

Resourcing the world

FUTURE-PROOFING UK WATER

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We are Veolia

The UK leader in environmental solutions,

we provide a comprehensive range of water, waste and energy management services designed to build the circular economy and preserve scarce raw materials.

www.veolia.co.uk



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The global challenge

We are faced with a global challenge that is integral to our survival on this planet.

Delivering water and energy services is fundamental to human activities. But the businesses, public services and industry of tomorrow will need to function in a world with less water and more people.

In this report, we explore how not only is this achievable, but makes sound business and environmental sense with insight drawn from our global leadership in water management, as well as a range of expert partners.

I believe the key to achieving the necessary rebalancing of water resource demand and production for a sustainable future is integrating the benefits of new technology with operational expertise.

Ground-breaking schemes from around the world are demonstrating that we can deliver major advances in water efficiency and energy reduction. By working in partnership with our clients we can ensure that water operations can make a step change in terms of infrastructure support.

Based on our experience and expertise and our commitment to 'Resourcing the World' and the circular economy, we are well placed to adopt best practices and integrate them into long-term sustainable solutions.

We can't wait. With the water industry set for a period of transformative change it's time to set the agenda by addressing the issues that will determine its future for the next ten years and beyond.



elle Brachlianof Senior Executive Vice-President, leolia I IK and Ireland

Optimising the future UK water industry

In the near future, there will be over 73 million people in the UK. Demand for water and energy is growing, our climate is changing and humanity will need more access to sustainable resources. This means we need to be more inventive, more joined-up in our thinking and actions.

To deliver a water industry that is fit for 2027 we believe it needs to answer the following questions:

- Has the water industry collaborated sufficiently with critical activities such as R&D, IoT and data analytics?
- The regulatory drive for a more balanced totex and improved customer service is at the forefront of change - but does this drive the best possible operational and maintenance service and value?
- A significant proportion of customers Э water bills cover finance charges and the cost of the debt created over the last 27 years - is this sustainable?
- Should the key players in water, gas, electricity, telephone, broadband, television and even flood defence collaborate more?

To future-proof UK Water we believe it needs to better secure supply, ensure even higher quality customer service and take the initiative by helping the industry further reduce its carbon footprint. We need to become more resourceefficient, improve sustainability and embrace the circular economy.

Pioneering technologies that mark a change in how water assets are managed will help us meet these challenging targets and deliver sustainable, resilient water services that meet the cost drivers and customer expectations.

By challenging the water industry we hope to create and drive value and opportunity for the future and in turn reduce the environmental impact of distributing and recycling water.



To achieve this, all elements of water infrastructure need to be managed and optimised for greater efficiency. We must maintain water supplies, recycle water more efficiently, control costs and reduce energy usage and carbon emissions.

Our purpose is to support the sector in meeting these challenges. We deliver optimised totex solutions by deploying our innovative technical, management and risk tools that have been developed and validated throughout the world.

Using this approach we are committed to be the water, energy and circular economy partner of choice for the long term and for those challenged with meeting the changing needs of the future.



John Abraham. Chief Operating Officer, UK Municipal Water & Ireland, Country Director for Ireland,

A changing world

From climate change and water scarcity, to robotics, regulation and circular economies, the water industry of 2027 will be very different to today.

The industry also faces a massive efficiency challenge which will mean it has to do more with less.

But the answer is not as simple as just reducing the cost of operations – it will need a step change in approach to conserve resources and gain the future benefits of emerging technologies and processes.

Trend #1 **Climate change, water scarcity** and population growth

The water sector is at the forefront of climate change. Rising temperatures, more intense and unpredictable rainfall and sea level rises are widely accepted as the increasingly common scenario. But water companies will also be exposed to more subtle impacts like saline intrusion into groundwater sources, changes to peak demand and lower dilution of discharges to watercourses during drought.

All of this will require higher levels of treatment and the associated extra energy use. Homes use approximately 33% of their water to flush toilets and run washing machines. Similarly for commercial developments, approximately 60% of the water demand is for non-potable purposes. To better protect potable water supplies, non-potable water supply could be increased to balance supply and demand. Non-potable water can originate from rainwater from buildings' roofs, stormwater from pedestrianised surfaces and road runoffs, greywater from baths, showers and sinks and blackwater from municipal and industrial wastewater.



