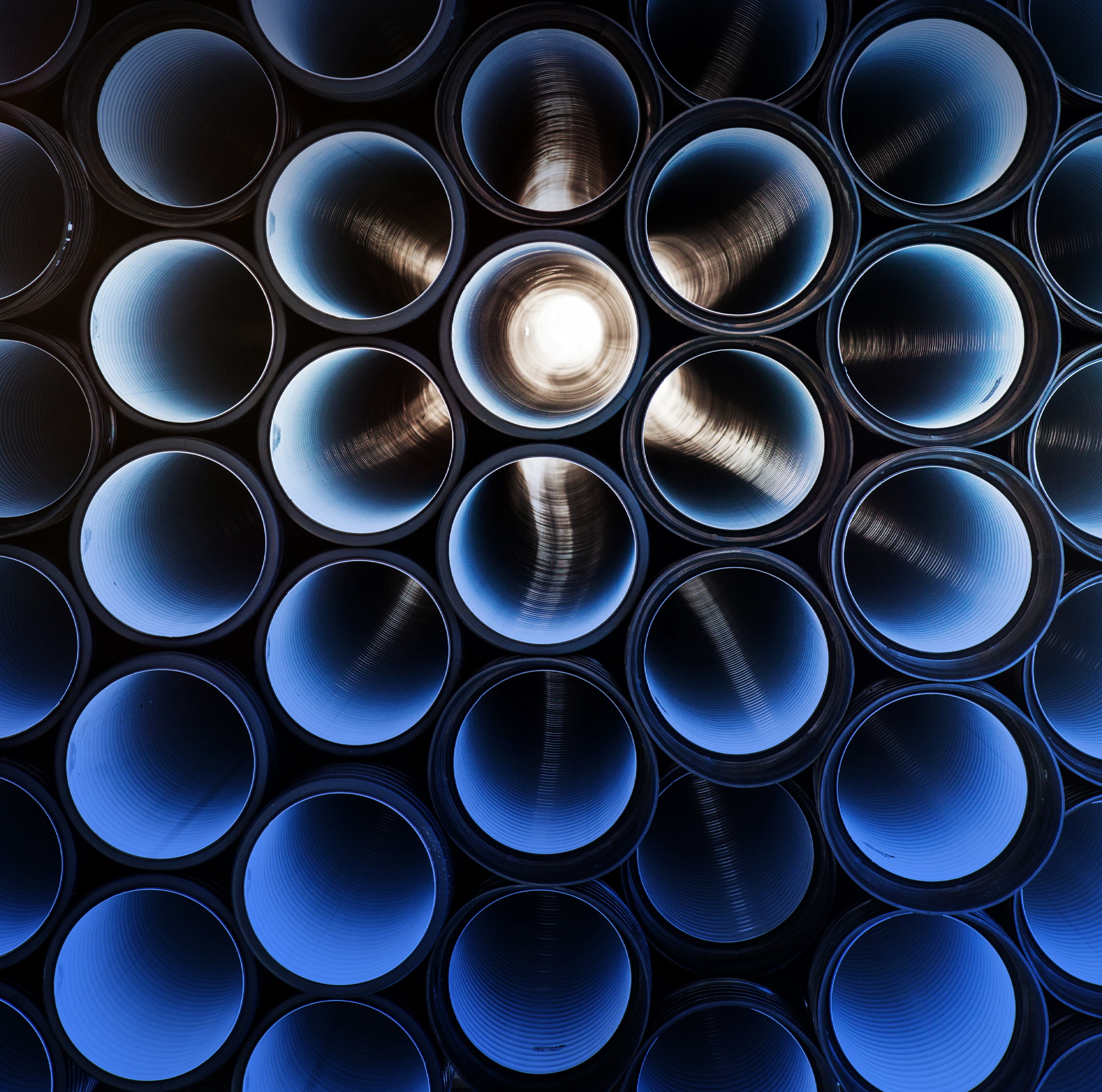
In collaboration with Acea and University of Cambridge

Bridging the €6.5 Trillion Water Infrastructure Gap: A Playbook

INSIGHT REPORT

DECEMBER 2025



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Forewords

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Water is increasingly recognized as a strategic driver of economic growth, security and employment. Yet, current investments and actions fall far short of what is needed, and poor water management remains one of the greatest sources of global inequality.

New evaluations of the benefits of closing the infrastructure gap and the positive socio-economic impacts of water investment presented in this paper are crucial to spur action. This paper shows that water infrastructure yields socio-economic returns significantly superior to those of comparable infrastructure sectors, including energy and digital technology. The message is clear: investing in water is not merely a social obligation, but a high-multiplier economic strategy with long-term dividends for growth, stability and competitiveness.

Besides the research done for this paper, progress in water science is accelerating. Advances in hydrology, freshwater ecology and data modelling now allow us to better understand how freshwater ecosystems function and to measure the benefits they provide to society. These advances strengthen our ability to assess human impacts on freshwater ecosystems across all scales and support more credible valuations of natural capital, thereby encouraging stronger action to protect and conserve water resources, especially for vulnerable communities. Rethinking the management of water resources is key to achieving global equity and inclusion.

Connecting billions to safe water and wastewater networks will demand substantial investment in new infrastructure, and a whole new attitude towards water from governments, industry and citizens. Education and behavioural change programmes can foster this culture of water resilience, a moral and economic imperative that will define our collective future.

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The urgency of addressing the global water challenge has been repeatedly highlighted by leading institutions and thought leaders, including the World Bank Group, the Global Commission on the Economics of Water and the Organisation for Economic Co-operation and Development (OECD). Recognizing the scale and implications of this challenge, the World Economic Forum is acting both to advance global water security and resilience through its multistakeholder community, and to elevate the collective voice of the water industry to foster stronger collaboration and reduce fragmentation.

This paper specifically amplifies the voice of the water industry within the Forum and seeks to expand the global conversation on water. Beyond the imperative of ensuring safe water and sanitation for all, it calls on the sector to look further by accelerating infrastructure resilience, circularity and innovation. The research focuses on civil and industrial water systems, excluding agriculture, though its challenges can often be eased through reuse solutions analysed in this work. The estimated financing gap amounts to €6.5 trillion: closing it could unlock €8.4 trillion in additional GDP while supporting more than 206 million jobs worldwide.

This report provides a strategic playbook of best practices, amplifying the voice of the water industry within the World Economic Forum and highlighting how collaboration across finance, policy, technology, and culture can accelerate progress. It presents 27 proven investment cases and enabling frameworks that show how meaningful progress is already being achieved across countries and sectors. Fundamentally, it aims to inspire adaptation and replication in scaling what already works. What is needed now is the determination to scale.

The overarching message is clear: collaboration across the water sector is essential. Policymakers can unlock investment through clear strategies, effective regulation and improved governance. Industry leaders can embed efficiency and circularity into their operations, mainly as a matter of continuity and long-term competitiveness. Financiers can deploy targeted instruments to scale impact and attract private capital.

Executive summary

Coordinated action across government, industry and finance is needed to close a €6.5 trillion water infrastructure gap.

Water infrastructure lies at the centre of the world's economic and climate resilience. To deliver equitable, resilient, sustainable and technologically advanced drinking water and sanitation systems for all, **global spending will need to double by 2040**. The total investment required amounts to **€11.4 trillion ($13.2 trillion)**, revealing a financing gap of about **€6.5 trillion** compared with current trajectories. Bridging this gap could generate **€8.4 trillion in additional GDP** and support more than **206 million full-time jobs worldwide by 2040**, equivalent to 14 million jobs each year.

The investment gap is determined by four structural drivers of demand that together define the transformation agenda for the global water sector. One, **equitable access,** the imperative to extend safe and affordable water to more than 2 billion people and sanitation to over 3 billion who still lack basic access. Two, **infrastructure resilience**, focused on modernizing ageing and inefficient assets that globally lose about 30% of distributed water and strengthening infrastructure to protect nearly 4 billion people from climate-related shocks. Three, **circularity**, advancing energy efficiency, pollution control, and, more importantly, water reuse, which today accounts for only 12% of global freshwater withdrawals. Finally, **innovation** to close the innovation gap by deploying digital tools, automation and artificial intelligence.

Circularity and innovation hold the key to transforming water systems from linear to circular, in which every drop is reused, every discharge repurposed, and resilience becomes inherent to the way the sector creates equitable access. Encouraging examples from **leading corporations and countries** presented in this paper demonstrate that progress is both possible and replicable. The challenge is therefore not invention but scaling, sharing best practices, raising awareness about them and adapting them to local realities.

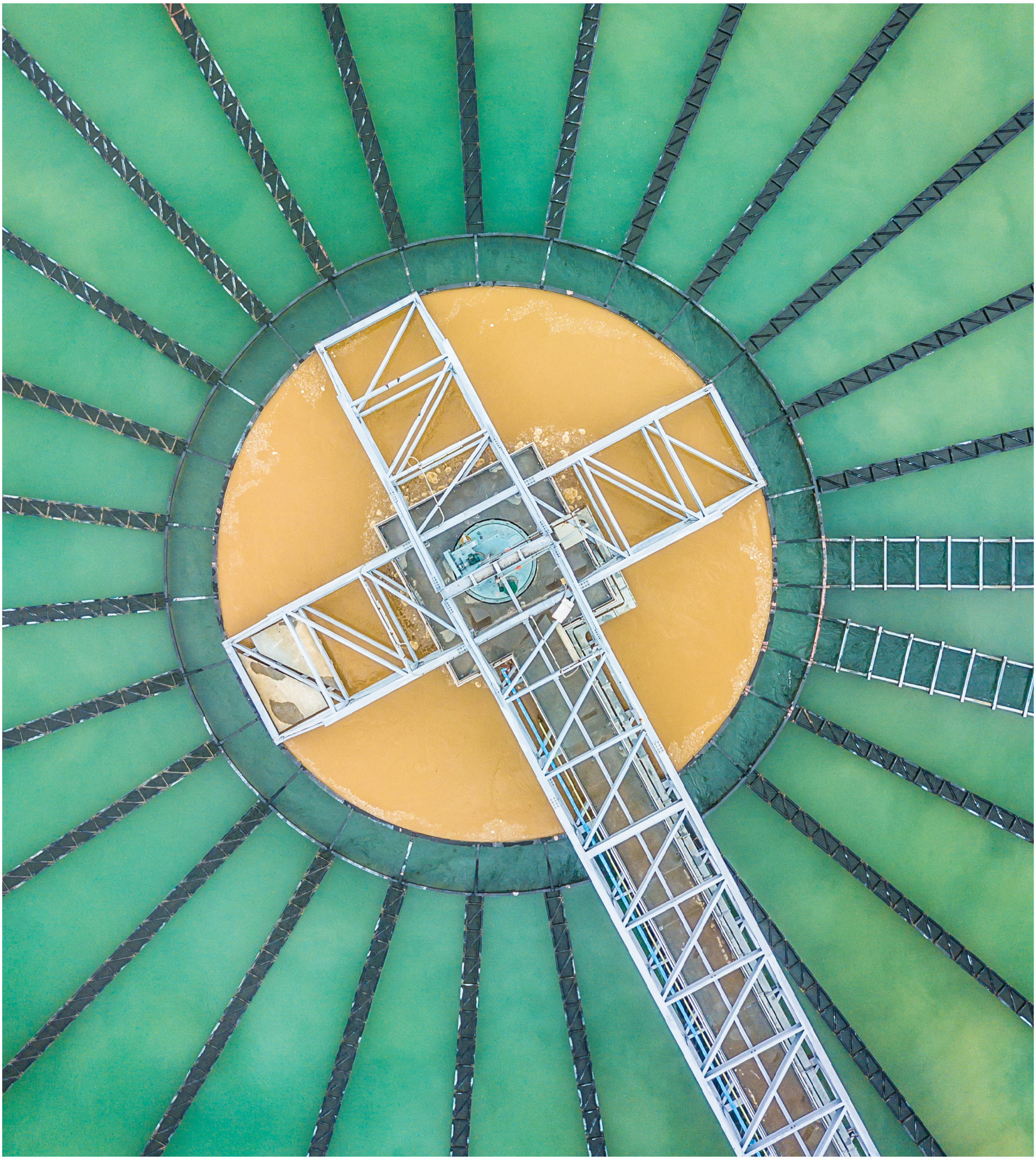
Delivering resilient and investable water systems will depend on four enablers that act in concert rather than sequence. **Policy reform** should establish coherent national water strategies, align tariffs with the real cost of service and improve coordination and data transparency to reduce water usage, improve efficiency of use and boost reuse, as well as bankability. **Financial innovation**, through instruments such as blue bonds, blended finance, and performance-based public-private partnership (PPP) and regulated asset base (RAB) models, can mobilize private capital when supported by public guarantees and development finance. **Technology adoption** should focus on creating a stimulating environment to accelerate research and development and venture capital investement, while ensuring that proven solutions are implemented and scaled without delay. Finally, **cultural transformation** is essential: building a culture of water stewardship through education and professional training ensures long-term behavioural change and societal engagement. These enablers are not ends in themselves; they form the **toolkit** that allows governments, investors and industry leaders to translate ambition into execution.

Closing the **global water infrastructure gap** is achievable, but it **requires coordination and leadership**. Governments should position water as a strategic asset in national priorities, creating predictable frameworks, boosting efficiency and reuse, and deploying strategic public capital or guarantees to attract private investment. Industry leaders should pursue operational excellence, circularity and measurable outcomes that enhance project bankability, while financiers can expand the use of innovative instruments and consider treating water as a separate asset class to channel capital towards.

This paper does not offer a single prescription, but rather **a menu of proven best practices** – adaptable, replicable and ready to scale. With coherent policy, innovative finance and technology deployed through partnership, water can evolve from a constraint into a catalyst for sustainable growth, infrastructure resilience and equitable access. The tools are available; what is needed now is decisive and collective action to deploy them at scale.

1 The €11.4 trillion water investment opportunity

Closing the global water infrastructure gap can generate €8.4 trillion in gross value added and 206 million new jobs.

