

BLUEPRINT FOR A CIRCULAR WATER SMART SOCIETY

Tangible solutions for
the practical implementation
of circular water



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GLOBAL EXPERT GROUP
CIRCULAR WATER

We do not inherit
the earth from our
ancestors.

We borrow it from
our children.



The vision of water uses within the urban environment

This blueprint provides an overview of the causes of the current water crisis and how the use of safe circular water sources in the urban environment is a quick-to-implement and smart solution to reduce tap water use and wastewater emissions by 20% to 45%.

Circular water can be applied without requiring residents to make concessions in their standard of living. On the contrary, even during long periods of drought and water scarcity, normal pre-water-scarcity living standards can be maintained while saving water and energy.

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The Cause

A global water crisis due to a bankrupt linear water system

Many parts of the world face a water crisis as natural water sources are depleted. This endangers the supply of tap water to hundreds of millions of people in many regions. Wastewater and pesticides also pollute nature and compromise natural water quality. Our society faces the challenging task of decisively addressing this water crisis. The traditional solution is to draw more and more water from nature, but natural resources are depleting. Alternative water sources such as desalination and extracting water from the air can contribute to the solution. However, these techniques are not sustainable because they use a lot of energy, and desalination is damaging to our natural habitat.

The cause of water scarcity

Water scarcity has three causes:

- 1 Population growth;
- 2 Climate change;
- 3 Inadequate decision-making by governments and decision makers in the past.



Numerous scientific studies predicted population growth and climate change decades ago. Despite the warnings, the countries now facing severe water scarcity largely failed to take adequate measures to adapt water systems to the predicted water scarcity. The cause often lies in political or administrative unwillingness or incompetence or the financial interests of dominant organizations. This is in direct contrast to the interests of the public and public health.

The current administrators now face the great task of taking accelerated measures to solve the water crisis and serve the public in the short term. Swift, appropriate, and creative action is needed to protect society from the effects of water scarcity. This Blueprint for a Circular, Water-Smart Society aims to provide a concise overview of circular water solutions that can be safely deployed in the short term to reduce tap water use.

There are hundreds of millions of homes and apartments worldwide. If all these residents start drastically reducing their tap water consumption by using circular water for non-potable applications, it will greatly reduce tap water consumption.

Example demonstrating that measures can be taken quickly

Even a water-rich country like the Netherlands, known for its innovative solutions to global water problems, has faced water scarcity recently. Summer droughts have compromised the availability of natural water for tap water production. The Dutch water utilities jointly called on the Dutch government to reduce the use of tap water for non-potable applications and encourage the use of alternative circular water for those applications. In response, at the end of 2022, the Dutch government communicated a goal to reduce the tap water consumption of its more than 18 million Dutch citizens by 20% over the next 13 years, from 125 liters (27.5 gallons) to 100 liters (22 gallons) per person per day. The government's objective is to be achieved by utilizing alternative circular water sources such as rainwater, recycled greywater, and circular showers for non-potable applications, as well as alternative technologies such as vacuum toilets. Flanders, a northern state of Belgium, was already facing water scarcity 20 years ago. In 2004, the building code implemented a mandate for the collection and circular reuse of rainwater in homes for non-potable uses.

The above shows that political will and good governance can allow adequate measures to be taken quickly and implemented in cooperation with all stakeholders to make society more resilient and less dependent on changing weather patterns.

Governments worldwide face enormous challenges, but the urgency demands choices, and the water transition is possibly even more relevant than the energy transition.



In this blueprint, the expert group discusses the following aspects that governments and decision-makers can use to manage the water crisis:

1 **Water-conscious building**

We must build homes and buildings that are climate-adaptive. In the area of water, for example, this means that everyone must be able to collect and reuse water. The water management system must become more democratic; as it serves all citizens. If people do not realize the value (and scarcity) of water, they are not going to appreciate it. We need to cherish water, understand that water is valuable and it is important to (re)define water that is fit for its purpose.

2 **Circular systems for water-conscious building**

We have to use circular systems for water-conscious building by deploying water-saving techniques for rainwater harvesting, greywater recycling, circular showers and low-water/waterless toilets. The greening needed to protect cities from heat stress requires the availability of circular water sources for green roofs and walls.

