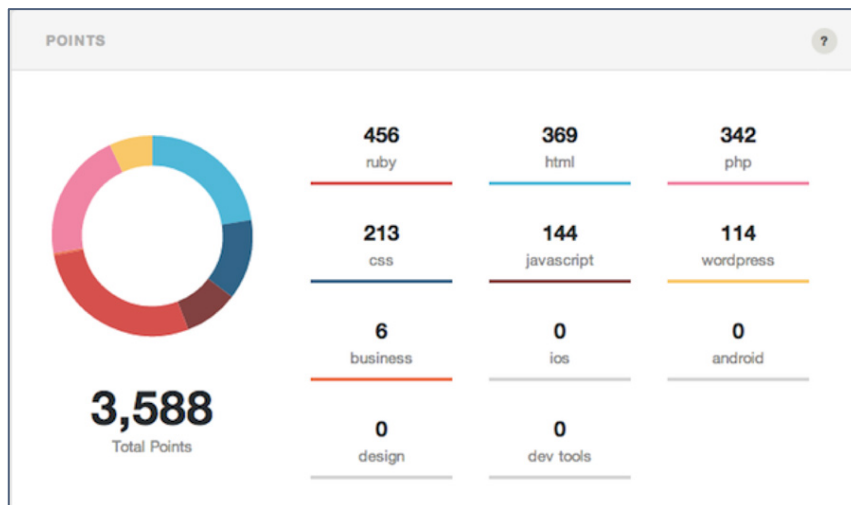
Points

Leaderboards

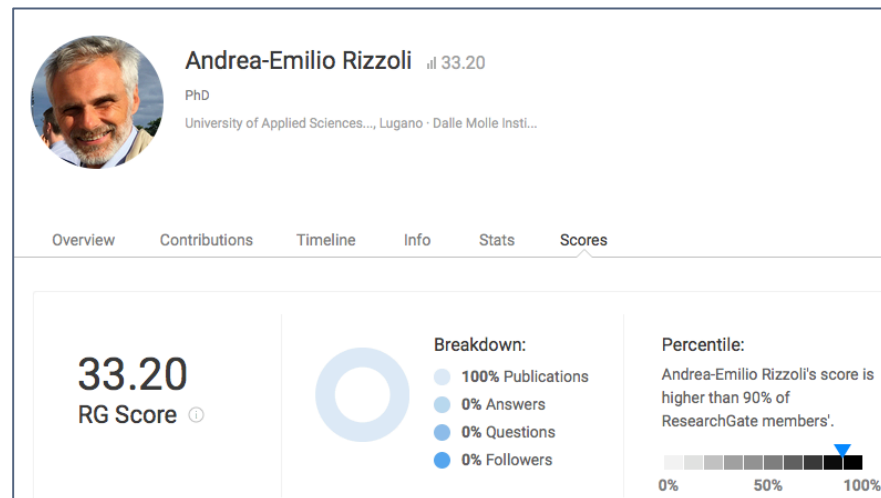
Achievements and badges

**Points** or **Player Scores** are a numerical value that represents a measure of the skill of a user.

- Immediate and lasting feedback
- External display of progression
- May determine the win state
- Connection between progress in the application and rewards



Source: Treehouse



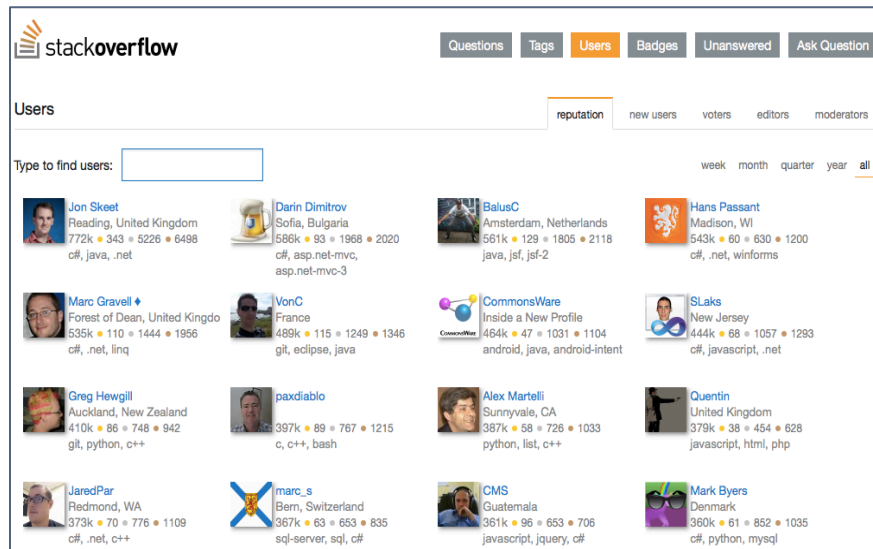
Source: Researchgate

Galli, L., Fraternali, P. "Achievement Systems Explained" SGSC2012, Singapore

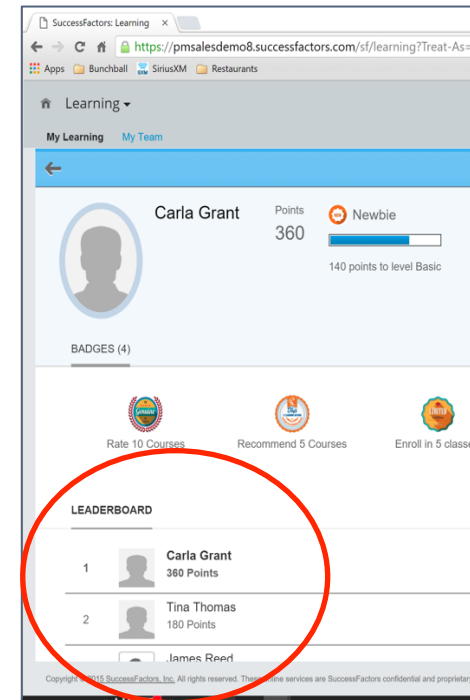
Werbach, K. & Hunter, D. For the Win: How Game Thinking Can Revolutionize Your Business, Wharton Digital Press, 2012

A **Leaderboard** is an ordered list of players based on the scores they have obtained in a specific game or system.

- Relates the performance of a player to the others
- Fosters competition and participation
- Risky: May be demotivating



Source: Stackoverflow



Source: SAP Success factors



# Game-like elements

Points

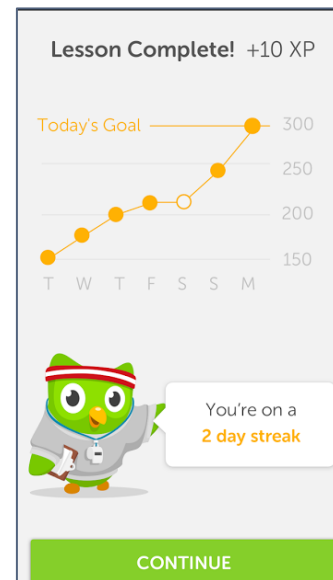
Leaderboards

Achievements and badges

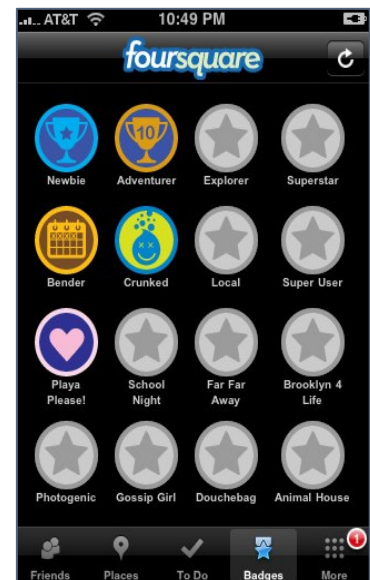
An **Achievement** is a set of tasks, defined by a designer, for the user to fulfill so to achieve a milestone and track the progress in a system.

A **Badge** is an artifact associated to the completion of an achievement and given to a player after its completion, or, in gaming terms, after “unlocking the achievement”.

