INDUSTRIAL WATER REUSE:

A SUSTAINABLE SOLUTION FOR EUROPEAN INDUSTRIES

WHITEPAPER

WATER TECHNOLOGIES

VEOLIA

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Introduction

Water is a central part of many industrial processes and is necessary for everything from manufacturing electronics to producing the food we consume every day. However, water is a resource **under pressure** due to population growth, climate change and global industrialisation. Large areas of the world are now experiencing long-term water stress due to increased demand and limited supplies.

As significant consumers of water, industrial sites must ensure they have a reliable supply of water for their own success. However, they also have a responsibility to help protect water resources to ensure there is enough to meet the needs of everyone. This is why sustainable water management is so important and at the heart of is water reuse.

Chapter 1: the importance of water reuse

The World Resources Institute (WRI) has published research showing that **25 countries worldwide are facing 'extreme water stress'** meaning that the country is using at least 80% of its available supply each year. This includes four in Europe: Cyprus, San Marino, Belgium and Greece. In fact, Cyprus and Sain Marina are second on the world list between Bahrain and Kuwait, Belgium and Greece (17 to 19 on the list) are just ahead of Tunisia. In addition to this, six European countries are facing high water stress, using between 40% and 80% of the available water annually – Spain, Andorra, Albania, Italy, Portugal and Macedonia.

There are several factors that have contributed to the increased scarcity of water. The first is population growth. In 1950 the population of Europe was around 550 million people, today it is 741 million. According to the European Environment Agency (EEA), water demand across Europe has increased steadily in the last 50 years and has resulted in **a 24% decrease in the available water per person.**

This has been exacerbated by the effects of climate change, which has already caused increased temperatures, drought conditions in many areas, especially in southern Europe, and greater unpredictability in rainfall.

Given the pressure on water resources it is important to consider where water is being consumed and how it can be used more sustainably. Industrial operations, including the manufacturing sector, is a major consumer of water across Europe with United Nations figures showing that they account for 45% of water withdrawal. This makes **industry** the leading user of water supplies in Europe, significantly ahead of agriculture, which accounts **for around 30% of water consumption.**

There are many ways to reduce the use of this precious resource, including more water-efficient processes, however one of the most effective is water recovery and reuse.

This can be achieved within an industrial or manufacturing site **by treating wastewater to allow it to be used for another purpose.**

2.5%

of European treated wastewater is currently processed for reuse

Water reuse: water is too precious to be used only once

Water reuse is the practice of recovering and treating industrial wastewater to allow it to be used for another purpose. For example, wastewater from a production line may be treated and reused as cooling or boiler feed water.

There are often misconceptions about water reuse. Firstly, that it is **expensive to achieve**, from both operational (OPEX) and capital expenditure (CAPEX) perspectives. However, industrial wastewater will need to be treated to some extent before it can be discharged to to ensure compliance with discharge standards. This means that **reuse can often be implemented in a relatively cost-effective way** by enhancing the existing treatment processes on site.

Another common assumption is that the reclaimed water does not meet the required standard for use in other areas. However, it is important to remember that all mains water has previously been used and treated ready for reuse. In other words: with the correct treatment processes, **wastewater can generally be safely and effectively recycled.**

There is a wide range of treatment **technologies** available that enable water reuse on site including filtration, ultrafiltration, reverse osmosis (RO), and evaporation. Each of these is suited to particular applications and types of wastewater. A water treatment specialist will be able to provide guidance on which solution is the most appropriate based on the characteristics of the wastewater and the needs of the business.