The water sector needs to be ready to adapt to climate change in the long term but also to mitigate against temperature rises now. Guarding against water lost through leakage will be key to efficiency and the technologies to detect and predict leakages can already reduce losses from as much as 40% to below 4%.

> **Running on empty:** even if global temperature increases are limited to **2°C** or less, there could be a 30%

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decrease in river flows during dry periods.

While the climate is changing, the world's population is growing – in the UK it is expected there will be 10 million more people living here in 20 years' time. This places even greater pressure on water supplies.

Less money down the drain: new technologies

have the potential to drive down mains water leaks and unauthorised use from an industry average of

> 22% to as low as 4%



London is drying up: water demand is expected to exceed supply by as much as 0% in the UK's capital by 2025, with a potential **414 million**

litres per day deficit by 2040.

Trend #2 Automation, digital technology and workforce

By 2027 the Internet of Things will play a significant role in the water industry. Data capture, smart networks and intelligent automated systems will enable unprecedented optimisation with predictive analytics able to balance systems, reduce losses and manage water delivery and associated services. There will be greater opportunities to monitor asset health, prevent failures and automatically order parts in line with just-in-time logistics.

Integrating data from a wide range of sensors located in different parts of the water and sewerage networks will offer new insights into how these complex systems work and interact. This new knowledge can be used to drive further operational efficiencies.

This equates to dramatic savings not only in water, but also carbon and costs, building the resilience of the water network to drought and climate-change challenges. Low cost sensors could also be used to measure the quality of surface water or to aid network maintenance by predicting faults before they happen.

The roll-out of metered water will help preserve supplies – industry trials have shown that metered customers generally use 12% less water than those who are unmetered. This, coupled with greater awareness will reduce demand a situation mirrored by the increasingly effective adoption of waste recycling over the last decade.

Automation, robotics and technology will have an impact on the water workforce, with less demand for manual roles but a potentially increased call for high-skilled, tech-savvy staff. Advanced materials and narrowing gaps in labour costs due to automation will create further demand for innovation that will lead to new business models and big leaps in technology.

"Autonomous machines will be able to handle more complicated decisions and be able to think more effectively than humans. They may be able to learn from and self-correct mistakes, but will still require humans to interact with them."

Brian Quinn, COO of Labs, Intel

A changing world

Trend #3

Energy and carbon

The water industry is the fourth most energy-intensive industry in the UK, using approximately 3% of UK generated electricity for pumping, water treatment and waste management. It is responsible for around 1% of the country's greenhouse gas emissions. The challenge for 2027 will be to move towards energy self-sufficiency, cut carbon and exploit all the opportunities for customer-controlled energy.

Harnessing the potential of seven million tonnes of human waste each year will become a vital strategy to meeting these challenges. Anaerobic Digestion (AD) and Combined Heat and Power (CHP) technology is advancing rapidly, with gas cleaning systems, lean-burn engine-based CHPs and thermal hydrolysis already creating the potential to double renewable generation capacity by 1,697 gigawatt hours -enough to power half a million homes.

Low-energy devices, controls and the use of consumption data will enable the industry to cut water consumption. At the same time, innovations like the recovery of low-grade heat from sewers could become a source of additional revenue.

Renewable energy from biogas will help drive the industry towards genuine carbon neutrality and energy self-sufficiency. As populations grow, more sludge will be available and this in turn will allow expansion in the ability to capture renewable biogas and generate renewable electricity.

As treatment processes are further optimised and AD and CHP technology advances, the opportunity for greater energy self-sufficiency and renewable energy export will rise. This would be further increased if any spare (headroom) capacity could be used for the co-digestion of energy crops or other liquid organic wastes.

To lower energy demand and use optimised energy management, based on implementation of low energy devices, controls and the use of consumption data will enable the industry to make a step change in reducing demand side consumption.

Innovations like recovery of low grade heat from the sewer and nutrient recovery will be adopted more widely and create additional revenues in the future and boost sustainability.

"We currently generate 17% of our electricity from 16 CHP sites. The capturing of biogas is a double win because not only do we collect free fuel but we also prevent the release of methane, which has a globalwarming potential 25 times more potent than carbon dioxide."