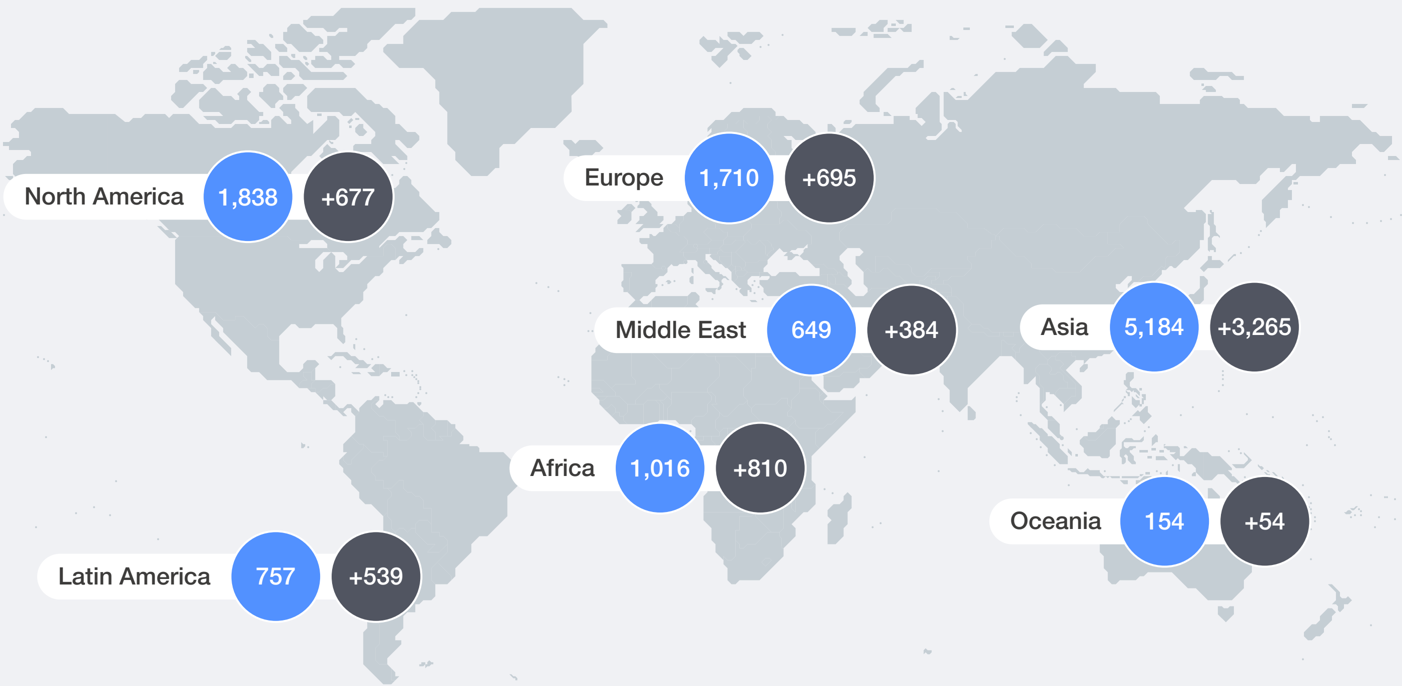


1.1 The size of the global water infrastructure gap

The global water infrastructure challenge, though unprecedented in scale, offers a unique opportunity for society to expand, modernize and make water systems more sustainable and innovative. Yet fragmentation, persistent underfunding, limited coordination and low efficiency continue to slow progress. Closing this gap would deliver wide benefits to everyone: citizens could gain more reliable and equitable services; governments could strengthen resilience and growth; financiers could access new sustainable investments; and the water industry could enhance its performance and competitiveness.

Seizing these investment opportunities to expand, upgrade, make more sustainable and innovate water infrastructure by 2040 will require an estimated **€11.4 trillion in cumulative investments**. This figure reveals a **financing gap of approximately €6.5 trillion** when compared to current spending, reflecting an ambitious scenario in which a range of water infrastructure investments are pursued to realize multiple economic, social and environmental benefits.

FIGURE 1 **Global value of water infrastructure gap**



To close the investment gap, the world needs:

€6.5 trillion more than current spending

€11.4 trillion in total investment

Investment need | Investment gap

Source: Acea Research & Studies analysis

To bridge this gap by 2040, annual investments would need to grow by an additional €431 billion per year, representing an increase of around €54 per capita.

Currently, global investment in water infrastructure amounts to roughly €326 billion per year, equivalent to just €41 per capita. To bridge this gap by 2040, annual investments would need to grow by an additional €431 billion per year, representing an increase of around €54 per capita. This implies that the required future spending must reach approximately €757 billion annually, or €94 per capita, equivalent to slightly less than 1% of global GDP in 2025.

The composition of global water infrastructure needs reveals important insights into the nature of the challenge. **Nearly half** of the total requirement, about **€5.3 trillion,** is tied to the **expansion of new infrastructure,** corresponding to €352 billion per year, largely reflecting the scale of the infrastructure access gap in low- and middle-income regions.

A further **€4.8 trillion**, or **40% of the global total**, is allocated to **infrastructure renewal**. These expenditures, amounting to approximately €323 billion per year, are directed towards revamping existing infrastructure, mostly in middle- and high-income regions, to improve efficiency and climate resilience.

Sustainability-focused investments, designed to scale up water reuse and circularity, account for another **10% of the overall need**, or about **€1 trillion**, translating to an annual requirement of €65 billion. Finally, about **€300 billion** is directed towards **innovation**, encompassing advanced technologies such as robotics and artificial intelligence (AI). While representing a smaller share of total expenditure, these investments are less capital-intensive yet expected to deliver disproportionately high returns in terms of efficiency gains.

When disaggregated along the value chain, **midstream** infrastructure dominates the picture, absorbing roughly **€6.2 trillion**, or **55% of the global need**. This figure is largely driven by the substantial investments required to extend and upgrade networks to connect populations to safe water and wastewater services. **Upstream** investments represent about **€3 trillion**, or **25% of the need**, reflecting the urgency of securing safe water sources for all. The **downstream** stage accounts for the **remaining 20%**, or **€2.2 trillion**, required to expand and modernize treatment facilities to enable water reuse and to reduce pollution.

The distribution of investment needs is not uniform across regions. **Asia** accounts for the largest share, with an estimated **€5.2 trillion**, equivalent to **46%** of the global requirement. Providing access to basic water and wastewater infrastructure drives much of the investment need, while water stress is pushing many countries to actively engage in reuse activities, requiring substantial investments to upgrade wastewater treatment plants and build dedicated networks.

Europe and **North America** together demand substantial resources, requiring **€1.7** and **€1.8 trillion**, respectively, or about **30% of the global gap**. In both regions, the dominant need lies in modernizing ageing systems to enhance efficiency and ensure long-term infrastructure resilience, alongside a strong push to upgrade wastewater treatment plants and address emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) in drinking water.

Africa and the Middle East contribute close to **€1 trillion**, representing **around 15% of the global total**. In Africa and lower-income Middle Eastern countries, more than two-thirds of resources are expected to be directed towards the expansion of new infrastructure, reflecting the urgent imperative to close persistent access gaps. This investment also offers the chance to adopt innovative technologies from the outset, rather than relying solely on traditional systems, potentially achieving faster and more efficient improvements.

BOX 1

Methodology

Purpose and scope: This white paper quantifies the global water infrastructure gap in the 2025-2040 timeframe. The analysis focuses on utility-managed infrastructure; and domestic, municipal and industrial water and wastewater systems. It excludes agriculture and privately managed assets, whose financing and governance structures differ substantially.

Analytical approach: The gap is defined as the difference between the investment needs projected to meet 2040 targets and the baseline spending under current policy trajectories.

Data and coverage: The model covers 100 representative countries across seven regions – Europe, North America, Latin America, the Middle East, Africa, Asia and Oceania. Data sources include Global Water Intelligence (GWI) databases and a series of expert interviews with utilities, regulators and financiers.

Investment gap closing goals: Investment needs are structured around four key goals that align with the sector's long-term transformation agenda: (1) achieving universal access to safe drinking water and basic sanitation for all; (2) revamping ageing assets at optimal replacement rates and reducing leakages to acceptable levels; (3) achieving high water reuse rates; and (4) deploying smart and advanced technologies across assets and networks in urban areas.

These drivers are applied across the upstream (water sourcing and treatment), midstream (water distribution and wastewater collection) and downstream (wastewater treatment and reuse) stages of the value chain.

By contrast, the Gulf countries are set to play a very different role, with investment strategies centred on water reuse and tech-enabled infrastructure development, reflecting ambitious targets established by local governments to advance circularity and secure long-term water resilience in one of the world's most water-scarce regions.

In **Latin America**, the bulk of the **€757 billion** investment needs are directed towards improving basic sanitation conditions and expanding access to reliable water supply. A central investment priority for utilities across the region is the reduction of non-revenue water – water distributed by a utility but lost before it can be billed to the customer, which averages around 40%, one of the highest levels globally.

Oceania accounts for a relatively small share of global investment needs, around **€154 billion**, or **1% of the total**, with heterogenous priorities, reflecting different levels of development and infrastructure coverage. Investments are projected to focus heavily on circularity and infrastructure resilience.

BOX 2

Socio-economic impact assessment methodology

Purpose and scope: This white paper quantifies the socio-economic benefits of global water infrastructure investment over the 2025-2040 period.

Data and coverage: The analysis draws on OECD Inter-Country Input-Output (ICIO) tables, macroeconomic datasets, literature review and expert consultations. These sources were harmonized to build a global input-output model representing around 100 countries, covering between 60% and 90% of global GDP across major regions.

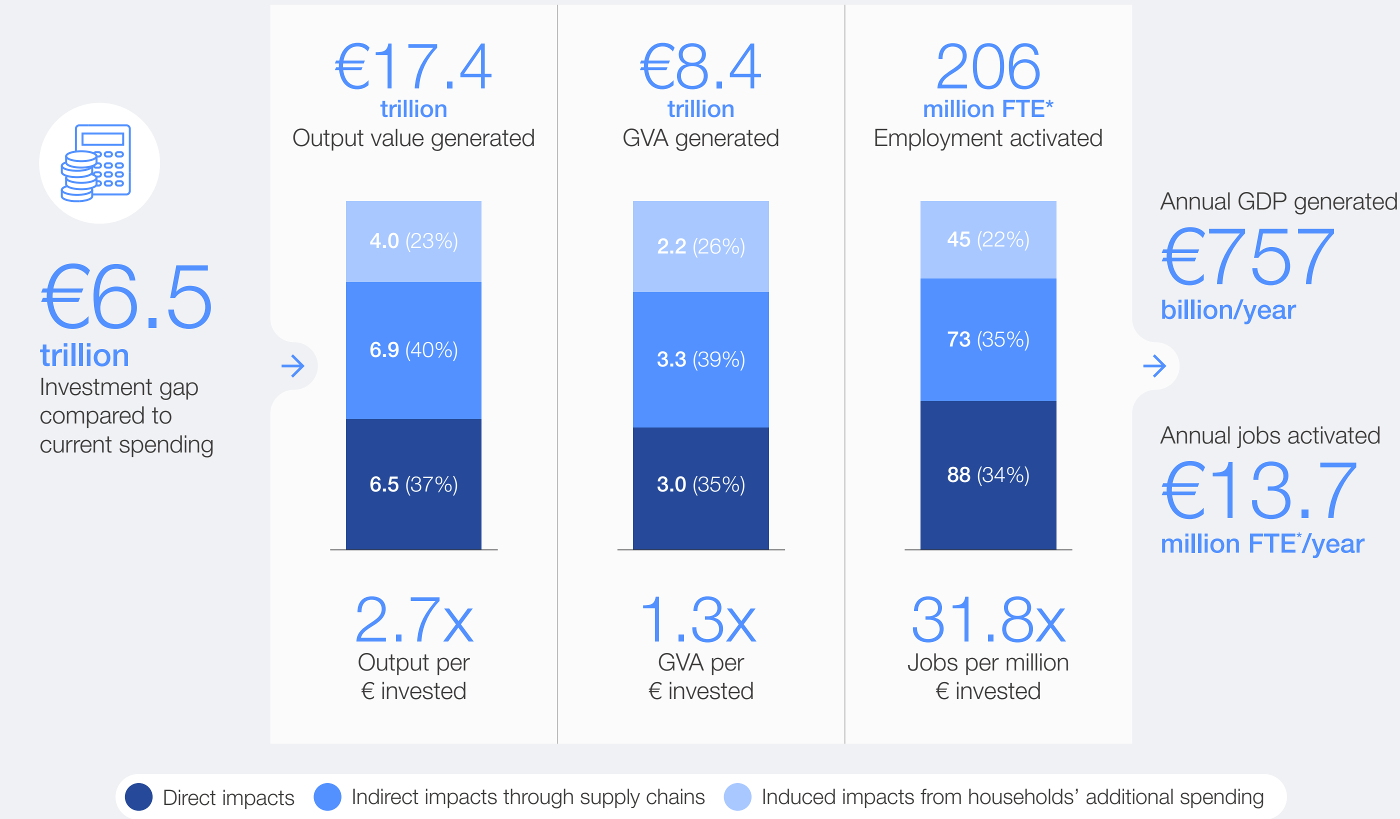
Analytical approach: The model applies country-specific input-output multipliers to the investment needs identified in the study, estimating the effects of water infrastructure spending on economic output, gross value added (GVA) and employment. It captures direct, indirect and induced impacts across the value chain and distinguishes a total of eight archetypes of intervention (renewal and new development of: water networks, wastewater networks, water treatment plants and wastewater treatment plants), covering all the main profiles of water sector investment.

Economic outputs: The model quantifies socio-economic returns, showing that every euro invested in water infrastructure generates direct, indirect and induced impacts on: (1) economic output; (2) gross value added (GVA); and (3) full-time jobs.

1.2 Socio-economic impact assessment

Closing the €6.5 trillion global water infrastructure investment gap by 2040 would generate profound socio-economic benefits. Insights from a socio-economic impact model developed for this paper indicate that such an effort could enable **€17.4 trillion in additional economic output, €8.4 trillion in gross value added (GVA)**, a proxy for GDP, and support the creation of more than **206 million full-time jobs worldwide by 2040**. Annually, these figures translate into the creation of about 14 million new jobs, equal to an additional 1% to the global workforce.

FIGURE 2 **Socio-economic impacts of the global water infrastructure gap**



Source: Acea Research & Studies analysis on OECD's ICIO tables. *Full-time equivalent

The results highlight the scale of the multiplier effects that can be gained from investment in water infrastructure. Globally, the socio-economic multiplier of considered investments is estimated at **2.7 in terms of output**, of which **1.3 is captured as GDP**. In practical terms, this means that every euro invested in closing the water infrastructure gap generates €2.70 of economic activity, including €1.30 of GDP. The employment effect is equally significant: for **every €1 billion** invested in water infrastructure, approximately **32,000 full-time jobs** are created.

These high multipliers can be explained by considering the pervasive nature of the sector's supply chains. Water infrastructure projects draw on, and benefit, a wide range of industries, from construction and engineering to manufacturing, digital technologies and professional services, creating extensive indirect and induced effects across the economy.

Even as a stand-alone sector, thus including operational expenditure (opex) as well as capital expenditure (capex), the water infrastructure investment multipliers can deliver superior socio-economic returns in comparison to those of other infrastructure sectors. In fact, water tops the rankings of economic and GDP multipliers, respectively equal to 2.3 and 1.2 per dollar invested, above energy (2.2x), transport (2.2x) and telecommunications (2.07x). In terms of employment generation per million euro of capital expenditure, water (24.7x) is second only to transport (25.2x), and superior to telecommunications (16.7x) and energy (11.7x).

FIGURE 3 **Socio-economic multipliers of stand-alone Infrastructure sectors**

Stand-alone sectors[1] / Socio-economic returns	Economic multiplier (output/€)	GDP multiplier (gross value added/€)	Employment multiplier (jobs/€ million)
Water	2.3x	1.2x	24.7x
Energy	2.2x	1.0x	11.7x
ICT[2]	2.1x	1.1x	16.7x
Transport	2.2x	1.1x	25.2x

Source: Acea Research & Studies analysis based on OECD's ICIO tables

Note: [1] "Water" sector: NACE code E (Water supply; sewerage, waste management and remediation activities). "Telecommunications" sector: NACE code J61 (Telecommunication); "Energy" sector: NACE code D (Electricity, gas, steam and air conditioning supply); "Transport" sector: NACE code H49 (Land transport and transport via pipelines). [2] Information and communications technology

Beyond these conventional channels, complementary socio-economic and environmental factors add to the upside potential of water infrastructure investments. Improved access to safe water and sanitation reduces the time and energy households spend collecting water, particularly in underserved regions, thereby freeing up hours for work, education and economic participation, especially for women and girls. At the same time, healthier populations benefit from lower morbidity and mortality linked to waterborne diseases, enabling individuals to contribute more consistently and productively to the economy. Sustainably managed water infrastructure also enhances ecosystems, for example by reducing pollutant loads in rivers, in turn supporting biodiversity and nature's ability to provide goods and services that economies and societies rely on.

2

Drivers of investment demand

Access, resilience, circularity and innovation will define the future of the global water industry, guiding investment and policy priorities.

Growing demand, climate change, technology acceleration and the energy transition are reshaping the water sector. World population is expected to reach 9.8 billion by 2050,[1] and per capita water availability has already dropped by more than 60% since the 1960s.[2] Industrial demand is also projected to surge, with new digital infrastructure, such as data centres, introducing a new source of water consumption.

