# Water in households


From new ways to bathe to a total swith in provision

Livinggreen Lab Water

ECO HUIS DUURZAAM [BE]LEVEN

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# Contents



# About this publication

This publication is about the Livinggreen Lab that was held in October 2010 in Antwerp, Belgium, as part of the Livinggreen.eu project.

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# Foreword

The Livinggreen Lab Water is the second of a serie of five. After the Livinggreen Lab in Ludwigsburg dealing with Energy, the theme this year was Water. Although water is all around us in Northwest Europe it is important to realize that much of that water is not potable. Worldwide the projection is that the availability of potable water will decline.

In response to that knowledge, this year's Lab focused on how more efficient use of potable water can be achieved, as well as how to make use of rainwater. The resulting product concepts were to be both attractive for end-users and an answer to the challenge to reduce potable water consumption in households.

Starting from the user perspective the participants worked their brains to come up with a specific problem to address in the Lab and how that could be solved. This creative process led to a proposal for a complete overhaul of the existing water system and novel bathroom concepts.

Please enjoy this publication and its suggestions to solve today's water consumption issues.

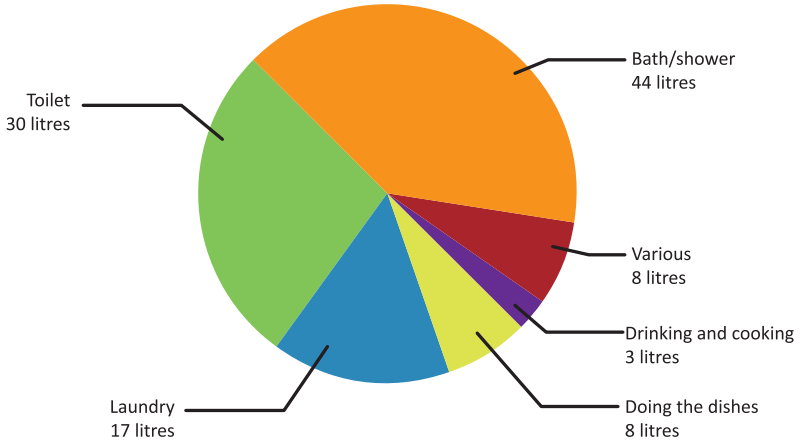
# *Livinggreen Lab 'Water'*

# Livinggreen Lab 2010: Water

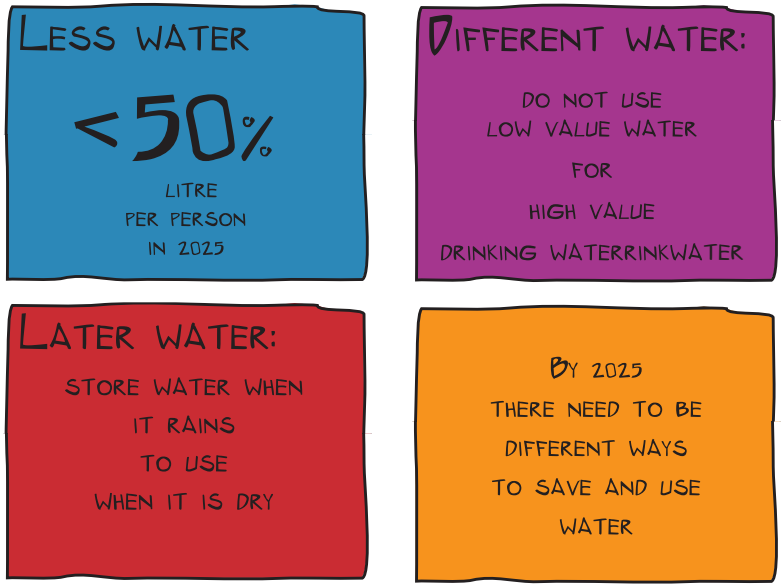
The theme of the Livinggreen Lab of 2010 was water consumption. The Livinggreen Lab was hosted by the EcoHouse Antwerp on the 7th of October.
Where the results of the first Livinggreen Lab about energy resulted in general solutions on a city planning scale, this Livinggreen Lab was aimed to end with more concrete product concepts that could be developed in cooperation with partners of the EcoHouse.
The Livinggreen Lab focused on water use in households. Before going into what happened in the Livinggreen Lab, the context of household water use is discussed.

## Current water consumption in households

In our daily lives we use a lot of valuable water, and often add all kinds of chemicals. A person in Belgium uses about 110 liters of water per day. The figure below shows how the consumption is divided over water using activities.
Most water is used for bathing, the toilet and laundry. Most of the water that is used in households is of drinking water quality. On average only 3 litres are used per day per person for cooking and drinking.
Smart and often simple technologies exist that can limit the use of water and chemicals. In practice, however, these technologies are very rarely applied in 'normal' homes. Reasons for this are that people are not aware that certain technologies exist, costs, or that technologies cannot easily be fitted in in a house or appartment.




Water consumption in Belgian households
Source: PIDPA; www.pidpa.be/nl/overwater/water_milieu/spaarzaam.htm




Rain water is increasingly collected in underground storage tanks and from these tanks te water is infitrated in the surrounding soil or used in households.

## Future scenario for water use

With the changing climate it will be necessary to make changes to the water system.
By 2025 we may face the following circumstances for water consumption:

Lower water consumption by 50%
We expect that the consumption of water must be radically lowered, due to the difficulty of procuring potable water and the expected irregular influx of precipitation year round. The less we are dependent on water, the better.

Use different water
In reducing the demand for water it is imperative to make the distinction between the different uses of water and the quality of water needed. In general, potable water is used for almost every function in the house, even when it could use a lower quality water, from flushing toilets to washing cars. We expect that the use of rainwater and groundwater in households will increase.

Later water
It may become more important to plan ahead in using water. When precipitation becomes more irregular and at the same time more intense, while there are extended periods of droughts, it becomes important to save water in times of plenty, to be able to use it in times of low availability.

To conclude, there is a need for other ways to save and use water, since in the near future it will not be possible to count on only the water purification plants to provide the (small) amounts of clean water needed in the cities.

## Set-up

The Livinggreen Lab was set up as a one day workshop in the EcoHouse. In addition to the workshop day, the participants were asked to do some preparatory work and the involved designers agreed to work out the results for presentation.

## Topics

Beforehand four topics were defined for exploration in the Livinggreen Lab.
Bathroom: Personal hygiene is closely related to water consumption. How can we minimise water use while maximising comfort?
Waterless toilets: Flushing toilets is one of the most water consuming activities in a household. Dry toilets exist, but they are hardly found in 'normal' households. What about a redesign?
Cleaning: We are used to cleaning with water, but there may be other ways to do this. Or at least with less water and chemicals.
Rain water use: Exploring how rain water can be collected and used in other (better) ways or how to make existing technologies more attractive.

## Participants

The people that participated in the Livinggreen Lab were professional designers, with experience in water and/or sustainable design. Furthermore there were EcoHouse employees and volunteers. These are experts on several aspects of sustainable building. and sustainable behaviour. The balanced mix of professionals (designers, planners and companies) and end-users that was aimed for in the organisation of the Livinggreen Lab could unfortunately not be composed. This was due to time limitations of both companies as the organising parties. This however did not affect the workshop format and potential outcomes.

Based on the amount of people in the workshop and the interest and expertise of the participants the group of participants was split in two:
1. Bathroom & toilet, combining two of the initial topics, and
2. Rain water use.

## Design brief

A design brief was formulated to give direction to the workshop. This design brief was kept general, so that all topics could fit, but also so that the participants could specify their assignment in the workshop.

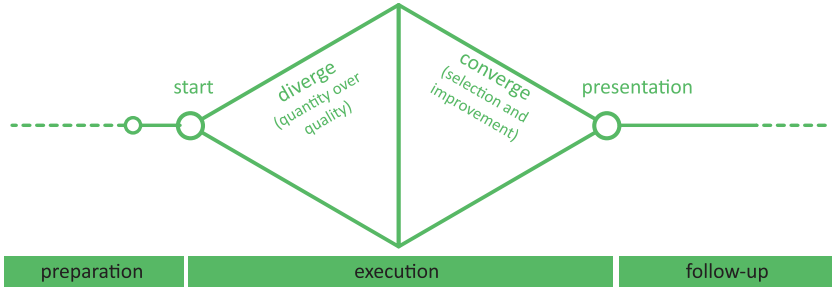
The design brief was to: develop products and/or services that enable people to live comfortably in accordance with the future scenario and that can be succesfull in the market.

The proposals had to take five aspects into account:

- Attractiveness
- Fitting in the home
- Cost/benefits
- User comfort
- Sustainability

## Process

The process of the workshop was set up to follow a typical design cycle, which starts with formulating a design brief, followed by a diverging phase where many ideas are explored and judgement of ideas is withheld. After this phase, selection of ideas takes place and the ideas are elaborated.



Preparation
In preparation of the Livinggreen Lab a preparation exercise (‘sensitizer’) was sent to the participants two weeks before, to already start their thinking about the topics of the workshop by relating them to their own situation at home.

Workshop introduction
The participants wer introducte to the design brief via a scenario of a family that looks into the possibilities of implementing water saving equipment, other cleaning methods, and a rain water collection system. It is not so easy for them and they are looking for attractive ways of using water in a smart way. The scenario is used to provide insight in end-user’s concerns.


Redefinition of design brief
Each group redefines the design brief for their specific topic. This way the groups themselves decide which problem to tackle and which direction to take. For creativity and cooperation this works better than a pre-defined assignment.

Divergence
Once the design challenge is clear, as many ideas as possible are generated that could solve the problem. The moderators take care that judgement of ideas is postponed as much as possible. Several techniques are used in this phase to stimulate creativity of indivituals and the group.

Convergence
Ideas are selected for for further elaboration. This is done with help of the criteria that were formulated in the design brief. The selected ideas are further improved to become concrete and feasible product proposals that can be developed now or in the near future.

