Equity Research
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Industry Report

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Tapping Into the World of Water

Technologies and Solutions for a Thirsty World

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Executive Summary

The Water Problems
The world continues to contend with widespread problems related to water. In this report, we organize the problems into three categories: water scarcity, aging infrastructure, and water quality and contamination. The world's water problems are not new, but they are becoming more urgent with every passing year—exacerbated by population growth and climate change. UNESCO estimates that over 2 billion people lack access to safe drinking water. Trillions of gallons of water leak out of water systems in the United States every year. Water systems servicing about 50% of the U.S. population have detectable levels of PFAS "forever chemicals." As the global population grows, climate change puts increasing stress on the water supply, and infrastructure continues to age, the need for solutions to these issues becomes even more pressing.

The Potential Solutions
Global water problems are being addressed with many different systems and technologies. Solutions to water scarcity include converting sea water into drinkable water and collecting condensation from the atmosphere. Companies are using an array of solutions to identify and repair water infrastructure. Complex systems are used to purify the most contaminated water. We discuss potential solutions in detail and highlight the challenges to implementing them in a highly fragmented global industry. We believe the market for water industry solutions exceeds $500 billion and is growing at a mid- to high-single-digit rate. We provide more detailed market size and growth estimates for subsegments of the industry throughout the report.

Agricultural Irrigation
Because agricultural irrigation accounts for about 70% of freshwater use globally, we provide a detailed overview of this industry. Public companies in this industry include Lindsay, Orbia, and Valmont. Lindsay has the greatest exposure to agricultural irrigation in terms of revenue mix.

Relevant Public Companies
Outside agricultural irrigation, select public companies that generate a significant portion of revenue through the provision of solutions to the water problems discussed in this report include Advanced Drainage Systems, A.O. Smith, Badger Meter, Ecolab, Franklin Electric, Itron, Mueller Water Products, Pentair, Tetra Tech, Veolia, Veralto, Watts Water, Xylem, and Zurn Elkay Water.

Introduction and Overview

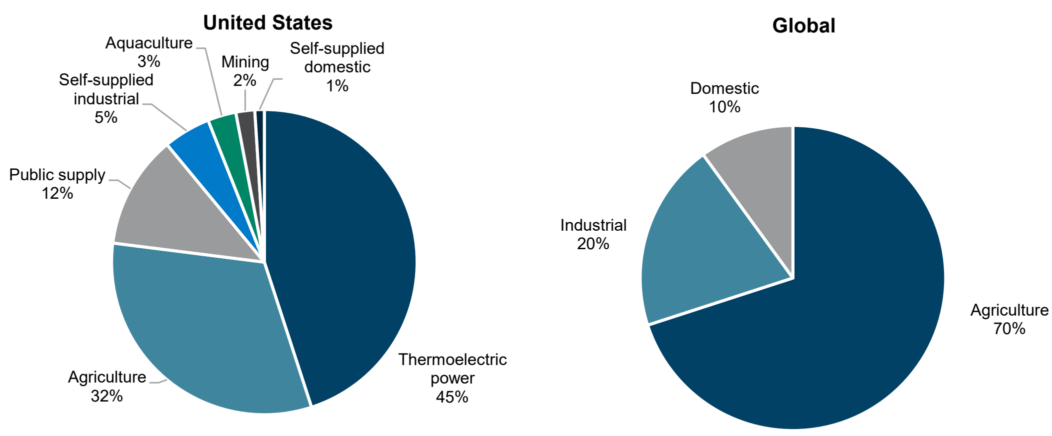
In this report, we highlight three major and urgent global problems related to water: water scarcity, aging infrastructure, and water quality and contamination. We then discuss potential solutions for these problems, including a range of methods, products, and technologies. The report also identifies companies developing or already providing these solutions. We also outline some of the more significant regulatory and governance challenges in the water industry. Later, we dedicate a section of the report to the agricultural irrigation industry, which uses more freshwater than any other industry.

Every day, the average American uses about 80 gallons of water, which translates to the average household using about 10,000 gallons every 30 days, according to the Environmental Protection Agency (EPA). Water is sourced and distributed through a network of public and private systems, including suppliers (sourcing and transporting water) and utilities (delivering water to end-point consumers). Water is perhaps humanity's most important asset given our reliance on daily freshwater consumption and important uses such as food production, irrigation for agriculture, industrial processes requiring cooling and cleaning, hydropower, maintaining hygiene, and sustaining healthy freshwater ecosystems. Nearly every modern-day supply chain and industry uses water to some degree; agriculture, textiles, food and beverage, chemicals, oil and gas, and mining all rely on consistent supplies of water. Only about 3% of the planet's water is fresh, and most of that is unavailable because it is trapped in glaciers, ice caps, or soil—or it is highly polluted. So, although water covers 71% of Earth's surface, only about 0.5% is available fresh water.

Managing our very limited amount of freshwater is a concern that grows every year as the population grows, domestic and industrial demand increases, water infrastructure ages, and new contamination issues arise. In the United States, the thermoelectric power and irrigation industries are the biggest users of freshwater. However, thermoelectric power systems return nearly all used water to water bodies (e.g., lakes, oceans, and rivers), resulting in actual consumption well below irrigation. Agricultural irrigation consumes a massive amount of water to supply crops with needed moisture. UNESCO estimates that agriculture accounts for about 70% of global freshwater consumption, industrial uses account for roughly 20%, and domestic/municipal uses account for about 10%.

The global water and wastewater treatment industry has many components or sub-industries and is highly fragmented. As a result, it is difficult to pinpoint a growth rate and size for the market. Based on several industry sources, including Fortune Business Insights and Organic Market Research, we peg the global water and wastewater treatment market at $340 billion to $380 billion, growing 6% to 7% annually.

Exhibit 1
United States and Global Freshwater Withdrawals



Sources: Schneider Electric, UNESCO

The Water Problems

Water Scarcity

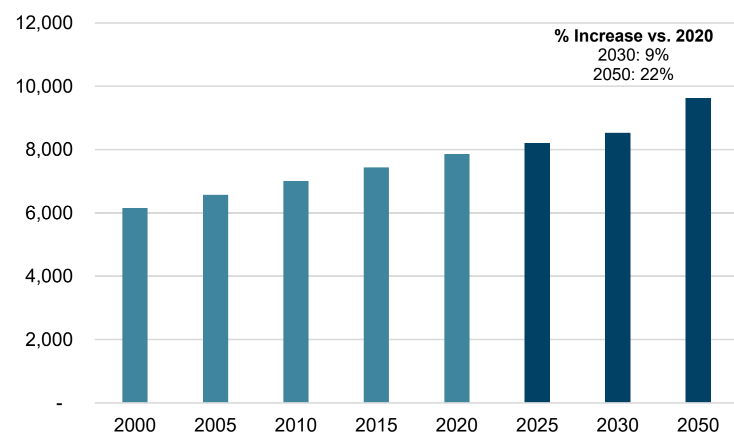
The issue of water scarcity is intensifying globally. According to UNESCO, 2 billion people do not have access to safe drinking water, and 3.6 billion people lack access to basic sanitation. Further, between 2 billion and 3 billion people experience water shortages for at least one month per year, which results in risks to health. Although the amount of freshwater has remained stable over time, population growth has stretched freshwater supplies thin and created challenges in developing nations that lack the infrastructure and resources to properly manage freshwater and treat wastewater. Before presenting potential solutions to the water scarcity issue, we discuss contributors to the issue, including population growth, water supply stress, climate change, and the rapidly growing data center industry.

Population Growth Is Driving Demand

Population growth in developing economies is likely to support a multi-decade upgrade and build-out cycle of water infrastructure systems. Global water scarcity has already reached alarming levels. Population growth is expected to accelerate this problem. The UN estimates the global population will increase from 8.2 billion at the end of 2024 to about 9.8 billion in 2050. Compared with 2020, the global population is expected to increase 9% by 2030 and 22% by 2050. Freshwater consumption is estimated to double every 20 years as a result of population growth and industrial development.

The UN also estimates that 68% of the world's population will live in urban areas by 2050, up from about 55% currently. Increasing concentrations of people in dense urban areas will likely exacerbate the demand for water and increase the need for more sophisticated water distribution and treatment systems. Population growth and its effects on water scarcity is of particular concern in developing economies such as those throughout Africa, where the population is expected to increase nearly 70% by 2050 (from about 1.5 billion in 2024 to nearly 2.5 billion in 2050). Safe access to water is critical to healthy population expansion, and the infrastructure and water systems in Africa are generally inadequate. The UN estimates that in sub-Saharan Africa, only 22% of the urban population has access to piped water as of 2024.

Exhibit 2
Global Population (millions) and Growth Estimates



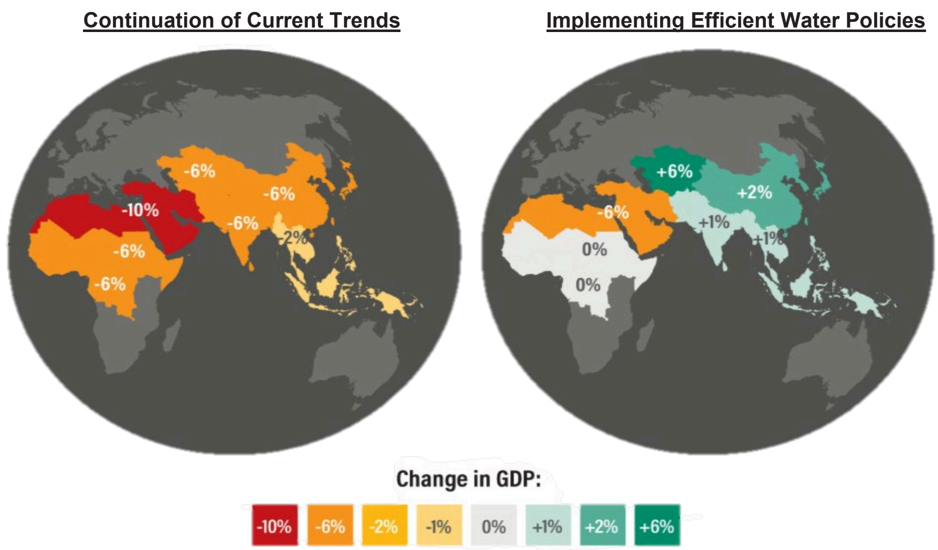
Source: World Bank Group

Economic Strain and Regional Water Scarcity

Water scarcity can present many challenges to the global economy. According to the World Bank, failing to implement improved water management policies could result in a 2% to 12% reduction in GDP across various countries by 2050.

In practice, based on actions taken to correct water problems, most countries either appear to underestimate the economic impact of poor water management or cannot afford to implement appropriate measures. The World Resources Institute estimates that 75 countries, representing half of the global population, would be able to achieve sustainable water management at a cost of less than 2% of each country's GDP. For the United States, the estimate is 0.78% of GDP, although this figure does not include the cost of replacing existing infrastructure. The costs to achieve sustainable water management are quite low when considering the potential economic impact of continuing water scarcity. For example, the drought-fueled wildfires in California caused about $17 billion of damages in 2018 (Camp Fire) and $12 billion of damages throughout 2020; most recently, in 2025 the Los Angeles fires could have caused as much as $164 billion in total damages with insured losses estimated at $75 billion. Clearly, there is significant economic incentive to improve water scarcity conditions globally.

Exhibit 3
Estimated Change in 2050 GDP Due to Water Scarcity



Source: World Resources Institute

Water scarcity is a global issue, but its effect on different countries and regions varies widely. For example, the Middle East and North Africa (MENA) region includes 16 of the top 25 most water-stressed countries. The MENA region has a complex network of shared water sources (e.g., the Nile River) that makes the region susceptible to tensions related to sharing water resources. Greenpeace reported that six African countries control 54% of the continent's water supply, while 27 countries facing severe water scarcity share only about 7%. Moreover, Africa as a whole faces an increasingly urgent water scarcity challenge. The UN estimates that over one-third of African countries face water insecurity, representing about 500 million people. The issue will likely only worsen given expected population growth.

Although the water scarcity situation in the Middle East and Africa is dire, steps are being taken and investments are being made to move the regions toward a water-secure future. Certain countries, including Egypt and Saudi Arabia, are investing heavily in efficient irrigation systems and expanding agricultural developments. Broader efforts to educate the population on water conservation and investments in water infrastructure, water-efficiency technologies (e.g., rainwater harvesting), and treatment systems are increasingly common.

Water Supply Stress

The depletion of groundwater aquifers, one of the largest freshwater sources in the world, is a major concern and contributor to global water scarcity. In a 2024 study titled "Rapid groundwater decline and some cases of recovery in aquifers globally" published with the National Institutes of Health (NIH), the authors' analysis of 170,000 monitoring wells and 1,693 aquifer systems that cover about 75% of global groundwater withdrawals found that groundwater declines are more widespread in the 21st century than the 20th century. Further, groundwater declines have accelerated over the past 40 years in 30% of the world's regional aquifers.

There were, however, some encouraging data points in the report. Saudi Arabia, for example, has reported slowing groundwater depletion in the Eastern Saq aquifer, likely the result of the country's banning of the growth of water-intensive crops and the implementation of more efficient farming practices and irrigation methods. Since agriculture consumes 70% of the world's freshwater, irrigation methods that reduce water usage in the irrigation industry are crucial to overall efficient water usage.

A 2024 study enabled by NASA's Gravity Recovery and Climate Experiment (GRACE) satellites revealed that the amount of fresh water on Earth dropped starting in May 2014 and has remained low since. NASA satellite observations between 2015 and 2023 showed that the average amount of inland freshwater was 290 cubic miles below the average level recorded between 2002 and 2014. One of the study's authors, NASA hydrologist Dr. Matthew Rodell, equated this loss of freshwater to roughly two and a half times the volume of Lake Erie. The decline in global freshwater appears to have begun with a significant drought in Brazil, followed by droughts in Australasia, South America, North America, Europe, and Africa. More concerning, NASA's GRACE satellites show that 13 of the world's 30 most intense droughts have occurred since tracking began in January 2015. The study concluded that climate change and resulting droughts are likely contributing to the global freshwater decline.

Climate Change

Many studies indicate that climate change is contributing to water scarcity, primarily through more frequent droughts and changing weather patterns. Over time, human settlements have tended to form around sources of water, such as lakes and rivers. Population growth and the effects of climate change have led to water becoming increasingly scarce where it is needed most. The World Bank estimates that two-thirds of the world lives in a water basin with water stress, where demand for water is outpacing supply for at least part of the year. The UN summarized the role of climate change as a factor contributing to water scarcity with the following points.

1. About 0.5% of water on Earth is usable and available freshwater, and climate change is dangerously affecting that supply. Over the past 20 years, terrestrial water storage—soil moisture, snow, and ice—has dropped at a rate of one centimeter per year, which has major ramifications for water security.

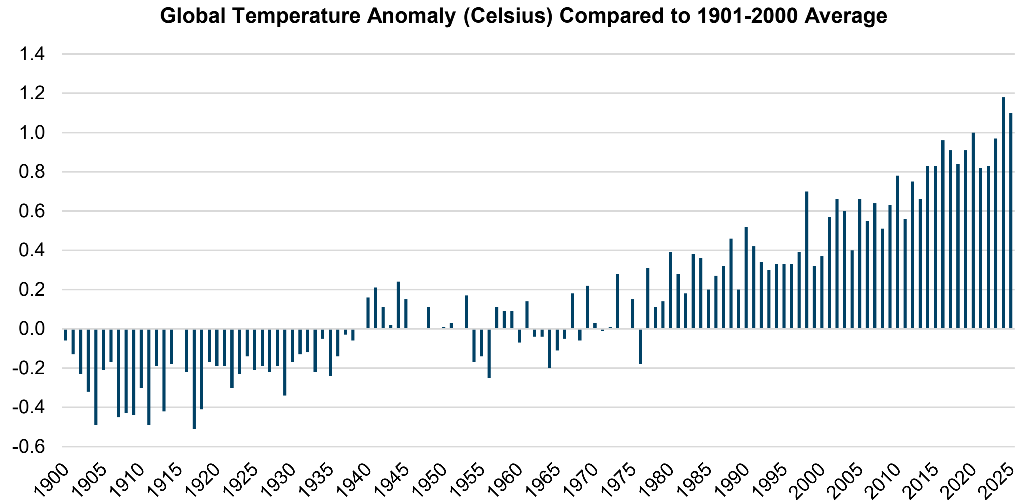
2. Melting glaciers, snow, and permafrost are affecting humans and ecosystems that depend on these as sources of irrigation, hydropower, and water supply.

3. Limiting global warming to 1.5°C compared with 2°C would roughly halve the proportion of the world population expected to suffer water scarcity.

4. Water quality is also affected by climate change because higher water temperatures and more frequent floods and droughts exacerbate several forms of water pollution, including sediments, pathogens, and pesticides.

Data from the National Oceanic and Atmospheric Administration (NOAA) show that global temperatures have risen steadily since 1982, with 2024 the warmest year on record. The exhibit below shows the average annual temperature relative to the average temperature during the 1901-2000 period.

Exhibit 4
Global Temperature Change Anomaly



Source: National Oceanic and Atmospheric Administration

Saltwater intrusion (SWI), the advance of saline water into freshwater aquifers, is threatening coastal agriculture. In February 2025, a peer-reviewed paper published by several scientists on ScienceDirect (titled "The growing trend of saltwater intrusion and its impact on coastal agriculture: Challenges and opportunities"), discussed how natural and human-caused SWI will likely intensify with climate change. Natural causes of SWI include higher sea levels, coastal land subsistence, storm surges and flooding, and prolonged droughts. Humans contribute to SWI through extensive extraction of groundwater, dam construction (limits outflow of freshwater to coastal areas), and water control structures (tide gates, canals, ditches) that limit hydrologic connectivity. The ScienceDirect paper estimates that sea level rise has accelerated from 1.4 mm per year (1901-1990) to 3.2 mm per year (1993-2015), with more current rates reaching 3.6 mm per year (2006-2015). Separately, NASA estimates that sea level rise in 2024 reached 5.9 mm, driven by a record increase in sea level temperatures. The ScienceDirect paper predicts that by 2100 more than 85% of coastal land loss will be attributable to sea level rise, potentially resulting in a 5% loss of global delta land. Flooding and sea level rise can impact agriculture as saltwater infiltrates freshwater sources and raises salinity levels. The impacts to agriculture can vary widely depending on the type of crop and its resistance to salinity.

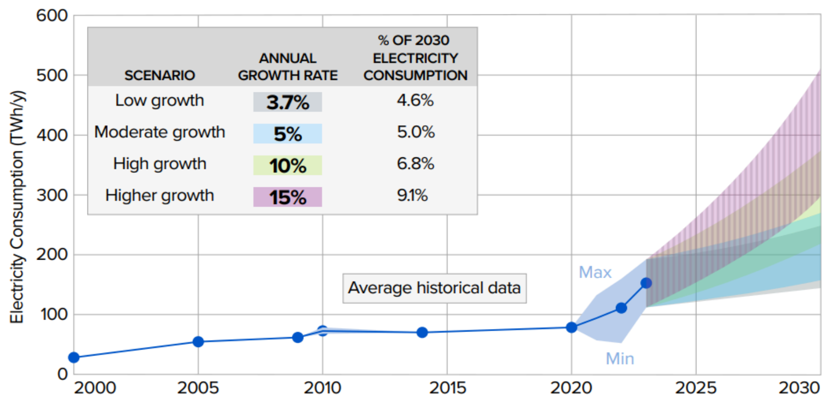
Data Centers: a New Contributor to Water Scarcity

Investment in advanced large language models (LLMs) and artificial intelligence (AI) technologies has been increasing at a rapid pace. Large hyperscalers such as Microsoft, Google, Meta, Amazon, and Oracle have been investing billions of dollars to build data centers capable of serving their growing AI and cloud computing businesses.

A typical data center contains servers, networking equipment, data storage devices, power infrastructure, cooling infrastructure, environmental monitoring systems, and physical security. Data centers consume water indirectly through the use of electricity, and directly to support cooling systems. As the rapid development of data centers continues and the need for more efficient cooling systems becomes a top priority, we believe investments will be made to enhance water infrastructure and efficiency at data center sites.

Data centers draw considerable amounts of energy from local power grids, which increases the consumption of water at power plants for cooling and steam generation. We expect data centers to play an increasingly large role in growing energy demand, because AI and LLMs used in services like ChatGPT require significantly more energy than traditional web searches. The Electric Power Research Institute's (EPRI) 2024 report forecasts electricity consumption by U.S. data centers to increase annually at a 5% rate from 2023 to 2030 in a moderate case and represent 5% of total U.S. electricity consumption in 2030. Over the past decade, U.S. data center energy consumption has been relatively flat and represented about 2% of total electricity consumption. Even in the EPRI's low-growth scenario, energy consumption growth and share of 2030 total electricity are estimated to roughly double from historical levels.