Inspired by a series of workshops and interviews with key water industry partners at the World Economic Forum, and drawing on significant literature review, this chapter outlines **four interconnected drivers** that will define the future of the global water industry and should guide investment and policy priorities:

1. **Equitable access**: Expanding connection to safe drinking water and sanitation for all, particularly in underserved regions.

2. **Infrastructure resilience**: Upgrading ageing assets and building operational capacity for water infrastructure systems to function and meet users' needs during and after a shock.

3. **Circularity and resource recovery**: Deploying efficient and sustainable solutions that advance circularity, reuse and resource recovery from water, wastewater and sludge.

4. **Innovation for efficiency**: Adopting smart water technologies (water-tech) to build up asset health, optimize operations and improve resource management, reducing withdrawals and advancing reuse.

These four drivers do not operate in isolation, but reinforce one another. The integration of circularity and innovation has the potential to transform the entire water value chain from a linear process of withdrawal and disposal into a closed-loop system that captures, reuses and regenerates resources. This shift is the foundation of true infrastructure resilience and equitable access, ensuring that every community and every ecosystem can thrive within the limits of available water. Failing to seize this opportunity risks undermining human and environmental health as well as economic development and stability.

FIGURE 4 **Water sector transformation drivers**

Mission	Investment need (trillion euros)	Interventions	Best practices
1. Equitable Access	5.3	1.1 Give global access to affordable and reliable safe drinking water	Green desalination, urban wastewater reuse, rainwater harvesting
		1.2 Give global access to basic wastewater and sanitation	Centralized systems for urban areas, Skid/decentralized systems for rural areas
2. Infrastructure resilience	4.8	2.1 Reduce water leakages	District metering, pressure management, AI-powered leakage detection
		2.2 Revamp ageing infrastructure	Advanced materials in water pipelines
		2.3 Increase resilience to floods and droughts	Grey infrastructure, nature-based solutions, climate forecasting
3. Circularity and resource recovery	1.0	3.1 Scale wastewater reuse	Industrial reuse facilities, closed-loop systems, rainwater harvesting
		3.2 Improve asset's energy efficiency and resource recovery	Microgrids, sludge's biogas recovery, energy efficient smart technologies
		3.3 Accelerate advanced water treatment for micropollutants	PFAS destruction technologies
4. Innovation	0.3	4.1 Deploy smart technologies	SCADA[1] and IoT[2] monitoring, digital twins, remote sensing
		4.2 Scale water-tech solutions	No-dig repair and trenchless technologies, unmanned robots

Note: [1] Supervisory control and data acquisition, a system comprising hardware and software for the remote monitoring and control of industrial processes
[2] Internet of things

2.1 Equitable access

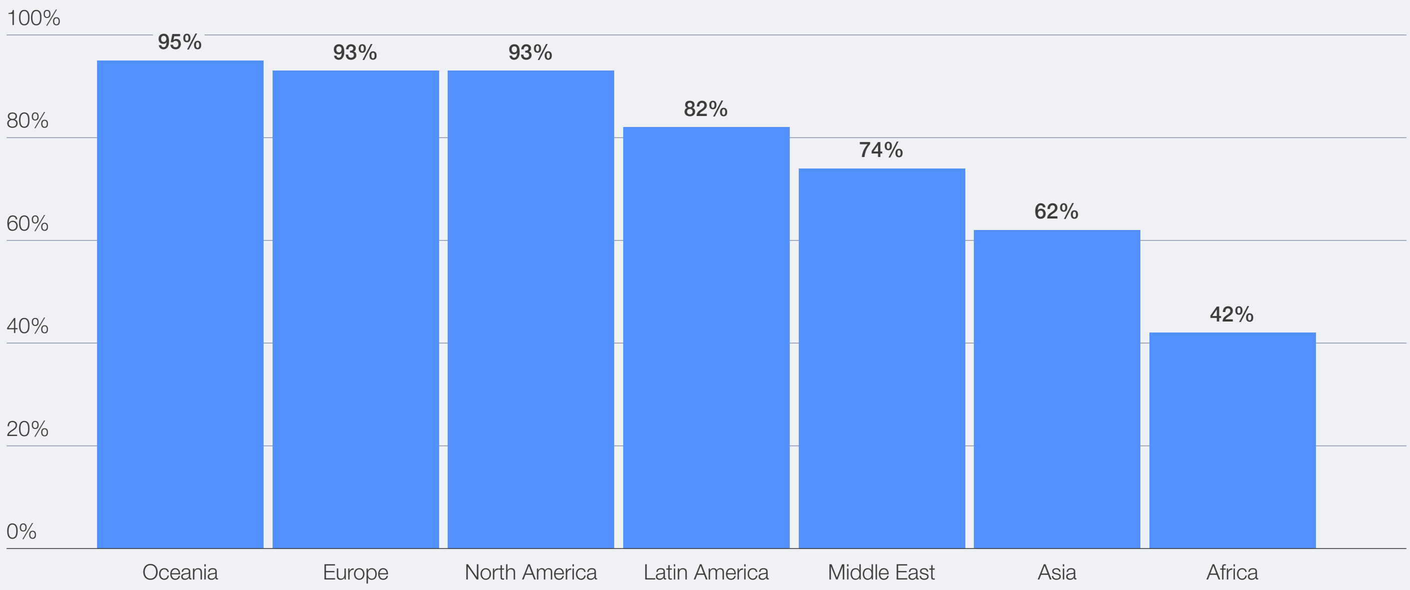
Ensuring universal access to safe and affordable drinking water and sanitation is not only a fundamental human right and a key target under the Sustainable Development Goals, but also a catalyst for socio-economic growth. In low-income countries with improved access to water and sanitation services, GDP grew at an annual rate of 3.7%, compared to just 0.1% in countries lacking such access.[3] Conversely, inadequate water supply and sanitation have severe economic and public health consequences, with global losses estimated at €225 billion annually.[4]

The investment required to meet this challenge is substantial. By 2040, an estimated **€5.3 trillion will need to be invested to expand water and sanitation systems worldwide**. The challenge is particularly acute in low-income regions, where deficits in both water and wastewater infrastructure limit service, exacerbate water stress and hinder social and economic development.

Provide global access to affordable and reliable safe drinking water

A large portion of the global population continues to lack access to safely managed drinking water, with the problem most acute in low-income countries. Around 26% of the world's population, equivalent to 2.2 billion people, still lacks access to safely managed drinking water, including 106 million who rely directly on untreated surface sources.[5] Regional disparities are striking: only 42% of the population in Africa and 62% in Asia has access to such services, compared with 93% in the developed countries.[6]

FIGURE 5 **Percentage of total population with access to safely managed drinking water supply**



Source: Global Water Intelligence

Meeting these needs requires not only expanding supply and conveyance infrastructure but also safeguarding natural freshwater sources such as watersheds. Circular water solutions, including water reuse and rainwater harvesting (RWH), are becoming essential to ensure reliable and sustainable supply for potable purposes. By turning wastewater and rainfall into new resources, these approaches close the water loop, preserve freshwater ecosystems and reduce reliance on overexploited groundwater. Pioneering examples such as Windhoek in Namibia and Singapore's NEWater programme demonstrate the potential of large-scale reuse to secure urban water supplies in both arid and high-density contexts.

Renewable energy-powered desalination can also play a role, particularly in arid regions. Green desalination relies on on-site renewable energy production to power operations, applies advanced brine management to protect marine ecosystems and uses next-generation reverse osmosis and other efficient technologies that cut energy use by up to 85% compared to older systems.[7]

CASE STUDY 1

Acciona – Casablanca Green Desalination Plant, Morocco

A large-scale example of renewable-powered desalination is underway in **Morocco**, where **Acciona**, in partnership with **Green of Africa** and **AfriquiaGaz**, is developing the **€600 million Casablanca Green Desalination Plant**. The facility is powered entirely by renewable wind energy through a long-term **power purchase agreement** (PPA), with half of the output from the 360 megawatt (MW) Bir Anzarane wind farm dedicated to the plant.

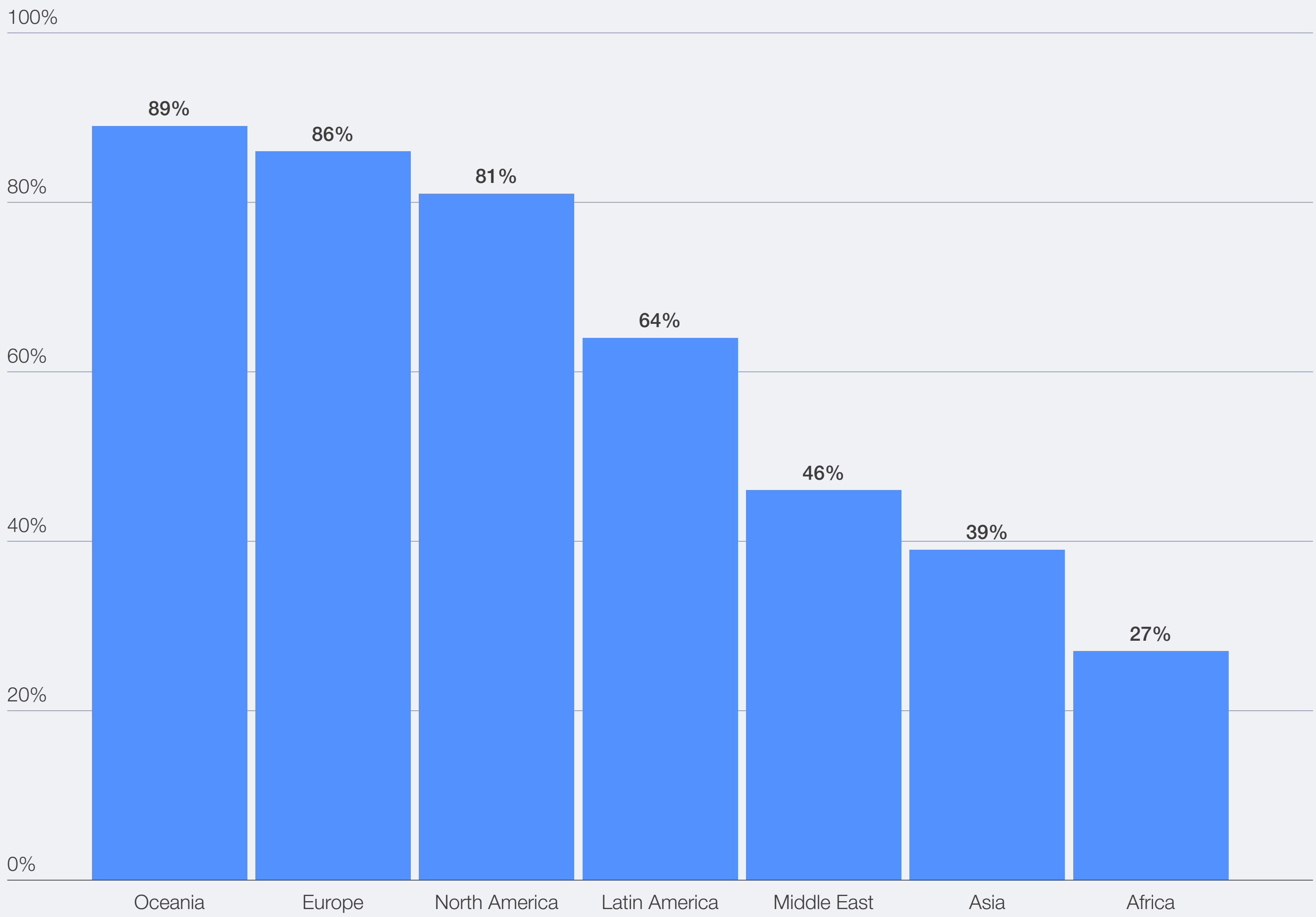
Designed to produce 300 million cubic meters (m^3) of water annually, it will supply **safe drinking water to 7.5 million people** and irrigation for agriculture, while avoiding the carbon emissions of conventional desalination. Economies of scale allow **water production at costs as low as $0.40/m³**.

Provide global access to basic wastewater and sanitation

Similarly, in most countries, sanitation and wastewater infrastructure remain underdeveloped or entirely absent. Over 40% of the global population, around 3.4 billion people, lack access to basic sanitation services and 1.7 billion people still do not have basic hygiene services at home.[8]

Access to sanitation is very low across Africa and Asia, with only 27% and 39% of the population having safe access, respectively. This is starkly lower than the 86% and 81% observed in Europe and North America, respectively.

FIGURE 6 **Percentage of total population connected to sewerage**



Source: Global Water Intelligence

Expanding wastewater collection, treatment and reuse infrastructure is integral to closing the existing gap and achieving universal access. However, solutions must be context-specific. In urban areas, centralized systems remain the most effective strategy. Centrally managed plants unlock economies of scale, enable advanced treatment technologies and integrate energy and resource recovery – capabilities that are often unfeasible in smaller systems.

In cities, capital costs per person fall from about $1,000 at 2,500 populations equivalent (PE) to less than $250 at 200,000 PE for centralized plants.[9] By contrast, rural and peri-urban areas might benefit more from decentralized, modular treatment units, which are flexible, scalable and locally managed. Decentralized systems can reduce expenditures by 40-45% compared to centralized facilities by cutting pumping, conveyance and other sunk costs.[10]

CASE STUDY 2

Veolia – Windhoek Water Reclamation Plant, Namibia

Windhoek, the capital of Namibia, lies in a desert area with only 250 mm of annual rainfall and extreme evaporation, as only 1% of rainwater filters down into the groundwater. As the city grew rapidly despite strict water controls, the authorities faced the dual challenge of securing water supply and improving wastewater treatment capacity.

In 2002, the government partnered with **Veolia** to design, build and operate the Goreangab Water Reclamation Plant, which treats and converts effluents from the older wastewater treatment plant. The advanced multi-barrier process combines physical and chemical treatments with continuous monitoring, **significantly enhancing wastewater treatment and transforming effluents into safe drinking water**. Producing **21,000 m^3 per day**, the plant meets about **30% of the needs of the city's 400,000 residents** and has strengthened the city's overall water security.

