INVESTING IN A WATER-SECURE FUTURE

Value creation strategies in a changing world

February 2024

GWI GLOBAL WATER INTELLIGENCE | XPV WATER PARTNERS

FOREWORD

David Henderson
Managing Partner, XPV Water Partners

Water has no substitute. Everything we do – not to mention everything we grow and make – requires water.

Today, our thirsty planet demands more than ever. At the same time, many parts of the world are experiencing combinations of extreme drought and flooding, failing infrastructure, diminishing supply, and historical levels of pollution. Water resources are no longer reliable. As a result, supply chains are slowing dramatically (even halting abruptly), the consistent production of food, power, and goods is uncertain, and, of course, everything costs more.

There is no question that global water security is an immense and immediate challenge. Water sustainability is the only way forward, and it offers an unprecedented opportunity to both innovate and scale the solutions our planet needs now.

It's already beginning to happen. Utilities, industry, and the commercial sector are leaning into technologies that help them better understand their systems, adapt to and build resilience to the changing climate, introduce new efficiencies, manage rapidly growing demand, and protect and improve water quality.

Combined with innovative business models and better policies, finance has a critical role to play. Our sector can leverage the billions, in some cases, trillions of dollars that some governments and corporations are beginning to direct to water security and climate resilience initiatives.

In partnership with Global Water Intelligence, we're proud to share this compelling argument for the investment community to participate fully in the water opportunity.

As the world recognises the critical importance of managing water sustainably, we're seeing strong momentum for the sector, and for the solutions that strengthen healthy, resilient ecosystems and economies.

Let's all make a difference in water – together!

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PUBLISHER'S INTRODUCTION

An appeal for engagement

Global Water Intelligence is publishing this white paper to draw attention to what is the most significant investment challenge the world is facing today: the need for a dramatic increase in the amount of capital directed towards ensuring global water security.

Historically, this appeal might have been directed at politicians, given that water is largely managed by the public sector. However, the growing value at risk for private sector companies, together with the weakness of public balance sheets, means that over the next decade, private investors are going to have to play a much greater role in shaping our water future than they have in the past.

The investment we envisage is only going to be possible if all levels of the global investment sector fully engage with the subject at hand. That is because financial innovation is needed as much as technical innovation. The potential is there for water to offer the returns needed to sustain a substantial surge in capital employed. The fundamental importance of water for the economy and for life on earth is strong enough to support any amount of capital. We just need to make better connections between water and the global investment ecosystem.

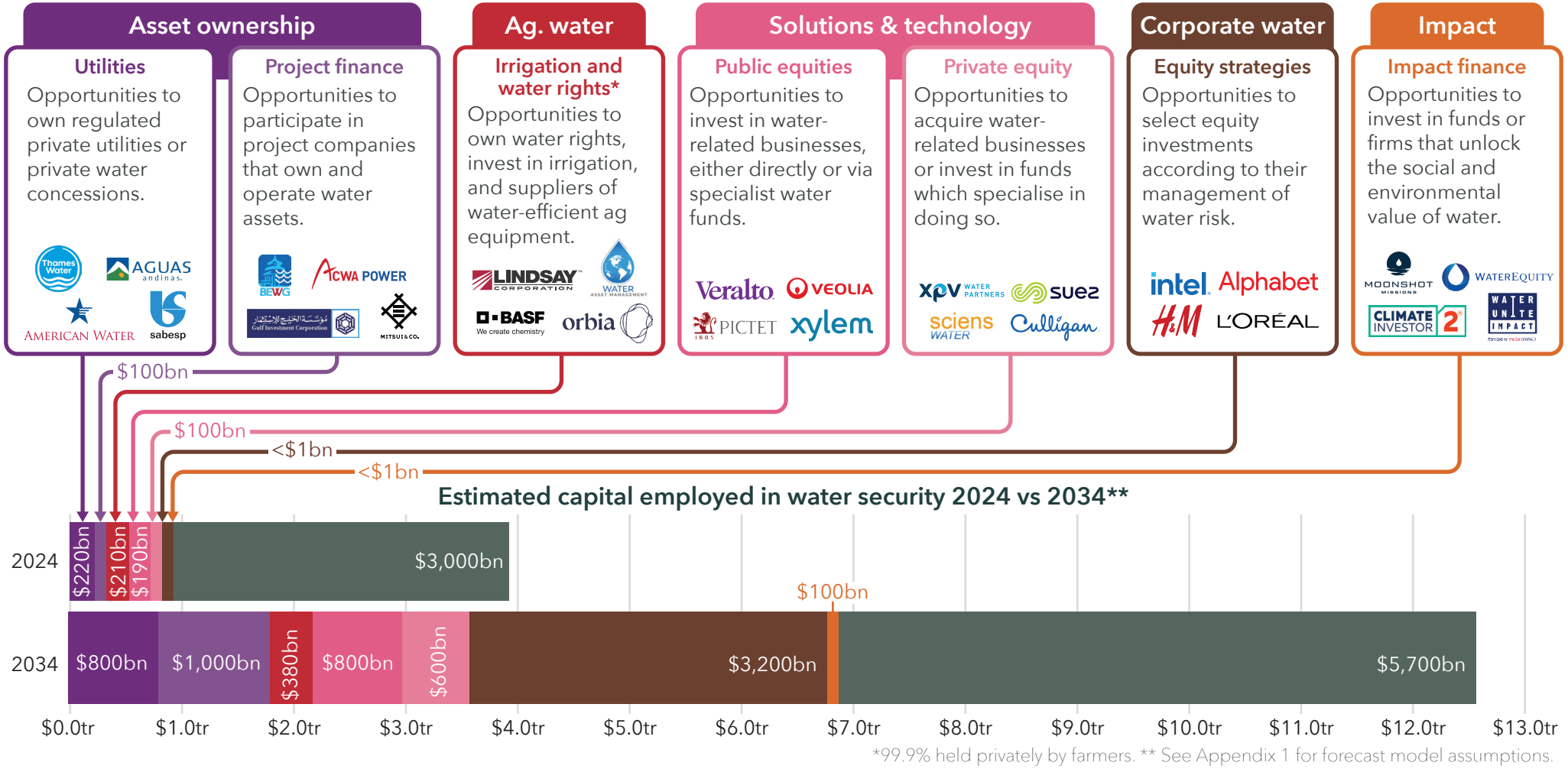
That is the point of this report: to outline the scale of the opportunity to the fund management sector, and to open up the debate about how it can most effectively be realised.

Christopher Gasson
Publisher, Global Water Intelligence
February 2024

Executive summary

Investing for water security will emerge as the biggest global investment theme over the next decade.

This will be driven by necessity: at least 69% of the impact of climate change is expressed through the water cycle. As global temperatures rise beyond 1.5°C above the pre-industrial norm, the world will need to adapt, and the focus this brings to the water security theme will open up new opportunities for private capital. Currently, around 78% of the capital employed in delivering water security is supplied by the public sector. Over the next decade, *Global Water Intelligence* predicts that this will fall to 43%, while the total capital employed in water security-related assets will rise from $3.8 trillion to $12.6 trillion. This report aims to explain the reasoning behind this trend, and to highlight the opportunities arising from it.



*99.9% held privately by farmers. ** See Appendix 1 for forecast model assumptions.

Executive summary

Water is the silent partner in all human activity. For thousands of years we have assumed that it will be there to facilitate our ambitions. Over the next decade that assumption will be challenged as never before. This will drive a surge of investment.

Why water security?

Water is becoming less reliable.

- **Climate change** is increasing the intensity of droughts and floods. The value at risk from water-related events is expected to reach $3.1 trillion by 2034. Cities, industries and farmers will all need to invest to accommodate the new reality of water.
- Increased **pollution** and the **overexploitation** of freshwater resources have an economic impact beyond their environmental impact. The marginal cost of accessing high-quality freshwater resources is rising steeply. New water quality regulations (around PFAS and other emerging contaminants, for example) are driving up the cost of compliance exponentially.
- **Rapid urbanisation** puts new demands on water resources and distribution infrastructure, as well as wastewater management. It has created an infrastructure gap in emerging markets that will cost trillions of dollars to close.

How to invest?

There are core water security investment strategies.

- **Solutions and technology**

Cost avoidance will be an important driver of investment in new technologies and services. It will create opportunities across the municipal, industrial and agricultural water markets. The key investment themes will be:

- **Water availability**
  Technologies for conservation, desalination, and water reuse will make a difference.
- **Water process efficiency**
  Along with digital technologies that improve the productivity of the water industry, we can lower demand for energy and chemicals.
- **Water quality**
  As water usage becomes more intensive, technologies for measuring and maintaining good water quality will become ever more valuable.

- **Asset ownership**

Water infrastructure has a unique value profile. It enjoys steady demand over long time periods, regardless of economic cycles and external shocks. It means that water infrastructure offers investors access to uniquely low-risk, long-term yields. Currently most water infrastructure is owned by governments, with around 11% of the market accessible to private investors. This is likely to change as the growing challenge of managing water in cities creates massive demand for additional infrastructure. New financing models will be required.

- **Corporate water management**

Businesses use twice as much water as households. It means two things. First, they are a significant market for water technologies and solutions; and second, they are greatly exposed to water risk in their operations. As the prevalence of droughts and floods increases, and regulations relating to industrial discharges become more challenging, water is becoming an increasingly important determinant of corporate profitability. Investors can benefit from this either through investing in solutions providers, or by backing businesses with the most effective water security strategies.

Additionally, there are growing opportunities for investors in **agricultural water** (irrigation solutions and water rights ownership) and in **impact finance**.

Water: the basics

What you need to know

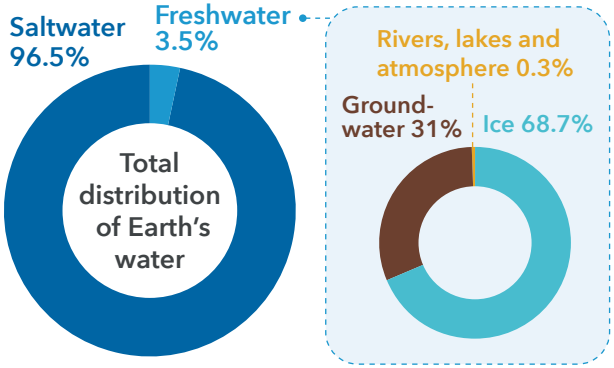
We need it to survive

Humans can only survive 7 days without water.

Humans are 60% water

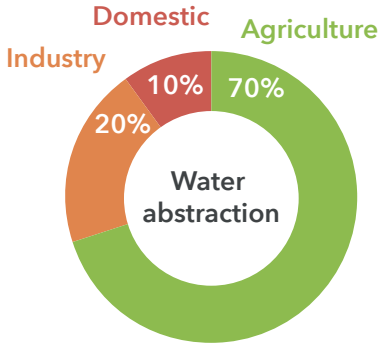
Fresh water is limited

Less than 3% of the world's water is fresh. Much of that is unavailable for human use.



Farming is thirsty

Agriculture is responsible for 70% of withdrawals.



Water is heavy

It weighs in at 8lbs per gallon (1kg/litre) and is expensive to move long distances.

Water is a vector for energy

It is used to power turbines, to heat and to cool, and to transport.

Water has no substitute

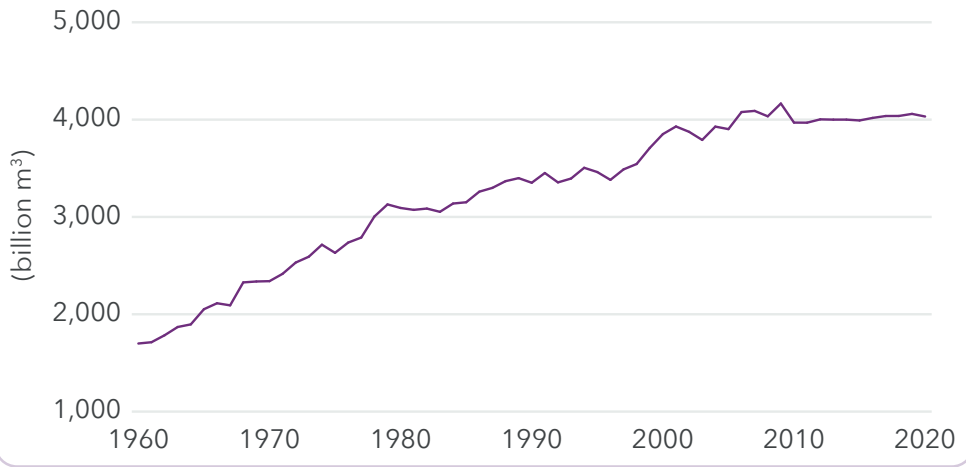
There are many alternatives to fossil fuels but no alternatives to water.

To produce...

- A plastic water bottle — 1.5 gallons / 5.7 litres
- A single sheet of paper — 1.3 gallons / 5.1 litres
- An apple — 25 gallons / 95 litres
- Single washing machine load — 22 gallons / 83.3 litres
- Chat GPT interaction — 17 ounces / 500 millilitres
- Cotton shirt — 659 gallons / 2,720 litres
- 1lb of beef — 1,852 gallons / 7,012 litres
- Pair of jeans — 2,866 gallons / 10,850 litres
- Car — 17, 832 gallons / 67,500 litres

(XPV, 2023)

Annual freshwater withdrawals



Water investment strategies

What are the options for investors looking to take advantage of the water security theme?

Water security will be the biggest global investment theme over the next decade. That is because the global economy depends on water, but water is becoming less dependable. Climate change, demographic trends and the overexploitation of the world's natural resources are together forcing water security to the top of the agenda. In the long term, the global economy cannot grow without first fixing water. It means that anyone responsible for an investment portfolio must develop a water security strategy right now. It is the most effective way to hedge against the financial impact of the big planetary risk we currently face.

There are three strategies to consider:

Corporate water

How do you invest to improve water security rather than accept the losses of growing insecurity? It demands investors adopt a new mindset, developing a deep understanding of the meaning of water security in the corporate context.

