

Wat€rnomics

D7.3 WATERNOMICS Water Bill

Sander Smit, Christos Kouroupetroglou, Riccardo Puglisi

Project Acronym:	Waternomics
Project Title:	ICT for Water Resource Management
Project Number:	619660
Instrument:	Collaborative project
Thematic Priority:	FP7-ICT-2013.11

D7.3

Work Package:	WP7	
Due Date:	30/04/2016	
Submission Date:	29/04/2016	
Start Date of Project:	01/02/2014	
Duration of Project:	36 Months	
Organisation Responsible of Deliverable:	BM-Change	
Version:	1.0	
Status:	Final	
Author name(s):	Sander Smit BM-Change Christos Kouroupetroglou ULTRA4 Riccardo Puglisi R2M	
Reviewer(s):	Eoghan Clifford NUIG Edward Curry NUIG	
Nature:	<input type="checkbox"/> R – Report <input type="checkbox"/> P – Prototype <input type="checkbox"/> D – Demonstrator <input checked="" type="checkbox"/> O - Other	
Dissemination level:	<input checked="" type="checkbox"/> PU - Public <input type="checkbox"/> CO - Confidential, only for members of the consortium (including the Commission) <input type="checkbox"/> RE - Restricted to a group specified by the consortium (including the Commission Services)	
Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		

Revision history			
Version	Date	Modified by	Comments
0.1	11/02/15	Sander Smit	Initial Version of Document
0.2	12/02/16	Christos Kouroupetroglou	Added current water bill
0.3	16/03/16	Sander Smit	Added toolbox
0.4	01/04/16	Christos Kouroupetroglou	Added new water bill & survey
0.5	06/04/16	Riccardo Puglisi	Added par 3.3
1.0	28/04/16	Sander Smit	Update after review

Copyright © 2016, Waternomics Consortium

The Waternomics Consortium (<http://www.waternomics.eu/>) grants third parties the right to use and distribute all or parts of this document, provided that the Waternomics project and the document are properly referenced.

THIS DOCUMENT IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS DOCUMENT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Table of Contents

1	Waternomics	5
2	Introduction.....	6
2.1	Document outline	6
2.2	Approach.....	6
2.3	Billing and behavioural change	7
3	Customer centric water billing.....	8
3.1	Segmentation of end-users	8
3.2	Personalised billing information	9
3.3	Impact of informative billing on water utilities.....	13
4	Waternomics Water Bill Toolbox	14
4.1	The toolbox	14
4.2	Example scenario	14
5	Waternomics water bill	17
5.1	Thermi water bill.....	17
5.2	Waternomics water bill for Thermi.....	18
6	Conclusions	22
7	References	23
	Appendix A: Water Awareness Survey	24

1 Waternomics

Waternomics is a three year, EU-funded project that started in February 2014. The goal of Waternomics is to explore how Information Technology can help households, businesses and municipalities with reducing their consumption of drinking water. Project results will be evaluated in four real life pilots in Italy, Greece and Ireland.

Waternomics is organized in seven different Work Packages as shown in Figure 1.

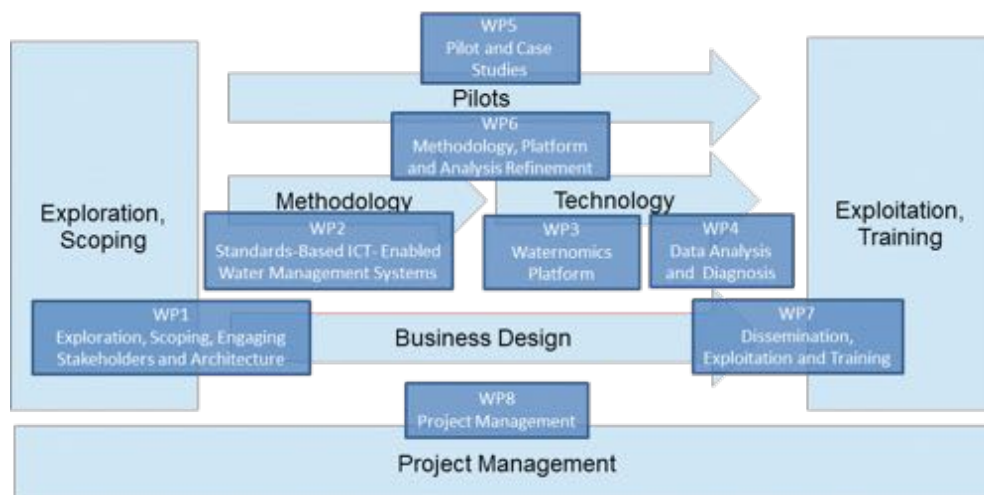


Figure 1 - Waternomics work package structure

WP7 focuses on, amongst other issues, the business design activities in Waternomics. This includes the research for a suitable business model for the Waternomics platform and the research on the impact of information systems on the business models of water utilities and businesses. The business model design related objectives of WP7 are:

- To define an innovative and profitable business model for the Waternomics Platform
- To define a business plan and business case for project exploitation supported by joint invention agreements, licensing provisions, and IPR protection where applicable

Billing is one of the few customer touch points for water utilities. Waternomics investigates how enriching the water bill with water related context information can contribute to an increased customer awareness regarding water consumption.

For the preparation of an informative water bill, Waternomics has adopted a consumer-centred approach. Consumers have been segmented based on willingness to change and readiness for change. Billing information is tailored to the needs and capabilities of the consumer and comprise a combination of billing mechanism, design and feedback To aid water utilities with the design of an informative water bill, a water bill toolbox has been prepared.

To investigate how an informative water bill could look like for an existing water utility by using the Waternomics Water Information Platform, a Waternomics water bill has been prepared based on the Thermi pilot. An existing water bill has been redesigned into an informative water bill which will be presented to participating households during the pilot execution phase.

2 Introduction

2.1 Document outline

This report accompanies the Waternomics Water Bill and describes the research results leading to the specific design of the Waternomics Water Bill. This introductory chapter describes the outline of this document and explains the methodology used. Chapter 3 discusses water billing from a customer perspective and looks in more detail at the variation in customer segments and their differences in motivations and attitude. Chapter 4 focuses on the relation of the water bill with other feedback interventions aimed at increasing awareness amongst customers of water utilities. This chapter also presents the Waternomics Water Bill Toolbox, which is a tool that helps with selecting the appropriate feedback information on water bills for a specific set of customers. In Chapter 5 the Waternomics Water Bill is presented as are examples of how a water bill for a specific customer segment could look like. The chapter also discusses the choice of feedback information and representation of this information in terms of its impact on consumers. Finally, Chapter 6 considers some conclusions as well as recommendations for water utilities or billing providers.

