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WATER INVESTING:
AN INVESTMENT CASE FOR THE VITAL RESOURCE

BNP PARIBAS
ASSET MANAGEMENT

The sustainable investor for a changing world

This paper has been written by Impax Asset Management. Founded in 1998, Impax Asset Management pioneered investment in the transition to a more sustainable global economy and today is one of the largest investment managers dedicated to this area.

Impax Asset Management is a delegated manager of BNP Paribas Asset Management.

About us

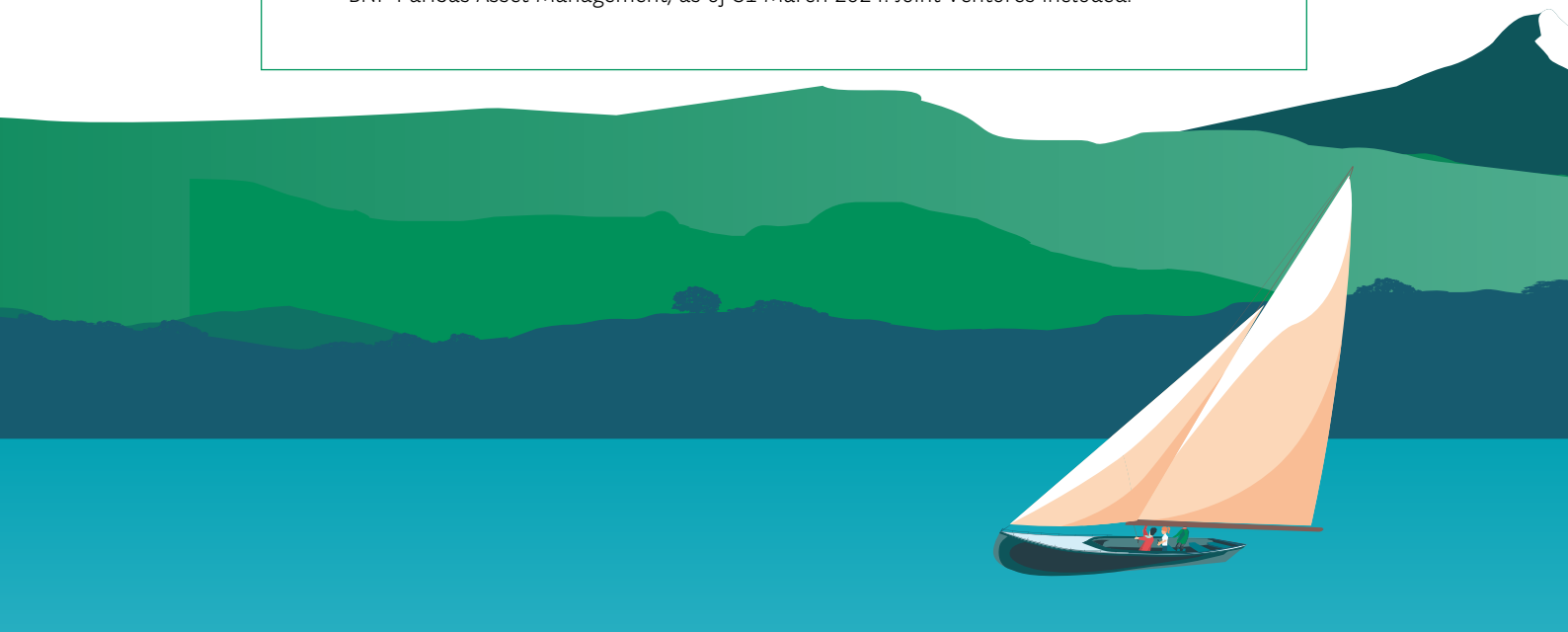
BNP Paribas Asset Management (BNPP AM) is BNP Paribas Group's dedicated asset management business that employs more than 3 200 people in more than 30 countries, including a large commercial presence in Europe and the Asia-Pacific region.

BNPP AM manages EUR 524 billion* of assets serving individual, corporate and institutional clients in more than 60 countries. We offer investment solutions for individual investors (through internal distributors within BNP Paribas Group and external distributors), and corporate and institutional investors including insurance companies, pension funds and official institutions. We offer portfolio investment expertise in line with clients' long-term sustainable performance expectations, including active, conviction-based strategies, multiassets and systematic & quantitative investments, liquidity solutions, emerging markets and private assets.

Our purpose

Our purpose is to achieve long-term sustainable returns for our clients, by placing sustainability at the heart of our strategy and investment philosophy.
Understanding and supporting the transition to a sustainable economy is a core objective. It guides our strategy, our culture, our structure, our products, our processes, the way we engage with our clients and with the companies and the markets we invest in.