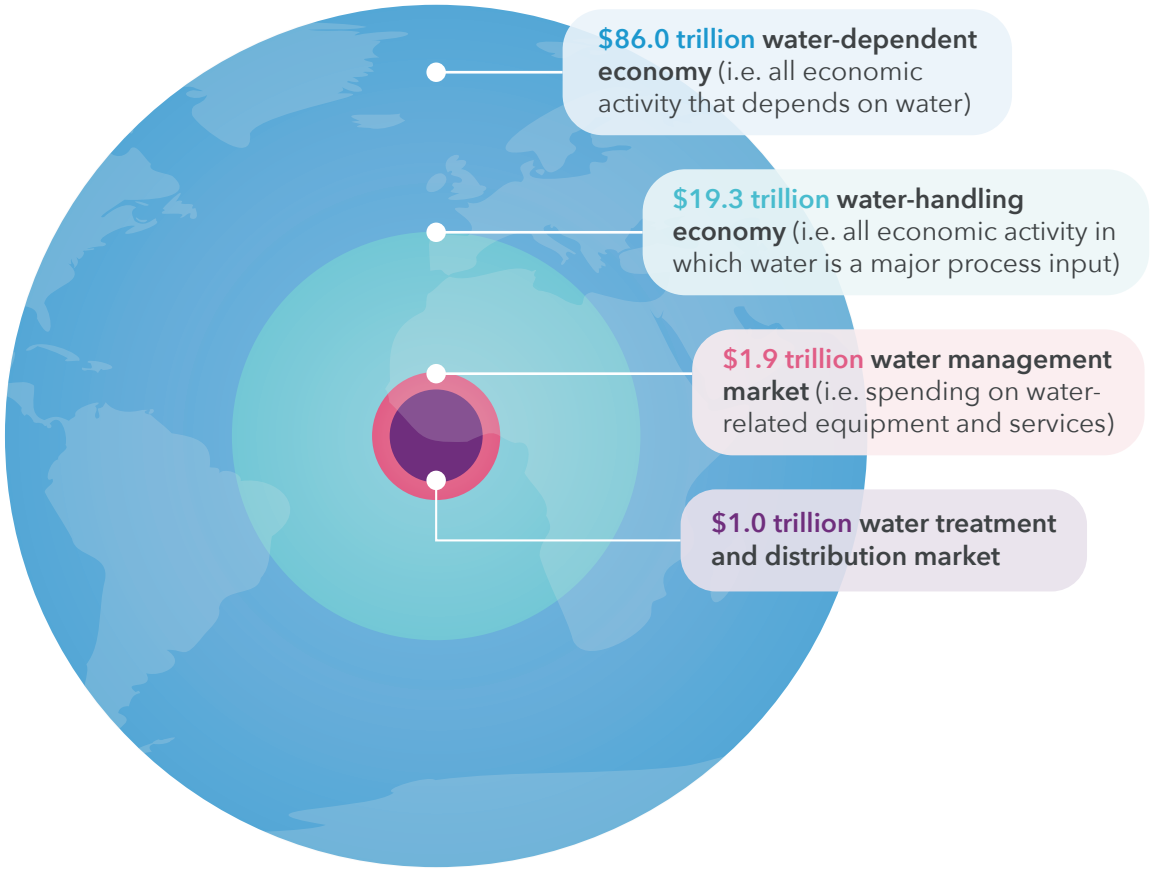
Solutions and technology

The pressures on the water cycle are accelerating the opportunity for technology in the water sector. Themes which offer a double benefit, such as digital systems – which deliver both cost avoidance and increased productivity – and approaches to resource recovery – which find value in waste – offer particular attractions.

Infrastructure

At the heart of the water investment play are long-term assets that deliver value steadily over decades. The unprecedented levels of investment required are driving new creativity in both the solutions developed and the financial structures used.

The global water-related economy by estimated 2024 revenue



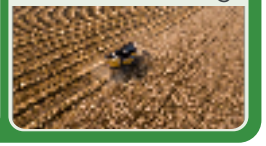
The water security imperative

What are the mega-trends that are shaping the future of water?

Land use change

Deforestation

Intensive farming



Climate change

Floods/rising seas

Drought

Industrialisation

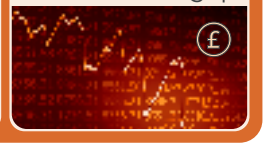
Discharges

Increased demand

Urbanisation

Population density

Infrastructure gap



Overabstraction, river levels fall, and groundwater levels fall

Pollution

Water insecurity

Too much

Solutions:

- Digital monitoring & control — T
- Nature-based solutions — I
- Flood defences — I
- Land use regulations — P

Challenge

Under-developed financial model

Too little

Solutions:

- Desalination & reuse — T I
- Resource development — I
- Conservation — P
- Rights trading — M

Challenge

Energy intensity & managing demand variability

Poor quality

Solutions:

- Treatment — T I
- Nature-based solutions — I
- Regulation — P
- Effluent trading — M

Challenge

Treating emerging contaminants & value recovery

Limited access

Solutions:

- Decentralised solutions — T I
- Water & wastewater networks — I

Challenge

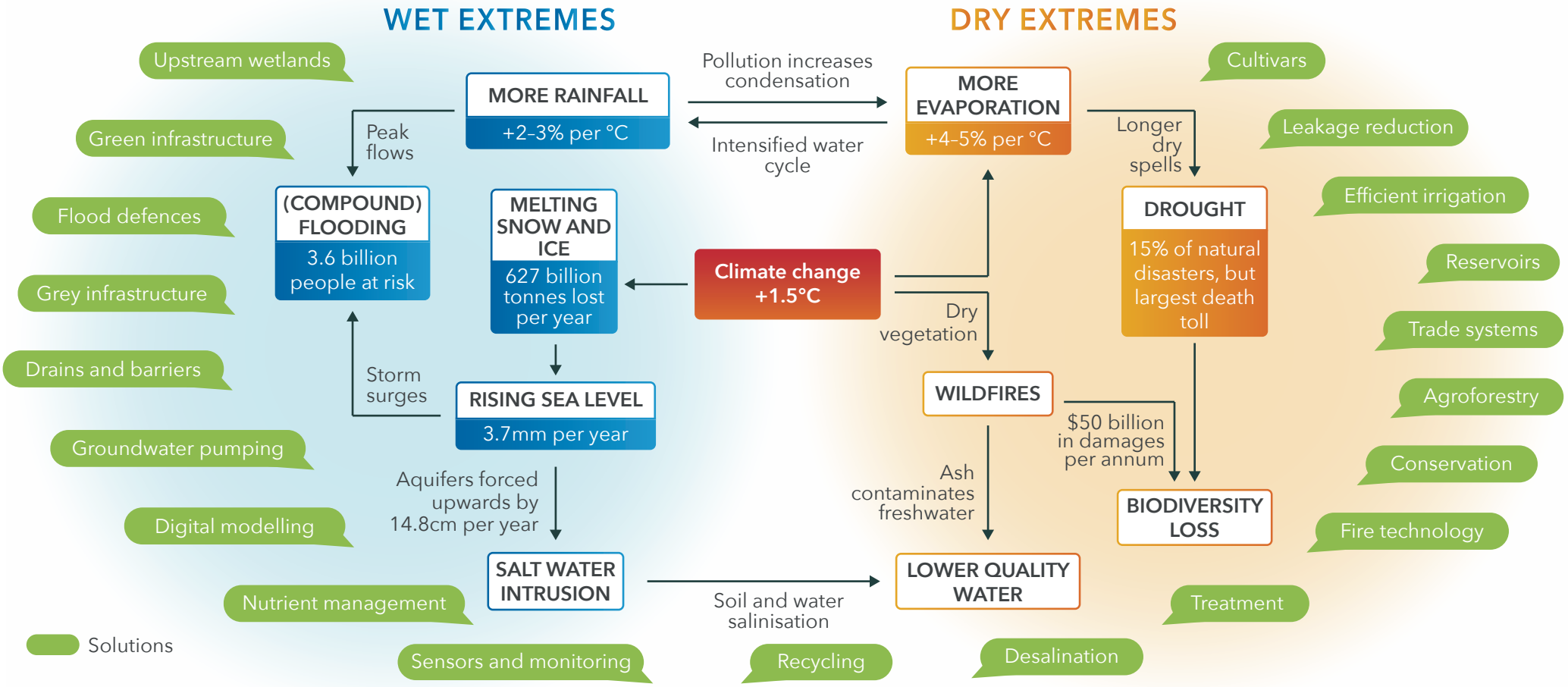
Affordability & attracting private capital

T TECHNOLOGY I INFRASTRUCTURE P POLICY M TRADING

Climate dynamics

How is climate change affecting the water cycle?

In 2023, the mean global temperature reached +1.48°C above the pre-industrial level, boosted by the return of El Niño. As this ocean-warming effect continues into 2024, there is a real risk that the UN's +1.5°C limit for climate change will be reached this year, and at some point in the next decade, +1.5°C years will become the norm. This will lead to the intensification of the impacts of climate change. The thesis of this white paper is that these impacts will be largely felt through the water cycle, and water-related investment will need to rise sharply to reduce their economic impact. The graphic below shows how it might play out.



Value at risk

Investment in climate change adaptation will become imperative.

Value at risk and investment in climate change adaptation

The International Energy Agency expected more than $1.7 trillion to be invested in the energy transition in 2023. The UN Conference on Trade and Development suggests that total annual spending between 2023 and 2030 should be $7.3 trillion in order to complete the transition to renewable energy.

This investment gap implies that climate change adaptation will become an urgent global priority over the next decade. It too will require massive capital deployment. **If we fail to keep global average temperatures within the UN's proposed limits, the potential damage to the global economy will be many times the cost of the energy transition.**

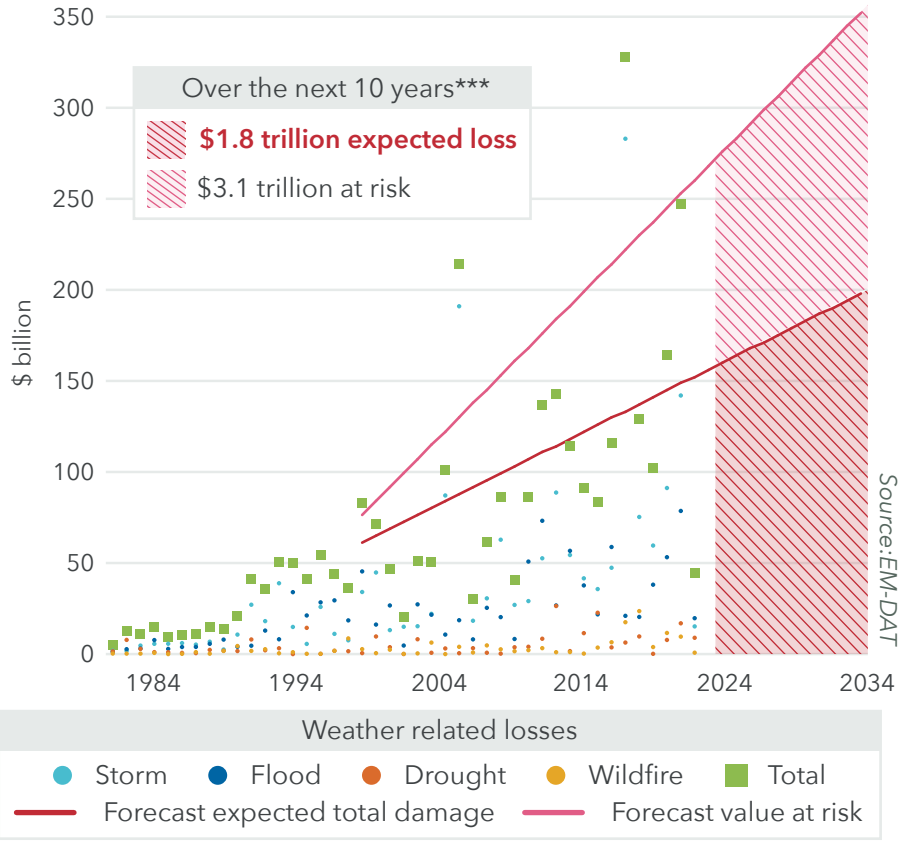
The rationale for climate change adaptation investment is therefore based on the value at risk that arises from any failure in our ability to mitigate climate change. This makes it different from other investment trends, which are typically driven by the sudden availability of productivity gains or market growth. However, as we have seen with the energy transition, as the theme develops, the productivity gains and market growth become apparent.

The graph opposite shows how weather-related insurance losses have grown steeply over the past decade. These direct losses do not present the full picture of the damage caused by climate change: much of the loss is not insurable. Nevertheless, the data illustrate the relationship between climate change and the growing value at risk from weather-related events.

Water is a common theme in these losses, and its management is a common theme in our efforts to adapt to higher global temperatures.

Direct losses

An analysis of global insurance losses to water-related events since 1980 shows a steep increase which correlates with climate change. By 2034, damage from water-driven events will reach an average of $200 bn* per year, with a maximum possible loss in a calendar year of $350 bn**.



*All values adjusted to 1st Sep 2023 USD. **95% value at risk. ***1st Jan 2024 to 1st Jan 2034.

Value at risk

What proportion of climate risk is water related?