Exhibit 5
Projected Electricity Consumption for U.S. Data Centers

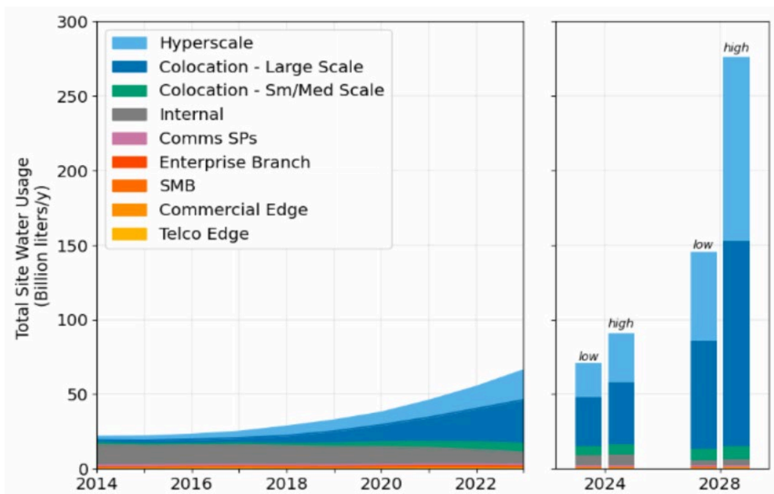


Source: Electric Power Research Institute, Inc. "Powering Intelligence: Analyzing Artificial Intelligence and Data Center Energy Consumption" 3002028905 (2024)

The increased demand for energy in data centers is driving a material step-up in demand for water. Berkeley Lab's 2024 United States Data Center Energy Usage Report provides helpful context to understand a data center's indirect water consumption. First, the United States has over 12,000 utility-scale power plants that use fossil fuels, nuclear, and renewables that each have unique water footprints based on the type of power plant and its efficiency. Thermoelectric plants require significant volumes of water for cooling applications, while hydroelectric plants lose water through evaporation. According to Berkeley Lab, U.S. data centers consumed about 176 TWh of electricity in 2023, which equated to indirect water usage of almost 800 billion liters. This translates to about 4.52L/kWh of indirect water consumption at U.S. data centers. The projected increase in data center energy use in the coming years should result in increased indirect water consumption, although future estimates are hard to gauge given potential changes in the mix of power generation and the rise of alternative energy sources. Decarbonization and the transition to cleaner power generation technologies will likely lower the indirect water consumption from data centers.

Data centers represent only about 1% or less of total U.S. freshwater consumption, but we believe the end-market will continue to grow its share of consumption as hyperscalers invest billions in data center expansion. Within a data center, water is used for cooling systems such as air conditioning and liquid cooling. Water has high thermal conductivity and heat capacity, making it ideal for use in cooling applications. The efficiency of water usage in data centers still varies widely depending on the design of the cooling systems and the location of the physical data center. Some facilities have implemented closed-loop systems that can recirculate 92% to 98% of the water used for cooling. Aside from cooling applications, data centers consume water through typical use-cases such as cleaning activities, handwashing, or other maintenance. According to Berkeley Lab, direct water consumption at U.S. data centers has increased more than 200%, from 21 billion liters in 2014 to 66 billion liters in 2023. Enterprise data centers represented 64% of the 2014 total, but by 2023 their share dropped to 12% as hyperscale and colocation data centers grew to represent 84% of direct water consumption. This trend will likely continue. Berkeley Lab estimates that hyperscale data centers (including major neocloud and colocation campuses) will represent 98% of data center water consumption in 2028, potentially consuming more than 120 billion liters of water (see exhibit below). Google noted in its 2024 Environmental Report that the company's data centers consumed 6.1 billion gallons of water in 2023, an increase of 17% year-over-year. As data centers proliferate in the coming years, direct water consumption is likely to increase. Increasingly efficient liquid cooling systems and a focus on sustainable water and wastewater management should help offset the projected increase in direct water consumption.

Exhibit 6
Direct Water Consumption by Data Center Type



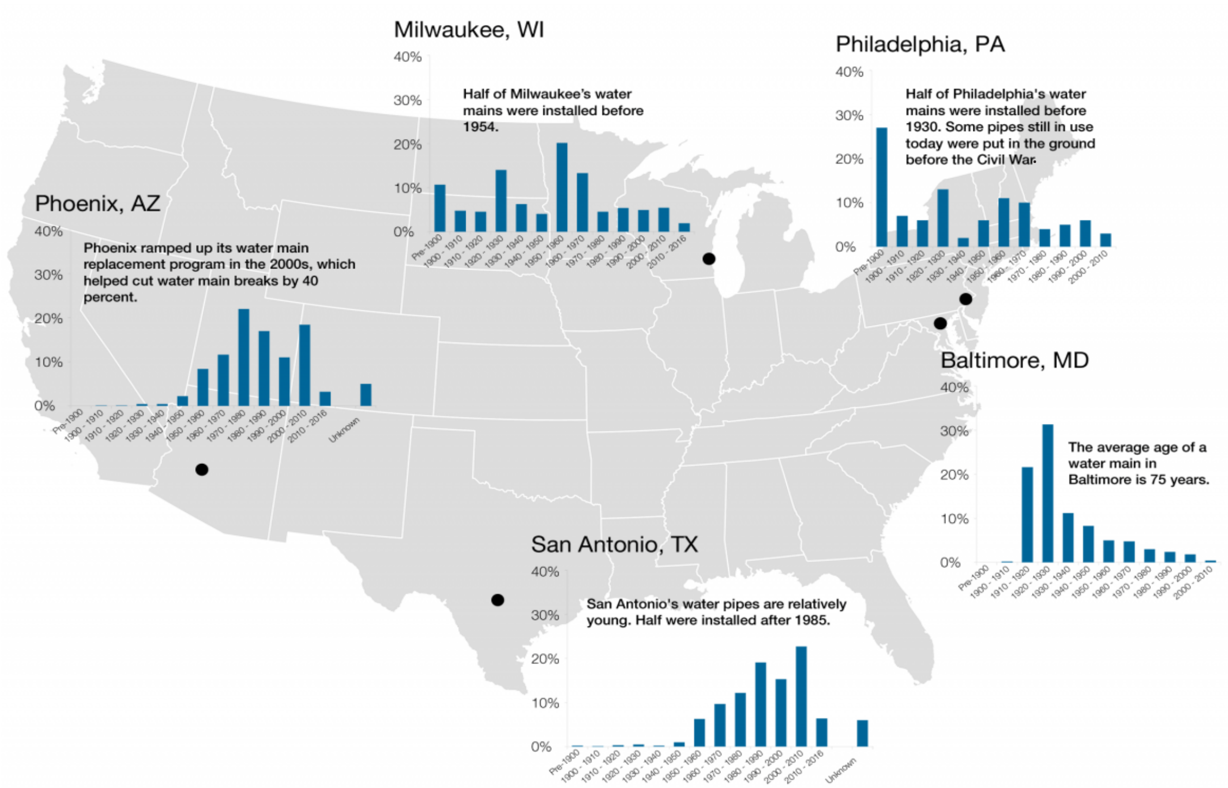
Source: Berkeley Lab, 2024 United States Data Center Energy Usage Report

Aging Water Infrastructure

Another issue the water industry faces is aging or inadequate infrastructure, which results in wide-ranging challenges for utilities, consumers, and the environment. Aging infrastructure is a global problem, but the issue is more acute in developed countries with infrastructure (pipes, pumps, valves, etc.) that in many cases is more than 100 years old. The average age of water pipes in the United States is 45 years, and the average life expectancy of most pipes in place is about 80 years, according to various industry sources. Certain cities have much older water infrastructure. The average age of water pipes in Chicago is between 40 and 50 years. Along the East Coast, infrastructure is generally much older, with the average age of water pipes about 70 years old in New York City, 80 years old in Philadelphia, and (in some areas) over 100 years old in Boston. Water networks in many U.S. cities still include lead pipes—which can leach lead into drinking water—that were put in place decades ago. Chicago's water system includes more lead pipes than any other city, according to the EPA. We believe aging water infrastructure and the need to replace harmful lead pipes has created a multiyear growth opportunity for companies that offer solutions, including advanced metering infrastructure (AMI), pipeline assessment services and technologies, and components and services for water networks.

The 2025 Report Card for America's Infrastructure notes that over half of the nation's public water systems have identified rehabilitation and replacement of aging infrastructure as their most pressing concern, and nearly 20% of installed water mains were reported to have exceeded their useful lives. Newer cities in the United States (relative to the Northeast) have younger water networks, and some cities have already implemented large-scale upgrade programs (e.g., Phoenix). The chart below from Circle of Blue shows the variation in water pipe ages for Philadelphia, Baltimore, Milwaukee, San Antonio, and Phoenix.

Exhibit 7
Water Pipe Ages for Select Cities



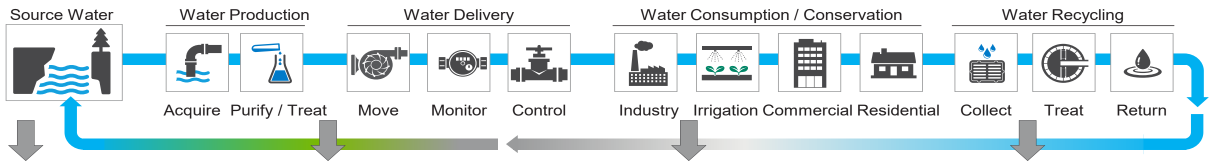
Source: Circle of Blue

Overview of Water Cycle and Water Infrastructure

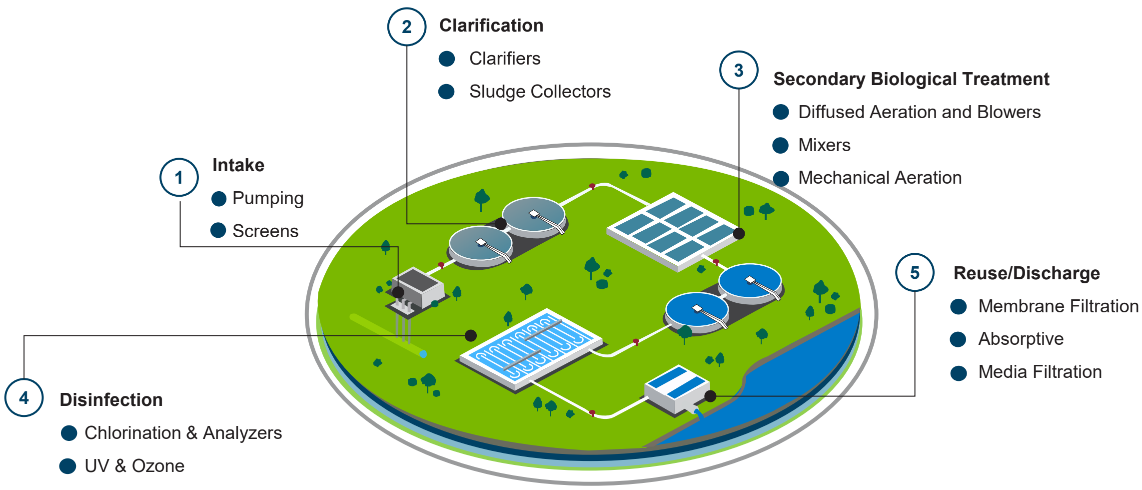
The water cycle involves a series of steps and processes involving sourcing, treatment, and distribution. At a high level, the water cycle includes five steps: sourcing, production, delivery, consumption, and recycling.

The cycle begins with water being sourced from aquifers, reservoirs, groundwater, lakes, or rivers before being treated to make the water suitable for consumption. Treated water is then distributed via complex supply networks (often after spending time in storage tanks). The water is used by industrial, commercial, agricultural, or residential customers. After use, the water requires varying levels of treatment. Following collection, water is returned to treatment plants through a separate wastewater network. At the plants, many processes—filtration, separation, UV light purification, chemical treatment, and other processes—can be used to return the water to a state appropriate for its next use.

Exhibit 8
Water Cycle and Wastewater Treatment Facility Process



Illustrative Example of Wastewater Utility



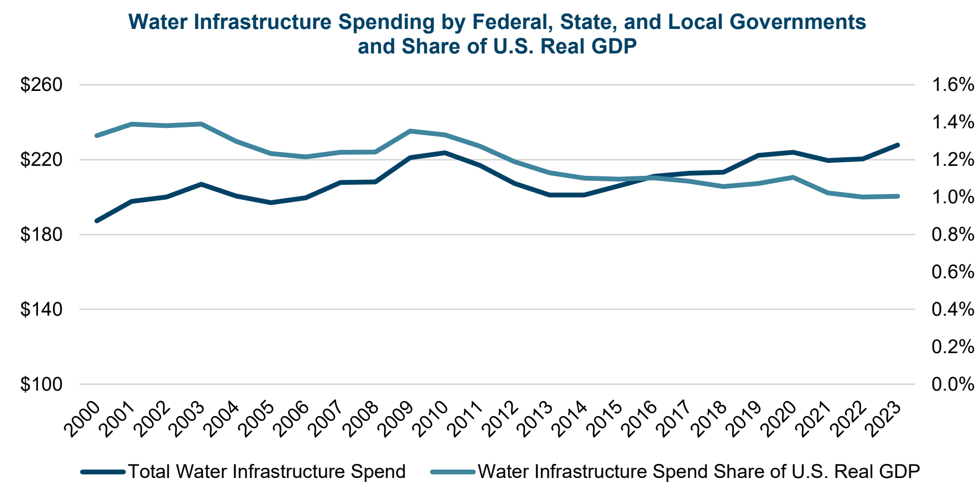
Sources: Xylem Inc., Ishiguro Co., William Blair Equity Research

The water utility market in the United States is highly fragmented. According to the EPA, there are about 150,000 public water systems in the United States. Public water systems are further divided into community and noncommunity water systems. Community water systems are those that supply water continuously to a specific population and serve at least 25 permanent structures. There are about 50,000 of these water systems across the United States. The remaining 100,000 noncommunity water systems are broken down into transient systems, which provide water to 25 or more customers for at least two months per year, but not on a permanent basis, and nontransient systems, which provide water on a regular basis to at least 25 permanent customers. The fragmented nature of the U.S. public water utility market is made even more clear when compared with the relatively small number of public electric and gas utilities. According to the Energy Information Administration, there are only about 2,000 public electric utilities in the United States, and the American Public Gas Association states there are about 1,000 public gas utilities across the country. Private water systems, which represent about 15% of total U.S. water supply, serve no more than 25 customers for at least 60 days per year. Private water systems represent a relatively small share of U.S. water supply but still invest at a high level to maintain and improve systems. According to the National Association of Water Companies (NAWC), the 15 largest private water companies collectively invest about $5.5 billion each year to maintain and upgrade systems.

Inadequate Government Spending on Water Infrastructure

Investment in water infrastructure in the United States over the last several decades has been limited. According to the Congressional Budget office (CBO), total water infrastructure spending by federal, state, and local governments grew at a compound annual rate of 1% from 2000 to 2023. The economic effects of the Great Recession resulted in many utilities shifting resources away from long-term capital projects, and those trends persisted for years. While government spending on water infrastructure has increased over time, this spending as a percentage of GDP has steadily declined over time.

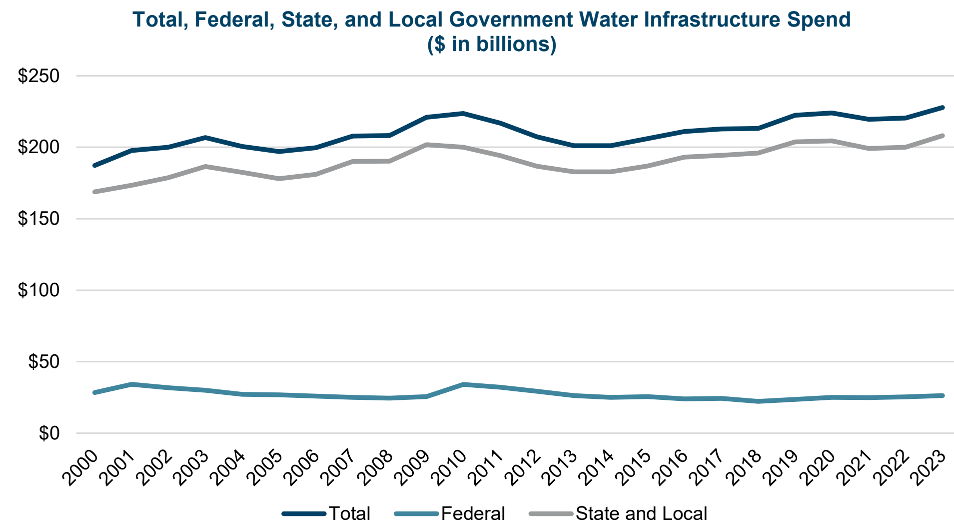
Exhibit 9
United States Public Spending on Water Infrastructure ($ in billions)



Note: Total water infrastructure spend shown in billions of 2023 USD; U.S real GDP is chained 2017 USD
Sources: Congressional Budget Office, Federal Reserve Economic Data

The CBO also provides data regarding spending on water infrastructure at the federal, state, and local level. Given the highly fragmented nature of water utilities and networks, government spending on water infrastructure primarily falls to state and local governments. As of 2023, federal spending represented 10% of total spending, and state and local sources accounted for 90%. Federal spending declined 0.4% on a compound annual basis from 2000 to 2023, while state and local spending increased 0.9% on a compound annual basis.

Exhibit 10
United States Public Spending on Water Infrastructure

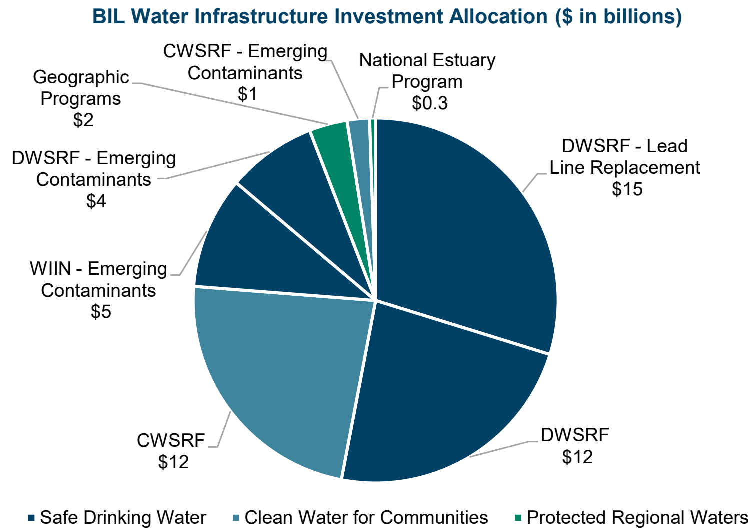


Note: Shown in billions of 2023 USD
Source: Congressional Budget Office

Sources of Funding and Requirements

At the federal level, the EPA, U.S. Department of Agriculture (USDA), and U.S. Department of Housing and Urban Development (HUD) are the main sources of funding for water infrastructure. Two of the main funds that the federal government has historically used to distribute money for water infrastructure investments are the Clean Water State Revolving Fund (CWSRF) and the Drinking Water State Revolving Fund (DWSRF). The CWSRF primarily funds water quality projects for wastewater treatment, while the DWSRF primarily funds improvements to drinking water systems. More recently, the 2021 Infrastructure Investment and Jobs Act (IIJA) provided additional funding for water projects—specifically $50 billion earmarked for water infrastructure upgrades (with a focus on lead service lines and PFAS removal).

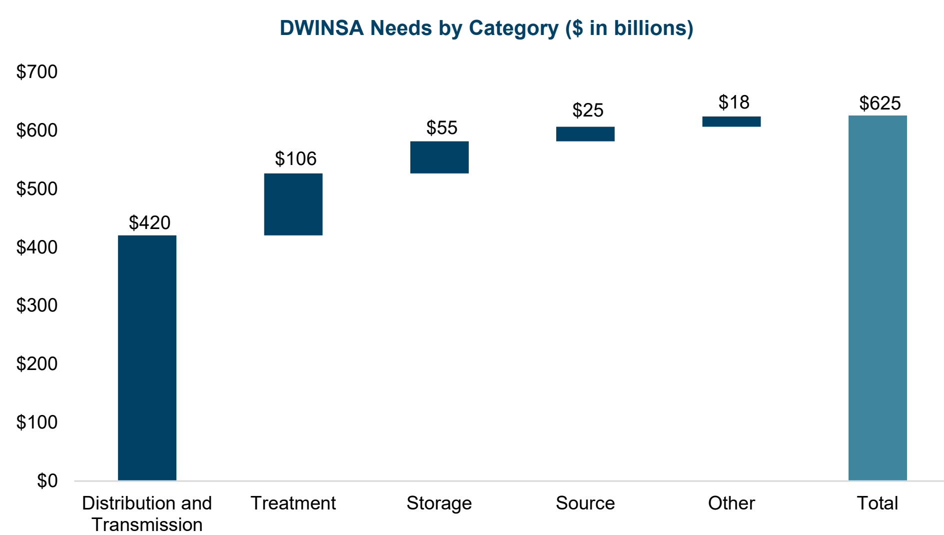
Exhibit 11
Breakdown of IIJA Water Infrastructure Funds



Source: United States Environmental Protection Agency

The EPA's 7th Drinking Water Infrastructure Needs Survey and Assessment (DWINSA) in 2023 determined that drinking water systems will need $625 billion for pipe replacement and other key upgrades over the next 20 years. A rough breakdown of the total required investment includes $420 billion for distribution and transmission upgrades; $106 billion to build, expand, or rehabilitate treatment infrastructure; $55 billion for water storage; $25 billion for sourcing and intake; and $18 billion for other needs. Notably, the 7th DWINSA needs estimate of $625 billion surpassed the previous 2018 assessment by more than $150 billion, suggesting continuation of underinvestment in recent years.