3 **The need to amend building codes**

Legislation and regulations should be accelerated to ensure that 'rules' are not an obstacle but provide opportunities for applying alternative circular water solutions to reduce tap water consumption while maintaining living comfort.

4 **Safeguard quality and health aspects**

We have to safeguard quality and health aspects of all circular water sources by applying existing standards for the safe use of circular water. The NSF/ANSI-350 standard is used in the USA and many other countries. In Europe, the safe applications of circular water are regulated by the EN 16941-1, EN 16941-2, and EN 1717 standards. The use of smart digital IoT-connected solutions can decentralize water quality testing down to the point-of-use level.

5 **Facilitating financial 'incentives'**

Financial 'incentives' can accelerate the adoption of tap water saving circular solutions; this could be tax exemptions or subsidies for 'water-conscious building', rebates on levies, connection fees or lower utility charges.

1 Water-conscious building

We must build homes and buildings that are climate-adaptive. In the area of water, for example, this means that everyone must be able to collect and reuse water.

DEFINITIONS

Tap water is water intended for consumptive purposes such as drinking and food preparation.

Circular water is water for applications that do not require drinking water quality, such as flushing toilets, washing clothes, and irrigating gardens, green roofs and green walls. Site-specific circular water systems are systems and techniques applied within the confines of buildings and gardens, whether individual homes or apartment buildings, office buildings, sports facilities, hotels, etc. On-site circular water systems have the great advantage of avoiding cross-connections at the district level, and cross-connection control can be checked before its verified for operation. On-site circular alternative water solutions allow the safeguarding of safety and public health through existing field and/or lab tested and certified techniques. The use of state-of-the-art digital IoT-connected technologies provides 24/7 security monitoring and user data provision.

Hygienic water is purified and disinfected water from alternative circular sources intended for safe use in applications such as circulation showers, whirlpools and swimming pools. Hygienic water is not for consumption but is safe for human health.

A **Rainwater system** is the technology for non-potable water systems where rainwater is collected, filtered and used for non-potable applications such as flushing toilets, washing clothes, and irrigation. Many countries have standards that allow the safe use of rainwater, such as the EN 16941-1 standard in Europe. It is advisable that standards include a mandatory inspection procedure to check circular water networks for cross-connections before commissioning. The European EN 16941-1 standard includes a verification procedure to check individual systems for cross-connections.

A **greywater recycling system** is the technology for non-potable water systems where greywater from showers, baths, sinks, washing machines and condensation water from heat pumps, air conditioners and clothes dryers is collected, treated and disinfected, after which it can be reused in the home or building for non-potable applications such as flushing toilets, washing clothes, and irrigation. Many countries already have excellent standards in place to safeguard public health when using treated and disinfected recycled water. The international NSF/ANSI-350 standard is used in the USA and other countries. EN 16941-2 is the European standard for greywater recycling systems. We recommend residual disinfection for larger collective distribution networks to ensure adequate disinfection throughout the distribution network. The recommendation is to maintain an inspection procedure to check circular water networks for cross-connections before commissioning. The European EN 16941-2 standard includes a verification procedure to check individual systems for cross-connections.

A **Circular shower** is a shower in which water from the shower channel or drain is filtered, disinfected, and reused during the shower session. This enables a spa shower experience using relatively little tap water.