Martin Ross, Southern Water **Energy Manager**

> Homes powered by sewage? If all current UK sewage bio-resource was converted into biogas, we could generate

> > gigawatt hours of electricity in the UK.

Trend #4

New materials and treatment technology

With advances in technology, it is realistic that new materials will help drive the water networks of the future. Take graphene – a hydrophobic carbon layer used in coatings. It can enable companies to switch to more energy-efficient filtering at low cost and even has the potential to turn seawater into drinking water.

New materials and innovative applications will advance microfiltration, ultrafiltration, reverse osmosis and nanofiltration. Some of the latest advances use titanium dioxide nanotechnology instead of the usual polymer-based water filtration membranes. This kills bacteria and reduces biofouling or the accumulation of microorganisms. In another development, acoustically driven nanotubes can push contaminants away from water molecules and there is growing interest in photocatalytic technology using ultraviolet rays to clean water.

The use of biological systems will also grow to include use of the aquatic organism Euglena to absorb pollutants.

Together the growing adoption of this approach will increase our ability to clean water and so make better use of water resources.



Ian Pearson, Futurologist

"With heavy engineering, you need to use very large quantities of steel, or something similar, to get the physical strength required. Graphene and nanotubes are several times stronger than what we use today and will in the future be much cheaper. They'll help us make structures much more elegant and use far less material."

A changing world

Micro-pollutants,

a macro-issue:

sophisticated analytics

capable of detecting new

contaminants at parts per

billion/trillion will enable

the development of more

advanced treatment

technologies.

Trend #5

Quality and environmental standards

A stable and predictable regulatory and business environment has enabled water companies to raise longterm finance to deliver benefits to customers and the environment at an affordable price. However, Brexit will have an impact on the level and direction of regulation, affecting water-sector procurement, employment and tariffs on goods and services.

> Therefore the development of a clear, long-term policy framework is essential for companies looking to progressively invest in low carbon technologies. This will encourage businesses to focus on higher emission reducing activities and longer-term gains.

As the impact of climate change and resource scarcity develops the societal need and appetite for sustainable developments, there may be a further requirement for legislative development as a precursor for tighter standards and new investment in the sector.

To match with environmental concerns, a biological wastewater treatment technique could be derived using microbial culture for biological waste processing in the municipal, industrial, commercial, residential and agricultural sectors. Microbial solutions can help to biodegrade and reduce hydrocarbons, absorb and degrade oil spills residue, deodorize the waste, restore micronutrient balance, reduce maintenance costs and ensure a limited exposure to environmental liabilities.

Trend #6

New resources and re-use

Grit: The Department for Environment, Food & Rural Affairs' (Defra) Resource Security Action Plan (2012) identifies aggregates as a material that will be critical to the long-term resilience of the UK economy. The limited supply estimates the availability of indigenous land sand and gravel supplies to be 10 years and 40 years for crushed rock. So sourcing secondary aggregates will become increasingly important. Recycled aggregates (such as processed construction and demolition waste) account for nearly 20% of the aggregates market in the UK. Recycling sewer grit could add to this market.

Bio resources (Sludge): We can extract biogas and produce renewable energy from sludge, but it has a much greater value as a bio-resource. By implementing the necessary processing and transformation technologies, sludge can now be used to harvest valuable nutrients and the raw materials required to produce plastics and biofuels.

14 million LED/LCD televisions or 10 million

game consoles could be powered continuously if the UK deployed the full potential of human sewage for energy.



When applied to agriculture it can support the ability to feed a growing global population as recycling treated sludge to land is a sustainable option and can reduce the need for artificial fertiliser to improve soil structure.

Separate binding price control for sludge, covering treatment, transport, recycling and disposal will lower industry costs.

Closed-loop thinking:

although not suitable for agriculture. non-compliant sludge has a valuable role in providing nutrients to the soils that are used to restore closed parts of landfill sites, improving old, tired soils and creating a nutrient rich base for the native species as part of the reclamation process.

Furthermore, by creating merchant sludge facilities to treat sludge and act as a broker for access to sludge treatment capacity this will optimise the use of facilities.

Phosphorus: Phosphorus is a key nutrient for all living beings - thermally conditioned sewage sludge serves as an excellent fertiliser to improve soil properties.