Exhibit 12
Drinking Water Infrastructure Needs Survey and Assessment (DWINSA)

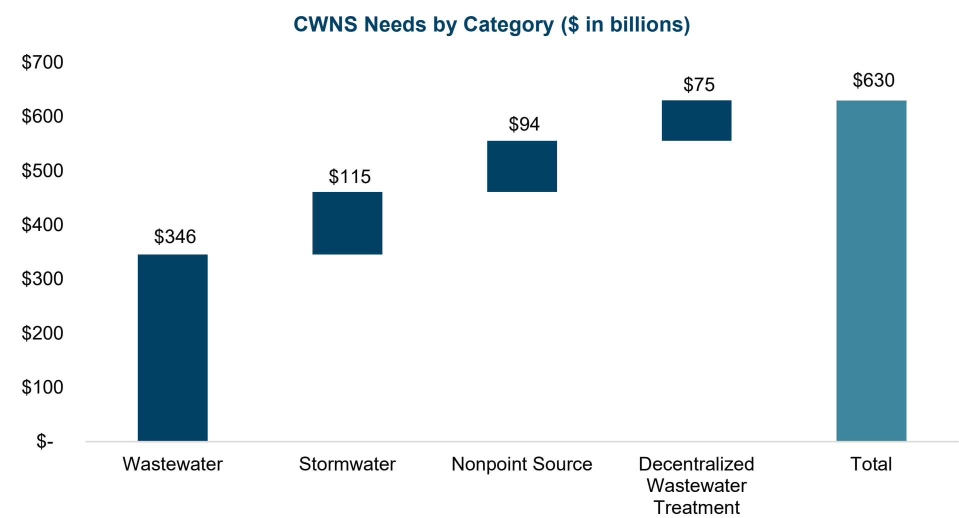


Note: Shown in billions of 2021 USD
Source: United States Environmental Protection Agency

In 2024, the EPA presented the 2022 Clean Watersheds Needs Survey (CWNS) to Congress in compliance with the Clean Water Act (CWA). The 2022 report is the EPA's 17th survey since the CWA was signed in 1972. The CWNS assesses the investments necessary to meet the CWA water quality goals over the next 20 years. The CWNS focuses on publicly owned wastewater treatment works, stormwater, nonpoint source control, and decentralized wastewater treatment. In total, the CWNS reported the needs for clean water infrastructure to be $630 billion as of January 1, 2022, which is a 37% increase over the reported needs in 2012. By category, the CWNS recommends $75 billion for decentralized wastewater treatment, $94 billion for nonpoint source control (nonpoint source refers to pollution that originates from various locations and not a single identifiable point like a pipe), $115 billion for stormwater, and $346 billion for wastewater. Within wastewater, the CWNS recommends $201 million in desalination investments. Just six states—New York, California, Florida, Virginia, Louisiana, and Georgia—accounted for 42% of the total nationwide needs.

Whereas the DWINSA focuses on investment needs for safe drinking water, the CWNS focuses on investment needs for stormwater and wastewater infrastructure. Together, these two assessments indicate that the real level of investment needed to upgrade water infrastructure across the United States is likely more than $1 trillion.

Exhibit 13
Clean Watersheds Needs Survey (CWNS)



Note: Shown in billions of 2022 USD
Source: United States Environmental Protection Agency

Infrastructure Repair

Replacing water infrastructure is difficult, time-sensitive, and expensive. Evaluating pipe conditions and possible repair needs depends on factors such as pipe material, age, soil conditions, and repair history. Water pipes are buried anywhere from 18 inches to 6 feet underground, so a thorough condition assessment is critical to ensuring the right decision is made to unearth a pipe. Water pipes can cost between $1 million and $2 million per mile to replace, so utility operators must have a comprehensive understanding of what sections of pipe need to be replaced versus those that still have years of useful life left.

Replacing portions of a broken water main pipe is a complex process, albeit significantly less complex than a large-scale upgrade or replacement project. In 2024, the EPA issued a mandate that all water systems across the country begin replacing lead service lines by 2027 and complete them over the subsequent 10 years. Alongside this mandate, the EPA announced $2.6 billion in additional IIJA funding available to support lead pipe replacement projects. The EPA estimates that up to 9 million homes across the country are still served through lead pipes. The following summary from the EPA shows examples of cities receiving funding from the IIJA to replace lead pipes.

- Milwaukee: Received $30 million to replace 3,400 lead service lines. The city is on track to replace its lead pipes within the 10-year time frame.

- Detroit: Received $90 million to replace more than 8,000 lead pipes. The city is on track to replace its lead pipes within the 10-year time frame.

- Erie, Pennsylvania: Received $49 million to replace its lead pipes within 5 years instead of 25 years.

- Denver: Received $76 million and is on track to replace its lead pipes within the 10-year time frame.

Nonrevenue Water Loss

Nonrevenue water loss is water that is produced by a utility but is lost before it reaches the customer, primarily from leakage. As a result, the utility cannot bill the customer for all the water produced. Every year, the United States loses nearly 20% of all treated drinking water before it reaches customers, according to estimates from Bluefield Research. Five states—California, Texas, Florida, New York, and Illinois—account for one-third of national water loss. Utilities in the United States collectively lose more than $6 billion in revenue every year in nonrevenue water.

Aging infrastructure and water main breaks are estimated to occur every two minutes in the United States and place significant stress on utilities and their customers. An S&P Global report estimates the volume of nonrevenue water globally to be about 125 billion cubic meters per year, roughly equivalent to the combined freshwater withdrawals of Germany, France, Spain, Italy, and the United Kingdom, equating to almost $200 billion in lost revenue. In a recent report, Liemberger & Wyatt estimated that nonrevenue water represented more than 30% of total water withdrawals in about 65% of the countries included in the study.

The level of nonrevenue water loss varies widely across utilities, countries, and geographies. Generally, the age of water infrastructure correlates with the amount of nonrevenue water loss, as older pipes are more prone to leaks, and out-of-date meters and measurement techniques lead to inaccuracies in tracking water. Several of the United States' largest and publicly traded water utilities publish their nonrevenue water loss in annual or sustainability reports. The exhibit below summarizes nonrevenue water loss rates for three of the United States' publicly traded water utilities that collectively serve about 18 million people. These nonrevenue water loss rates translate to tens of millions of gallons of water lost each year.

Exhibit 14
U.S. Public Water Utility Nonrevenue Water

Company	Ticker	States Served	Population Served	Nonrevenue Water %		
				2022	2023	2024
American Water Works	AWK	Top Five: New Jersey, Pennsylvania, Missouri, Illinois, California Other: Georgia, Hawaii, Indiana, Iowa, Kentucky, Maryland, Tennessee, Virginia, West Virginia	14 million	24%	22%	21%
California Water Service Group	CWT	California, Hawaii, New Mexico, Washington, Texas	2 million	*5%*	*5%*	*5%*
H2O America (formerly: SJW Group)	HTO (formerly: SJW)	California, Texas, Connecticut, Maine	2 million	NA	10%	8%

Note: NRW % for CWT is William Blair estimate based on data provided in company filings
Sources: Company filings, William Blair Equity Research

Nonrevenue water loss not only has a negative impact on water utilities, but also affects the environment. Water utilities must overproduce water for customers, knowing that a certain percentage will be lost before it reaches the end-customer. This contributes to the water scarcity issue. Furthermore, treating and pumping water requires significant energy, which means the energy used to produce and transport water that ends up as nonrevenue water is wasted. As a result, greenhouse gas emissions from energy used to produce nonrevenue water are significant; Liemberger & Wyatt estimates that total global carbon dioxide emissions from treating nonrevenue water is 11.9 billion kilograms per year (equivalent to the emissions from about 2.5 million cars over the course of a year).

Nonrevenue water is a critical issue for water utilities given the financial and environmental consequences. Solutions to nonrevenue water loss include upgrading aging infrastructure and implementing AMI to improve leak detection and billing accuracy. In the following section, we provide an overview of communicated capital expenditure goals from public water utilities in the United States and internationally. In our view, these select public U.S. water utilities are at the forefront of a significant capital expenditure and upgrade cycle.

Public Water Utility Investment Cycle

In our view, the public water utility industry is at the leading edge of a large capital investment cycle to address aging infrastructure, water security, safety and reliability, and PFAS contaminant concerns. Capital expenditures and infrastructure investments across major U.S. water utilities vary widely; smaller utilities often spend about $100 million or less per year, while large industry leaders invest multiple billions of dollars per year. The exhibit below summarizes capital expenditure plans for select large and public water utility companies. In total, the select U.S. water utilities invested $5.3 billion in infrastructure improvements in 2024 and intend to invest roughly $6 billion in 2025, representing growth of about 13%. Looking at longer-term plans for the next five-year investment cycle, compared with roughly $21 billion spent on capital expenditures from 2020 to 2024, the select U.S. water companies expect to spend about $31 billion from 2025 to 2029, an increase of about 50%.

Exhibit 15
Major Public U.S. Water Utilities Capital Expenditures and Outlook

Company	Ticker	2024 Capex Spend	2025 Outlook	Long-Term Plan	Commentary
American Water Works	AWK	$2.9B	$3.3B	2025-2029 plan: Invest $17B-$18B	Focus: Addressing aging infrastructure and water quality across network that serves 14M+ people
Essential Utilities	WTRG	$1.3B	$1.4-$1.5B	2025-2029 plan: Invest $8B for infrastructure improvements	Invested $27M in PFAS mitigation at 13 plants. Four-year goal: Invest $450M to mitigate PFAS at 300 plants
California Water Service Group	CWT	$471M	~$533M	2025-2027 plan: Invest $1.6B	Plan does not include $226M investment in PFAS projects through 2027. Focused in CA, WA, NM
H2O America (formerly: SJW Group)	HTO (formerly: SJW)	$353M	$473M	Five-year capital plan increasing 25% (vs previous 5-year plan) to $2B	Investment plan includes $300M for installation of PFAS treatment tech
American States Water	AWR	$236M	$170-$210M	Golden State Water (subsidiary) plan: Invest $573M over next 3 years	NA

Source: Company filings, FactSet, William Blair Equity Research

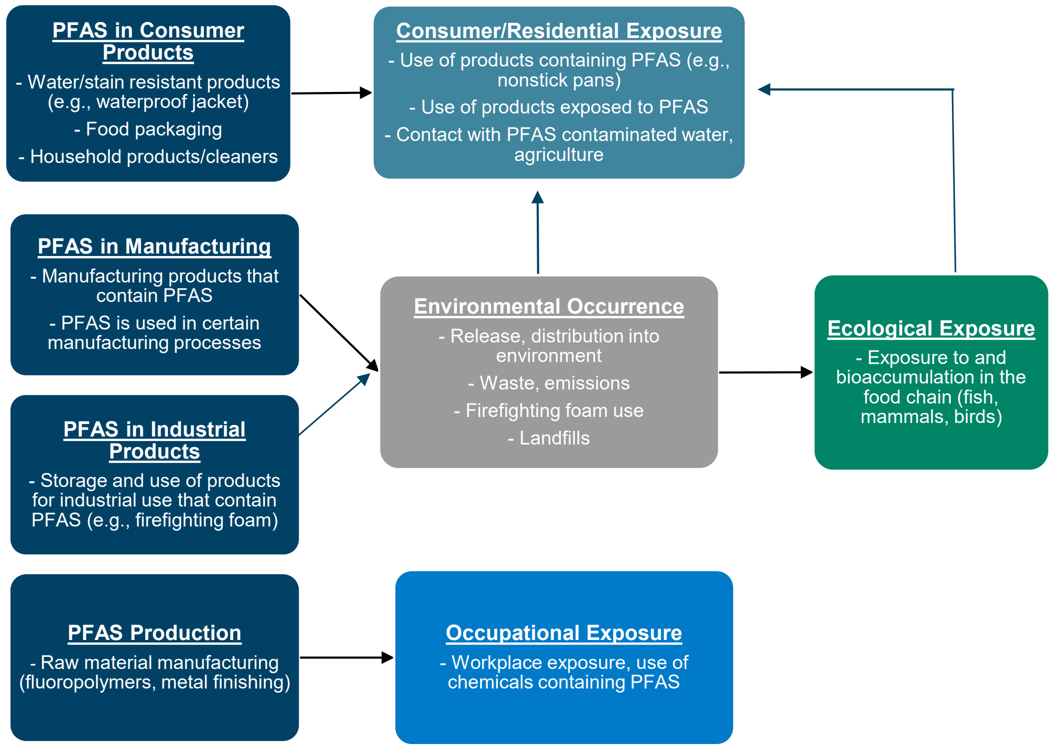
Water Quality and Contamination

In this section, we discuss water quality and contamination issues including per- and polyfluoroalkyl substances (PFAS) and other hazardous materials, industrial waste, and agricultural runoff. In the solutions section, we will discuss several methods of filtration and technologies as solutions to water quality and contamination.

PFAS and Other Contaminants

PFAS are a group of thousands of synthetic chemicals—and may be referred to as the specific chemical itself like PFOS or PFOA—that are used by various end-markets including aerospace, semiconductor, medical, and consumer products. These chemicals serve different purposes, including stain and water resistance, nonstick coatings, firefighting foams, and manufacturing electronic components. PFAS have been manufactured since the 1950s but were not viewed as a major concern until many years later, culminating with two key EPA regulations that were finalized in April 2024. Improvements in technology and testing methods have enhanced visibility into water systems. It is well documented that emerging contaminants, such as PFAS, microplastics, and biopharmaceuticals, have entered our drinking water systems in a way our current infrastructure is not well equipped to deal with. The exhibit below from the Interstate Technology Regulatory Council outlines the sources, uses, and environmental impacts of the PFAS lifecycle.

Exhibit 16
PFAS Use, Exposure, and Environmental Impact



Sources: Interstate Technology Regulatory Council

Addressing PFAS and implementing remediation techniques is important because these forever chemicals have been linked to cancer, negative effects on the liver and heart, and developmental damage in children. Research is still underway to determine how different levels of exposure to PFAS may impact human health. The CDC's National Health and Nutrition Examination Survey measures blood PFAS in the U.S. population and shows that nearly all people in the United States have some PFAS in their blood. While this statistic is daunting, the trend over time is more positive. From 1999 to 2019, blood PFOS levels declined more than 85%, and blood PFOA levels declined more than 70%. This trend can be explained by the decreasing production and use of PFAS and the increasing level of remediation and treatment in drinking water. Still, the prevalence of PFAS in water, everyday consumer products, and the environment is an urgent concern that governments around the world and treatment companies are working to address.

In April 2024, the EPA finalized the first national and legally enforceable drinking water standard to protect communities from harmful exposure to PFAS. The EPA defined maximum contaminant levels (MCLs) for several PFAS chemicals including PFOA, PFOS, PFHxS, PFNA, HFPO-DA (GenX chemicals), and certain mixtures containing two or more chemicals. The MCLs are four parts per trillion for PFOA and PFOS and 10 parts per trillion for PFHxS, PFNA, and HFPO-DA. These MCLs set thresholds for PFAS chemicals to essentially nondetectable levels. The EPA has earmarked a $9 billion investment through the IIJA to help states implement PFAS testing and treatment. The EPA estimates that 6% to 10% of the 66,000 U.S. public drinking water systems may have to implement solutions to reduce PFAS in order to meet new standards. Moreover, all public water systems have three years to complete initial monitoring for PFAS and must inform the public of the PFAS levels measured in drinking water. If PFAS are found to be above the new standards, the water utility must implement solutions to reduce PFAS within five years. In May 2025, the Trump administration proposed several changes to the existing EPA regulations on PFAS. In summary, the proposal intends to maintain the four parts per trillion MCL for PFOA and PFOS but rescind the 10 parts per trillion and hazard index on GenX chemicals. The EPA also intends to push out the compliance deadline to 2031 (from 2029 currently).

Drinking water systems, or the downstream receivers, are expected to apply PFAS remediation on-site, but true remediation must start further upstream. Upstream dischargers (e.g., chemical, plastics, and textile manufacturers, airports, and military bases) are likely to implement their own remediation solutions to decrease their PFAS effluent that ultimately ends up in drinking water systems. A few large upstream chemical companies have already faced large lawsuits and environmental settlements to address their contribution to PFAS discharge. In 2024, 3M agreed to pay $10.3 billion over 13 years to settle lawsuits over its contribution to PFAS in drinking water. In 2023, Chemours, Dupont, and Corteva reached a $1.2 billion settlement regarding their contribution to PFAS in drinking water systems.

The government's allocation of funds to address the PFAS issue is a promising step, but various industry sources estimate that the real funding needs are much higher. Environmental Business International estimates that over the next 15-20 years, PFAS treatment for drinking water and wastewater systems will cost approximately $100 billion, and remediation will cost approximately $100 billion. This $200 billion total estimate has increased from $160 billion several years ago because of enhanced understanding of PFAS exposure, new regulations setting lower MCLs, and the development of new technologies to address PFAS. We believe companies that offer filtration, treatment, and remediation services will be beneficiaries of the deployment of funding to address PFAS in drinking water systems and the environment.

Beyond PFAS, common drinking water contaminants include microorganisms and diseases, inorganic chemicals like lead or arsenic, and other chemicals like those from industrial or agricultural processes. Drinking water that contains microorganisms or diseases (E. coli, noroviruses, etc.) poses obvious risks to human health and especially to children because their immune systems are less developed. The CDC estimates that waterborne diseases affect over 7 million people in the United States every year and cost the healthcare system over $3 billion. Microorganisms and diseases can be removed from drinking water systems through disinfection (chlorination, ultraviolet) and filtration (reverse osmosis, sedimentation) techniques. Monitoring and treating water systems for potentially harmful levels of disease is crucial to avoiding large-scale breakouts and protecting the health of communities.

As discussed above, lead pipes pose significant health risks to communities, and action is being taken to replace them. Still, the associated health risks (developmental delays, cardiovascular issues, kidney problems) can result from low levels of lead in drinking water. When public utilities are slow to replace lead pipes, consumers can use simple in-home water filter pitchers (e.g., Brita) or more advanced whole-home (e.g., sediment, activated carbon, reverse osmosis) systems to remove lead.

Arsenic is a naturally occurring metal found in the earth's crust and enters our water system through either groundwater or human activities like mining, smelting, or other industrial processes. Long-term exposure to high levels of inorganic arsenic (i.e., arsenic found in drinking water or food) is associated with cancer, adverse pregnancy outcomes, and impacts on cognitive development. The International Agency for Research on Cancer has classified arsenic in drinking water as carcinogenic to humans. The World Health Organization (WHO) estimates that 140 million people in 70 countries have been drinking water containing arsenic above the WHO guideline value of 10 μg/L. Reverse osmosis is the most effective treatment method for removing arsenic from drinking water, but ion exchange and distillation are also effective.

Industrial and agricultural processes can lead to contamination of drinking water through the simple usage or improper disposal of solvents, pesticides, cleaning products, or industrial waste. The subset of contaminants within this topic is wide-ranging; for this reason, we discuss both industrial waste and agricultural runoff in more detail in the following sections.

Exhibit 17
Prevalent Contaminants in U.S. Water Systems

Contaminant	Common Sources	Potential Health Effects	Prevalence in U.S. Water Systems
Lead	Lead pipes, brass fixtures, old plumbing	Brain damage in children, developmental delays, kidney and heart issues	251 million Americans exposed to lead at or above the American Academy of Pediatrics recommended maximum level for children (1ppb)
Nitrates	Fertilizers, septic systems, animal waste	Reduced oxygen in blood, headaches, stomach cramps	Common in agricultural areas; exact national prevalence varies
Arsenic	Natural deposits, industrial/farming pollution	Nausea, abnormal heart rhythm, nerve damage, cancer	U.S. Geological Survey estimates high levels of arsenic in drinking wells in 25 states; 2.1 million people exposed to high levels of arsenic
PFAS (e.g., PFOA, PFOS)	Industrial waste, consumer products (e.g., nonstick cookware)	High cholesterol, liver enzyme changes, cancer, developmental effects	CDC estimates nearly all people in U.S. have some PFAS in their blood
Copper	Corroded copper pipes, industrial pollution	Nausea, vomiting, diarrhea, stomach pain	Common in homes with copper plumbing
Radon	Natural radioactive decay in groundwater	Lung cancer	Only 1%-2% of radon in the air comes from drinking water; found in groundwater in areas with high uranium content
Legionella	Plumbing systems, cooling towers	Legionnaires' disease	Most common cause of waterborne disease outbreaks in the U.S.