* BNP Paribas Asset Management, as of 31 March 2024. Joint Ventures included.



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1. INTRODUCTION

Water has been described as the lifeblood of humanity. Elaborate water systems were at the heart of many ancient civilisations, from the aqueducts that spanned the Roman Empire to the network of dams that protected the Nabataean capital of Petra from flash flooding. The Babylonian Code of Hammurabi laid out rules on irrigation practices as far back as the 18th century BC.

It is no exaggeration to say that the modern economy continues to run on water, from household appliances to water-intensive, advanced manufacturing. Rising global living standards reinforce long-term demand growth.

In many parts of the world, however, water resources are under severe strain from over-consumption, pollution and the effects of climate change. Around two billion people don't have access to safe drinking water, with profound implications for health.[1] Problems with water supply do not just affect the emerging world – ageing infrastructure compromises reliable supply and contributes to pollution across the developed world.

To address the world's water challenges, investment in the global water industry must increase significantly. The United Nations (UN) estimated in 2020 that an additional USD 260 billion would need to be spent on water-related infrastructure each year to realise its Sustainable Development Goals by 2030.[2] Many governments acknowledge the importance of upgrading water systems and many regulators are permitting utility bills to rise to finance new investments. Some governments are directly supporting the sector: most significantly, the 2021 US Bipartisan Infrastructure Law included USD 55 billion for improving water-related infrastructure.

Expanded fiscal support and investment by utilities and water users should trickle down to suppliers of products and services to the industry, creating widespread opportunities across the water value chain for innovative companies.

Impax has considerable expertise and experience in this sector, having been investing in water-related industries for more than 20 years and running an investment strategy dedicated to the theme since 2008. Over this period, the number of companies in the water value chain has increased significantly. Impax's team of water sector specialists have an in-depth understanding of companies in the global industry and the technologies that set them apart. They also follow policy and regulatory developments around the world and apply this knowledge to their stock selection process.

In this paper, Impax discusses the fundamental drivers of the global water industry's growth and regulatory dynamics, which both shape priorities within the sector. Impax then outlines how it conceptualises the opportunity set for investors within the water industry and explores some of the evolving technologies and solutions that it believes could create and shape the water market over the coming years and decades.

1 UN, 2023: Water – at the center of the climate crisis
2 United Nations Conference on Trade and Development (UNCTAD) estimates, 2020

2. THE CASE FOR INVESTING IN WATER

Global demand for fresh water has risen six-fold since the start of the 20th century.[3] The structural forces behind this rapid growth – chiefly, rising living standards, demographics and the rise of water-intensive industrial processes – remain intact. Despite technological advances and water efficiency efforts, global water consumption per capita has grown faster than the world's population since 1900.

With water scarcity rising, exacerbated by pollution issues and the effects of climate change, stewardship of finite freshwater resources must improve.

Overcoming these challenges and meeting rising demand for water will require vast investment across the water industry value chain. It is our conviction that this provides favourable currents for companies operating in the sector, from those operating upstream – building and managing physical water infrastructure – to those downstream, providing products and services to harness this valuable resource.

Here, we discuss the interrelated structural trends that support long-term investment in the global water industry.

1. WATER SCARCITY

Water may cover more than two-thirds of the Earth's surface, but only 0.5% of the world's water is useable and available fresh water.[4] The scale of the problem is clear: a recent report suggested that global demand for fresh water is likely to outstrip supply by 40% by 2030.[5] Many of the most populous parts of the world, including Pakistan, Central Asia and parts of the Middle East, suffer from 'extremely high' water stress, according to the World Resources Institute.[6]

This growing challenge emphasises the need for better water management, to avoid waste and unsustainable consumption. An absence of effective water pricing – in many parts of the world it is essentially free to use – contributes to poor management of water resources. Daily water consumption in Denmark, where water is priced effectively, is less than one-third of that in the US.[7] Alongside better policy, products and services that can improve the efficiency of water usage can significantly reduce pressure on freshwater sources.