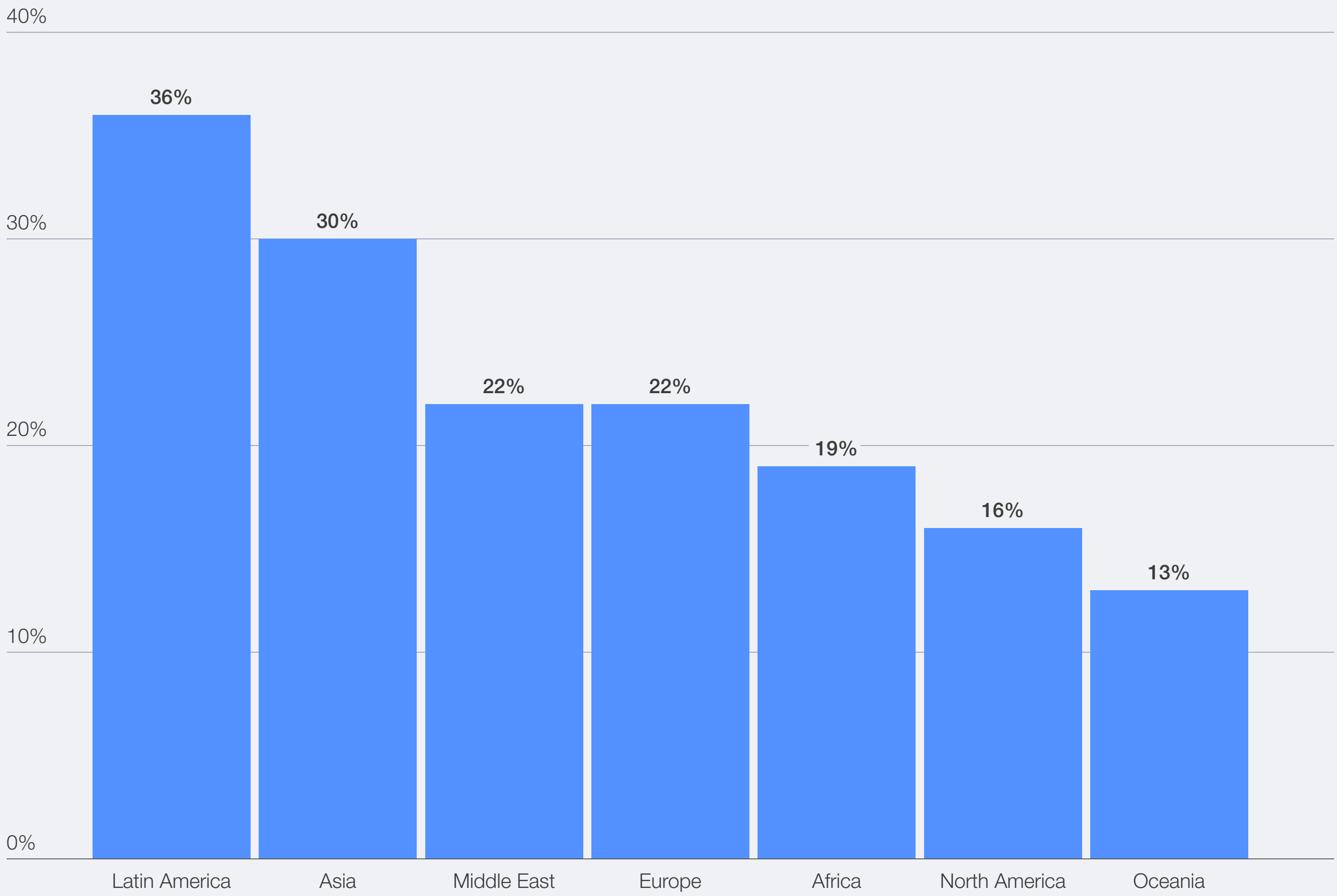
2.2 Infrastructure resilience

By 2040, an estimated **€4.8 trillion** will need to be invested to renew water infrastructure, with the aim of strengthening infrastructure resilience and addressing climate-related risks. Priority investments will focus on three critical areas: reducing water losses to improve efficiency and reliability, replacing and modernizing ageing networks to ensure continuity of service and enhancing resilience to floods and droughts.

Reduce water leakages

Water losses within distribution networks represent a critical vulnerability for the entire sector. Globally, around 30% of water is lost before reaching consumers.[11] Lost water, classified as non-revenue water (NRW), arises from leaks, unauthorized use and metering inaccuracies. Outdated infrastructure and limited maintenance exacerbate these losses, straining utilities already under pressure from rising demand and declining water availability.

FIGURE 7 **Percentage of water lost in the distribution network (non-revenue water*)**



* Water that is pumped and then lost or unaccounted for before reaching the consumer

Source: Global Water Intelligence

One of the most effective strategies is segmenting the distribution network into district metered areas (DMAs), creating smaller zones where flow and pressure can be closely monitored and controlled. Through a combination of smart sensors and meters coupled with advanced technologies, such as analytics and digital twins, DMA enables utilities to respond to leaks in real time. Depending on local conditions, leakage reductions achieved through DMAs can range from 26 to 59%.[12] Importantly, such innovative approaches can deliver major efficiency gains without the need for large-scale pipe replacement, extending asset life while cutting costs and losses.

CASE STUDY 3

Acea – District metering areas in Rome

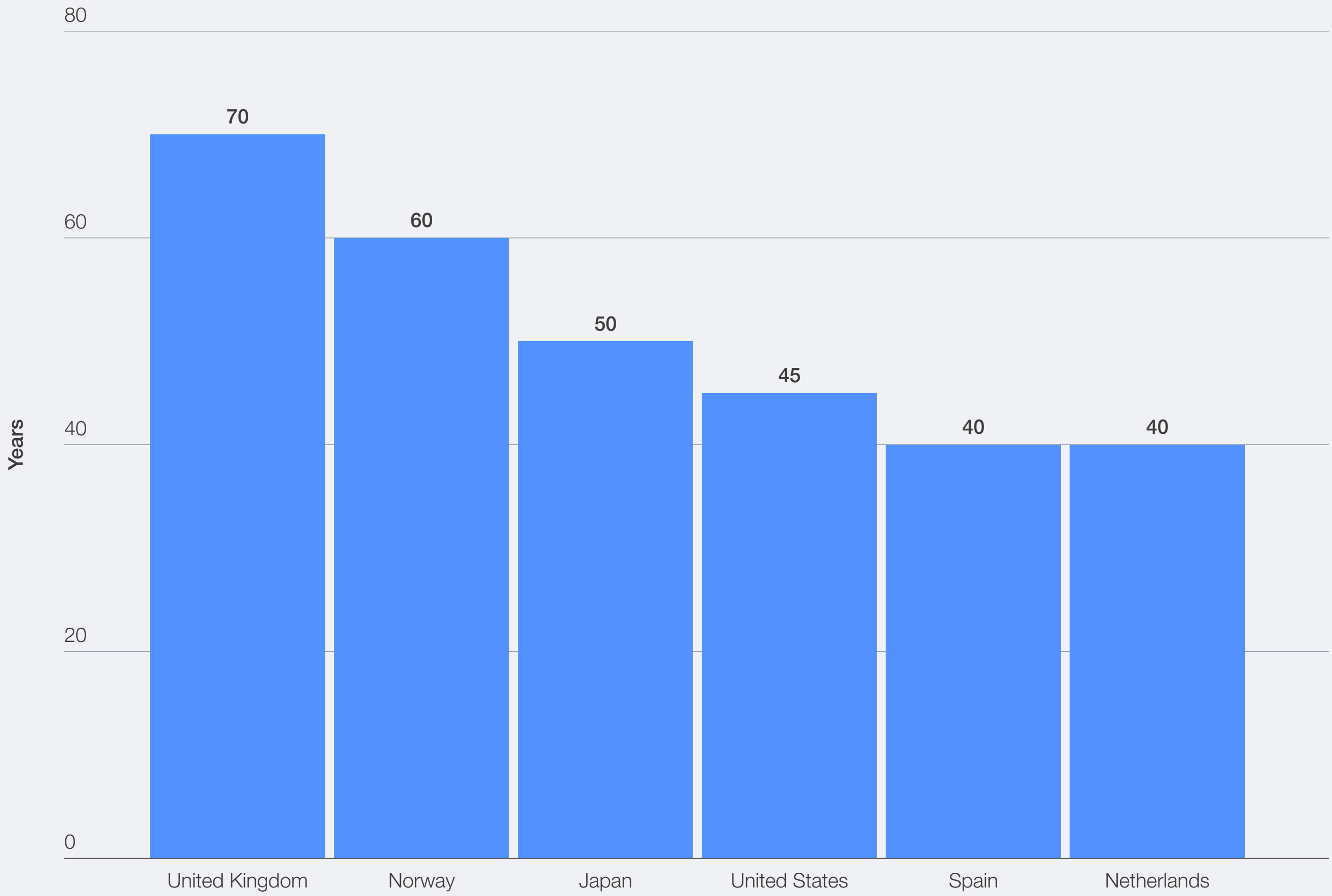
Acea Ato2, part of the Acea Group, the water utility serving Rome, Italy, operates a 17,000 km network where ageing infrastructure and difficult topography had pushed losses to nearly 50% of production. Climate change has reduced availability by up to 20%, while European Union (EU) regulations now impose stricter limits on water losses.

To respond, Acea launched an **€850 million programme** to segment the network into more than **790 DMAs**, covering 80% of the system, deploying smart sensors and valves coupled with a water management system to predict leaks and optimize pressure. Since 2017, water losses have fallen by 10%, saving 80 million m^3 of non-revenue water while expanding service to 150,000 new residents.

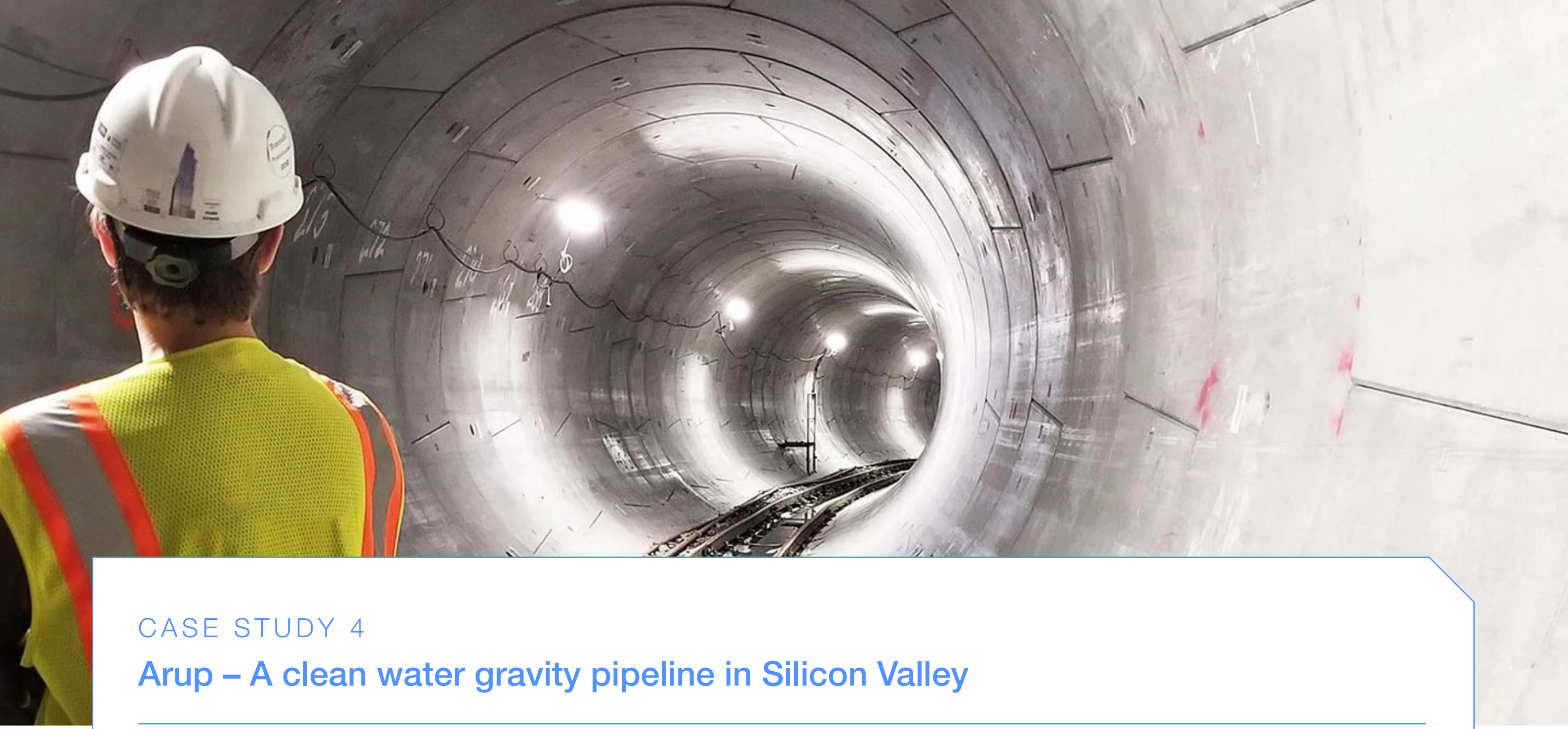
Revamp ageing infrastructure

Much of the world's water distribution infrastructure now exceeds its optimal design life, reflecting decades of deferred investment in network renewal and modernization, and resulting in higher risk of breakdown and service disruption. In the United Kingdom (UK), for instance, the average pipeline age reaches 70 years, while in Europe it ranges from 40 to 60 years, and in the United States (US), 45 years.[13] Additionally, renewal rates remain far below what is considered sustainable: in Europe, the average annual renewal rate is only 0.6%, while in the US, it is about 1%. However, a renewal rate of around 2% is generally deemed appropriate for OECD countries, with at least 1% necessary to maintain system integrity over time.[14]

FIGURE 8 **Average age of water networks for select high-income countries**



Source: Global Water Intelligence



CASE STUDY 4

Arup – A clean water gravity pipeline in Silicon Valley

Silicon Valley Clean Water (SVCW) manages a wastewater network and treatment plant serving approximately 220,000 population equivalent (PE) and several global information technology (IT) industry companies in a coastal zone of the San Francisco Bay Area (California, USA), an earthquake-prone region. Facing increasing volumes to treat, in 2017, SVCW approved RESCU, a $580 million programme[15] to upgrade its 50-year-old infrastructure to increase its capacity from 272 million litres to 380 million litres.

A key component of the project ($253 million) was the replacement of a 5.3-km gravity pipeline that had surpassed its design life.[16] **Arup**, in association with local and international contractors, designed and constructed a new 4-metre-wide concrete tunnel housing a 3-metre-wide fibreglass-reinforced polymer mortar pipeline. Engineered for a 100-year lifespan, roughly twice the age of the original infrastructure, the new main is designed to withstand earthquakes and extreme weather conditions.[17]

Increase resilience to floods and droughts

Increasingly frequent and severe hydrological extremes are putting populations and economies at risk worldwide. The World Bank projects that by 2050, cumulative global economic losses from droughts may reach $5.6 trillion, putting at risk about 6% of GDP in vulnerable regions.[18]

Strengthening water systems to withstand floods and droughts requires a combination of infrastructural, nature-based and technological solutions. Grey infrastructure includes flood protection works, drought-resilient storage and stormwater infrastructure. Nature-based solutions, including wetlands, permeable surfaces and urban green spaces, help manage rainfall and runoff. Technology, including integrated watershed management, early-warning systems and the use of AI-based climate forecasting, plays an increasingly important role by improving risk prediction and optimizing operations.

CASE STUDY 5

Tasreef – A stormwater management plan in Dubai

In 2024, Dubai was hit by a historic flood caused by record rainfall, resulting in widespread damage and insured losses exceeding €3 billion. In response, the city has approved a major long-term infrastructure initiative, the €7 billion Tasreef project, to comprehensively **upgrade its rainwater drainage network**.

The network will span the entire emirate and deploy advanced tunnelling and drainage technologies, including high-precision tunnel boring machines (TBMs) equipped with automated controls, real-time monitoring and data analytics to ensure safe and efficient excavation. Once completed in 2033, the system will **expand the city's stormwater capacity by 700%**, enabling the management of more than **20 million m^3 of water per day**, with a peak flow of **230 m^3 per second**.