Water management holds the key to climate adaptation

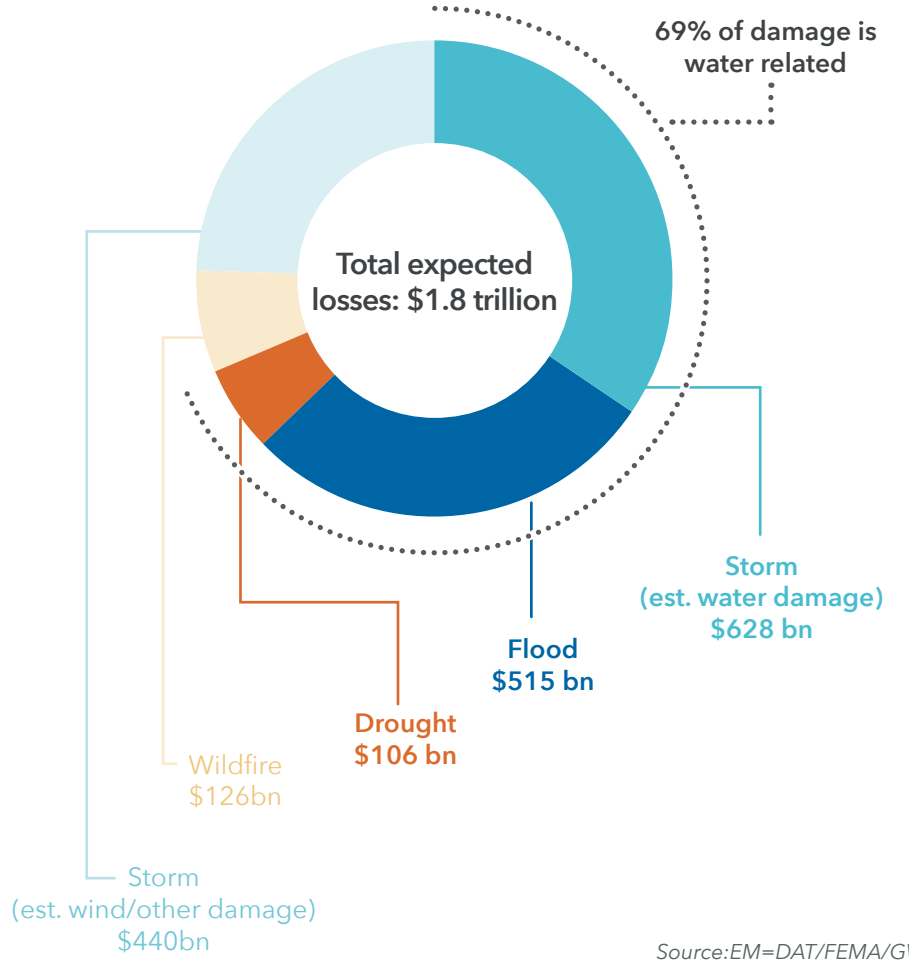
For this white paper we conducted a study of weather related insurance losses going back to 1980 using the EM-DAT database. We then projected the historic trends forwards to determine the expected weather related losses over the next decade. We then divided these losses between those for which water was the primary cause (e.g. droughts, and flooding) as those for which it was not (e.g. wildfires and some storm damage). Data from FEMA in the US suggests that 59% of storm damage is flood related. Applying that ratio to flood loss forecast allows us to conclude that around 69% of the insurable impact of climate change is felt through the water cycle. We draw the following additional conclusions:

The actual direct economic impact of climate change is much greater than the direct insurance losses. Specifically the costs of extreme droughts are likely to be significantly understated in the insurance data.

At least 69% of investment related to climate change adaptation will focus on the water cycle. Although water cannot be fully managed, it is more manageable than the other two major elements of atmospheric change: temperature and wind. Infrastructure and technology can make water available wherever it is needed. Floods can also be managed if we are prepared to make the investment. We can use air-conditioning to cool buildings, but it won't quench a wildfire and nothing can stop the wind.

The unimaginable will rapidly become normal. The global economy has been built according to a set of assumptions about atmospheric risk that are no longer tenable. It will need to be reshaped to match the new reality. It means that the water security theme should be at the heart of every fund manager's strategy.

Expected losses 2024–2034



Source:EM=DAT/FEMA/GWI

Corporate water investment

Industry uses twice as much water as households. Investors should take note.

Water is both a category of expenditure and a category of risk for corporate water users. It is a category of expenditure because most industrial processes require water as an input. Currently around 3% of corporate capital expenditure goes towards water-related infrastructure and systems. As a category of risk, however, water is far more significant, but under-appreciated. The thesis of this report is that over the next decade, the scale of the inherent risks will emerge as a significant driver of corporate value, with two implications. Expenditure on water management will accelerate; and water will emerge as a trillion-dollar theme for investors picking stocks.

Why will capital employed grow 6x?

Our prediction is that capital employed in delivering corporate water security will grow from $500 billion in 2024 to $3,200 billion in 2034. How is this confidence justified?

The first point to make is that this estimate of capital employed includes both the physical water management assets owned by corporate water users, and the assets under management deployed by investors pursuing the water theme outside traditional water industry stocks.

At the moment, almost all the $500 billion relates to physical water management assets. Perhaps only $1 billion is deployed by investors pursuing water as an ESG theme. Over the next decade, we expect the total value of physical assets to reach $2.2 trillion as a result of accelerated investment by corporate water users, but the value of assets under management pursuing the water theme will grow to reach $1 trillion. This will happen for the following reasons:

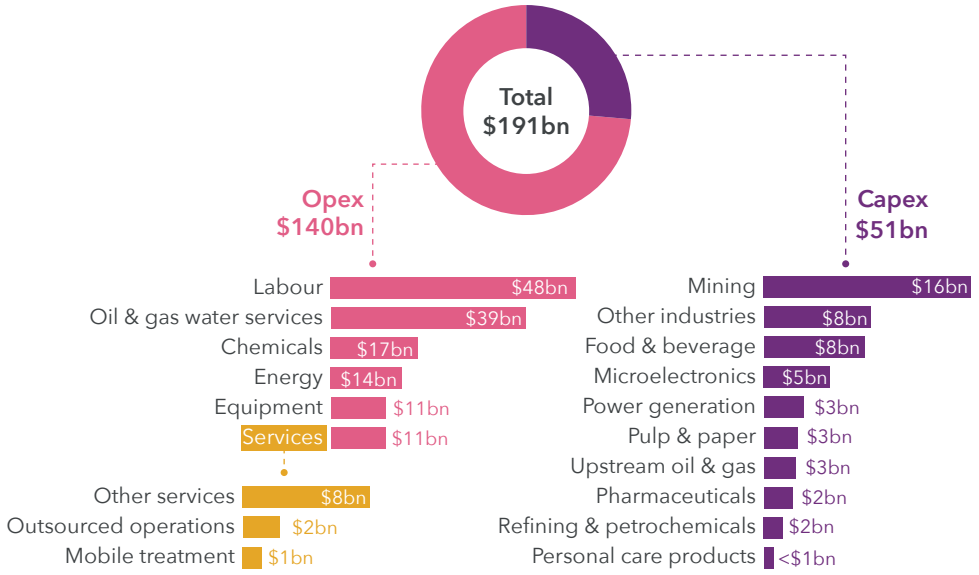
Public concern about climate change will switch to focus on its impacts. The most significant impact of rising atmospheric temperatures is on the reliability of the water cycle.

Water will emerge as a key ESG strategy for fund managers and their clients. It is uncontroversial compared to other themes, easily relatable, and can be expected to outperform.

The value at risk from water insecurity is growing exponentially. It is difficult to track on the basis of data availability, but the growth of corporate losses relating to water risk is likely to reflect the growth of insurance losses outlined on the previous slide.

Who is most exposed to water?

The industries which spend the most on managing water are also the ones most exposed to water risk. The largest volumetric water users are power generation, oil and gas, chemicals, and mining. These industries are exposed to water availability and licence-to-operate issues. Smaller-volume users such as food & beverage, textiles, and personal care are consumer-facing, and are therefore more exposed to reputational risk if they mismanage water in sensitive areas.



Source: GWI WaterData

Corporate strategies

How can businesses turn their water risks into opportunities and achieve a triple bottom line?

The investment agenda

There is a triple bottom line for water investment in industry: it can drive corporate profitability, benefit the environment, and bring businesses closer to the communities they serve. The key challenge is to understand both the drivers of change and the opportunities that arise from them.

The drivers of change

Value at risk: The increased intensity of floods and droughts, together with growing pressures on water resources and declining water quality, is putting value at risk both within businesses and within their supply chains.

Regulation: Tighter regulation of water quality is forcing industrial water users to rethink their process and wastewater strategies. It is no longer economic to think of used process water as a vector for industrial waste.

Customer preferences: Consumers are increasingly aware of the global water crisis: they won't buy products that they think will make it worse.

The opportunities

Water reuse: There are financial benefits from on-site water reuse even when there is no pressure on water resources. It gives businesses better control of their process water, it saves on water bills, and it saves on discharge costs.

Value recovery: Used water can become a resource in itself. It typically contains energy (either in the form of heat or material from which biogas can be recovered), traces of product, and raw materials. Circular thinking is a big potential driver of value across industry.

New products and services: The biggest opportunity for businesses in the water crisis is in understanding how it is changing customer needs across the value chain. These include concepts such as permeable concrete (for flood risk reduction) and water efficiency.

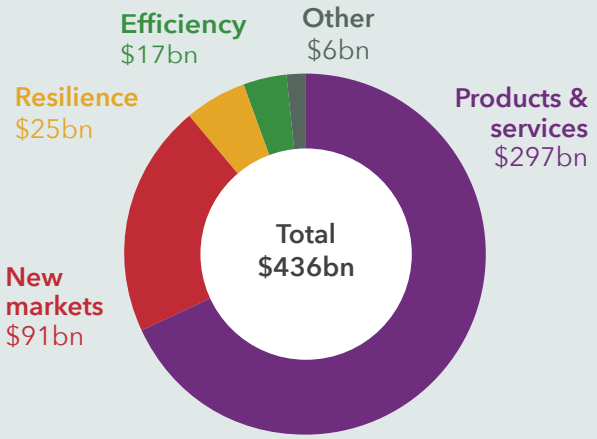
What does business say?

The global environmental risk disclosure organisation CDP conducts an annual survey of water stewardship. Its 2022 Global Water Report synthesised responses from 3,909 companies. It found:

Global brands report water-related opportunities worth $436 billion.

The opportunities are four times greater in those firms which have integrated water into their business strategies.

Applying an internal price estimation of the value of water is the most effective way of uncovering the opportunity in water.



Source: Self-reported, CDP 2022

Solutions and technology

How innovation holds the key to water investment

Our forecast model suggests that the total value of water solutions and technology companies will increase from $290 billion to $1.4 trillion between 2024 and 2034 - a 4.8-fold increase. This optimism is based on the fact that as demand for water infrastructure investment increases in the utility, industrial and agricultural sectors, so will demand for innovative solutions and technologies. That is because the challenges are becoming more complex, and without innovation, more expensive. This will increase the profitability and value of the suppliers which deliver that innovation. This slide describes the environment in which these businesses exist.

Understanding the supply chain

Conception and project design: When a utility or an industrial water user needs to expand or upgrade their water systems or infrastructure, they will typically approach a design engineer first to define the scope of the project. Professional firms such as Jacobs, AECOM and Stantec are leaders in this field.

Project delivery: Public utilities are required to publish open tenders and award to the lowest bidder, which restricts innovation. Industrial customers typically tender in private, and award to the supplier which offers the best overall value, creating space for innovation.
US: In the US, the engineer will draw up a detailed specification which will then be put out to a local construction company to procure and deliver the contract to specification. Increasingly, engineers offer to share the cost of overspends on construction.
Rest of the World: Outside the US, the EPC (engineering, procurement and construction) contract is the norm. This gives contractors such as Acciona, Aqualia, Suez, and Veolia a much greater role in project design. Some contracts require the contractor to supply operations and finance as well as project delivery. This gives greater recognition of lifecycle costs, although it is rarer in the US.

Technology and equipment supply: Water projects typically comprise civil engineering, electro-mechanical works, basic equipment such as pipes, pumps and valves, as well as specialist technologies. Xylem, Veolia, Veralto, and DuPont are leaders in this sector.

Distribution: The water supply chain is highly fragmented, which means that significant value is lost in the network of distributors, wholesalers, and agents which stand between the suppliers and the end-user customers. This sector is the focus of consolidation in the US, led by companies such as Core & Main, Vessco and United Flow Technologies.

Operations and services: Recurring revenues in the water sector come from long-term service contracts, the supply of chemicals and consumables, and outsourced operations. Veolia, Suez, and Ecolab are the leaders in this sector. Testing and quality monitoring are also important long-term markets, with Veralto and Xylem leading those segments.

Where is the growth?

The next seven pages outline the opportunities for solutions and technology companies across the three most important water investment themes: water availability, water process efficiency, and water quality. Within these themes, there are some key value creation strategies:

- **Decentralised systems:** Historically, water and wastewater have been managed through large centralised systems. Decentralised alternatives increasingly look cost-effective.
- **The circular economy:** The value-from-waste proposition promises to turn environmental liabilities into profit centres.
- **Remote monitoring & control:** This revolutionises the service offering that technology suppliers can provide.
- **Big data and AI:** Historically, water networks have been manually operated, with limited scope for optimisation and effective trouble-shooting.
- **Emerging contaminants:** The public are increasingly concerned about the purity of the water they drink, and regulators are responding with new rules that test the very limits of detection and treatment technology.
- **New markets:** Agriculture is emerging as a significant new market for water technology companies, as irrigators become more sophisticated in their water management. Wildfire suppression could also become an important new market.
- **Energy and water:** New linkages between water and the renewable energy market are emerging with the hydrogen economy, solar desalination, biogas recovery from wastewater, energy mineral refining, and pumped storage.

Investing for water availability

The mismatch between water supply and demand is getting more acute.

Water is endlessly renewable, so it won't run out. The challenge is how much is available of the right quality in the right place. This kind of water stress is driven by three factors:

Too much demand in areas of low natural availability

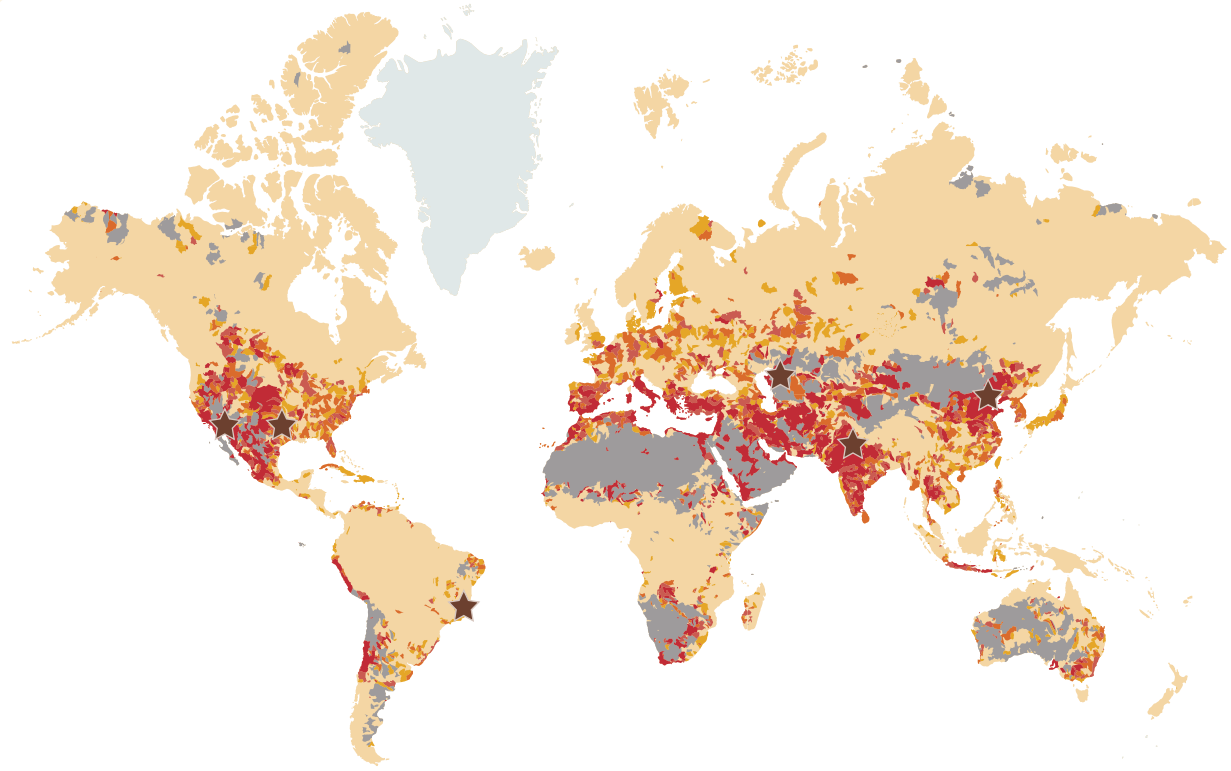
This has been exacerbated by population growth and economic development in urban areas in arid regions.