Key benefits

- Reduced cost of main supply and wastewater discharge
- Lowered water footprint
- Alignment with corporate social responsibility policies
- Greater operational resilience
- Reliable supply of water resources

Chapter 2: economic benefits of water reuse

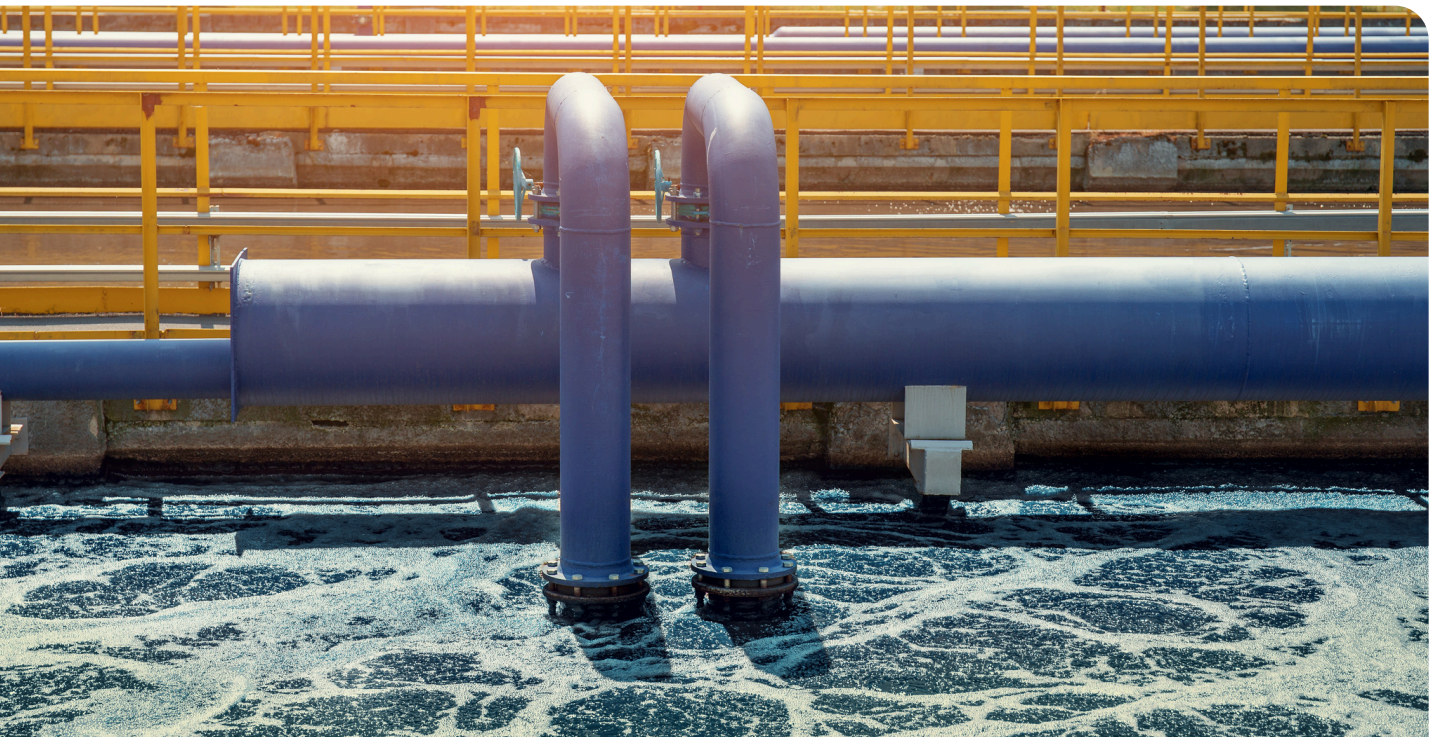
Water prices across Europe have been increasing in recent years, with significant rises seen in 2024, well above the rate of inflation. For example, in the Netherlands the price paid by industrial users **increased by 15%**, while in the UK, business water rates **went up by an average of 9% in 2024**. There are several drivers behind these price increases.

Firstly, **inflation** in material, service, labour and energy costs has affected water suppliers in the same way as almost all businesses, which they have no choice but to pass on to customers. In addition, water companies have needed to increase investment in their assets to meet the demands of growing populations, water scarcity and ageing water infrastructure.

Another reason is the **stricter environmental standards** that water companies must meet, which in many cases requires more rigorous treatment that increases the cost. These are long-term factors that are not easily resolved, meaning it is likely that water will continue to become more expensive.