Presentation
The workshop closes with a presentation of the proposals to an expert panel. Their reactions to the proposal are taken into account for further elaboration fo the proposals.

Follow up
After the workshop the designers work out the proposals in presentation drawings, that can be presented to a wider public and potenial clients. Furthermore the proposals are presented to interested stakeholders that could develop them further.

# *Existing products*

# What is already out there?

The question of reducing water use is constantly being addressed. To give the participants of the Lab a head start, we provided an inventory of radical or plain smart products that currently are designed and developed. These products set the standard for the results of the Lab. Although not all of the produtcs are for sale yet, they still provide valuable insight in the current trends and expectations.

## In the bathroom

Phyto-Purification

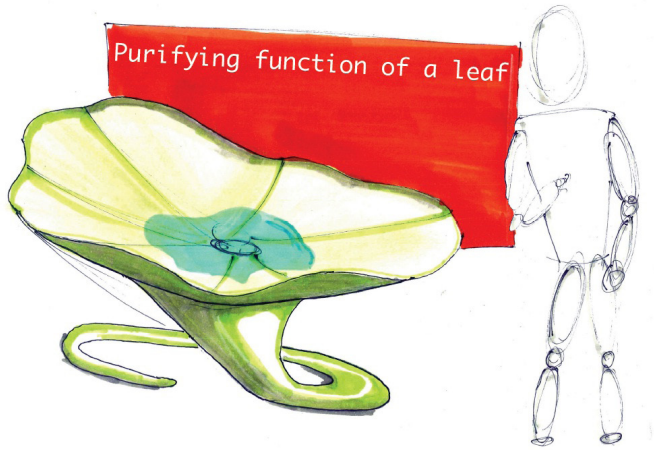
Jun Yasumoto's Phyto-Purification Bathroom is a conceptual system that turns your shower into a mini-ecosystem. The design is a clever take on the water-saving conundrum that relies on plants to do its dirty work. The bathroom works kind of like a miniature river. Water from your shower travels to a series of rushes, reeds, hyacinths, and lemnas—all plants that are known to absorb bacteria, metals and other waterborne particles. A carbon filter captures any particles that remain, and the filtered water is then recycled back into the shower system for use.

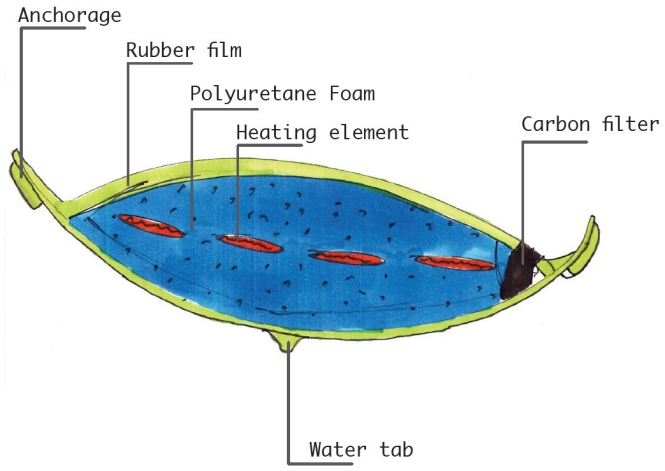
Taken from www.adistinctiveworld.net/?p=1814

Lotus Bath

The Lotus Bath, designed by George-emile Tokaya, saves at least 50% water by adapting to the body's shape. The bath is made of foam that takes the shape of the person sitting in it. In this way less space has to be filled with water.

The design of the rubber bath is a mix between two chaises longue (Charles and Ray Eames, le Corbusier) and a lotus leaf.

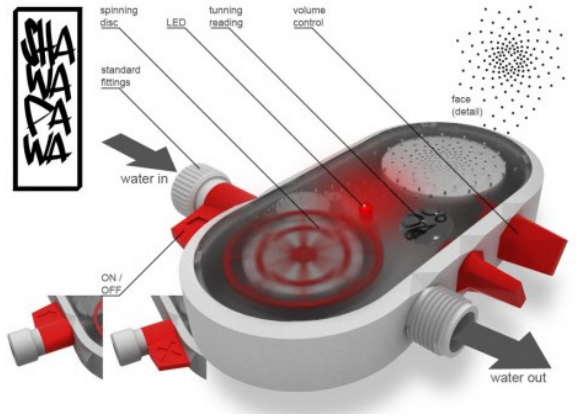



Designed by George-emile Tokaya at the Faculty of Industrial Design Engineering Delft University of Technology. Ingetokaya@hotmail.com

SHAWAPAWA

SHAWAPAWA is a water-powered shower radio. It is self-powered, working without chemical batteries and induces a poetic exchange between power source and use. SHAWAPAWA plugs between the tap and the shower hose using standard fittings. The water flowing through the pipes makes a little turbine spin, producing enough energy for the radio to play.




Design by Arthur Schmitt. §
Taken from www.hometone.org/tags/shawapawa/

Water Pebble

Originally conceived as Water Watch, the Water Pebble is a unique water-saving device and a world's first. Paul Priestman was inspired by a sign in a hotel bathroom to, "Please use water sparingly" and he started developing the concept for Water Watch on his return home. Water Pebble is a little product designed to help you reduce your water usage for simple daily tasks such as brushing your teeth or having a shower. Place in your sink or shower and it indicates how much water goes down the plug hole.


Taken from www.priestmangoode.com/products/

iSAVE

This gadget, designed by Reamon Yu, easily attaches to your sink or showerhead to provide a digital readout of the amount of water that was being used in a shower. What's more, iSAVE is powered by energy generated by the water passing through it, using a small turbine embedded in the device.

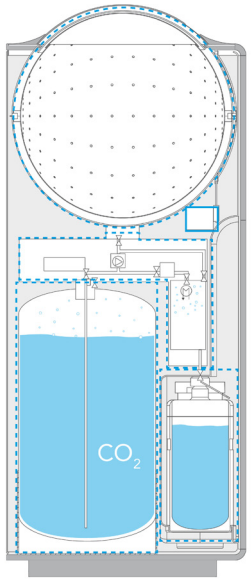

Two different models of the iSAVE were created, an integrated shower faucet with LED display and a handheld showerhead or a standard faucet.

Yu's inspiration was simple: people tend to waste water because it is difficult to know how much is being used (the more you know, the more you care). This is especially true when using a public bathroom, such as one in a hotel, airport or a mall, thus warranting the need for a device that would make people conscious of their water usage.

Taken from www.inhabitat.com/2007/05/08/isave-faucets-monitor-water-use/

## To clean around the house

CO2 washing
eCO2 is an cleaning system for clothes for the private household, designed to be formally integrated into the living space. eCO2 cleans with liquid CO2 instead of water.
User-benefit: The machine needs neither water supply nor water drain, and the dirty laundry can be cleaned wherever it piles up - in the bed- and bathroom.
eCO2 has a plain and simple form language, therefore it is perfect for the combination with other home furnishings. The access to the “cleaning drum” is possible through a dome-shaped top, which gives the device a high recognition value.
Each year about 330 million cubic meters of water are needed in Germany for the cleaning of laundry. The goal of this project was to reduce the use of water.




Designed by Barbara Grosse-Hering, grosse-hering@web.de

Washup
Washup is a conceptual design integrating washing machine with toilet-flush. It suggests a sustainable water consuption by storing the wasted water in toilet-flush tank and reuse it with flushing. Moreover, Washup brings a solution for the problem of location of washing machines in small bathrooms, overlapping washing machine usage space with toilet usage space. It is fixed on the wall above the toilet, so that loading of clothes would be easier for the user without bending or crouching down. An interface including three semi-sphere control units & two flushing buttons is designed for a practical usage of the product.

Designed by Sevin Coskun.
See www.core77.com/competitions/GreenerGadgets/projects/4609/

Bio cleaning products

Ecover is a Belgian company that manufactures environmentally friendly cleaning products. There are products for washing up, household cleaning, laundry, personal care and more. Ecover products are made from plant-based and mineral ingredients.


Taken from http://www.ecover.com

Microfiber cloths

Microfiber is made from a blend of high quality nylon and polyester. Using an environmentally-friendly heat-weaving process in which polyester and nylon fibers are repeatedly pressed, blended and intertwined, the result is the microfiber. Microfiber reduces the need for cleaning with chemicals or harmful subtances. Other advantages are that it is:

Non-toxic: No harmful chemicals, fumes or vapors – just add water.

Environmentally friendly: Reusable & long lasting, no more paper towel waste.

Allergen friendly: Magnetically attract dust, eliminates flying dust particles.

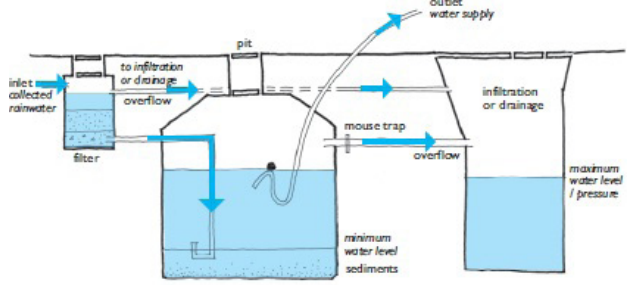
Usable anywhere: Ideal for stainless steel, counters, glass, porcelain & more.

