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Five key trends highlighting the urgency to fight climate change



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This report features third party quotes that do not relate to Veolia Water Technologies

Sir David Attenborough, English broadcaster and natural historian; Christina Chan, Co-chair, United Nations Adaptation Committee; Sangji Lee, Climate Change and Green Economy Technical Specialist, United Nations Development Programme; Priscilla Negreiros, Manager of the Climate Finance Alliance at Climate Policy Initiative; and Barack Obama, the 44th President of the United States.

This report features third party facts and figures that do not relate to Veolia Water Technologies

European Commission: “Joint Research Centre’s PESETA IV project” and “EU taxonomy for sustainable activities”; Global Carbon Project; Intergovernmental Panel on Climate Change: “Climate Change 2022”, “Climate change widespread, rapid, and intensifying” and “IPCC Sixth Assessment Report, WG1, Chapter 2”; International Energy Agency: “Global CO₂ emissions rose less than initially feared in 2022 as clean energy growth offset much of the impact of greater coal and oil use” and “World needs \$48 trillion in investment to meet its energy needs to 2035”; NASA’s Jet Propulsion Laboratory with the California Institute of Technology: “The Effects of Climate Change”; PwC: Net Zero Economy Index 2022; Our World in Data: “CO₂ and Greenhouse Gas Emissions” and “Emissions by sector” by Hannah Ritchie and Max Roser; United Nations, Framework Convention on Climate Change: “The Paris Agreement”; United Nations, Climate Action: Secretary-General, Statements and messages, July 2021; The World Bank: Carbon Pricing Dashboard; World Economic Forum: “The Net-Zero Challenge: Fast-Forward to Decisive Climate Action 2020”; World Meteorological Organization: “Droughts threaten sustainable development” and “Weather-related disasters increase over past 50 years, causing more damage but fewer deaths”; World Wildlife Fund: “Water scarcity, threats”.

Whatever your industry, [contact us](#) today to see how we can help you deliver on both performance and sustainability without compromise.

To find our more, visit: www.veoliawatertechnologies.com



A lack of water presents an existential threat.

Safeguarding our resources must be at the top of our global agenda.

At Veolia Water Technologies, we are intentionally looking, listening and finding answers to the most significant water challenges of our time, including the ones brought on by climate change.

In this report, we explore five global megatrends that underline the need for immediate climate action. From the water innovations that mitigate global warming through decarbonization, to the financial instruments, such as carbon tax and public sector investments, that are aiding the switch from fossil fuels to clean energy.

We share the stories of our customers who are already taking action to overcome, adapt and mitigate the impacts of climate change, and highlight our technologies enabling them to do so.



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It's impossible not to notice

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The temperature of our planet is the highest since records began.

The rapid warming we see altering our weather patterns could occur naturally over thousands of years. However, we are seeing drastic changes in mere decades. There is no denying that climate change is real. Or that human activities have been a huge contributor to the acceleration.

In the years to come, we will continue to experience unprecedented heatwaves, flooding and drought, resulting in fires engulfing our forests, the failure of our crops and ultimately the loss of life; unless we intervene.

We have the power — and a narrowing window of opportunity — to contain the climate emergency and weaken its devastating and far-reaching consequences.

To slow the rate of climate change, limit the impact of global warming and stabilize the long-term shifts in our climate, we need to take urgent, decisive and precise action.

We need to radically adapt, improve and prioritize sustainable patterns of production and consumption. And we need to do this now.

At Veolia Water Technologies, we are taking action and encouraging our customers to do the same. We recognize that the world does not have time for a slow and steady ecological transition, we need immediate ecological transformation.

From local authorities to industrial players, our mission is to work with all of our stakeholders and provide water technology solutions to help decarbonize industry, turn wastewater into a source of affordable and clean energy, and help our cities and industries become more resilient as we adapt to reoccurring climate change disasters.

Scientific evidence is certain: climate change is our greatest global threat. We all have a role to play so join us. Our time is now.



Arnaud Valleteau de Moulliac
CEO
Veolia Water Technologies

A handwritten signature in black ink, consisting of a large, stylized 'A' followed by a horizontal line extending to the right.