"The use of biosolids in land applications is an excellent example of the circular economy, where synthetic fertilisers are replaced with sustainable materials naturally rich in nitrogen and phosphorus and also adding back organic matter to the soil (its skeleton)."

Raquel Carrasco, Organics and Technology Director, Veolia

The forces shaping water and wastewater companies

The trends described in the previous chapter will affect both supply and demand for water, with the need for resilient water and wastewater infrastructure. environmental regulation and innovation to support sustainable levels of abstraction.

What's driving change?

- Increased demand and the cost of investment to maintain infrastructure.
- Environmental pressures such as biodiversity implications of abstraction and the carbon footprint from energy / chemical use.
- Ageing pipes and other water assets.
- Increased surface run-off from urbanisation, increasing the risk of overloaded sewers.
- Water companies have to operate as wholesalers to a retail market.

The regulatory landscape is already evolving to reflect the forces of change in this sector, as well as enhanced societal awareness and scrutiny around responsible consumption. For example, circular economy and life cycle thinking is growing in importance in government policy and sewerage planning has much longer timeframes. We are also seeing more legislation around catchment management, ecosystem services, phosphorus levels and water trading.

Market opportunities

To keep taps running and pipes flowing for more and more people, the sector could adopt an open mindset to technology. Every day, systems are emerging that can predict and optimise water management. For example, hypervision technology can combine sets of data to manage supply and unaccounted for water in building long-term network resilience.

Untapped markets exist in energy and mineral extraction from sludge. As populations grow, more sludge will be available and this in turn means more biogas to generate renewable electricity and to create new products like plastics and fertilisers.

"Wastewater can no longer be regarded as waste. Today, only 2% of the wastewater produced in the world is reused. There is a lot of room for improvement!"

Antoine Frérot, Veolia Chairman and CEO

Veolia: unlocking the potential

Our specialist teams and market-leading monitoring and management systems provide increased operational efficiency and improved environmental performance.

	We supply 100 million people with drinking water and 61 million people with wastewater services worldwide
(We optimise treatment and generate renewable energy for more than 30 water and wastewater sites in the UK
3	We manage Ireland's largest water treatment plant on behalf of Irish Wa
Ţ	We operate the world's largest sludge treatment and recovery plant in Hong Kong
	We manage a fleet of 427 biogas CHP plants including 10 of Southern Water's treatment works
**	We recover heat from sewage to warm swimming pools in northern Fran
	We recover nutrient directly from wastewater hydroponic systems in Vancouver, Canada
	We recycle large volumes of wastewater to produce drinking water for nearly 300,000 inhabitants to help with the chronic water shortage in Windhoek, Namibia
	We build closed-loop water treatment systems for oil installations throughout the world
	Water power is back Our CHP experts design, install and operate biogas generation units for customers. For example, this year we've installed CHP engines at three of Southern Water's treatment works - Budds Farm and Fullerton in Hamps and Gravesend in Kent and this adds to the systems already serving sever other Southern Water treatment sites. These CHPs will now deliver arour 48.3GWh of renewable electricity each year, taking pressure off the local

Water savings for Wales

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We are using PEARL software to help Dwr Cymru (Welsh Water) in Pembrokeshire compare how it's doing against over 4,000 drinking water plants operated globally by Veolia.

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for ree of ampshire seven around electricity infrastructure and saving 8,800 tonnes of CO₂ emissions.

Towards 2027

Water and wastewater companies need to work side by side to shift consumer mindsets around issues like the potability of recycled water and what ends up in sewers. The long term nature of investment needed raises questions around the extent to which today's customers should pay for future customer and environmental benefits.

Agility is needed to reap the commercial benefits in energy and new materials from waste sludge, while flexible financing models will help secure the upfront capital needed for long term change. Investment in people is required to provide the skills needed to future-proof water operations many companies in the sector have already backed a new strategy to bring in 221,000 new jobs by 2027 under the Energy and

"Technology alone will not solve the problems of providing access to water services and adapting to climate change. It is necessary to go beyond the traditional silos and bring together public authorities, economic actors and civil society to develop new partnerships, and innovative and inclusive solutions to meet these major challenges."