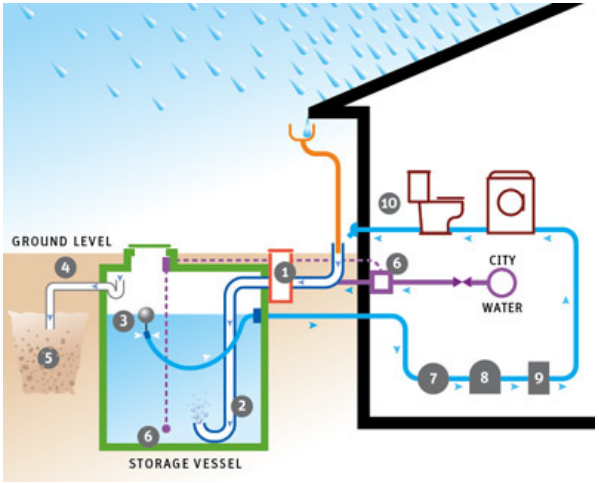
Taken from www.bluewondercloth.com

## Collecting rain water

Collection systems

One example of a rain water collection system is the RainKeeper System. The system makes it simple and affordable to collect and use the abundant supply of naturally pure and soft rainwater that falls on your roof every time it rains. The shortage and cost of producing purified water for drinking is a growing problem, yet every day a large percentage of this treated water is wasted in homes and industry on uses such as toilet flushing, laundry, pool and hot tub filling, car washing, fire suppression, and lawn and garden watering.

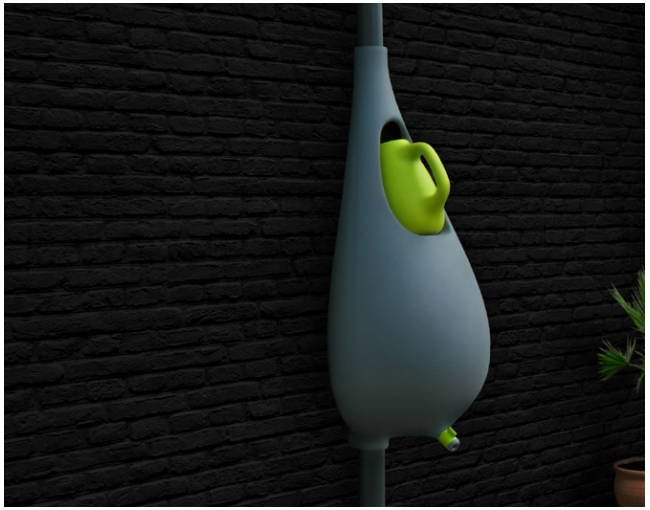



Taken from “Every Drop Counts”, a report published by UNEP.

Taken from http://www.starkenvironmental.com

Garden tank



‘A Drop of Water’ is a rain barrel that makes saving water really easy by providing a watering can that is automatically filled when it rains. This way, the user doesn’t have to fill the can with our precious tap water, but uses ‘free’ rainwater instead for the garden.

Design by Bas van der Veer, www.basvanderveer.nl

P.I.P.A.

The P.I.P.A. system is an attractive alternative to the current water delivery system found in rural areas of developing countries, where water infrastructure is deteriorated and inefficient.

The P.I.P.A. System aims to deliver sufficient water (20 liters/person/day) for 10% of the population that lives in the slum areas of Rio de Janeiro, Brazil. It utilizes rain water and consumes less energy and chemical substances than existing water logistics systems. The P.I.P.A. System is typically installed on the rooftops to collect rain water and locally provide drinking water to households.

PIPA was designed by Fernando Del Caro Secomandi at the Faculty of Industrial Design Engineering Delft University of Technology.

Filtration
Nano filtration is a technique that has prospered over the past few years. Today, nano filtration is mainly applied in drinking water purification process steps, such as water softening, decolouring and micro pollutant removal.
During industrial processes nano filtration is applied for the removal of specific components, such as colouring agents.
Nano filtration is a pressure related process, during which separation takes place, based on molecule size. Membranes bring about the separation. The technique is mainly applied for the removal of organic substances, such as micro pollutants and multivalent ions. Nano filtration membranes have a moderate retention for univalent salts.

Other applications of nano filtration are:
- The removal of pesticides from groundwater
- The removal of heavy metals from wastewater
- Wastewater recycling in laundries
- Water softening
- Nitrates removal

Taken from www.lenntech.com

## Going to the toilet?

Sink/Toilet
The SinkPositive is an add-on to the existing toilets. Upon flushing, fresh water from the supply line, comes out of the faucet while the user washes his hands. The amount of water is the same as when a cistern is refilled, but the 'grey water' is drained from the basin into the bowl, which is then reused when the next person goes to the bathroom.

Taken from sinkpositive.com

Roca, an international sanitaryware producer, took a more integral approach. They combined toilet and wash basin in one product, called W+W. The 'grey water' from the sink is filtered before it enters the cistern, allowing for sufficient hygiene. Furthermore the designers took care of ease of use and space use of the product.

Taken from www.roca.com.es/ww/index.html?en

See-through tank

Visualising the water that is flushed down the toilet contributes to consiousness about water consumption. When the toilet cisterns show the amount of water that is flushed people are more inclined to push the ‘stop’ button.

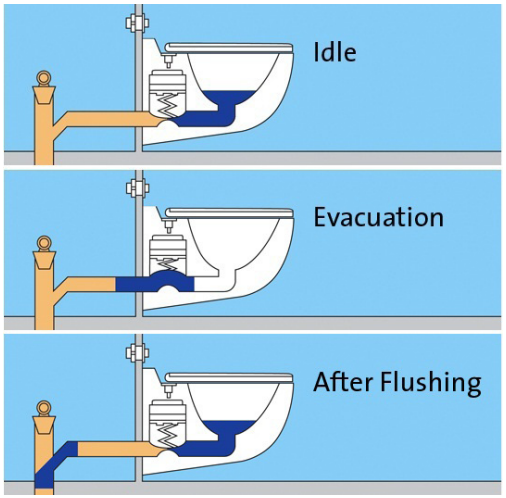

Taken from The Sustainable Dance club (left), and www.re-nest.com (right)

Vacuum toilet

The RoeVac® vacuum toilet has been designed particularly as a water saving device and for maximum convenience. It is available for wall or floor mounting. Both models are available in china and the floor-mounted model is also available in stainless steel.

The RoeVac® vacuum toilet operates as follows:

Step 1: The user pushes the flush-button, the interface valve is opened and the wastewater is evacuated. Air is also sucked into the system. At the same time the clean water valve is opened and rinsing water is sprayed into the bowl.

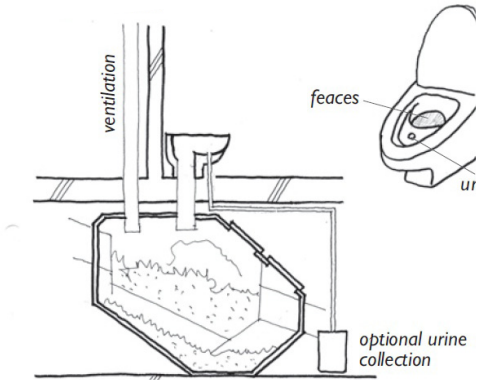


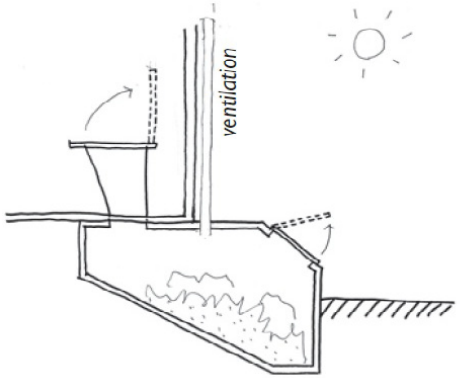

Step 2: The vacuum valve is closed but the water valve remains open. A small amount of fresh water is sprayed into the bowl.

Step 3: The water valve is closed, a small volume of clean water is retained in the bowl and the toilet is ready for use.

Taken from http://www.roevac.pl

vWaterless toilet




Waterless toilets use no water for flushing and require only small amounts of water for cleaning. Therefore waterless toilets are an effective sanitation technology for the saving of water resources in the urban and domestic environment. The most common types are pre-composting, composting and dehydration toilets, based on dehydration and composting processes.

Taken from “Every Drop Counts”, a report published by UNEP.

# Results

The group was split into two, each of which worked on their own subject within the Lab theme. In this chapter the process and result of each group is discussed.

## Bathroom & Toilet

This group worked on the bathroom topic, including the toilet. An inventory was done on what, according to the group, were important issues in water use around the house. From those, they formulated their problem by defining the key conditions for any solution they would formulate later in the process. It was decided that any solution should offer a minimum amount of comfort, should be easy to use, should make smart use of all kinds of water available in the house (rain water and drinking water), and should sensibilise the user.

### Design challenges

Next, the group identified the most interesting design challenges. Formulated as 'how can we'-questions these were the following challenges:

- How can we shower or use the toilet using as little water as possible?

The group decided that it was inevitable that toilets would continue to use water. The waterless alternatives were deemed impractical or inconvenient to use.

- How can we make a distinction between showering to clean and to relax?

The group identified different goals to take a shower. They reasoned that these goals offer opportunities to change the way we shower.

- How can we keep our wastewater as clean as possible?