2.2 Approach

The steps and relations between the steps that have been taken as part of the development of the Waternomics water bill are shown in Figure 2.



Figure 2 – Overview of the approach for the development of the Waternomics water bill

Step 1: Research. To gain understanding about the role of the water bill in increasing water consumption awareness amongst customers, case studies from the energy domain have been studied (Wilhite 1997, Roberts 2004). Also relevant literature and publications on informative billing and feedback mechanisms have been studied to understand the underlying principles for creating awareness and facilitating behavioural change.

Step 2: Analyse. Using a customer centric approach, the differences in customer segments as described in D1.1 (Waternomics, [D1.1, 2014](#)) have been analysed. Also the applicability and suitability of the various feedback interventions from the energy domain have been analysed, resulting in the development of a water bill toolbox. This toolbox contains the relevant types of feedback information and feedback channels for the drinking water domain.

Step 3: Design: Based on the different customer profiles and the water bill toolbox, a set of water bills have been designed, each targeting a specific customer segment. Colours, different type fonts, graphs, visuals cartoons and infographics have been used to present feedback information in an appealing way to customers. As an example, the current Thermi water bill has been redesigned for the households participating in the pilot.

Step 4: Validate. To validate the new design of the Thermi water bill, the new water bill has been presented to- and discussed with- the households involved in the Thermi pilot.

2.3 Billing and behavioural change

Water billing is one of the instruments water utilities have to communicate with their customers. If water utilities wish to stimulate their customers to improve their water efficiency, a behavioural change communication strategy should be developed. Such a strategy should address and align the different levels on which communication is targeted, namely: individual, community, organisational and public policy.

Literature (SØnderlund 2014, Kappel 2009) also shows that direct instantaneous feedback, e.g. shower timers or in home displays, in combination with frequent indirect feedback like billing, is needed as a basis for sustained reduction of water consumption. With water billing, utilities communicate on an individual level with their customers. Initiatives with informative billing in Norway showed that customers had a better understanding of their energy bill, increased their awareness of energy and reduced their energy consumption (Wilhite 1997). An element that is important for the effectiveness of the informative water billing is the level of trust of the customer in the water utility. If the provider of the feedback, the water utility, is not trusted by the customer, the effect of the feedback will be limited.

Mass	Cut off water	TV Press Internet campaign
Group	Real time pricing Water rationing	Demonstrations Training
Individual	Shower timer Smart meter In home display Ambient displays	Water bill Home visit Audit
Direct		Indirect

Figure 3 – Types of feedback

In this report the focus is solely on informative water billing but it should be noted that informative billing is more effective when combined with direct feedback interventions and with feedback interventions targeting at community and policy level.

3 Customer centric water billing

Despite the large variation in consumer profiles, most water utilities have only one uniform billing method for all their customers. This doesn't do justice to the differences in attitude, motivations, capabilities, knowledge and resources amongst their customers, which causes them to act and respond in different ways on enhanced billing information. Ideally, every customer would receive personalised billing information tailored to their needs and preferences, maximising the effect of informative billing. Practically, this is not yet feasible and a next-best solution is using segmentation to address groups of similar customers in a uniform way.

3.1 Segmentation of end-users

While it may be possible and desirable to segment consumers based on various characteristics it should be noted that closer research of individual customers is required, enabling a deeper understanding of customer needs, pains and gains. Customer segmentation is a widely adopted marketing technique used by companies to have their communications, products and services better fit the customer's needs and preferences and as a result, establish a more meaningful relation with their customers and increasing customer intimacy. Segmentation is simply a way of arranging a large group of customers in smaller groups, based on particular attributes. For the Waternomics water bill, customers have been segmented based on two attributes (i) willingness to change, indicated by pro-environmental behaviour, and (ii) readiness for change, indicated by the stage in the change cycle the customer is in. Both willingness to change and readiness for change can inform *which* information should be presented best to customers to support behavioural change.

For the creation of customer segments for willingness to change, an existing framework was used. To support policy development and implementation in UK's Department for Environment, Food and Rural Affairs (Defra), a framework for pro-environmental behaviours was developed. This framework segmented the population into seven distinct and independent groups based on pro-environmental behaviours. The segments are briefly summarised below:

Segment 1: Positive greens (18%): This group shows positive pro-environmental beliefs and attitudes. They tend to act in more environmentally friendly ways than any other segment does.

Segment 2: Waste watchers (12%): This segment has a slightly more pro-environmental than the average ecological worldview. They try to avoid waste but can be somewhat sceptical about the scale and urgency of environmental problems.

Segment 3: Concerned consumers (14%): This group is sympathetic to the concept of 'climate change', acknowledging their personal impact and seeing taking action as important. However, they reject the idea that we are reaching our limits to growth. They may focus on environmental behaviours in the home.

Segment 4: Side-line supporters (14%): The Side-line supporters have in general a pro-environmental worldview, although these beliefs are held relatively weakly. They recognise the environmental issues, are willing to learn and do more – they appear receptive though are unlikely to be proactive in acquiring information or adapting their behaviours.

Segment 5: Cautious participants (14%): Cautious participants agree there is a pressing crisis, and that there are limits to growth. They are pessimistic about our ability to tackle climate change, but recognise their impacts. Environmentally friendly behaviours are not a natural fit with their self-identity.

Segment 6: Stalled starters (10%): Stalled starters have a strongly negative environmental view. They say that their behaviour does not contribute to climate change, and that the environment is a low priority for them personally. This group has a lot of serious life priorities to address before they consider the environment.

Segment 7: Honestly disengaged (18%): This segment has an ecological worldview which is predominantly shaped by a lack of interest and concern. They do not seek excuses for their lifestyles. Debates about the environment and climate change do not touch their lives.

The percentages shown are characteristic for the UK population and serve as an example of how water consumers in the UK are distributed across the various segments. Water utilities operating in other countries should identify what the segmentation of their customer base looks like.

For the level of customer awareness with respect to water efficiency, the Stages of Change model, also known as the Transtheoretical model (Prochaska), is used. In this model people go through a five-step cycle, each reflecting a different level of motivation and readiness for change. The five stages are (i) pre-contemplation – no intention of changing behaviour, (ii) contemplation – aware the problem exists but with no commitment to action, (iii) preparation – intent on taking action to address the problem, (iv) action – active modification of behaviour and (v) maintenance – sustained change, new behaviour replaces old.