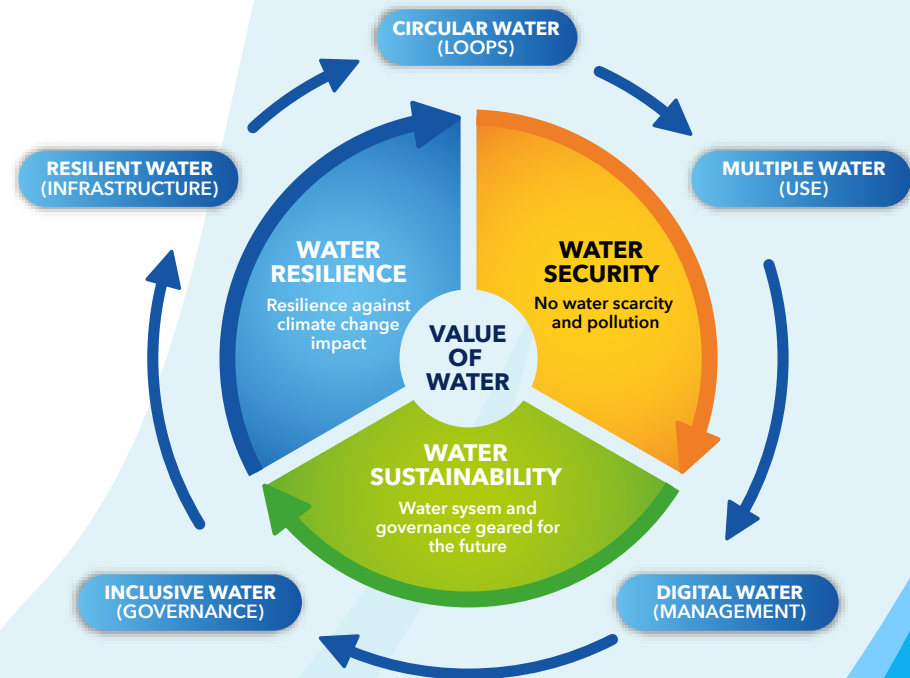
Vacuum toilets are toilets that use little or no water for flushing. Vacuum toilet systems are ideal for installation during the new construction of larger buildings.

Digital water management is the method by which circular water use and UV-C disinfection can be checked through sensors. This can be an important safeguard for public health and safety in circular water systems combined with smartphone apps. The apps provide consumers with 24/7 monitoring and real-time information on water quality, usage, conservation, optimization, and leak detection. These information flows will strengthen consumer engagement and greatly increase awareness of the value of water, both to the consumer personally and to society. There are also opportunities for the use of dynamic tap water rates to allow the value of water to be expressed in variable rates at any time of day, based on peak load and scarcity. The energy market - with its digital information flows - provides a good example of how digital metering, could also be applied for water.

Water-Smart Society is a concept by Water Europe in Brussels. Initiated by the European Commission in 2004, Water Europe has evolved into a multi-stakeholder platform that represents members from across the European Union water value chain and aims to create a 'Water-Smart Society'.

A Water-Smart Society is one in which the value of water is recognized and realized to ensure water security, sustainability, and resilience; all available water sources are managed so that water scarcity and pollution are avoided; water and resource loops are largely closed to foster a circular economy and optimal resource efficiency; the water system is resilient against the impact of climate and demographic change; and all relevant stakeholders are engaged in guaranteeing sustainable water governance.

Water Europe has developed the Water-Smart Society model to illustrate the main objectives and the various elements involved in the aforementioned paradigm shift and their interrelationships. The model consists of one core value, three core objectives that must be achieved to realize the core value, and five specific innovation concepts that are critical to achieving the objectives. The model shows how the innovation concepts and core goals are interrelated, generating a 'flywheel' that drives the process toward the Water-Smart Society.



Circular water is one of the five innovation concepts. This blueprint document aims to further explain the concept of circular water with practical information that can foster the implementation of circular water systems.

2 Circular systems for water-conscious building

Increasing and structural water scarcity is taking a toll on water availability and demonstrates that we will need to make major changes to our water system to secure the world's water supply for the coming decades.

Water-saving circular systems should become the norm for new construction and home renovations.

The Global Expert Group Circular Water highlights that the water technology sector is already present in many countries to provide proven, market-ready solutions to optimally deploy rainwater systems,

greywater recycling systems, and equipment such as circular showers and vacuum toilets.

Homes and buildings built 'recycle-ready' can be equipped with water-saving circular technologies during construction or even years after completion. The house or building is technically prepared to be able to use circular water.

Vacuum toilet systems and circular showers are also proven applications for water-saving construction.

The savings potential is significant. Using circular water as an alternative source for toilets, washing machines, and gardens, the total potable water consumption can be reduced by up to 45%. And water recycling systems can reduce wastewater emissions by up to 45%.

If hygienic water is used for showering, tap water consumption could be reduced by up to 85%.