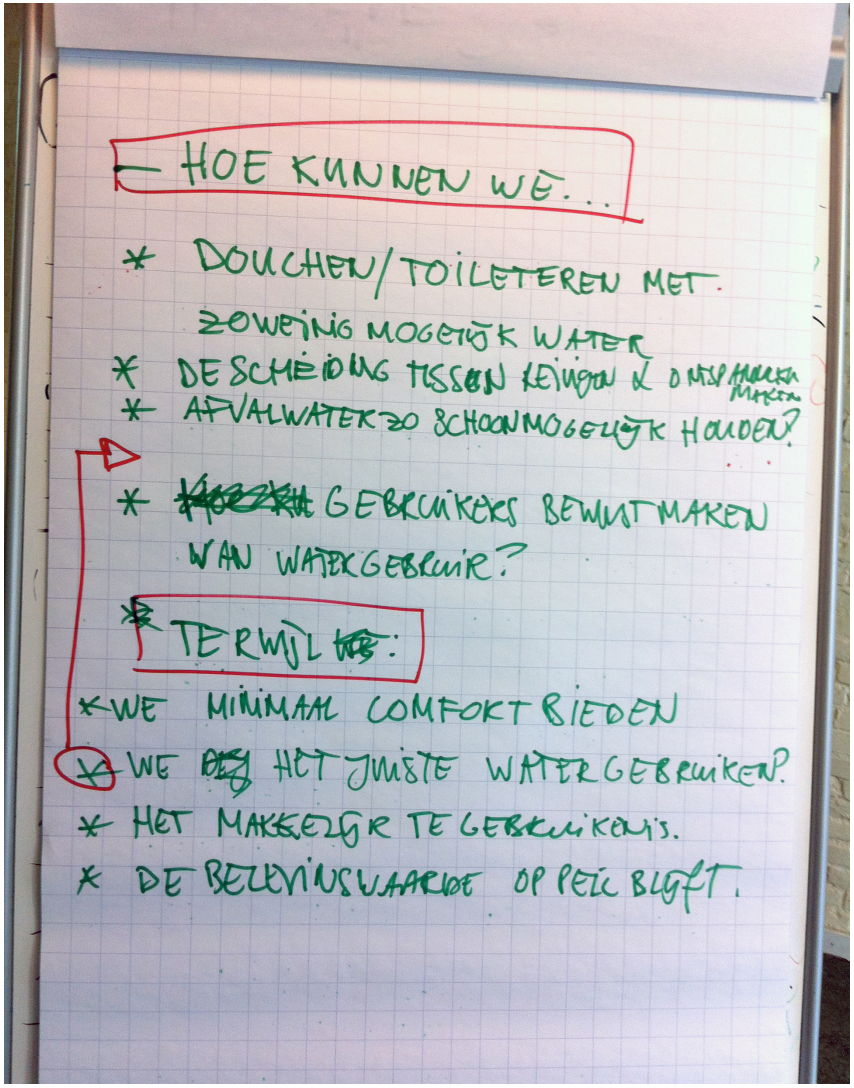
It seems that it becomes harder and harder to clean our wastewater. Therefore it would be smart to pollute the water we use as little as possible.

- How can we make people aware of their water use?

In order to save water and use water sensibly people must be aware of their water use. This can be done by incorporating sensitizing elements into a water related product.

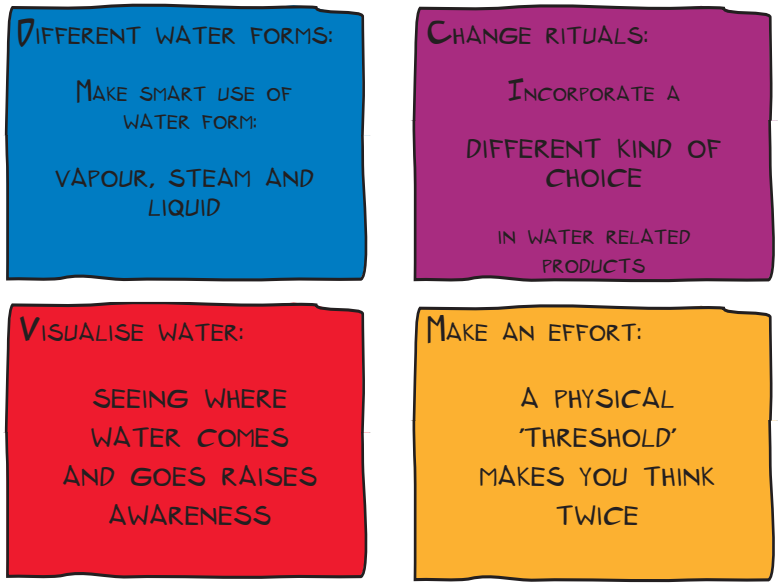
- How can comfort be retained when using less water?

The general belief is that saving water equals having less comfort. The group decided that it is important that the level of comfort should be equal. This also opened up the range of solutions.



## Intermediate ideas

After having used several creativity techniques to answer the above questions, the following directions of solutions were chosen to be most interesting:




Use different 'forms' of water
By this is meant that steam, vapour and running water are forms of water that can be experienced differently. These differences can be advantageous for product experience.

Change rituals and choices
When offered a reasonable choice, the group believed that people are willing to change. This choice and subsequent change should be incorporated in the product and its use.

Make the water use visible
According to the group believe the invisibility of water use facilitates the waste of water. By making both the water and the use of it visible they thought that the use of water and the people's awareness could be altered for the better.

Make people put in extra effort to use excessive amounts of water
When people physically feel that they have to make an effort to get extra water, they will be sensitized and might use less water.

## Final concepts

For the final elaboration of the concepts, four ideas were chosen. They were selected based on their potential to be marketable. Each product additionally has a specific quality that makes it a potential success.

The toilet concept was chosen for its combination of ease of use and very low water consumption. Contrary to 'ordinary' waterless toilets, this toilet does not require the maintenance and care for the compost. The 'ecological' balance of the compost culture is very delicate, it can be fairly easily disrupted. Furthermore it is required to empty the compost-container very often, a job that is not very appealing to many people. These drawbacks are solved in this concept.

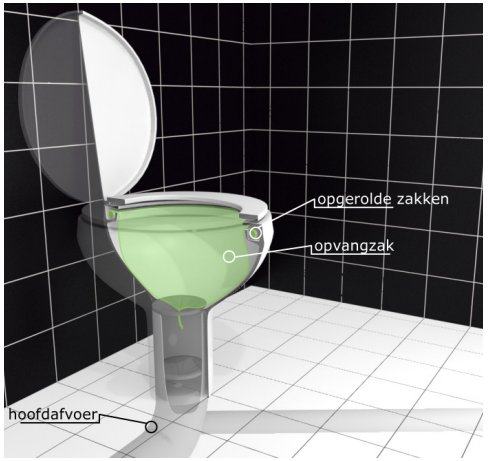
The eco-button is an easily applicable solution to raise awareness concerning the use of water. Its simplicity is key in its success. Contrary to the existing thermostat taps, this eco-button has a gentle increase in the resistance when it is opened more. The gentleness is believed to be more attractive and less patronizing, while retaining its awareness potential.

The shower heavily draws on a luxury approach. While the use of different forms of water is intended to lower water consumption, the idea to be able to choose the form of the water is one of luxury. Following the diffusion of innovation theory, the group proposed to introduce this product to the high-end market segment and then diffuse it gradually to the masses. By this time the total amount of water saved will be significant.

The water meter is a device that takes water measuring out of obscurity. This is combined with a way to consciously decide the amount of water one will be using during a week. The attraction of the product lies in the role it can play in shortening in the feedback loops concerning water in the household. In the regular situation in Europe, where potable water is delivered through a water provider, the consumer has no idea that potable water comes from a limited source. The intervention of the water provider cuts the consumer loose from its direct link with the water source. The product restores part of this relationship.

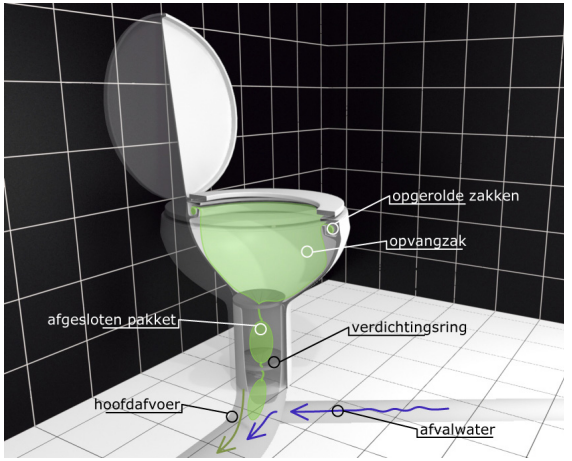
# Don,t use water, use a bag!
# How to not use water when you have to go

## Water-free Toilet




1. Toilet is used

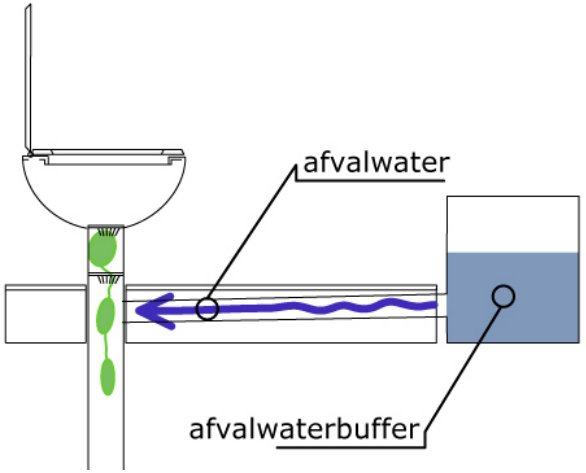

2. Package is compressed




3. Package is led away

The toilet is the product using the biggest amount of water in the household. About 30% of the water used in the household is used for flushing the toilet. Most households use drinking water for this. On average a person uses 37.800 liters per year.

The Water-free toilet uses biologically degradable bags that are sealed airtight and thus do not smell. The closing mechnism is based on the well known system for diapers. The packages are led away through a standard pipe. To make transport of the packages through the pipe easier, grey water is used (from shower, sink, washing machine etc.). When pushing the button part of the grey water will be released and will carry the package away. Once in the reservoir, the packages can start degrading.




Images by Roel van de Beek

# Evaluation of the water-free toilet

Attractiveness
Is this solution attractive to end users? The water-free toilet offers a number of attractions to the users. Firstly, it greatly reduces the amount of water used. This translates to a reduction in water costs. Secondly, the toilet is soils less and is odor free. Thirdly, there are few waste products like diapers that can not be ‘flushed’ away.

Embedding in houses
The traditional place for the toilets in ordinary houses is possible. However, a vacuum system has to be installed and should be done in multpile houses. Retro-fitting therefore is harder than construction in new developments.

Cost/benefit ratio
When considering retro-fitting, the water-free toilet does not perform well concerning its cost/beneift ratio. The return-on-investment (ROI) will take too long, since the price for water is very low. If the price of water will rise, it might perform better. In a new development project, this product can perform better, when applied on a larger (neighbourhood) scale.