By combining the aforementioned methods of segmentation, thirty-five combinations of customer segments can be realised, each combination with its own information need. For example if addressing Positive Greens in the pre-contemplation phase the focus will be on educating customers in this segment about water scarcity or water quality issues.

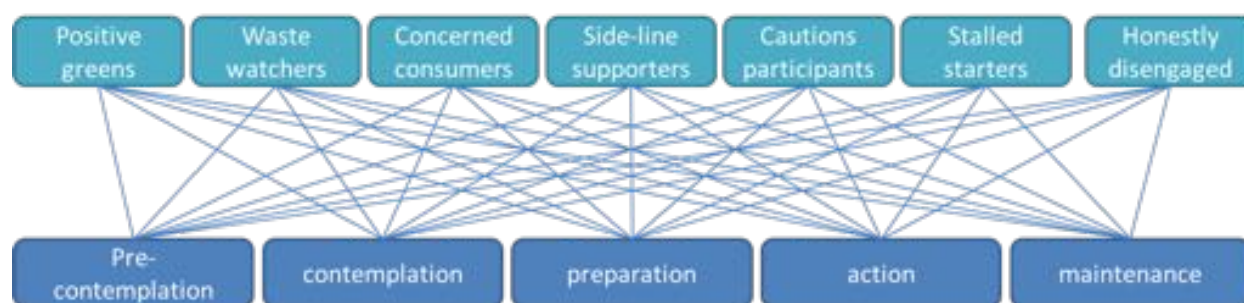


Figure 4 – Thirty-five customer segments based on willingness and readiness for change

3.2 Personalised billing information

By tailoring the billing information to the needs and capabilities of the customer,

Three types of feedback information are recognised:

1. Usage related information
2. Frequency & level
3. Context related information

Usage related information contains all information directly related to the water consumption of the customer. Information about water consumption can be presented in different ways, including water consumption in litres, m3 or euros, water reduction in litres, m3 or euros saved, energy usage related to water consumption in kWh or carbon dioxide equivalent (CO_{2e}) emissions related to water consumption.

Research shows that billing based on actual readings is more effective in terms of increasing customer awareness compared to estimated billing.

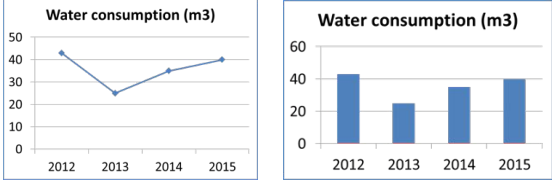
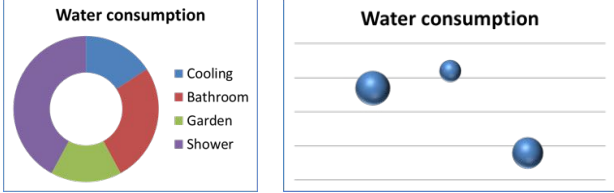


The billing frequency and the level of detail of the water bill also have an impact on customer awareness. In general, research shows that more frequent billing results in higher reductions in water consumption. Furthermore, providing more detailed information about the customers water consumption, e.g. presenting water usage per application or activity or per apartment instead of per building, results in a better understanding of one's water consumption and will more likely lead to more water efficient behaviour.

Examples of context related feedback are historic feedback, normative feedback, benchmarking information, tips and advice or information on water availability. Research shows that historic feedback seems more effective than comparative or normative feedback. In terms of household energy consumption, savings achieved by providing historic feedback ranged from 0-12%.

Finally, the method used to present feedback to the consumer affects the effectiveness of the feedback. Two aspects of presentation are the media used and the design of the information. Various media can be used for providing billing information to customers. Still, the most used channel is the printed invoice sent by regular mail. Alternatives are invoices send as PDF by email or invoices that can be accessed through a web portal. In the case of web portals, customers are alerted when a new water bill is available through email or SMS. Billing information can also be made available to customers through mobile devices like smartphones or tablets. In home displays can also be used by utilities to show billing information. Each medium has its own capabilities in terms of presenting feedback.

The following table shows different forms of presenting information.

Table 1 – Forms of graphical presentation of information

Text	abcsABCD abcABCD abcdABCD
Numbers	1234 1234 1234
Charts	
Graphs	
Emoticons	
Metaphors	

Animation	
Graphics	

Undoubtedly, the use of specific colours and the positioning of information on the screen or water bill affects the effectiveness of the feedback but this element has not been researched in Waternomics. During the design of the Waternomics Water Marketplace, end-users were involved in the design of the lay-out ([Kouroupetroglou C. ao, 2015](#)). It was observed that users had different preferences and in the end a solution was chosen in which the user could modify the portal to their needs. Table 2 shows some examples of informative billing from the energy and telecom domain.

Table 2 – Examples of informative billing

<p>Bridgely (http://www.bidgely.com/) - based in California, USA) provides customers with a mobile application with which they retrieve detailed information about their energy consumption like usage per application, time of use rate and comparative feedback.</p>	
--	--

BLUENERGY

DECEMBER 2022 ENERGY OVERVIEW

Joe Sample
Account Number: 12345-SK43322
6789 Amber Timbers Lane
Anytown, Texas 12321

Billing Period: Dec 6th to Jan 5th

Spent

\$181.00

Consumed

1222 kWh

Category	Amount
Pool Pump	\$35.09
Heat/Cool	\$49.45
Base Load	\$24.22
Refrigeration	\$8.30
Cooking	\$1.86
Others	\$41.26

ENERGIZED CONSUMPTION

- Pool Pump: 30.6%
- Heat/Cool: 27.6%
- Base Load: 19.4%
- Others: 28.22%
- Cooking: 0.5%
- Refrigeration: 4.3%

YOUR ENERGY RATE

Your energy rate for last month is at its lowest for your Texas energy rate plan!

A Texas residential rate plan. See [www.psc.state.tx.us](#) for more information.

Rate 1	Rate 2	Rate 3	Rate 4	Rate 5
\$0.13	\$0.16	\$0.26	\$0.29	\$0.33

Average Rate Per kWh - \$0.13 / 9.8%

1222 kWh

EFFICIENCY SCALE

Water Heater: A
Heat/Cool: B
Pool Pump: C
Base Load: D

PAST USAGE

Reduce Month-to-Month Spending

Legend: Base Load, Heating, Heat/Cool, Pool & Hot Water

HEATING

Your heater's status pattern indicates that your house needs insulation improvements. Your house is losing energy at a faster rate than an efficient and insulated house in your region does.

