SAVE WATER
Solutions for the Planet

Culligan

WATER IN CIRCULAR ECONOMY

CONSERVATION, EFFICIENCY AND QUALITY OF OUR MOST PRECIOUS RESOURCE: THE NEW CHALLENGES IN THE INDUSTRIAL, MUNICIPAL, HOSPITALITY, RESIDENTIAL AND AGRICULTURAL SECTORS

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CONTENTS

1. WHY IS IT IMPORTANT TO TALK ABOUT WATER CONSERVATION?

a. A basic fact

Talking about water conservation means accepting one basic fact. Water is a limited, exhaustible resource without any chemical replacements, which must be safeguarded, as it is essential for human life, the environment and every living creature on our planet. It is no coincidence that "Blue Marble" was the title of the first colour portrait of the Earth taken in 1972 by the Apollo 17 Mission astronauts of the American space agency NASA. A photo that could, however, raise doubts: how can our blue Gold be so precious if it covers over 70% of the earth's surface?

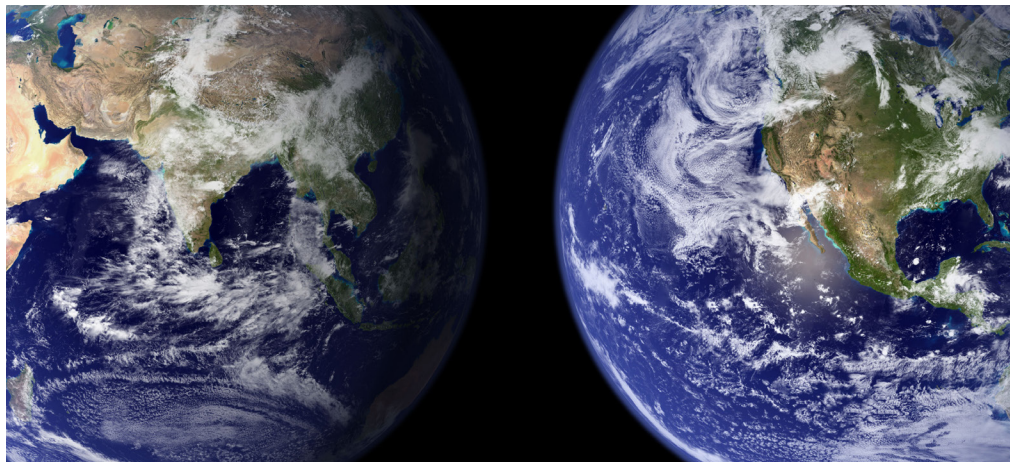
The answer is simple: what is scarce is not the salty water we find in our seas and oceans, but fresh water, which represents a mere 2.5% of all the water resources on the planet.
A minute fraction and not entirely accessible.
In fact, over two thirds of this amount is blocked in the Polar icecaps and glaciers. The fresh water available to sustain and nourish 8 billion people [1] - in rivers, lakes, aquifers and the atmosphere - is less than 1% of the total.
Which is why it has to be preserved.

Read for more information

[1] Day of Eight Billion

b. Climate change has turned water scarcity into a global challenge

Evaporation, condensation, precipitation, infiltration.
These are the main steps in the water cycle we have all learnt as a child.
However, global warming due to anthropic climate change is altering this phenomenon and accelerating it. One of the reasons[2] is the rise in surface water evaporation from the seas and oceans, which causes more water to circulate in the atmosphere in the form of vapor.
This means an increase in the number of extreme meteorological events, such as floods and drought.
Too much water too fast, or too little.
There have been many examples in recent months. We only have to think of the off-the-scale monsoon rains that in August 2022 left a third of Pakistan under water and affected over 33 million people and leaving 1500 dead.
At the opposite end of the scale in the west of the United States, the so-called Mega Drought[3] was described as the worst drought in the last 1200 years, whereas the populations of Kenya, Somalia and Ethiopia in the Horn of Africa have now entered their sixth year without sufficient rainfall.
The 6th Assessment Report of the IPCC[4], the most comprehensive and up-to-date review of scientific knowledge on climate change for governments, the international scientific community and global public opinion, has also confirmed the seriousness of the situation.



2. Olmedo, E., Turiel, A., González-Gambau, V. et al. Increasing stratification as observed by satellite sea surface salinity measurements. Sci Rep 12, 6279 (2022) DOI

3. Williams, A.P., Cook, B.I. & Smerdon, J.E. Rapid intensification of the emerging southwestern North American megadrought in 2020–2021 Nat. Clim. Chang. 12, 232–234 (2022). DOI

4. IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844. DOI

Approximately four billion people are currently living in conditions of serious fresh water shortage for at least one month a year, whereas half a billion people in the world have to face serious drought throughout the year. Approximately 80% of the world population already faces a high threat to their water security.
If the average global temperatures increase by +2°C or +4°C, there could be a water shortage for 3 to 4 billion people.

Climate change - including the melting of the perennial ice cover into the large rivers of the world - will influence water availability, quality and quantity for basic human needs, and threaten the human rights of billions of people to effectively enjoy water and sanitation services.
Not to mention the impacts on food security due to the decrease in agricultural yield, on energy security and the rise in the phenomenon of migration. Suffice it to say that according to the Global Risks Report 2023[5] by the World Economic Forum, the climate and environmental risks, including above all, not only the decrease in available fresh water, but also the loss of biodiversity, will be the main concern in our perception of global threats for the next decade, as they are the risks humanity is least prepared to tackle.

c. The causes of water scarcity

Water scarcity is a relative concept as the amount of water that can be physically accessed varies according to supply and demand. Thus, water scarcity not only intensifies as demand increases, but also when the water supply is affected by a decrease in the quantity (or quality) of the available resource. Fresh water will be available provided the volume abstracted does not exceed the minimum required to maintain the ecosystem "flow" or its natural ability to restore itself. This is why we are greatly responsible for: saving, restoring and replenishing water.