It's impossible not to notice.

In 2022 alone: one-third of Pakistan was underwater; the worst droughts in 500 years were experienced throughout Europe; and deadly wildfires ravaged the U.S., to list but a few.

Climate change and its increasing severity can be — and is — overwhelming. But we cannot neglect our responsibility to act. We must use our collective strength and knowledge to mobilize for the sake of our planet, our home.

The climate emergency requires deep commitments and calls for accelerated change in our collective global mindset, behavior and policies. Across every level in society from world leaders to academic and scientific experts, policymakers and industry leaders to consumers, you and I, action is needed to both mitigate and adapt to climate change.

An incredibly complex, interconnected web of urgent tasks

lies ahead and we need to switch gears to get our global economies, investments and policies aligned.

Without immediate and unified action, global temperatures could increase an additional 4°C by the end of the century which would be catastrophic for us all. The good news is, solutions already exist and we are working on the solutions of tomorrow.

We are committed to helping prevent this. We develop and deploy water solutions that contribute to turning the tide and answering our stakeholders' concerns. But we want to do more.

This brief report explores five key trends that are impacting the climate change movement. Intending to open communication channels between our stakeholders to share ideas and challenge the status quo, these are the trends we believe will impact our future existence and help us to conquer the greatest challenge humanity has ever faced.



Anne Abraham
Sustainability Director
Veolia Water Technologies

Anne Abraham

EXTREME WEATHER EVENTS

The water cycle in the face of climate change

Our planet's temperature has risen 1°C since 1880, causing worldwide changes in our weather patterns. As a result, the associated loss and damages caused by floods, heatwaves, droughts and storms are escalating.

The ambition of the Paris Agreement — a legally binding international treaty — was to keep the Earth's temperature below a 1.5°C increase by the end of the century. However, on our current trajectory, the Intergovernmental Panel on Climate Change predicts, we are facing a rise of an additional 4°C.

The warming we see today is already impacting us but a 4°C rise would cause drastic shifts in our

weather patterns and consequently significantly impact the availability and quality of our water resources, directly and indirectly.

"The truth is: the natural world is changing. And we are totally dependent on that world. It provides our food, water and air. It is the most precious thing we have and we need to defend it." — Sir David Attenborough, English broadcaster and natural historian.

As our glaciers melt and sea levels rise, we will need to treat additional saline, as saltwater intrudes into freshwater sources; flooding and heavy rain will increase sediments and pollutants in water bodies. This will disrupt aquatic ecosystems and pollutants like pesticides could contaminate widespread water supplies and pose risks to human health. Flooding also contributes to

the spread of waterborne diseases either via contaminated water sources or inadequate sanitation following the event.

At the other end of the scale, droughts reduce the availability of water for agriculture, industry and domestic use, and increase soil erosion. Drought conditions also considerably increase the risk of wildfires. In turn, these can have a serious impact on water resources by affecting watersheds, polluting water bodies and damaging water infrastructure.

Addressing these consequences of extreme weather requires a comprehensive approach, including better water management practices and improved infrastructure for water treatment and distribution.



Current warming is occurring roughly 10 times faster than the average rate of warming after an ice age — Intergovernmental Panel on Climate Change

Climate related incidents have killed an average of 115 people and caused \$202 million in losses per day over the past 50 years — World Meteorological Organization



Wildfire conditions exacerbated by climate change

Water treatment works at 150% capacity to tackle blaze

Not just making headlines in 2023, Canada has faced several extreme weather events in recent years, including the Fort McMurray wildfire in Alberta, Western Canada, which caused damages exceeding \$9.9 billion CAD.

Prior to the fire starting in May 2016, it had been an unusually dry month which contributed to the ideal conditions for a longer and drier fire.

Known as The Beast, the wildfire was declared a national state of emergency within hours. It burned for a total of 93 days, spreading across 1,500,000 acres of land and destroying approximately 2,400 homes and buildings.