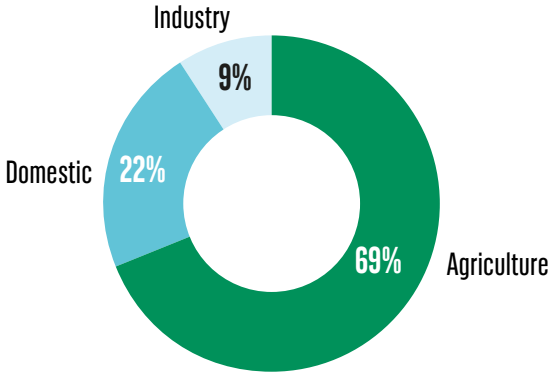
3 Our World in Data, 2018: Water Use and Stress
4 UN, 2023: Water – at the center of the climate crisis
5 Global Commission on the Economics of Water, March 2023: Turning the Tide - A Call to Collective Action
6 World Resources Institute, December 2023: Water Stress by Country. In 'extremely stressed' areas, the amount water withdrawn exceeds 80% of the total renewable supply.
7 Danva, 2020: Water in figures / US Environmental Protection Agency, 2023

2. GROWING POPULATIONS

While improving technologies are leading to more efficient water management, growing populations place the world's limited freshwater resources under further strain over the long term. According to the UN, the global population is expected to increase from eight billion in 2023 to close to 10 billion by 2050.[8] This will not only raise demand for drinking water, but also for other products and processes that rely on water, like agriculture and industry.

Around 70% of global freshwater usage is in agriculture, highlighting the importance of innovations that can reduce water wastage in growing crops and improve agricultural water management.[9] Water efficiency solutions have already helped reduce per capita water withdrawals in advanced economies: in the US, per capita withdrawals fell by almost 30% between 1990 and 2010.[10]

Exhibit 1: **Global groundwater abstractions by use**



Source: UNECSO, 2022: United Nations World Water Development Report 2022

3. CLIMATE CHANGE

Rising temperatures pose profound challenges to secure, reliable water supplies around the world. For every 1°C increase in average global temperatures, the UN projects a 20% drop in renewable water resources.[11]

Climate change is leading to more intense droughts, and the amount of water stored on land in the forms of soil moisture, snow and ice has dropped sharply, at a rate of 1cm per year.[12] Water supplies stored in glaciers and snow cover are forecast to decline further as temperatures rise, depleting a historically reliable source of water during warm, dry periods.[13] Meanwhile, rising sea levels are expected to lead to further salinisation (increased dissolved salt content) of groundwater supplies in vulnerable coastal areas like Florida.[14]

8 UN, 2017
9 OECD, 2023: Water and agriculture
10 Food and Agriculture Organisation of the UN, 2017: Total water withdrawal per capita
11 Council on Foreign Relations, 2023: Water Stress: A Global Problem That's Getting Worse
12 UN, 2023: Water – at the center of the climate crisis
13 UN, 2023: Water – at the center of the climate crisis
14 UN, 2023: Water – at the center of the climate crisis

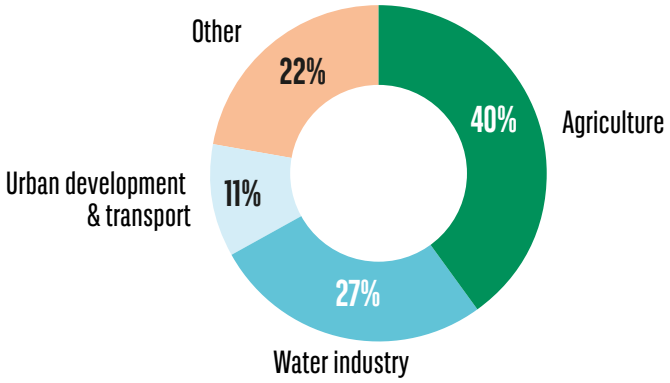
Mounting evidence of the costs arising from physical climate risks highlights the growing urgency with which investment must accelerate in climate adaptation, including more sustainable water management. The UN estimates that 400 million more people will be at risk of flooding by 2050 as climate change intensifies the water cycle.[15]

4. POLLUTION

Over 80% of used water flows back into the environment untreated, often containing human waste and toxic industrial byproducts.[16] In some developing economies, it is as high as 95%. Agriculture is also a major source of water pollution, with rainfall washing fertilisers, pesticides and animal waste from farms into the world's waterways.[17] Nitrate from farming is the most common chemical contaminant found in aquifers.[18]

A tightening regulatory environment supports innovative approaches and technologies that address water quality issues throughout the water system, from water testing technologies to wastewater treatment.

Exhibit 2: Reasons for English rivers not achieving 'Good Ecological Status'



Source: Environment Agency, August 2022

5. URBANISATION

The UN has forecast that 2.5 billion more people will live in cities in 2050 than in 2018, with most of this growth in the developing world.[19] Urbanisation poses two major challenges. First, providing clean water and sanitation to more people in a concentrated area. Second, increased flooding risks due to water run-off from impermeable surfaces like roads and roofs.

These challenges can be addressed, however, with adequate investment in expanding clean and wastewater systems and in better drainage solutions that capture run-off and prevent surface flooding.