POOL PUMP

Save \$444 annually by replacing your pool pump with an efficient, variable speed pump and control.

REFRIGERATION

Refrigerators, freezers are operating at an efficient level and refrigerators for your house.

Scan the code with your smart phone to learn, compare and save money on your savings.

Powered by **bidgely**

POWER

2

SWITCH

Account # 53183900050
 Jack Power
 2100 N Avenue, Chicago -
 312-300-1000

Billing Summary
 Previous Balance: PAID \$55.45
 Amount Due: May 5, 2012 **\$34.72**

METER INFO

READ DATE: 4/12 (29 Days)

METER # 0928000000

LOAD TYPE: GENERAL

PRESENT (kWh) PREVIOUS (kWh) MULTIPLIER USAGE

95477 - 95279 x 1 = 198 kWh

Month	Usage (kWh)
2011 A	173
M	200
J	161
J	244
A	334
S	224
O	215
N	213
D	193
J	228
F	231
M	204
A 2012	198

SERVICE INFO

RESIDENTIAL - MULTIPLE

"Alternative Supplier"

SUPPLY

\$16.30

Electricity Supply Charge
 198 kWh x 0.08164
13.80

Transmission Service Charge
 198 kWh x 0.00505
1.51

Purchased Electricity Adjustment
.99

ComEd DELIVERY

\$15.16

Customer Charge
7.21

Standard Meter Charge
2.86

Distribution Facilities Charge
 198 kWh x 0.02884
4.84

Electricity Distribution Charge
 198 kWh x 0.00126
.25

TOTAL CHARGE

\$34.72

PRICE TO COMPARE

price = 0.03763 x 100

7.73¢

TAX / OTHER

\$3.26

Environmental Cost Recovery Ad
 198 kWh x 0.00027
.05

Energy Efficiency Programs
 198 kWh x 0.00129
.26

State Tax **.65**

Municipal Tax **1.25**

3.3 Impact of informative billing on water utilities

Within an economic environment where larger segments of the population are increasingly concerned about water consumption and waste, water utilities will find it optimal to anticipate and/or accommodate this change through a set of strategic and tactical choices. As discussed above, literature has shown that direct and indirect feedback on consumption –and a combination of them (real-time meters plus informative billing) - has a sizeable effect on consumption itself, in the expected direction of reducing it.

Informative billing, as a strategic choice by water utilities, would imply a different use of the information that water utilities already have about their customers, in order to implement a tailored service, i.e. offer different types of water bills that are specific to each customer segment, depending on their willingness to change and readiness for change. This information set would include household-level data on family size, type of house, type and number of applications in the house, of course coupled with data on water consumption and water availability, i.e. on capacity constraints.

Consumers and producers of utilities such as energy, telecom services and water in a long-term economic relationship which includes recurrent exchanges of not only money and services but also of information. By definition, this information exchange is particularly relevant in the case of informative billing. As a starting point, utilities need to investigate and understand how their customers wish to receive more informative billing and react to consumer feedback on how they wish to be informed in the future, once they start to get acquainted with informative billing.

Voluntary surveys of existing and potential customers are certainly useful to gauge those preferences, and especially those regarding the favourite medium and favourite time-frequency of billing. However, because of systematic non-compliance voluntary surveys might provide a biased picture of customer preferences, so that it could be optimal to start directly with provisional, informative water bills, ascertain feedback from customers and amend future water bills accordingly. This type of “dialogue” between utilities and customers is also consistent with literature in behavioural economics, according to which regulators and firms should provide a “nudge” (Thaler & Sunstein 2008) in order to induce good, non-myopic behaviour by customers and citizens, without using coercive methods. From this point of view, informative billing can be considered as a nudge to inducing more efficient water consumption, and at the same time it can engage customers into a dialogue with the utility about improvements in the billing method itself. Of course, any dialogue between sides of a market is more fruitful the more it is based on trust regarding the information and behaviour between the consumer and the utility. This might partly explain why historic feedback –i.e., the comparison of current consumption with past consumption by the same household- fares better than comparison of consumption with similar households in reducing consumption itself: information about past behaviour is more easily verifiable by the household itself than information about the distribution of cross-household behaviour, where the customer must solely rely on the information provided by the utility itself and its overall level of credibility.(with no straightforward way to self-verify).

4 Waternomics Water Bill Toolbox

To help water utilities with the design of an informative water bill, a toolbox has been created. With this toolbox, water utilities can design water bills for specific customer segments. The following sections explain the toolbox and show examples of designs for different customer segments.

4.1 The toolbox

The Water Bill Toolbox helps utilities with the design of tailored water bills that can comprise a combination of billing mechanism, design and feedback. The toolbox consists of building blocks that can be utilised as required. Each column represents the building blocks that can be chosen within various categories: billing mechanism, design and feedback. Any given combination of selected building blocks creates a basic design for a tailored water bill aimed at a specific customer segment.

BILLING MECHANISM		DESIGN	FEEDBACK		
BILLING	CHANNEL	FORMAT	USAGE RELATED	FREQUENCY / LEVEL	CONTEXT RELATED
Prepaid	Post	Text	Used litres	Per period	Water source
Estimated	Email	Numbers	Reduction litres	Per application	Availability
Volumetric	Web portal	Chart	Used m ³	Per consumer	Comparative
Ratio rating	SMS	Graphs	Reduction m ³	Per household	Normative
Fixed fee	In Home Display	Emoticons	Used €	Per building	Tailored tips
Block tariff	Smart meter	Graphics	Reduction €	Per activity	Goal setting
Seasonal pricing	3 rd party bill	Animation	Related kWh	Per building	Goal setting
		Metaphors	CO ₂ emission	Per activity	Benchmark
			CO ₂ Reduction		

Figure 5 – Toolbox for informative water bills

4.2 Example scenario

As an example, a basic design is shown of a tailored informative water bill for the waste watcher consumer in the preparation stage (see Section 3.1). The table below shows the considerations for this specific customer segment.

Table 3 – Example of customer segment Waste watchers in preparations stage

Segment 2: Waste watchers in Preparations stage

General considerations

This group is willing to reduce water consumption but needs a bit more evidence as to why is it important. They are reluctant to make financial sacrifices if they don't realize the benefit. This group is knowledgeable and highly educated but not aware of the environmental impact of their water consumption.