Even though Fort McMurray and the surrounding area was fully evacuated, the Regional Municipality of Wood Buffalo had to produce water at unprecedented volumes.

At times, the water treatment plant was working at 150% of its design capacity, partly because firefighters relied on the drinking water distribution system to tackle the blaze, and also because fire damage caused severe system pressure loss.

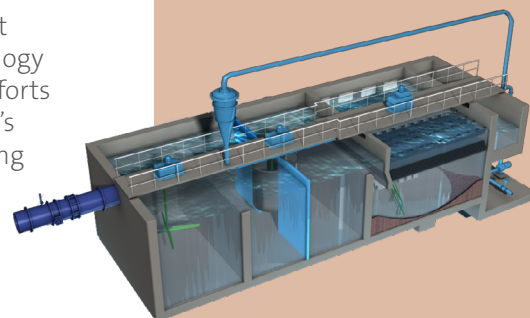
Additionally, the fire burned large areas along the Athabasca River's watershed which seriously impacted raw water quality. Turbidity worsened owing to excess vegetation in the water and the burning forest released dissolved organic carbon and phosphorus into the river meaning it needed extensive clarification.

Nevertheless, the water treatment plant and the clarification technology endured, supporting firefighter efforts and maintaining the municipality's network to avoid extensive cleaning and disinfection once the 90,000 residents could return.

Actiflo® battles Fort McMurray wildfire

High-rate clarification technology passes the crisis-test

Owing to the wildfires, the water quality deteriorated very rapidly, spiking to over 2,000 nephelometric turbidity units in just two days. Actiflo® is the Veolia-patented, high-performance clarifier that was able to handle the pressure owing to its very short hydraulic retention time. This meant it was responsive to the rapid raw water quality variations and its overall robustness dealt with the wide range of contaminants and highly contaminated concentrations effectively.



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MITIGATING THE IMPACT OF CLIMATE CHANGE

Acceleration of decarbonization activities must be adopted

The growth of sustainable solutions helped to keep the rise of global carbon dioxide emissions under 1% in 2022; however, this is still a rise. To meet our global net-zero commitments, our global greenhouse gas emissions (GHG) need to be reduced by 45% by 2030.

Despite strong international political support, without fast and positive action to reduce GHGs our global carbon budget — the tipping point for our climate — will be consumed in less than a decade. And so, a successful mitigation strategy must include means to reduce and/or remove GHGs from the atmosphere. According to the World Data Center, the energy sector, unsurprisingly,

is responsible for 73% of GHG emissions, followed by agriculture and transportation. Though the water treatment sector is directly responsible for only 1%, water is used across all industries — from pure water in drug manufacturing to cooling tower water in power generation. Consequently, there are numerous opportunities to better manage this resource and reduce emissions.

In the water treatment sector alone, it is possible to improve the energy efficiency of water treatment processes by choosing the right treatment lines, optimizing processes and ensuring the efficiency of mechanical equipment. Additionally, anaerobic digestion can transform wastewater sludge into biogas to be used to generate clean electricity or heat, thereby reducing the reliance on external energy sources or even allowing self-sufficiency.

Nitrous oxide is a well-known by-product in wastewater treatment and has a global warming potential 265 times greater than CO₂. This significant contribution to GHG emissions stresses the importance of improved operations and treatment methods.

“We are the first generation to feel the effect of climate change and the last generation who can do something about it.” — Barack Obama, Former U.S. President.

Across all sectors, the advancement of technology will continue to play a large mitigation role. Reducing our carbon emissions requires a comprehensive approach, including better water management practices and improved use of existing infrastructure for water treatment and distribution.



If current trends continue, we will reach 62 gigatons (GT) of GHGs by 2030. Making the gap between actual emissions and what is needed to keep below 1.5°C more than 30 GT — Intergovernmental Panel on Climate Change.





*Rethinking resources:
turning sewage into
a source of green energy*

Wastewater treatment plant produces twice as much energy as it consumes to help mitigate climate change

To help lessen the impacts of climate change, cities and companies are investing in technology to optimize their infrastructure to reduce costs, while reducing emissions.