- Define goals
- Onboarding tool
- Visual markers for reputation,
- Provide lasting rewards



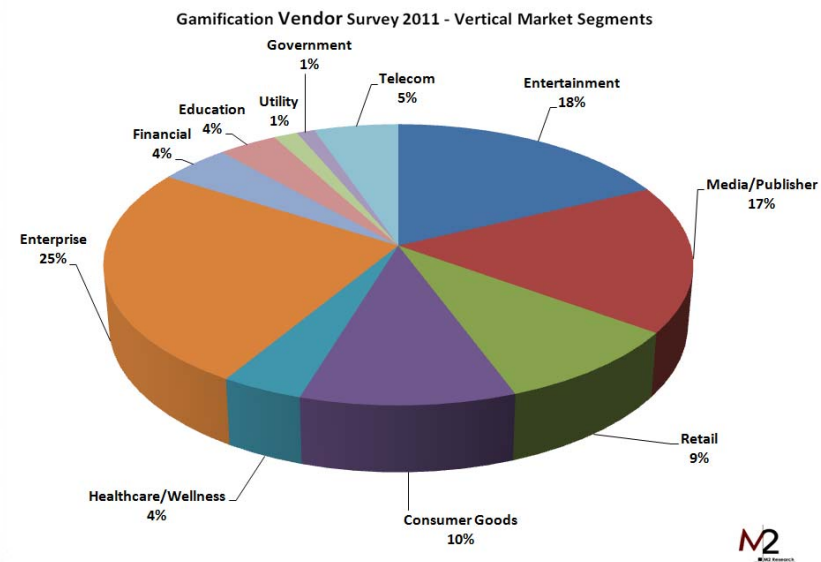
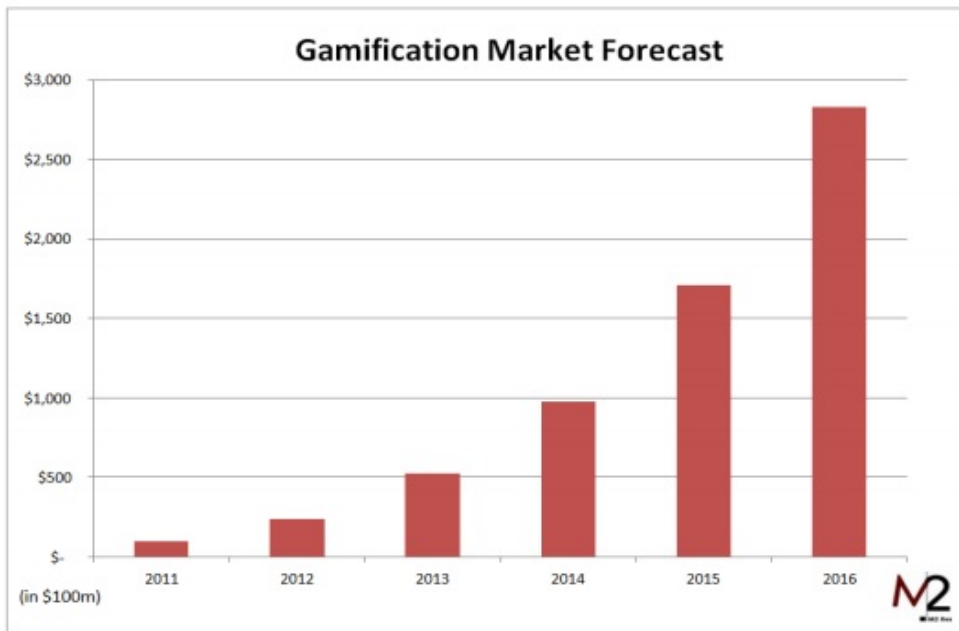
Source: Duolingo



Source: Foursquare

# Gamification market

## Market Size and Projections



(in millions)	2011	2012	2013	2014	2015	2016
Total	\$100	\$242	\$522	\$980	\$1,707	\$2,830

Source: M2 Research

# Is it working?

## Case Study – Samsung Nation

### Samsung Nation

Welcome to Samsung Nation<sup>BETA</sup>  
Let's Round Up Everyone

Samsung Nation is the exciting new social loyalty program where you earn badges, move up the ranks and have fun discovering everything Samsung.com has to offer. Unlock badges and level up just by visiting, reviewing products, watching videos, participating in user-generated Q&As, and much more. Plus, you can see what others are doing in real time and even uncover a few surprises along the way.

Like 204 | Like 469 | Send



#### Log In

Enter your existing Samsung.com username and password:

Email

Password

[Forget your password?](#)

Remember my email address

[Log In](#)

or

Sign in using your account

[f](#) [t](#) [in](#) [u](#)

New to Samsung Nation? [Join now!](#)

#### Samsung Nation

What's this?

Leaderboard [My Rewards](#)

Daily

Are you a Samsung fan?  
[Join now!](#) [Sign In](#)

1		braxton anderson	6,350 pts
2		luke binter	6,025 pts
3		glenn fox	3,025 pts
4		michael conklin	1,825 pts
5		victoria crabtree	1,625 pts
6		skipper carlisie	1,625 pts

[How do I earn points?](#)

#### Activities

What's this?

- chris gardner unlocked the Player badge 7 minutes ago
- chris gardner unlocked the Early Adopter badge 7 minutes ago
- chris gardner leveled up to Novice 7 minutes ago
- theresa schwarz unlocked the Streamer 4.0 badge 7 minutes ago
- ewald bushman unlocked the Player badge 7 minutes ago
- ewald bushman unlocked the Early Adopter badge 7 minutes ago
- ewald bushman leveled up to Novice 7 minutes ago
- ames rooco leveled up to Novice 7 minutes ago

[Pause](#) [How do I earn points?](#)

#### Early Adopter Sweepstakes



Register to unlock the Early Adopter Badge and a chance to win a Galaxy Tab 10.1. [Register now.](#)

[Offer Details](#)

#### This Month's Promotion



Have you posted a product review to unlock the Star Badge? You could win a MultiView MV900 Digital Camera!

[Offer Details](#)

## Samsung Nation

### Purposes:

Samsung Nation, a social loyalty program that lets users earn badges for activities as writing reviews, watching videos and compete for rewards.

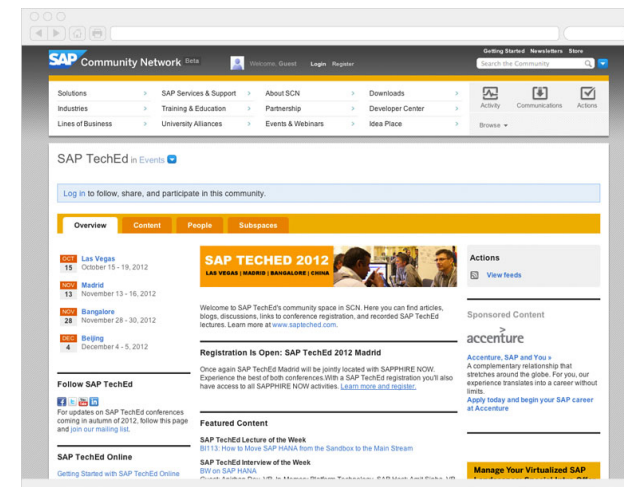
### Results:

- 500% increase in customers product reviews
- 66% increase in site visitors
- 30% increase in comments
- reduced marketing costs
- reduced product support costs

# Is it working?

## Case Study – Gamification in the SAP Community Network (SCN)

- SCN started in 2003 as an SAP developers network
- At first typical online community problems occurred
- 2004 – Integration of a **points system** for the participation in forums (knowledge exchange, support for other members)
- 2006 introduction of a „**top contributors**“ list (leaderboard)
- 2009 Implementation of a **mentor program**
- 2011 update of existing elements
- **Points and levels have significantly attributed to fostering participation and knowledge exchange**
- Unexpected result: Status (reputation) in the SCN wasn't just used inside SAP but also externally (CV, LinkedIn) and for other organisations