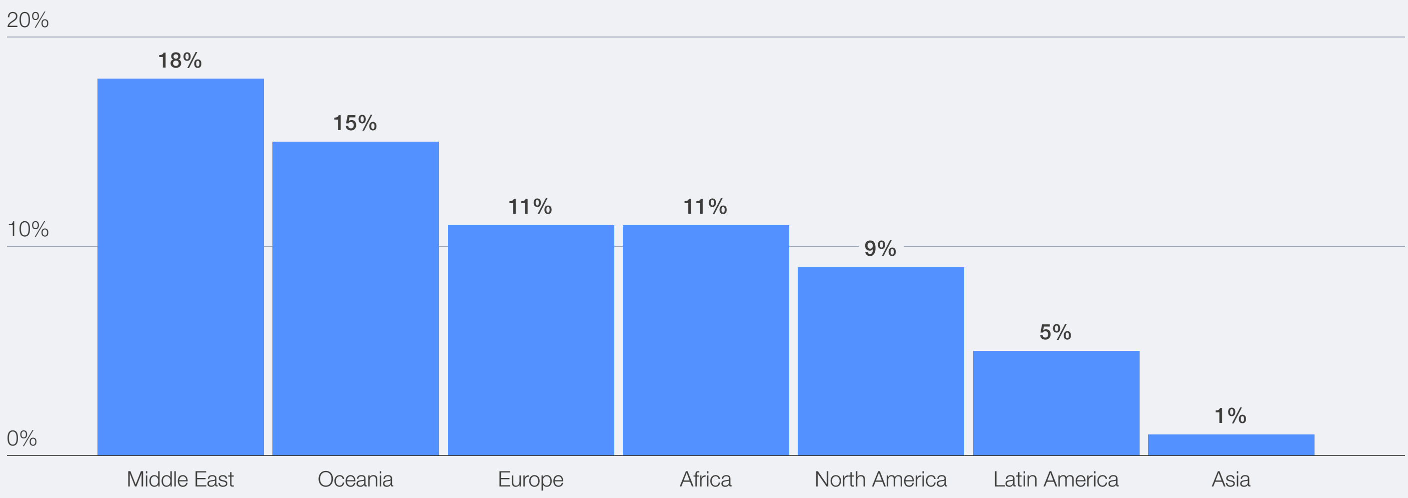
2.3 Circularity and resource recovery

Unsustainable patterns of water and energy use highlight the urgent need for systemic transformation in water infrastructure management towards circularity. This shift demands significant financial commitments: by 2040, almost **€1 trillion** will need to be invested in circular practices integrating water reuse, energy recovery and pollution control. Strategic investment in **advanced reuse, sludge-to-resource valorization and rainwater harvesting (RWH) can enable utilities** to move beyond traditional service delivery, establishing themselves **as resilient hubs** that secure water, energy and nutrient resources.

Scale wastewater reuse

Despite the well-recognized potential of circular water management practices, including water reuse and RWH, their adoption remains limited. Currently **only 12% of municipal freshwater withdrawal is reused** worldwide, despite projections suggesting a potential of up to **50% of municipal freshwater withdrawals by 2040.**[19] Reuse can be implemented through centralized systems, applying advanced tertiary processes to wastewater treatment plants and delivering reclaimed water via dedicated pipelines to industrial clusters or farmers. Alternatively, decentralized systems can be applied to residential or commercial buildings, treating greywater or blackwater for non-potable uses such as toilet flushing and irrigation.

FIGURE 9 **Reuse as a percentage of freshwater withdrawals in the municipal sector**



Source: World Bank Group, 2025

CASE STUDY 6

Aquapolo Ambiental – A PPP in São Paulo

São Paulo's ABC region, home to 3 million people and 24,000 industries, faces acute water scarcity, with only 130 m^3 of freshwater available per person annually, just 5% of the United Nations (UN) benchmark. To address this, Sabesp and GS Inima Industrial created Aquapolo Ambiental in 2012, Latin America's largest industrial reuse facility.

Structured as **a €90 million public-private partnership** (90% debt-financed), it operates under a 42-year take-or-pay contract between Aquapolo and Braskem petrochemical complex. Effluent from Sabesp's ABC wastewater plant undergoes tertiary treatment, ultra filtration and nano filtration, before being delivered via a **17-km pipeline**. With a capacity of **1,000 litres per second**, Aquapolo supplies 12 industries, has produced **135 million m^3** of recycled water, and serves as an educational hub.

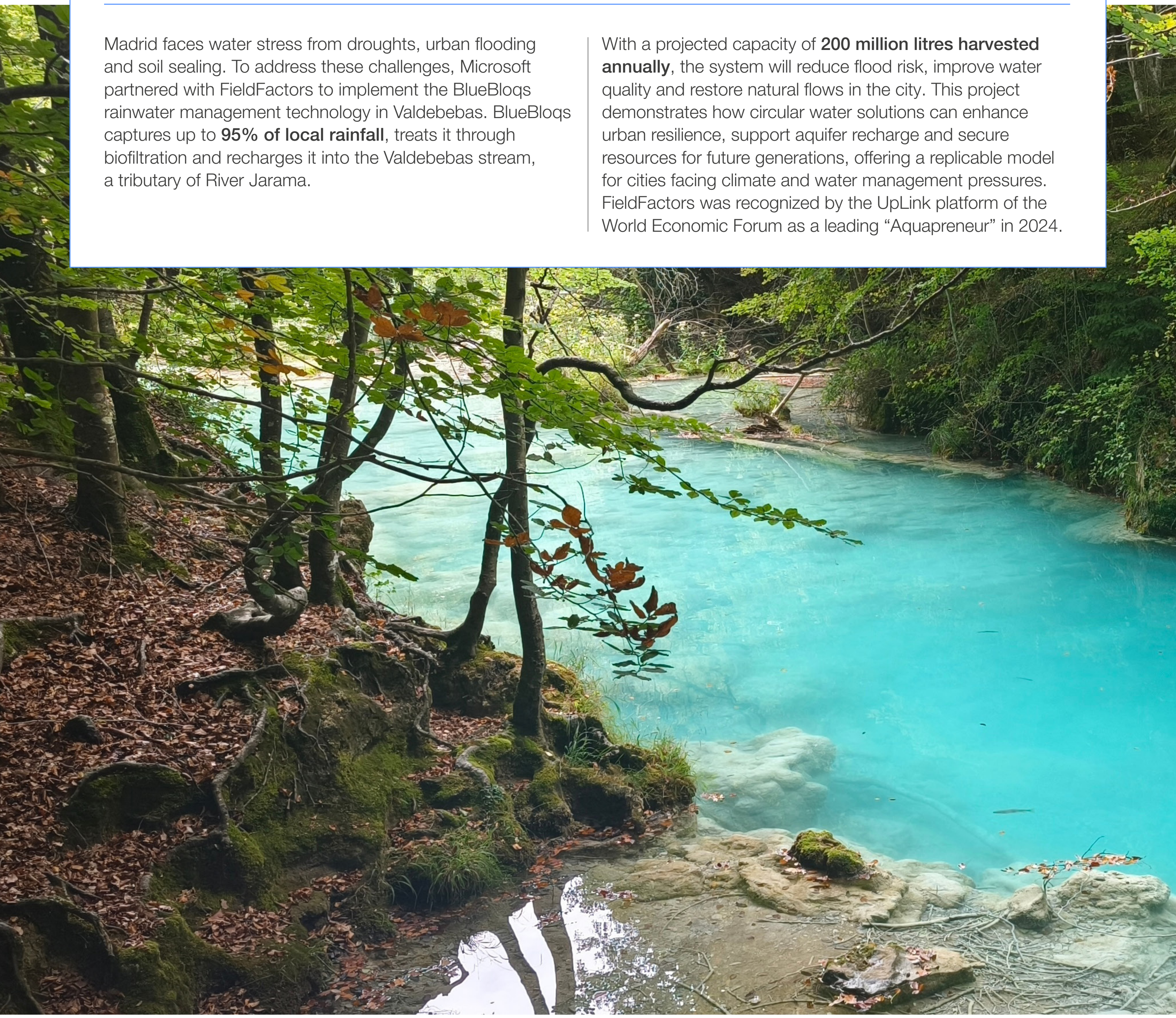
Similarly, RWH offers a complementary circular water practice with significant potential. Today's high population densities and increasingly extreme weather events expose limitations on traditional stormwater networks. In response, RWH captures rainfall that would otherwise be lost, storing it for later use. The collected water can serve non-potable and, when properly treated, even potable uses. RWH can also enhance infiltration and contribute to aquifer recharge. RWH helps balance supply during peak periods, reducing stormwater runoff and flood risk by up to 70%,[20] with a water-saving potential of 10-30%.[21]

CASE STUDY 7

Microsoft and FieldFactors – BlueBloqs Urban Replenishment in Madrid

Madrid faces water stress from droughts, urban flooding and soil sealing. To address these challenges, Microsoft partnered with FieldFactors to implement the BlueBloqs rainwater management technology in Valdebebas. BlueBloqs captures up to **95% of local rainfall**, treats it through biofiltration and recharges it into the Valdebebas stream, a tributary of River Jarama.

With a projected capacity of **200 million litres harvested annually**, the system will reduce flood risk, improve water quality and restore natural flows in the city. This project demonstrates how circular water solutions can enhance urban resilience, support aquifer recharge and secure resources for future generations, offering a replicable model for cities facing climate and water management pressures. FieldFactors was recognized by the UpLink platform of the World Economic Forum as a leading "Aquapreneur" in 2024.



Finally, closed-loop systems can address the water conservation challenge in industrial contexts, especially in cooling processes. By collecting used process water and treating it through technologies such as membrane filtration, biological treatment or disinfection, water is reintroduced into the production cycles, offering a **water saving potential estimated at 50-75%** of the current industrial consumption of water.[22]

CASE STUDY 8

Grundfos – Total water management at Carlsberg's Fredericia Plant

Carlsberg Group's Fredericia brewery in Denmark historically required 3.4 litres of water per litre of beer produced, with 60-65% used for cleaning, cooling and auxiliary processes. To enhance water efficiency, Carlsberg built a total water management (TWM) plant that treats process water to potable standards for reuse in utilities, **achieving 90% recovery** (**1,800 m^3/day** from 2,000 m^3/day inflow).

The plant integrates anaerobic and aerobic treatment, ultrafiltration, reverse osmosis, remineralization, ultraviolet (UV) disinfection and chemical dosing. The anaerobic stage generates biogas for combined heat and power, supplying around **10% of heat demand**. Grundfos supplied 95% of pumps, dosing and monitoring systems. The facility **saves 560,000 m^3 annually**, reducing water use to **1.4 litres** per litre of beer produced**.**

Improve assets' energy efficiency and resource recovery

The treatment of water for drinking purposes and of wastewater (including desalination) is a highly energy-intensive process, accounting for more than **5% of global electricity consumption**.[23]

Combining microgrids, energy efficiency smart technologies, and resource valorization such as biomethane production, can represent a pathway to reduce energy footprint. **Microgrids** are localized energy systems, such as solar panels and battery storage, that operate close to treatment plants producing renewable energy.

Smart technologies such as digital twins, internet of things (IoT) sensors, supervisory control and data acquisition (SCADA) systems and predictive AI models enable automation and real-time management of assets to reduce energy use for pumping and treatment. Finally, sludges can be turned into an energy source. Anaerobic digestion produces biogas, which can be used to generate electricity and heat to power treatment operations and even supply surplus energy and heat to the grid: **wastewater plants, including those for reuse, can achieve between 30% and 110% net-zero energy supply through a mix of solar PV and biogas**.[24]

CASE STUDY 9

Schneider Electric – Punta Gradelle wastewater treatment plant

In Italy's Sorrento peninsula (140,000 population equivalent), wastewater treatment relied on an obsolete facility that caused environmental degradation, affected tourism and agriculture, and triggered a European infringement procedure. A public-private consortium led by Veolia and Schneider Electric invested **€46 million** to build a fully automated underground plant in the Punta Gradelle cape.

Leveraging Schneider Electric's **EcoStruxure platform** for integrated energy and automation management, the system connects control units, automation panels and a central supervision platform via high-speed intranet. This configuration delivers **15% energy savings**, a **20% increase in process efficiency** and flexible capacity to manage seasonal peaks while safeguarding coastal ecosystems and local livelihoods.[25]

Advanced water treatment

Emerging pollutants, whose total number could exceed 12,000 globally, include persistent substances such as PFAS, pharmaceuticals and microplastics. These emerging pollutants have been found to contaminate at least a third of global water bodies[26] and are largely resistant to removal through conventional water treatment plants.[27]

To address these gaps, advanced solutions are being developed as modular, "plug-and-play" systems that integrate seamlessly into existing treatment infrastructure. These technologies enable targeted and efficient permanent destruction through a combination of concentration capabilities and molecular destruction, achieving up to 99% removal efficiency.[28]

CASE STUDY 10

Oxyle – PFAS destruction in Switzerland

At a construction site in Switzerland, groundwater analysis revealed the presence of perfluorobutanoic acid (PFBA), a highly mobile short-chain PFAS. Oxyle is a Swiss cleantech company recognized by the World Economic Forum's UpLink platform as an "Aquapreneur", a leading water start-up. It has designed **modular treatment systems** that **permanently destroy PFAS in water**, including the short- and ultra short-chain variants often resistant to conventional methods.

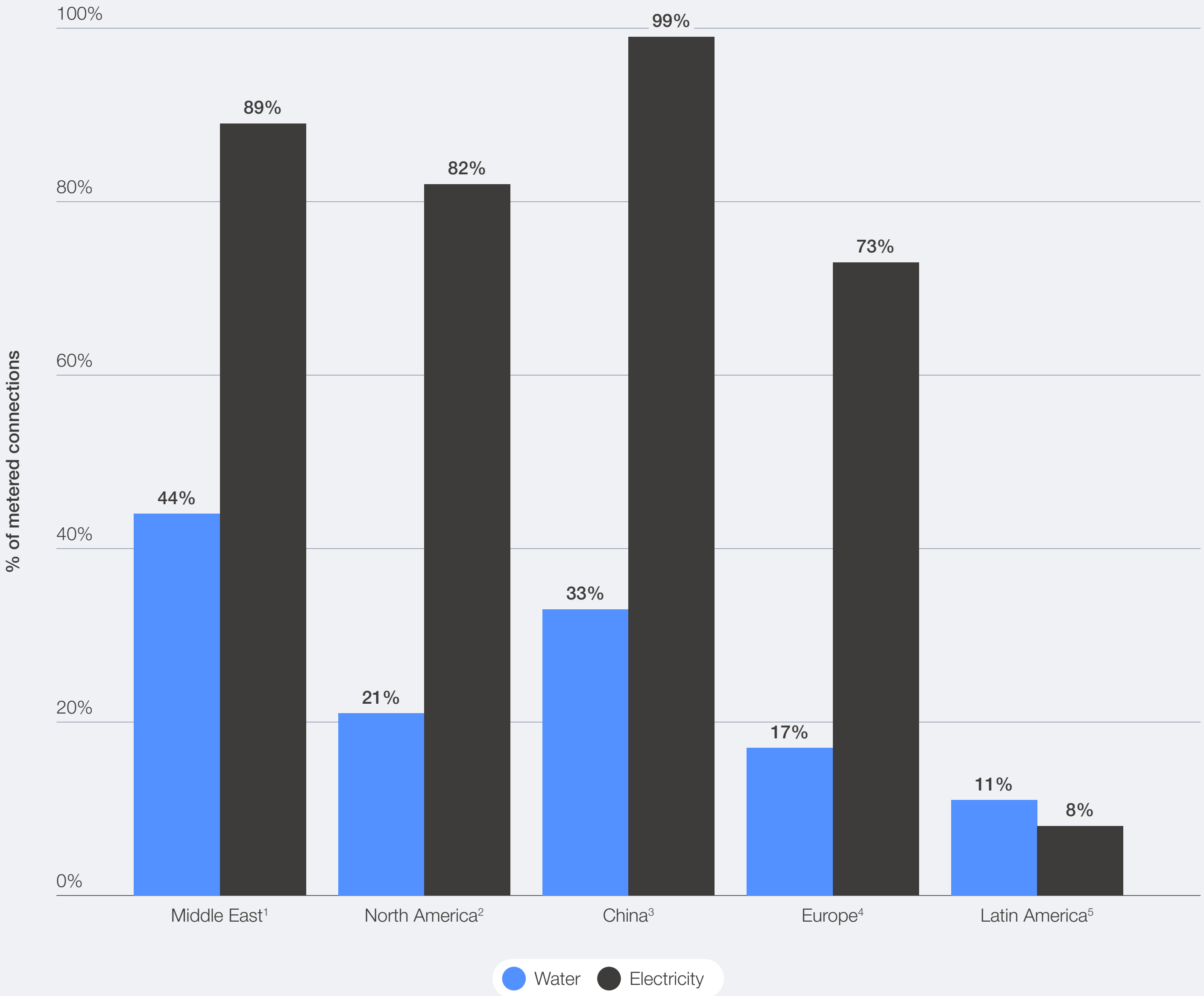
As part of site remediation, Oxyle conducted a **lab-scale trial** with a tailored treatment train designed for the site's specific water chemistry. The system combined nanofiltration, used to separate and concentrate PFAS, with **OxLight**, Oxyle's proprietary photochemical reduction technology, which permanently degrades and defluorinates the concentrated PFAS while utilizing the mechanical energy of flowing water to power the degradation process.