In the south of France, the metropolis of Montpellier is upgrading its wastewater treatment plant, Maera, aligned to the national Climate Air Energy strategy — launched to reduce carbon, boost renewable energy production and preserve water resources nationwide.

The modernization of Maera includes an extension of the treatment capacity from 470,000 population equivalent (PE) to 695,000 PE, plus the implementation of a thermal sludge recovery system to generate renewable energy.

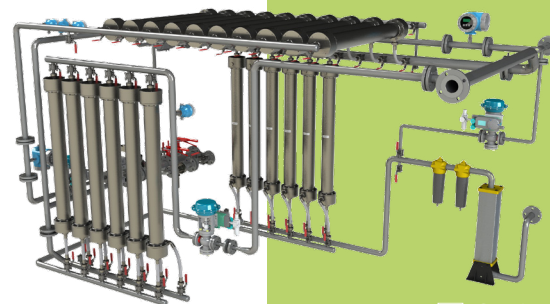
By using the sludge from the water treatment to produce renewable energy, the plant will produce twice as much energy as it consumes with the excess energy used, among other things, to supply gas to 9,000 local homes and heat to more than 7,500 households.

The treatment capacity of Maera will be increased by 10% in the first year without enlarging the plant's land area and with treatment processes that combine safety and durability: tertiary treatment that allows for a higher quality of discharge and technologies that are low in consumption. Once completed, the wastewater treatment plant will have the ability to cover 205% of its energy consumption by 2031. The plant will also reduce its net CO₂ emissions by more than half.

Producing renewable energy with maximum efficiency

Membrane technology purifies raw biogas above 97% methane

*Sludge and organic waste are no longer a matter of discharge when technologies like **MemGas™** revalorize it into a valuable source of renewable energy: biogas. MemGas uses membranes to separate methane and carbon dioxide compounds to concentrate the methane into biomethane — at more than 97% methane of renewable origin — which can be injected into the gas network for domestic or industrial use. As part of the Maera project, MemGas will produce biomethane for the municipality at a low energy consumption with up to 99.5% efficiency.*



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ADAPTING TO CLIMATE CHANGE

Resilience matters in a changing climate

Water is significantly impacted by climate change; its availability is altered as weather patterns shift, adding additional pressure to arid regions, causing flooding elsewhere, and creating uncertainty across the board.

Adaptation to extreme weather has long been on the agenda to help reduce the associated loss and damages. The ability of countries, industries and communities to work together to adapt to floods, heatwaves, droughts and storms will determine the human, societal and economic burdens we will face.

Scientists from the Joint Research Center estimate current annual

damages from flooding in the EU and the UK are €7.6 billion. However, in a 3°C global warming scenario and without any adaptation to extreme weather events, this could rise to €44 billion per year. The same report also forecasts that for every Euro invested it would save €4 in avoided damages in the same 3°C scenario.

“We have an opportunity to act now, and make investments in adaptation that will have an impact in terms of the future.” — Christina Chan, Co-chair, United Nations Adaptation Committee.

In the water sector, this translates to stormwater management, the use of early warning systems and risk assessments to minimize the damages to infrastructure and environment. It also includes water

network optimization through digitalization and the use of local emergency storage capacity.

Meanwhile, an estimated 55 million people globally are affected by droughts every year. Severe water scarcity has wide reaching consequences for those directly impacted since it causes significant damage to agriculture, global food supplies and energy production.

To reduce the impact, robust wastewater treatment and reuse are vital. Once secured and treated, water needs to be reused to meet soaring demand. The technology is readily available to clean water and keep it in the loop for everything from industrial processes, irrigation and potable water.



In 2023, two thirds of the world population will face water scarcity — World Wildlife Fund.

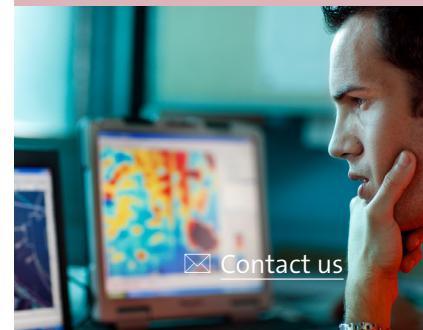
Estimated adaptation costs in developing countries could reach \$300 billion every year by 2030 — United Nations Climate Action.