5. World Economic Forum, Global Risks Report 2023 DOI

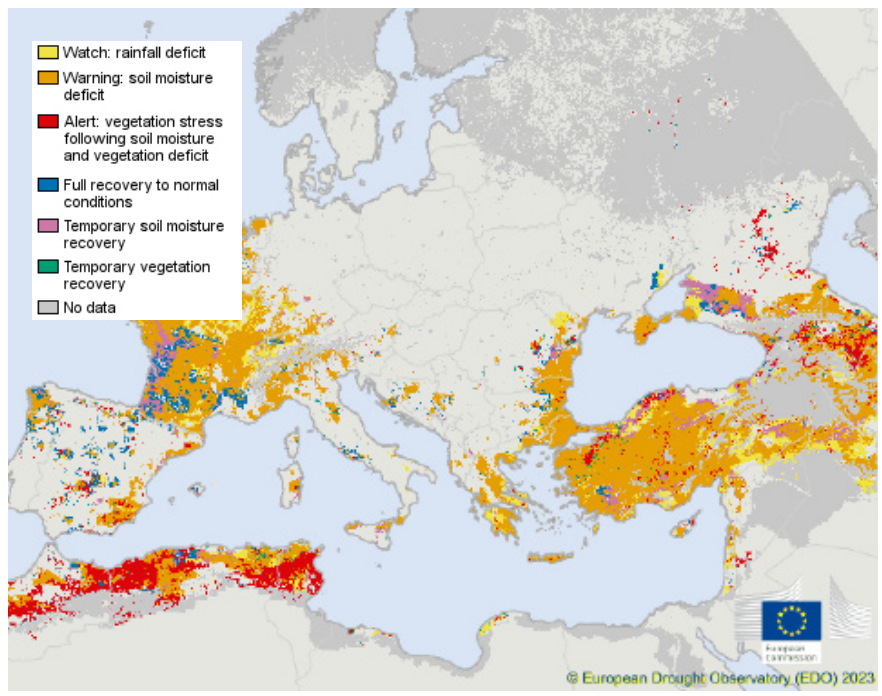
But what are the causes of water scarcity?
On the one hand, as we have seen, climate change will reduce the amount of available fresh water and increase water stress, i.e. the frequency and intensity of cases in which water is insufficient to fulfil the requirements of the people and the environment. On the other, anthropic pressure is rising. Not only as the result of the increase in the global population, which could reach 9 billion by 2037, but also of the extremely intense economic exploitation of resources and the effects of polluting activities, especially by industry.

The most hazardous substances released by the industries are heavy metals, especially cadmium, mercury, nickel and lead. Not forgetting the chemical perfluoroalkyl substances (PFAS), that are virtually impossible to break down, used for their ability to make products impermeable to water and oils.
PFAS not only tend to accumulate in the environment, those, such as micro-plastics, are emerging environmental pollutants, which also remain in living organisms, including man, where they become toxic in high concentrations.
Other especially hazardous substances are nitrogen and phosphorous which, when released in large quantities, endanger aquatic species by acidifying their habitat.
In order to guarantee adequate levels of quality, water replenishment of the natural environment must be as pollutant-free as possible to safeguard the ecosystems.

d. What about Italy?

Italy, together with Europe, is preparing to enter its second consecutive year of hydrological drought associated with a decrease in the water in its rivers, lakes and underground aquifers, and agricultural drought, i.e. with repercussions on crops. This is the worst crisis in the last 70 years: according to the data from the Institute of Science of the Atmosphere and Climate (ISAC) and the CNR, contained in the bulletin from the Drought Observatory, 2022 was the driest year since 1800, with a 30% deficit.

Drought is due not only to a prolonged lack of rainfall, but also to temperatures above the historic average. This shouldn't come as a surprise.
The Mediterranean, which touches on several nations in southern Europe, including Italy, has been called a



"climate hotspot", as temperatures have increased 20% compared to the global average. Although the early months of the year are traditionally considered as the rainy winter period, early 2023 has not revealed any significant improvement in rainfall. As reported by the Observatory of the National Association of Consortiums to Manage and Protect the Land and Irrigation Water (ANBI), the mild February temperatures have had an additional impact on the layer of snow in the alpine regions, on which approximately 6 out of 10 liters of water in the River Po and its tributaries depend throughout the entire year.

In late February 2023, the filling percentage of the big lakes in northern Italy was very low, from 35% for Lake Garda to 38% for Lake Maggiore. However, although the summer of 2022 reminded us of how drought can increase the risk of forest fires and lead to rationing and the shutdown of hydroelectric and thermoelectric power stations, it is agriculture which suffers most.

2. REDUCE WATER WASTAGE AND IMPROVE WATER QUALITY:
INDUSTRIAL, MUNICIPAL, HOSPITALITY, PUBLIC ADMINISTRATION AND RESIDENTIAL SECTORS

We need to increase water use efficiency in all sectors (civil, industrial, energy, agricultural), by activating monitoring systems, investing in maintenance and developing networks and systems, and encouraging recycling and storage.