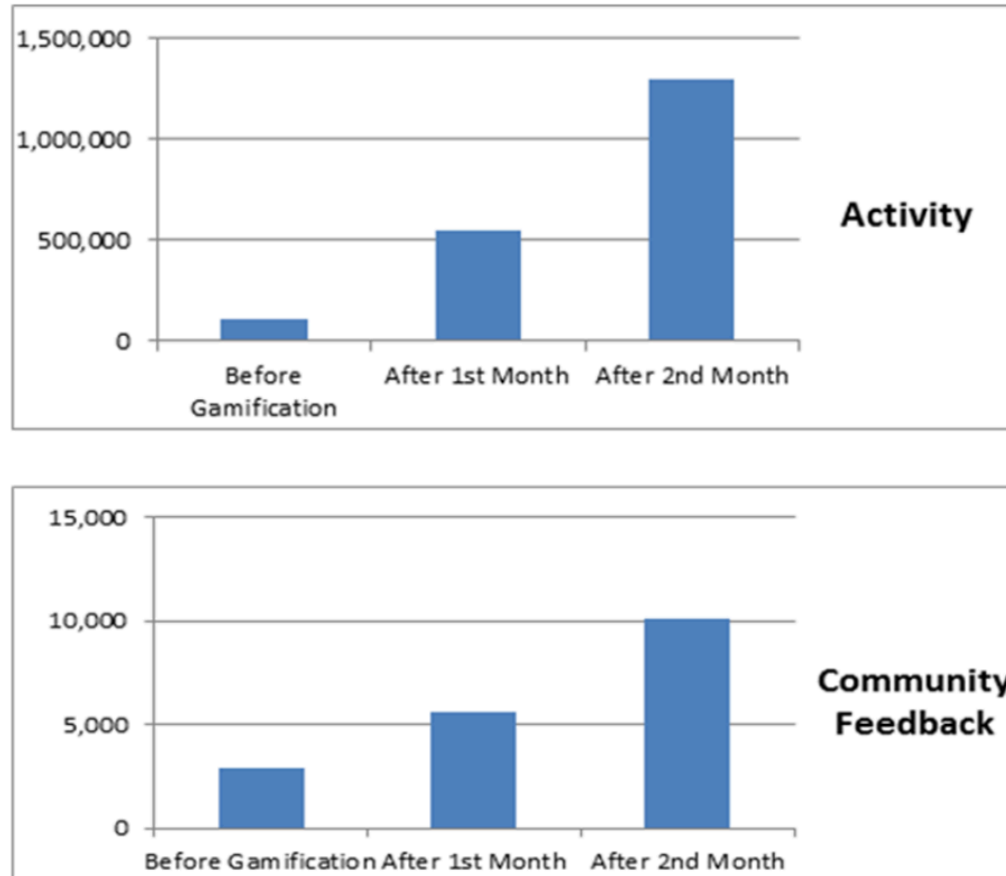


# Case Study – Gamification in the SAP Community Network (SCN)



Source: Lusher, C. (2013): Case Study: Gamification at SAP Community Network

# Results SAP Community Network



Source: Lusher, C. (2013): Case Study: Gamification at SAP Community Network

# Is it working?

## Gamification in literature

- Literature review by Hamari et al., 2014:

**Table 4. Effects reported in quantitative studies**

<b>Results</b>	<b>Paper</b>
All tests positive	[13][37]
Part of the tests positive	[8][10][12][14][15][16][18][22][23][25][27][32][33]
All tests not significant	-
Only descriptive statistics	[2][4][17][20][21][36][41]

**The majority of the reviewed studies did yield positive effects/results from gamification.**

The studies bring forth two main aspects to be considered:

- 1) the role of the context being gamified, and the
- 2) qualities of the users

# Criticism of gamification

- Short term effects
- Not every process or every activity is equally suitable for gamification
- Sometimes processes may have to be restructured to be gamified
- Gamification alone is often not efficient enough
- Little attention has been paid to the gamification process (incl. selection of suitable game dynamics and mechanics)
- Marketing Hype
- Pointsification



# Gamification as a strategy for water demand management

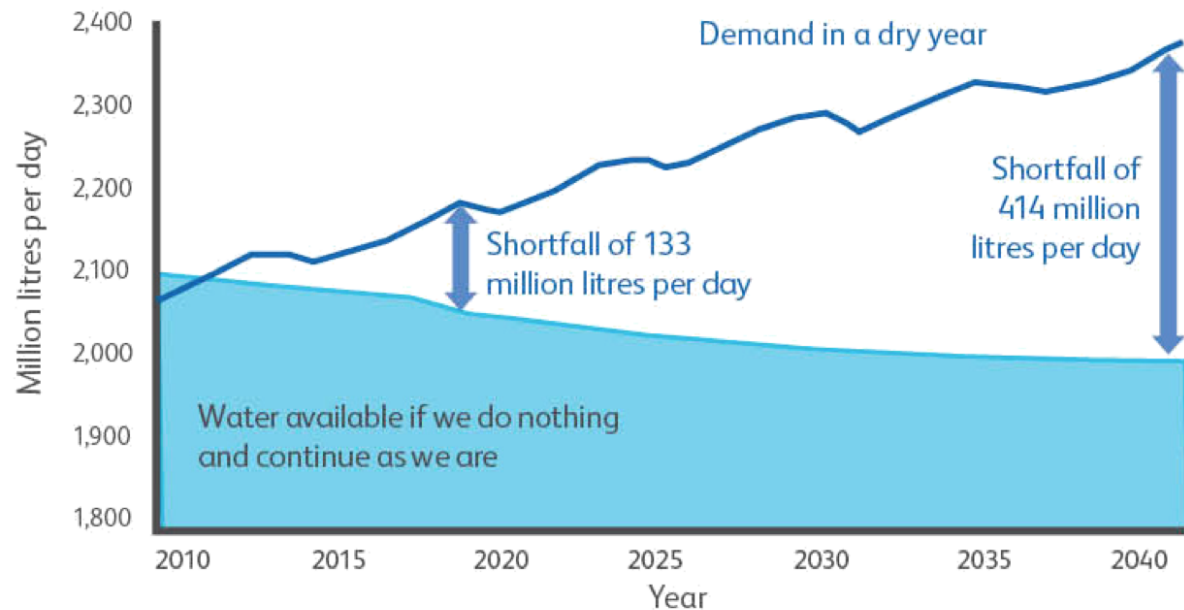
# Water demand management: a case study

- The problem



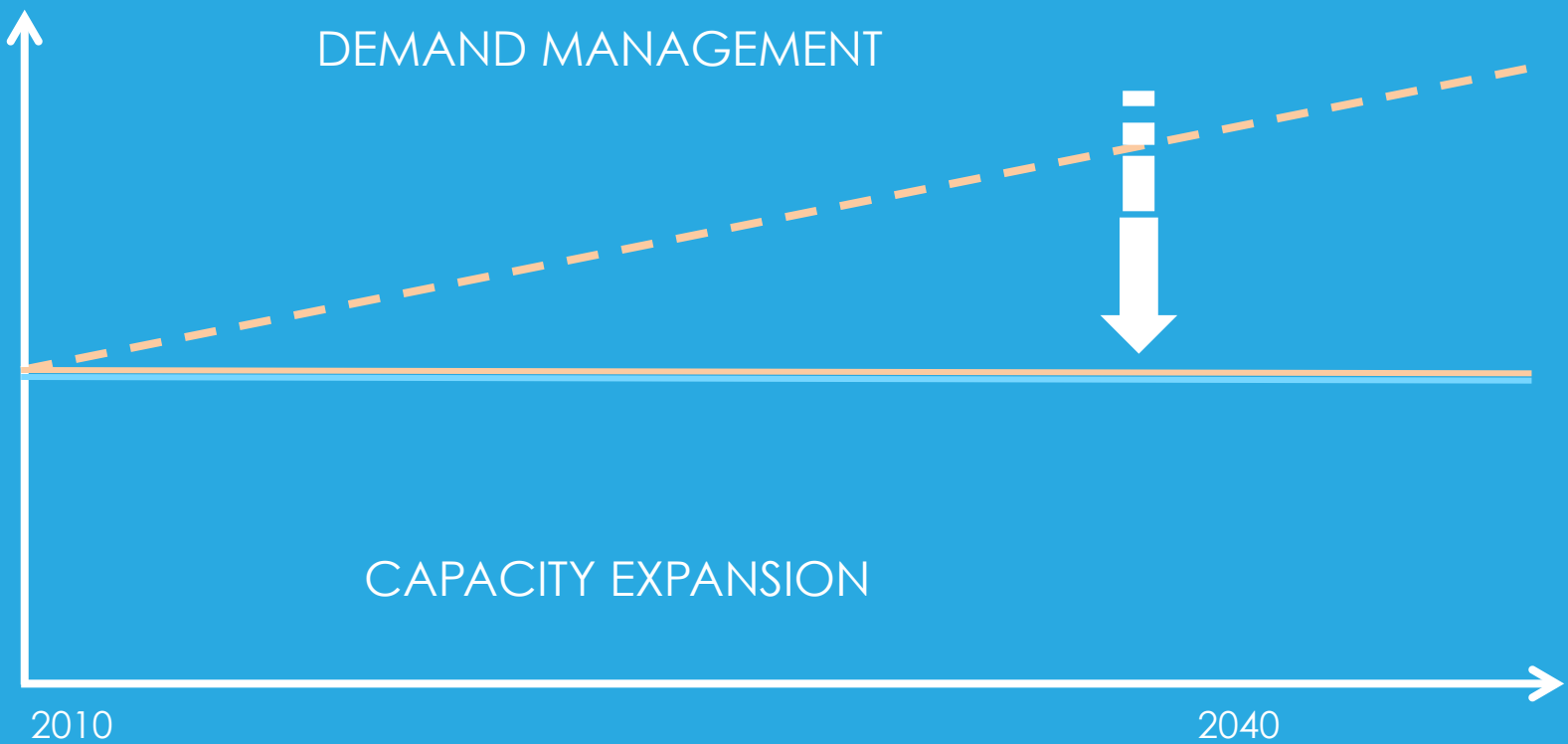
UK\_WATER SUPPLY UTILITY  
15 million customers  
2.6 Gl/day drinking water  
3 billion \$ revenue (2013-14)