Preferred behaviour

Changing routine behaviour

Main motivation

This group can be motivated to reduce their water consumption both from a financial and an environmental perspective

Choices related to billing mechanism

The billing mechanism is largely determined by the technical infrastructure of the water utility. In this case, the water is priced according an increasing block tariff and the water bill is send to customers every three months by regular mail.

Choices related to format

Since this group is highly educated and well-informed it is well able to interpret the billing information. Text, numbers, charts, graphs and metaphors can be used to convey both environmental and financial implications of their consumption.

Choices related to feedback

This group is not aware of their water footprint and might have a wrong view for their consumption feeling they are saving enough water. That is why the bill focuses on comparative and benchmark information. Information about water usage per household is limited to this level due to metering infrastructure and pre period can use past metered period to provide evidence of actual progress on the efficiency measures they might take.

When placed in the toolbox, the selection of building blocks is shown as the white blocks in the grid, as shown in Figure 6.

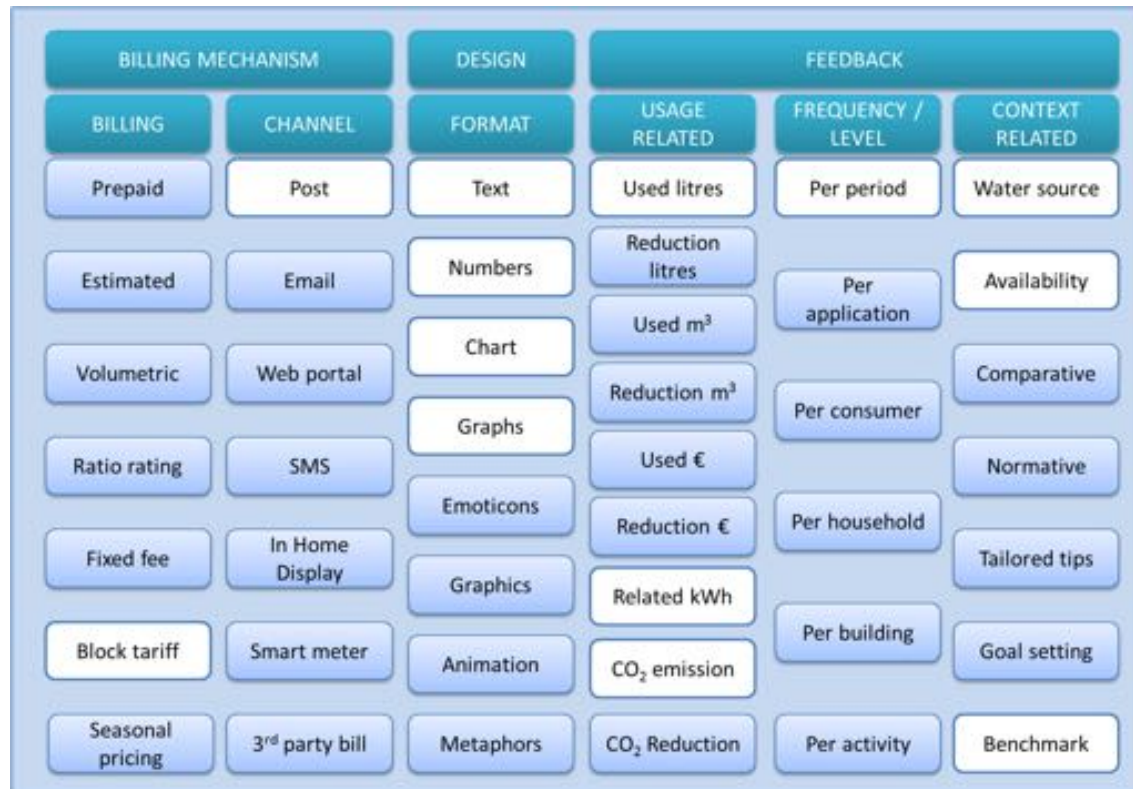


Figure 6 – Tailored water bill approach for segment 1 (white blocks)

5 Waternomics water bill

To investigate how an informative water bill could look like for an existing water utility by using the Waternomics Water Information Platform, a Waternomics water bill has been prepared based on the Thermi pilot. The pilot is located in the Municipality of Thermi in Greece, in the southeastern part of the prefecture of Thessaloniki. Houses of ten participating households have been equipped with smart meters in the main supply pipes and in some cases also in specific household usage outlets such as kitchen, dishwasher, toilet flush, etc. Participant households receive real-time and personalised information about water usage and conservation measures.

For the preparation of an informative water bill, an existing water bill has been analysed. Based on the customer and context information available and within the limitations of the Waternomics platform, a new water bill has been designed. The next paragraphs describe the current water bill for Thermi citizens and the newly designed water bill.

5.1 Thermi water bill

The current Thermi water bill as depicted in Figure 7, is text only. The bill is divided into three sections. The first section shows administrative information such as customer name and address, billing period and references. In this case water bills are send every three months to the customers by regular mail

The second section displays the amount payable and the breakdown of the charges for water. The charges for water is composed of various elements which are not obvious for the customer.

Thermi uses an increasing block tariff for the price of water. The left side of the second section shows the water consumption in each block. In this example, all water is consumed in the first block (0-75 m3 per billing period) and the total water costs (TWC) are €6,30.

The right table shows the decomposition of the water charge that contains the following elements:

1. VAT (13% over TWC)
2. Interest + stamp duty ($TWC \cdot 75\% + 0,64$)
3. Drains usage ($Consumption \cdot 75\% \cdot 0,32$)
4. Special water fee ($TWC \cdot 80\%$)
5. Network Maintenance (fixed costs)
6. Fixed drains duty (fixed costs)
7. VAT (23% over 3, 4, 5 & 6).

The third section provides information for paying the bill including banking account information and payment reference numbers.

Figure 7 – Example of Thermi water bill

5.2 Waternomics water bill for Thermi

A Waternomics water bill was designed for and piloted with the volunteers of the Thermi pilot. It is assumed that this group have a positive attitude towards water efficiency and the environment but are not very aware of the impact of water consumption on carbon footprint. Therefore the target group is placed in the segment “Positive Greens” being in the pre-contemplation stage with respect to changing their water consumption behaviour. Table 4 shows the characteristics of this customer segment.