Ease of use
The product is very easy to use, In fact, existing rituals do not have to be changed at all. The water-free toilet performs ans id operated much like a usual toilet. The difference lies herein that the roll of bags will run out and will have to be replaced. Cleaning of the tiolet not be necessary as much as it is with traditional toilets.

Sustainability
- Trias Ecologica
The water-free toilet reduces water use, and what little water is used can be supplied by rain water or grey water collectors. The bags are made of bio-degradable materials. The material of the toilet bowl itself is expected to be of porcelain, performing equally as before. The desogin of the bowl however, lacking a water container, will not use any plastics. Another bonus is that, with the lesser need to clean, the amount of waste water created when cleaning will overall be reduced..

- Resilience
The water-freee toilet contributees to a lesser reliance of the household on drinking water. This is beneficial. On the other hand, there are less ‘storage spaces’ in the house, as the water container is missing.

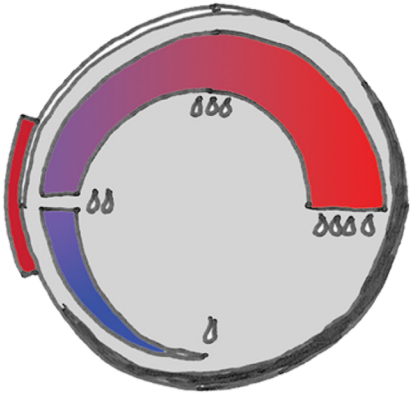
Concluding
The water-free toilet opens up new possibilities for the use and design of toilets. However, in a renovation context is it less useful. The water-free toilet will come to its maximum potential when integrated in a new development.

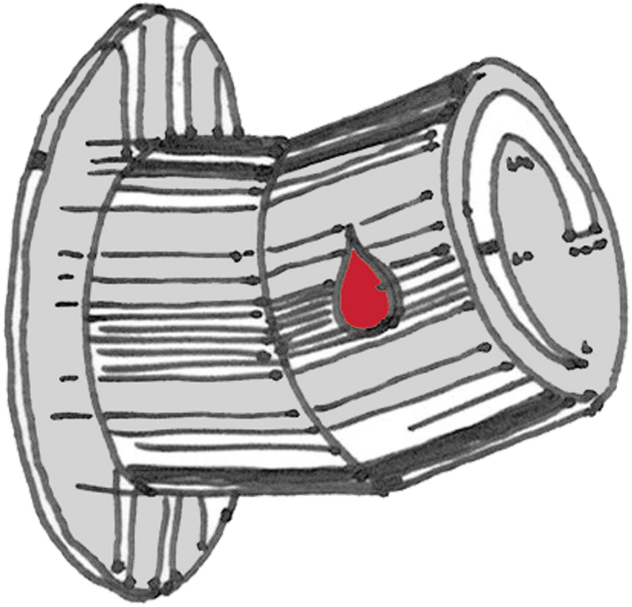
The eco-performance exceeds that of a traditional toilet, both use less resources and producing cleaner waste water.

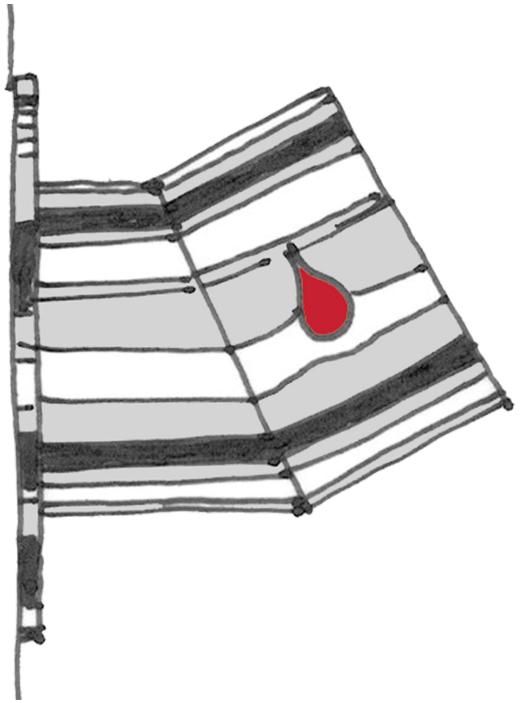
# Are you prepared to put in that extra effort? Think twice when you feel the resistance..

## Ecological water management: the eco-button

The ecological water management is based on the temperature control in the shower where a button has to be pressed before one can turn the button to increase the temperature.
The eco-button uses this system to create a perfect balance between comfort and ecological water use. If the button is not pressed in the amount and temperature of the water shall be ecological and at the same time feel comfortable.
If the button is pressed and turned the parameters will rise: more water and energy is used for showering, washing hands or brushing the teeth then is necessary if one wants to behave in a manner that is water efficient.







Images by Roel van de Beek

# Evaluation of the Ecobutton

Attractiveness
The eco-button will fit in well in any ordinary portfolio of taps. The look and feel of the button is designed so that it resembles a normal tap combining both the amount and temperature of the water in a single action. This provides a simple and elegant design.

Embedding in houses
This product is a bolt-on solution: it will easily replace any tap in the house.

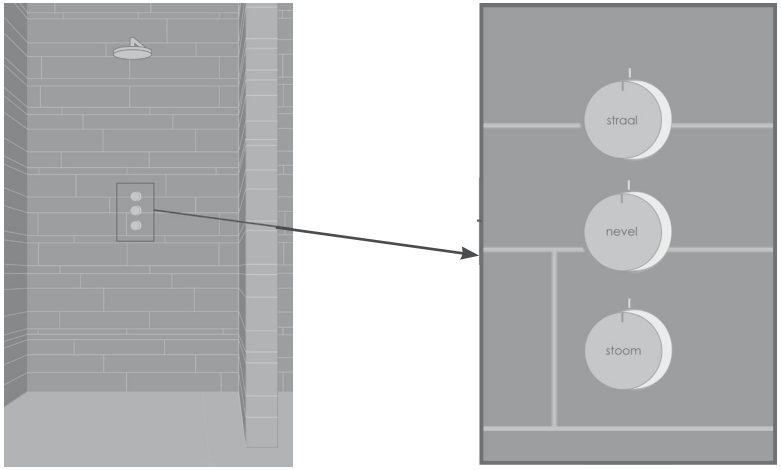
Cost/benefit ratio
The tap will not cost more than any other ordinary tap. When in a renovation taps are replaced anyway, this tap may be bought instead. When bought as a replacement before the old tap has worn out, the ratio will not be as favourable, as would be the case with any other tap.

Ease of use
The product is designed to be installed and used as an ordinary tap. However, the ease of use diminishes after the point where water and energy waste is highly likely. To accomplish this, the effort needed to turn the tap after this point is increased and increases until the maximum or hottest and largest volume of water.

Sustainability
- Trias Ecologica
The Ecobutton has the ability to reduce the amount of water and energy used. This is ultimately determined by the user's behaviour. The product itself does not instill this. The type and amount of material for the Ecobutton is comparable to the average tap.
- Resilience
The Ecobutton is a tool to raise awareness and can not raise the resilience of society or the household itself.

Concluding
The Ecobutton is an easy way of raising awareness in the use of water and energy. By being interchangable with ordinary taps, the Ecobutton has a high success potential.

# Choose the water that fits you!
# . . . about showers and watermeters

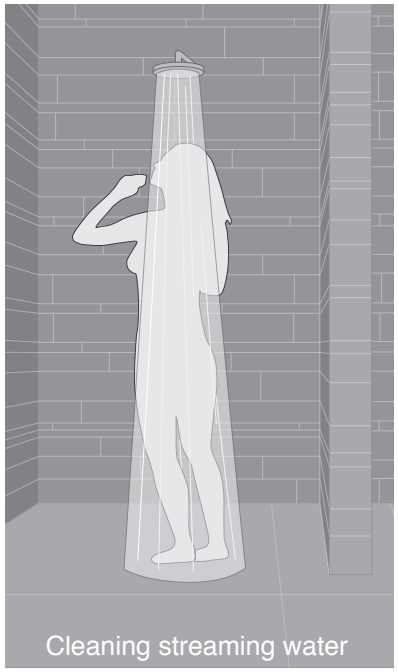


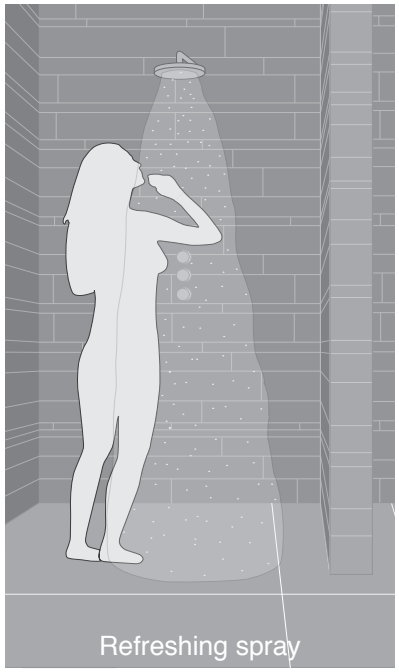

Options for the shower modes

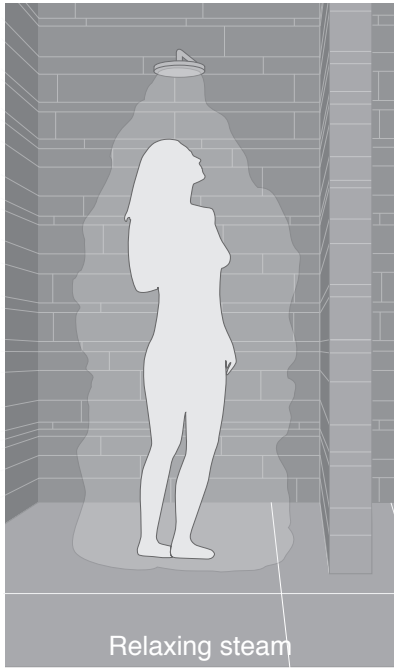
## Choice of shower mode is up to the user

There are three different reasons to take a shower. To clean up, to freshen up or to relax. The shower heads on the market at the moment often have only a few modes for different water flows. However, the amount of water used is always the same.