Hubgrade Performance provides real-time monitoring of sewer network

Unlocking the vital insight that lies beneath

Hubgrade Performance's Sewer module utilizes real-time data and advanced algorithms to provide continuously optimized setpoints offering valuable insight so operators can make informed decisions quickly.

By leveraging crucial real-time data such as rainfall, water level, flow data, and stormwater forecasting, the module helps increase the sewer system's capacity to handle excessive flows. In turn, this enhances the overall performance and resilience of wastewater networks and minimizes environmental risks that impact human health too.



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Heavy rains threaten health and environment in Ecuador

Digital innovation tackles infiltrations in the sewer network

Ecuador's largest city, Guayaquil, is known as the Pearl of the Pacific. Located in the southeast of the country, the economic hub of Ecuador is also one of the fastest growing tourist cities, being the closest to the Galapagos Islands.

With its warm tropical climate and due to climate change, the port city has experienced an increase in frequent heavy rainfall in recent years. Despite ongoing efforts from the water utility, Interagua, to reduce flooding, problems caused by the complexity of the aged sewage system became a major local challenge. Already facing problems with cracked and faulty sewage connections, the damage exposed the city to real health and sanitation risks as well as major environmental troubles.

To increase resilience, during maintenance works in 2021, the city invested in Hubgrade Performance's sewer module —

a digital solution that allows data-driven time series analysis based on any pump or flow data.

Predicting and understanding flow conditions was vital to get their system under control. And thanks to advanced and predictive analysis, the city's sewer network infiltration levels could be constantly analyzed and maintenance tasks prioritized.

Additionally, the alerts and fault tracking allow more productivity, reducing inspection time and improving work efficiency. As a result the system grew in resilience, protecting the population while preserving water resources and safeguarding the environment.

Thanks to real-time optimization and with minimum investment, sewer operators can reduce up to 40% of overflows.

FINANCIAL INSTRUMENTS SUPPORTING SUSTAINABILITY

Placing a price on carbon

Financial resources, taxes and sound investments are needed to address climate change, reduce emissions, promote adaptation and build resilience. But where is the money coming from?

Governments are introducing measures to control and reduce GHG emissions and fund this transformation. As a result, climate legislation, from national carbon budgets to cap and trade systems, and carbon taxes, are commonplace on national and international agendas.

These require the public and private sectors to pursue short and long-term climate change mitigation strategies with many facing fines and legal consequences for non-compliance.

In July 2022, Denmark introduced

the highest global carbon tax of \$54; however, the average global cost per metric ton of carbon dioxide is \$6. Experts predict, to limit global warming, prices need to rise globally to \$75 by 2030.

Such legislation encourages organizations to lower their emissions, which become an extra business cost. Therefore, by optimizing their operations, for example, lowering the energy consumption for water treatment, they reduce their carbon footprint and associated tax they need to pay.

Another strong financial trend is the shift of investors who recognize the value of integrating environmental, social and governance strategies, which maximize risk-adjusted returns and generate real profits.

“It is important to examine various development pathways and understand how best to handle the climate crisis while also taking into account the imperatives of sustainable development – creating jobs, securing food, and ensuring equality for all. All of these crises are clearly interlinked, and the scale and nature of the policy decisions being made now will crucially affect climate outcomes far into the future.” — Sangji Lee, Climate Change and Green Economy Technical Specialist, UNDP.

New classification systems such as the European Green Taxonomy help direct investments by defining criteria for economic activities that are aligned with a net zero trajectory by 2050. This is twofold, it gives companies the ability to adapt to climate change in line with legislation and helps them secure investors. And for investors it creates security.



\$3 trillion should be invested in the world energy sector by 2035 to prevent life-threatening climate change — The International Energy Agency.



*TRX financial center
focused on world-class
sustainable innovation*

Sustainable investment for a better future

In Kuala Lumpur, the Government's Economic Transformation Program was put in place to transform the country into a high-income nation through sustainable policies.