Extreme droughts related to climate change

Nowhere is safe. Even relatively wet cities such as Rio de Janeiro and Montevideo have come close to running out of water.

Excessive groundwater withdrawals

Many of the world's most productive agricultural regions are fed by non-renewable groundwater. It is starting to run out.



Historically, the response to water scarcity has been to increase water storage capacity, to tap distant freshwater resources, and to pump more groundwater. In future, the most important solutions will be:

Conservation

Reuse

Desalination

Investing for water availability: conservation

The simplest solution to water scarcity is to use less

Telling people to use less water is the cheapest and most effective short-term response to drought. It is not an investible strategy, however, and it is not effective in the longer term. That is because direct cuts to water use have an economic impact in agriculture and industry, and many household uses of water contribute to quality of life. The best longer-term solution is reducing wastage and improving the efficiency of water use. This is an investible strategy.

Leakage reduction: On average, around 30% of the water supplied by water utilities around the world is lost to leakage. This is an economic loss to the sector, and it exacerbates water scarcity. Technologies to detect and address leakage are a significant opportunity for investors. Increasingly we are also seeing performance-based service contracts being used to tackle the problem.

Customer communication: Most water customers don't know enough about their water usage to respond effectively to water conservation campaigns. Smart meters which can identify leaks on the customer's premises and identify the most water-intensive applications make it possible for customers to conserve water more effectively See page 20 on investing in digital solutions for further details.

Efficient irrigation: Agriculture is responsible for 70% of water use, and has the greatest scope for improved efficiency. Irrigation systems, water-efficient crop varieties and agricultural chemicals are the key opportunities. See page 26 on agricultural water investment for details.

Water-efficient products: There is a growing market for appliances that save water (such as toilets and washing machines) and consumer products that require less water when they are used (such as shampoos and detergents).

Rainwater harvesting: Collecting and conserving rainwater is growing in popularity. This can involve storing rainfall run-off in tanks, or installing permeable surfaces that ensure that stormwater percolates into aquifers.

Australia's Millennium Drought

Between 1996 and 2010, Australia experienced its worst recorded historical drought. Its major cities responded with extreme conservation measures and investment in water production infrastructure. Melbourne, for example, built a $5.4 billion desalination plant, only completed after the drought broke. The main reason the dams did not run dry was because the city used less water: consumption fell from 247 litres/head/day in 2000 to 147l/h/d in 2010. Since that drought, urban water strategies have evolved: there is an appreciation that water is an essential component of the liveability of cities during extreme heat, and that focusing on smart water use rather than total consumption is the best approach.

Cape Town's Day Zero

In 2017–18, there was a real risk that the water levels in the dams serving the City of Cape Town would fall below 13.5%, and piped water supplies to households would have to be shut off. The threat of this "Day Zero" sent a strong conservation message to households, and overall water use by the city fell by 50% during the drought period. Eventually the drought broke before Day Zero arrived. New water production infrastructure did not play a significant role in addressing the drought, and no significant facilities have been brought online since. Instead, the focus has been on improving the governance and efficiency of the city's water department – creating a world-class utility better placed to manage future droughts.

Megadrought in the US Southwest

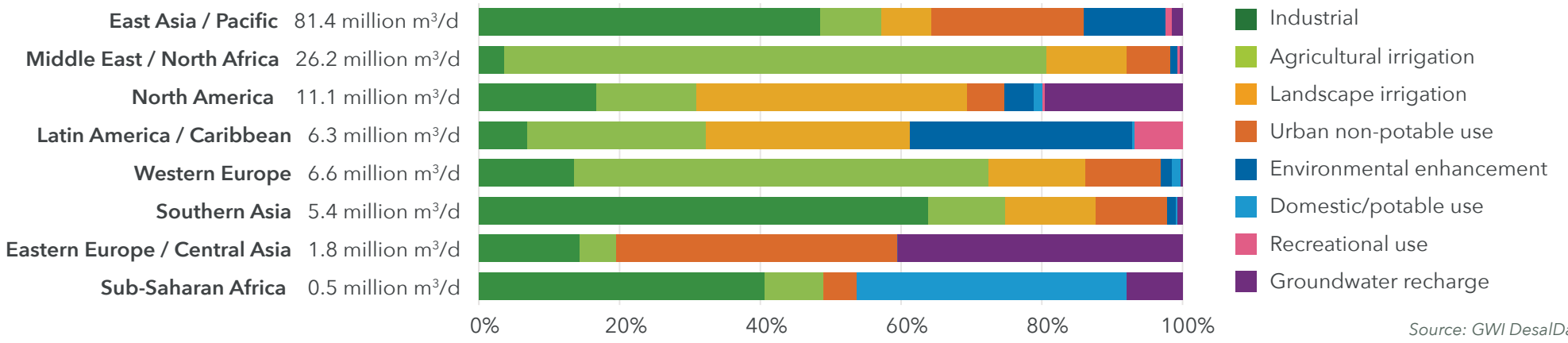
Between 2000 and 2022, the southwestern United States experienced severe and extended periods of drought. There have been no "Day Zero" moments during this period largely because most cities are protected by the seniority of their water rights. At the same time, many irrigators have had access to groundwater, and there has been sufficient storage capacity in the Colorado River system. Looking forward, however, legislation to bring groundwater supply and demand into balance, and the agreement by Nevada, Arizona and California to reduce withdrawals from Lake Mead by 13% will make conservation – and water reuse – a top priority in the region.

Investing for water availability: water reuse

What are the technologies that will solve the water availability challenge?

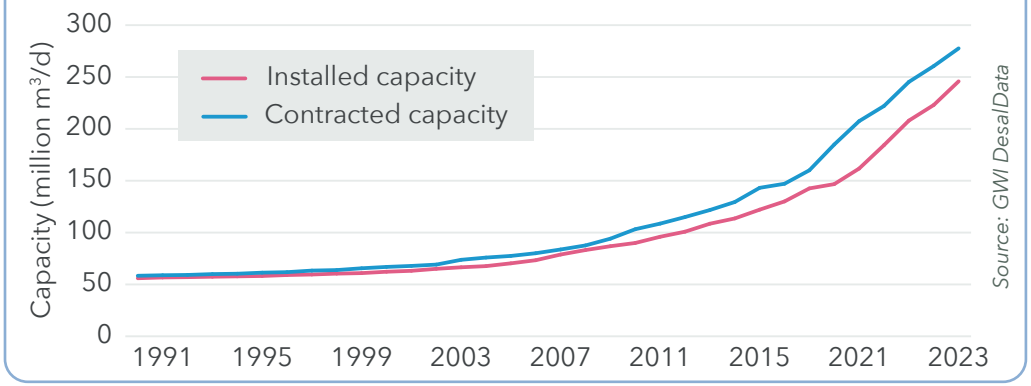
Water reuse is rapidly becoming both an economic and an environmental imperative for industrial water users. That is because on-site recycling of process water enables manufacturers to abstract less water from the environment and use less energy, while reducing costs and improving their water security.

The reuse of municipal wastewater is also growing rapidly, although some inhibitions remain about direct potable reuse.



Source: GWI DesalData

Growth in global water reuse capacity



Water reuse investment strategies

There are very few investible companies which could be described as water reuse pure-plays. That is because the recycling theme connects two value chains: wastewater treatment, and water resources. Currently, the main beneficiaries of the trend towards greater reliance on reclaimed water are the engineering firms that design the systems (such as Jacobs, Stantec, and AECOM), and the high-end wastewater purification systems suppliers (such as Veolia, Xylem, and H2O Innovation). Reuse infrastructure investment is still in its infancy, although there is strong potential to develop the opportunity. For example, the UN-supported Green Climate Fund is investing in South Africa's National Water Reuse Programme. The fund views water as an asset class, and sees the potential to create value by acquiring wastewater assets.

Investing for water availability: desalination

97% of the world's water resources are found in the oceans. It is an enormous resource.

Seawater desalination offers an unlimited drought-proof resource for coastal cities. Brackish water desalination addresses the problem of the rising salinity of many groundwater sources. There are three options for investors in the sector: technology, systems integration, and project ownership.

The technology for desalination is now relatively mature: few in the industry expect a novel approach to replace reverse osmosis (RO) in the market for large seawater projects. There are, however, a number of areas where better technology is likely to deliver significant returns:

Energy consumption

SWRO plants typically consume around 3.5 kWh/m³, although 2.6 kWh/m³ has been achieved. The theoretical minimum energy consumption is around 1kWh/m³.

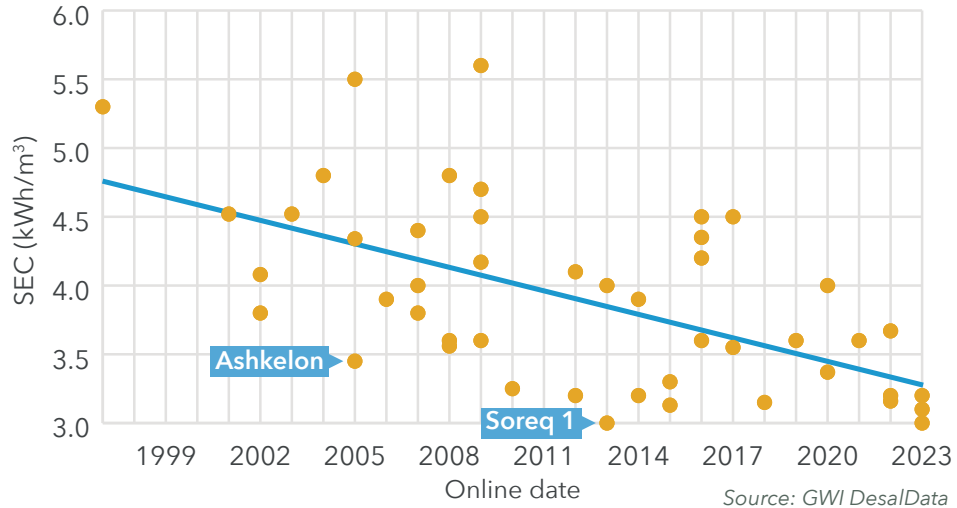
Biofouling

RO membrane performance declines as biofilms form across the membrane surface. Pre-treatment and cleaning protocols can reduce the problem but it has yet to be eliminated.

Value from brine

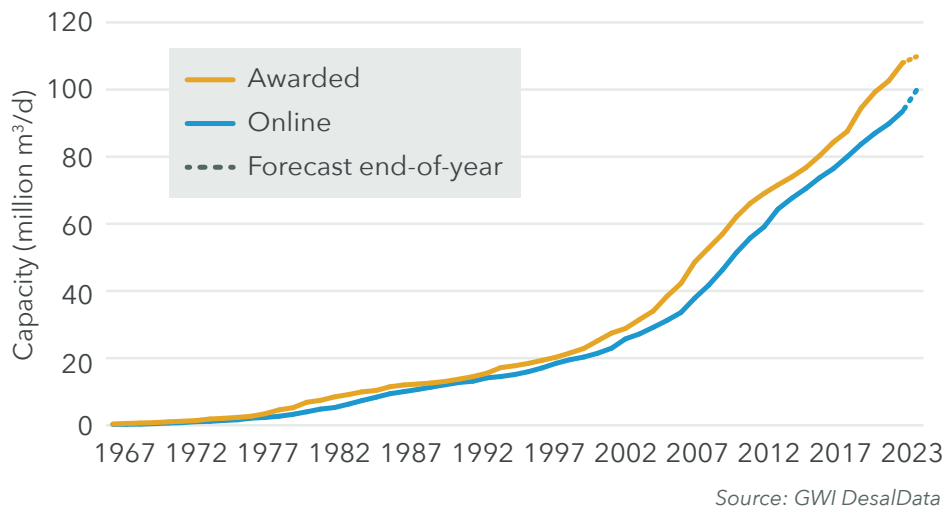
Potentially the largest opportunity in desalination technology is in recovering minerals from the waste stream.

Trends in specific energy consumption



Source: GWI DesalData

Growth in global desalination capacity



Source: GWI DesalData

Investing for water process efficiency

New technologies offer significant scope to reduce the cost of water management.

Rising chemical, energy, and labour costs are inexorably squeezing utility operational budgets, while volatility in supply chains has severely affected the availability of water treatment chemicals. It is very difficult for utilities to increase tariffs enough to absorb these costs. Investment in solutions that can mitigate these factors mean that utilities can do much more with less.

Chemicals

Real-time monitoring of water or wastewater considers load fluctuations, enabling optimal chemical dosing.

Machine learning techniques can recommend optimal cleaning frequencies for equipment, e.g. RO membranes.

Energy

Digital pump optimisation, hydraulic modelling, and improved leak detection can all reduce energy use in the water network.