These rising costs mean that there is a growing incentive for businesses to **reduce their demand for mains water**, with investment in reuse processes being a clear and effective way of doing so. In addition to the cost saving from reduced water demand, reuse also **reduces the costs associated with discharging wastewater.**

Another important benefit of water reuse is that it provides a dependable supply of water for the business. By recovering and reusing water already on the site, businesses can become **more self-sufficient** as they are less dependent on local supplies of groundwater or mains supply. This can help futureproof operations as with water supplies becoming more uncertain in many areas, a secure water supply can prevent interruptions to production processes.



Case study: cost savings through water reuse at a major Belgian brewery

A brewery in Belgium wanted to reduce water consumption and associated costs. Veolia Water Technologies implemented a water reuse system at its site that allowed food contact quality water to be used for washing tanks, bottles, and conducting cleaning in place (CIP). The system consists of multiple treatment technologies to achieve the required water quality. The first stage is pre-filtration followed by ultrafiltration to remove suspended solids, then reverse osmosis for the treatment of dissolved solids and finally UV disinfection for the elimination of pathogenic micro-organisms.

Key results

- 60 m^3/hour of water reused
- A water saving of around 30% per litre of beer
- 500,000 m^3 of water saved per year
- An investment of €2 million to €3 million
- Around €1 million saved per year

Chapter 3: environmental impact and sustainability

There is now pressure on businesses in all sectors to minimise their environmental impact. Demonstrating that sustainable practices have been implemented is an essential consideration. Customers, both corporate and consumer, are increasingly aware of the environmental and corporate social responsibility policies and actions of the organisations they work with or buy from.

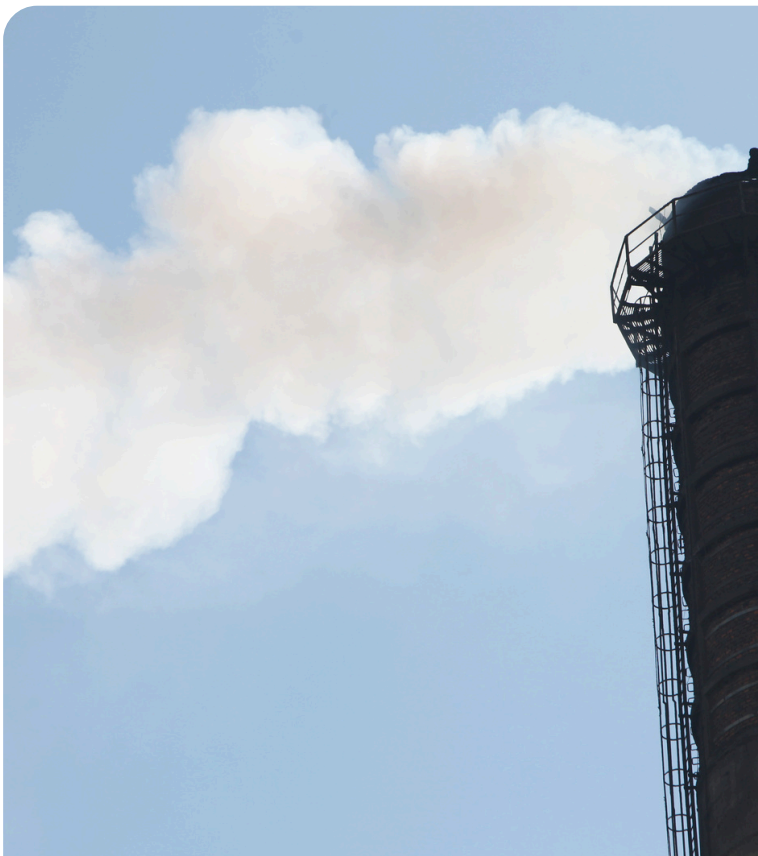
When seeking to reduce the environmental impact of a business, there are several key areas to consider. Firstly, there is **the water footprint of the operations**. With water becoming an increasingly precious resource, responsible businesses must look at how water can be used more efficiently. As with any resource that is under pressure, it is essential to establish a circular economy for water. The aim should be to keep the same water in use for as long as possible through recovery, treatment and reuse.

Creating this circularity in water management is also important in addressing the issue of the **carbon impact of water use.** There is a significant energy cost to treating wastewater, and therefore a corresponding contribution to greenhouse gas (GHG) emissions.