Laurent Auguste, Veolia's Senior Executive Vice President Development, Innovation and Markets

The forces shaping **retail water**

Households and businesses are being given more control over their water supply and **costs** and there will be more competition in the retail market. This presents both challenges and opportunities.

Since April 2017, customers were able to select their water and sewerage service provider. Also, with smart metering now the norm, customers can see what they're using in real time, giving them more power to curb spending.

With customers expecting discounted tariffs, e-billing, long term contracts and value added services as the norm, the impetus for water companies to innovate has never been greater.

Market opportunities

Advances in metering and smart networks have the potential to catalyse a step change in intelligent water infrastructure, even in the context of water scarcity. Already, sensors and data analysis systems are able to detect potential leaks before pipes burst, while cloud applications mean that information can be gathered, analysed and monitored remotely in real-time. Mapping this information onto Geographic Information Systems offers an even more accurate view of what is happening across any network, reducing the need for reactive maintenance.



Veolia: unlocking the potential

On behalf of customers, we consolidate network information, automate key processes and analyse trends. This identifies cost savings and efficiencies, as well as opportunities for energy recovery.

We can help customers benchmark performance against thousands of Veolia operated sites around the world.

Veolia has teamed up with Scottish Water Business Stream to create a wide ranging retail water market offering for businesses across the UK.

The partnership combines Veolia's global innovation and engineering expertise across water, waste and energy with Business Stream's retailing strength, experience and large market presence. This provides business customers with a holistic approach to resource management, a reduced carbon footprint and cost savings.

"Our partnership with Business Stream will provide clear long term benefits to customers as together we can provide a complete retail water package which can reduce utility bills, supported by optimised on-site project engineering and operational solutions, such as AD and CHP."

John Abraham, Chief Operating Officer, UK Municipal Water & Ireland, Country Director for Ireland, Veolia

Towards 2027



By tapping into a wider consumer base, the latest digital systems, retail water companies have the potential to shift the consumer experience in a 2027 economy. To do so, they will need to adopt sustainable strategies to reduce customer use and secure supplies in acting as change agents for sector efficiency improvements.

The forces shaping strategic infrastructure

Airports, Ministry of Defence (MOD) estates, large industrial sites, hospitals and university campuses face particular challenges in **water resourcing, management, cost control and carbon/ energy efficiencies.**



By 2027, 5.7 billion passengers are expected to travel by air each year. This means more pressure on UK airports to seamlessly manage water supply and waste, with hubs in drought-prone areas of the south-east at greatest exposure to business continuity risks.

For the defence sector, the challenges relate to its 2040 objective of downsizing the managed estate by 30%, while also managing rising costs in energy and water. Automated, integrated sites or 'smart bases' will look to meet and exceed water and wastewater targets, including generating energy from wastewater and selling the surplus to the National Grid.

Market opportunities

By adding an energy focus to smart metering, companies can not only pre-empt and avoid energy losses and water leaks, they can also offset their upfront investments. Submeters allow even more data to be gathered, reducing the risk of missed meter readings or late payment of bills, while monitoring energy and water consumption in compliance with regulations. Cloud based data systems on metered supplies can reduce non-revenue water losses from **40%** to below **4%**

"Data processing has already advanced beyond the ability of human analysis and machine learning is now dominating the landscape. A vast amount of data is being collected through the Internet of Things."

Richard Kirkman, Chief Technical and Innovation Officer, Veolia

Veolia: unlocking the potential

We work with clients that have their own private water and wastewater networks and facilities, taking full responsibility for maintaining and operating high pressure networks, monitoring quality and billing end users. This frees up our customers to focus on delivering their core business.

Hubgrade

Our Hubgrade technology combines real-time monitoring and remote management with the support of a specialist technician.

Taking off: Luton and Edinburgh airports

Under a 20 year contract, we manage all water and wastewater services for Luton Airport. As well as running its physical water networks, we also manage the customer service and billing of around 100 tenants and meter points. All water and energy usage data is captured through Veolia's real-time, automatic metering system and applied to a GIS-based model. Unaccounted for water, including leakage, has been reduced from more than 40% to around 12%. Customer enquiries, complaints, technical support requests and emergency response have also improved.

Protecting Forres from flooding

We have taken on the day-to-day maintenance of a £44 million flood alleviation scheme in Forres on the Moray coast of Scotland. Designed to withstand heavy rainfall events, it's already estimated to have avoided £27 million in flood damage, protecting residents, businesses and transport routes.