Better real-time monitoring of wastewater influent and effluent optimises aeration, while new technologies such as membrane aerated biofilm reactors mean more efficient transfer of oxygen to bacteria.

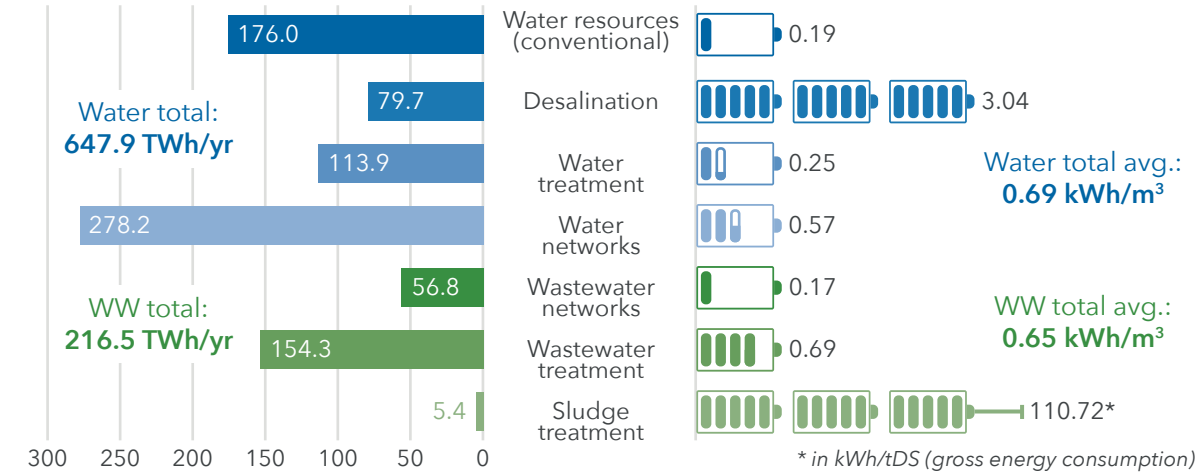
Labour

Technology for accurate remote inspection of assets reduces the frequency of manual inspections.

Artificial intelligence can analyse thousands of hours of sewer footage, identifying defects and recommending courses of action.

Energy-hungry

Outside of desalination, water networks and wastewater treatment are the most energy-intensive parts of the water cycle. For WWTPs, aeration accounts for 60-70% of total energy consumption.



Total global energy consumption: **864.3 TWh/yr** Average global energy intensity: **0.91 kWh/m³**

XPV portfolio company: LuminUltra

Traditionally, microbiological management was undertaken using laboratory tests that took days for results to come through, but focused exclusively on a handful of known health risks, while ignoring a litany of other impacts.

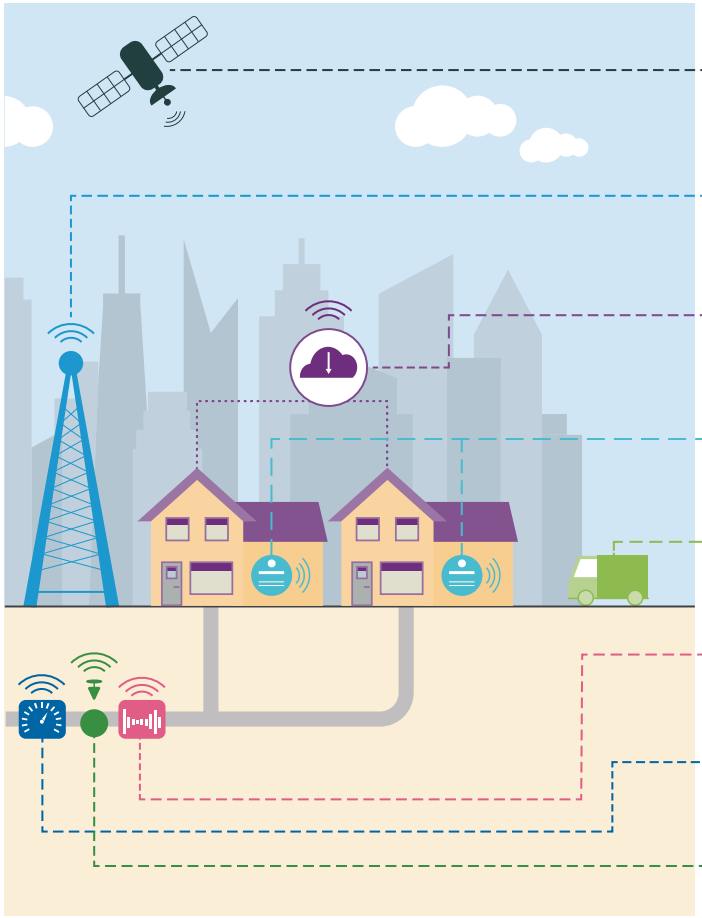
LuminUltra is leading the water microbiology revolution with a suite of in-line, at-line and mail-in solutions proving fast, accurate and comprehensive results to reduce health risks, chemical costs, and energy consumption.

Investing in digital solutions

Why are digital and AI solutions essential for any water security strategy?

The advent of digital services is bringing a revolution in productivity to the water industry. Traditionally, the water industry has been heavily reliant on inflexible concrete and manual operations. Smart solutions incorporating remote monitoring and control, digital twins, and artificial intelligence are bringing dramatic savings in terms of cost avoidance and improved labour productivity.

The two main opportunities in drinking water supply are reducing leakage, and extending the life of underground assets.



Satellites
Imagery taken by satellite can be used to find leaks by looking for new and abnormal patches of vegetation, or by examining imagery for the spectral signatures of potable water in the soil.

Telecommunications
Underground physical assets can be connected to telecoms so they can be installed permanently and transmit data remotely.

Smart analytics
Platforms combine and analyse data from physical assets to produce actionable insights that help utilities operate the network as efficiently as possible.

Smart meters
These precisely monitor consumption and transmit data so that they can be read remotely. High-resolution data is analysed to allow customers to manage and optimise their water usage.

Condition monitoring
Technologies are now available to inspect the state of pipes and determine the risk of leakage.

Acoustic loggers
The most commonly used tool for active leak detection. They listen for noises in the pipe that may indicate leakage.

Pressure sensors
These devices can sample the flow 128 times a second to identify pressure waves that may damage pipes.

Pressure control
Advanced analytics services enable utilities to dynamically adjust control valves.

Metron-Farnier
Smart Water Meters & Systems

XPV portfolio company: Metron-Farnier

Metron-Farnier's WaterScope platform helps users visualise and understand water consumption driven by leaks, toilet flushes, showering, garden irrigation, and other uses. Combined with smart meters that gather data every minute, the company is offering utilities and their ratepayers the clearest possible view of how water is being used or lost, empowering them to make smart decisions about their next actions.

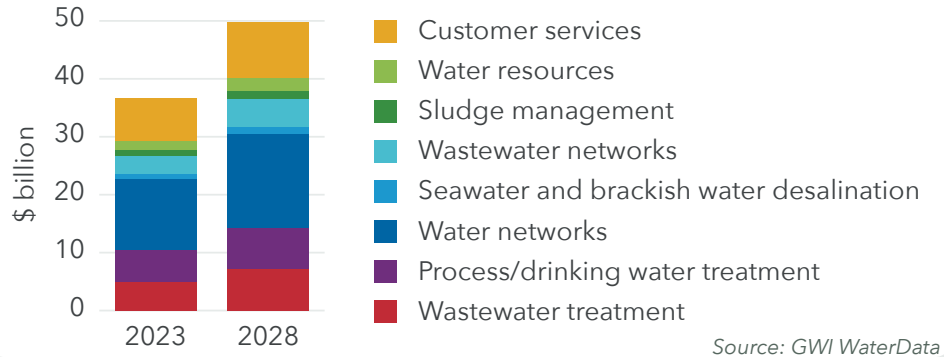
Investing for water quality

Smart solutions can make the wet side of climate change more manageable.

By 2040, the mean global temperature will reach 1.5°C above pre-industrial levels. Investment must focus on adaptation over prevention. Wet extremes will intensify. All forms of flooding will increase due to rising sea levels and heavier rainfall in wet regions, placing up to 3.6 billion people at risk by 2040. Aquifer quality is also under risk of saltwater intrusion from rising seas. On the other hand, dry events and water scarcity threaten to increase droughts and wildfires. The intensification of the water cycle and water-driven events can be met with investment to mitigate these likely risks, and this paper will further discuss these potential solutions.

Market outlook

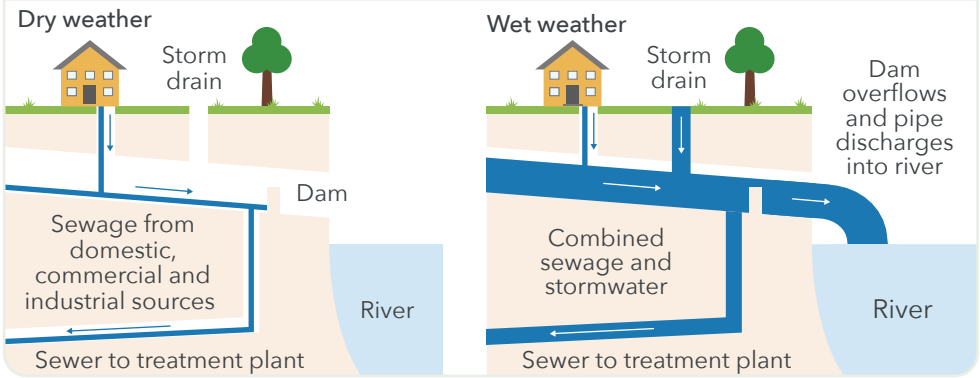
Digital technologies for water and wastewater management are expected to become a $50 billion-a-year market over the next five years:



Source: GWI WaterData

Combined sewer overflows

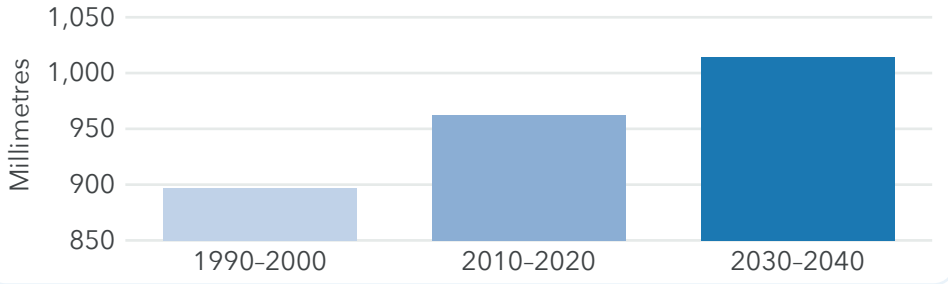
Without smart technology, the cost of separating stormwater flows from wastewater flows could top $500 billion globally.



The world is getting wetter

Precipitation events are becoming more intense, and average annual precipitation is rising.

Source: NASA, NCEI



XPV portfolio company: SmartCover

SMARTCOVER
WE'VE GOT IT COVERED™

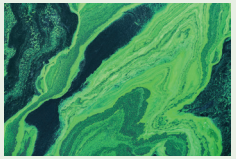
Maintaining underground infrastructure costs American cities billions of dollars per year. Spills caused by failing and ageing systems cost billions, too. SmartCover's technology is helping 800+ cities in North America build resilience with real-time visibility and predictive analytics for their sewer and stormwater collection systems. SmartCover is helping utilities prevent spills, optimise maintenance, identify inflow and infiltration without the need for costly inspections, and optimise lift station pumping efficiency.

Investing for water quality

As we use more water in agriculture and industry, maintaining quality is a growing challenge.

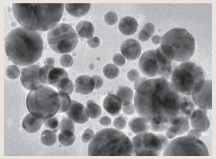
Freshwater quality is in decline globally. It is impacting public health, biodiversity, and the economy. There are three main drivers:

Intensive agricultural practices have led to a build-up of nutrients and salinity in surface water bodies.

The former is destroying the aquatic environment and leading to algal blooms at sea. The latter is steadily impacting agricultural productivity.

Industrial water usage is creating new and complex challenges.

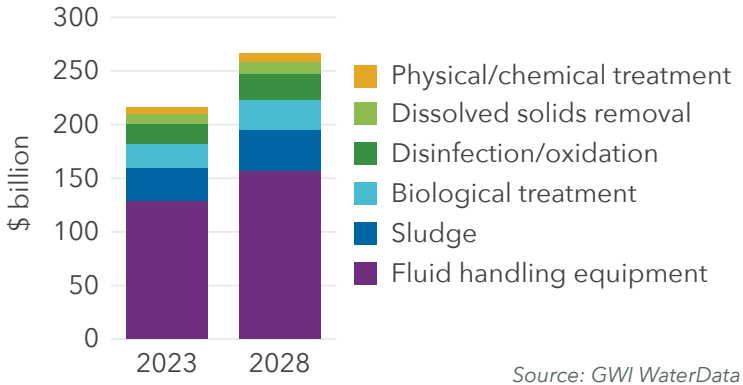



As regulations are increasingly effective at controlling the most egregious pollution, we are identifying the dangers of micropollutants that had previously gone unnoticed.

Households are becoming ever more conscious of the quality of the water they consume.


This is placing new pressures on utilities and creating new opportunities for point-of-use water treatment systems. On the flip side, wastewater production in big cities in emerging markets is a direct cause of drinking water contamination.

The downward trend in freshwater quality is creating new opportunities for water technology companies, both in the supply of water and wastewater treatment systems, and in the development of advanced sensors for water quality testing.