Forecast gap between supply and demand in London



Source: Draft Water Resources Management Plan, 2014

# Water demand management: a case study



## Two main challenges

- How to present consumption information and convey its meaning to users?

 **increase awareness**

- How to enable and motivate consumers to change their consumption?

 **induce & sustain behavior change**

actionable tips

gamification

comparison

visualization

disaggregation

# Playful appliance-based water consumption feedback

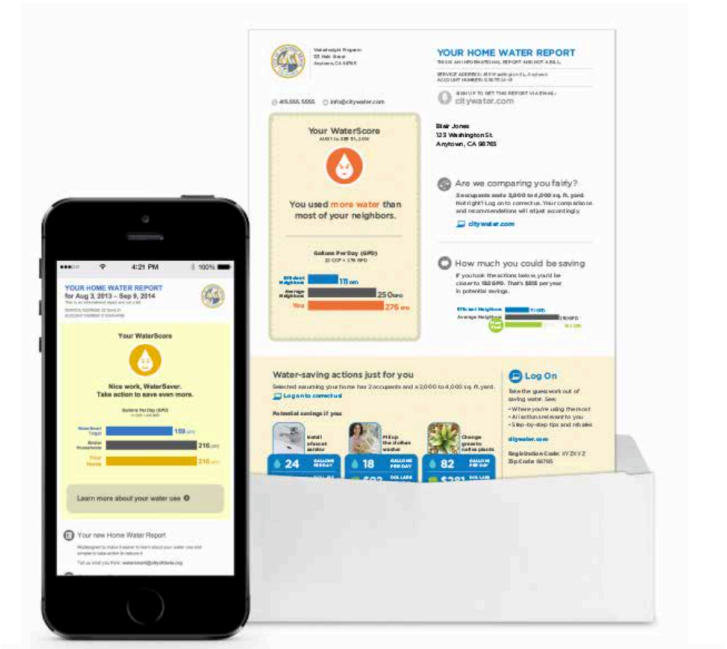
Displays attached to water appliances, assuming that feedback is most effective when delivered close to the cause of the consumption (Kappel & Grechenig, 2009):

- **Waterbot** displaying water consumption to at the tap in the kitchen (Arroyo et al., 2005)
- **Shower Calendar** showing the water consumption of household members on a calendar display in the shower (Laschke et al., 2011)
- **Amphiro** on-shower device combines in-shower visualisation with reports viewable on web-based and mobile apps (Tiefenback et al., 2014)



# Commercial SaaS products like WaterSmart: customer engagement and data analytics platform

- Personalized WaterScore every billing period
- Social norm-based, comparison of water use with similar households
- Data insights to improve understanding of water use
- Customized, water-saving recommendations
- Targeted communications and utility messages





- WATERNOMICS project



- Integration of personalized feedback on water consumption
- Data from sensors and fault detection algorithms
- Interactive water information services: Enabling visual dashboards, Decision support systems for water saving, Games and interactive learning applications

(Clifford et al., 2014)



- WISDOM project



- Aims at behavioural change in water consumption
- Near real-time consumption feedback on an in-home display
- Virtual game

(Terlet et al., 2016)



- SmartH2O project



<http://www.smarth2o-fp7.eu/>  
@smarH2Oproject



Grant agreement no.: 619172

# Gamification in the SmartH2O project



# SmartH<sub>2</sub>O: An ICT platform to leverage social computing for the efficient management of water consumption



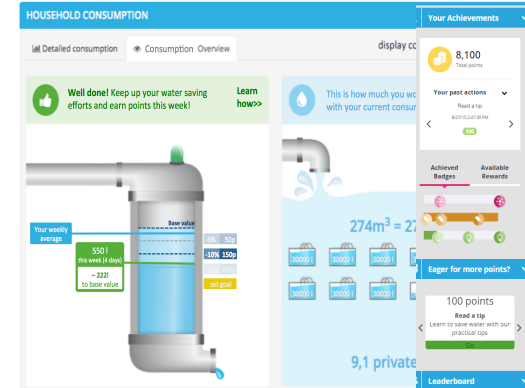
- High-resolution water consumption data



- Interaction with customers for human-centered design, awareness campaigns & socio-psychographic data gathering



- Innovative water demand management strategies: customized feedback and rewards
- Gamification and visualization



**SmartH<sub>2</sub>O project** goes beyond social comparison and rebates by combining visualisation and saving tips with personal, social, virtual & physical rewards