15 UN, 2023: Water and climate change
16 NRDC, 2023: Water Pollution: Everything You Need to Know
17 NRDC, 2023: Water Pollution: Everything You Need to Know
18 International Institute for Sustainable Development, 2018: Report Identifies Agriculture as Greatest Source of Water Pollution
19 UN, 2018

6. INFRASTRUCTURE

UNESCO has calculated that between USD 0.9 trillion and USD 1.5 trillion of annual investment will be needed in global water and sanitation infrastructure by 2030.[20] Much of this will be to serve the developing world's rapidly growing cities, but there is also a desperate need to upgrade water infrastructure in the developed world, much of which was built in the late 19th and early 20th centuries. For example, it was estimated that in 2021 around 27 000 megalitres of treated water were lost in the US each day due to leaks and burst water mains – enough to fill over 9 000 Olympic swimming pools.[21]

USD 0.9 trillion to USD 1.5 trillion

Annual investment needed in global water-related infrastructure by 2030

The need to expand and upgrade global water infrastructure should create opportunities across the water sector value chain, from companies that supply products integral to moving water around economies to companies engaged in the development and construction of utilities' systems. Smart monitoring technologies, meanwhile, can identify leaking pipes and predict faults before they occur.

7. NEW INDUSTRIES

The energy intensity of the digital economy has been relatively well documented. The data centres that process and store the world's information, and that power emerging applications enabled by artificial intelligence (AI), consume roughly 1% of global electricity.[22] Less widely known, perhaps, is their thirst: vast volumes of water are used to cool servers and maintain operational temperatures.

Making the semiconductors that are embedded in modern electronics and machinery, and that are at the heart of the digital transformation, is also very water intensive. Microchips must be repeatedly rinsed using ultra-pure water. The global semiconductor industry uses an estimated 1.2 million megalitres of water every year, mainly in the five countries with the most 'fabs' (semiconductor manufacturing plants): South Korea, Japan, Taiwan, China and the US.[23]

High-tech manufacturing firms generally try to enhance energy efficiency because of the immediate cost benefit. Further to the importance of water efficiency for a company's profitability, potential droughts and water scarcity pose operational risks given the water intensity of processes. Innovative water management solutions can play an important role in addressing the sustainability challenges associated with water-intensive processes. There is a trend towards closed-loop systems that re-use and recycle water in industrial settings, particularly in semiconductor plants located in water-stressed areas. TSMC, a major Taiwanese chipmaker, has water recycling rates in excess of 85%.[24]

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20 United Nations Educational, Scientific and Cultural Organization (UNESCO), 2023
21 American Society of Civil Engineers, 2021: Report Card for America's Infrastructure
22 International Energy Agency, 2023: Data Centers and Data Transmission Networks
23 Semiconductor Digest, October 2022: Water Supply Challenges for the Semiconductor Industry
24 TSMC, 2023: Water Management

3. REGULATION

In the face of water shortages, pollution and leakages, governments around the world are imposing stricter regulation to safeguard water quality, improve infrastructure and ensure water is correctly priced. There is also an increasing focus on addressing drivers of biodiversity loss.

Regulators need to balance the protection of consumer rights with the need to attract private investment at the scale needed to source, treat and transport water reliably in line with legislative requirements. Global regulatory regimes also play a critical role in establishing frameworks to govern tariffs and operating standards. As such, a deep understanding of regulation aimed at anticipating regulatory responses should form an important part of the due diligence of any water-related investment opportunities.

Here, we consider three main areas of regulatory focus.

1. WATER QUALITY

Around the world, water quality standards are becoming increasingly stringent. Compliance with tighter regulations will involve vast investment in improved water infrastructure, supporting opportunities for companies across the global water value chain.

The two most important laws regulating water quality in the US are the Clean Water Act, which regulates the discharge of pollutants into waterways, and the Safe Drinking Water Act, which ensures the quality of drinking water. These were developed in the 1970s but have since evolved. More recently, the 2021 Bipartisan Infrastructure Law included USD 55 billion for water-related infrastructure, with most funds allocated to improving drinking water and replacing the millions of lead pipes across the US.[25]

USD 55 billion

US federal government funding for water-related infrastructure in the Bipartisan Infrastructure Law

The EU's recast Drinking Water Directive came into effect in 2021. It reinforces water standards tackling emerging pollutants such as endocrine disruptors and microplastics, and favouring actions to reduce pollution at source.[26] Drinking water across the EU is now being monitored more closely for the presence of two endocrine-disrupting compounds – beta-estradiol and nonylphenol – throughout the water supply chain. Endocrine-disrupting compounds are chemicals that can interfere with physiological and biochemical processes in the human body.