Making seawater drinkable for the MOD

Our seawater desalination plant provides the MOD in Gibraltar with a sustainable water supply that complies with environmental regulations, as well as their own strict security and reliability criteria. What's more, recovered energy has increased by 40% giving the MOD a significant cost saving.

Towards 2027

Over the next ten years, strategic infrastructure organisations will need to take a holistic approach to managing their water networks in ways that keep costs down and taps flowing. This will involve continually optimising water management processes, reducing leakage and reviewing ways of using available resources more effectively and includes the use of grey water or potable water recovery and recycling. This will deliver the benefits of conserving water and will address energy use and maintenance requirements which directly impact cost and carbon emissions.

By thinking circular, strategic infrastructure will implement circular business models meaning waste will be a resource. Its value extracted and reinvested and water and energy are conserved delivering long-term strategic benefits to the environment and the community.

The forces shaping **industry**

Given the volumes used. the cost of energy and water will become an increasing burden for UK manufacturing. **Businesses will need to** think differently about how they generate, use and recover these resources.

"We could see water dependent industries moving to areas that are in a better position relating to total water stress."

Tony Conway, Water Expert

Market opportunities

Advanced new materials and lower overall labour costs (due to automation) are enabling change at scale. There are also more renewable technologies available that will help counter energy price volatility, create bottom-line savings and support credible reporting. Wastewater can be treated and processed onsite without the need for transportation across the country, whilst optimised operations will further increase this efficiency. This will also offer more opportunities to smaller businesses that can operate locally. Increasing water scarcity will be the catalyst for greater uptake of water recycling and heat recovery schemes.

> There is £2.8 billion worth of hidden value in unutilised resources within the manufacturing industry.



Our Hubgrade smart monitoring centres already monitor heat, electricity and gas usage in real-time. Central control centres remotely adjust their systems to ensure constant optimisation. Customers can also be identified, prioritised and notified when improvements could be paid for by cost efficiencies.

We believe the miniaturisation of waste treatment systems will reduce centralised plants to on site facilities. No longer will rubbish be carried across the country, but processed onsite as it comes out of the factory. Smaller businesses could see shared facilities installed and managed by integrated environmental services companies.

"By embracing the revolution in big data, industry will see a step change in how it views and pays for services. This transformation will see complete contract visibility, faster forecasting and flexible payments based on performance that will improve the B2B experience."

Kevin Hurst, COO, Industrial Customers, Veolia

Veolia: unlocking the potential

We're already extracting and selling fertiliser, road salt, paint thinners, glass, fibre, road building materials, plastic polymers for car bumpers and oils - all from industrial waste products. By breaking down waste into these valuable commodities, businesses can trade on the open market through our existing Veolia brokerage team.

> How you stack up: we offer performance benchmarking to compare how your circular thinking and practice is doing compared to other Veolia operated sites around the world.

As a nation we are using more water, but there's less to go around. This is why water supply and wastewater treatment is a national priority.

Working with Tilmamstone Salads in Kent, we created a water recycling facility that took the wastewater from the factory and safely recycled 72% of it back into the food production process.

The first example in the UK of recycled water being used in food production, it has delivered significant cost savings and reduced our client's environmental footprint.

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In the water-parched Mexican state of Jalisco, Veolia has helped Nestlé implement zero-water dairy production to improve stewardship of water in a country where the resource is under serious stress.



Towards 2027



For many industrial sites, water is both a vital utility and a significant cost. By introducing greater efficiencies and adopting new technologies, industrial sites will see cost reductions. more accurate effect on the £ per litre of water used in

Industry will find a growing need to implement water conservation measures and advanced water recycling that can be utilised in their production processes.

As the UK's leading provider of water, waste and energy services, Veolia can offer unique support to the UK Water industry. This important role also comes with a position of responsibility.

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That is why we are actively looking, listening and seeking out answers to some of the significant challenges that will shape the future of our world. Only by working closely with customers like you can we help make the difference. Whatever industry you are in, speak to us today about how we can help you get ahead in the future.

Please get in touch with Veolia at: uki.sustainability@veolia.com

> To find out more visit: www.veolia.co.uk



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