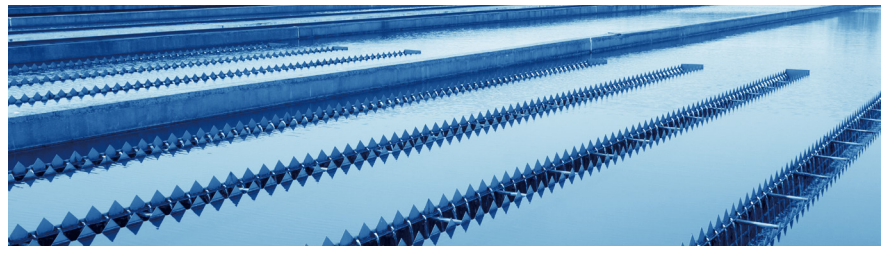
This is where companies can also play their part, thanks to good investments in the research and development of smart, anti-waste innovations that can be used in various contexts. This, for example, is the path Culligan has chosen to follow. We are a benchmark company in the sector of water treatment and aim to design solutions to recover water in the commercial and industrial heavy water use sectors and combine water and economic savings.
With over 80 years' experience and an integrated, transversal approach that covers the entire water certification chain – from project design to production, from sales to maintenance for every type of system – Culligan develops specific solutions for water conservation.

a. Industrial

The water footprint in the industrial sector reveals a complex parameter.
When calculating the water used to produce goods and services, we also need to consider the entire procurement chain. However, many industrial processes can easily use waste water, instead of consuming drinking water in order to reduce their water consumption. Companies can, therefore, use various strategies. E.g. improving water efficiency, installing water recovery and recycling systems (thus avoiding enormous disposal or sewage costs), implementing maintenance programmes (including predictive maintenance) and using less water-guzzling machinery. Not forgetting to regularly monitor and assess their water footprint to identify the production processes that use most water in order to adopt targeted strategies to reduce water consumption.

As regards raw water treatment, i.e. water that has not been subjected to drinking water treatment, Culligan offers a complete range of technologies: from multi-layer filters to ultra-filtration, via reverse osmosis, chemical dosage and disinfectant systems. Whatever the type of industrial water required and whatever the raw water used: well, river, lake, sea, reused waste water or drinking water, a good pretreatment is essential in order to protect treatment plants and save considerably on the costs.
Raw water often contains contaminants, such as suspended solids, organic substances, ammonia, heavy metals e.g. manganese, iron and arsenic.
All these contaminants must be removed or reduced before introducing the water into the industrial processes.

b. Municipal



After experiencing a serious period of drought, waste water reuse has become a top priority and the main vector of the development of water in the circular economy
Pretreated water can be used to clean streets, for industrial processes and to irrigate fields, and safeguard the resource.
After collection from the various sewage networks, the waste water is sent via inter-municipal collectors to the treatment plant to be subjected to accurate purification consisting of various stages: from screening to abstraction via the sedimentation, filtering and aeration tanks and on to disinfection.
Thus, the water can now be considered clean and exits the treatment plant to be safely returned to the environment.

The most common treatment techniques include radiation. The water passes through a purification system where a combination of lamp and UV reactor radiations guarantee bacteria, viruses and moulds are eliminated. An alternative is biosolar purification, a technology that uses solar energy and photosynthesis to remove organic matter, nutrients and pathogens form the waste water.
The treated water can then be reused.
Among the most important projects in Italy on this subject regard the treatment plants in Assago and Basiglio, where the treated water is used for civil and agricultural purposes. More specifically, it is used to clean the streets and irrigate the green areas in Assago.
Two treated water abstraction points have been created in Basiglio, one to be used by the motorized sweepers to wash the streets, the other to feed an irrigation system used to irrigate a wooded area of over 2,000 sqm.

The so-called Nature Based Solutions are also becoming increasingly popular. In Italy, the reason why over half our rivers fail to achieve the “good ecological and chemical status” imposed by the Framework Directive on Water (2000/60) does not appear to depend on the few towns still without treatment plants, but rather on the loads due

to insufficient treatment compared not only to the flows of the water receptor body, the overflow of mixed networks, widespread urban and agricultural pollution, but also to the flow abstraction and morphological changes.

Throughout the Old World, these reasons, as stated by the Joint Research Centre in its 2019 report, render the tools introduced by the Framework Directive to intercept polluting loads, eg. BOD, phosphorous, nitrogen and coliform bacteria, partially ineffective. To collect and treat sewage is essential, especially in the large towns and cities, but in order to have healthy rivers, various existing remedies can be implemented. Decentralized nature-based solutions can be facilitated not only to reduce the pressure caused by modifications to the river bed and by unnecessary abstractions instead of large collectors.

Phytopurification systems capable of replacing old active sludge plants can be used in small towns. What are the advantages? A phytopurifying system not only facilitates insertion into environmentally valuable landscapes, it exploits the combined action of the gravel substrate, plants, waste water and micro-organisms. It does not deteriorate even though it remains inactive for a long period due to a lack of waste water.
Although the construction cost is the same as that of traditional plants, phytopurifying also has lower management costs due mainly to its reduced energy consumption, which can vary from 25% to 50% compared to a conventional treatment plant.

c. Hospitality

The hospitality sector has an extremely high average consumption rate per head.
The report by the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), conducted by analyzing the water consumption of 31 4 star hotels belonging to a well-known hotel chain, estimated an average water consumption per person in the hotel to be 645 liters, as opposed to the 250 liters per head required in the domestic sector.
To reduce water consumption in the tourist-hospitality structures, air flow reducers, low consumption shower heads and latest generation taps should be installed to decrease water flow per minute, which can reach a 50% drop.

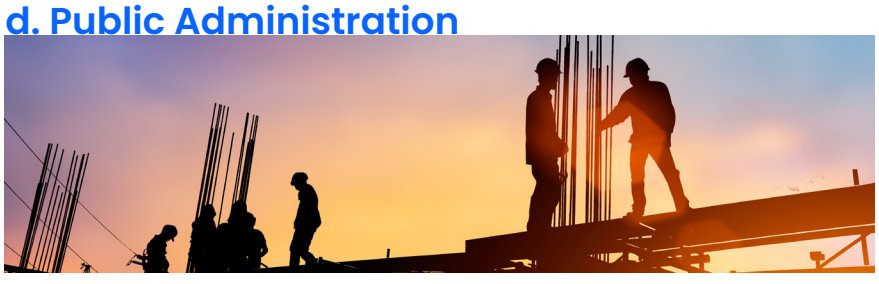
Another solution is to install timed taps with a manual control button to release limited amounts of water or touchless electronic taps, which stop the water flow the moment the user walks away. Toilet flushes can also be adjusted. Install dual flush toilet cisterns to differentiate between the amount of water discharged each time the button is pressed to reduce the volume of water used.
This allows the discharge to go from an average of 10 liters to just 3 liters, with the additional advantage of being able to stop the flow of water at will by pressing the button a second time.