Source: GWI WaterData

XPV portfolio company: Axius Water

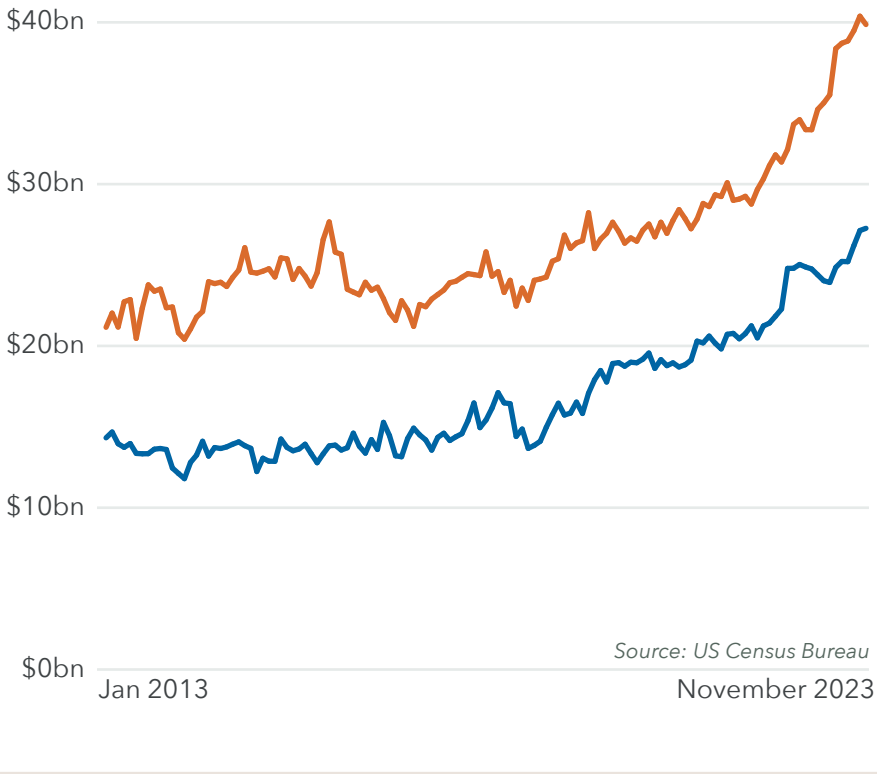
In 2019, the EPA named nutrient pollution "one of America's most widespread, costly, and challenging environmental problems." In response, XPV and KKR created Axius Water, with a mission to drive out nutrient pollution. Consisting of six companies to date (ATAC, EDI, EOSi, Napier-Reid, Nexom, and Triplepoint), Axius process experts have worked together with their customers to prevent more than one billion pounds of harmful nutrients from entering waterways since 2020.

The US water market

What is driving growth in the short term and the long term?

The US water market is worth $235 billion per year in terms of combined capital and operating expenditure. The municipal sector is highly fragmented: there are over 50,000 publicly owned drinking water utilities in the country. The industrial market is enjoying something of a renaissance thanks to the reshoring of manufacturing back to the US.

Capital spending* on water and sewer infrastructure has surged since 2019



* Value of construction put in place on an annualised monthly basis

This surge can be expected to continue, for the following reasons:

The Infrastructure Investment and Jobs Act

This brings $55 billion of additional funding into the water sector, and it has only recently started to filter down into municipal budgets. The Environmental Protection Agency's technical assistance programme should ensure that the funding reaches parts of the highly fragmented US utility sector which have historically struggled to secure the financing they need.

Droughts

Droughts in the western United States are becoming ever more threatening to cities, agriculture, and the economy. The 2020–22 drought reduced water availability in the Colorado basin to the extent that it triggered a 21% forced reduction in withdrawals by the state of Arizona. A combination of exceptional heat and a lack of rain are now creating challenging conditions in Texas, New Mexico, Louisiana, and parts of the Midwest.

Regulation

Correcting combined sewer overflows in order to meet EPA requirements has been a major driver of investment in the US water sector over the past 20 years. That investment pales in comparison to the financing that will be required to take per- and polyfluoroalkyl substances (PFAS) out of drinking water to the detection level. It could well cost more than $100 billion.

Infrastructure renewal

Decades of underinvestment have left water and wastewater infrastructure in the US in a very poor state. The situation is made worse by the fact that networks are ageing unevenly: pipes which were laid 100 years ago were designed to last 100 years, while those laid 70 years ago were designed to last 70 years. The bills are now all coming in at once. Pipe replacement is incredibly expensive but digital technologies can reduce costs by pinpointing the repairs needed.

Investing in asset ownership

How can we drive more private capital to finance water infrastructure?

Water infrastructure is a highly attractive asset class, offering steady inflation-proof yields which are not correlated to other economic activity. Over the next decade, the opportunity for water asset ownership is expected to grow from $320 billion to $1.8 trillion. This will be driven by a sharp increase in the need for infrastructure investment, as well as a switch to a greater dependence on private sector finance (which is expected to rise from 10% to 24% of the total value of urban water infrastructure by 2034). There are two main options for private investors in water infrastructure: project equity (demand for which is likely to grow rapidly) and investor-owned utilities (where growth will be driven by organic investment needs, rather than new privatisations).

Understanding the project equity market

Most large desalination plants and some water and wastewater treatment plants are privately financed. This kind of project has many different names (BOT, DBFO, IWP, etc.) but the essential element is that the client (off-taker) is paying for the outcome (drinking water or clean wastewater) rather than the inputs (project design, construction and commissioning) – typically through a water purchase agreement. The model has proved extraordinarily effective in driving down the costs of desalination in the Middle East because it forces project developers to optimise every aspect of a project – design, procurement, construction, operations, financing, risk management – to deliver the lowest cost of water, while insulating the client from many of the overspends and operational risks. The key trends in this market are as follows:

Private finance works best for wholesale water assets: The politics of water are such that the public prefer the retail interface to be under public control, but there is an appreciation that the private sector offers value in terms of more effective risk management and efficient operations.

A secondary market for project equity is developing: There is a large differential between the yields that investors expect from greenfield developments (6%–14% above dollar interest rates depending on country risk) and the yields available in the secondary market for project equity (2%–8% above dollar interest rates).

Development finance institutions are increasingly looking to private finance for growth: They need to show that they are complementing private finance, rather than competing with it. They are looking to attract private developers by structuring "blended finance" projects to offer commercial returns to equity investors.

Low-cost debt is a key determinant of success: Access to public guarantees and concessionary lending can make or break a project bid, but also blurs the line between public and private finance.

Project developers

Privately financed water projects are typically delivered by consortia of investors which inject capital into the special purpose vehicle that signs the water purchase agreement with the off-taker, as well as separate contracts with the EPC contractor, operator, power supplier, insurers, and lenders (which provide non-recourse debt). The EPC contractor will often take a stake in the developer consortium to secure the work, and in some markets (e.g. Abu Dhabi) a financial entity related to the off-takers also takes a stake. The most active project developers outside China are:

Company	Exchange & ticker	Gross capacity	Est. net capacity
ACWA Power	SASE:2082	6.8Mm³/d	3.2Mm³/d
Taqa	ADX:TAQA	4.4Mm³/d	2.7Mm³/d
ACS Group	BME: ACS	2.2Mm³/d	2.0Mm³/d
Mitsui	TYO: 8031	4.2Mm³/d	1.9Mm³/d
Engie SA	EPA: ENGI	6.3Mm³/d	1.8Mm³/d
Qatar Electricity and Water Company	QSE:QEWS	2.4Mm³/d	1.7Mm³/d
Veolia	PAR:VIE	2.9Mm³/d	1.7Mm³/d
Acciona	BME:ANA	4.1Mm³/d	1.2Mm³/d
TTW PCL	BKK:TTW	1.0Mm³/d	1.0Mm³/d
Impulsora del Desarrollo y el Empleo en América Latina	BMV:IDEALB1	2.0Mm³/d	1.0Mm³/d

Source: GWI WaterData

What is the opportunity in owning retail water assets?

Water is a natural monopoly. It makes no sense for multiple companies to build supply networks down the same streets to compete for customers. As a result, most utilities are publicly owned. A small number – largely in the UK and US – are investor-owned, but subject to economic regulation. Elsewhere in the world, there are opportunities for private investors to deploy capital into utility assets through the concession model.

Privatisation models

There are a number of different models for water privatisation:

UK regulated utilities: Private investors took over the water utilities sector in England and Wales in 1989, and have been regulated by Ofwat ever since. Every five years they agree on the targets for service improvement, calculate the investment required to deliver it, and Ofwat rules on the allowable spend and the weighed average cost of capital that can be added to customer bills to deliver it.

US investor-owned utilities: These grew up as historical anomalies, and are regulated by state public utility commissions. They can increase their tariffs to reflect additional investment and the prevailing cost of capital by filing rate cases with the PUCs. Growth comes from successful rate cases, organic expansion, and acquisitions. In some states, "fair market value" rules allow investor-owned utilities to include acquisition premia in their rate cases.

The French affermage model: Municipalities contract out operations to private operators under medium-term contracts (the average is 9 years) in exchange for a fee. Capex remains the responsibility of the municipality. A similar model exists in Spain, although in that market, operators make some contribution to capex, recoverable through the profits made on the contract.

The concession model: This applies in various geographies (such as Brazil, the Philippines, and Senegal). The concessionaire takes over the utility assets from the public sector after a competitive bid, and invests in developing them over the concession period (typically 20 years) with costs recouped through tariff revenues. Enthusiasm for this model in Brazil and Saudi Arabia means that it is likely to experience faster growth rates over the next decade than fully privatised utilities.

Private water utilities

Private water companies are typically publicly traded or held by infrastructure funds. They are considered to be an excellent defensive asset: they performed well during the Global Financial Crisis because they continued to deliver regulated returns at times when other businesses were more affected by broader economic conditions. They are, however, capital-intensive, so they perform better in low-interest environments than high-interest environments. They are also subject to political risk: regulators have to strike a balance between allowing the returns necessary to attract investors into the sector, and public complaints about high prices and sub-par service.

Company	Exchange & ticker	Population served	Revenue (2022)
American Water	NYSE:AWK	14.0m	$3,792m
Thames Water	Private	15.5m	$2,741m
Severn Trent	LON: SVT	9.2m	$2,415m
United Utilities	LON: UU	7.7m	$2,254m
Anglian Water	Private	6.2m	$1,809m
Yorkshire Water	Private	5.4m	$1,385m
Essential Utilities	NYSE: WTRG	3.0m	$1,080m
Southern Water	Private	4.7m	$959m
Northumbrian Water	Private	4.6m	$947m
California Water Service	NYSE: CWT	2.0m	$846m

Source: GWI WaterData

Investing in agricultural water

Insatiable demand and limited supply of freshwater drives a growing need for solutions.

Agriculture is responsible for around 70% of all water withdrawals globally. Water demand in agriculture is essentially insatiable, but freshwater availability is not. In fact, some of the most productive agricultural regions of the world abstract substantially more water from the environment than is replenished through annual precipitation. The fundamental unsustainability of global agriculture means that strategies to deliver more "crop per drop" are becoming imperative. The challenge for investors is to find a way to access this market.

Investing in agricultural water security

There are four main strategies for investors looking to pursue the water security theme.

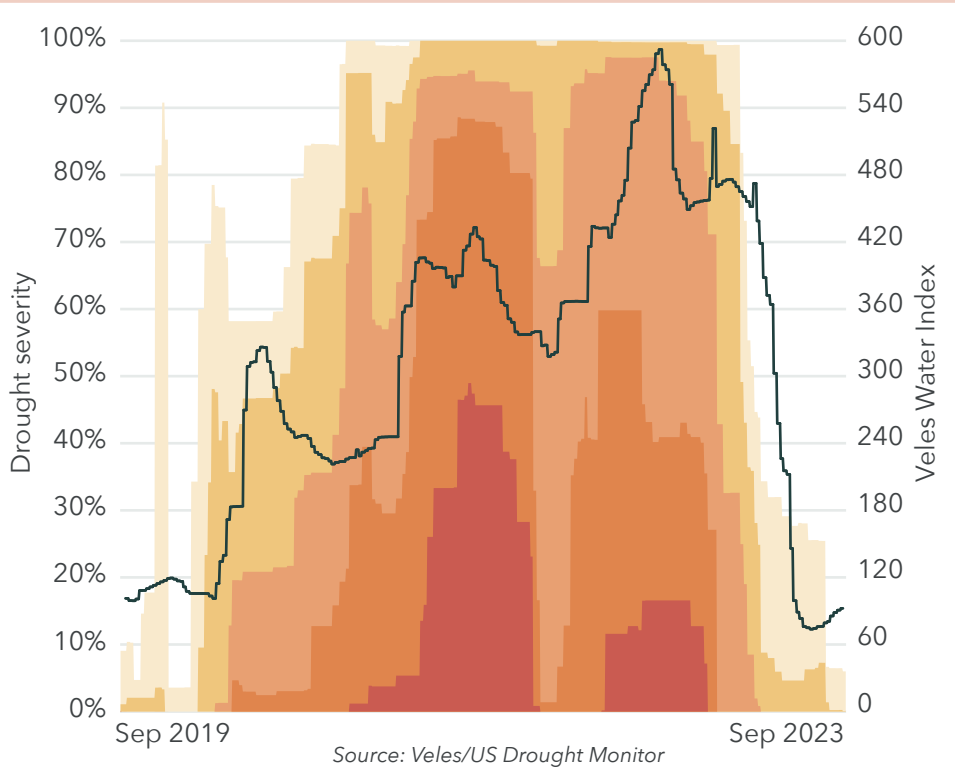
Through suppliers of irrigation equipment: The least water-efficient means of irrigation is flood irrigation, supplied through open channels. The most efficient is drip irrigation, although this is only suitable for certain types of crop. In between are centre-pivot and sprinkler systems fed by hoses. These are increasingly informed by digital and satellite data, ensuring that water goes to where it is most needed. Orbia and Jain Irrigation are the leaders in drip irrigation, while Valmont Industries, Lindsay Corporation, and Rain Bird (privately held), are leaders in centre-pivot irrigation.

Through the water rights market: In the western United States and in the Murray-Darling Basin of Australia, there is scope to own and trade water rights. Historically these have largely been traded between farmers, but financial investors have been taking an increasing interest in this market. There are now four specialist agricultural water fund managers (Water Asset Management, Aetos, Duxton Water, and Aqua Capital) and an index (Veles) that supports synthetic derivatives. This index reflects prices paid for water in some of California's major groundwater basins. The chart opposite shows how it traded during California's most recent drought.

Through agricultural suppliers: The biggest opportunity for water efficiency improvement is through changing farm practices. No-till agriculture, directly seeded rice, and using fertilisers, herbicides, and pesticides with a smaller water footprint are some of the ways that this can happen.

Through commodity markets: Water insecurity ultimately feeds through into agricultural commodity prices.

California: Major basin groundwater price index vs drought severity



Source: Veles/US Drought Monitor

The impact of water investment

A dollar invested in water has much more than a dollar of impact.