25 White House, 2021: A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments and Other Partners

26 European Commission, 2020: Directive (EU) 2020/2184 of the European Parliament and of the Council

A 2022 update to China's drinking water quality standards also brings the world's second-largest economy more closely into line with international standards. The regulation specifies quality requirements for drinking water and drinking water sources, as well as sanitation requirements for centralised water supply, secondary water supplies, products involving drinking water sanitation, safety products and water quality standard examination methods.

2. 'FOREVER CHEMICALS'

Awareness of one specific water quality issue has been rising in particular: the presence of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in drinking water and water courses. These are a broad group of man-made chemicals commonly used in a range of consumer goods and clothing, dubbed 'forever chemicals' because they hardly break down in the natural environment. Studies have linked exposure to certain levels of PFAS to long-term human health problems including cancer, liver disease and fertility issues. They have been found in hundreds of animal species.[27] In Europe alone, the annual costs to human health and the environment arising from PFAS are estimated to be as much as EUR 84 billion.[28]

Regulators are introducing new standards intended to support long-term demand growth for water testing and treatment solutions.

In the EU, the revised Drinking Water Directive limits combined PFAS levels in drinking water to 100 nanograms (ng) per litre.[29] To illustrate the scale of ambition, a recent UK study detected PFAS concentrations above 1 000ng per litre at around 640 out of 17 000 sites.[30] Some member states have set limits as low as 2ng per litre – close to the physical limits for measuring PFAS using mass spectrometry.

In the US, the Environmental Protection Agency (EPA) has proposed legally enforceable levels for six PFAS chemicals in drinking water. The proposed rule would require public water systems to monitor PFAS levels, notify the public about these levels and reduce their concentration in drinking water if it exceeds the proposed standards.[31] Though it is estimated that the regulations will cost US water utilities in the order of USD 1 billion to comply with, most of the funding for remediating the PFAS issue is ultimately expected to come from the manufacturers of the chemicals.

27 Environmental Working Group, 2023: Groundbreaking map shows toxic 'forever chemicals' in more than 330 wildlife species
28 Nordic Council of Ministers, 2019: The cost of inaction
29 Eurofins, 2023: PFAS Legislation
30 Salvidge, R. & Hosea, L., 23 February 2023: Revealed: scale of 'forever chemical' pollution across UK and Europe. The Guardian
31 US Environmental Protection Agency, 2023: Safe Drinking Water Act - Per- and Polyfluoroalkyl Substances (PFAS)

3. BIODIVERSITY

There is growing recognition among governments that the current rate of biodiversity loss is unsustainable and constitutes a global emergency. Regulators are increasingly turning their attention to water, since water quality and the state of biodiversity are deeply interconnected. For example, high levels of agricultural fertilisers in waterways can lead to rapid growth of algae and aquatic plants – a process known as 'eutrophication' – quickly depleting oxygen levels for aquatic life. Meanwhile, the effects of plastic pollution on marine wildlife have received considerable publicity in recent years.

Several major economies are implementing rules that aim to improve water quality and protect biodiversity. The European Water Framework proposes heavier restrictions on sewage and limits on agricultural run-off to deal with eutrophication. As a result, the Baltic Sea, home to seven of the world's 10 largest marine 'dead zones', has become the first 'macro-region' targeted by the EU. Meanwhile, the UK government has proposed a plan that would require water companies to invest an estimated GBP 60 billion in infrastructure over 25 years to reduce the use of storm overflows for sewage.[32]

A keener focus on addressing biodiversity loss, and related risks to businesses and global society, should support opportunities for products and services that can address, or at least alleviate, the pressures on ecosystems. Companies involved in the testing and treatment of water can play a vital role in helping to control pollution and reduce or prevent harm to water-borne life.

32 Department for Environment, Food & Rural Affairs, September 2023: All storm overflows now covered by plan to clean up waterways

WATER PRICING

Water pricing is of major importance to water utilities, affecting their operations, the security of their revenues and their ability to provide a reliable and sustainable water supply. How water is priced in particular regions is influenced by several factors, including supply and demand dynamics, regulatory frameworks, environmental concerns and social equity considerations. If prices are too low, water companies may be unable to update their infrastructure or adapt to climate change, but prices that are too high may make water unaffordable for low-income groups. Another consideration is that high prices can encourage responsible usage in water-stressed areas.