Reported results indicate **99% degradation**, with effluent concentrations below detection limits (PFBA from 8 parts per billion (ppb) to 0.02 ppb). These findings suggest potential for energy-efficient mineralization of persistent PFAS in contaminated groundwater.

2.4 Innovation for efficiency

Technology has the potential to transform core operations, from asset management to inspection and maintenance. Yet the sector remains under-digitized, with only a small share of investment directed towards innovation, leaving many utilities reliant on reactive systems. Although proven use cases and effective technology already exist, water-tech is not yet fully activated. By 2040, nearly **€0.3 trillion**, about **€2 per capita annually**, will be needed for predictive analytics, robotics and cybersecurity.

FIGURE 10 **Average smart meter penetration by region**



Notes: [1] Middle East: Bahrain, Jordan, Oman, Qatar, Saudi Arabia. Sources: Global Water Intelligence. The Peninsula. https://thepeninsulaqatar.com/article/13/07/2025/kahramaa-completes-smart-electricity-meter-installation; Bahrain Closing in on 'Full' Transition to Smart Meters: Less Than 2% Of Accounts Rely On Electricity Reading Estimates. (2025, January 26). The Daily Tribune. https://www.newsofbahrain.com/bahrain/107796.html; EMRC Reports 87 Percent Smart Meter Coverage, Strengthens Regulatory Oversight. (2025, August 13). Jordan News Agency Petra. https://petra.gov.jo/Include/InnerPage.jsp?ID=74528&lang=en&name=en_news.; 1.13 million electricity smart metres installed across Oman. (2025, May 27). Oman Observer. https://www.omanobserver.om/article/1171188/business/113-million-electricity-smart-metres-installed-across-oman.

[2] North America: Canada, United States. Sources: Global Water Intelligence; Berg Insight. (2025, July 8). Smart electricity meter penetration rate in North America reached 82 percent in 2024. https://www.berginsight.com/smart-electricity-meter-penetration-rate-in-north-america-reached-82-percent-in-2024

[3] Global Water Intelligence

[4] Europe: France, Germany, Italy, Spain. Sources: Global Water Intelligence; Eurelectric. (2023) Powerbarometer 2023 https://powerbarometer.eurelectric.org/power-barometer-2023/

[5] Latin America: Brazil, Mexico. Sources: Global Water Intelligence; Berg Insight. (2024, August 16). Massive growth ahead in the Latin American smart electricity metering market. https://www.berginsight.com/massive-growth-ahead-in-the-latin-american-smart-electricity-metering-market

Deploy smart technologies

Water operations' digitization remains low. In Europe and North America, **smart water meter penetration is only 17% and 21%,**[29] compared to 73% and 82% for smart electricity meters. Traditional reactive maintenance models generate high inefficiencies, service interruptions and unforeseen costs, besides being more prone to cyberattacks.

Smart technologies transform this paradigm by using data and AI-enabled analytics, real-time monitoring through sensors and IoT, and automated dispatch systems to anticipate asset failures before they occur. Applied to both networks and plants, predictive models draw on real-time and historical data to detect stress, material corrosion or anomalies and to deploy resources precisely where and when they are needed. Utilities that deploy these systems typically report **annual savings of 10-20% in opex** and **20-30% in capex.**[30]

CASE STUDY 11

Siemens – Integrated water management for a transmission authority in the Middle East

A Middle Eastern water transmission authority faced inefficiencies from numerous pumping stations operating under disparate automation systems. Siemens implemented an integrated water management system featuring advanced SCADA with a standardization library to harmonize automation, unified data and analytics for decision support, AI-driven leak detection, real-time optimization and cybersecurity.

Supported by a **€10 million public investment**, the system makes it possible to centralize operation and maintenance complemented with advanced technology for predictive maintenance, early fault detection and continuous performance improvement. It has enabled **over 98% asset availability** and **99.99% service system availability**. Implementation of Siemens' real-time optimization software suite (SIWA) at various utilities globally has shown the potential to **reduce workflow time by up to 85% and leakages by 50%**. This improves efficiency and reliability, demonstrating how digital integration can transform water management.

Scale water-tech solutions

Water infrastructure often exists in confined, remote or hazardous locations, making inspections and maintenance risky and costly. Robotic systems – autonomous or semi-autonomous aerial, ground and underwater devices – can conduct precise inspections, detect faults and perform minor repairs in pipes, tanks and treatment facilities. These solutions **can cut the time spent by human workers on hazardous tasks by up to 70%**, while **improving inspection accuracy by over 50%.**[31] **Trenchless or no-dig repair technologies** further enhance these capabilities by enabling pipe rehabilitation and leakage reduction without disruptive excavation, cutting **maintenance costs by up to 20-65%** compared with traditional open-cut replacement, depending on pipe size.[32]

CASE STUDY 12

Xylem – Robotics and smart monitoring for water network resilience in the UK

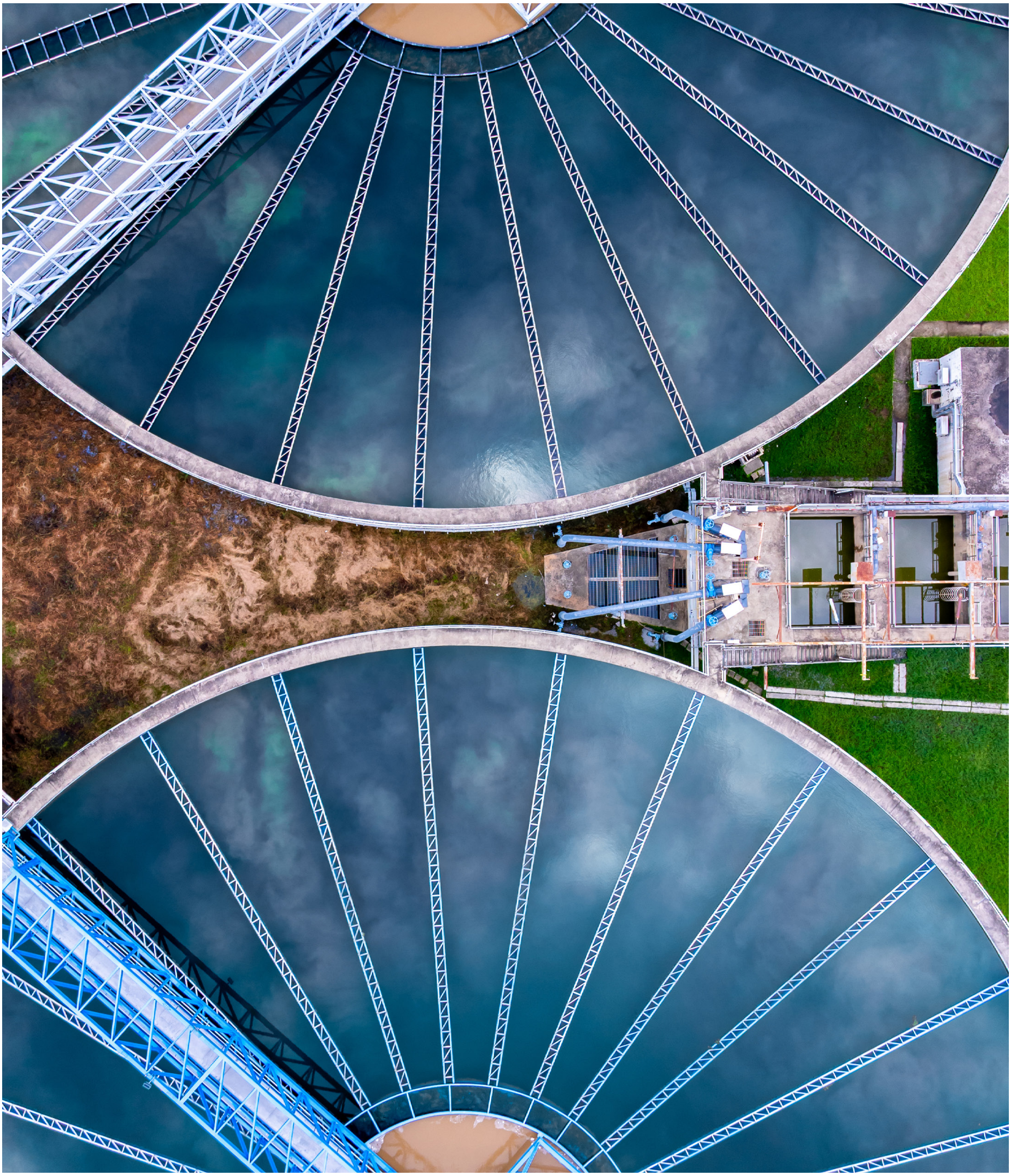
In the UK, ageing and hard-to-access infrastructure, along with rigorous water quality monitoring requirements, presents major operational challenges for utilities. To address these, Xylem has supported utilities in adopting remote-operated inspection tools and smart monitoring systems that improve efficiency and safety while reducing costs.

Scottish Water, for example, used Xylem's SmartBall and PipeDiver technologies to inspect the vulnerable Newmore raw water transmission main without excavation. These trenchless, unmanned tools collected detailed condition data that enabled precise, targeted repairs costing under £1.6 million, avoiding an estimated £16 million full pipeline replacement.

In parallel, Xylem's EXO multiparameter sensors have empowered utilities to continuously monitor water quality remotely. By distinguishing between causes of sudden water quality changes such as rainfall events or sewage overflows, operators can respond quickly and confidently without putting personnel in hazardous environments.

3 Key enablers to bridge the investment gap

Policy, finance, technology and culture can accelerate change.



Capturing the water infrastructure opportunity requires a multifaceted approach involving four enablers: policy, finance, technology and cultural change. Based on a series of about 20 workshops and interviews with senior representatives from across the water industry, regulators and policy-makers, 15 priority actions have been identified to help accelerate water infrastructure investments. These enablers are not ends in themselves; they form the toolkit that allows governments, investors and industry leaders to translate ambition into execution.

FIGURE 11 **Enablers for water sector transformation**

Policy enablers

– National or regional water resilience strategy
– Institutional reform and pricing
– Improved governance
– Interoperable national open data infrastructure
– Industry collaboration

Finance enablers

– PPP and RAB* models
– Water insurance and risk transfer
– Water finance instruments
– Strategic public capital
– Market-based instruments

Culture enablers

– Citizenship programmes
– Education and training

Technology enablers

– Innovation hubs
– Regulatory sandboxes
– Water-tech funds

* Regulated asset base

3.1 Policy

Policy enablers, inspired from international best practices and OECD Principles on Water Governance,[33] aim to boost utility efficiency, promote water conservation, implement effective water pricing and enhance the bankability of investments, ultimately attracting more private capital.

National or regional water vision and resilience strategy

Developing a clear, time-bound vision for water is the critical first step in setting and aligning a country's water-related opportunities with climate, economic and social objectives. This vision should outline quantitative, time-bound targets and industry minimum performance indicators for water resilience, from wastewater reuse to leakage rates. The vision and related strategy should also include a pipeline of nationally significant water projects, guiding public spending and catalysing private investment.

CASE STUDY 12

The 2020 Brazilian new sanitation framework

In 2020, Brazil introduced the New Sanitation Framework to shape a new, national vision for sanitation and address structural deficiencies in water and wastewater services. The reform liberalized the sector through competitive bidding, set binding universal water and sanitation coverage targets for 2033, strengthened the regulatory authority of the National Water Agency and promoted the formation of regional blocs of municipalities to reduce fragmentation.

BNDES, Brazil's national development bank, plays a major role in the implementation of the strategy by providing local councils with contractual frameworks for concession auctions, offering public guarantees to financial institutions and co-financing PPPs.

Between 2020 and Q3 2025, Brazil mobilized close to $50 billion, of which more than $36 billion was private investment.[34] During this period, the length of the drinking water and sanitation networks increased by 21% and 16%, respectively.[35] By 2025, 23 of 26 federal entities had grouped their local concessions and roughly a third of the municipalities had awarded the service to a private actor.

Water resilience policies and pricing

Drawing from success stories, effective water sector transformation can be guided by three complementary approaches: end-user policies, incentives and subsidies, and pricing mechanisms.

End-user policies can encourage water users, ranging from households to industrial clusters, to adopt more sustainable practices. These may include water abstraction and discharge limits, water efficiency labelling for consumer products, corporate disclosure requirements on water use and adoption of circular practices.

Incentives and subsidies can be adapted to promote sustainable water management, infrastructure upgrades and adoption of new technologies. Repurposing currently inefficient subsidies to promote sustainable water management, infrastructure upgrades and technological adoption can enhance service levels and operational efficiency – critical elements for increasing bankability and creditworthiness of water investments.

Pricing instruments, such as tariffs, and abstraction and discharge fees, are essential to reflect the true value of water. The challenge is to design rate structures that reflect the true cost of service delivery, including infrastructure, environmental and consumption factors. While the specific design will vary by region and context, effective pricing strengthens conservation and efficiency efforts while ensuring cost recovery. Without adequate pricing, new water sources such as reuse or rainwater harvesting cannot compete with underpriced conventional supply, limiting their potential to scale sustainably.[36]

CASE STUDY 13

Australia's National Water Initiative (NWI)

NWI, signed in 2004, represents one of the most comprehensive national water reform plans globally, establishing a consistent framework for secure entitlements, efficient markets, cost-reflective pricing and environmental protection. NWI introduced water pricing principles; a Water Efficiency Labelling and Standards (WELS) scheme, mandating star-rated labels for water-using appliances; industrial/agricultural disclosure requirements; statutory water plans, now covering over 80% of water use, to guide allocation, environmental flows and risk management; and water access rights as tradeable financial assets.[37]

Improved governance

Water governance is often fragmented and multilayered, with responsibilities spread across multiple entities. In contexts where fragmentation limits progress, establishing – or further supporting, where already existing – a centralized national water agency may help consolidate expertise, streamline project delivery and harmonize implementation standards. While centralization is not a universal solution, dependent on the context, a water agency can support strategic planning, guide funding allocation and oversee infrastructure delivery. In some cases, this approach can reduce duplication and promote operational efficiency, becoming vital to scaling investment and improving project bankability.

CASE STUDY 14

Israeli Water Authority

In 2007, the Israel Water Authority was established to consolidate fragmented water governance under a single independent entity. The authority manages policy, infrastructure, tariffs and strategic planning, ensuring representation and transparency. Between 2007 and 2023, freshwater abstraction fell by 38%, household consumption dropped 15%, non-revenue water receded from 14% to 8%, and water stress declined from 60% to 45%,[38] supported by investments in desalination and wastewater reuse, which now account for 48% of total supply.[39]

Interoperable national open water data infrastructure

Reliable data is the backbone of water governance. Data enables evidence-based decisions, supports regulatory enforcement, improves risk management and attracts investment by reducing information asymmetry. Data also enables development of more accurate and trustworthy AI tools.[40] Countries should invest in national water data infrastructure facilities, which can collect, standardize, store and disseminate data on availability, usage, quality and reuse across sectors.