Sources: National Resources Defense Council, CDC, EPA, William Blair Equity Research

Industrial Waste

Dumping of industrial waste in waterways has been an issue since the Industrial Revolution in the 18th and 19th centuries. The Industrial Revolution brought about a substantial increase in industrial activity that led to direct discharge of pollutants into rivers and lakes. The practice continued into the 20th century until 1948 when the federal government passed the Federal Water Pollution Control Act, the first major piece of legislation aimed at addressing water pollution in the United States. The 1948 act was limited in scope and primarily focused on providing assistance and funding to state governments for addressing water pollution, but it laid the groundwork for a significantly expanded Clean Water Act in 1972. Leading up to 1972, public awareness of water pollution increased through a growing environmental movement in the 1960s and the infamous 1969 Cuyahoga River fire. The river that moves through Cleveland, Ohio, had long served as an open sewer and dump site for the city's industrial companies. The 1969 fire, caused by an oil slick, served as a major turning point in public awareness of pollution. Cleveland's mayor at the time, Carl Stokes, worked with his brother, Louis, in Congress to push for environmental regulation, which is considered a key step toward Congress establishing the Environmental Protection Agency (EPA) in 1970.

Today, industrial waste pollution in waterways is still a concern. Hazardous chemicals or products are used in a wide variety of industries and processes, many of which people do not consider when thinking about industrial waste pollution. Moreover, industrial waste pollution does not always involve the deliberate dumping of waste into waterways; it may also be the chemically dense runoff water from a carwash seeping into the ground, medical wastewater that contains active pharmaceutical ingredients, paint shops releasing airborne particles that settle in waterways, or industrial laundries' wastewater that may contain oil, lint, sand, or heavy metals. The main point is that industrial waste can affect water sources in a broad set of ways, and for this reason, determining a quantifiable amount of waste that pollutes water each year is challenging.

The mainstream adoption and focus on environmental, sustainability, and governance (ESG) that intensified through the 2010s has driven many companies across various manufacturing sectors to integrate ESG goals into their corporate strategies. Many of these goals center on sustainable water management and responsible discharge or even treatment of wastewater. Several high-profile companies have implemented wastewater treatment capabilities on-site at certain manufacturing facilities; we believe the following example is demonstrative of increasing demand for the providers of wastewater treatment technologies and services as manufacturers add on-site treatment capabilities.

- ***Case study:*** Freshpet is a provider of fresh, refrigerated dog food that is sold in branded refrigerators in major retailers. Freshpet began construction on its newest facility in Ennis, Texas, in 2020. The nature of Freshpet's food and manufacturing processes results in wastewater that is contaminated with residual fines of meat, vegetables, and fats. The company built a 15,000-square-foot wastewater treatment plant on-site that purifies water to a quality high enough to be reused in the building's cooling system. Freshpet began reusing the treated wastewater in its building cooling systems in 2023 and estimates this effort will eventually result in reusing 50 million gallons of water per year. Further, at its Pennsylvania manufacturing site, Freshpet installed underground rainwater harvesting reservoirs that hold up to 427,500 gallons of rainwater that is used to irrigate 62,000 square feet of landscaping.

Industrial waste contaminating waterways has become less of an issue over the last few decades as more companies invest in environmental stewardship and implement solutions to treat wastewater. In our view, the increased focus on ESG goals and enhanced understanding by manufacturing companies on their impact to the environment, and specifically waterways, is leading to increased demand for providers of water treatment, storage, and disposal solutions and services.

Agricultural Runoff

Agricultural runoff is a complex environmental challenge where nutrients, chemicals, and other contaminants migrate from fields into water systems through multiple pathways. Contamination can occur through surface water runoff caused by rain or snowmelt, groundwater infiltration through soil, and atmospheric deposition from crop spraying. The primary compounds from agricultural runoff are nitrogen (sewage, manure) and phosphorous (pesticides, herbicides). High levels of nitrogen and phosphorous can cause eutrophication, which can cause hypoxia, or dead zones, in water bodies that often kills fish or other aquatic life. Excess nutrients can also cause algal blooms in freshwater systems that can result in harmful toxins entering drinking water. Given the large scope of this issue, it is difficult to estimate the total amount of nitrogen and phosphorous in U.S. drinking water systems that is because of agricultural runoff. However, we believe a representative example is the Chesapeake Bay. The mid-Atlantic bay is the largest estuary in the United States, and the Chesapeake Bay Foundation estimates that roughly 60% of nitrogen and 45% of phosphorous entering the bay is from agricultural runoff. The foundation estimates that agricultural runoff is the largest source of pollution in the bay.

Glyphosate is the world's most heavily applied pesticide. It was first introduced in 1974 by Monsanto, under the brand name Roundup. After various corporate changes, Bayer AG, a German pharmaceutical and chemical company, acquired Monsanto in 2018 and now owns Roundup. For years, glyphosate has been under scrutiny related to its potential impacts on health. In 2015, the International Agency for Research on Cancer (IARC), part of the WHO, classified glyphosate as "probably carcinogenic to humans." The issue of glyphosate's carcinogenicity is not one-sided, however. In

2020 the EPA published an interim decision for glyphosate that found that there are no risks of concern to human health when it is used in accordance with its current label. The EPA also found that glyphosate is unlikely to be a human carcinogen. Monsanto has been accused of undermining the EPA's scientific integrity by lobbying EPA scientists for favorable rulings. In addition, as the potential risks of glyphosate exposure became known, thousands of lawsuits were filed against Monsanto and now Bayer, alleging the company failed to warn customers about potential cancer risks. As of 2025, Bayer has paid out about $10 billion to settle what is estimated to be over 100,000 lawsuits. In April 2025, Bayer announced it would stop producing Roundup unless it received court protections against lawsuits claiming the herbicide causes cancer.

In our view, and in the context of this report, the most effective method to reduce agricultural runoff pollution of waterways is implementing intelligent irrigation and fertilizer systems that apply nutrients in the right amount, at the right time, and with accurate placement. In this way, farms can avoid spraying excessive amounts of pesticides and herbicides or overspraying (aerial applications) that may drift into nearby waterways.

Solutions to the Water Problems

In this section, we present what we believe to be the most effective solutions to addressing the three water problems previously presented: water scarcity, aging infrastructure, and water quality and contamination. We provide each solution, the specific issue(s) it addresses, descriptions of the solutions, and the companies that we believe are best positioned to benefit from growing demand for the solutions.

Smart Water and Infrastructure Assessment Technology (Problems Addressed: Water Scarcity, Aging Infrastructure)
We define this solution set as smart water systems and advanced metering infrastructure (AMI), which includes hardware (physical meters and instruments) and software (communications networks and analytics platforms) that enable consumers and businesses to accurately track and analyze water usage and predict or prevent water leaks. We also include other technologies, solutions, and engineering services used to assess the state of water infrastructure.

Smart water meters, or AMI, enable consumers to track more accurately, and become more aware of, their water usage. Moreover, smart meters can alert consumers to unusual spikes in usage, which could be the result of a leak. Taking quick action on leaks or burst pipes can prevent significant water waste and resulting property damage or high repair costs. As the world faces growing concerns about water scarcity, smart meters enable consumers to do their part and be more conscious of their water impact.

The benefits of AMI are more pronounced in larger-scale utility and industrial use-cases. Monitoring water usage across a water utility, large building, or manufacturing facility that uses multiple water sources is critical to efficient water usage. Smart meters allow businesses to act quickly if leaks are detected and prevent nonrevenue water loss or downtime in a manufacturing setting. Xylem is a provider of AMI and has a strong presence both in North America and internationally. At the company's 2024 investor day, management estimated the AMI market is roughly $15 billion and growing at a midsingle-digit rate. Xylem management estimates AMI penetration into the U.S. market to be only about 45%, indicating significant opportunity for growth going forward.

Smart water systems and AMI are critical to alleviating water scarcity and water loss related to aging infrastructure. Below we present two case studies from Xylem and Badger Meter that showcase the benefits of these technologies.

- ***Case study:*** Xylem worked with a southeastern U.S. water utility whose population growth was straining its existing infrastructure. The goal was for the utility to optimize its existing infrastructure while new infrastructure was being built. Xylem implemented smart metering solutions from its Idrica, Sensus, and YSI brands that collected data on pressure, temperature, and flow. The data and real-time decision support was consolidated into an interoperable platform. Xylem's efforts resulted in an 85% reduction of water breaks, roughly $200,000 in monthly savings through reduced cost per meter read, and about $40 million in pull-through sales.

- ***Case study:*** Badger Meter provides measurement and control products to municipal, commercial, and industrial customers. The city of Columbia, South Carolina, recently underwent a significant water meter upgrade project to improve service, support sustainability, and provide reliable drinking water for its growing population. The utility previously deployed technicians into the field to physically read a meter, which was a highly labor-intensive process that required 30 technicians to read 15,000 meters every two days. The utility began installing a variety of smart water technologies from Badger to deliver accurate measurement data that could be viewable from anywhere. In one example, Badger's Beacon software detected a building on Christmas Day that was using 1,000 gallons a minute when no one was in the building. The software provided the location of a burst fire line, and a crew was dispatched to shut off the water. Overall, the results of the meter upgrade project were a 96% reduction in monthly service calls and a 21% decrease in inactive accounts consuming water within Columbia's network.

Pipeline assessment services and technologies are an important step in determining replacement needs for aging infrastructure. Four main technologies are used for pipeline assessment: acoustic leak detection using sound waves and vibrations, smart sensors and internet of things (IoT) networks for continuous monitoring, intelligent pipeline inspection gauges (PIGs), and predictive analytics software.

Acoustic leak detection can detect the sound waves and vibrations caused by pressurized water escaping through cracked or damaged pipes. The sounds and vibrations can be detected with microphones and analyzed with software to pinpoint the leak's location. Smart sensors and IoT networks use devices that are placed within infrastructure and measure parameters including temperature, pressure, flow rate, vibrations, and chemical or gas signatures, which then feed data into intelligent algorithms that continuously monitor patterns and anomalies that may indicate leaks. PIGs are small devices that travel through pipes and use sensors to detect corrosion, cracks, or deformations. Predictive analytics software collects data from various sensors and combines it with information regarding weather or maintenance history to inform utility operators regarding when and where a leak might occur, and thus where to focus inspection activity.

We expect pipeline assessment technology to become increasingly important as more water infrastructure components reach the end of their useful lives and leaks become more frequent. Further, labor constraints—aging workforce, skills gap, retention challenges—are pushing utility operators to find ways to be more labor-efficient. Using assessment technologies enables operators to quickly find and solve issues at the source, avoiding unnecessary labor scheduling or mistakenly digging up a section of pipe that has no issue.

The following exhibit highlights companies that are well positioned to benefit from further penetration of smart water systems and AMI, and increasing adoption of advanced pipeline assessment technologies.

Exhibit 18
Select Providers of Smart Water and Infrastructure Assessment Technology

Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
AECOM	ACM	~$15B	$16.1B (FYE Sep 2024)	Dallas, Texas	Provides professional infrastructure consulting, engineering design, and construction services for various sectors, including water; capabilities in water infrastructure include comprehensive risk/lifespan assessments and development of digital and software solutions to monitor system health and operational data
Badger Meter	BMI	~$6B	$827M ~$650M water metering	Milwaukee, Wisconsin	Specializes in flow measurement, water quality monitoring, and control products for water utilities, municipalities, and commercial applications; product portfolio includes ultrasonic and electromagnetic flow meters, AMI and AMR systems, and analytics software; integrates acoustic leak detection with real-time monitoring
Diehl Metering	Private	NA	€3.9B (2023) (~$4.2B) ~$500M water metering	Nuremberg, Germany	Manufactures volumetric (ALTAIR series) and ultrasonic (Hydrus 2.0) water meters and connectivity and software solutions; installed base of more than 60 million meters globally; supports leak alarms and continuous flow detection
Gutterman AG	Private	NA	NA	Zug, Switzerland	Develops technologies exclusively for leak detection and water loss management; portfolio includes acoustic correlators and loggers, ground microphones, and listening sticks; configurations include fully automated networks of acoustic loggers that monitor water mains; maintains partnerships with larger industry participants (e.g., Hubbell)
Honeywell	HON	~$141B	$38.5B (2024)	Charlotte, NC	Produces full range of water meters for residential, commercial, and industrial applications; provides end-to-end smart metering solutions, including hardware, predictive maintenance tools, and cloud analytics; building-level leak alert capability integrated into smart meters and integrated into building management systems
Hubbell	HUBB	~$23B	$5.6B (2024)	Shelton, Connecticut	Manufactures meters for electric, gas, and water metering, primarily under Aclara brand; provided integrated hardware, communications, and software ecosystem; offers acoustic leak-detection systems with sensors along water mains to pinpoint underground leaks
Hydromax USA	Private	NA	NA	Flower Mound, Texas	Provides advanced field services and solutions for utilities to use infrastructure data; water dashboards and pipeline assessment technologies provide utilities with an accurate way to detect leaks and evaluate condition of infrastructure; 1M+ valves assessed and maintained, 600+ miles of pipeline condition assessment performed
Itron	ITRI	~$6B	$2.4B (2024) ~$700M water metering	Liberty Lake, Washington	Manufactures smart meters and IoT devices for electric, gas, and water utility applications; water segment accounts for about 30% of revenue; provides end-to-end networking solutions and software and analytics tools; tens of millions of volumetric and ultrasonic water meters installed globally; offers leak-sensing hardware and analytics
Kamstrup	NA	NA	DKK 3.6B (2024) (~$430M)	Skanderborg, Denmark	Produces electric meters and ultrasonic water meters; water meter business focused largely on high-volume utility rollouts in residential settings, but portfolio includes high-volume meters for commercial and industrial applications; provides leak detection systems for infrastructure using ultrasonic meters and the company's cloud-based Leak Detector platform
Landis + Gyr	LAND-SW (SIX Swiss)	~₣2B (~$2B)	₣1.5B (FYE end March 2025) (~$1.7B)	Cham, Switzerland	Provider of integrated energy management solutions with significant presence in smart water metering technologies; specializes in connected intelligent metering devices, advanced metering infrastructure (AMI), and software platforms that enable utilities to optimize water distribution networks; smart metering solutions provide real-time data analytics, leak detection capabilities, and remote monitoring systems
Mueller Water	MWA	~$4B	$1.3B (FYE Sep 2024)	Atlanta, Georgia	Manufactures wide range of water metering products used in residential, commercial, and industrial applications, including fire-service meters; Sentryx platform provides cloud-based analytics and monitoring; sells ultrasonic and volumetric meters under Mueller Systems brand; Echologics subsidiary specializes in noninvasive acoustic leak detection and pipe condition assessment for buried water pipelines
Ovarro	Private	N/A	N/A	Sheffield, England	Provider of connected technologies for water and wastewater networks aimed at reducing leakage and pollution incidents; three focus areas are water network management, control of water flow, and leak detection; specific applications include network modelling, consumer flow monitoring, pressure and flow surveys, meter verification, remote and on-site leak detection

Sources: FactSet, Company filings, William Blair Equity Research

Exhibit 18 (Continued)
Select Providers of Smart Water and Infrastructure Assessment Technology

Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
Roper/ Neptune	ROP	~$59B	$7.0B (2024)	Sarasota, Florida	Produces volumetric and ultrasonic water meters for residential, commercial, and industrial applications; portfolio includes software used for data collection and analytics; infrastructure leak detection enabled by Neptune 360 platform via continuous flow/consumption anomaly detection; many reports in early 2025 indicated Roper was exploring selling Neptune for approximately $4 billion
Schneider Electric	SU.PA	~€135B (~$155B)	€38.2B (2024) ($41.3B)	Rueil-Malmaison, France	Manufactures wide range of meters for water, electricity, and thermal flow; monitoring and analytics solutions branded ExoStruxure; global player with strong competitive position in both North America and Europe; deploys sensors, computational models, and analytics to detect infrastructure leaks
Teledyne	TDY	~$26B	$5.7B (2024)	Thousand Oaks, California	Instrumentation (24% of revenue) and digital imaging (54% of revenue) segments serve water infrastructure through advanced monitoring, measurement, and analytical equipment; company's water-related technologies include sensors, monitoring systems, and analytical instruments used in municipal water treatment facilities, industrial water management, and environmental monitoring applications; company's precision instruments enable water quality testing, leak detection, and infrastructure monitoring capabilities
Trimble	TRMB	~$20B	$3.7B (2024)	Westminster, Colorado	Offerings include Trimble Unity, a SaaS platform for water, wastewater, and stormwater network monitoring, sensors for remote monitoring, and digital mapping of networks
Veolia	VIE.PA (Euronext Paris)	~€22B (~$25B)	€44.7B (2024) ($47.8B)	Aubervilliers, France	Specializes in communication modules and sensor systems for smart water metering through Birdz subsidiary, but does not manufacture water meters; communication modules can be retrofitted to existing meters or integrated into new meters; frequently partners with Mueller, Xylem, and others; provides acoustic leak detection, pressure monitoring, and analytics
Veralto	VLTO	~$26B	$5.2B (2024) $3.1B water quality	Waltham, Massachusetts	Smart water business lines include Aquatic Informatics (platforms for managing water data; 1,500+ customers) and OTT HydroMet (water and weather data solutions platform; 8,000+ customers)
Xylem	XYL	~$32B	$8.6B (2024)	Washington, D.C.	Manufactures broad portfolio of water metering solutions under the Sensus brand, including volumetric and ultrasonic meters for residential, commercial, industrial applications; full smart-metering solution includes meters, communication networks, analytics, and services for utility customers; offers range of solutions to detect and prevent leaks in water mains, distribution networks, and transmission systems
Zenner International	Private	NA	NA	Saarbrücken, Germany	Manufactures water (volumetric and ultrasonic), heat, and gas meters; more prominent in Europe than North America; operates in China via Zenner Shanghai joint venture; relatively limited leak detection capabilities

Sources: FactSet, Company filings, William Blair Equity Research

More Robust Infrastructure (Problems Addressed: Water Scarcity, Aging Infrastructure)

We believe more robust water infrastructure is needed to address the water scarcity and aging infrastructure issues. In the United States, the average age of water pipes is 45 years, and the average life expectancy of most pipes is about 80 years. While there is a sizable gap between the average age and life expectancy, about 20% of installed water mains have exceeded their useful lives. The 2025 Report Card for America's Infrastructure estimates that over half of the U.S. public water systems have identified rehabilitation and replacement of aging infrastructure as their most pressing concern. The IIJA, signed in 2021, allocated more than $50 billion to improving the nation's water infrastructure. Although a step in the right direction, the allocation of $50 billion is a fraction of what is needed. The EPA's 7th DWINSA in 2023 determined that drinking water systems will require $625 billion for pipe replacement and other key upgrades over the next 20 years. The companies we present in the following table offer a wide variety of products and services across pipes, pumps, valves, transport, and treatment. In our view, the companies presented stand to benefit from the deployment of government funds to address aging infrastructure and water scarcity globally.