With pricing strategies coming under increasing regulatory scrutiny, some providers are adopting innovative tariff structures. For example, UK water supplier, Affinity Water, has trialled a sliding scale of tariffs, whereby people who only use small amounts of water pay lower tariffs than those who use a large amount, encouraging more sustainable water use.[33]

Water companies have not been immune to the recent increase in cost inflation but have demonstrated, in many markets at least, that they can raise prices in response. Regulators in markets where prices are linked to inflation recognise that companies need to raise revenues in line with prices – if not more – to pay for much-needed investment in water infrastructure. Water companies in the UK have requested a 26% increase in consumer bills from 2025 to 2030 to help finance GBP 104 billion of investment in their water infrastructure.[34] Water prices in Singapore are set to rise by 18% over the two years from April 2024.[35]

33 Affinity Water, 2023
34 Average bills 2025/26 press statement - Ofwat
35 Bloomberg, 27 September 2023: Singapore to Raise Water Prices in Phases Over Two Years

4. INVESTMENT OPPORTUNITIES ACROSS THE WATER VALUE CHAIN

As an investor focused on the transition to a more sustainable economy, Impax perceives a range of opportunities for companies that can help meet expanding global water demand in the context of limited supply and tightening regulations.

Long-term opportunities are being created across the entire water industry value chain, from the utility companies managing water supply infrastructure to the suppliers of products and services that enable smarter treatment, use and testing of the world's most important commodity.

1. WATER UTILITIES

From consumers' perspective, the most visible elements of water infrastructure are likely the utility companies that they pay to provide, treat and dispose of their water. Impax believes there are selective opportunities for investors in the companies that operate water treatment and supply infrastructure, providing clean water, wastewater and sewerage services.

National and regional regulatory regimes are key to interpreting the investment opportunities among water utilities. Generally, regulatory environments that support and encourage appropriate investment should provide the highest quality of service to water consumers. The UK uses a five-year regulatory cycle of defined investment to upgrade and expand a utilities regulatory asset base, upon which an allowed return is calculated. The US system, meanwhile, is such that utilities invest and subsequently request a region-specific cost of capital from the regulator to enable competitive returns. China operates on a cost-plus model, set and approved by local governments.

Impax believes utilities that demonstrate progressive water stewardship processes face lower regulatory risks in the form of potential fines or loss of social licence to operate. Clear disclosure and reporting systems are important to inform investors and other stakeholders of the net environmental impact of their operations.

2. WATER INFRASTRUCTURE

Impax also focuses on the companies that supply products and services integral to the end-to-end infrastructure that moves water in industrial, residential and commercial applications. Impax can break these down into three overarching categories.

First, companies that make or distribute network equipment products like specialised pipes, pumps and valves that assist in the transmission of water. As water infrastructure is expanded and renewed, demand for these critical products should logically rise in tandem, especially given the need for better management and monitoring of water resources as demand grows. Meanwhile more extreme precipitation patterns, combined with rising urbanisation, support demand for stormwater management equipment.

Second, companies that specialise in making or supplying parts and systems that distribute water around buildings and within industrial processes. Water-efficient solutions within this vast addressable market can deliver material savings, financially and in terms of water usage, for buildings owners and tenants.

Third, companies that provide support in the design and construction of water infrastructure projects, from inter-regional transmission projects and groundwater assessments to flood defence planning. Demand for these services should be expected to rise in line with the need for new infrastructure and to respond to the numerous challenges posed in earlier sections of this report.

3. WATER TREATMENT, EFFICIENCY AND TESTING

Treating water to make it fit for human consumption (and for refined industrial processes) involves a breadth of companies that design, manufacture and install technologies or facilities for the treatment, separation and purification of water. Companies in this field tend to have relatively high margins, specialised technologies and strong pricing power. Impax can break these down into three broad groups.

First, companies that provide services or products that enable the chemical or non-chemical treatment of water. The former includes aerobic biological wastewater treatment and heavy metal removal from used industrial water. Non-chemical filtration and ultraviolet (UV) technologies are among the latter. The growing focus on water quality – and on removing undesirable particles and pathogens – supports long-term growth for sustainable water treatment solutions. This is also a key area for expansion given the increasing focus on advanced treatment in applications such as semiconductor manufacturing, where ultrapure water is needed.

Second, companies whose products and services improve the water efficiency of processes or reduce water demand. Examples of solutions here include flow management technologies and smart water meters, which use data analytics to identify leaks and help to flag up potential supply issues. Alongside these are companies that supply products and services for irrigation systems. These range from water-efficient appliances used in agriculture to systems that incorporate satellite positioning and remote monitoring capabilities. It is estimated that around 2 500 cubic kilometres of water are used for irrigation every year, highlighting the potential impact of water-saving solutions.[36] Ultimately, demand for solutions that reduce water consumption should be driven by the price of water.