5%

of global greenhouse gas emissions is attributable to wastewater treatment.

Although not often appreciated, there is an advantage to treating wastewater on site rather than at a larger municipal facility. By removing the majority of contamination on site, the GHG emissions at the downstream treatment facility can be reduced by as much as 90%. This is partly because the treatment of the wastewater can be tailored to the characteristics of the wastewater, **avoiding unnecessary processing**. For example, water that has only been used for cooling and is relatively uncontaminated may require less intensive treatment before reuse compared with wastewater that contains large amounts of suspended solids, such as water from dairy processes.



Case Study: creating a circular economy for water in Tarragona, Spain

The Mediterranean climate and the demands of both tourism and industrial activity means that the province of **Tarragona in Spain's Catalonia** region consistently faces water supply shortages. Since 1989, water has been drawn from the Ebro River, however increased demand, especially during the summer, pushed the available supply to its limit.

In response, the **Catalan Water Agency, the Association of Chemical Companies of Tarragona and Aguas Industriales de Tarragona**, launched a pioneering water reuse project. The aim was to reuse the treated wastewater from two urban wastewater treatment plants to supply water to the local petrochemical companies – among the main consumers of water in the area.

This facility uses a combination of **Actiflo® clarification, Hydrotech filtration, double-stage filtration, reverse osmosis and disinfection** to produce up to 6.9 hm3 (6.9 million m3) of regenerated water per year. This represents a **considerable reduction (between 18 and 19%)** in the use of river water concessions for industrial use

Key results

- Pioneering water reuse project
- Facility in operation since 2012
- Production capacity up to 6.9 hm^3/year of water reuse

Chapter 4: regulatory compliance

Each country has its own water regulations and requirements, with several European nations introducing measures to enable and encourage water reuse, especially for agricultural and industrial purposes.

The EU has established overarching water regulations to help drive improvements in the quality of surface waters, such as lakes and rivers, as well as the quantity and quality of groundwater from which a large proportion of useable water is sourced. One of the key pieces of legislation is the **Water Framework Directive (WFD), which was introduced in 2000.**

In 2020, the EU also introduced **the Water Reuse Regulation**, which highlights the important role that water reuse has in ensuring sustainable supplies of water across Europe and sets out minimum quality standards for the reused water.

Futhermore, businesses will have agreements with local water authorities on the quality and quantity of the wastewater discharged from a site. Breaching these agreements can mean the business incurs financial penalties or even legal action, which can be very harmful to its reputation.

Therefore, full compliance with the conditions of the agreement is essential. Implementing water reuse to minimise the discharge of wastewater is an excellent way to ensure compliance, avoid penalties and even enhance the reputation of the business.

Case study: helping FrieslandCampina to meet wastewater discharge limits

The multinational dairy business, FrieslandCampina decided to **increase the production capacity at its biggest production site in Belgium by 50%** with a possible further 50% increase in the coming years. This was to be achieved whilst maintaining its commitment **to reduce water usage by 20% by 2020 and another 20% reduction by 2025.**

However, FrieslandCampina faced several challenges regarding the expansion. Strict governmental regulations limiting ground water extraction forced FrieslandCampina to rely on relatively expensive mains water, which already meant higher production costs. In addition, the site had reached its wastewater discharge capacity.

To grow sustainably, FrieslandCampina needed an efficient and reliable water treatment system that would allow water reuse. This would reduce the need for groundwater extraction and mains water supply as well as cut the volume of wastewater that needed to be discharged. To this end, three areas have been targeted:

- **COW water:** achieved with a BiopROtector® system combined with ultrafiltration (UF), reverse osmosis (RO) and ultraviolet (UV) processes.
- **New wastewater treatment plant:** upgraded to a more effective and higher capacity system that utilised Dissolved Air Flotation (DAF), Aerobic Membrane Bioreactor (MBR), sludge dewatering system, RO and UV.
- **Chemical reuse:** a reduction in chemical usage for Cleaning in Place (CIP) as well as increased water reuse was achieved through the use of a ceramic UF system.