Exhibit 19
Select Providers of Systems and Technologies for Robust Water Infrastructure

	Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
	Advanced Drainage Systems	WMS	~$9B	$2.9B (2024)	Hilliard, Ohio	Provides water management solutions for stormwater and onsite wastewater industries; manufactures high-performance corrugated plastic pipes, advanced drainage systems, and water quality products serving commercial, residential, infrastructure, and agricultural markets; through its subsidiary Infiltrator Water Technologies, WMS offers onsite wastewater treatment solutions including septic tanks, advanced treatment systems, and decentralized wastewater management products
	Azuria Water Solutions	Private	NA	~$1B	Chesterfield, Missouri	Technology-enabled infrastructure rehabilitation, specifically focused on renewing and protecting water pipelines and structures in municipal, industrial, and residential systems; includes company formerly known as Insituform (and later Aegion) and several other businesses; now owned by New Mountain Capital along with several other businesses
	Flowserve	FLS	~$7B	$4.5B (2024)	Irving, Texas	Manufacturer and aftermarket service provider of comprehensive flow control systems, specializing in engineered pumps, valves, seals, and related services for industrial applications; operates in 50 countries with a combined installed base of 5.5 million assets
	Franklin Electric	FELE	~$4B	$2.0B (2024)	Fort Wayne, Indiana	Provides pumps, motors, drives, and controls for use in a wide variety of residential, commercial, agricultural, industrial, and municipal installations for both clean and gray water applications
	Grundfos	Private	N/A	€4.5B (2024) (~$5.2B)	Bjerringbro, Denmark	Designs and manufactures pumping solutions to optimize water management and water infrastructure for domestic, commercial, industrial, and utility customers; strong reputation as a pump manufacturer since 1945
	Puris/Inliner Solutions	Private	NA	NA	The Woodlands, Texas	Offers proprietary cured-in-place pipe (CIPP) as a no-dig solution for leaking or deteriorated pipes; serves municipal, industrial, and institutional customers; Inliner was previously owned by Reynolds, Layne Christensen, and Granite Construction
	KSB	KSB-DE (Xetra)	~€2B (~$2B)	€2.9B (~$3.4B)	Frankenthal, Germany	Global provider of pumps, valves, and flow control systems for water supply and wastewater management; offers wastewater pumps in a range of designs and fully bespoke solutions
	Mueller Water Products	MWA	~$4B	$1.3B (FYE Sep 2024)	Atlanta, Georgia	Operates through two segments: water flow solutions and water management solutions; products include valves, pressure/flow control, and leak detection; 60% to 65% of 2024 sales were associated with the repair and replacement of municipal water infrastructure
	NWPX Infrastructure	NWPX	~$400M	$492M (2024)	Vancouver, Washington	Provides water infrastructure products and solutions that move, manage, and protect water; product groups include engineered steel pipe, precast concrete, water distribution and management, wastewater pretreatment, and stormwater quality
	Sulzer	SUN-SW (Six Swiss)	~₣5B (~$6B)	₣3.5B (2024) (~$4.0B)	Zurich, Switzerland	Flow division specializes in pumping solutions for water and various industrial end-markets; product categories include pumps, agitators and mixers, compressors and aeration, and submersible mixers; high-efficiency pumps serve an estimated global customer capacity of over 20M cubic meters of water per day
	Tetra Tech	TTEK	~$10B	$5.2B (FYE Sep 2024)	Pasadena, California	Offers wide range of services, including advisory, planning, permitting, engineering, and design of industrial and municipal water supply systems, design of wastewater treatment facilities, engineering services for industrial and municipal process water, stormwater, and watersheds; develops and deploys treatment solutions for PFAS and other contaminants
	Wilo	Private	NA	NA	Dortmund, Germany	Manufacturer of pump solutions for residential and commercial buildings, water management, and industry; applications include cooling, hot water, wastewater collection and transport, raw water intake, water distribution and boosting, and dewatering
	Xylem	XYL	~$32B	$8.6B (2024)	Washington, D.C.	Two segments, water infrastructure (30% of revenue) and applied water (21% of sales), offer broad portfolios of products for water infrastructure, transport, building and industrial solutions; products include pumps, valves, heat exchangers, and controls; water infrastructure segment has global installed base of 2M+
	Zurn Elkay	ZWS	~$7B	$1.6B (2024)	Milwaukee, Wisconsin	Offers a comprehensive portfolio of specification-driven water solutions; products include water safety and control products, flow systems, hygienic and environmental solutions, and filtered drinking water products for public and private spaces; serves building owners and facility managers with mission-critical water infrastructure solutions that improve health, hydration, and safety

Sources: FactSet, Company filings, William Blair Equity Research

Advanced Water Filtration and Treatment (Problems Addressed: Water Scarcity, Water Quality and Contamination)

Advanced water filtration and treatment technologies and systems are critical in addressing water scarcity—converting saltwater, wastewater, contaminated water, and water from other various sources to clean, potable water. In this section, we highlight water filtration and treatment methods as solutions to the water scarcity and water quality and contamination issues. Within water treatment as a solution to water scarcity, we focus specifically on the generation of freshwater through desalination.

Water filtration involves the physical separation of materials, typically done by passing water through porous filtration materials. Three common water filtration methods are reverse osmosis, activated carbon, and ion exchange. Water treatment refers to chemical, biological, or physical processes that make water safe to drink. Common methods of water treatment include desalination, coagulation and flocculation, advanced oxidation processes, and membrane bioreactors. Filtration and treatment surrounds nearly every interaction we have with water across the residential (water pitcher filters, whole-home filtration systems), commercial (drinking fountains, clean water for sterilization and patient care in hospitals), and industrial (food and beverage processing, pharmaceuticals, power plant cooling) markets. Effective water treatment is a critical step in the water cycle for utilities and industrial customers. Ensuring the availability of clean drinking water for communities, the use of treated water in food and pharmaceutical processes, and the discharge of wastewater that meets environmental regulations are all critical applications for water treatment. Improper water treatment or discharge of untreated wastewater into the environment can result in significant financial penalties, legal liability, ecosystem disruption, and risks to human and animal health. Estimating the size and growth of the global filtration and treatment industry can be challenging given the scope of solutions offered and the fragmented nature of water treatment plants. Grand View Research estimates that the global water treatment systems market was valued at $39 billion in 2023 and is expected to grow at a compound annual rate of 8% from 2024 to 2030.

Exhibit 20
Water Filtration System Examples

In-Home Drinking Water Filtration

Industrial Reverse Osmosis System

Ion Exchange System

In-Home Well Water Filtration System

Source: William Blair Equity Research

Exhibit 21
Select Providers of Advanced Water Filtration and Treatment Systems

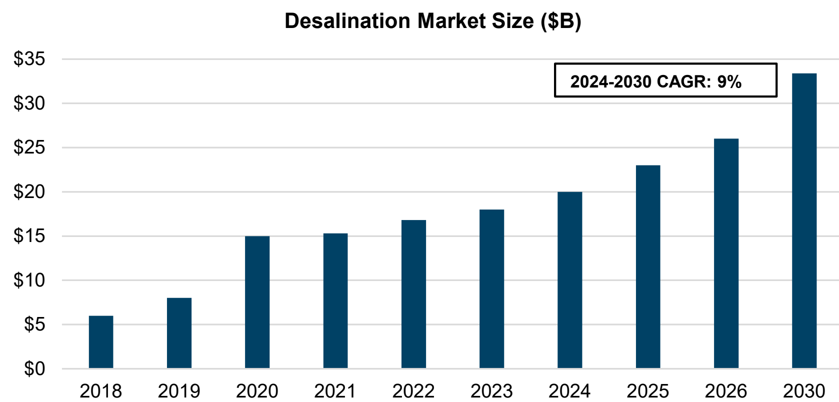
Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
A.O. Smith	AOS	~$10B	$3.8B (2024)	Milwaukee, Wisconsin	Leader in water technology, water heating equipment, and water treatment products for residential and light commercial applications; entered water treatment market in 2016 with Aquasana acquisition; products include softeners, whole-home filtration, carbon filtration, and reverse osmosis
Culligan	Private	NA	~$2.4B	Rosemont, Illinois	Provides drinking water and water filtration and treatment products for residential, workplace, and commercial applications; products include softening, membrane solutions, PFAS filtration, and high purity solutions; serves diverse industries including healthcare, manufacturing, food service, and industrial
De Nora	DNR-MIL (Euronext Milan)	~€1B (~$2B)	€863M (~$933M)	Milan, Italy	De Nora's water technologies business represents 35% (€304M) of sales; portfolio includes disinfection and filtration technologies; specific applications include offshore wastewater treatment, PFAS remediation, industrial water and municipal water
Ecolab	ECL	~$75B	$15.7B (2024)	St. Paul, Minnesota	Global sustainability leader providing broad array of water and hygiene solutions and services for multiple industries; solutions include water pretreatment, wastewater treatment, and cooling water treatment (e.g., data centers); also offers services, rental equipment, performance monitoring, and software solutions
Fluence Corporation	FLC (ASX)	~$41M	$48.6M (2024)	Melbourne, Australia	Specializes in high-strength wastewater treatment, wastewater-to-energy, and industrial and drinking water markets; Fluence has deployed over 300 membrane aerated biofilm reactor (MABR) plants globally; offers decentralized treatment solutions (portable, containerized treatment systems that be deployed where needed)
Pentair	PNR	~$17B	$4.1B (2024)	Minneapolis, Minnesota	Produces a broad portfolio of products for residential, industrial, and municipal water applications; provides whole-house filtration and softening systems and point-of-use filtration systems; commercial offering includes comprehensive systems from diagnostics to treatment and filtration with focus on foodservice industry; offers large-scale filtration and treatment solutions for municipalities and commercial customers
ProMinent	Private	NA	NA	Heidelberg, Germany	Provides water treatment solutions for the chemical, industrial and municipal water treatment, food and beverage, swimming pool water treatment, oil and gas, and process industries; supplies common treatment technologies including UV, ozone, chlorine, and membrane
Veolia	VIE.PA (Euronext Paris)	~€22B (~$25B)	€44.7B (2024) ($47.8B)	Aubervilliers, France	Leader in water treatment solutions and services globally; engineers and operates drinking water plants (includes production of ultrapure water for pharma, microelectronics, food & beverage), wastewater treatment plants (biological and advanced treatment processes), and PFAS remediation (expects €1 billion PFAS remediation revenue by 2030); in North America, Veolia treats more than 2.2 billion gallons of water & wastewater daily
Veralto	VLTO	~$26B	$5.2B (2024) $3.1B water quality	Waltham, Massachusetts	Primary business lines include instruments and reagents for water testing (Hach), UV disinfection systems for municipalities and industrial applications (Trojan), and industrial chemical water treatment and services (ChemTreat); also offers technologies such as electrochemical oxidation to target PFAS, precision flow instrumentation, and aquatic data management platforms
Watts Water Technologies	WTS	~$9B	$2.3B (2024)	North Andover, Massachusetts	Water quality products represent 5% of annual sales (~$110M); includes point-of-use filtration, reverse osmosis, UV disinfection, and softeners for residential and commercial applications
Xylem	XYL	~$32B	$8.6B (2024)	Washington, D.C.	Leading producer of water reuse and recycling systems; enabled reuse of over 18 billion cubic meters of water since 2019; offers predictive monitoring and analytics solutions that prevent leaks in water networks, avoiding loss of approximately 4 billion cubic meters of water since 2019; produces advanced water treatment services that, since 2019, prevented over 10 billion cubic meters of contaminated water from entering waterways

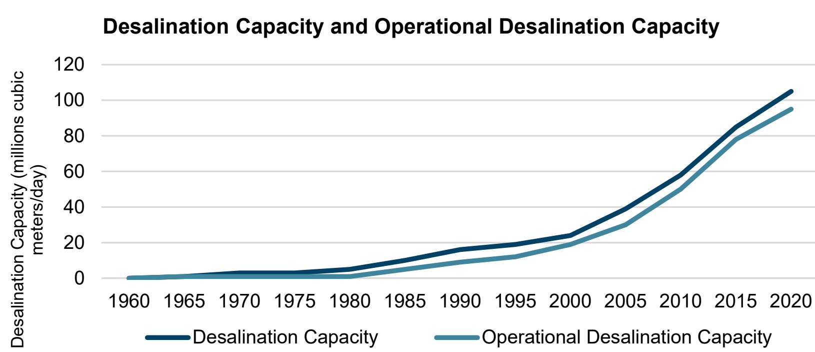
Sources: FactSet, Company filings, William Blair Equity Research

Desalination stands out as a promising solution to water scarcity given that the process converts abundant salt water into water that is safe for drinking, irrigation, or industrial use. According to the U.S. Bureau of Reclamation, only 3% of Earth's water is fresh water, but about 80% of fresh water is unavailable because it is tied up in glaciers, polar ice caps, and the atmosphere. Desalination is accomplished in two ways: thermal and membrane-based. The thermal process involves heating water until it evaporates, which separates it from impurities, followed by a condensation step that collects the purified water. Membrane-based desalination passes water through a semipermeable material that holds back dissolved solids. Reverse osmosis is a common type of membrane-based desalination. Thermal systems can treat water to a much higher purity than membrane systems and can treat input water with a much higher salt content, but these systems require more energy. Research and Markets estimates that the global desalination market will grow from about $19 billion in 2024 to $32 billion in 2030, exhibiting a compound annual growth rate (CAGR) of 9%. The European Commission (EC) estimates that global installed capacity for the production of desalinated water has increased at an average rate of 7% per year, or about 4.3 million m^3, since 2010. The EC also estimates there are more than 21,000 desalination plants globally with daily global production of 99 million m3 per day. Desalination is heavily used in the Middle East; the region accounts for about 70% of global production capacity. The costs of desalination have come down over time as the technology has improved and plants have become more efficient. On average, costs to operate thermal desalination processes are higher than membrane processes given the former's higher electrical and thermal energy costs.

Based on multiple industry sources, the operating costs associated with treating water through thermal processes is roughly $1.00-$2.50 per cubic meter, down from $9-$10 per cubic meter when the technology was first introduced a few decades ago. Similarly, the operating costs associated with membrane-based (reverse osmosis) desalination are roughly $0.50-$1.00 per cubic meter, down from about $5 per cubic meter.

Exhibit 22
Desalination Global Market Size and Capacity Over Time





Source: Market Research Future; "A closer look at the history of the desalination industry: the evolution of the practice of desalination through the course of time," IWA Publishing; William Blair Equity Research

Exhibit 23
Select Desalination Industry Participants

	Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
	ACWA Power	2082.SR (Riyadh Exchange)	~SAR 171B (~$46B)	~SAR 6.3B (~$1.7B)	Riyadh, Saudi Arabia	Major developer, owner, and operator of power generation and desalination plants with over 100 projects across more than a dozen countries (majority of assets in the Saudi Arabia and the UAE); total portfolio can generate nearly 100 GW of power and produce nearly 10 million cubic meters of desalinated water per day
	Acciona	ANA.MC (Madrid Exchange)	~€9B (~$10B)	€19.2B (2024) (~$20B)	Alcobendas, Spain	Global full-service EPC company with focus on sustainable infrastructure, including renewable energy and water management; constructed desalination plants with a total capacity of about 8 million cubic meters per day, supplying approximately 35 million people; projects include more than 80 desalination plants worldwide
	Aquatech	Private	NA	NA	Canonsburg, Pennsylvania	Global EPC company with a focus on water treatment solutions, including desalination projects; completed over 2,000 water treatment projects, including desalination systems, across 60 countries
	Alfa Laval	ALFA.ST (Nasdaq Stockholm)	~177B SEK (~$18B)	67B SEK (2024) ($6.3B)	Lund, Sweden	Manufacturer of heat transfer, separation, and fluid-handling technologies; water purification applications include 1) production of fresh water and purification of ballast water in marine settings and 2) large-scale desalination and water treatment systems for industrial and municipal customers
	Consolidated Water Co.	CWCO	~$460M	$134M (2024)	Grand Cayman, Cayman Islands	Designs, builds, and operates water systems, including desalination plants, water distribution systems, and wastewater collection and treatment systems; focuses on the Caribbean and select regions in the United States (primarily Arizona, California, Colorado, Florida, Hawaii, and New Mexico)
	Danfoss	Private	NA	~€9.7B (2024) (~$11.7B)	Nordborg, Denmark	Produces a range of high-efficiency pumps and energy-recovery devices for desalination applications; systems helped achieve world-class desalination energy efficiency (likely world record) in Canary Islands plant completed in 2024
	Doosan Enerbility	034020.KS (Korea Exchange)	~42T KRW (~$30B)	16.2T KRW (2024) ($11.8B)	Seoul, South Korea	Heavy industrial conglomerate that both designs/manufactures components (e.g., reverse osmosis membranes, distillation systems, and generators) and provides turnkey EPC services; provided desalination technologies and construction services for dozens of desalination plants, with focus on the Middle East
	DuPont	DD	~$30B	$12.4B (2024)	Wilmington, Delaware	Global science and technology company; claims to be a top-three global supplier of desalination membranes (other top desalination membrane manufacturers: Toray, Korea Water Solution Holdings, Hydranautics, Koch Separation Solutions)
	Energy Recovery Inc.	ERII	~$700M	$145M (2024)	San Leandro, California	Designs and manufactures energy recovery devices primarily in desalination, wastewater treatment, and refrigeration systems; over 7,000 PX energy recovery devices installed in saltwater reverse osmosis applications
	Flowserve	FLS	~$7B	$4.6B (2024)	Irving, Texas	Global provider of reverse osmosis systems, including high-pressure pumps, energy-recovery devices, and control and monitoring technology; products deployed in desalination plants globally, including in major projects in Cyprus, the UAE, and Saudi Arabia
	IDE Technologies	Private	NA	NA	Kadima, Israel	Specializes in the development, engineering, construction, and operation of desalination and industrial water treatment plants; over 60 years has designed and operated approximately 500 desalination and water treatment plants across 40 countries; operates installed base of facilities that produce more than 6 million cubic meters of high-quality water daily
	Korea Water Solution Holdings (previously part of LG Chem)	Private	NA	~220B KRW (2024) ~$162M	Incheon, South Korea	Global leader in water filtration membranes, including those used in desalination and other ultrafiltration applications; products are used to filter hundreds of thousands of cubic meters of water per day in plants around the world, including major plants in Egypt, Israel, Morocco, and Oman; primary desalination membrane brand is NanoH_2O
	Nitto Denko/ Hydranautics	6988.T (Tokyo Exchange)	~¥2T (~$15B)	~1T JPY (FYE Mar 2025) (~$6.3B)	Osaka, Japan	Produces a range of filtration membranes for various applications, including reverse osmosis, nanofiltration, and ultrafiltration; unit of Nitto Denko based in Oceanside, CA; also provides integrated membrane solutions for industrial and municipal customers
	Pentair	PNR	~$17B	$4.1B (2024)	Minneapolis, Minnesota	Produces a broad portfolio of products for residential, industrial, and municipal water applications; primary water scarcity solutions include membrane filtration and biological treatment systems for converting water (including wastewater) into potable water, point-of-use and point-of-entry filtration, and desalination pretreatment components
	Toray	3402.T (Tokyo Exchange)	~¥1T (~$11B)	¥$2.56T (FYE Mar 2025) ($16.8B)	Tokyo, Japan	Leader in reverse osmosis membrane technology (top three globally); many large-scale desalination plants use Toray membranes, including major facilities in the Middle East, North Africa, Saudi Arabia, and Singapore
	Veolia	VIE.PA (Euronext Paris)	~€22B (~$25B)	€44.7B (2024) ($47.8B)	Aubervilliers, France	Leader in desalination with about 15% of global installed desalination capacity (about 15 million cubic meters daily, including plants Veolia was involved in but does not operate); primarily integrates desalination technologies from a range of partner companies to design, construct, and operate desalination plants; operates over 2,300 desalination sites across 108 countries, delivering about 1.4 million cubic meters of desalinated water daily; plans to double capacity the company operates to 2.8 million cubic meters by 2030
	Xylem	XYL	~$32B	$8.6B (2024)	Washington, D.C.	Global water technology company specializing in water and wastewater solutions; desalination portfolio includes pumps, filtration systems, instrumentation, analytics, and other technologies for pretreatment, post-treatment, and system optimization

Sources: FactSet, Company filings, William Blair Equity Research

Precision Agricultural Irrigation (Problems Addressed: Water Scarcity, Water Quality and Contamination)

Precision agricultural irrigation involves the use of mechanized systems (aka pivots) and microirrigation systems to deliver water to crops. The use of water-efficient agricultural irrigation technology can both reduce water usage and improve crop yields. We believe more efficient use of water in agricultural irrigation is one of the keys to alleviating the world's water scarcity issues. Our view stems from the fact that about 70% of worldwide freshwater withdrawals (up to 90% in some developing countries) are for agricultural applications, according to UNESCO. Given that agriculture is the No. 1 consumer of fresh water, efforts to combat global water scarcity will continue to involve more efficient use of water in agricultural applications. Precision agricultural irrigation systems and technologies can also be used to solve the water quality and contamination issue, in our view. Farms can use mechanized irrigation systems to apply pesticides and herbicides more accurately and prevent excess runoff into waterways. We believe Lindsay and Valmont are the two largest players in agricultural irrigation, together accounting for about 70% of the mechanized irrigation market share. We highlight the agricultural irrigation industry in more depth later in this report.