Scuola universitaria professionale  
della Svizzera italiana

**SUPSI**



**POLITECNICO  
DI MILANO**



The University of Manchester



**UNIVERSITAT  
POLITÈCNICA  
DE VALÈNCIA**



**SETMOBILE**



moonsubmarine



### Consumer Portal

- Awareness
- Feedback

### Engagement & Behavior Change

- Recommendations
- Goals, Achievements, Rewards

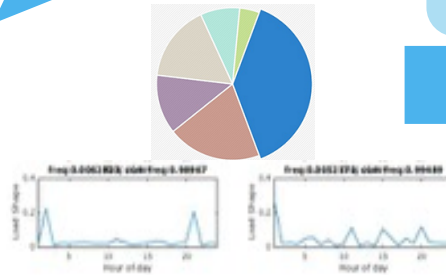


### Data acquisition (smart meter)



### Consumption data repository

- Privacy
- Security

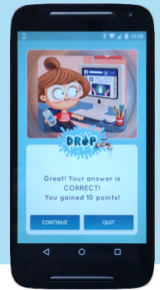


### Water data analytics

- End use disaggregation
- Consumption patterns detection

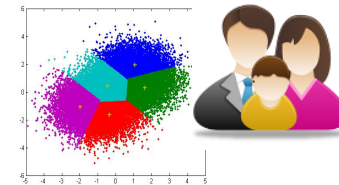


- Digital+real games
- Personalized tips

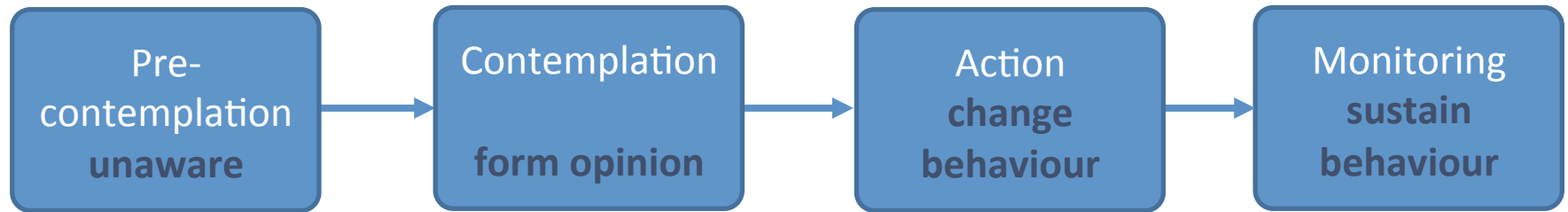


### User modeling

- Household features
- Clustering
- Demand prediction and simulation

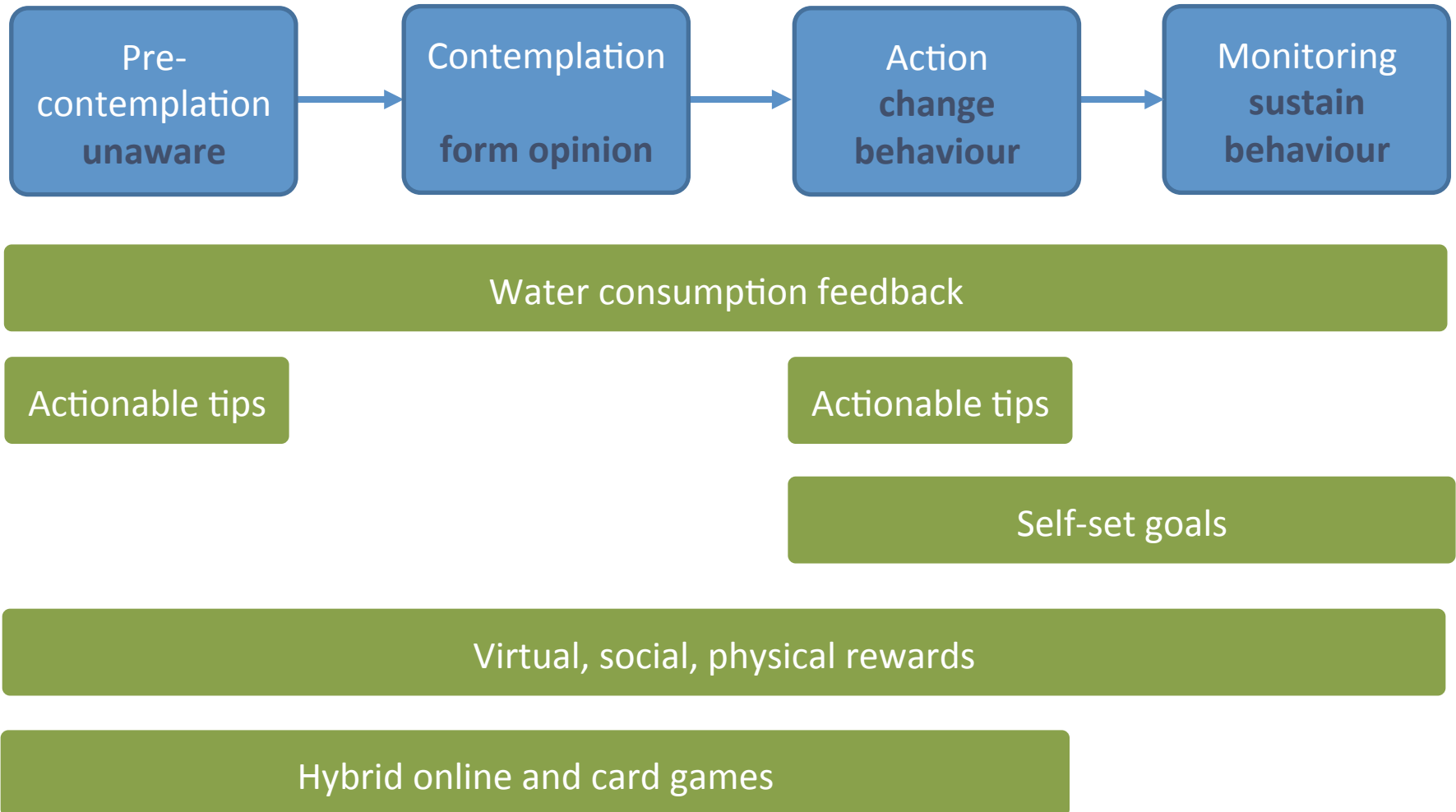


**Changing water consumption behaviour is perceived as a multistage process**  
**Different stages, different needs, different incentives**



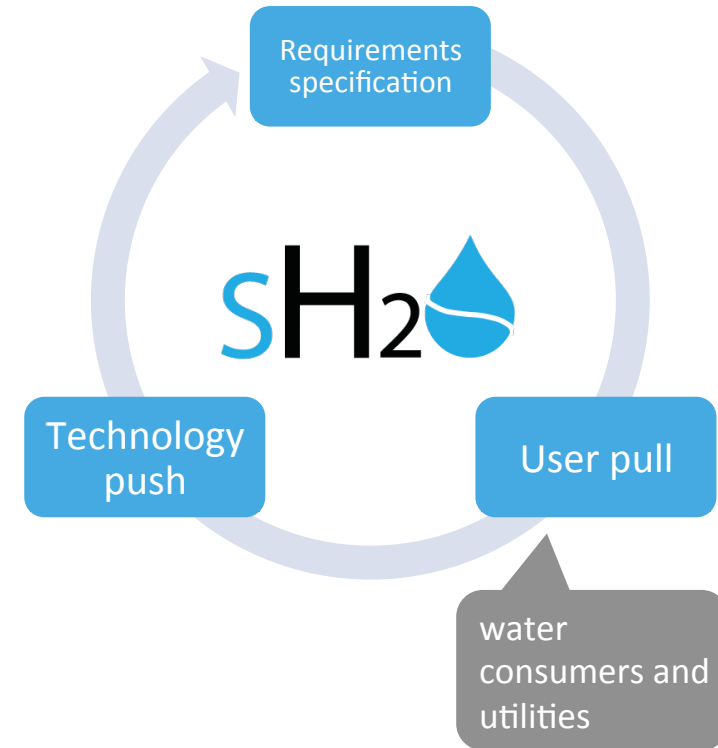
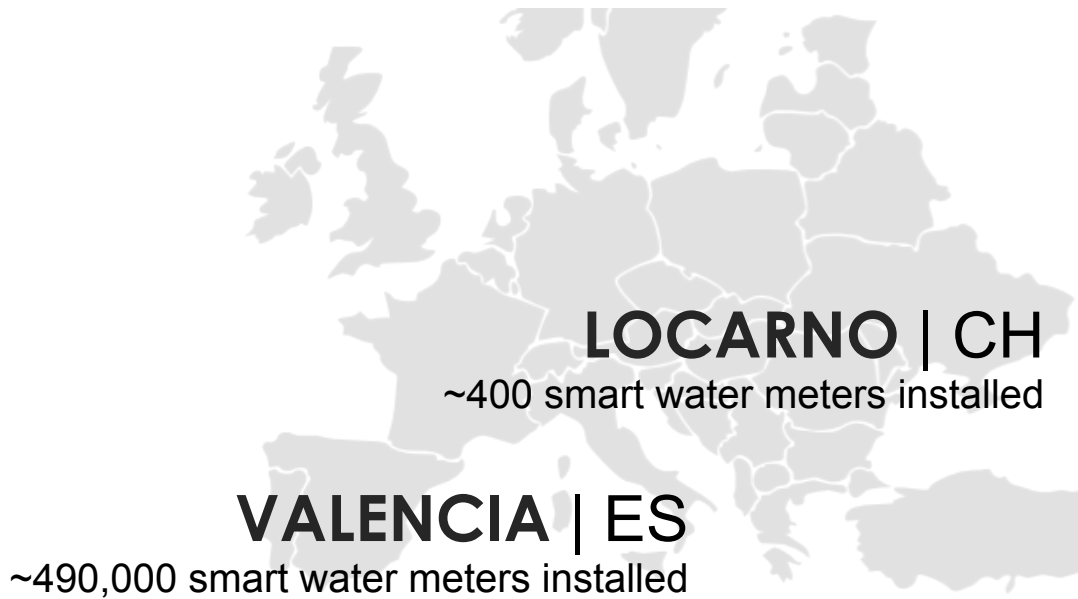
*Transtheoretical model of behavioural change (Prochaska & Di Declemente, 1992)*

# Incentive model



## Prototyping & user feedback

- SmartH2O objectives: Reduce water consumption, raise awareness
- Application for water utility customers
- 2 case studies:



# Raising awareness through gamifying consumption



First visual prototype of the gamified portal

- Prototype was discussed in a workshop session with 30 local residents in a Swiss municipality
  - More pragmatic users should be considered

- Gamified application connected to a user's smart meter
- User actions earn points, badges and rewards
- Leaderboard, neighborhood map, teams



# Differentiating pragmatic and hedonic scenarios and users

**SH<sub>2</sub> Visual water meter** Upgrade to the advanced version

Current meter reading: 12345 m<sup>3</sup>

Welcome, Paolo

Start Tips

Well done, Paolo! If you keep your current water saving efforts, this is how much you can save in 1 year: **13440 litres ≈ 40€** (this equals 65 bathtubs full of water)

**Water Saving Tip** 5.02.2015  
**Save water every time you have a cuppa**  
Only boil the amount of water you need so that you don't heat water you won't use.