To ensure ecosystem communication and interoperability, it is crucial to mandate open data standards, covering various data formats, APIs and procurement standards. Interoperability should also facilitate alignment with other utilities such as electricity and gas, with climate goals and with urban planning.

CASE STUDY 15

UK's Stream water data portal

Stream is a utility-led, regulator-seeded initiative under development in the UK, which aims at establishing an open, standardized national water data capability by aggregating more than 160 diverse datasets (so far), from anonymized water meter readings to water quality reports to performance reviews. The initiative reunites 16 of the 18 major water companies and data management and strategy consulting firms.

The programme produced an open data framework, machine-readable metadata and application programming interface (API) specifications and a pragmatic data analysis process to prioritize high-value dataset releases, while addressing legal sensitivity, stewardship and governance through proposed operating and datatrust models.[41]

Industry collaboration

The water sector is often highly fragmented, with several small operators in many countries. For example, the EU counts over 27,000 operators and the US more than 150,000. In contexts where fragmentation limits efficiency or investment capacity, encouraging the consolidation of smaller utilities into larger regional operators can help achieve economies of scale and improve service delivery. Governments can support this process through coordinated measures such as setting thresholds that trigger consolidation, promoting inter-municipal cooperation and enabling shared service platforms for procurement, technology deployment or financing. However, solutions must remain place-based and flexible to local contexts, recognizing that no single governance model can fit all situations.

CASE STUDY 16

Netherlands' regional consolidation

Prior to the 1970s, the Netherlands had approximately 150 municipal water companies and 2,000 local water boards, serving a population of 11.5 million. Government-led reforms initiated in the 1970s introduced a minimum customer base of 100,000 connections and empowered local authorities to consolidate utilities into limited companies, promoting corporatization.

A second wave of voluntary mergers followed during the liberalization trends of the 1990s and early 2000s. These reforms reduced the number of water companies by 70% over 25 years, reaching the current number, 10, by 2007.[42] In parallel, national and local governments consolidated water boards, with further mergers in the 2010s, reducing their number to 21.[43]

3.2 Finance

Accelerating water investments requires more than strong policy; it also demands financial innovation. Finance enablers encompass a mix of actions across public and private institutions to stimulate demand for water financing.

PPP and RAB models

Governments can play a catalytic role by promoting public-private models for large-scale water infrastructure, tailoring the approach to project characteristics. For assets with well-defined outputs and shorter construction periods (e.g. wastewater treatment plants), PPPs are effective. Policy-makers should facilitate PPPs through transparent legal frameworks, competitive tenders, project preparation support and fair risk-sharing tools such as guarantees or subsidies.

For capital-intensive projects with long lead times and higher construction risk (e.g. mega-projects and large networks), regulated asset base (RAB) models – which enable a project developer to earn revenue during the construction phase, while a government regulator oversees the project – offer advantages by allowing revenue recovery during construction, lowering the cost of capital and attracting long-term institutional investors.

Governments should therefore empower independent regulators to set stable tariffs, establish centres of excellence for regulatory design and provide targeted backstops to strengthen investor confidence.

CASE STUDY 17

London’s Thames tideway tunnel

The Thames Tideway Tunnel, London’s £4.2 billion “super-sewer”, illustrates how the **RAB model** can unlock investment in complex infrastructure. Traditional PPPs typically defer investor returns until after commissioning, forcing reliance on expensive debt during long build phases and inflating costs. By contrast, the Tideway licence, overseen by Ofwat (UK’s water regulator), allowed **revenue recovery during construction**, financed through a modest surcharge on consumer bills of about £20 per year, against an initial estimation of £70-80.

This model helped lower the cost of capital, reducing reliance on short-term project finance and delivering regulated, stable and inflation-linked returns, thus attracting long-term institutional investors such as pension funds that would possibly be deterred under PPP models.[44]

Insurance and risk transfer

Water-related risks remain largely under-recognized and under-insured, despite growing impacts of floods and droughts. In Europe, for instance, only about 25% of €900 billion of losses caused by natural disasters in the past 40 years were insured.[45]

Insurance instruments, such as parametric insurance and sovereign catastrophe pools, disburse funds based on predefined triggers like rainfall deficits or reservoir levels and should be promoted globally.

The insurance industry can play a crucial role to quantify water-related risks by collaborating with ecosystem players. Insurers may be incentivized to design water-specific products, with dedicated risk parameters, payout structures and blended finance mechanisms.

CASE STUDY 18

Zurich Insurance – Resilience Solutions

Zurich Resilience Solutions (ZRS) is Zurich Insurance's dedicated business unit focused on climate resilience and risk management. It combines advanced analytics, using proprietary climate models, with on-site assessments to help clients identify, quantify and adapt to climate vulnerabilities across assets and operations. ZRS evaluates water-related vulnerabilities, such as flood and drought exposure, using scenario models with quantifiable triggers like rainfall thresholds and reservoir levels, linked to mitigation strategies and financing.[46]

A practical example is Zurich Syariah Parametric Weather Index Insurance in Indonesia, where smallholding coffee farmers face extreme weather but lack access to traditional insurance. Zurich Syariah introduced a weather index-based insurance, which activates using satellite data and rainfall triggers, bypassing on-site damage assessment to enable fast payouts – enhancing agricultural resilience.[47]

Water finance instruments

Water finance, via blue bonds, sustainability-linked loans and blended models, remains underdeveloped. Blue bonds represented less than 1% of global sustainable bond issuance in 2024, despite being well suited to water, given that average nine-year maturities align with infrastructure payback periods.[48] Water-specific instruments can stimulate demand from financiers by linking capital-raising to clear efficiency and resilience targets.

Still, enhancing the operational efficiency of water utilities remains even more crucial to strengthening their bankability and creditworthiness, creating the conditions for finance to flow at scale. To unlock the market, policy-makers should support the development of a water taxonomy, mandate harmonized impact reporting and integrate water metrics into corporate sustainability disclosures – all of which increase clarity and stimulate demand. At the same time, governments, DFIs and multilateral development banks (MDBs) can catalyse financing by promoting collaboration, acting as anchor investors or guarantors, and deploying blended finance tools to de-risk private participation.

CASE STUDY 19

World Bank's 2030 Water Resources Group (WRG)

WRG is a leading accelerator of water finance, mobilizing investment by bringing together governments, private sector actors and civil society for defined programmes and projects at the national, sub-national and city levels. Its own operations are supported by bilateral donors, foundations and corporate partners, with WRG playing a catalytic role in unlocking much larger financing flows from public budgets, DFIs and private capital.

It does so by fostering conditions to enable private sector innovation, expertise and capital mobilization in the water sector, ranging from the creation of fit-for-purpose policies, regulations and standards, to supporting the design of public-private partnerships and innovative financing mechanisms. For example, in the Ganga basin in India, WRG co-developed a hybrid annuity PPP model for municipal wastewater plants, which has already mobilized $1.5 billion in contracts with private sector participation. In Mongolia, WRG's development of a new water pollution fee regulation, coupled with wastewater reuse standards, unlocked $98 million for a water recycling plant in Ulaanbaatar.[49]

Strategic public capital

Public funds should back private capital and be used strategically to unlock it and bolster investment demand. Governments and national and multilateral development banks can close the viability gap through targeted financial instruments that lower risk and improve bankability. For early-stage solutions, such as nature-based solutions, concessional loans or first-loss guarantees can help validate financial feasibility and attract co-investors.

More mature and proven technologies, such as wastewater reuse or desalination, often benefit from sovereign guarantees or blended finance structures. Meanwhile, tax credits and consumer rebates can stimulate adoption of water-efficient technologies, such as leakage detection or decentralized water reuse, helping build financing demand.

CASE STUDY 20

European Investment Bank (EIB) Water Resilience Programme

To operationalize the EU Water Resilience Strategy, EIB has launched a **Water Resilience Programme** with more than **€40 billion planned for 2025-27**. The initiative combines a wide range of instruments: **loans** (framework loans for governments, intermediated loans for small and medium-sized enterprises and utilities), **equity** (venture debt for early-stage water-tech and infrastructure/environmental funds), and **guarantees** (credit enhancement for project finance and portfolio guarantees for SMEs and mid-caps).

Alongside finance, EIB provides **advisory services** for project preparation, capacity building and regulatory reforms. Co-financing can reach **75% of project costs** for high-priority climate projects. By blending direct lending with de-risking tools and equity support, the programme seeks to crowd in private capital and scale investment in desalination, wastewater reuse, pollution control and nature-based solutions.[50]

Market-based instruments

Public funds should back private capital and be used strategically to unlock it and bolster investment demand. Policy-makers should look beyond traditional financing approaches and explore market-based mechanisms that reward performance and enable flexible compliance, such as “blue certificates” and cap-and-trade schemes for water allocation. These instruments can stimulate demand for water investing, specifically targeting private capital.

To operationalize such instruments, policy-makers should define eligible activities (e.g. volumetric savings and biodiversity conservation) and issuers (e.g. industrial users and farmers); establish monitoring and verification protocols; and develop transparent trading platforms. These instruments might also facilitate the creation of water service companies (WaSCos), which, like energy service companies (ESCos), focus on advisory services and capital raising related to water conservation and resilience.

CASE STUDY 21

Australian water markets

Australia has developed one of the world’s most advanced water markets in the Murray-Darling Basin (MDB), where farmers, industries and state governments can buy and sell water rights. The market includes **permanent rights** (entitlements) and **seasonal allocations**, giving users flexibility to adapt to dry or wet years.

Each year, billions of litres of water are traded, generating an estimated market turnover of over AUD 6 billion in 2021.[51] Farmers use the market to secure water for high-value crops, lease rights for several years, or “carry over” unused water for the next season. While challenges remain around transparency and access, the MDB market has provided a model for managing scarce resources through pricing and trade.[52]

3.3 Technology

Technology is another critical enabler for water investing. While not capital intensive, it can rapidly enhance operational efficiency and unlock value, strengthening the impact of supportive policy, finance and culture.

Innovation hubs

To bridge the gap between research and large-scale deployment, utilities, investors, start-ups and academia should partner to create water innovation hubs that serve as testbeds for new technologies and business models. The public sector has a role to play, for example by setting overall strategic research and development (R&D) directions and priorities, and by encouraging joint R&D by water utilities and other sectors ((e.g. information and communication technology (ICT), energy and waste)) by launching pilot projects to address specific issues.

These hubs can become commercialization platforms that help bridge the "valley of death" by linking start-ups with utilities and investors. This aligns with insights from the Forum's recently published report, "Water-BOOST: Enabling Innovation for Future-Ready Cities".

CASE STUDY 22

Singapore's Public Utilities Board (PUB)

PUB has built a leading water innovation hub by supporting the full water-tech life cycle, from funding and test-bedding to scaling and commercialization. Instruments such as the **R&D Fund** and Industrial Water Solutions Demonstration Fund provide capital, while dedicated facilities enable real-world trials.

Scaling is accelerated through the **Separation Technologies Applied Research and Translation (START) Centre, the Environmental and Water Technology Centre of Innovation (EWTCOL)** and the **Singapore Water Exchange,**[53] a marketplace that clusters over 38 firms and research groups. From 2002-2022, PUB and partners invested SGD 800 million in 700 projects across 30 countries, and two-thirds have advanced to implementation.[54]

Regulatory sandboxes

A regulatory sandbox is a controlled environment that allows innovators to test and validate new technologies under real operating conditions, with temporary regulatory flexibility and close government supervision. Sandboxes enable companies to trial solutions, such as digital monitoring systems, advanced treatment methods and reuse technologies, without full regulatory compliance at the outset, while ensuring safety and oversight – helping regulators learn from innovation and accelerate market adoption of new technologies.

CASE STUDY 23

Saudi Arabia's Ministry of Environment, Water and Agriculture (MEWA)

MEWA has established a **water regulatory sandbox** to support the testing and adoption of innovative water-tech solutions within a controlled regulatory environment. The authority has identified core focus areas to guide submissions and foster innovation in the water sector (e.g. smart leakage management and advanced desalination).

Innovators are invited to submit proposals that describe regulatory challenges, technical readiness and expected benefits. MEWA reviews applications, grants temporary regulatory flexibility and monitors performance. Insights from these pilots are then used to inform regulatory adjustments and support nationwide scaling of proven technologies, strengthening public-private collaboration.[55]

Water innovation ecosystem

Policy-makers can play a critical role in building a more investable innovation ecosystem. Countries can attract talent through targeted visa and relocation programmes, as seen in AI and biotechnology, and use tax incentives to encourage firms to establish R&D centres domestically.

Publicly sponsored innovation challenges that incentivize commercially viable solutions for leakage reduction, water reuse or water stress can significantly enhance visibility and stimulate market demand. Finally, governments can catalyse early-stage ventures by supporting public-private water-tech funds, blending concessional capital with institutional and corporate finance. To optimize the cost-efficiency of capital allocation, the government should concentrate resources on a limited number of projects with high scalability potential, providing them with substantial funding.

CASE STUDY 24

US National Alliance for Water Innovation (NAWI) Fund

NAWI is a US Department of Energy-funded research consortium led by the Lawrence Berkely National Laboratory. It was established in 2019 with a $110 million budget for five years. Its objective is to make 90% of non-traditional water sources treatable at a levelized cost comparable to today's marginal water supplies, within 10 years.

NAWI coordinates over 70 research projects and pilot demonstrators on desalination and water reuse, each focused on one of three areas: process innovation and intensification, materials and manufacturing, and data modelling and analysis. The consortium is composed of more than 400 partner organizations, including research centres and academia, industry, federal and state bodies, and nonprofit institutions.

3.4 Culture

All the enablers described above cannot succeed in isolation. A culture that values water, understands its socio-economic importance and supports stewardship at all levels is essential.

Citizenship programmes

The first step is to reinforce public awareness campaigns for water resilience. Campaigns should highlight the socio-economic and environmental importance of water. Water utilities and governments can partner with media, academia and civil society to maximize reach and resonance. Governments can establish awards or certifications for businesses, communities or individuals who demonstrate leadership in water resilience. Recognition programmes can be built at all levels, from municipalities to regions and states.

Also, small yet sustained behavioural nudges can lead to better water resilience. Mobile apps and real-time feedback tools help consumers track usage and adjust habits accordingly.

CASE STUDY 25

Scottish Water

In early 2025, as Scotland faced its driest start to a year in six decades, Scottish Water launched a national behavioural campaign motivating customers to adopt simple yet impactful actions: turning off sprinklers, using watering cans and shortening showers. Supported by multi-channel communications and community engagement, these collective efforts reduced daily demand by an estimated 60 million litres, enough to supply half of Fife, a Scottish local government area with a population of approximately 375,000.

The campaign not only protected supplies but also fostered a culture of shared responsibility for water. By linking water efficiency to energy savings, Scottish Water demonstrated how behavioural nudges can strengthen national resilience and deliver economic and environmental benefits simultaneously.

Education and professional training

Embedding water literacy in school and university curricula builds long-term awareness and resilience. Topics should cover the water cycle, climate change, economics and technology, and be co-designed by education ministries in partnership with utilities and tech companies. Targeted training programmes can also equip professionals – from industry engineers to financiers – to adopt new technologies and practices.

Governments can support universities, vocational schools and corporate academies in developing tailored curricula and certifications aligned with evolving industry, regulatory and sustainability needs.

CASE STUDY 26

Acea and Intesa Sanpaolo – Water Academy

Acea has launched Water Academy, a comprehensive programme structured around three action areas.