Exhibit 24
Select Providers of Mechanized Irrigation Systems

Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
Alkhorayef Group	Private	NA	NA	Riyadh, Saudi Arabia	Rising competitor in the global mechanized irrigation industry; majority of installations to date in the Middle East, North Africa, and Europe; irrigation division—Alkhorayef Irrigation Solutions Company, or AISCO—sells pivot and lateral irrigation systems under the Pierce brand in North America and the Western brand outside North America; acquired Proxima (Spain) in 2023 to enhance system automation and connectivity
Bauer	Private	NA	NA	Voitsberg, Austria	Manufacturer of a range of irrigation products, including pivots, laterals, hose reels, and sprinklers; part of larger company that makes a range of manufacturing and industrial equipment and offers construction and environmental services
Farmfront Irrigation Group	Private	NA	Est. >$200M (2024)	Milan, Italy	Relatively new competitor in mechanized irrigation formed in late 2023 by Carlyle, combining European irrigation companies Irrimec, Ocmis, Otech, and RKD; products include pivots, hose reels, and digital platforms; manufacturing located in Europe but serves more than 100 countries with more than 350 dealers
Lindsay Corporation	LNN	~$1B	$607M (FYE Aug 2024) $514M agricultural irrigation	Omaha, Nebraska	No. 2 global provider of mechanized irrigation systems with approximately 30% market share; products include pivot and lateral irrigation systems, smart irrigation technology through the FieldNET platform (remote control and analytics)
Reinke	Private	NA	NA	Deshler, Nebraska	Largest privately held provider of pivot and lateral irrigation systems for the global agriculture industry with an installed base that spans over 35 countries, serviced by about 350 dealers
T-L	Private	NA	NA	Hastings, Nebraska	Provides pivot and lateral irrigation sytems that are powered by proprietary hydraulic drive systems; most significant presence in the U.S., but major secondary markets include New Zealand and the Middle East; uses network of over 250 dealers globally
Valmont	VMI	~$7B	$4.1B (2024) ~$1.0B agricultural irrigation	Omaha, Nebraska	No. 1 global provider of mechanized irrigation systems with about 40% market share; products include pivot and lateral irrigation systems, smart irrigation technology through the AgSense platform (remote control and analytics)

Sources: FactSet, Company filings, William Blair Equity Research

Exhibit 25
Select Providers of Microirrigation Systems

	Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
Jain Irrigation Systems Ltd. Small Ideas. Big Revolutions.	Jain Irrigation Systems (India)	JAIR (National Stock Exchange of India)	~₹36B (~$400M)	₹57B (FYE Mar 2025) (~$690M) (~$200M irrigation)	Maharashtra, India	No. 1 irrigation company in India; products include drip-irrigation and sprinkler systems, piping and plastic product, and irrigation design and installation services; operates 12 manufacturing plants in India
NETAFIM An Orbia business.	Orbia/Netafim	ORBIA.MX (Mexico Exchange)	~$1B	$7.5B (2024) ~$1B agricultural irrigation	Mexico City, Mexico	Netafim is the world leader in drip irrigation (~$1B annual revenue); introduced first commercial drip-irrigation system in 1965; manufactured more than 150 billion drip irrigation systems that have irrigated more than 10 million hectares for about 8.5 million growers in about 110 countries
Rivulis	Rivulis	Private	N/A	~$750M	Singapore/ Israel	Former John Deere business that was built on the acquisitions of Roberts, T-Systems, and Plastro (acquired 2006-2008); acquired from Deere by FIMI Opportunity Funds (Israel) in 2014; combined with Eurodrip in 2017 and then Jain's non-India business in 2022; M&A ultimately created No. 2 microirrigation company globally; combined business has ~25 factories and over 3,000 employees across 35 countries
TORO	Toro	TTC	~$7B	$4.6B (FYE Oct 2024) ~$180M agricultural irrigation	Bloomington, Minnesota	Provides a range of products for turf maintenance, including mowers, tractors, and irrigation systems; agricultural irrigation products include dripline systems, including controllers and automation; applications include large fields and greenhouses

Sources: FactSet, Company filings, William Blair Equity Research

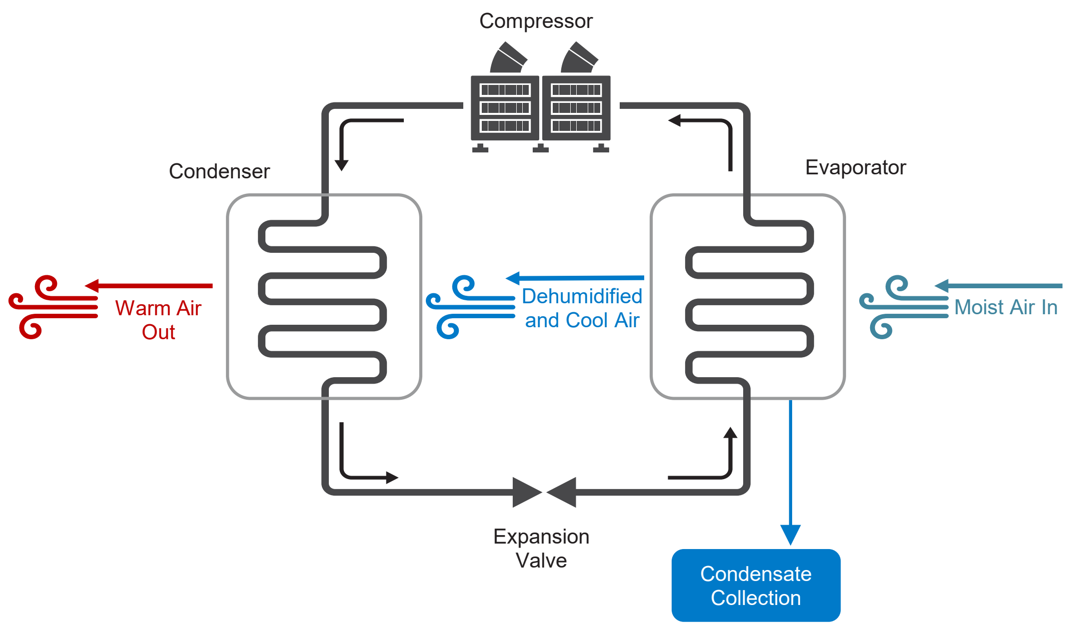
Alternative Technologies and Solutions (Problems Addressed: Water Scarcity)
Technological and scientific advances in the water industry have resulted in new alternative solutions to the water scarcity issue. Two of the most prominent and effective are atmospheric water generation (AWG) and rainwater harvesting. AWG is accomplished through four methods: refrigeration, sorption, fog collection, and membrane-assisted water generation. We provide brief overviews of the two most common AWG methods: refrigeration and sorption. For rainwater harvesting, we highlight three common methods: rooftop, surface runoff, and recharge pits.

Refrigeration-based AWG uses a fan to take in air and pass it through a filter to remove dust and dirt before moving the water through a heat exchanger that cools and condenses the air into liquid water. Sorption-based AWG works through two steps. First, an absorbent material (zeolites, polymeric hydrogels, hygroscopic salts, etc.) captures water vapor from the air until it reaches its full saturation. Second is the desorption process. Once the sorbent has reached saturation, heat or pressure is applied, which causes the material to release water vapor, after which it is condensed and cooled into liquid water. Sorbent-based AWG is a highly efficient and environmentally friendly method of producing water given the ability to use low-grade solar power (instead of a mechanical compressor), which results in low energy consumption and operating costs.

Subsequent steps in AWG processes can include filtration, treatment, mineralization, purification, and distribution, depending on the intended end-use for the water. Water production from AWG can vary based on the humidity levels of the air and the system used; residential AWG systems can produce 1 to 20 liters of water per day and commercial systems can produce 1,000 to 10,000-plus liters per day. The cost to produce a liter of water with an AWG system can be as little as $0.01 per liter if a highly efficient industrial system is used in an ideal climate with relatively low energy prices. The cost per liter can be as high as $1.00 per liter if a small, residential unit is used in a suboptimal climate and energy prices are high. Given that AWG is more effective in areas with higher humidity, the technology is most suitable for coastal areas or tropical climates. Some AWG systems are portable and can be deployed for use during natural disasters—which is especially helpful for high-humidity areas (coasts) where the prevalence of natural disasters (storms and floods) is higher—and during other emergencies where water scarcity is a concern.

AWG presents a compelling solution to water scarcity and is expected to achieve increasing adoption in the coming years. According to Allied Market Research, the AWG market was valued at $2.7 billion in 2023 and is estimated to grow at a compound annual rate of 15% and reach $10.8 billion in 2033.

Exhibit 26
Atmospheric Water Generation Process



Source: William Blair Equity Research

Exhibit 27
Select Providers of Atmospheric Water Generation Systems

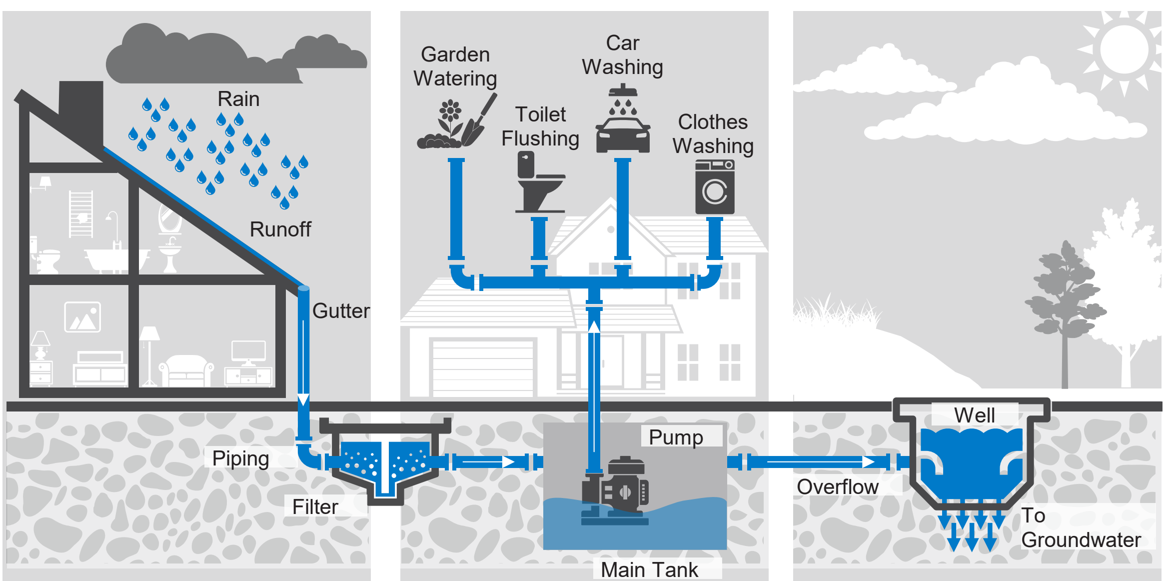
	Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
	Akvo Water Systems	Private	NA	NA	West Bengal, India	Designs and manufactures AWG systems that can generate up to 1,000 L of water per day; installed over 2,000 machines across 15 countries
	Dew Point Manufacturing	Private	NA	NA	Vancouver, British Columbia, Canada	Manufacturer of residential and commercial AWGs; systems are capable of producing up to 200,000 L of water per day
	Imhotep Industries	Private	NA	NA	Freistadt, Austria	Manufacturer of industrial AWGs with 40-foot-long flagship product Phantor capable of producing about 10,000 L of water per day; integrated solar panels supplement external energy requirements
	PlanetsWater	Private	NA	NA	Douglas, Isle of Man	Offers a wide range of AWGs that produce between 100 L and 10,000 L of water per day
	Ray Agua	Private	NA	NA	Madrid, Spain	Global provider of AWGs with strong presence in Europe and Mexico; units capable of generating up to 7,200 L or water per day
	Shenzhen Fnd Environmental	Private	NA	NA	Shenzhen, China	Manufacturer of residential, commercial, and industrial AWGs capable of generating up to 1,000 L of water per day
	SkyH2O	Private	NA	NA	West Palm Beach, Florida	Manufactures AWGs for commercial, industrial, and government applications; unit called the Maximus is 40 feet long, with a form factor ideal for transport by rail or sea; Maximus produces about 10,500 liters of filtered water per day
	Watergen	Private	NA	NA	Petah Tikva, Israel	Specializes in AWG systems for household and municipal applications, including everyday use and humanitarian missions; systems are being used in over 65 countries

Sources: FactSet, Company filings, William Blair Equity Research

Rooftop rainwater harvesting collects rainwater from rooftops and funnels it through gutters and downpipes into storage tanks or recharge systems. Surface runoff harvesting collects water that flows over roads, fields, or pavement through trenches, check dams, or percolation ponds. Surface runoff is useful in urban and agricultural settings to recharge aquifers. Recharge pits are small pits or trenches that have been filled with gravel and sand that allow rainwater to collect and percolate into the ground, recharging aquifers. Recharge pits are useful in areas where water scarcity is high and groundwater aquifer levels are low. Rainwater harvesting, depending on how much rain is collected, can be an effective way to gather water and reduce reliance on public utilities or pumping from groundwater. The Texas Water Development Board states that a 2,000-square-foot roof can collect roughly 1,000 gallons of water for every inch of rainfall, assuming a collection efficiency of 80%. In East Texas, where average annual rainfall can reach 50 to 60 inches, a home with a 2,000-square-foot roof could collect about 55,000 gallons in a year. Rainwater harvesting presents an effective solution to managing water scarcity in areas with high annual rainfall. Further, building certifications and standards such as Leadership in Energy and Environmental Design and the Living Building Challenge encourage or require rainwater harvesting systems to meet their respective requirements and water management strategies. We view the continuing adoption of sustainability-focused building certifications as a catalyst for the adoption of rainwater harvesting technology.

Rainwater harvesting shows promise as a solution to water scarcity, but the market is still relatively nascent. The Business Research Company estimates the global rainwater harvesting market to reach $2.1 billion in 2025 and grow at a compound annual rate of 6.5% to $2.7 billion in 2029.

Exhibit 28
Rooftop Rainwater Harvesting Process



Source: William Blair Equity Research

Exhibit 29
Select Providers of Rainwater Harvesting Systems

	Company	Ticker	Market Cap	Total Revenue	Headquarters	Description
	ACO Group	Private	NA	€1.14B (2023) (~$1.34B)	Büdelsdorf, Germany	ACO's Remosa business offers RainSave RWH systems in a range of sizes and applications; also offers treatment and filtration products for RWH systems
	Graf Group	Private	NA	€305M (2022) (~$330M)	Teningen, Germany	Offers a large portfolio of RWH systems, pumps, and filters for residential, commercial, and industrial use; tank storage amounts range from less than 1,000 gallons (residential) to 30,000+ gallons (industrial)
	Kingspan Group	KRX.IR (Euronext Dublin)	~€13B (~$15B)	€8.6B (2024) (~$8.9B)	Kingscourt, Ireland	Manufacturer of domestic and commercial RWH systems; domestic systems hold 2,000-4,600 liters for flushing, landscape, laundry; commercial systems hold up to 79,000 liters for large buildings, car washes, golf courses; also offers treatment and filtration products for RWH systems
	Watts Water Technologies	WTS	~$9B	$2.3B (2024)	North Andover, Massachusetts	Designs and manufactures commercial and industrial RWH systems under its RainCycle brand; collects, stores, and treats rainwater for nonpotable uses in large buildings (including data center cooling)

Sources: FactSet, Company filings, William Blair Equity Research

Regulatory Environment Overview

United Nations Sustainable Development Goals

In 2015, the United Nations (UN) released its 2030 Agenda for Sustainable Development, encompassing 17 Sustainable Development Goals (SDGs) with 169 associated targets. All UN member states are expected to align national policies with SDGs. Goal No. 6 (SDG 6) is focused on clean water and sanitation. The UN projects that about half of the world's population is already experiencing severe water scarcity for at least one month of the year, and as discussed earlier in this report, investments must be made in infrastructure and sanitation to support the projected population growth in both developed and developing countries. SDG 6 outlines several targets that organizations and governments should work to achieve by 2030:

- ***6.1:*** Achieve universal and equitable access to safe and affordable drinking water
- ***6.2:*** Achieve access to adequate sanitation and hygiene and end open defecation
- ***6.3:*** Improve water quality by reducing pollution (dumping and release of hazardous materials); halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- ***6.4:*** Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater
- ***6.5:*** Implement integrated water resources management at all levels
- ***6.6:*** Protect and restore water-related ecosystems (mountains, forests, and lakes)
- ***6.a:*** Expand international cooperation and support to develop countries' water- and sanitation-related activities and programs (desalination, treatment, recycling, and reuse)
- ***6.b:*** Support and strengthen the participation of local communities in improving water and sanitation management

While progress has been made on some issues in some regions over the last decade, the world is not on track to meet SDG 6 by 2030. Billions of people still lack access to safe drinking water and sanitation, significant amounts of wastewater are still discharged without proper treatment, and many developing countries lack adequate drinking water and wastewater infrastructure. The UN's goals are an important outline for the world to follow, but implementing large-scale changes to meet these goals requires more time and allocation of resources.

Fragmentation Makes Oversight Difficult

The water and wastewater utility markets are highly fragmented globally, including in the United States. According to the EPA, there are about 150,000 public water systems across the nation. Hundreds of thousands of water utilities and systems exist worldwide. Most are small-scale and serve fewer than 10,000 people. Given this industry structure, implementation of new regulations is complex.

Emerging Contaminants Outpace Regulations

Emerging contaminants (ECs) are a group of pollutants in the environment that pose various risks to human health. This group consists of pollutants including PFAS, but also includes other chemicals and consumer products like pharmaceuticals and personal care products (PPCPs). A 2024 research study published in ScienceDirect's *Ecotoxicology and Environmental Safety Journal* titled "Comprehensive review of emerging contaminants: Detection technologies, environmental impact, and management strategies" details ECs, environmental and health impacts, detection and analysis, regulation, and remediation techniques. For the purpose of this section, we highlight the regulation and management strategies discussed in the report.

In the United States, the EPA regulates water contaminants through the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). The SDWA sets maximum contaminant levels (MCLs) for various pollutants and empowers the EPA to monitor and enforce these MCLs across public water utilities. The CWA regulates pollutant discharge and establishes a framework for surface water quality standards. Internationally, the EU regulates water quality through two regulations: REACH and the Water Framework Directive (WFD). REACH requires chemicals to be registered and evaluated to understand potential impacts to human health. WFD monitors and sets quality standards for water bodies. The UN and WHO are the leaders in the global effort to manage ECs. The two bodies work together to create and promote international standards to mitigate the impacts of ECs. The UN and WHO also help developing countries implement their own policies to ensure the safety of water supplies.

The most challenging aspect of implementing regulations is the timing lag between the identification of ECs, studying and understanding them, and then establishing regulations. ECs can be complex and difficult to understand; the potential health risks are often debated and, in some cases, not fully understood. For example, PFAS are one of the more widely known ECs, but represent an entirely separate group of chemicals themselves (e.g., PFOA, PFOS, PFHxS, PFNA), so implementing one broad set of regulations could be inadequate. Further, new chemicals are being developed and introduced for a variety of use-cases at a pace that often exceeds the analysis of their potential health impacts and the development of regulations.

The Economics of Water

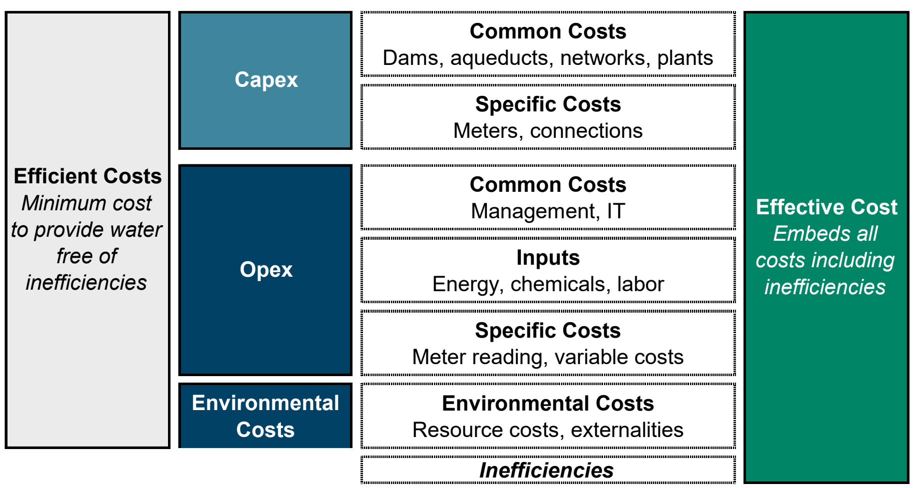
Water Affordability Needs Assessment (EPA)

The EPA published its 2024 Water Affordability Needs Assessment to highlight the growing burden of increasing water costs on U.S. households. Water utilities are dealing with rising costs of operations and maintenance and upgrading aging infrastructure while also attempting to keep rates affordable. The assessment highlights four important facts: 1) the cost of water services has grown at more than twice the rate of other goods; 2) the estimated annual national cost of unaffordable water bills ranges from \$5.1 billion to \$8.8 billion; 3) unpaid water bills can lead to debt and economic hardship, water shutoffs, and loss of housing; and 4) about 10,340 community water systems in the United States service a disproportionate number of households experiencing high water burden. Through the IIJA, the federal government directed the EPA to provide recommendations to address water affordability. In the Water Affordability Needs Assessment report, the EPA provides three categories of solutions: 1) establishing a permanent federal water assistance program; 2) increasing education, outreach, and knowledge around solutions to affordability; and 3) increasing ways to reduce water infrastructure capital and operating costs. The EPA's assessment and the IIJA's directives are encouraging steps toward addressing rising water costs. In our view, companies that offer water infrastructure and smart water systems and services are positioned to benefit from utilities' efforts to address water pricing challenges.