**Your Savings**

Your water consumption per day per week per month

Consumption metrics

your town  
your household  
your neighbors  
similar households

750l

daily average today's total

SH<sub>2</sub> Advanced water meter

Current meter reading: 12345 m<sup>3</sup>

Welcome, Paolo

Start Household profile Water diary Tips Leaderboards & teams

Well done, Paolo! If you keep your current water saving efforts, this is how much you can save in 1 year: **13440 litres ≈ 40CHF** (this equals 65 bathtubs full of water)

f I rock! Share this on Facebook

**Basic portal:**  
consumption visualization  
and practical water  
consumption alerts and tips

**Gamified portal (opt-in):**  
+ gamification and social  
features

**Savings Goals**

Your water consumption per day per week per month

estimate cost Consumption metrics

3,92m<sup>3</sup>  
Your goal 3,5 m<sup>3</sup>  
500

Utility goal

Badges Weekly Goals

400l

200l

5am 6am 7am 8am 9am 10am 11am

today's total monthly goal

daily average monthly average

**Your achievements**

2 Congratulations! You are now a level 2 super smart saver! Share

Expand to see all

**Hungry for more points?** Complete your profile and get a reward! Profile completion 75%

**Water saving action**

Did you know? Installing a water saving showerhead can reduce up to % of water consumption! 500 points  
Learn how! I already did it!  
Thanks, not for me.

**Leaderboard & Teams**

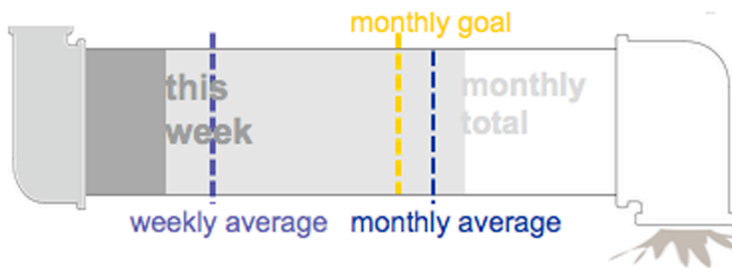
Leaderboard My teams

Antonio	1
Maria	2



# Designing actionable consumption visualizations

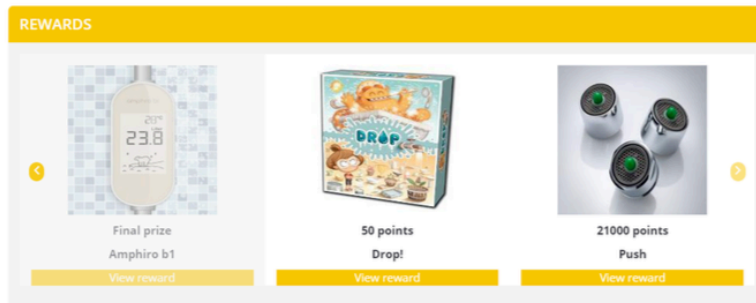
- Interactive layered visualization at different levels of detail
- Addressing data & time granularity, different consumption comparison and measurement units
- Embedded actionable tips
- **Water pipe metaphor:** self-comparison, goal-comparison



# Case study differences in incentive model

## Swiss case study (400 households)

- Reward market place



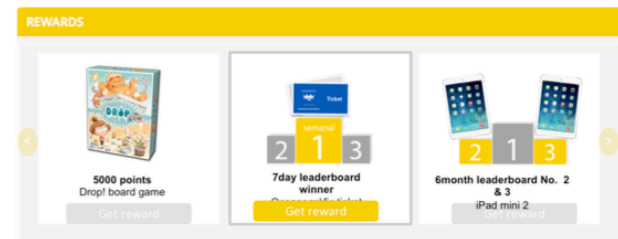
### Amphiro b1

The Amphiro b1 gives you real-time consumption feedback in the shower on the used water and energy amount and the current temperature, and sends the information via Bluetooth 4.0 to your mobile device

[See product website](#)

## Spanish case study (400'000 households)

- Different reward types:
  - Onboarding
  - Competition-based



Be the first in the 7day leaderboard to win a ticket to the Oceanogràfic

At the end of each week, SmarH2O announces the winner of last week's 7-day leaderboard, who gets a **free ticket to the Oceanogràfic**. If you are the lucky winner, you will receive an email notification, and you can claim your free ticket below. So start saving water and collect points on the portal to make it to the top.



### Ticket to the Oceanogràfic museum

Visitar el mayor parque marino de Europa donde podrás realizar una apasionante travesía a lo largo de los ecosistemas marinos más importantes del planeta. Belugas, delfines, tiburones y pingüinos te esperan para descubrirte los secretos del mar.

[Get reward](#)

The screenshot displays the SmartH<sub>2</sub>O portal interface. At the top, there is a navigation bar with the SH<sub>2</sub> logo, a 'BETA TEST' label, a language selector (UK), notification icons, and a user profile for 'Chiara'. The main content area is divided into several sections:

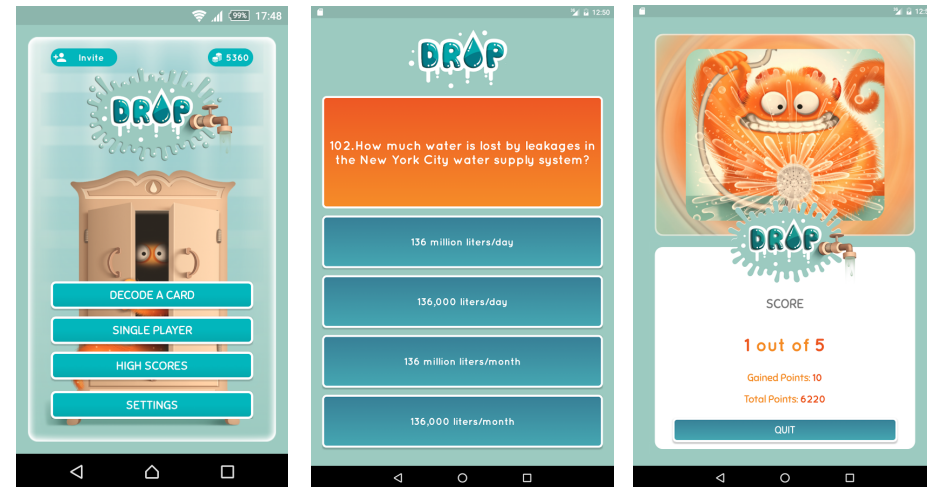
- Consumption:** A tabbed interface with 'Consumption' selected. It shows 'HOUSEHOLD CONSUMPTION' with options for 'Detailed consumption' and 'Overview'. A 'Well done!' message encourages keeping current water saving efforts. A diagram of a water meter shows a 'your weekly average' of 1195 l (week total) and a 'Base value' of 420 l (below your goal). A callout indicates a '-5% 100pt' reward for staying below the goal.
- Current meter reading:** A blue box at the top right shows a current reading of 137.435 m<sup>3</sup>.
- Your Achievements:** A section showing '12,950 Total points' and 'Your past actions' with a 'View details' button. Below are progress bars for 'Achieved Badges' and 'Available Rewards'.
- Eager for more points?:** A section offering '100 points' for reading a tip about saving water, with a 'Go' button.
- Leaderboard:** A section showing a list of users, with Chiara at rank 8.

Additional visual elements include a water tap illustration with a '4m<sup>3</sup> = 4000 l' label and a '26,6 bath tub' equivalent, and a row of water meter icons representing consumption goals.