Culligan has developed other specific water conservation solutions, including water desalination systems for

2. Reduce water wastage and improve water quality:

drinking water systems to be used in large structures such as cruise ships, companies and campsites. Sea Water technology is applied to treat sea water and provide cruise ships with water that can be used for all requirements: from the kitchen to catering, from the swimming pools to the utilities.
Sea water desalination uses SW EVO reverse osmosis desalinators, capable of producing fresh water from sea water up to 41,000 PPM with flows from 4 to 40 m3/h
The reverse osmosis membrane technology eliminates over 99% of the salt and other contaminants to provide safe, top quality water.

d. Public Administration

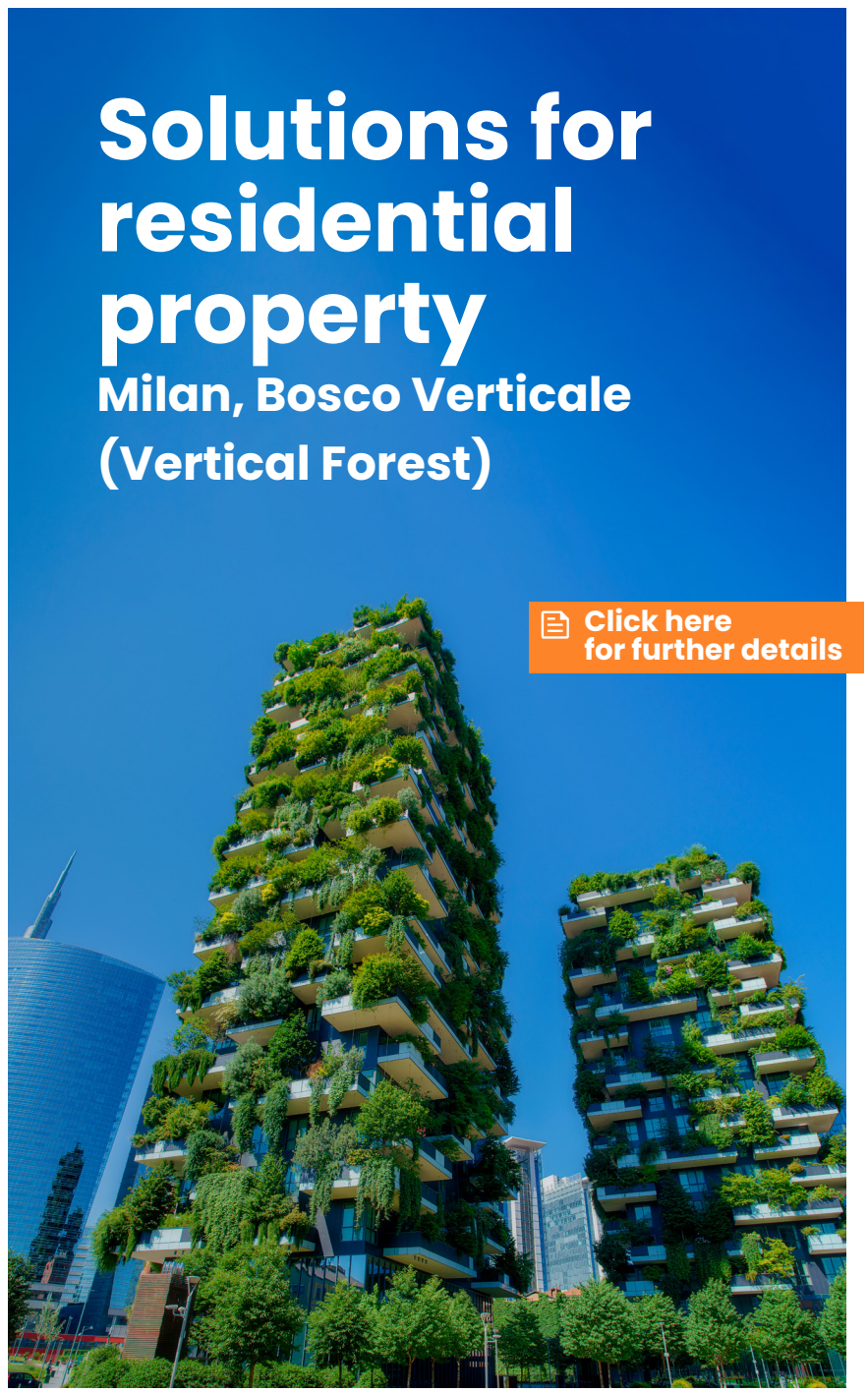


Public Administration can also adopt various measures to conserve water and reduce water consumption. It is useful to install low flow taps and dual flush toilet cisterns in public buildings, as in the hospitality and residential sectors.
Administrations can also adopt sustainable water management practices, e.g. rainwater recovery to irrigate public parks and reused water to wash the streets, or activate water consumption monitoring in their buildings and services to identify the processes that use most water and adopt strategies to reduce consumption, by using drip irrigation systems for public parks, or facilitating water recovery e.g. the condensate from air conditioning systems which would be opportunely treated.
Public administrations could introduce tax incentives to encourage interventions to save and recover water: this is what they do in California, a state which has had to face record drought in recent years. The administrations offer a variety of discounts on water to encourage consumers to take action to save water.
The WaterSense program, for example is sponsored by the Environmental Protection Agency (EPA) and designed to offer consumers low water consumption products: When a product carries the WaterSense label, it means it complies with the EPA criteria for water conservation.
There are programmes with incentives to replace water-guzzling garden lawns with autocthtonous plants and xerophyles, which can adapt to drought conditions. A good example of water management is to be found in the city of Barcelona.
The city is preparing to stop the use of drinking water to irrigate the parks and clean the streets and using water from the underground aquifers instead. In 2018, Barcelona had already introduced its first Action Protocol for the drought emergency: this envisaged up to a 96% reduction in water consumption to irrigate gardens and green spaces and up to 97% reduction for urban cleaning (sewers and streets).