Key results

Up to 700,000 m^3/year of water has been reused

A 60-80% water recovery rate

Savings of approximately €1million/year

A 75% increase in production capacity in five years

Chapter 5: understanding water use

The first step in creating a sustainable water management plan is conducting a comprehensive site audit, referred to as a global water audit at Veolia. It is always recommended that businesses engage with a water treatment specialist, such as Veolia Water Technologies, to achieve this. A leading provider of this service will carry out full water mapping to generate a complete view of how and where water is being used across the site from water intake to final discharge.

A complete water audit will:

- Examine water flows, rates and volumes - including seasonal fluctuations
- Document usage patterns and quantify water usage for each production stage and purpose
- Pinpoint areas of excessive consumption
- Identify opportunities for process optimisation to reduce water consumption
- Determine which processes can feasibly integrate reclaimed water

Following the site audit, the specialist will be able to work with the business to create a plan for optimising its water usage. It also provides the opportunity to benchmark the business against others in the sector.

Read our blog post on the Veolia Global Water Audit

Click here

A 360° evaluation to reveal the potential for water reuse

Example audit outcomes and recommendations

When conducting a site audit, a range of factors may be identified alongside insights into potential improvements and efficiencies. Below are common findings and the corresponding recommendations based on typical audit results.

High water consumption and cost

- **Outcome:** The audit may reveal excessive water use, leading to high operational costs.
- **Recommendation:** Implement water-saving technologies such as closed-loop systems, water-efficient fixtures, and process optimisation to reduce consumption. This not only decreases costs but also enhances sustainability by conserving water resources.

Poor water quality and treatment gaps

- **Outcome:** Analysis may show that the existing water treatment processes are insufficient, leading to poor water quality that can affect both product quality and equipment lifespan.
- **Recommendation:** Upgrade treatment systems with advanced technologies like ultrafiltration or reverse osmosis. These solutions can improve water quality, ensuring compliance with industry standards and prolonging equipment life.

Inefficient water reuse practices

- **Outcome:** The audit might identify underutilised opportunities for water reuse, where wastewater is not being adequately treated or repurposed.
- **Recommendation:** Introduce advanced water recycling systems that can treat and repurpose water for non-potable uses within the facility, such as cooling or cleaning processes. This reduces freshwater intake and wastewater discharge, promoting a circular water management approach.

Compliance and regulatory issues

- **Outcome:** Potential non-compliance with local, national, or European water regulations may be discovered, risking fines or operational shutdowns.
- **Recommendation:** Ensure adherence to regulations by adopting best practices in water treatment and discharge. Regular monitoring and reporting should be established to maintain compliance and improve corporate reputation.

Operational resilience and risk management

- **Outcome:** The audit may highlight vulnerabilities in water supply and treatment systems that could disrupt operations.
- **Recommendation:** Enhance operational resilience by diversifying water sources, including alternative water supplies like rainwater harvesting or greywater recycling. Establish backup systems and contingency plans to ensure continuous operations during supply disruptions.

Environmental impact and sustainability performance

- **Outcome:** The facility may have a significant environmental footprint due to high water usage and wastewater discharge.
- **Recommendation:** Implement sustainable practices, such as reducing the environmental impact through advanced treatment technologies and adopting a zero-liquid discharge (ZLD) approach. This can improve the facility's environmental credentials and contribute to corporate sustainability goals.

Economic and financial analysis

- **Outcome:** The financial benefits of implementing water reuse systems are not clearly understood or quantified.
- **Recommendation:** Conduct a detailed cost-benefit analysis to demonstrate the economic advantages of water reuse, including potential savings, return on investment (ROI), and long-term financial stability.