2,500 km^3
Water used for irrigation globally each year

Third, companies whose products and services enable the testing of water quality. This includes equipment for water sample testing and laboratories involved in water quality analysis. Increasingly strict water purity regulations globally help drive demand for technologies that enable companies, particularly in industrial sectors, to fulfil their regulatory requirements.

36 The European Space Agency, 2023: Satellites unveil the far-reaching impact of irrigation

5. EVOLVING TECHNOLOGIES AND SOLUTIONS

Innovative technologies promise to play a critical role in helping address water-related challenges, creating new markets and tapping into structural demand growth.

Emerging solutions are improving water treatment processes and the measurement of water quality, including detecting contaminants like PFAS. Impax believes suppliers of specialist equipment and services in these areas are well-positioned to thrive as regulators and society place a growing value on water quality.

Meanwhile, data and software solutions promise to improve the sophistication of water system management and modelling. When combined with hardware, 'smart irrigation' techniques have been shown to vastly reduce water consumption in the water-intensive agricultural sector. Finally, innovative technologies that can enhance the reuse and recycling of water in industrial processes can help reduce costs and operational risks for industries central to the modern economy. By adding value to their users, Impax believes solutions providers in these areas can thrive where there is a competitive advantage.

In this section, Impax discusses what it sees as some of the most promising innovations within the water sector.

1. ADVANCED TREATMENT

Innovative treatments have been developed to remove newly identified contaminants from drinking water and to produce ultra-pure water for processes such as semiconductor production.

Membrane filtration has transformed water treatment processes by mitigating the need for certain chemicals to separate out impurities. Membranes work as a physical barrier that only selected particles can pass through, removing unwanted particles, micro-organisms and dissolved substances. Pores in the membranes used for nanofiltration and reverse osmosis are so small that they are measured in Angstrom (equivalent to 0.1 nanometre).

Advanced oxidation processes are also useful in wastewater treatment. To remove organic pollutants, they typically combine the use of oxidants such as ozone and hydrogen peroxide with ultraviolet (UV) radiation and catalysts such as titanium dioxide.

2. ADVANCED MEASUREMENT

It is vital that water companies can accurately monitor the quantity and rate of water passing through a distribution network if they are to make informed decisions about water allocation and conservation.

Advanced flowmeters provide reliable, real-time insights that helps operators respond quickly to changing conditions. These meters also feature onboard verification capabilities and can provide accurate readings, regardless of external factors such as vibration, hydraulic noise or changes in temperature.[37] Meanwhile, smart meters that collect and transmit real-time water usage data have an important role to play in leak detection. Studies have shown that smart metering technologies can reduce water consumption by up to 22%.[38]

22%

Potential water use savings from smart metering technologies

Advanced measurement systems can also be of significant benefit in agriculture, helping farmers to track moisture levels, acidity and salinity in the soil, weather conditions and crop health. This data can inform irrigation decisions, helping to conserve water and maximise crop yields. Such systems often make use of advanced connected sensors, drones and GPS satellite systems.

3. DETECTING NEW CONTAMINANTS

With growing regulatory and public focus on water contaminants including PFAS, microplastics and waterborne viruses, detection systems are vital to identify whether contamination levels are within safe levels.

Among solutions that can measure PFAS compounds in water is high-resolution mass spectrometry. This technology is highly sensitive, detecting trace levels of PFAS and able to distinguish between them.[39] Fluorine nuclear magnetic resonance spectroscopy, which works by specifically targeting the fluorine atoms with PFAS molecules, can quantify the total concentration of PFAS in a complex sample.[40]

To detect microplastics in water, a technique called flow cytometry can be used. It works by staining plastic particles with a detectable dye using a method that is widely used in biology to rapidly quantify fluorescent cells. One of its main advantages is that it can distinguish microplastics from other substances that can provide false positives, such as bacteria.[41] An alternative is automated image analysis, whereby sophisticated software using image processing algorithms can detect microplastics under UV light.[42]

37 ABB, 2019: Accurate measurement in water distribution systems
38 Global Infrastructure Hub, 2020: Smart Metering for Water Efficiency
39 Liu, Y., et al., 2019: High-resolution mass spectrometry (HRMS) methods for nontarget discovery and characterization of poly- and per-fluoroalkyl substances (PFASs) in environmental and human samples. *Trends in Analytical Chemistry*
40 Camdzic, D., 2023: Quantitation of Total PFAS Including Trifluoroacetic Acid with Fluorine Nuclear Magnetic Resonance Spectroscopy. *Analytical Chemistry*
41 Li, C., et al., 2023: A novel high-throughput analytical method to quantify microplastics in water by flow cytometry. *Green Analytical Chemistry*
42 Giardino, M., et al., 2023: Automated method for routine microplastic detection and quantification. *Science of the Total Environment*

Techniques to detect waterborne viruses – and so trigger effective policy responses – include next-generation sequencing. This can provide a comprehensive analysis of the range of viruses, including novel or unexpected strains, present in a water sample.[43] When viruses are present in only low concentrations, immunomagnetic separation techniques can be particularly useful. These use magnetic beads coated with antibodies to selectively capture and concentrate waterborne viruses.