This shower takes the different ways of usage as a starting point and changes the use of water accordingly. Not every form of usage needs streaming water.
The shower has three different modes. The modes correspond to what kind of shower the user wants at the given moment. The flow of water as we know it now can be used for cleaning, vapour can be used to freshen up and stream is suited if you want to relax under the shower. By chosing `vapour` or `stream` water is saved. The use of water at that moment is significantly less then during the normal flow of water. The comfort and freedom of choice are kept by changing the way of water usage to the specific needs of the user.


Cleaning streaming water


Refreshing spray


Relaxing steam

Images by Maaike Zeegers.

# Evaluation of the three modes shower

## Attractiveness

The product radiates luxury. The ability to choose one of three forms of water reminds people of spas, Turkish baths, saunas and the like. The design is of an attractive simplicity.

## Embedding in houses

This product requires a rebuild of the bathroom. The installations needed for producing vapour and steam have to be placed in or near the bathroom.

## Cost/benefit ratio

With current water prices the installation of this product is only interesting if the added value to the bathroom as a luxury product is wished for. But  rising water prices can turn this product from luxury into a money saver. the ROI will then also be shorter.

## Ease of use

The product is easy to use: for each form of water there is a separate button, indicating its function. Although theoretically this form of showering can limit the amount of water used, the user itself has to decide whether he or she chooses to switch water form depending on the reason for showering. Choosing a form of water is as eay as pushing a button.

## Sustainability

- Trias Ecologica

The shower has the potential to reduce the amount of water use and subsequently the amount of waste water. There is no influence on the qualtiy of the waste water. The potential drawback of this product is energy consumption. Although producing of water vapour will require less energy than an equal amount of hot water, the production of steam will cost more.

- Resilience

The shower will be more dependent on electricity as an energy source, while it remains equally dependent on gas as a way of heating water.

Concluding

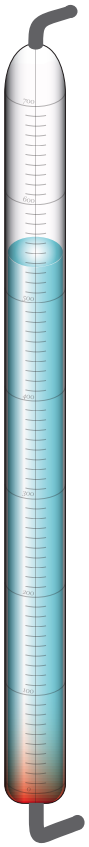
The goal of the workshop was to create awareness of water use and reduce the amount of water used in the bathroom, The product definitely performs well in this respect. The product fits well in the innovation models, as it will first serve as luxury product and later can be adpoted by a larger group as water prices rise and alternative ways of water use and reduction are needed.

## The new watermeter

The watermeter helps to visualize the water usage in the house. Other than the watermeters that at present are mostly hidden somewhere in the house, the watermeter is clearly visible and readable. In addition to that, it is an aesthetic object that can be placed central in the house.

The watermeter shows how much water you can and wish to use during the week and how much you have already used. This is how you can see immediately when you should use less and when you have not yet used a lot. It symbolizes a personal water storage. The product shown is for a family with four members that has a weekly storage of 700 liters (100 liters per day, 25 liters per person per day).

The direct relation between the visible watermeter and water consumption is a stimulus to use less water in the household.



Images by Lizanne Dirkx

# Evaluation of the Water meter

Attractiveness

The Water meter is a low tech device, requires little maintenance and provides direct feedback concerning the water usage in a household. The design can be altered to fit different styles, matching potential buyers' personal preference.

Embedding in houses

The device can be either a stand alone product or be coupled to another vessel. Either way, a storage tank of water, allowing for a days' or weeks' worth of water must be installed. That means that there needs to be enough space in the house.

Cost/benefit ratio

The product is very low tech and therefore low cost in purchase. When used to limit the amount of water use, the ROI will be acceptable and is likely to become better with rising water prices.

Ease of use

Since the product offers direct feedback, it is very easy to use.

Sustainability

- Trias Ecologica

The device will contribute to the reduction in both water use and waste water. As it is an added product in the cycle of water use, it has an impact.

- Resilience

This product is an awareness raiser and will help household to keep an eye on their water use. When water is short or expensive this product can help households.

Concluding:

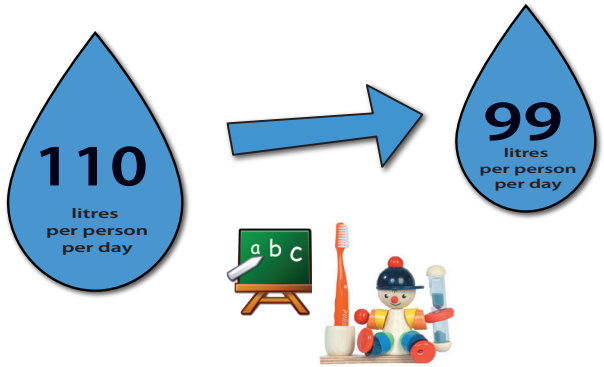
This productis easily adopted in households and rewuires little or no time to invest to lern how to use it. Its direct feedback ability lends it to easily see how the household is performing on the water front.

# Rain water

Starting point for this group were two questions:
How can we promote rainwater use for activities that do not need water of drinking water quality? And what kind of products can facilitate use of rainwater in a household?

## Use less drinking water

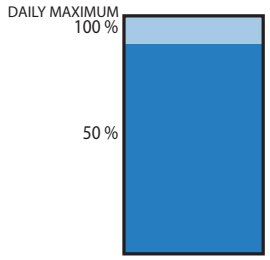
One approach to let households use more rain water is to reduce the amount of drinking water used in households, either by awareness raising or by a system change.



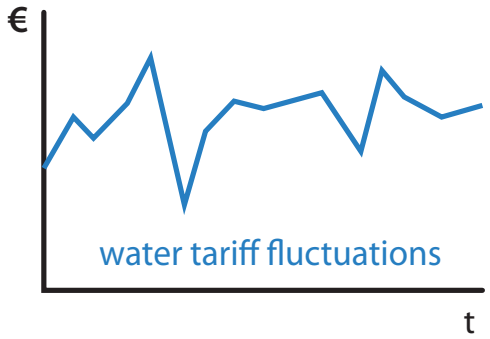

The average water consumption in a Belgian household is about 110 litres per person per day. This amount could be brought down by using a collection of smart gadgets and campaigns to make the user conscious about their water consumption. For example with:

**Pre-paid water consumption**
Each household gets cards with watercredits. This way one has to be aware of the amount of credit left and actively ensure there is sufficient credit. Additionally It creates a direct link between between the amount of water consumed and the costs related to water consumption.


**Water quota**
Set a limit to the water consumption per person. When the daily quotum of water has been used, one starts paying more, will receive a message, or will not get water anymore.




**Water tariff fluctuations**
In line with the previous idea: the more water consumption per person is consumed, the higher the price. Or the other way around, being frugal with water is rewarded.

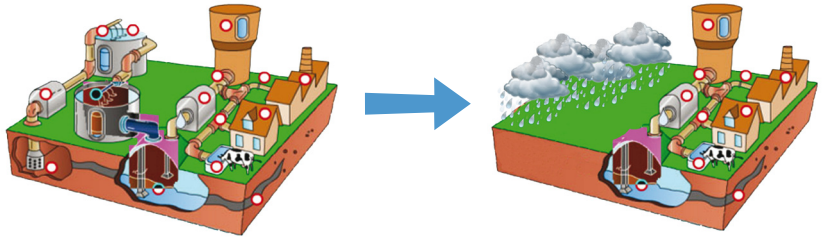



**Visibility of water consumption**
Water consumption has to be visible in kitchen, bathroom etcetera. This could be done by meters or lights on taps.

**Educating the new generation**
When children are taught well about saving water, for instance at school, they can take it with them into their adult life. Additionally children can engage their parents. Campaigns could use this, by for instance providing incentives for the children to engage their parents in water saving activities.

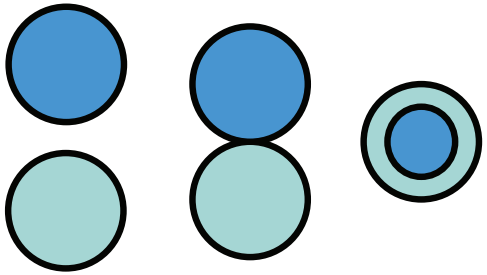
## System change

Less drinking water consumption can be achieved by campaigns and products that facilitate lower water consumption. Would that however lead to fundamental changes in user behaviour in favour of using rain water? In addition to behavioral change, the water supply system system would have to change.



## Additional rain water infrastrucure

The first option under consideration was to introduce a complementary water network for rain water. The amount of drinking water consumption could significantly be reduced because rain water would easily be available in the household. This can reduce the environmental impact of water purification.

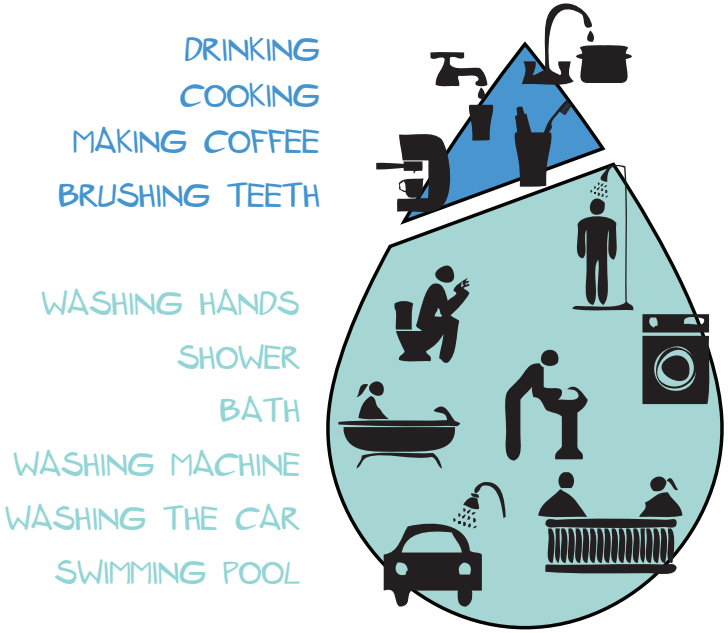


Additional piping for rain water infrastructure:
two pipes, combined pipes, pipe-in-pipe

A fact to consider however, is that implementing a new water network would be expensive and complex. Environmental gains in the water purification would be counteracted by the implementation of a new infrastructure. It was thus concluded that developing products and services for an additional infrastructure was not an feasible direction.