Chapter 6: choosing the right treatment processes

There are a wide range of wastewater treatment technologies that can be used to generate water for reuse. However, there are **many factors** that will determine which is best suited to a particular business or site. **Here are a few examples**:

- The volume, quality and characteristics of the wastewater
- How the reclaimed water will be used
- Site configuration and constraints
- Industry specific standards
- National or regional regulations
- Budgets and financial constraints
- Water treatment plant already in place on the site

Some of the **water treatment technologies commonly used** for reuse solutions include:

Reverse osmosis

Reverse osmosis uses a semi-permeable membrane to separate and remove a large proportion of water impurities. The feed water enters the semi-permeable membrane under pressure and the water molecules pass through, while the contaminants are captured and discharged through a reject stream. RO can remove up to 99% of the dissolved solids, particles, colloids, organics, bacteria and pyrogens from the feed water. The reject stream can be fed through a secondary RO unit to reduce water rejected to drain, while the permeate from this reverse osmosis can be recycled back to the feed water of the main system.

Ultrafiltration

Ultrafiltration is a membrane process that uses filters with pore sizes of 1 to 10 Nanometre (nm), which can remove particles as small as protein macromolecules.

Vacuum evaporation

Evaporation treatment separates water from the contamination by turning the water into vapour. One of the most effective forms of this technology is vacuum evaporation, which creates low-pressure conditions that allow wastewater to boil and evaporate at lower temperatures, minimising energy usage.

Ultraviolet

UV treatment is very effective in eliminating pathogens present in water, such as bacteria, viruses, algae and certain types of protozoa. As it cannot treat non-microbiological or dissolved contaminants, it is often used in combination with other treatment technologies such as filtration and RO.

Membrane Bioreactor

MBR technology combines a biological treatment process with membrane filtration to achieve high quality water that is virtually free of microbiological contaminants and suspended solids. It is often used with a downstream RO unit to remove the dissolved materials.

Given the range of technologies available, the complexity of water systems on many sites and the need to comply with all relevant regulations, it is advisable to partner with a specialist who can provide expert guidance and a wide array of solutions. A global business such as Veolia Water Technologies will also be able to provide best practice from projects across many sectors and around the world.

Read our blog post on efficient processes and practices

Click here

Case Study: precision foundry achieves 94% water reuse in France

A French precision investment casting specialist faced significant challenges with their wastewater management at their site. The facility was generating **500 m³/year of effluents** that required external treatment, leading to high operational costs and environmental concerns.

To address these issues and reduce their environmental impact, the company sought an innovative solution that would allow them to treat and reuse their wastewater on-site. They partnered with Veolia Water Technologies teams to implement an evapo-concentration treatment system. After careful consideration, the **EVALED** heat pump process was selected as the most suitable technology for their needs.

The implementation of this system aimed to achieve **three primary objectives**:

- **On-site wastewater treatment**: eliminate the need for external treatment facilities.
- **Water reuse:** implement a closed-loop system to recycle treated water back into the production process.
- **Cost reduction: s**ignificantly decrease wastewater disposal expenses.

Key results

92-94% of wastewater reused in the production process

Drastic reduction in wastewater disposal costs

Return on investment achieved in just 2 years

Chapter 7: balancing benefits and risks

Despite the extensive benefits of water reuse for industrial businesses, it is also important to ensure that **the risks are managed correctly**. As with any type of water treatment process, ensuring the water it produces meets the expected and required standard is essential. **The correct choice of treatment technology**, best practice design and commissioning, and expert support will help mitigate the risks and ensure compliance. Additionally, it is essential to ensure that the onsite team is adequately trained to understand and operate the water treatment plant.

It is also important to carefully consider **servicing and maintenance**. Establishing an effective program of preventative and predictive maintenance can help ensure water treatment equipment operates as designed throughout its life. This also prevents breakdowns and downtime that can impact the operations of the site.

Remote monitoring is also an effective tool for ensuring performance and mitigating risks. For example, our **Hubgrade digital monitoring** system enables a real-time overview of the performance of all elements of the water treatment system. It also provides users with alarms and alerts to potential issues, allowing corrective action to be taken swiftly. Implementing remote monitoring also enables our engineers to deliver more precise and timely support to customers.

Finally, **stakeholder engagement** plays a critical role in reducing risks associated with industrial water reuse. By involving internal teams, external partners, and the community, companies ensure a shared understanding and alignment on project goals and standards. This collaboration leads to better decision-making, enhanced training, and operational competence, which are vital for maintaining system reliability and compliance. Engaging stakeholders also aids in early risk identification and fosters a culture of transparency, building trust and support. This proactive involvement helps prevent issues and drives continuous improvement, ensuring sustainable and efficient water management practices.