4. DATA AND SOFTWARE

Data analysis tools help water utilities identify trends, optimise their operations and make better-informed decisions about water treatment and distribution. According to a 2020 report, US and Canadian water utilities' total annual spending on digitalisation is forecast to grow at 6.5% per year, doubling to USD 10.8 billion by 2030.[44]

There are three promising applications of software in the water industry that are already delivering efficiencies and improving regulatory compliance.

First, sophisticated hydrological modelling software can simulate various scenarios, aiding in the management of watersheds, reservoirs and groundwater resources.

Second, geospatial data solutions are increasingly being adopted to create up-to-date databases of water pipe networks and improve modelling. The industry is drawing upon insights from the likes of NASA's GRACE programme and Cloud to Street, a leading flood mapping and monitoring platform. These use satellites and drones to map water resources and gauge variations in supply, prepare for the consequences of extreme weather conditions and provide water quality data.[45] By creating 'digital twins' of their networks, water and wastewater network operators can better manage flows, leakage and flooding, remotely and efficiently.

Third, compliance management software is helping water utilities ensure they adhere to evolving regulations governing water quality and environmental standards. By automating data collection and reporting, these software solutions help streamline the compliance process.[46]

43 Hata, A., et al., 2018: Next-generation amplicon sequencing identifies genetically diverse human astroviruses, including recombinant strains, in environmental waters. *Scientific Reports*.
44 Bluefield Research, 2020: Water Industry 4.0: U.S. & Canada Digital Water Market Forecast, 2019-2030
45 Milena, L., et al., 2021: Global flood monitoring with GRACE/GRACE-FO
46 Impax, 2021: Water: from a systemic and unpriced risk to a measurable opportunity with positive impact

5. SMART IRRIGATION

Given that agriculture accounts for most of the world's freshwater consumption, there is a vast market for solutions that can improve agricultural water efficiency.

40%

Potential water use savings in agriculture though smart irrigation technologies

Innovative 'smart irrigation' approaches integrate technology to optimise water usage and crop yields. These systems make use of sensors, weather data, soil moisture measurements and automated controls to deliver precise and efficient irrigation. Unlike traditional methods that follow fixed schedules or are based on manual observations, smart irrigation adapts in real time to environmental conditions and the specific needs of plants. Research has found predictive models can deliver water savings of 40%.[47] Smart irrigation can provide other important environmental benefits as well, including minimising fertiliser and pesticide run-off into neighbouring water bodies.

Smart irrigation solutions can be applied in other major end-markets beyond farming, including gardening and the management of urban green spaces and golf courses.

6. WATER REUSE

With growing volumes of water being used in homes and industrial processes, there are environmental and financial advantages in reusing wastewater wherever possible. Water re-use systems often combine several processes, including biological treatment, filtration, evaporation, disinfection and demineralisation. High-purity condensate, a byproduct of the evaporation process, is a potentially valuable resource for certain industrial applications.[48]

Water reuse systems are now being embedded to optimise and mitigate water consumption, and alleviate local water scarcity issues. Much of the world's semiconductor manufacturing takes place in water-stressed regions, for example.

47 Lefkowitz, M., 2019: Smart irrigation model predicts rainfall to conserve water. *Cornell Chronicle*
48 Veolia, 2023: Water reuse

OUTLOOK

Impax firmly believes that water represents an exciting opportunity set for investors in listed equities. Addressing the challenges posed by climate change, ageing infrastructure and pollution issues, and meeting rising demand from growing populations and emerging water-intensive industries, look set to provide long-term growth drivers for businesses operating in the water sector.

By carefully choosing from the universe of listed companies that have exposure to the water theme, Impax aims to build a high-quality portfolio of stocks that is well balanced between economically resilient businesses and firms that are more growth oriented.

Impax believes that the tightening ratchet of regulation, combined with structural drivers of global water industry growth, will support opportunities for expertise-led active investors to outperform over the years and decades ahead.

Impax Asset Management, March 2025

This article has been written by Impax Asset Management. Founded in 1998, Impax Asset Management has pioneered investment in the transition to a more sustainable global economy and today is one of the largest investment managers dedicated to this area.

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VIEWPOINT

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