## Amount of necessary drinking water

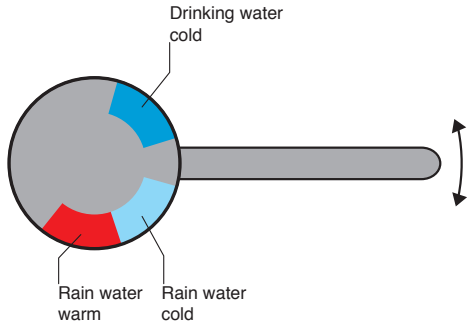
Analysis of the water consuming household activities was done. This showed that only about 10% of the water used in the household has to be of drinking water quality, for drinking, cooking, making coffee and brushing teeth. The remaining 90% could be provided by filtered rainwater.




Therefore the following is proposed:
If only 10% of the water consumption in households has to be of drinking water quality, why don't we 'switch' the water provision to rain water quality? Instead of providing households with drinking water quality water, households are provided by lower quality water, based on rain water. The purification process can stay under control of the existing water works, thus providing a safe standard. The water companies will intensify the collection of rain water which will only need a light treatment.

## Produce drinking water at home

This ‘Switch’ means that users have to filter the water locally to make drinking water. This introduces a new product category with many possibilities. Novel products are to be developed that make it possible to purify water according to the actual drinking water needs.
They can be a central filter system in the house, filter systems for under the sink and could include new taps that provide cold drinking water (after filtering), cold rain water and warm rain water.




Tap providing three ‘types’ of water. Cold drinking water, cold rain water, hot rainwater.

Another direction is the introduction of ‘drinking water makers’. These devices are dedicated to producing drinking water, in a similar way as we now make coffee or tea. In terms of product and service development this solution provides interesting opportunities. What about for example providing filters with a variety of filters that have different effects on the taste of the water?
The value of this direction is that drinking water is perceived as something valuable rather than a commodity. With a double piping system or filters that are not visible drinking water production would remain a commodity, as is for instance the case with central heating systems.

Images provided by Peter Van Riet, Stefan Schöning, Ben Hagenaars

A docking system that ‘recharges’ with drinkable water. The filters are installed under the counter. The filters could be differentiated, providing a variety of water flavours.

A ‘watermaker’: rain water is purified to drinking water, with an choice between hot and cold water. The use fills it with the amount of required water, thus avoiding to waste water.

# Evaluation of the ‘rain water switch’

Attractiveness
Changing the water system will not be easy to achieve. From a user perspective it requires a big change in the sense that one has to actively make sure drinking water is available. On the other hand, the system remains quite simple.
A concern may be safety. When the quality of the provided water is guaranteed anddrinking that water is not harmful when taken in at low frequencies, this concern may be overcome. It does need a carefully organised transition. Thourough product design as well as marketing/ awareness raising programs will need to be part of it.

In terms of water purification devices, the differentation in products can be attractive to end-users. It provides them with options to choose the product that fulfills their needs in the best way.

Embedding in houses
Major adjustments to buildings are not necessary. Implementation of either a filter system or water makers do not require big modifiications to a building. The major change is made outside the buildings in the water purification system.

Cost/benefit ratio
Considering that water collecion and purification wil become more difficult, the price of water is expected to rise. When using a lower quality water, process costs for water purification can be lower. Nevertheless the costs for purification in the households increase due to purchase and maintenance of in home purification systems, but also in terms of effort.
It depends on the balance between the water prize and the in home purification costs if the cost/benefit ratio turns out positive.

Ease of use
The convenience of opening the tap and having drinking water remains when central filters, or filters in the taps are used. A point of attention is the replacement of filters. The availability of filters (where to buy), how often it has to be done, and how will further determine the ease of use of the filter systems.
For the ‘water makers’ ease of use can be compared to that of boiling water in a kettle or making coffee. According to the end-users demands and habits, drinking water can always or very quickly be available. Compare it for instance with the water containers that can be found in offices, or preparing water for the day analogous to preparing a thermos with tea for a day. Product designers have the skills to develop ‘water makers’ that can satisfactorily address end-users concerns.

Sustainability
- Trias ecologica
The switch reduces the environmental impact of water purification in water purification plants. However, decentralised purification means that more products and services are used in households. The environmental gain in the water purification plants may not balance this impact.

In terms of water consumption, the switch may result in lower drinking water consumption, but does not assure lower water consumption overall. The system does make people councious of their water consumption, which in turn would result in lower water consumption.

- Resilience
With decentral water purification, in each building people will be able to produce drinking water. This is a very welcome fail-save mechanism in case of disasters or failures of the central water system.

Concluding
At first sight this solution may not be the most convenient for end users. We’re talking about a paradigm change in response to the changing circumstances related to the availability of water.
In terms of environmental impact this solution may have more environmental impact due to the increased need of appliances.
At the same time, the proposed solution has the potential to achieve a radical change in behaviour, drastically lowering the amount of water consumption.

## Conclusions

Looking back at this edition of the Livinggreen Lab we can conclude a number of things. First of all the testing of the new format yielded good results. The participants were enthousiastic about the workshop and the elaborated results were of the expected quality. The one-day version of the Lab worked well, even though the timeframe was rather limited compared to the Livinggreen Lab Energy.

But unfortunately there were also some disappointments. Also this edition, the lack of company presence resulted in a one sided view on the issues of Water. Also the number of participants were lower than expected and wished for.

The focus on bringing together both companies and users to develop products and services will shift toward awareness raising of participants. We noticed in the evaluation that the participants indicated that they both learned more about the subject than they expected, yet wished they would have learned even more. At the same time the participants indicated that they were more aware of the issues and that they would try to act upon it after the Lab.

Concerning the results of this Livinggreen Lab, the expert panel to which the ideas were presented at the end of the day, expressed to be positively surprised by the novel views of the participants. They appreciated that the participants addressed the problem on both a product and a system level.
Of course the proposals are not flawless. Time was too limited to fully think the proposals through. However, we hope that they can be starting points for further development of products and services.

Again, we enjoyed the organization of the Lab and appreciated the cooperation with Ecohouse Antwerp and the special partner REcentre.

## Epilogue

The format of the Lab is undergoing continuous inporovements. Instead of focussing on several target groups at the same time, we now move to working with one target group at a time. Work is in progress for the next Livinggreen Lab, in London. The hosting organisation will be the National Trust, whose main target group consists of families. Therefore a different approach is needed. In addition, we will be working closely with students, who will work with us to prepare the theme, Materials.

In the meantime the promising results of this Livinggreen Lab are taken as a starting point by graduation students from the Faculty of Industrial Design Engineering. They will elaborate on the theme and proposals of the Lab. We hope to produce prototypes of their designs before the end of this year.

Sietze Meijer
Daphne Geelen

# *Livinggreen.eu*

## Introduction

With the Livinggreen Labs, Delft University of Technology aims to develop innovative product concepts that stimulate consumers to adopt sustainable lifestyles. Livinggreen Labs are part of the Livinggreen.eu project. The Livinggreen Lab approach is developed over the duration of the project, until 2013.
This publication specifically addresses the Livinggreen Lab about water use in households, which was held in Antwerp in October 2010. It is the second in a series of Livinggreen Labs. A publication about the Livinggreen Lab about energy, held in 2009, can be found on the project website.
Chapter 1 discusses the Livinggreen Lab in general. The Livinggreen Lab approach is addressed in chapter 2. And the results of the Livinggreen Labs are discussed in chapter 3. Finally, conclusions about the Livinggreen Lab about water, as well as lessons learned for the Livinggreen Lab approach are presented.

This edition of the Livinggreen Lab is co-organised by REcentre.
REcentre – centre for sustainable design is a knowledge and promotion centre propelling the development of sustainable design in the Meuse-Rhine Euregion, consisting of Belgian and Dutch Limburg, Regio Aachen and Liège.

REcentre creates an expertise cluster in sustainable design within the Meuse-Rhine Euregion. By setting up projects together with designers, schools, companies and public institutions REcentre will show how sustainability can become real and what role design can take in this.

REcentre is an Interreg IVa project supported by Wallonie Design (Liège, BE), Z33/Design Platform Limburg (Hasselt, BE) and NAiM/ Bureau Europa (Maastricht, NL), Flanders District of Creativity (Leuven, BE) and Dutch Design Week (Eindhoven, NL).

# Demonstration of sustainable renovation

## The renovation challenge in North West Europe

North West Europe is characterised by its rich urban heritage, which is an asset of the North West European cities. Existing building stock gives identity to cities as ‘places to be’ for the creative class and innovative economic activities.
For conservation and renovation of the existing building stock, sustainability is a prerequisite for mitigation of climate change. For new buildings there is a vast range of examples and standards abovut the integration of sustainability principles. However, the amount of new buildings that are added to the existing building stock in North West Europe, is about 1% per year. Applying sustainable technologies in new buildings thus has very little effect on the overall quality of the built environment, while renovation of the existing building stock can achieve enormous gains in sustainability.
Currently there is a risk of neglect and deterioration of architectural heritage. Maintenance and renovation require small scale, labour intensive operations and craftsmanship. Building at the city fringes is thus cheaper and faster. Nevertheless, there is a great market potential in sustainable renovation. The do-it-yourself market, the construction and installation sector, the practice of housing corporations, consultants and public authorities offer intriguing opportunities to make our built heritage sustainable. Howver, the possibilities of how to renovate, restore or ameliorate the existing building stock in a sustainable way are generally unknown to house owners, housing corporations, public authorities, contractors, investors and consultants. If we wish to keep the architectural quality, multifunctionality and social cohesion of our urban centres, and foster our local economies, action must be taken. Technology is available. The challenge is to bridge the gap between knowledge and practice, to engage people in sustainable renovation.