Putting this program into practice, the Malaysian state-owned company, TRX City Sdn Bhd, launched the Tun Razak Exchange (TRX), a new international trading hub and financial district with alternative and sustainable solutions at its core.

Located in the heart of the capital, minimizing water consumption was a key sustainability driver. They decided all buildings would utilize water-efficient fittings to reduce water demand on local supplies and all non-potable water would be supplied with recycled water produced on-site via an advanced wastewater treatment.

The plant will operate 24 hours a day, seven days a week. To reach the required targets, we combined four key technologies with reduced chemical consumption and the lowest possible energy requirements to minimize carbon footprint. And treated water is delivered in a smart network eliminating leakage and targeting better than 98% network efficiency.

Thanks to wastewater treatment and reuse, TRX will reduce its carbon emissions by 40%, freshwater consumption by 50%, and it will divert 70% of its waste from landfill. It is rated platinum on Malaysia's Green Building Index.

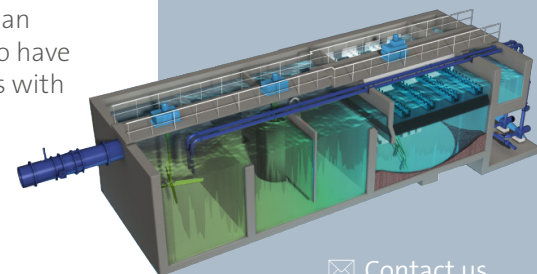
This project has become a global reference for sustainable development and an inspiration proving it is possible to have bold and innovative constructions with low environmental impact.

Four technologies,
one innovative
solution

High-performance with
small footprint

*Wastewater treatment and reuse are fundamental to the sustainable credentials of the TRX project. To achieve this, we combined four Veolia technologies: **Multiflo™, AnoxKaldnes™ MBBR, Hydrotech™ Discfilter and Alizair™.***

To highlight one, the Multiflo clarifier can handle different water characteristics and loads and so is ideal as a primary treatment solution. It is a compact lamella settler that successfully removes total suspended solids, color and heavy metal co-precipitates to produce settled water and a concentrated and thickened sludge.



REACHING NET ZERO

All sectors need to reduce their CO₂ emissions

To achieve net zero our global economy needs to transform. Our focus needs to be placed on radically adapting, improving and prioritizing sustainable patterns of production and consumption, to sustainably meet our needs, from energy and food production to healthcare and commerce.

Despite the Paris Agreement commitment, we are lagging behind our target of limiting global warming as global CO₂ emissions continue to rise.

The Net Zero Economy Index 2022 from PwC shows G20 members — representing 80% of global gross domestic product and approximately

80% of global CO₂ emissions — only managed to reduce the carbon intensity of their economies in 2021 by 0.2%, its lowest level for two decades.

“To achieve the transition to a sustainable, net zero emissions and resilient world this decade, climate investment must increase dramatically. Reaching this goal without the private sector won’t be nearly as possible.” — Priscilla Negreiros, Manager of the Climate Finance Alliance at Climate Policy Initiative.

In contrast, net zero ambitions are on the rise due to mounting social pressure from across the stakeholder map. As a result, many companies and sectors are committing themselves independently to help secure their market position and future growth.