Water-conscious building can be achieved at a relatively low cost

By designing and building recycle-ready homes and buildings using:

- The installation of a separate water supply system for the toilets, washing machine and garden;
- The installation of a separate greywater drainage system from shower/bath/washing machine/condensation water for decentralized collection, treatment and reuse.

3 The need to adjust building codes

Current legislation and regulations should be adapted more to ensure that rules are not an obstacle but provide opportunities for the application of alternative circular water solutions to reduce tap water consumption while maintaining living comfort.

Adjust building codes to include a national requirement for water-saving construction by installing recycle ready plumbing for water-saving circular systems.



4 Safeguarding the quality and health aspects of all alternative water sources

The Global Expert Group Circular Water endorses the importance of uniform standardization of quality requirements for the various types of water.

Existing standards provide an excellent basis for ensuring the necessary safe circular water quality. The NSF/ANSI-350 standard is used in the USA and many other countries. The EN 16941-1, EN 16941-2, and EN 1717 standards are used in Europe. Safety can be further ensured by applying smart digital IoT-connected monitoring solutions.

It is very important to have the right fit-for-purpose water quality standards so that, on the one hand, water safety and public health are assured, and on the other hand, water quality requirements are not too high. Too high water quality standards will inevitably result in purchasing costs for water treatment equipment that will be significantly higher than necessary. Purchasing costs that are too high will prevent the introduction and application of circular water technologies.

Extensive practical experience has already been gained internationally with the responsible use of alternative circular water sources for non-potable applications. Certified products and solutions are already widely deployed and are now “tried-and-tested technology”. Alternative circular water sources have been well regulated and safely deployed for years in countries such as Australia and European countries. There are also many peer-reviewed studies on the application of extreme decentralized water recycling systems.

The environmental aspects of alternative circular water sources

Alternative water sources offer substantial environmental benefits. The impact of the overuse of water from natural sources is a drain on the ecological balance. The use of circular water can reduce the withdrawal of water from natural sources, which positively affects the environment. In the coming years, we will have to reduce water withdrawal from natural sources to allow groundwater levels to recover to levels seen several decades ago. The use of circular water helps restore the natural water balance.

The carbon footprint of circular water is lower than that of tap water. By the time tap water reaches the end user, a great deal of energy has been consumed for transportation and purification. After use, the wastewater is again transported over long distances to the wastewater treatment plant, which also consumes a lot of energy. The construction of water treatment plants and the construction and maintenance of water supply networks also have an ecological footprint. When all components such as CO2 emissions for materials, energy, production, transportation, maintenance, and water scarcity are included, circular water’s ecological footprint is lower than tap water’s.

5 Facilitating financial incentives

The Global Expert Group Circular Water advocates that the government should develop schemes that provide financial incentives for citizens and developers to co-invest in the inevitable transformation of the water chain. Incentives could include tax exemptions and subsidies for water-conscious building, discounts on utility fees, or lower utility charges. The positive effects of the financial incentives deployed in the energy transition have shown that these incentives are effective at setting the flywheel in motion.



Blueprint for a Circular Water Smart Society



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Conclusion: Water scarcity requires urgent adequate action

To shape the inevitable future vision of the water transition, we recommend governments to:

- 1** Discourage and eventually ban the use of tap water for non-potable purposes in the shortest possible time, starting with new construction and renovation;
- 2** Encourage and eventually mandate the use of alternative circular water sources in the broadest sense;
- 3** Ensure the livability of cities by deploying smart, efficient and safe alternative circular water sources for watering gardens, green roofs and green walls, and to prohibit the use of tap water for these applications;
- 4** Urgently adjust regulations and building codes;
- 5** Accelerate the implementation of existing standards for safe circular water use or expand existing standards with sections on safe circular water use. If standards for safe circular water use are not yet available, governments could speed up the introduction of standards and cooperate with existing standards organizations such as NSF or European organizations;
- 6** Safeguard public health and make circular water available at a lower cost than tap water by applying fit-for-purpose circular water quality criteria;
- 7** Encourage public-private collaboration among water sector stakeholders to enable them to play a leading role in the transformation to a Water-Smart Society.

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