# Drop! The Question mobile game

<https://play.google.com/store/apps/details?id=it.polimi.sh2o.drop>

- Water trivia quizz app
- Users earn points for correct questions
- Syncs with SmartH2O portal
- Can be played as stand-alone app or with Drop! card game:
  - Lily and the water waster monster
  - QR code on monster cards
  - Scanning and responding correctly: bonus points



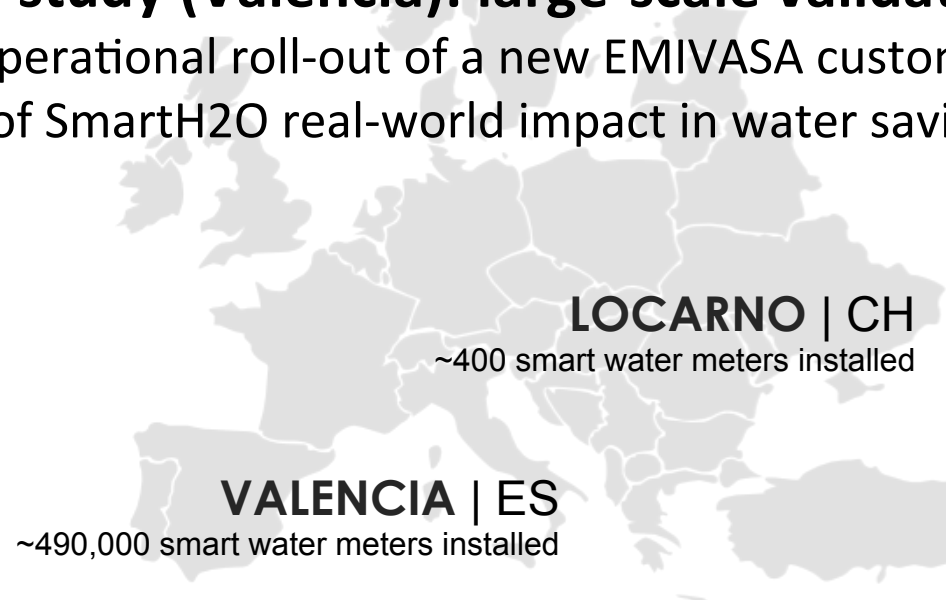
# First results from the SmartH2O validation

Novak, J., Melenhorst, M., Micheel, I., Pasini, C., Fraternali, P., Rizzoli, A.-E., 2016. Behaviour change and incentive modelling for water saving: first results from the SmartH2O project, Proc. of iEMSS 2016 – 8th International Congress on Environmental Modelling and Software, Toulouse. Vol. 3, pp. 776

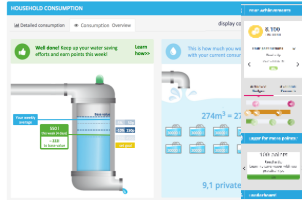
<http://www.iemss.org/sites/iemss2016/vol3.php>

## Two real-world deployments of the SmartH2O platform

- **Swiss case study (Tegna): small-scale validation**
  - testing and tuning of the incentive model and gamification techniques
  - testing the measurement infrastructure, system and user acceptance
- **Spanish case study (Valencia): large-scale validation**
  - full-scale operational roll-out of a new EMIVASA customer service
  - validation of SmartH2O real-world impact in water saving



## Social awareness app



## Awareness



## Behaviour



### Measurements:

- Technology acceptance on portal level and use-case level
- Behaviour on the portal



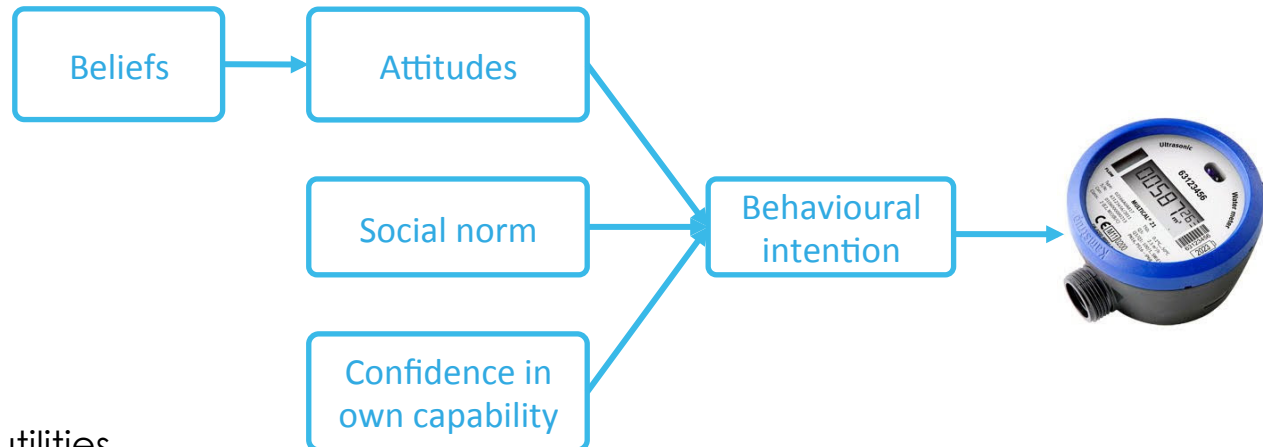
### Measurements:

Operationalization of awareness:  
water consumption determinants  
(*Theory of Planned Behaviour*)



### Measurements:

Comparison of smart meter  
readings against baseline



## Preliminary results in water consumption reduction

First results of portal with visualisations and tips, but without gamification

Consumption class	No. of users	Average reduction
Low	10	41.2%
Medium-low	22	26.9%
Medium-high	10	41.2%
High	1	21.2%
<b>Overall</b>	<b>43</b>	<b>33.8%</b>

Average reduction over 3 month period (1 Nov 2015 to 6 Feb 2016) vs. baseline (readings start - Oct 31 2015)

Seasonal influences account for 25-30% of the reduction



## Status:

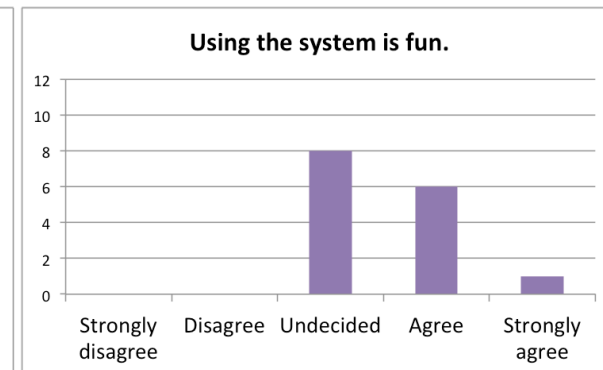
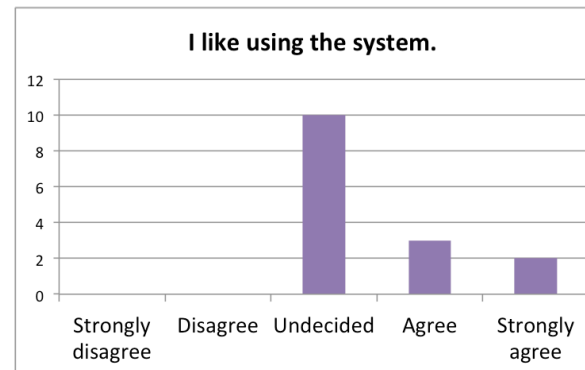
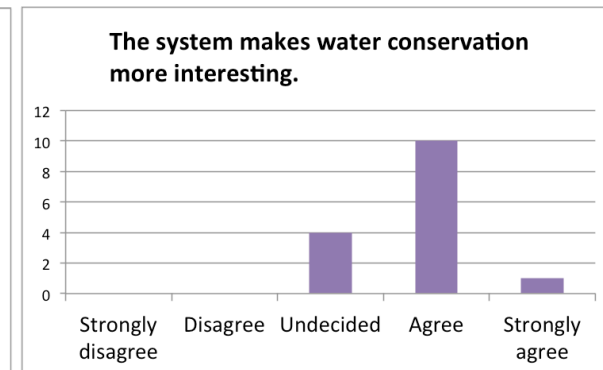
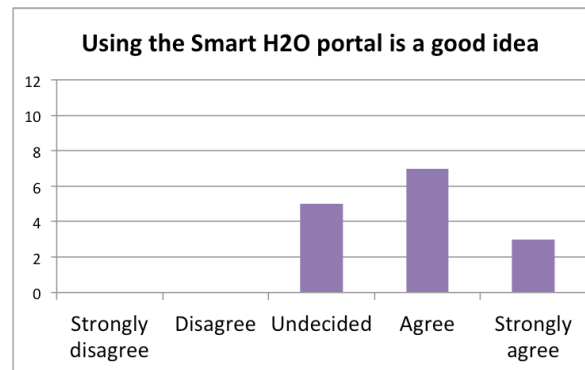
- 49 registered users
- 46 for the Drop! Game