e. Residential

There are numerous solutions in the civil and commercial sectors to avoid the loss of water.
Each house and building now has the opportunity to recycle its water via a decentralized recycling system.
The company Hydraloop has designed an innovative, certified recycling system which enables approximately 85% of all the water used in the home and in hospitality to be collected – from showers to toilets, from washing machines to air conditioning systems – to be cleaned, disinfected and reused for different purposes, e.g. toilet cisterns, garden irrigation, swimming pool top up and cleaning.
Other solutions for the smart management of water assets in the home and commercial sector are based on IoT technologies, which use artificial intelligence systems to measure and monitor the water treatment systems, sanitation and domestic appliances and to accurately analyse the water processes. Thus, customers can access data in real time, such as consumption parameters and water quality at any point of use, in order to optimise their water use.

In the residential sector, part of the daily water requirement that is not drinkable (wc flush, vegetable gardens, etc.) could be fulfilled by recovering rainwater and giving economic vale to the recovered rainfall. The basic idea is to cover roofs, gardens and green areas with sustainable, urban drainage systems that replicate the drainage models of natural systems using economical, low environmental impact solutions.



3. WATER RECOVERY IN HEAVY WATER USERS IN THE INDUSTRIAL SECTOR

We are giving a few examples of solutions designed to recover water for heavy water users in the industrial sector, capable of combining water conservation and economy.

First of all, let's start with the water services. According to the World Bank report Water in Circular Economy and Resilience (Wicer)[10], even though circular economy is becoming increasingly widespread, the water sector has not yet been included in the high level discussions on the topic. The report develops a series of solutions to help professionals to incorporate the principles of circular economy and resilience into their policies and planning strategies, to identify priorities for investments, project design and operations.
The document shows how water companies that recover resources from waste water and collaborate with the private sector have created a new flow of income by selling energy, water and fertilizers to cover operational costs.

In terms of impact, especially in a phase of economy decarburization, they could also take a look at existing dams and invest in hydroelectric pumping systems capable of raising water from downstream to upstream of the storage dam. Where possible and with respect for the ecosystems, when the mains network receives more energy than the required load, it enables energy to be stored and facilitates the use of energy from renewable sources to its maximum potential, as it allows intermittent use of solar and wind energy production. In some cases, the dams would operate like true rechargeable batteries, as they could store water to be released during periods of greater scarcity.

Let's take a look at the paper mills. According to the Assocarta Environmental Report, the amount of water used for the same amount of paper produced has been halved over the last thirty years, thanks to circular economy and increasingly efficient processes. Nowadays, a paper mill can use 90% of recycled water and only 10% of fresh water with obvious benefits to the surrounding areas.
Paper mill production actually requires large quantities of water throughout the process, from treating the cellulose fibre to bleaching the pulp with chlorine-based products.

Efficient water use is also becoming increasingly essential for data centers, as extreme heat and drought put cooling systems and the mains network to the test. And that's not all: the server density increase and the chipsets that operate at higher temperatures require effective cooling solutions.
These cooling systems are often water-based. The textile industry is also a high water user. According to the report ”A new textiles economy. Redesigning fashion's future” drawn up by the Ellen MacArthur Foundation, textile production (Including the cultivation of cotton) uses approximately 93 billion cubic metres of water a year, which represent 4% of the global abstraction of fresh water.

10. Delgado, Anna, Diego J. Rodriguez, Carlo A. Amadei and Midori Makino. 2021. "Water in Circular Economy and Resilience (WICER).” World Bank, Washington, DC
DOI

Click here for further details

The company EcoloRo has developed the ECWRTI (Reuse of Waste Water from the Textile Industry) technique to stop the resource from being wasted. The process developed uses electro-coagulation (EC) combined with flotation to effectively remove the pollutants, colourants and chemical substances from the textile industry's waste water. This innovation is followed by ultrafiltration and reverse osmosis (RO) membrane processes downstream. The innovation is based on an initial waste water treatment using electro-coagulation, in which Fe3+ ions are released from a source of iron via the electrolytic action of continual, low voltage currents The Fe3+ ion coagulates directly with the impurities in the textile waste water to produce round flocs which can be removed from the water by sedimentation. After coagulation and flotation/sedimentation, the water is passed through membrane processes; the resulting sludge is dehydrated in a conventional chamber filter press, and the extracted water is recycled for reuse as fresh water. Thanks to this technology, recovery rates could exceed 95%.

Cooling water in the industrial sector is an integral part of numerous critical processes and if a cooling system malfunctions, it can have a big impact on the entire production system. By using the treatment and conditioning systems developed by Culligan - which guarantee the requisites for top quality replenishment and drainage water - it is possible to:

- Reduce the use of water and energy - cooling towers will be able to carry out a greater number of concentration cycles without the risk of deposits and sediments forming

- Minimize the risk of sudden downtime thanks to the prevention of corrosion, sediments and deposits in the heat exchangers

- Safely manage to control biological development and responsibilities for Legionella

4. AGRI-FOOD SECTOR

THE AGRICULTURAL AND ZOOTECHNICAL SECTOR STANDS OUT AS THE HIGHEST USER OF WATER ON A GLOBAL SCALE. AS A RESULT OF ITS GEOGRAPHICAL POSITION, ITALY IS THE SECOND EUROPEAN COUNTRY TO MAKE MOST USE OF IRRIGATION AND USES APPROXIMATELY 60% OF THE WATER RESOURCES AVAILABLE, OF WHICH APPROXIMATELY 35% COMES FROM UNDERGROUND WATER (ANBI, 2020)[11]. ACCORDING TO THE AQUASTAT DATA IN THE FAI DATABASE ON WATER RESOURCES, THE ITALIAN AGRICULTURAL SECTOR IS ALSO THE TOP SECTOR AS REGARDS WATER CONSUMPTION AND IS RESPONSIBLE FOR HALF THE ABSTRACTIONS, APPROXIMATELY 17 BILLION CUBIC METRES PER YEAR.