The social and environmental impact of water investment is much greater than its direct monetary returns. Lack of water has been identified as a major contributing factor to wars and mass migration. Waterborne diseases are one of the most significant causes of death in infancy. Inadequate water and sanitation traps people in poverty because of the time it takes to source water, and the illnesses it inflicts on those who have no better alternatives. Concern about this led to the development of SDG6: the Sustainable Development Goal for Water and Sanitation. Its logic is outlined below.

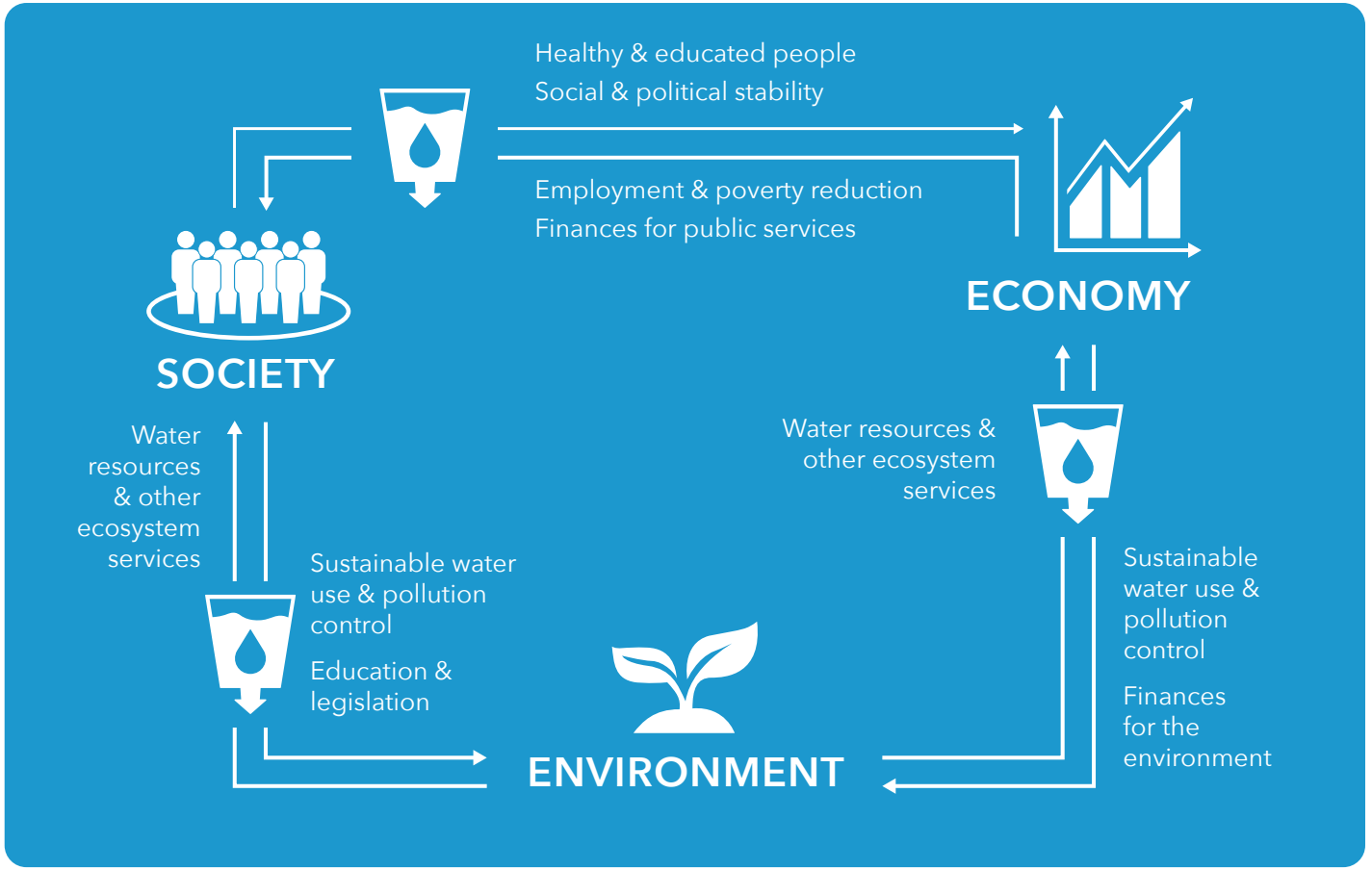
Benefit-cost ratios for **investment in water and sanitation** services have been reported to be as high as **7 to 1** in developing countries.

Poor sanitation, water, and hygiene lead to **675,000 premature deaths annually** and **losses of up to 7% of GDP** in certain countries.

Annual economic losses

$260 billion due to inadequate water supply and sanitation.
$120 billion due to urban property flooding.
$94 billion due to water insecurity among existing irrigators.

Water-related losses in agriculture, health, income and property could result in a decline of as much as **6% of GDP by 2050** in some regions of the world.

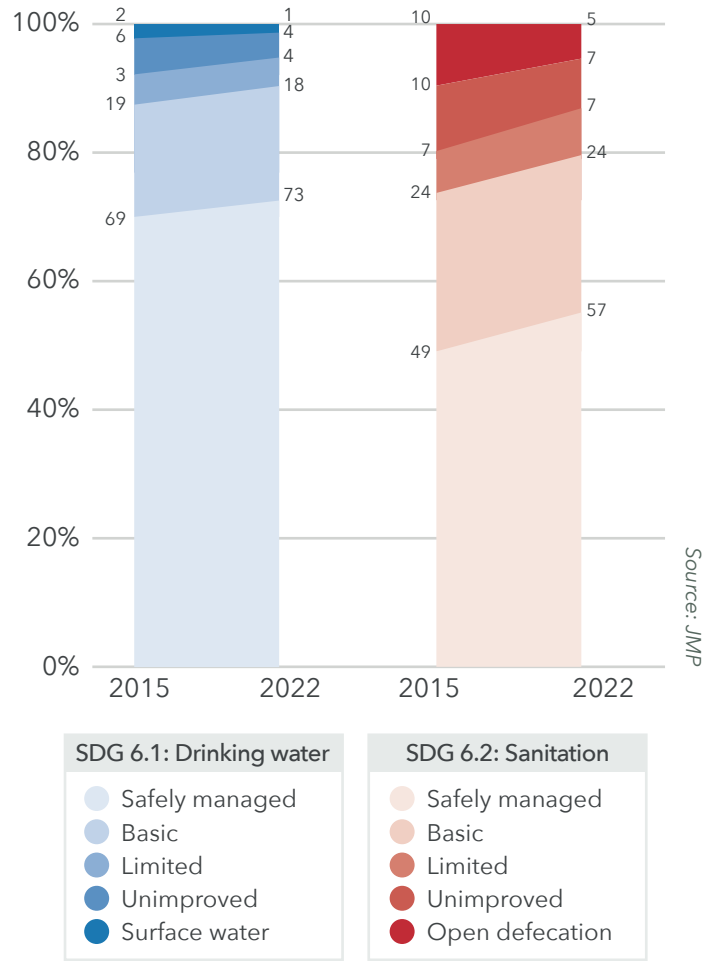


Impact strategies

Innovative approaches to SDG6

Impact investment in water is set to grow from less than $1 billion of capital employed to $10 billion over the next decade. There are two reasons for this. First, water is an attractive sector for impact investors: it delivers higher social returns per dollar invested than most other impact strategies. Second, development finance institutions are looking to attract more private capital to supplement their own investments in delivering SDG6, and are developing structured project finance opportunities that are attractive to impact investors.

Progress towards SDG 6.1 and 6.2



Source: JMP

SDG6 Impact strategies

Utilities are the institutions best set up to deliver SDG6 at scale. It means that most opportunities for impact investors are designed to complement the activities of traditional water and wastewater utility networks. There are four main approaches:

Project finance alongside development finance institutions: The World Bank and other DFIs are prioritising blended finance models for delivering SDG6 at scale. These are structured to enable private investors to invest equity in projects with concessional "first loss" debt provided by the DFI.

Safe water services: People living beyond the reach of conventional networks often rely on informal water vendors to meet their daily needs. Private companies (such as dloHaiti and Water Health International) backed by impact investors have entered this market to ensure the quality and safety of decentralised water services.

Technology investing: There is scope to develop new technologies that deliver SDG6 at a lower cost than conventional models. Wellers Impact's partnership with Water Unite is a good example of investors pursuing this theme.

Micro-finance: Low-income households often struggle to finance the cost of capital items such as water connections and toilets. Micro-finance can make these more affordable by reducing the up-front cost.

WaterEquity

Micro-finance for improved water and sanitation

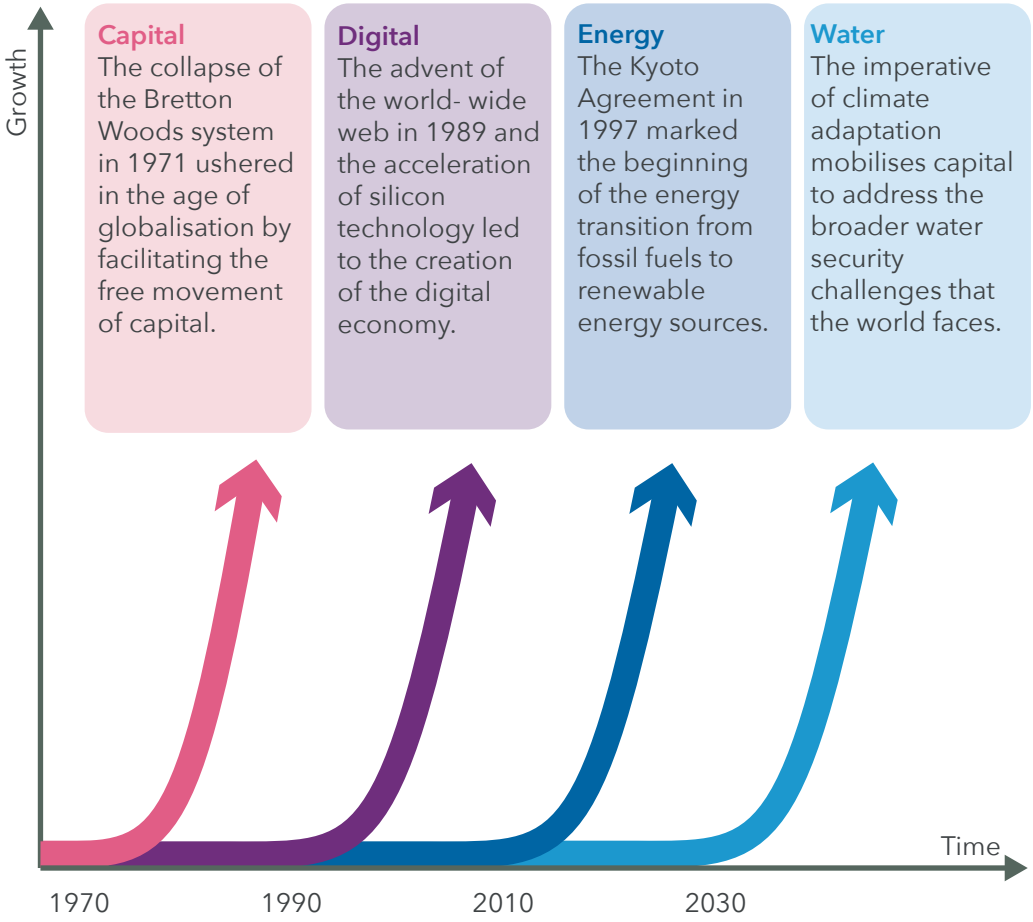
WaterEquity is perhaps the most successful impact investor in water. It has deployed over $350 million to deliver safe water or improved sanitation to 4.9 million people through 930,000 micro-loans to low-income households in 20 countries across Asia, Africa, and Latin America. It operates by lending money to financial institutions in developing countries, and delivering a return to its investors on the basis of the interest payments it receives. More recently, the fund manager has expanded into project development, focusing on climate-resilient infrastructure for water and sanitation, and investments in companies that can deliver it.

Conclusion

Why should investors make space in their portfolios for water?

The conclusion of this report is that a dramatic increase in investment in water is going to become unavoidable if we are to confront the challenges of climate change, urbanisation, and land use change effectively. The current set of economic models the world relies on to finance water infrastructure and services will not be sufficient to attract the money required. We need innovation in finance as much as we need innovation in technology to deliver the change.

Three mega-trends have shaped the global economy over the past 50 years. Water security will be the next. There are six main drivers that explain why.



2x

Infrastructure renewal: Globally, the rate of investment in water infrastructure is not keeping pace with the depreciation of the assets. In order to ensure that the standard of service does not go backwards, the rate of investment will need to double.

5x

Scarcity: We must increase spending on desalination, reuse, and water efficiency in agriculture fivefold to minimise the impact of the over-abstraction of freshwater resources and climate change-related droughts.

10x

Floods and storms: The annual rate of investment in stormwater infrastructure and flood control will need to increase tenfold in order to reduce economic risks from climate change-related weather events to pre-2010 levels.

3x

Water quality: Meeting the requirements of the next generation of water quality regulations proposed by agencies in Europe and North America will involve a tripling of current rates of investment, and dramatic improvements in the available technology.

8x

Access: A report to the UN in July 2023 argued that the rate of investment in water and wastewater services will need to increase by five to eight times to meet the targets set by the Sustainable Development Goal for Water and Sanitation.

100x

Fires: Climate change has increased the severity of wildfires to the point at which conventional firefighting strategies are entirely inadequate. It means that over the next decade we will need to completely rethink water infrastructure for firefighting.

Appendix 1: Forecast assumptions

What are the numbers based on?

In order to forecast the growth of capital employed in the water sector between 2024 and 2034, we have had to make assumptions about the future. The most important ones are listed below. They represent our best analysis of how events are likely to transpire, but they are tentative and should be reassessed as time passes.

Climate change will, in different geographies, continue to set new records for the extremes of droughts, floods and storms throughout the period. This reflects developments over the past three decades.

Average combined water and wastewater tariffs will rise from $2.36/m^3 to more than $7.00/m^3 in real terms during the period. The experience to date has been that the public are reluctant to pay more for water until they have experienced a crisis. The combination of climate change and historic underinvestment is making such crises more frequent, so it is not unreasonable to expect willingness to pay for water to increase substantially (even at $7.00/m^3, monthly water bills would still be less than half the cost of average energy bills).