## Positive technology acceptance results

- Performance expectancy
- Effort expectancy
- Attitude towards technology

(UTAUT, Venkatesh et al., 2003)

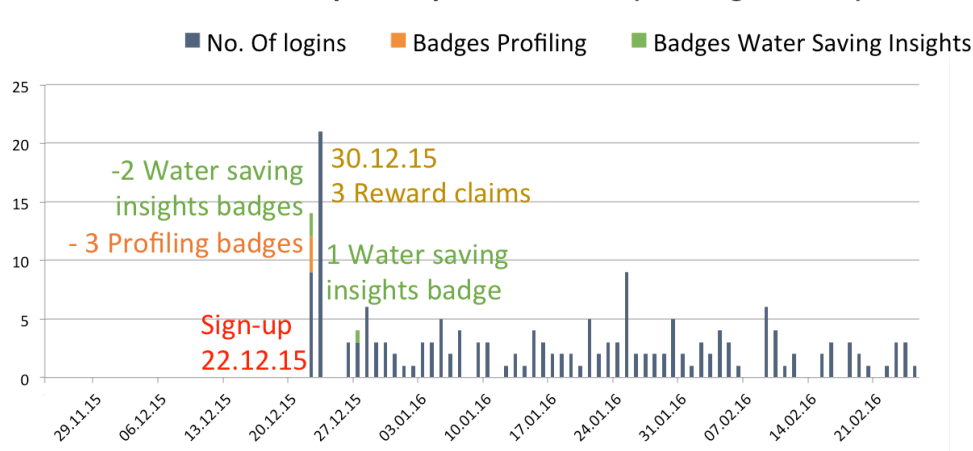
*Technology acceptance results for visualisations and water saving tips, not for gamification (yet)*



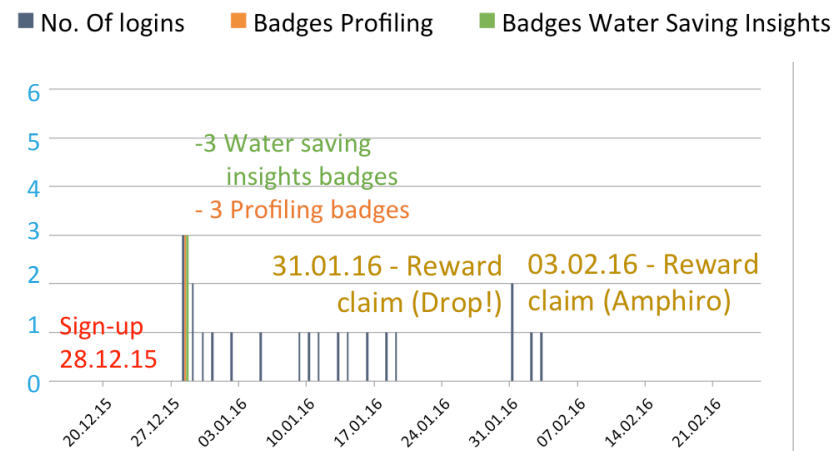
## Data show promising lead user activity on the platform, including interaction with gamification, already after short time

- Peak activity after initial incentives and rewards
- Activity level remains constant after initial peak
- Users interact with gamification elements (e.g. badges, rewards)

Daily activity of lead user A (total logins = 176)



Daily activity of lead user #3 (total logins = 21)



## Current recruitment results

- **SmartH2O users:**
  - Promotion via e-mail and paper bill
  - 344 users
  - 295 (87%) filled out baseline awareness questionnaires
- **Control group:**
  - Call center
  - 204 answered to baseline awareness questionnaire
- Continuous promotion campaign for scale-up

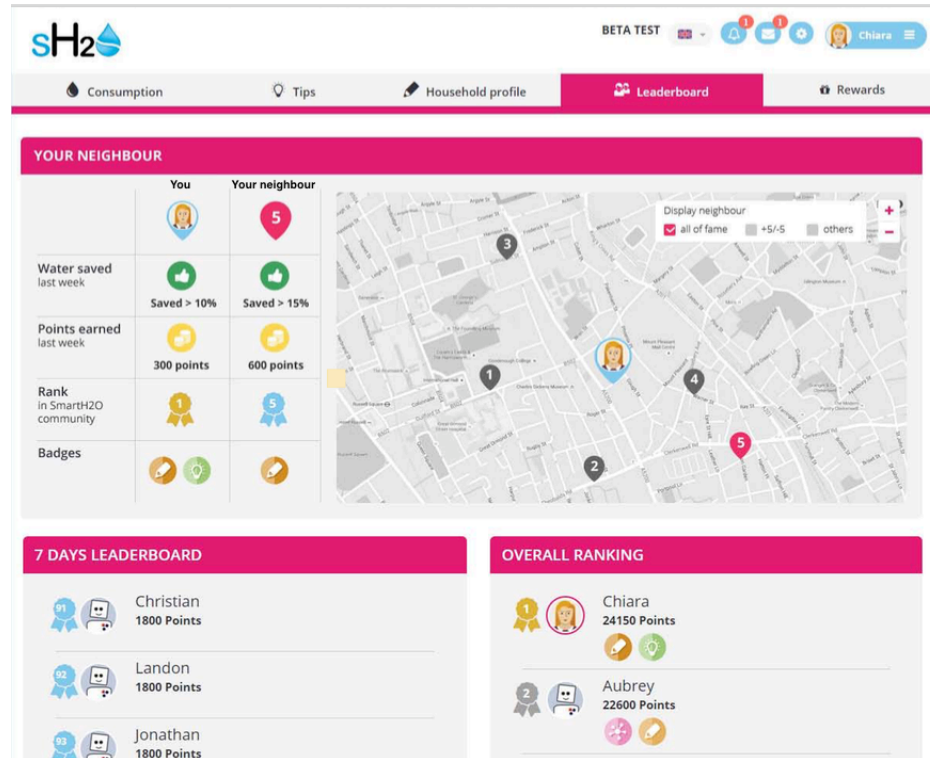
## Conclusion

- Behavioural psychology was used to construct a gamified incentive model for a real-world application to save water, offering support to users across the behavioural change process.
- Initial promising findings were found in a small-scale pilot

## Future work

- Large-scale validation in Valencia with potentially ~500k households, featuring:
  - experimental comparison of SmartH2O vs. a control group
  - the currently presented system, extended with social sharing features
  - supported by promotion campaigns to recruit users

- New release will include:
  - Mobile app
  - Weekly digest
  - Social sharing features:
    - Facebook
    - Twitter
    - E-Mail
  - Neighbourhood comparison

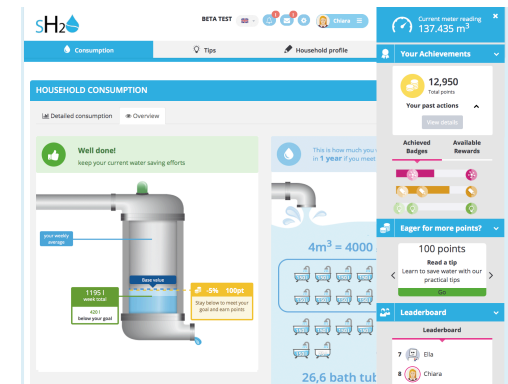


# Thank you.

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- Gamification and how it works
- Gamification for demand management
- Main Challenges:
  - How to increase awareness
  - How to induce & sustain behavior change
- Experiences from the SmartH2O project & demo
- First results from the SmartH2O project



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