However, climate change is making the sector very uncertain: prolonged periods of drought and higher temperatures reduce the available water resource. According to an analysis by Coldiretti conducted when the images were published from the European programme Copernicus of observation of the Earth, run by the European Commission and the European Space Agency (Esa), 2022 saw the worst drought in Europe for 500 years and cost Italian agriculture EUR 6 billion in damages, equal to 10% of the national agri-food production from durum wheat for pasta to tomato sauce, from fruit to vegetables and including maize to feed the animals for the production of cheeses and cold meats, and not forgetting rice, the predictions for sowing this year envisage a cut of 8 thousand hectares which will be the lowest in 30 years.
An improvement in water management in agriculture is, therefore, essential for a sustainable, productive agri-food sector. To tackle water scarcity, provisions and adequate strategies need to be put in place, especially in view of resource circularity.

11. ANBI, 2020, Post PAC 2020 and Frame-work Directive on Water

*Source

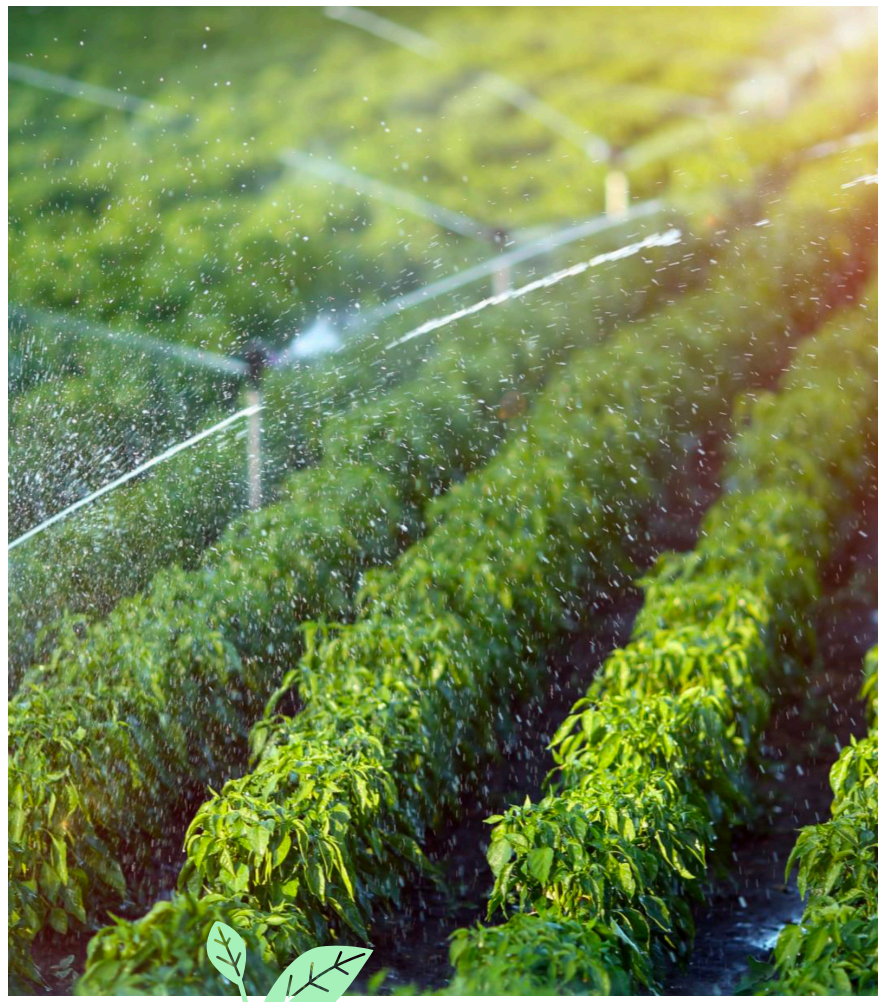
a. Reuse of waste water

The EU Regulation 2020/741[12] of the European Parliament and Council establishes parameters to guarantee the safety for the reuse of water for agricultural irrigation and aims to encourage that practice and contribute to tackling drought and the lack of water.
Although only 5%, i.e. 475 million cubic metres of treated waste water is used in Italy, the potential is much greater. In fact, the water that leaves the national treatment plants is approximately 9 billion cubic metres per year. This was revealed by the investigation "The reuse of waste water in Italy" by Utilotalia, the Federation of Italian Utilities.

The sample analysed by Utilitalia (equivalent to approximately 21 million inhabitants served) revealed that 79 plants already exist to produce reusable water with an overall potential of 1.3 million cubic metres per day (475 million cubic metres per year). Another 24 plants are programmed (they should all be completed within the next 5 years) and a further 40 are currently at the feasibility study stage.
In the short-medium term, we can expect these installations to almost double from 79 to 143.
Furthermore, Italy has 18,140 active treatment plants, of which 7,781 are equipped with a secondary/advanced treatment, which could be upgraded to make them more suitable to produce reusable water.
On the basis of the aforementioned regulation - which will come into force from June 2023 - the refining plant operator will ensure that the refined water intended for agricultural irrigation complies with:

- the minimum provisions for water quality as regards the microbiological parameters, e.g. the levels of Escherichia coli bacteria and the provisions for ordinary monitoring activities and monitoring for assessment purposes;

- every other condition regarding water quality established by the competent authority in their respective permit issued.



b. Precision agriculture

The Italian Ministerial Decree of 22 December 2017[13] approved the Guidelines to develop precision agriculture in Italy. Precision Agriculture is a method, which uses IT technology to acquire data regarding soil and crop conditions in order to take decisions. The purpose is to improve efficiency in the use of resources and productivity by minimizing the inputs and environmental damage and raising the standards of quality of agricultural products.