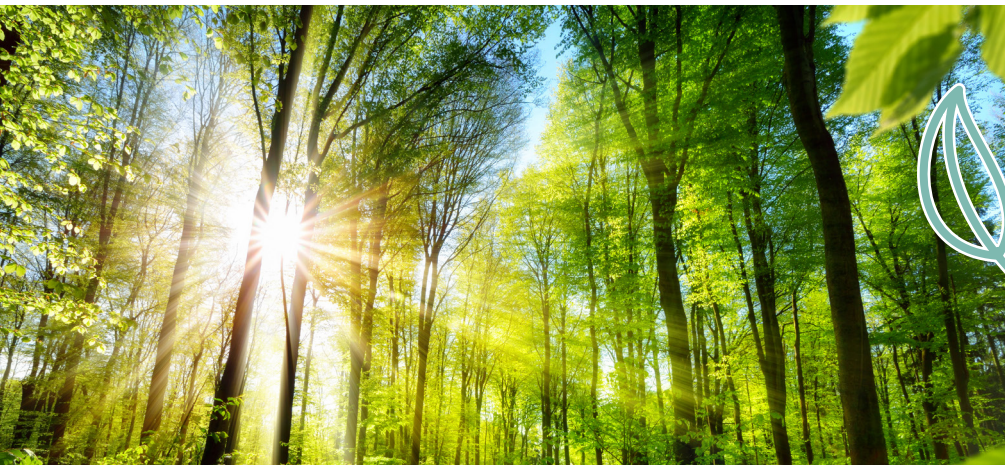
Carbon is admitted during every industrial process, including those that involve water. Through optimization, these processes can be more energy efficient and wastewater can be used to create green energy in the form of biogas.

Biogas is produced when bacteria digest organic matter, everything from sludge to food waste. This can be used locally for heat or power or upgraded to biomethane and replace natural gas. In this form, it can replace fossil fuels and aid our transition to a net zero energy system.

To get back on track, it is crucial that global CO₂ emissions are reduced by 45% by 2030 (when compared to 2010 levels) and that we reach net zero emissions by 2050.

At the current rate of emissions, our remaining carbon budget to stay below 1.5°C of warming — at 380 billion tonnes of CO₂ — will be gone by 2031 — Global Carbon Project.

Short and long-term net zero transitions — from decarbonizing energy systems to reusing resources — can support profitability, especially when compared to inaction — World Economic Forum.





Turkey's private sector leads the way to net zero

Dairy leader reduces emissions by 13%

Like most countries in the Mediterranean, Turkey is increasingly vulnerable to climate change. The toughest year to date was 2021, when the country faced both torrential rains, causing severe flooding and landslides, and droughts, causing wildfires that killed people and destroyed critical infrastructure.

Perhaps it was no coincidence that 2021 was also the year Turkey ratified the Paris Agreement and released its roadmap to reach net zero by 2053. The vast majority of Turkey's emissions are from its energy use and the 217 recommendations in its roadmap heavily focus on energy, transportation and industry emissions reduction.

Ahead of the game is Turkey's private sector with many companies acting to safeguard their operations through sustainable means.

Corporate carbon footprint calculations and reporting studies have been performed by Pinar Süt, one of the country's biggest dairy producers, since 2011. Accordingly, the company takes action to reduce its carbon emissions and between the years 2015 to 2020 it achieved a 13% reduction.

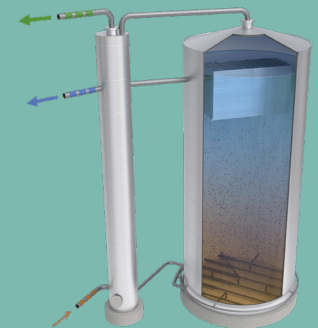
Pinar Süt acted on its sustainable ambition with a new wastewater treatment plant designed and managed by Veolia Water Technologies in İzmir.

The plant enables biogas production — used in the factory boilers — which has reduced the plant's carbon emissions by 17% while generating substantial savings on natural gas. Additionally, the treated water is suitable for reuse with further tertiary treatment for certain applications in the factory, reducing the strain on local water supplies as water scarcity intensifies.

Trio of technologies reduce carbon emissions

Innovation creates valuable biogas and treats wastewater for reuse

At the heart of the Pinar Süt wastewater treatment plant are three Veolia-patented technologies. The wastewater passes through a screen and an **Idraflot™** dissolved air flotation (DAF) unit captures the fat, oil and grease (FOG) before entering the **Biobed® EGSB** granular biomass anaerobic treatment unit, where over 80% of the chemical oxygen demand is removed. This treatment stage produces approximately 45% of the biogas generated at the plant. The FOG retained in the DAF is then sent to a **Biobulk™ CSTR** unit for purification and further biogas production.



Resourcing the world