Water Pricing and Economics

Water pricing is complex and often does not consider the true costs of transport and delivery to the end-user. Moreover, water pricing can vary significantly across endpoints, industries, and geographies. Water pricing should reflect both the direct (actual costs of pumping water from the source) and indirect (environmental impact) costs. The delivery of water to homes or businesses involves fixed capital costs and variable costs. Fixed costs (capex) include the costs associated with building and upgrading physical infrastructure. Variable costs (opex) are tied to the amount of water treated and delivered. Ideally, the price charged to end-users would cover fixed and variable costs. The exhibit below provides an overview of the factors that influence the cost of delivering water to consumers.

Exhibit 30
Water Cost Inputs



Source: "Water Pricing, Costs, and Markets," Global Commission on the Economics of Water.

The actual implementation of effective pricing that fully covers fixed, variable, and environmental costs, along with system inefficiencies, is quite challenging. Input costs such as management, energy, and infrastructure can be difficult to apply accurately across a network's customer base. Environmental costs and inefficiencies across the network are near impossible to price because they cannot be precisely quantified. Water tariffs are different types of fee structures that are used by utilities to cover the costs of providing water services (essentially the price charged for water service) and are implemented in several different formats, summarized below.

1. Fixed/connection charge (single flat fee)
2. Two-part tariff (fixed charge plus a flat volumetric rate)
3. Increasing block tariff (price increases in respect to amount used)
4. Decreasing block tariff (price decreases with higher usage)
5. Volume-differentiated (jump) tariffs (all water is charged at the highest price tier reach by a consumer)

The challenge for water tariffs is that each structure can typically accomplish only one goal and fails in other dimensions. Equity and affordability are often claimed as objectives, but challenges exist in achieving those objectives. For example, increasing block tariffs have become popular in developing nations because a common thought is that lower-income households consume less water and would therefore benefit from lower rates. In actuality, lower-income households are not always on the low end of water consumption, especially if the family is large or the house shares a connection with another. The bottom line is that including all input costs to achieve an accurate effective cost and then implementing the best tariff structure for consumers is difficult and frequently results in costs not being fully recovered.

A 2025 research study published in the journal Applied Economic Perspectives and Policy analyzes the complexities of water pricing and recommends several solutions to the issue. In the exhibit below, we summarize several of the core challenges to accurate water pricing presented by the research study and the recommendations for improved water governance and pricing.

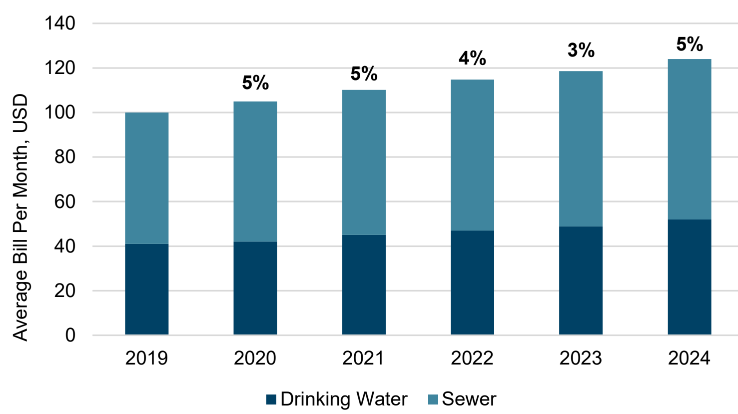
Exhibit 31
Water Price Challenges and Recommendations

Challenges	Description	Solutions	Description
Misaligned Goals	*Cost recovery, conservation, equity, affordability are competing goals*	**Use a Single Policy Instrument per Goal**	*Combine volumetric pricing and rebates for low-income households*
Hidden Costs	*Prices rarely reflect environmental and opportunity costs*	**Reflect Full Water Value in Prices**	*Prices should cover: Opex and maint. costs, capex, environmental cost*
Political Resistance	*Governments often hesitate to raise prices due to social pushback*	**Combine Pricing with Other Demand Tools**	*Awareness campaigns, seasonal pricing, rebates for water-saving appliances*
Aging Infrastructure	*Leaks, poor service quality, outdated systems lead to ineffective pricing*	**Invest in Monitoring, Leak Detection Systems**	*Enhance visibility into aging water systems and improve monitoring (e.g., lower nonrevenue water) by investing in smart water systems*
Monitoring Challenges	*Water metering is often inaccurate, unreliable, or tampered with*		
Pricing Equity	*Subsidies, tariffs often fail to benefit the poorest populations*	**Increase Equitable Distribution and Pricing**	*Initial allocation of water rights is critical*

Sources: “Water Pricing and Markets: Principles, Practices and Proposals.” William Blair Equity Research

The price of water has risen steadily as the costs to maintain and upgrade aging infrastructure systems also continue to rise. Bluefield Research estimates that from 2019 to 2024, combined U.S. drinking water and sewer bills have increased 24%. The research also differentiates costs by region and shows how aging infrastructure can contribute to higher costs. In 2024, the Northeast had the highest average combined monthly bills at $141, while the South’s average was $118. A contributing factor to the Northeast's higher bills is the higher age of the systems in that part of the country, which require expensive upgrades or repairs. As prices have increased, some cities and low-income communities have faced affordability challenges. The Bluefield Research analysis highlights that water bills in Birmingham, Alabama, and Cleveland, Ohio, exceed the EPA's affordability threshold of 4.5% of median household income. This means that minimum-wage earners in these cities must work as much as 20 hours per month just to cover their water and sewer bills. Water utilities are using various strategies to control costs and maintain reliable delivery of water and sewer services. The challenge, however, is that the fragmented nature of U.S. water and wastewater utilities leads to varying levels of effectiveness.

Exhibit 32
U.S. Household Water and Sewer Bills and % Change, 2019-2024



Source: Bluefield Research

The implementation of effective pricing starts with utilities having the best understanding of their costs and how water is distributed across their network. We believe the companies in exhibit 18 that offer smart water systems including advanced metering infrastructure and software solutions for water system management are best positioned to address water pricing challenges.

Highlighted Industry: Agricultural Irrigation

Introduction

While fears of food shortages and water scarcity are not new, we believe they have reached an unprecedented level of urgency. The need for increased food production is driven by multiple factors. The world population is booming and the growing middle class in developing nations is leading to millions of people demanding higher-quality food, and more of it. The continuing shift to protein-based diets is also straining the food supply. The need for increased crop production means increased demand for irrigation water, but the water supply is running short.

According to the UN, more than half of the world is depleting its water supply faster than it is being replaced, and half of the world's population could face serious water shortages by 2025. About 70% of the world's fresh water is used for agricultural irrigation. With this in mind, it seems clear that the agricultural irrigation industry will play a role in any potential solution to water scarcity. With about 90% of irrigation systems in use today based on rudimentary, wasteful methods, the opportunity for suppliers of more-efficient irrigation systems is significant. We anticipate continuing adoption of mechanized and microirrigation systems, which can produce water savings of 50% or more. In addition, advanced irrigation technology will be important in addressing food shortages, given that implementing these systems can more than double crop yields in many cases. There are several other factors that will likely have bearing on industry growth. On the positive side, we expect increasing government subsidy of irrigation technology to support demand. Also, growers will likely continue to seek improved crop yields in an effort to meet not only food production needs, but also alternative fuel demand (e.g., ethanol). In the short term, we anticipate swings in demand for irrigation equipment to be driven by agricultural commodity prices, which determine the economic attractiveness of an investment in an irrigation system.

At a time when water is becoming increasingly scarce, more is needed. The world's demand for food is rising, adding to the stress on the water supply. One of the most obvious factors steadily driving demand for food is growth in the global population. Even though this growth has slowed somewhat over the last few decades (peaking at 2.2% annual growth in the early 1960s and falling to slightly less than 1% annual growth today), in terms of additional people to feed, the numbers are staggering. For example, every day the populations of India and China are growing by about 67,000 and 24,000 people, respectively, according to World Population Review. The UN estimates that global population will grow from 8.2 billion at the end of 2024 to about 9.8 billion in 2050.

According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), global demographic changes and increased consumption as a result of higher incomes are currently greater contributors to growing food demand than general population growth. High rates of economic growth in developing countries have led to higher incomes and an expanding global middle class, resulting in improved diets and lifestyles. Tens of millions of people are transitioning from eating one meal to two meals a day. In additions, diets are increasingly including more protein, with more and more people upgrading from grain-based to meat-based meals. Given the inefficient flow of energy through the food chain, this shift places enormous strain on the food supply. As an illustration of the food chain's inefficiency, consider that about 10 kilocalories of energy are required to produce 1 kilocalorie of beef (according to UNESCO). Said another way, farmers need to grow 10 times the amount of grain to produce a steak than they would if the grain itself were the meal. The World Water Council estimates it takes about 250 gallons of water to produce about 2 pounds (1 kilogram) of wheat, whereas more than 4,000 gallons of water are required to produce about 2 pounds of beef.

Pursuit of Alternative Energy Sources Requires Increased Crop Production

Demand for ethanol is being driven by nations' efforts to achieve energy autonomy, volatility in the price of oil, and rising concerns about greenhouse gas emissions. Since 2020, U.S. ethanol production capacity has increased at an approximate 4% compounded annual rate, to about 16.2 billion gallons by the end of 2024, according to the Renewable Fuels Association. Global production of ethanol increased to 31.2 billion gallons in 2024, up 4% from 2023. The rapid growth in this industry is now a major component of demand for corn and sugarcane. Ethanol production consumed about 5 billion bushels of corn in the United States in 2023, or roughly 38% of the total 2023 crop. According to industry sources, global ethanol production is expected to grow at a midsingle-digit rate through 2032, adding to the strain on the world's food and water supply.

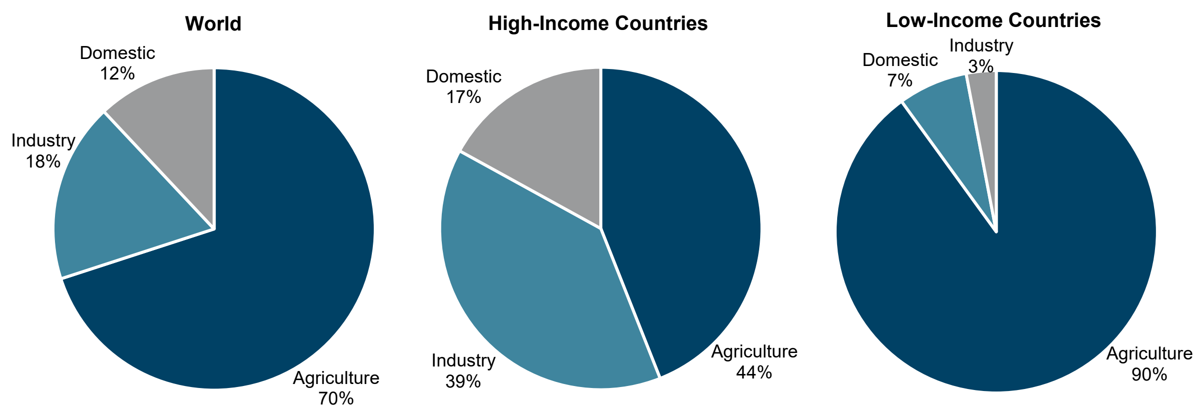
Land Shortage Should Drive Pursuit of Improved Yields

Taking into account the necessary increases in crop production to satisfy food and biofuel demand, it seems unlikely that additional land put into agricultural production alone will be the solution. Many nations are simply running out of arable land (meaning land that can be used to grow crops). For example, China is home to 7%-8% of the world's arable land but 17%-18% of the world's population. This has led the Chinese to lease land for food production in places such as Ukraine, Africa, Australia, and Brazil. With many other countries facing similar circumstances, an international land grab is intensifying. According to data from Land Matrix, about 40% of recent global large-scale agricultural land investments have occurred in Africa given that the continent is home to 65% of the world's uncultivated arable land. Specific examples of this trend include Saudi Arabia and the UAE securing farmland in Sudan, Ethiopia, and Tanzania.

In Addressing Water Scarcity, Agricultural Irrigation Is the Place to Start

The use of more efficient agricultural irrigation technology can both reduce water usage and improve crop yields, leading us to anticipate that the dynamics described above will contribute to ongoing proliferation of advanced irrigation technology. Improved water infrastructure, more efficient domestic and industrial water use, and increasing water reuse are all critical components of a solution to the water scarcity issue. But we believe more efficient use of water in agricultural irrigation is one of the keys to alleviating the world's water problems. Our view stems from the fact that about 70% of worldwide freshwater withdrawals (up to 90% in some developing countries) are for agricultural applications, according to UNESCO. Given that agriculture is the No. 1 consumer of fresh water, efforts to combat global water scarcity will continue to involve more efficient use of water in agricultural applications.

Exhibit 33
Freshwater Uses



Note: World data is as of 2024; high- and low-income countries data is as of 2020
Source: United Nations, World Bank

In the *2024 World Water Development Report,* UNESCO states:

1. Since 1961, land under irrigation has more than doubled, from 139 million hectares to over 328 million hectares in 2018.

2. About 40% of global agriculture production comes from irrigated land, which is only about 20% of all agricultural land.

3. Irrigation plays a critical role in transitioning to commercial farming and economic growth. Irrigated yields tend to be 30% to 100% higher than adjacent rainfed fields.

4. To feed a projected global population of 10 billion in 2050, agricultural production will need to increase by almost 50% over 2012. Much of this growth is expected to be achieved through efficient irrigation and water capture and storage.

Given the above statements, it is easy to conclude that 1) irrigated land is the best method for improved agriculture yields and 2) there remains significant white space (land) to increase irrigated agriculture from the current level of about 20%. Further, the projected population growth and needed increase in irrigated agriculture are daunting. Water scarcity is not only driving the need for more efficient irrigation solutions, but also enhancing the importance of who controls land in regions where water is scarce. The below case study summarizes the history of a Saudi Arabian company buying land and water rights in Arizona to grow alfalfa.

- ***Case study:*** Fondomonte Arizona, a subsidiary of Saudi Arabian dairy company Almarai co., has owned farmland in Arizona since 2014 when it purchased roughly 10,000 acres for $47.5 million. Over the years, worsening drought in the state and increased awareness of potential issues related to foreign-owned farms and their water usage impelled the state to evaluate its leases with the company. Fondomonte uses the farmland to grow alfalfa, which it then exports back to Saudi Arabia for livestock feed. Saudi Arabia is a water-stressed country, and it is illegal to farm alfalfa there because of how much water is required to grow the crop. In 2023, Arizona Governor Katie Hobbs said her administration was terminating state land leases in the Butler Valley that have given Fondomonte unlimited access to pump groundwater. The governor also said it would not renew three other leases that were soon up for renewal.

Overview of Agricultural Irrigation Industry

Precision Irrigation Market Poised for Long-Term Growth

Given the need for water conservation and improved crop yields, we believe the foundation for long-term growth in the agricultural irrigation industry is in place. We estimate the combined market for mechanized and microirrigation systems (including components and ancillary technology) is $4.1 billion to $4.5 billion. We estimate that the market has grown at a 4%-6% compound annual rate for the 2010-2024 period. More recently, for the 2018-2024 period, the market has grown at a low-single-digit rate, including a significant increase in the 2021-2022 period, fueled by higher agricultural commodity prices resulting from the pandemic, supply chain disruptions, and global conflict. The market has more recently declined materially from those peak levels. Over the long term, we expect the industry to grow at a midsingle-digit rate. Our market size and growth rate estimates are based on various industry sources, including historical performance of industry competitors, UN and U.S. Department of Agriculture data, and discussions with industry experts. Although surface irrigation, also known as flood or gravity-flow irrigation, remains the most common form of irrigation globally, we do not include that form of irrigation in our market size calculation and forecast. The surface irrigation industry is extremely fragmented, with systems often constructed with basic components (PVC pipe, valves, pumps, etc.) and installed by contractors or growers themselves. Below, we provide an overview of the industry, an analysis of the different types of irrigation solutions in use today, and a look at the competitive landscape and growth prospects in each market segment.

Types of Irrigation

We segment irrigation technology into three main types: 1) surface, 2) sprinkler, and 3) microirrigation. Below are brief descriptions of each type, with more detail later in this report.

Surface (aka flood or gravity-flow irrigation)

This type of irrigation is defined as the group of application techniques that rely on gravity to distribute water over the soil surface. In some instances, surface irrigation includes the use of dikes and/or furrows/corrugations to control water flow, but often water distribution is uncontrolled. As a result, this type of irrigation is inherently inefficient.

Sprinkler/mechanized

This method distributes pressurized water with nozzles (sprinklers). This category includes several subtypes, but the most common is termed mechanized (including pivot and lateral systems). We focus on mechanized irrigation in this report, as it is the most common type of sprinkler system used in agricultural irrigation, as well as one of the most water efficient. Mechanized irrigation is most often found in the form of a pivot, an automated system consisting of a boom (with sprinklers mounted on it) rotating about a pivot point and supported by a number of self-propelled towers. Water is supplied at the pivot point and flows outward through the pipeline supplying the individual sprinklers.

Other sprinkler irrigation systems (not included in our market size calculation above) include:

- *Travelers:* Rotating sprinkler (or sprinklers) mounted to a trailer. The trailer/sprinkler is towed through the field. This type of irrigation is also called cable-tow, hard hose, or hose drag.

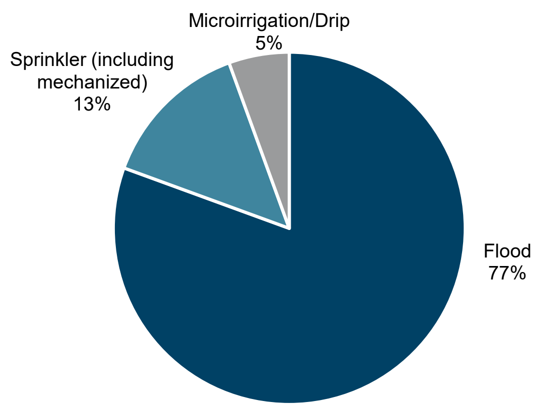
- *Solid set/fixed:* System of surface or buried sprinklers that completely cover the irrigated area or field.

- *Gun type:* Single sprinkler head with a large diameter nozzle, periodically moved by hand or mechanically with a tractor or cable.

Microirrigation (aka drip irrigation or trickle irrigation)
This system distributes water at low pressure in proximity to the root zone through a network of pipes or flexible tubing. Water is applied to the soil surface (or below the soil surface) as drops or small streams through emitters.

Ongoing Shift Away From Flood Irrigation
Although surface irrigation results in a significant amount of wasted water and lower crop yields than competing methods, it is by far the most common method used throughout the world.

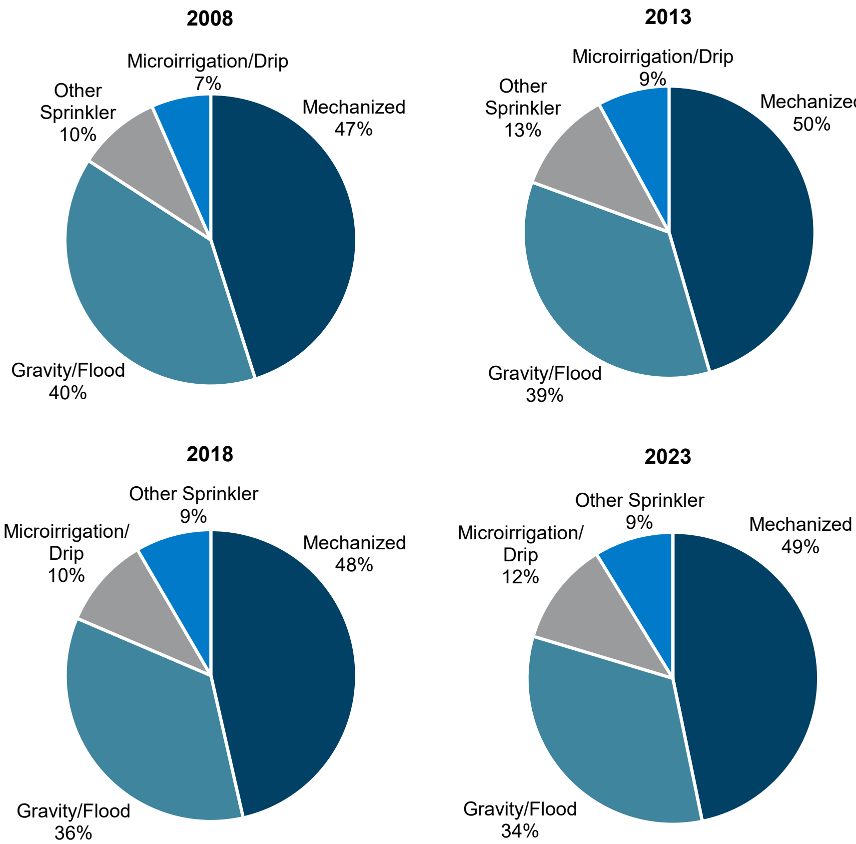
Exhibit 34
Irrigated Farmland by Type – World



Source: FAO Aquastat

The USDA Irrigation and Water Management Survey—typically considered by industry participants to contain the most comprehensive and reliable data on the U.S. agricultural irrigation industry—was last published in 2023. The percentage of irrigated farmland under mechanized systems grew from 47% to 49% between 2008 and 2023. In addition, the percentage of irrigated farmland under microirrigation grew from 7% to 12% over the same five-year period.