First, an education initiative for primary and secondary schools, developed with the Italian Ministry of Education, promotes awareness of water sustainability and responsible consumption. Second, a Corporate Master's in Water Management, created in partnership with Intesa Sanpaolo, equips mid-level managers from utilities, manufacturing and finance with practical skills in infrastructure, circular economy, water law and digital transformation through both classroom and on-site training.

Third, a Robotics Lab established jointly with the Italian Institute of Technology (IIT) advances research and development in water-tech, supporting innovation for Acea and external partners alike.

Conclusion

The world stands at a crossroads. Bridging the **€6.5 trillion water infrastructure gap** is not only a developmental necessity but also one of the most significant **socio-economic opportunities** of today. Achieving it could unlock **€8 trillion in global GDP** and create **200 million new jobs**, particularly in emerging economies, while strengthening resilience across regions, industries and communities.

This white paper aims to serve as a **strategic playbook for transformation**, a collection of replicable investments and enabling conditions that illustrate how meaningful progress can be achieved in different contexts. The intention of the playbook is not to impose a single global model but to **inspire action and adaptation**, offering governments, companies and investors the flexibility to apply the insights most relevant to their contexts. Water is a global concern, but every solution is local. The task ahead is therefore not to invent anew, but to **accelerate and replicate what already works**. Experience from leading corporations and countries such as **Australia, Brazil, Italy and Singapore** demonstrates that this transformation is achievable when best practices are in place.

The need for equitable access, resilience, circularity and innovation will drive the transformation of the water sector. These four interconnected pillars define both the urgency and direction of change. When sustainability and technology converge, they can reshape the sector from a **linear model of extraction and discharge** into a **circular system of reuse and recovery**, where every drop of water is valued, reused and re-purposed.

Realizing this potential will require a renewed spirit of ecosystem collaboration. Policy-makers, industry leaders and financiers can each play a decisive role in driving and sustaining change.

Governments should position water as a strategic national asset, integral to economic competitiveness, climate adaptation and social inclusion. By improving utility performance, aligning tariffs with the true cost of service, and establishing stable, transparent governance frameworks, they can create the conditions necessary for investment and innovation to thrive.

Industry leaders, in turn, can translate ambition into execution. By embedding digitalization, circularity and resilience in their operations, companies can increase efficiency, reduce non-revenue water, enhance financial credibility and demonstrate that sustainable water management is not a cost but a competitive advantage. Their leadership will be instrumental to promote a cultural change in societies towards water stewardship. The time has come to move from pilots to deployment at scale – by accelerating proven technologies and management models across sectors and geographies to achieve measurable impact.

The financial sector also has a pivotal role to play in this transition. Through **innovative instruments** such as blue bonds, sustainability-linked loans, PPP and RAB models, and blended finance mechanisms, financiers can mobilize private capital while aligning financial performance with measurable sustainability outcomes. In parallel, the investment community should consider reviewing their corporate strategy to include water as a **mainstream asset class** that attracts institutional investors and accelerates systemic change.

The path forward is clear. With coherent policy, innovative finance, technological acceleration and a shared commitment to collaboration, the global community can transform water infrastructure from a constraint into a **catalyst for sustainable growth and resilience**. The tools exist, the examples are proven and the moment to act is now. Only through collective leadership, by governments, industry leaders and financiers alike, can the sector unlock its full potential and secure water as the foundation of prosperity for generations to come.

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1. United Nations. (2017). *World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100*. https://www.un.org/en/desa/world-population-projected-reach-98-billion-2050-and-112-billion-2100.
2. World Bank Group. (2019). *Renewable internal freshwater resources per capita (cubic meters)*. https://data.worldbank.org/indicator/ER.H2O.INTR.PC.
3. Sanitation and Water for All (SWA). (2020). *A Handbook for Finance Ministers – how to make public investment work*. https://www.sanitationandwaterforall.org/handbook-finance-ministers-how-make-public-investment-work.
4. OECD. (2018). *Financing water: Investing in sustainable growth*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2018/03/financing-water_2be68120/bf67ec4e-en.pdf.
5. World Health Organization (WHO), & United Nations Children's Fund (UNICEF). (2025). Progress on household drinking water, sanitation and hygiene 2000–2024: Special focus on inequalities. https://data.unicef.org/resources/jmp-report-2025/.
6. World Bank Group (2025). *Water Security Financing Report 2024*. https://www.worldbank.org/en/topic/water/publication/water-security-financing-report-2024.
7. Alnajdi, S., Naderi Beni, A., Alsaati, A.A., Luhar, M., Childress, A.E., & Warsinger, D.M. (2024). Practical minimum energy use of seawater reverse osmosis. *Joule*, *8*(11), 3088–3105. https://doi.org/10.1016/j.joule.2024.08.005.
8. World Health Organization. (2023). *Water supply, sanitation and hygiene monitoring*. https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/monitoring-and-evidence/wash-monitoring.
9. Saadatinavaz, F., Alomari, M.A., Ali, M., & Saikaly, P.E. (2024). Striking a Balance: Decentralized and Centralized Wastewater Treatment Systems for Advancing Sustainable Development Goal 6. *Adv. Energy Sustainability Res.*, *5*(10), 2400097. https://doi.org/10.1002/aesr.202400097.
10. Jung, Y.T., Narayanan, N.C., & Cheng, Y.L. (2018). Cost comparison of centralized and decentralized wastewater management systems using optimization model. *Journal of environmental management*, *213*, 90-97. https://doi.org/10.1016/j.jenvman.2018.01.081.
11. AbuEltayef, H.T., Abualhin, K., & Alastal, K. (2023). *Addressing non-revenue water as a global problem and its interlinkages with sustainable development goals. Water Practice & Technology.* https://doi.org/10.2166/wpt.2023.157
12. Ferrari, G., & Savic, D. (2015). Economic Performance of DMAs in Water Distribution Systems. *Computing and Control for the Water Industry (CCWI2015) Sharing the Best Practice in Water Management*, *119*, 189–195. https://doi.org/10.1016/j.proeng.2015.08.874.
13. Global Water Intelligence (GWI). (2025). GWI water data. https://www.gwiwaterdata.com/.
14. Daulat, S., Rokstad, M.M., Bruaset, S., Langeveld, J., & Tscheikner-Gratl, F. (2024). Evaluating the generalizability and transferability of water distribution deterioration models. *Reliability Engineering & System Safety*, *241*, 109611. https://doi.org/10.1016/j.ress.2023.109611.
15. SVCW-RESCU Program (2024, June 11). Silicon Valley Clean Water Launches New $580 Million Wastewater Conveyance System. https://svcw-rescu.org/silicon-valley-clean-water-launches-new-580-million-wastewater-conveyance-system/.
16. Rush, J. (2021, August 25). *Silicon Valley Clean Water Turns to PDB Contracting for RESCU Tunnel.* Tunnel Business Magazine. https://tunnelingonline.com/silicon-valley-clean-water-turns-to-pdb-contracting-for-rescu-tunnel/; McGovern, J. (2019, August 6). *The Icky Business no one wants to talk about or do without*. Climate Online Redwood City. https://climaterwc.com/2019/08/06/the-icky-business-no-one-wants-to-talk-about-or-do-without/.
17. Arup. (2022). *Delivering a vital sewer upgrade capable of withstanding earthquakes and extreme weather.* https://www.arup.com/projects/silicon-valley-clean-water-gravity-pipeline/.
18. World Bank Group. (2023). *Scaling Up Finance for Water: A World Bank Strategic Framework and Roadmap for Action*. https://www.worldbank.org/en/topic/water/publication/scaling-up-finance-for-water-a-world-bank-strategic-framework-and-roadmap-for-action.
19. World Bank Group. (2025). *Scaling Water Reuse: A Tipping Point for Municipal and Industrial Use*. https://www.worldbank.org/en/topic/water/publication/scaling-water-reuse.
20. Boncz, M.A., Bezerra, E.T., Jr, M., Inacia, G., Dittmer, U., & Paulo, L. (2025). Rainwater harvesting potential and impact on stormwater drainage in an urban environment. *Water Reuse*, jwrd2025091. https://doi.org/10.2166/wrd.2025.091.
21. Bousdira, A., Aouissi, K., & Antune, M. (2025). Rainwater harvesting (RWH): an alternative or a mitigation to water stress? the case of the city of Jijel, Algeria. *Urban Water Journal*, 1-22. https://doi.org/10.1080/1573062x.2025.2531459.
22. Grundfos. (2024). *Industrial water savings: an untapped potential in light industries*.
23. Magni, M., Jones, E.R., Bierkens, M.F.P., & van Vliet, M.T.H. (2025). Global energy consumption of water treatment technologies. *Water Research*, *277*, 123245. https://doi.org/10.1016/j.watres.2025.123245.

24. Strazzabosco, A, Kenway, S., Lant, P. (2019). Solar PV adoption in wastewater treatment plants: A review of practice in California. *Journal of Environmental Management*. 248. https://doi.org/10.1016/j.jenvman.2019.109337; Maktabifard, M., Zaborowska, E. & Makinia, J. (2018). Achieving energy neutrality in wastewater treatment plants through energy savings and enhancing renewable energy production. *Rev Environ Sci Biotechnol* 17, 655–689. https://doi.org/10.1007/s11157-018-9478-x.
25. Schneider Electric. *Veolia Water* https://www.se.com/ww/en/work/campaign/life-is-on/case-study/veolia-water/.
26. Ackerman Grunfeld, D., Gilbert, D., Hou, J., Jones, A.M., Lee, M.J., Kibbey, T.C.G., & O'Carroll, D.M. (2024). *Underestimated burden of per- and polyfluoroalkyl substances in global surface waters and groundwaters*. *Nature Geoscience*, *17*(17), 1–7. https://doi.org/10.1038/s41561-024-01402-8.
27. MacKeown, H., Magi, E., Carro, D., & Benedetti, B. (2024). Removal of perfluoroalkyl and polyfluoroalkyl substances from tap water by means of pointofuse treatment: A review. *Science of the Total Environment*, *954*, 176764. https://doi.org/10.1016/j.scitotenv.2024.176764.
28. Tshangana, C.S., Nhlengethwa, S.T., Glass, S., Denison, S., Kuvarega, A.T., Nkambule, T.T.I., Mamba, B.B., Alvarez, P.J.J., & Muleja, A.A. (2025). Technology status to treat PFAS-contaminated water and limiting factors for their effective full-scale application. *Npj Clean Water*, *8*(1). https://doi.org/10.1038/s41545-025-00457-3.
29. Berg Insight. (2025). *Smart Water Metering in Europe and North America*. https://www.berginsight.com/smart-water-metering-in-europe-and-north-america.
30. McKinsey & Company. (2021). *How to use analytics to improve water asset management*. https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-power-and-gas-blog/how-to-use-analytics-to-improve-water-asset-management.
31. Brosque, C., & Fischer, M. (2022). Safety, quality, schedule and cost impacts of ten construction robots. *Construction Robotics*, *6*(2), 163–186. https://doi.org/10.1007/s41693-022-00072-5.
32. Kaushal, V., Mohammad, N., Serajiantehrani, R., Mohammadi, M., & Shirkhanloo, S. (2022). Construction cost comparison between trenchless cured-in-place pipe (CIPP) renewal and open-cut replacement for sanitary sewer applications. In *Pipelines 2022* (pp. 171–177). https://doi.org/10.1061/9780784484272.021.
33. OECD. (2015). *The OECD Principles on Water Governance and implementation strategy*. https://www.oecd.org/en/topics/sub-issues/water-governance/the-oecd-principles-on-water-governance-and-implementation-strategy.html.
34. ABCON. (2025). *ABCON Data - projetos*. https://abconsindcon.com.br/abcondata/.
35. ABCON. (2025). *Panorama 2025*. https://abconsindcon.com.br/panorama/.
36. Garrick, D., Hanemann, M. & Hepburn, C. (2020). Rethinking the economics of water: an assessment. *Oxford Rev. Econ. Policy* 36, 1–23. https://doi.org/10.1093/oxrep/grz035.
37. National Water Commission. (2014). *10 years of water wins: Australia's National Water Initiative*.
38. Zaide M. (2025). *Israel Water Authority Presentation.* https://aiguabaixter.cat/wp-content/uploads/2025/01/Presentacio_MICHAEL_ZAIDE.pdf.
39. OECD. (2023). *OECD Environmental Performance Reviews: Israel 2023.* https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/05/oecd-environmental-performance-reviews-israel-2023_7d20073c/0175ae95-en.pdf.
40. Borgomeo, E., Billari, C.G., Garg, S., Girona-Mata, M., Tlhomole, J., & Marinoni, A. (2025). Diving into AI? Exploring the potential for AI to help deliver clean rivers, lakes and seas in England. University of Cambridge. https://doi.org/10.17863/CAM.118743.
41. OFWAT. (2025, March 20). *Open data in the water industry.* https://www.ofwat.gov.uk/regulated-companies/open-data-in-the-water-industry/.
42. Blank, J.L.T., Enserink, B., & van Heezik, A.A.S. (2019). Policy Reforms and Productivity Change in the Dutch Drinking Water Industry: A Time Series Analysis 1980–2015. *Sustainability*, *11*(12), 3463. https://doi.org/10.3390/su11123463.
43. Dutch Water Authorities. (n.d.). *About us.* https://dutchwaterauthorities.com/about/.
44. Slaughter and May. (2025). *Regulated Asset Base Models: Their role in energy and infrastructure investment in the UK*. https://www.slaughterandmay.com/insights/new-insights/regulated-asset-base-models-their-role-in-energy-and-infrastructure-investment-in-the-uk/.
45. Arnold, M. (2024, October 2). *EU watchdogs call for disaster-relief fund in wake of Valencia floods*. Financial Times. https://www.ft.com/content/8a817c1e-dca4-4784-aba3-8cb414e23977.
46. Zurich Resilience Solutions. (2025). Risk Management for a Resilient Future. https://www.zurichresilience.com/.
47. Zurich (2025). *Brewing resilience: How Zurich is protecting thousands of Indonesian coffee farmers from extreme weather*. https://www.zurich.com/media/magazine/2025/brewing-resilience.
48. OECD. (2025). *Leveraging bond finance for sustainable water investments 12th Roundtable on Financing Water*. https://www.oecd.org/content/dam/oecd/en/events/2025/04/twelfth-meeting-of-the-roundtable-on-financing-water/background-paper-leveraging-bond-finance-for-sustainable-water-investments.pdf.
49. World Bank. (2025). *2030 Water Resources Group Offering: Advancing Global Water Security through Public-Private Collaboration*. http://documents.worldbank.org/curated/en/099012925083046808.

50. World Bank, ADB, AfDB, AIIB, CEB, EBRD, EIB, IDB, IsDB, & NDB 2025. Water Security Financing Report 2024. https://www.worldbank.org/en/topic/water/publication/water-security-financing-report-2024.

51. Department of Climate Change, Energy, Environment and Water. (2024). *Introduction to water markets - DCCEEW*. https://www.dcceew.gov.au/water/policy/markets/introduction-water-markets.

52. Marsden Jacob Associates. (2023). *Analysis of market-based mechanisms available in the water market in the Murray-Darling Basin*. Department of Climate Change, Energy, the Environment and Water. https://www.dcceew.gov.au/sites/default/files/documents/analysis-market-based-mechanisms-water-market-mdb.pdf.

53. PUB, Singapore's National Water Agency. (2018). https://www.pub.gov.sg/Industry/Enterprise/Singapore-Water-Exchange.

54. PUB, Singapore's National Water Agency (2022). Innovation In Water Singapore – Closing The Loop Towards More Sustainable Water.

55. Ministry of Environment, Water and Agriculture. (2025). *Water. Deputy Ministry for Research and Innovation, Saudi Arabia.* https://www.mewa.gov.sa/en/Ministry/Agencies/AgencyForInnovation/Topics/LegislativeExperimentalEnvProgram/Pages/Water.aspx.

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