## Livinggreen.eu to demonstrate the possibilities

The Livinggreen.eu project, supported by the European Union in an Interreg IVB program, aims to demonstrate technologies, methods and strategies for sustainable renovation. Five cultural heritage buildings in North West Europe are renovated in a sustainable way to demonstrate the possibilities for sustainable renovation.
Additionally, two knowledge partners work with methods for product and service development and knowledge transfer.
The project partners have defined five focal themes for the project: architectural values, climate robustness, efficient use of energy, efficient use of water and sustainable building materials.

## Livinggreen centres

Five of the Livinggreen.eu project partners invest in the renovation of a cultural heritage building. After completion these buildings will have a public function, exploited by a foundation or a municipality. These ‘centres for sustainable living’ act as live examples of sustainable renovation and actively promote sustainable renovation among their target groups, ranging from policy makers to construction companies, house owners and families.

The renovation projects are:
The White Rose Foundation from Delft, The Netherlands, renovates a listed monument (16th to 19th century) in the historic city centre of Delft. In this building the foundation will open a centre that focuses on demonstration and learning of sustainable practices in everyday life.

The conservation charity National Trust for England, Wales and Northern Ireland renovates a 19th century stable yard and waterwheel in Morden Hall Park (South-West London) where visitors can experience how

Facade of The White Rose building

Stableyard entrance, National Trust

renewable energy and other technololgies for sustainable living can be used in their lives. Especially the waterwheel will enable homes and businesses based along the river to look at options to harness the power of the river.

The City of Ludwigsburg redevelops an old barrack area and turns it into the new residential area called “Hartenecker Höhe”. In this area the listed monument flak-hall will be renovated sustainably by using a house-in-house concept. The old flak-hall will house a Child and Family Centre.
Moreover, together with local partners the City of Ludwigsburg renovates a disused factory building. In this building a centre for sustainable living with focus on energy, climate protection and ecodesign will be established. This centre is called “Energetikom”.

The EcoHouse in Antwerp, Belgium, is a former warehouse located in a 19th century, densely populated area. It was renovated in 2001 and since then functions as a centre for sustainable living. The EcoHouse serves as an example for the other centres for sustainable living in this project.
The building will be expanded with an “eco-practice”: a working place and advice centre for building owners and professionals, including a help desk and ict-applications to calculate saving of resources.

The City of Lille, France, renovates a 19th century industrial building to promote eco-housing and eco-building. The main objective is to bridge the gap between supply and demand: by welcoming and advising inhabitants, by qualifying, federating and guiding professionals in the housing and construction/renovation sector.

Flak-hall in Ludwigsburg

EcoHouse Antwerp

Industry building in Lille

# Knowledge transfer and product development methods

In addition to the practical challenge of renovation of cultural heritage, involvement of and communication to the target groups of the Livinggreen centres is an important aspect of the Livinggreen.eu project.
Two approaches are explored in depth by Espace Environnement and Delft University of Technology. The investing partners themselves already have a number of ways to promote and communicate about sustainable renovation or are currently developing them. Furthermore, the project can make use of the experience of the Dutch Curnet foundation, lead partner of the project and coordinator of the communication and dissemination of the project outcomes. The Curnet Foundation creates and facilitates coalitions of partners from the building sector, the urban and regional planning sector, the water management sector and relevant knowledge institutions and authorities in the Netherlands.

## Reno-teams - a team approach to renovation

The Reno-teams method is an approach in which groups of house owners work together with professionals in sustainable renovation. The process is organised by Espace Environnement and Eco-Construction. The Reno-teams approach are training sessions and excursions focussing on specific problems. Such as how to insulate a 19th century wall, while respecting its architectural characteristics. Also financial aspects such as the owners' budgets are addressed.
Espace Environnement and Eco-Construction make the methodology available to the other partners and assist in the implementation of the method in their centres for sustainable living.

## Livinggreen Labs - a user-centered approach to renovation

With the Livinggreen Labs, Delft University of Technology applies a user-centred design approach to come up with innovative concepts for products and services. Each year of the project, a Livinggreen Lab is held with one of the partners. The design challenges are related to the local situation of the partner and will be taken up by local stakeholders. The aim is to develop a method during the project that can be applied independently by the partners or similar organisations.

## Livinggreen toolbox - synthesis of the Livinggreen.eu project

Together all partners will contribute to a toolbox for sustainable renovation, in which the experiences, lessons learned and recommendations are combined, so that other parties can also benefit from the Livinggreen.eu project. The toolbox development is coordinated by Curnet and due by the end of the project.

# Livinggreen Labs

## Introduction and goal

The organisation of Livinggreen Labs is one of the methods used in the Livinggreen.eu project to promote sustainable renovation. Rather than providing information to end-users or companies, we sketch ways in which sustainability can be incorporated in products and services, taking both users, with their practices and behaviour, and technologies into account.
The core of the Livinggreen Labs is a user-centred approach, which springs from the field of Industrial Design Engineering. The design faculty of Delft University of Technology has a vast background in combining technical aspects of a product with the way users perceive and interact with products and services.
In both building construction and renovation little attention is being paid to how the renovation practice can benefit from engaging the people that actually live and work in a building or execute the renovation. These are the users of the products and services. These users decide whether and how they adopt a certain product or service. This decision is very much dependent on factors that are not directly related to the actual functioning of a product, but to personal circumstances and preferences such as accessibility, aesthetics, ease of use and perceived value.
Additionally, user behaviour is a significant determinant of environmental impact. While technical innovations permit increased efficiency of product (or building) operation, the user's decisions and habits ultimately have a major effect on the energy or other resources used.
To enable the adoption of sustainable technologies and behavior, it is thus important to approach product and service development from a user perspective.
The goal of the Livinggreen Labs is to make a user-centred design approach to product and service development available to the Livinggreen partners and to produce a number of product and service concepts that can be implemented by the Livinggreen Centres or their local partners. With each partner a Livinggreen Lab will be organised on one of the Livinggreen themes, tailored to the specific context of the Livinggreen partner. We aim to develop a Livinggreen Lab method that can be used independently by the Livinggreen partners after the finishing of the Livinggreen.eu project.

## Towards a Livinggreen Lab approach

The theoretical basis of the Livinggreen Labs is formed by an interdisciplinary approach to design, human centred design approaches - co-design approach, product-service systems design approaches - and design tools - creativity techniques, scenario building/backcasting methods. Below these elements will be briefly addressed. The method will be developed over a period of 4 to 5 years in the course of the Livinggreen.eu project.
The first Livinggreen Lab was held in 2009 in Ludwigsburg. Following is the discussion of the second Livinggreen Lab, which is about water consumption and hosted by the EcoHouse in the City of Antwerp.

## Livinggreen Lab ingredients

Bringing stakeholders together
An interdisciplinary approach is crucial for innovation in sustainablility. Often it involves the development of complex systems of products and services, the networks of production and consumption may need to be reorganised. To be able to envision such complex systems one has to get actors from different fields together, to exchange ideas, develop ideas together and collaborate to realise them.
For the Livinggreen Lab we bring local authorities, companies and end-users together and furthermore add some designers. Designers are trained to translate ideas from a technology perspective and from user perspective into one concept and can thus bridge the gap between technology and user practice.

Participation of end-users in the design process
There are several ways in which end-users can be involved in the generation of product and service ideas. They can be observed or interviewed but also actively take part in the design process. In co-design the end-users are invited to actively participate in the design process. This is an interesting approach since successful innovation often addresses a (latent) need of end-users. It takes user's desires and needs as a starting point for innovation, rather than technology.
In the Livinggreen Labs the desires, needs and perceptions of the users are used are combined with technology.

Creativity techniques
Creativity can be defined as all the ways of thinking that lead to something new and useful for the thinker. A creativity technique can help generate new ideas, break through fixed ways of thinking, think beyond current solutions, facilitate cooperation and exchange ideas. There are quite a number of commonly used creativity techniques. A creative session typically makes use of several techniques and goes through diverging

phases in which everything is possible, and converging stages where clustering and selection of ideas takes place.
In the Livinggreen Labs we these techniques are used to come to a successful cooperation between stakeholders and reach results that are novel and interesting to all stakeholders.

Designing into the future
The degree of innovation can be set in a scale from incremental to radical innovations. With incremental innovation there are small changes compared to the existing system, e.g. changing the fuel type needed for a car. Radical innovation breaks with the existing system, e.g. the current system of cars for personal transport will be replaced by a different transport system. For long-term sustainability we have to think in terms of radical innovation; in system innovation rather than product innovation.
In the Livinggreen Labs development of radical ideas is aimed for by looking at the future, developing visions, setting new standards. From these visions, one can draw a roadmap towards that situation (through backcasting) and develop concepts for the steps on the roadmap.

Designing combinations of products and services
Most companies are producer of either products or services. However, there is an increasing integration of products and services to fulfill a certain functionality, to bring a certain value for the customers. Transport can for instance be provided by a single product, like a car or a bicycle. But for some situations a more valuable way of providing transport can be the combination a product and a service. Examples are car sharing systems and public transport bike rental systems.
The concept of product-service systems (PSS) is both a business and a design strategy. It has the potential to lead to radical innovation and sustainable solutions for companies and consumers, because the entire production and consumption system is rethought. It can lead to a more efficient use of resources.
The PSS strategy is very customer focused. With a product-service system one aims to fulfill a need of a consumer and then looks for ways to fulfill it with a combination of one or more products and services.
In the Livinggreen Labs the concept of product-service systems is used as a means to rethink the way functions are being fulfilled and come up with radical alternatives to the currently used products and services.
Additionally, the range of tools developed for product-service systems design and evaluation will be used for the generation of ideas, as well as for the evaluation of the developed concepts.

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# Colofon

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