Table 4 – Assumed characteristics of the target customer group

<p>Segment 1: Positive Greens in Pre-contemplation stage</p> <p>General considerations</p> <p>This group is already doing a lot to reduce their carbon footprint and is driven by idealism. These people are willing to make financial sacrifices. This group is knowledgeable and highly educated but not aware of the environmental impact of their water consumption.</p> <p>Preferred behaviour</p> <p>Changing routine behaviour</p> <p>Main motivation</p> <p>This group can be motivated to reduce their water consumption but from an environmental perspective</p> <p>Choices related to billing mechanism</p> <p>The billing mechanism is largely determined by the technical infrastructure of the water utility. In this case, the water is priced according an increasing block tariff and the water bill is send to customers every three months by regular mail.</p> <p>Choices related to format</p> <p>Since this group is highly educated and well-informed it is well able to interpret the billing information. Text, graphs and graphics can be used.</p> <p>Choices related to feedback</p> <p>This group is not aware of their water footprint so focus is on education and context information. Information about availability of water, water usage per application and water related energy usage will make this group move to the contemplation phase.</p>
--

To validate if this assumption is correct, participants in the Thermi pilot will be asked to complete a survey prior to the pilot. The survey is designed in such a way that it addresses the various motivations for saving water or energy and exposes the knowledge level of the volunteer with respect to water availability and water efficiency. This survey can be found in Appendix A. For the design of the new water bill, the toolbox has been used and a selection of components has been chosen based on the consumer characteristics as outlined above.

Billing mechanism: The pricing mechanism remains the same, block tariff, but next to regular mail, customers will also be able to view their bill through the Waternomics on-line portal.

Design: Next to text and numbers, information will also be presented through charts, graphs and metaphors. The assumption is that the customers in the pilot will be able to understand the

graphical information and that this would make it easier for customers to extract actionable information from the water bill.

Feedback: To increase the customer's awareness of their water consumption, it was decided to focus on providing more detailed feedback about their own water consumption. Therefore information about water usage per outlet and historical water usage information has been included in the bill.

Figure 8 shows the resulting selection of components for the new water bill. The components marked in white have been used for the new water bill.

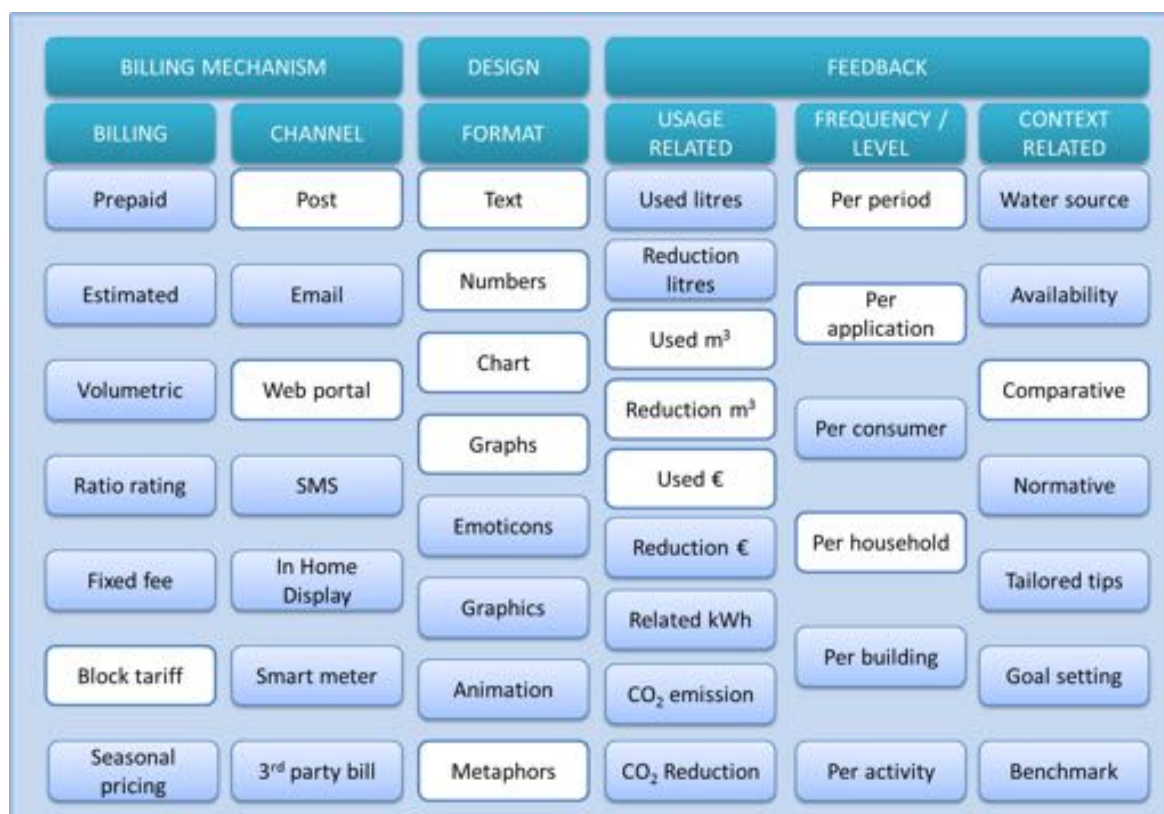


Figure 8 – Selected building blocks for Thermi water bill

Figure 9 shows an example of the resulting water bill. This example has been prepared by using the functionality of the Waternomics platform. The new water bill will be presented to the volunteers in the Thermi pilot and by the use of interviews and questionnaires their observations of this new form of billing will be measured.