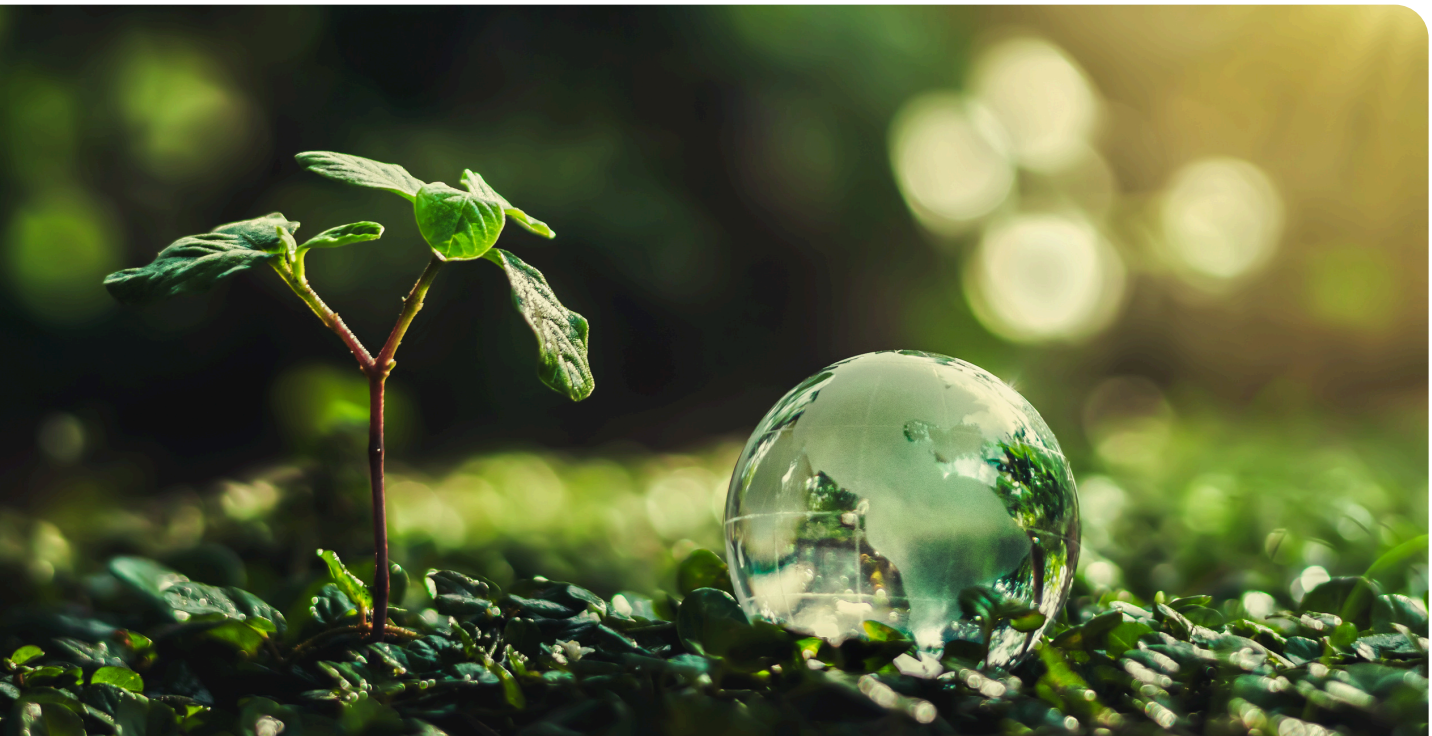
Conclusion

Water is an essential resource for many businesses, but it is also one that must be managed carefully to prevent additional pressure being placed on the already limited supplies. Water reuse is an effective solution to this issue. It also has tangible benefits for the business including cost savings, greater operational resilience and achieving environmental targets.

Veolia Water Technologies can offer a wide range of services and solutions to help businesses take advantage of water reuse. **Contact our team** to find out more and request a comprehensive global water audit.

Click here

To contact us



Resourcing the world

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