New financing models will be developed in order to facilitate increased private finance in the water infrastructure sector. This is a core part of the World Bank's agenda for the water sector. It is also likely to be driven by weakening public balance sheets and the massive amounts of infrastructure investment that will be needed to deliver water security over the next decade. Some changes in governance models may be required to make greater private sector participation more politically acceptable.

Est. capital employed			
$ billion	2024	2034	Growth
Regulated utilities	220	800	3.6x
Project finance	100	1,000	10x
Water rights	210	380	1.8x
Solutions: Public equity	190	800	4.2x
Solutions: Private equity	100	600	6x
Corporate water	>1	3,200	NA
Impact	>1	100	NA
Public sector	3,000	5,700	1.9x
Total	**3,822**	**12,580**	**3.3x**

Interest rates will return to pre-COVID levels. Water is an extraordinarily capital-intensive industry – typically requiring $7 of capex to generate $1 of revenue. It means that growth is highly dependent on the cost of capital (which explains the relative underperformance of US investor-owned water utilities during 2023).

ESG investment will evolve, rather than decline. Environmental, social and governance themes have proved popular among retail investors, but during 2023 became a political issue in the US, and this has slowed the growth of ESG funds in that market. We believe that water is the least controversial sector of the ESG investment market, and we anticipate that the theme will evolve to give greater weight to the water security objective.

The rate of innovation in water will continue to accelerate. Without technologies that enable utilities, businesses and farmers to do more for water for less money, growth will stall.

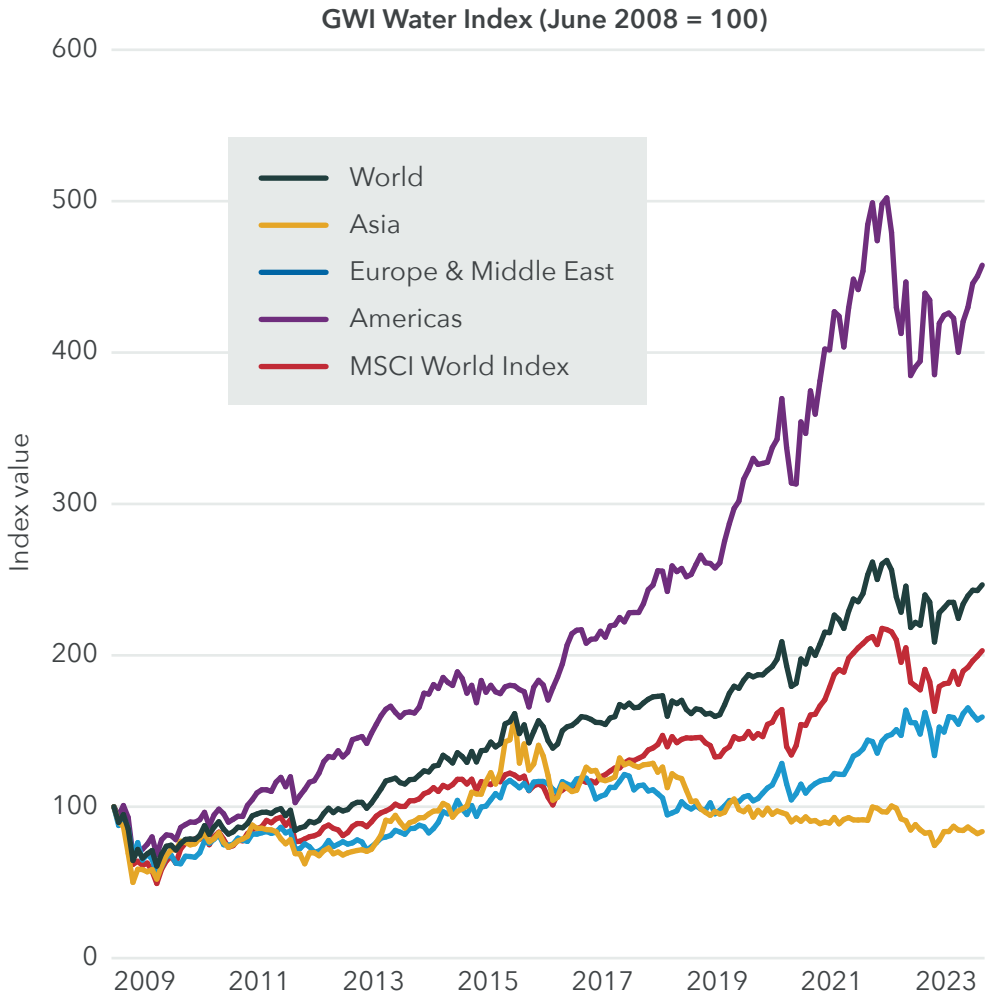
The global security situation will not deteriorate further. Other exogenous downside risks are similarly discounted.

Investors will see the opportunity and engage with the challenge. That is the purpose of this white paper.

Appendix 2: The Global Water Index

Performance by region

The GWI Global Water Index has been tracking the performance of water related stocks since 2008. The components of the index are weighted according to the water exposure multiplied by their market capitalisation. The Index has outperformed the MSCI World Index, largely because of the strength of US water stocks.



Americas top five

Name	Ticker	Exchange	Water %	Mar. Cap.
Ecolab	ECL	NYSE	50	$55.6bn
American Water	AWK	NYSE	100	$25.7bn
Xylem	XYL	NYSE	100	$27.6bn
Pentair	PNR	NYSE	100	$12.0bn
Veralto	VLTO	NYSE	59	$20.3bn

Europe & Middle East top five

Name	Ticker	Exchange	Water %	Mar. Cap.
ACWA Power	2082	Tadawul	39	$50.1bn
Veolia	VIE	Paris	43	$20.7bn
United Utilities	UU	LSE	100	$7.2bn
Severn Trent	SVT	LSE	97	$7.8bn
Qatar Electricity & Water Co.	QEWS	Doha	53	$5.7bn

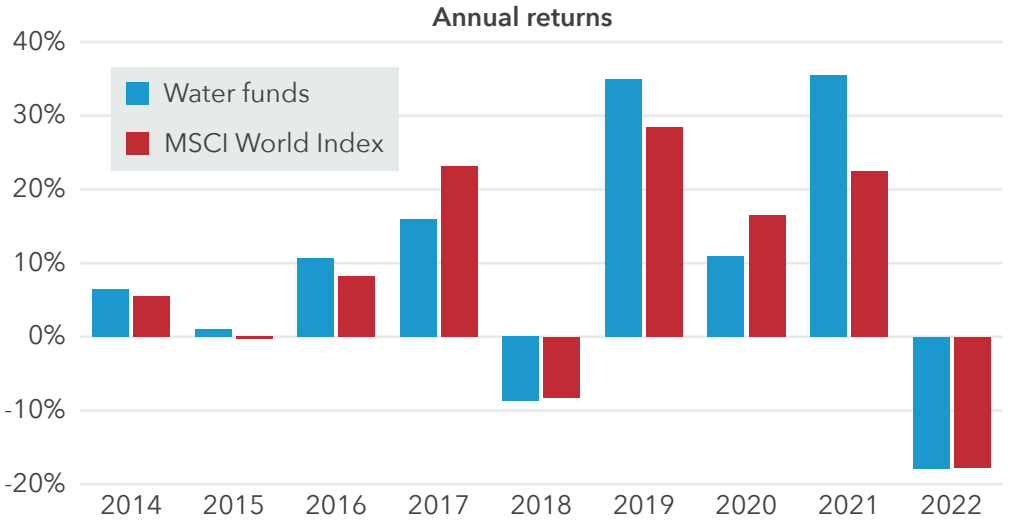
Asia top five

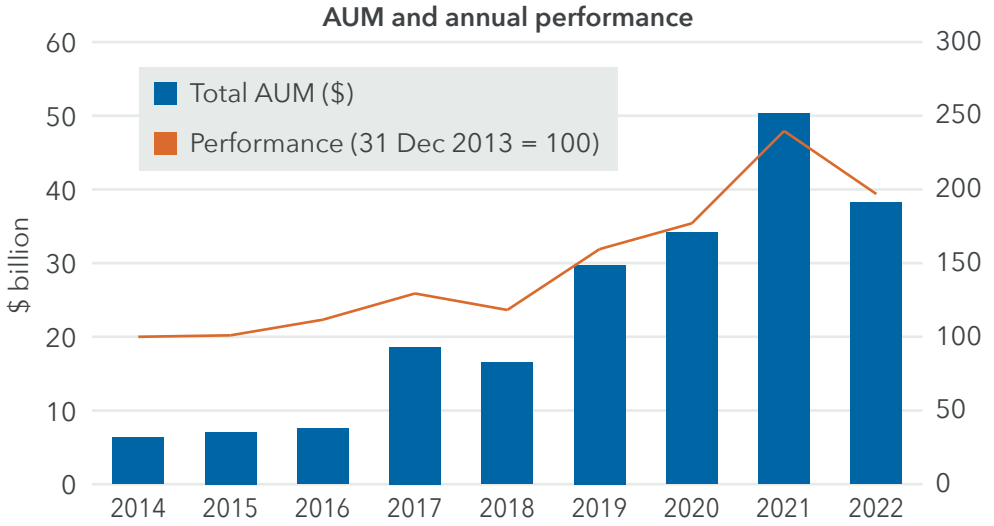
Name	Ticker	Exchange	Water %	Mar. Cap.
Kurita Water Industries	6370	TYO	100	$5.4bn
Chongqing Water	061158	SHG	100	$3.8bn
Guangdong Investment	0270	HKSE	76	$4.8bn
Beijing Origin Water Tech	300070	Shenzhen	92	$2.6bn
Chengdu Xingrong Env.	000598	Shenzhen	91	$2.4bn

Market capitalisation calculated as at 10th January 2024 Source: GWI

Appendix 3: Public Equity Funds

GWI keeps track of mutual funds and ETFs specialised in water investment. AUM and performance took a hit in 2022, but thematic funds tracked by GWI have returned 9.9% in US dollars annually since 2014.





The ten largest thematic water funds

Fund name	Fund manager/s	AUM* (31 Dec 2022)	Annual return*
Pictet Water Strategy	Cédric Lecamp/Louis Veilleux/Ola Obanubi	EUR 9.2bn	7.36%
BNP Paribas Aqua (Lux)	Hubert Aarts/Justin Winter	EUR 3.4bn	6.69%
RobecoSAM Sustainable Water Strategy	Dieter Kueffer	EUR 3.2bn	8.70%
BNP Paribas Aqua (France)	Hubert Aarts/Justin Winter	EUR 3.2bn	8.17%
KBI Water Strategy	Matt Sheldon/Catherine Cahill/Martin Conroy	USD 2.8bn	7.18%
iShares Global Water UCITS ETF	BlackRock Asset Management	USD 2.0bn	9.08%
Fidelity Sustainable Water & Waste Fund	Velislava Dimitrova/Cornelia Furse	USD 1.9bn	3.43%
Invesco Water Resources ETF	N/A	USD 1.7bn	13.03%
KBC Eco Water Fund	Anthony Sandra	EUR 1.3bn	6.68%
Lyxor UCITS ETF World Water	Amundi Asset Management	EUR 1.2bn	9.45%

*in reported currency

Appendix 4: Private Equity and Venture Funds

Water is an underdeveloped theme among private equity investors: there are currently very few specialist fund managers with long-term experience of investing in water-related companies. Most privately held assets are managed by generalist funds, a small number of which have multiple water-related holdings.

Water specialists

Name	Portfolio companies
XPV Water Partners	Axius Water, Atlas SSI, BCR, Holland Pump, Isle Utilities, LuminUltra, Metron-Farnier, Mobiltex, SmartCover, SoliOrganic
Cimbria Capital	Aganova, AMI Global, APX10, Fixed Earth, Slater Infrastructure
Sciens Water	Central States Water Resources, Integrated Water Services, CROM, SWFC

Active venture funds

Name	Portfolio companies
Burnt Island Ventures	SwiftComply, Shower Stream, Aquafortus, Zilper Trenchless, ZwitterCo, Ziptility, StormSensor, SewerAI, Aclarity, 2S Water, LAIIER, Beagle Services, Floodbase, Irrigreen
Echo River Capital	Uravu Labs, Irrigreen, Hohonu, SWAN Systems, 3Rwater, Aclarity, AgMonitor, CityTaps, Digital Paani, Epic Cleantec, Glanris, Gybe, Kairospace Technologies, Varuna, Verdi, Voda.ai, Watergenics, waterplan
Emerald Technology Ventures	TaKaDu, HydroPoint, Sofi Filtration, SewerAI, FIDO Tech, Aganova, bNovate, MentorAPM, Indra Water
HG Ventures	Puraffinity, 120Water, Transcend Software, PowerTech Water, Aclarity
Mazarine Ventures	PowerTech Water, SimpleLab, Pani Energy, EQO Diagnostics
PureTerra Ventures	Rubix S&I, Transcend Software, SIGA OT Solutions, SWAN Systems, Membrion

Active generalists

Name	Portfolio companies
Advent International	Eureka Forbes, Culligan
Audax Private Equity	Liquid Enviro, S.J. Electro
Bain Capital	Harrington, AqueoUS Vets, Arxada, Italmatch Chemicals
Blackstone	Geosyntec, Desotec, Legence, Suez
Ember Infrastructure	H2O Innovation, OnSyte Performance, Ground/Water Treatment & Technology, Low Impact Development Technologies
EQT Infrastructure	Covanta, Saur
Gryphon Investors	Vessco, HEPACO
HIG Capital	United Flow Technologies, USALCO, Standard Hidráulica
KKR	Flow Control Group, Axius Water, Resource Environmental Solutions, Northumbrian Water, Ecorbit
LDC	HSL Compliance, Stonbury
Littlejohn & Co.	Ardurra, Dana Kepner
Morgan Stanley Capital Partners	Alliance Technical, Seven Seas Water, Apex Companies
New Mountain Capital	Aegion Corporation, Inframark, TRC Companies, PerkinElmer
Oaktree Capital	Aqseptence, Montrose Environmental
Platinum Equity	Solenis
Ridgewood Infrastructure	Waste Resources Management, Undine, Vista Ridge
Sun Capital	Koch Separation Solutions, EIS Holdings
Wind Point Partners	Hasa, ClockSpring|NRI

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Value creation strategies in a changing world

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