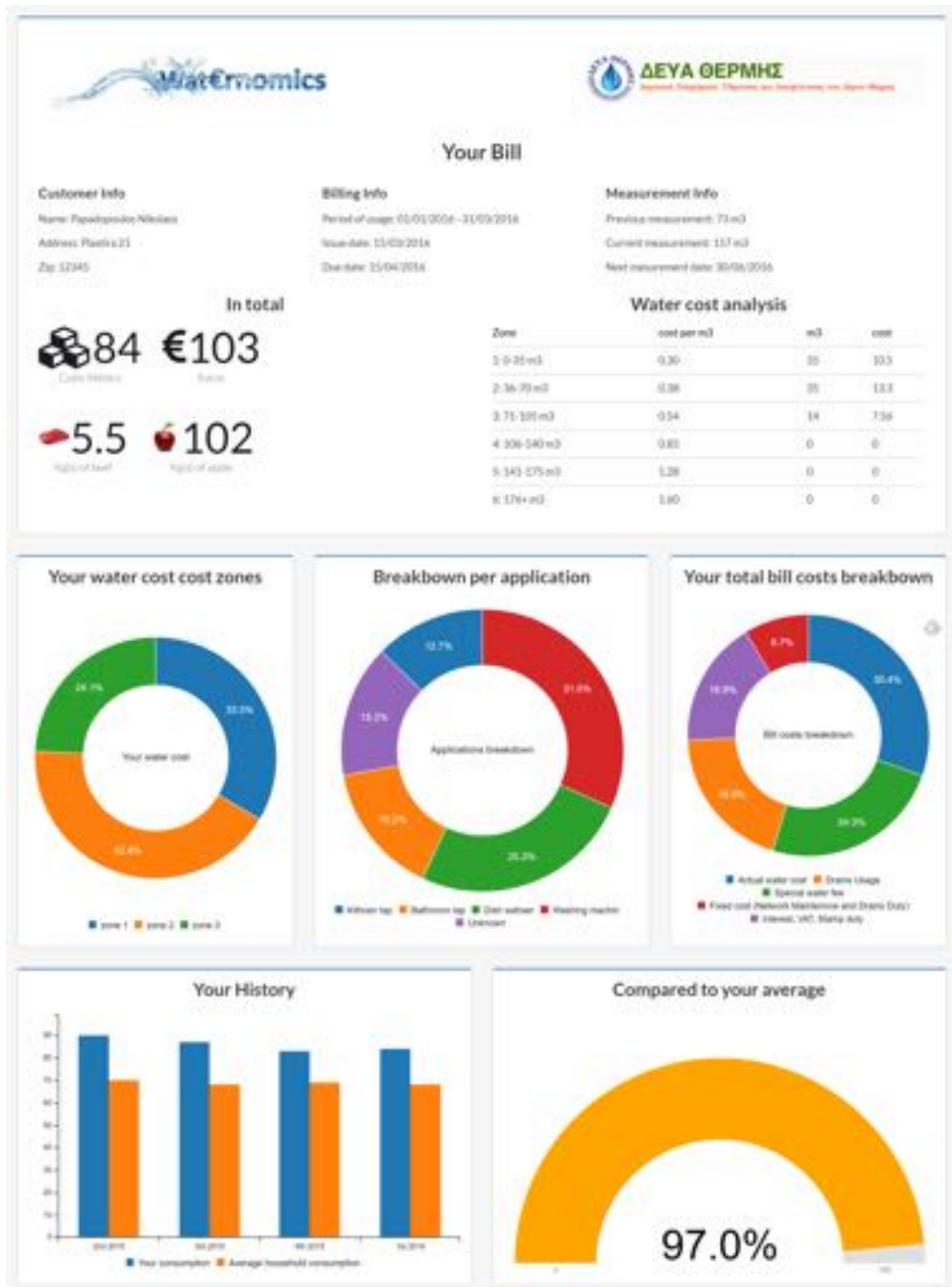


Figure 9 – Waternomics water bill for Thermi

The new water bill is separated in three major sections. The first section on the top of the bill includes in large the information that is already displayed in the current water bill. However, after the billing details such as the name of the customer, the address, etc. it focuses on two main aspects. The first one on the left hand side is presenting the total consumption of the household in cubic meters and the cost of the bill. Below these two most important numbers there are two additional metaphors that are used to show the amount of a specific product that could be produced with the amount of water consumed in the household. The selection of food

related products is aiming to connect in users cognitive models that water conservation is not only achieved by reducing the actual water consumption but by also changing lifestyle habits. The comparison between apples and beef meat, which are two widely used products, demonstrates the high water demand for producing beef meat in comparison to apples. The left hand side of the first section breaks down the cost of the water in the various water billing tariff zones. This way the customer can easily see the different amounts related with each tariff zone.

The second section includes three donut diagrams explaining the water consumption and billing to the user. The first diagram shows the cost of the water in the different tariff zones and make evident that although the amounts of water billed under zones 1 and 2 are equal, the difference in pricing is evident. In the second diagram the customer can drill down on his/her own consumption and identify the applications that use the biggest amount of water. The diagram shows that machines like the washing machine and the dishwasher account for the biggest part of the consumption in the household. The final diagram displays the breakdown of costs in the bill so that the customer can easily understand how much is the actual water cost and what other costs are depending on it.

Finally the third and last section aims to provide a comparison of the customer's consumption with average consumption and with his own average consumption. The first part shows the historical evolution of the customer's bill in comparison with the average bill of other customers for the same period while the second part compare the current bill with the average bill of the customer in order to understand if he managed to lower his consumption upon consecutive billing periods.

6 Conclusions

Informative billing is a good instrument for increasing water efficiency awareness amongst customers of water utilities but should be considered in the context of a behavioural change communication strategy. New information technologies like the Waternomics platform enable the enrichment of current water bills with targeted, personalised and contextual information. By designing water bills from a customer perspective and by respecting differences in attitude towards sustainability and variations in knowledge levels, the impact of informative water bills can be increased.

The Waternomics Water Bill toolbox aides water utilities with the design of informative water bills. By combining existing pricing structures and channels with new types of feedback made possible by smart water systems, the toolbox can be used by every water utility, regardless of the technology adoption level of the utility.

From the validation with the customers in the Thermi pilot, the project will learn if the initial clustering of customers was correct and if the selected feedback information and format results in an increase in knowledge about water consumption and water efficiency awareness.

7 References

- Breukers, S. and Mourik, R. (2013) The end-users as starting point for designing dynamic pricing approaches to change household energy consumption behaviours. Report for Netbeheer Nederland, Project group Smart Grids (Pg SG). Arnhem: March 2013.
- DAIAD (2014), D3.1.1 – Design Studies
- Darby S. (2001), Making it obvious: designing feedback into energy consumption, Energy efficiency in household appliances and lighting, Edited by Bertoldi, Ricci, de Almeida. Springer. ISBN 3-540-41482-7
- Darby S. (2006), The Effectiveness of Feedback on Energy Consumption: a review for Defra of the literature on metering, billing and direct displays. Environmental Change Institute, University of Oxford
- Defra (2008), A framework for pro-environmental behaviours, Department for Environment, Food and Rural Affairs January, 2008
- Fischer C. (2008), Feedback on household electricity consumption: a tool for saving energy? Energy Efficiency (2008) 1:79–104
- Kappel K. & Grechenig T, (2009) “show-me”: Water Consumption at a glance to promote Water Conservation in the Shower, Persuasive’09, April 26-29, Claremont, California, USA.
- Kouroupetroglou C. ao, (2015) WATERNOMICS: Serving diverge user needs under a single water information platform, E-proceedings of the 36th IAHR World Congress 28 June – 3 July, 2015, The Hague, the Netherlands
- Niedderer et al (2014) Creating sustainable innovation through design for behavioural change – Full Project Report, ISBN: 978-0-9560204-9-9
- Prochaska et al (1994) Stages of change and decisional balance for 12 problem behaviours, Health Psychology 1994 Vol. 13, No. 1, 39-46
- Roberts S, Humphries H and Hyldon V (2004) Consumer preferences for improving energy consumption feedback. Report for Ofgem. Centre for Sustainable Energy, Bristol, UK
- Seung Hyo Jeong (2014) The impact of combined water and energy consumption eco-feedback on conservation, Energy and Buildings September 2014
- SØnderlund, A. ao (2014) Using Smart Meters for Household Water Consumption Feedback: Knowns and Unknowns, 16th Conference on Water Distribution System Analysis, WDSA 2014
- Strengers Y. (2010), Conceptualising everyday practices: composition, reproduction and change, Working Paper No. 6, Carbon Neutral Communities
- Thaler, R. & Sunstein C, Nudge (2008) Improving decisions about health, wealth, and happiness, Yale University Press, New Haven, CT, 2008
- Waternomics (2015), D1.1 – Usage Case and Exploitation Scenarios
- Wilhite H (1997) Experiences with the implementation of an informative energy bill in Norway. Ressurskonsult report 750, Oslo