12. EurLex, Minimum requirements for water reuse, EU Regulation 2020/741 which establishes the minimum requirements for the reuse of water

13. MASAF, 2017, Approval of the guidelines for the development of Precision Agriculture in Italy

Two fundamental technologies can be identified: the semi-automatic guide and variable doses.
The latter technology is a good idea for water conservation. Doses in variable rate applications actually enable the plants to be supplied with the precise inputs they require (water, fertilizers, plant protection product): not uniformly across the entire field, but taking into account the real different requirements within the plot. Maps are used for this purpose that have been created using instruments such as satellites, drones, proximity sensors (to measure the indices of crop vegetation, "on the go" sensors to identify the land).

Doses in variable rate applications are also part of precision irrigation systems. According to the research by Mordor Intelligence “Precision irrigation market – growth, trends, covid-19 impact, and forecasts (2022 – 2027)”[14], the market for precision irrigation systems in agriculture will show a compound annual growth (CAGR) of 8.6% over the next five years (2022-2027), as they enable an efficient use of a scarce resource such as water. Precision irrigation needs to be implemented on Italian soils. In 2020, 62% of water in Italy was distributed to crops using low efficiency irrigation systems (due to surface runoff, lateral infiltration and submersion), the remainder by sprinkling (26.8%), micro-irrigation (9.6%) and other systems (1.5%). (ANBI, 2020)

14. Mordor Intelligence, Precision irrigation market – growth, trends, covid-19 impact, and forecasts (2022 – 2027)

c. Hydroponics

Hydroponics, or growing plants without soil is an alternative solution to restrict continual abstractions The plants are cultivated in a solution of water and minerals with up to a 90% decrease in water consumption compared to traditional agriculture and with an increase of up to 20% in productivity. All the water within the system can be recovered and reused, so that the hydroponic system is called "closed". The technical and scientific control and the absence of soil enable products to be obtained without any heavy metals and they avoid the use of pesticides and other plant protection products which would degrade the soil. Some excellent examples can already found in Italy: Sfera, a 13 hectare plant, guarantees a 15-fold increase in productivity and 80-90% water conservation compared to open-field crops. Planet Farm in Cavenago, the largest vertical farm in Europe, cultivates five different varieties of lettuce with just the required amount of water, which is then recovered and rebalanced to reduce waste.

d. Water footprint: the water incorporated in products and in the agri-food chains

The link between water and food has recently received greater attention with the introduction of the concept of a water footprint. The water footprint measures the volume of water incorporated in a product or service all along its supply chain, i.e. the amount of water used to produce, process and transport it.

It includes the water abstracted from rivers, lakes and aquifers (blue water) used in the agricultural, industrial and domestic sectors; rain water (green water) used mainly in agriculture and the water required to dilute pollutants until the quality standards of the resource have been restored. According to the estimates made by FAO, 2 liters of water are often sufficient for one person's daily consumption. However, approximately 3,000 liters are required to produce the food required. During the entire production phase of a food or product, water often enters the chain with the highest quality standards, as though it were an ingredient. In many cases, however, top quality water is used for cleaning and production and after use it is thrown away into the waste water circuit. This leads to a potential impoverishment of the best quality water which is not intended for high value consumption, e.g. drinking water.

A grave error that must be stopped everywhere.

To do this, waste water from treatment processes needs to be used for cleaning activities. Depending on its composition and level of contamination, waste water can be treated and reused for processes or treated before being discharged into the environment or the sewage network.

The food industry follows a best practice of using different water for different uses, and mixes well water for technical purposes and drinking water as an ingredient.

The ability to maximise water reuse for technical purposes (water as durable goods) thus becomes a key element within the agri-food industry.

e. The use of water resources in livestock farming

The volume of water used in zootechnics is the result of the sum of the volumes of "drinking water" and "service water", i.e. water used to fulfill the livestock's need for water (an adult cow can consume up to 200 liters of water a day) and water to wash the buildings and equipment needed for production, respectively.

The unit values of daily abstraction are as follows:

(1) washing in the waiting area = 12 liters/m2;
(2) washing in the milking parlor = 8 liters/m2;
(3) washing the milking box = 6 liters/m2
(4) washing the milk room = 6 liters/m2
(5) washing the udders = 4 liters/cow
(6) washing the milking system = 60 liters/unit
(7) washing WC = 100 liters/m2

As a result, the water used in Italian livestock farms plays a large part in the total Italian water abstraction equal to approximately 3% (Istat, 2015).
For the animal drinking water, the breeders use mainly water from wells, which take water directly from the aquifer. The use of technical or treated water for animal drinking water can actually cause not only a reduction in production (e.g. milk), but also a decline in the animal's general state of health.
The sludge from the livestock farms is a major source of water for various uses; adequately treated it can be used on the farm as water for technical use and to wash the animals and sheds, or it can be transformed into a source of biogas to produce energy