Appendix A: Water Awareness Survey

WATER AWARENESS SURVEY

As part of the EU Research Project Waternomics <http://waternomics.eu> that examines the use of ICT to influence change in people's behaviour towards water consumption, NUIG is conducting a study on people's current behaviour and attitude towards water usage. We kindly invite you to participate in this study.

If you agree to take part in this study, you will be asked to complete a questionnaire, which will take approximately 10 minutes to complete. There are no "right" or "wrong" answers: we are interested in your opinion. All the information you provide will be strictly anonymous. No data collected allows you to be identified from the data set.

Your participation in this study is completely voluntary, if you have questions about this project you may contact the researcher, Louise Hannon at 091-492-733 or via email at louise.hannon@nuigalway.ie.

Thank you very much for your participation,

Louise Hannon
Senior Research Associate
Civil Engineering, College of Engineering & Informatics
NUI Galway

Part 1 – General information about you

To best assess the information that we collect, we would like to know about you. Please read each question or statement and tick the box that indicates your response

1. Are you male or female?

Male	Female

2. What is your age range?

17 - 20	21 - 24	25 - 28	29 - 32	33 - 36	37 - 44	45+

3. What is the highest education that you finished?

No formal education	Primary Certificate	Junior /Inter /Group Cert (Lower secondary)	Leaving Certificate (Upper secondary)	Certificate/Diploma	Degree or equivalent	Post Graduate Masters /PhD	Don't want to say

4. What best describes your role within university?

Undergraduate Student	Post-graduate Student	Academic Staff	Research Staff	Technical Staff	Administrative Staff

5. What best describes your main residence?

I am a homeowner	I rent my home	I live with my Parents	I am in a house/apartment share	Other

Part 2 – General Questions about Your Current Water Use

In this part of the survey we are interested in your current involvement in water conservation activities. Please read each question and indicate how often you do this by ticking the box that represents your current behaviour best.

1. Do you turn the tap off during tooth brushing?

Always	Often	Sometimes	Rarely	Never	N/A

2. Do you Keep Showering Time to a minimum?

Always	Often	Sometimes	Rarely	Never	N/A

3. Do you wash your car with water bucket instead of a hose?

Always	Often	Sometimes	Rarely	Never	N/A

4. Do you fill the kettle only to the volume of water you need?

Always	Often	Sometimes	Rarely	Never	N/A

5. Do you choose water saving technologies where possible?

Always	Often	Sometimes	Rarely	Never	N/A

Part 3 – Your Opinion on the Use and Conservation of Water

In this part of the survey we are interested in your opinion and feelings regarding the use of water and its conservation. Please read each statement and consider whether you agree or disagree with it. Indicate by ticking a box the strength of your response from completely disagreeing at point 1 to completely agreeing at point 5.

1. I feel a strong personal obligation to conserve water

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

2. I worry about the negative impact of increasing water consumption on the environment

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

3. I am willing to put extra effort into reducing my water consumption

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

4. I'd feel guilty if I did not implement water conservation measures in my day to day activities

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

5. The way in which we currently use water is a problem for society

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

6. I believe that the lack of water conservation has a significant negative environmental impact

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

7. It is pointless to change my habits; it will not have an effect on the overall consumption of water

Completely Disagree	1	2	3	4	5	Completely Agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

8. I think that promoting water efficiency measures at work /school /college would result in a reduction in my water consumption

Completely Disagree	1	2	3	4	5	Completely Agree

9. I feel responsible to take measures to reduce my water consumption

Completely Disagree	1	2	3	4	5	Completely Agree

10. I feel a responsibility to promote water efficiency measures at home

Completely Disagree	1	2	3	4	5	Completely Agree

11. I think that I can reduce my water consumption by making changes to my existing habits

Completely Disagree	1	2	3	4	5	Completely Agree

12. I feel a responsibility to promote water efficiency measures at work /school /college

Completely Disagree	1	2	3	4	5	Completely Agree

13. I think that promoting water efficiency measures at work /school /college would result in a reduction in overall water consumption

Completely Disagree	1	2	3	4	5	Completely Agree

14. I believe that I have some responsibility for reducing the consumption of water in my area

Completely Disagree	1	2	3	4	5	Completely Agree

15. I believe that promoting water efficiency measures will have little effect on people's water consumption habits

Completely Disagree	1	2	3	4	5	Completely Agree

Part 4 – Your Views on Practicing and Promoting Water Conservation

In this part of the survey we are interested in recording your views on participating in water conservation activities. Please read each statement and consider whether you agree or disagree with it. Indicate by ticking a box the strength of your response from completely disagreeing at point 1 to completely agreeing at point 5.

1. Would you be willing to adopt changes in your routine (e.g. turning off tap while brushing teeth, limiting shower length) to reduce the consumption of water?

Definitely Not	Probably Not	Possibly	Probably	Definitively Yes

2. Would you be willing to encourage others to change their routines (e.g. turning off tap while brushing teeth, limiting shower length etc.) to reduce the consumption of water?

Definitely Not	Probably Not	Possibly	Probably	Definitively Yes

3. Would you be willing to take part in a demonstration at work or at school to promote greater water efficiency?

Definitely Not	Probably Not	Possibly	Probably	Definitively Yes