f. The use of water resources in the dairy industries

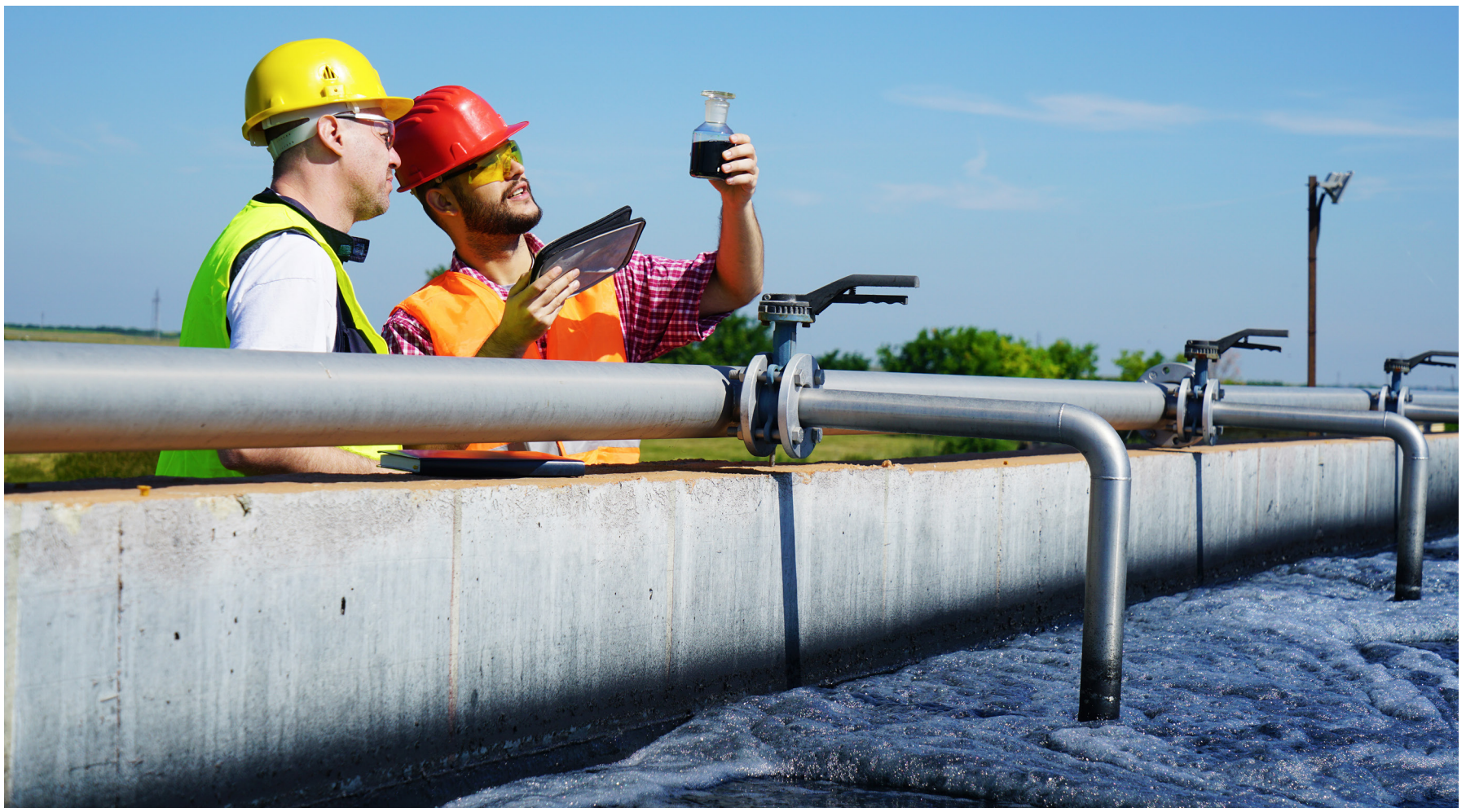
The dairy sector, which produces milk, butter, fresh cheeses, requires enormous amounts of water to disinfect the premises and equipment and to process the product. Water abstraction in the milk and butter production plants is extremely variable and depends on plant efficiency and the type of process used. Water abstraction for bottling varies from 7.5 to 35 liters/kg of milk processed, with an average of 17.3 l/kg of processed milk. As a result, this activity produces a considerable amount of waste water.

The liquid waste produced mostly in the dairy process is: water to wash the recipients containing coagulation; discharge of the curd; spent brine in the salting rooms; water used to cool the cells and warehouse air conditioning; water used at the end of the day to clean the premises and machinery. The waste water produced by dairies finds an alternative use as an organic improver by spreading it over agricultural soil using the agronomic practice of ferti-irrigation. This practice is permitted only if the plant water contains "natural non-hazardous substances" and complies with the criteria and procedures established by the legislation in force.

g. The use of water resources in tomato processing

Italy is one of the major producers of tomatoes intended for processing, together with the United States and China (these three countries together cover 60% of the total production).
The tomato processing phase generates water effluents, consisting of water from washing and transporting the raw material, process water and carton cooling, the condensation of fumes eliminated during concentration, and from washing plants, forecourts and premises.
The outlet water depends on the type of end product: tomato puree production produces waste of approximately 10-13 m3/t of processed tomatoes; the production of peeled, crushed and pulp tomato produces a considerably lower quantity of water discharged, bearing in mind the water needed is 6-7 m3 /t. Waste water can be treated in active sludge treatment plants which enable the water to be purified and to obtain dehydrated sludge. Once stabilized, this can be used as an organic improver.
In order to tackle the dispersion of water used in processing, the agri-food industry is increasingly using Membrane Bioreactor technology (MBR) to treat waste water.
MBR technology combines active sludge treatment with solid-liquid separation via micro-porous membranes instead of traditional separation with secondary clarification.

MBR has less impact on the environment as it creates less sludge, a high quality, highly stable effluent with no bacteria or pathogens and enables biological activity to be controlled well.
Anaerobic digestion together with the anaerobic/anoxic processes of MBR technology can be used to treat manure and waste water form livestock farms to render them suitable for direct reuse. The reuse of waste water is, therefore, one of the tools with which to implement rational, sustainable water management from a circularity viewpoint.



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Culligan

SAVE WATER
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WATER IN CIRCULAR ECONOMY

“We need to increase water use efficiency in all sectors (civil, industrial, energy, agricultural), by activating monitoring systems, investing in maintenance and developing networks and systems, and encouraging recycling and storage.”

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