Exhibit 35
Freshwater Uses



Note: Totals may exceed 100% due to redundancy of irrigation systems (e.g., land now irrigated with a mechanize system where a preexisting flood system remains).

Source: United States Department of Agriculture

Much of the World's Cultivated Land Is Not Irrigated

A relatively small amount of cultivated land is irrigated. The Food and Agriculture Organization of the United Nations (FAO) estimates that only about 23% of the world's cultivated land is irrigated as of 2022. This figure is about 17% in the United States and 59% in China. Implementation of an efficient irrigation system on rainfed land can improve crop yields by 50% or more. Given the benefits of irrigation and the underutilization of the technology today, we see great opportunity for the continued adoption of efficient irrigation technology. The tables below offer more detail—by continent and by country—on the amount of cultivated land that is irrigated.

Exhibit 36
Area Equipped for Irrigation and Percentage of Cultivated Land – By Continent

Continent/Region	Irrigation					
	Irrigated Area (million hectares)			As % of Cultivated Land		
	2012	2017	2022	2012	2017	2022
World	**323**	**342**	**364**	**21%**	**22%**	**23%**
Asia	232	234	238	40%	41%	41%
Latin America & the Caribbean	23	35	56	13%	20%	32%
North America	27	N/A	26	14%	14%	13%
Europe	22	26	22	8%	9%	8%
Africa	17	18	24	6%	6%	7%
Oceania	3	3	3	9%	9%	8%

Source: FAO AQUASTAT

Exhibit 37
2022 Area Equipped for Irrigation and Percentage of Cultivated Land – By Country

Country	Cultivated Area (million hectares)	Irrigated Area (million hectares)	Irrigated Area as % of Cultivated
China	128.4	75.7	59%
India	168.0	70.4	42%
Mexico	21.9	7.3	33%
Spain	16.8	3.8	22%
United States	154.7	25.9	17%
Turkey	23.9	3.6	15%
Indonesia	45.4	6.7	15%
France	19.7	2.8	14%
Ukraine	33.8	2.2	6%
Argentina	44.2	1.1	2%
Brazil	63.4	5.7	9%
Germany	11.9	0.8	7%
Russia	123.4	3.8	3%

Source: FAO AQUASTAT

Overview of Major Agricultural Irrigation Methods

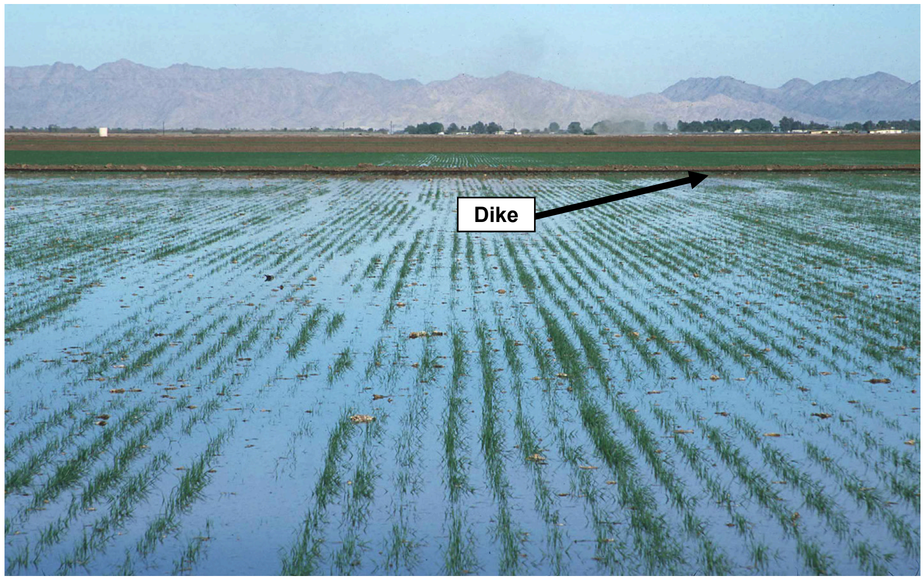
A grower must consider many different factors when selecting an irrigation system, including climate, topography, type of soil, depth of topsoil, quality and availability of water, labor and energy costs, and maintenance requirements. Earlier in this report, we offered brief descriptions of the basic types of agricultural irrigation. In the following pages, we provide a more detailed discussion, including advantages and drawbacks of each method. We also look at the major suppliers of equipment and services for each irrigation method and analyze the respective competitive landscapes. Of the three major types of agricultural irrigation—surface, mechanized (sprinkler), and microirrigation—we believe mechanized and microirrigation hold the highest potential for growth. Accordingly, we offer a relatively brief summary of surface irrigation and focus more on the sprinkler and microirrigation markets.

Surface Irrigation

One of the oldest, most basic agricultural irrigation methods is surface irrigation (also known as flood or gravity-flow irrigation). As highlighted previously, it is the most common form of irrigation throughout the world (accounting for almost 90% of irrigated farmland), and, in many regions, it has been practiced essentially unchanged for thousands of years. Surface irrigation can be segmented into three major categories: basin, furrow, and border strip.

1. ***Basin irrigation.*** This method involves flooding areas of level land surrounded by dikes. It has historically been applied in relatively small, level fields that are surrounded by earth banks. Water is applied rapidly to the entire basin and is allowed to soak into the soil over time.

Exhibit 38
Basin Irrigation



Level basin flood irrigation of wheat field

Source: United States Department of Agriculture

2. ***Furrow irrigation.*** In furrow irrigation, water is supplied to small ditches or furrows, which guide it across the field. Water is applied at the high end of each furrow and then carried through the field by gravity. Water may be supplied using gated pipe or siphons. The crop is planted on the ridge between furrows. Furrow irrigation is particularly suited to row crops such as cotton, corn, and sugar cane.

Exhibit 39
Furrow Irrigation

Furrow irrigation on a field of lettuce

Furrow irrigation using siphon tubes from a lateral waterway

Source: United States Department of Agriculture

3. ***Border strip irrigation.*** This type of irrigation involves flooding strips of rectangular-shaped land, which are bordered by dikes. Border strip irrigation is essentially a combination of basin and furrow irrigation. Borders of the irrigated strip are longer, and the strips are narrower, than those used in basin irrigation. The water is typically applied to the top end of the basin, which is constructed to facilitate free-flowing conditions at the downstream end.

The primary components of a surface irrigation system are a water source, pumps, and a channel to guide the water. Many systems incorporate aluminum or plastic piping and prefiltration equipment (to remove debris). Concrete is frequently used to form water channels, from which water is transferred to the field by gates or siphons. Given the basic nature of surface irrigation designs, and the simple materials and components they are composed of, surface irrigation is not a highly competitive industry. Surface irrigation systems are, in general, put in place by a local contractor certified in agricultural irrigation design and construction. Therefore, the market is highly fragmented. Although almost 90% of irrigated cultivated land is under surface irrigation today, we believe mechanized and microirrigation systems will continue to take share from surface irrigation, resulting in further declines in land area under flood irrigation in the years to come.

Advantages and disadvantages

The following is a summary of the advantages and disadvantages of surface irrigation relative to sprinkler and microirrigation systems. Later in this report (see exhibit 55), we provide a side-by-side comparison of each of the three major types of irrigation (surface, mechanized, microirrigation).

Advantages

- Lower initial capital requirements than sprinkler or microirrigation systems
- Relatively low maintenance/repair costs

Disadvantages

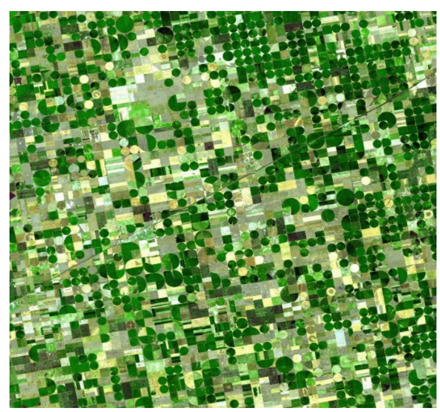
- Relatively high labor requirements
  - Multiple equipment passes required to clean the field and bury debris so water can flow from one end to the other
  - Growers must continually move equipment (e.g., gated pipes and siphon tubes); open and close water gates
  - Fertilizer is applied manually (or aerially, which is expensive)
- Can cause significant soil erosion
- Inefficient water use
- Water runoff can carry chemicals (e.g., fertilizers, herbicides, pesticides) into fresh water sources
- Greater leaching of nutrients from soil
- Crop yields are relatively low compared with fields under sprinkler or microirrigation, in part due to water-logging of fields (which can drown plants and result in increased soil salinity levels)

Mechanized Irrigation

Mechanized irrigation systems are continuous-move systems consisting of sprinklers mounted on a water-carrying pipeline (most often made of galvanized steel or aluminum). Water is usually pumped from a nearby well. The pipeline, supported by a set of trusses, is generally suspended between towers about 11 feet above the ground. In most cases, the pipeline/sprinkler system rotates around a center pivot point. Such systems are often referred to as pivots. The circular motion of the system creates the crop circles often seen from above.

Exhibit 40
Aerial View of Farmland Under Mechanized Irrigation

Irrigated land in Alamosa, Colorado



Irrigated farmland in Kansas

Source: Valmont Industries, NASA

The typical center pivot system sold in the domestic market is a seven-tower system spanning about a quarter of a mile, capable of irrigating 130-135 acres. (In general, center pivots sold outside the United States are somewhat shorter due to smaller average field size.) The purchase price of such a system is about $90,000-$100,000 (or roughly $560-$625 per acre). If the grower is installing a system from scratch (converting dry land to mechanized irrigation), an additional capital investment of more than $50,000 is typically required for a new well, pumps, pipes, and electrical systems. A center pivot or lateral move system can be custom designed to irrigate anywhere from about 25 to over 600 acres.

Exhibit 41
Mechanized Irrigation System

Mechanized irrigation equipment manufactured by industry leader Valmont Industries

Source: Valmont Industries, Inc. reports

Exhibit 42
Mechanized Pivot Irrigation System

Center pivot irrigation system on an alfalfa field in California

Source: United States Department of Agriculture

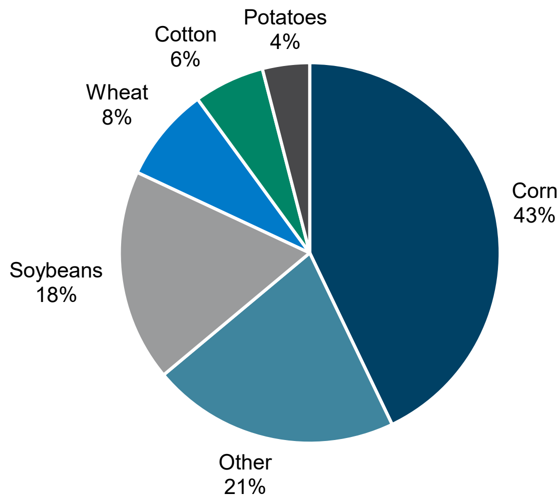
Lateral move systems, or laterals, use the same technology as center-pivot systems. As the name suggests, they move laterally, or back and forth, across a field instead of rotating. Laterals allow farmers to irrigate up to 98% of square or rectangular fields, as well as handle L-shaped fields. We estimate that lateral systems account for less than 10% of mechanized systems in use today, with pivots accounting for more than 90%. While a lateral system offers more field coverage, drawbacks include its higher initial cost (more equipment required because system spans entire field) and more labor (hose needs to be reattached periodically given water source is not stationary, as it is with a pivot system).

Originally, most mechanized irrigation systems were water-powered. Today, the equipment is powered by hydraulic drive systems (different from water power) or with electric motors. Electric power is most common, with systems typically driven by an electric motor mounted at each tower.

Common applications

While a mechanized irrigation system can be designed for fields of almost any size, this type of system is most commonly used on farms that cover hundreds of acres. More specifically, mechanized irrigation is well suited for field crops, such as corn, cotton, soybeans, and wheat (see exhibit 43). This type of system is attractive in large-field applications given that: 1) the capital investment can be leveraged over more area, 2) the system can be controlled remotely (eliminating hours of traveling back and forth across the farm), and 3) the additional labor associated with competing drip irrigation technology (discussed in detail later in this report) is amplified in large-field applications.

Exhibit 43
Crops Irrigated by Center Pivot – United States



Sources: United States Department of Agriculture, William Blair Equity Research

Mechanized irrigation economics

A mechanized irrigation system offers an attractive financial return to the grower. As discussed above, implementing a mechanized irrigation system in a previously rainfed field can result in significant crop yield improvement. In general, converting a flood irrigated field to mechanized irrigation not only results in improved yields, but also lowers energy and labor costs. As a result, the payback period for an investment in a mechanized system is relatively short relative to the useful life of the equipment. More specifically, the life of a pivot ranges from 15 to 25 years, and we estimate the payback period for such a system typically ranges from 1.5 to 5 years, regardless of whether a field is being converted from rainfed or flood irrigation.

Exhibit 44
Corn Price Effect on Payback Period (Conversion From Either Rainfed or Flood)

Corn Price	$3.00	$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
Payback Period	3-5 Years	3-4 Years	2-4 Years	2-3 Years	1.5-3 Years	1.5-3 Years	1.5-2.5 Years

Sources: University of Nebraska data and William Blair Equity Research

Advantages and disadvantages

The following is a summary of the advantages and disadvantages of mechanized irrigation relative to surface (flood) and microirrigation systems.

Advantages

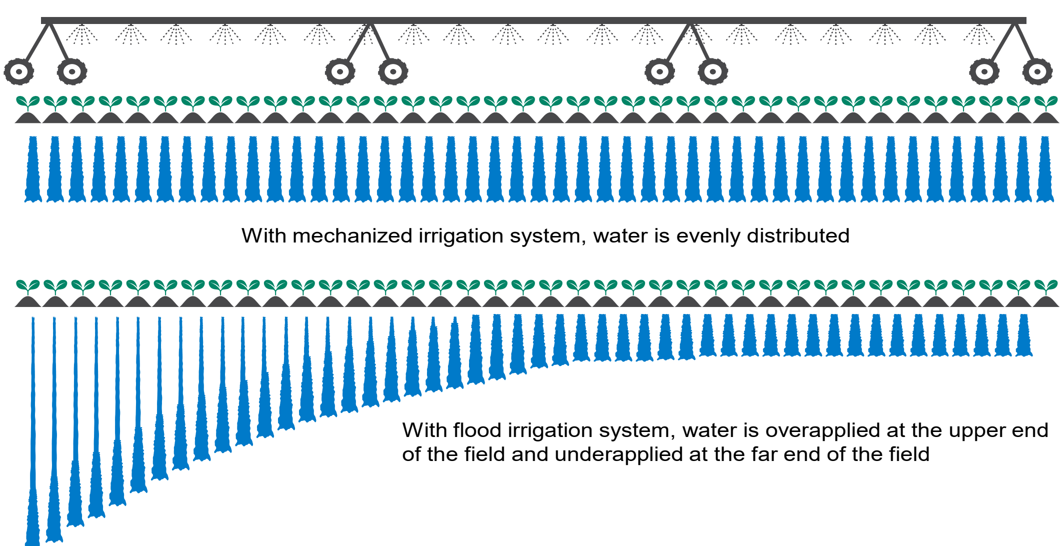
- Higher crop yields
  - Estimated yield improvement of 50% to 100%, or even more, compared with rainfed land
  - Estimated yield improvement of 20% or more compared with flood system

- Decreased water use
  - Estimated decrease in water use of 50% or more compared with flood system
  - Mechanized irrigation systems capable of greater than 90% water efficiency, meaning 90% or more of dispensed water arrives at the roots of the crop (compared with 35%-50% water efficiency for flood systems)
  - More uniform distribution of water than with flood system leads to less waste due to over-watering and runoff (see exhibit 45)
- Ability to apply fertilizers, herbicides, and pesticides uniformly
- Little or no runoff (water runoff can carry chemicals into freshwater sources)
- Less leaching of soil nutrients than with flood system
- No prefiltration of water required
- Relatively low labor requirements (compared with flood irrigation, labor costs can be reduced by up to 75%)
- Less energy used for pumping than with flood system (compared with flood irrigation, pumping costs can be reduced by more than 50% in many cases)
- Systems are mobile and can be moved from one field to another
- Ability to control the system remotely saves time/labor and can significantly enhance a grower's lifestyle

Disadvantages

- Higher initial capital requirement than flood system
- Maintenance/repair costs typically higher than those associated with flood system
- Not ideal for small or odd-shaped fields
- Water efficiency and crop quality/yield slightly inferior compared with microirrigation

Exhibit 45
Water Distribution – Mechanized Versus Flood



Sources: Valmont Industries, Inc. reports and William Blair Equity Research

Mechanized agricultural irrigation market size and expected growth

We estimate the mechanized agricultural irrigation market to be $2.1 billion to $2.3 billion, growing at a midsingle-digit rate over the long term. Our market size and growth rate estimates are based on various industry sources, including historical performance of industry competitors, UN and U.S. Department of Agriculture data, and discussions with industry experts. Drivers of long-term market growth discussed previously include: 1) the need to conserve water, 2) the need to improve crop yields, and 3) the attractive economics of an investment in a mechanized irrigation system. Several other factors should contribute to market growth. Specifically, there is an expanding market for replacement systems. About one-third of mechanized irrigation sales are driven by the need to replace old or damaged equipment. There are about 200,000 pivots in use in North America, and roughly 50% of these are more than 10 years old (average pivot life is 15-25 years). In addition, improved technology supports a growing upgrade market. For example, many farmers are adding GPS, remote control functionality, and image processing and moisture-sensing capability, or replacing high-pressure systems with more advanced low-pressure systems.

International growth opportunities

The mechanized irrigation industry has benefited from significant large project activity outside the United States over the last decade, and especially in the last five years. The largest projects have been in Egypt, driven by the need for food security. In addition, mechanized irrigation sales in Brazil accelerated in recent years.

Middle East and North Africa (MENA) investment potential. Mechanized irrigation companies are experiencing strong growth in the MENA region. Specifically, the largest agricultural irrigation projects in history have been taking place in Egypt over the last several years, and Lindsay and Valmont have both participated (see exhibit 46). Factors that are driving the Egyptian government to invest in irrigation projects include population growth, food and water scarcity, and overreliance on the Nile River. The country's population has been steadily increasing at a low-single-digit rate, pressuring already limited water resources. In an effort to solve the water scarcity challenge and raise the population out of water poverty, Egypt launched its Vision 2030 project in 2016, which is based on sustainable development in three areas: economic, social, and environmental.

Egypt's Ministry of Water Resources and Irrigation estimates the country's total annual water needs at 114 billion cubic meters, with available water resources providing only about 60 billion each year. About 90% of Egypt's water supply is sourced from the Nile River. The 1959 Nile Waters agreement between Egypt and Sudan confirmed Egypt's annual water rights from the Nile to be 55.5 billion cubic meters of water annually. Alternative Policy Solutions (a nonpartisan policy research project at the American University in Cairo) estimates Egypt's annual per capita water availability was about 560 cubic meters in 2022, well below the UN's defined water poverty level of 1,000 cubic meters. Since this is a significant risk to the population of Egypt, the Vision 2030 project focuses on two approaches to enhance water efficiency in the country.

The first approach is rationalizing water usage and recycling in the agriculture sector, which accounted for roughly 76% of water usage in 2019. The second approach is exploring alternative water sources and using technologies such as desalination, wastewater treatment, and rainwater harvesting. Egypt is allocating a significant amount of money toward investing in the agricultural sector as part of the Vision 2030 project. In April 2025, Egypt's Minister of Planning, Economic Development, and International Cooperation announced that the government will direct EGP 17.5 billion (about USD 340 million) to public investments in agriculture and irrigation projects under the 2025/2026 development plan.

Valmont and Lindsay are the two largest publicly traded agricultural irrigation companies. Both companies manufacture and sell irrigation systems including center pivots, linear pivots, sprinklers, pumping solutions, and software systems. Given the Egyptian government's increased investments in agriculture and irrigation, both Lindsay and Valmont have won large projects in the country for thousands of pivots each. In January 2025, we wrote that it was our belief another large irrigation project in the Toshka region of Egypt had reached the bidding stages and could call for roughly 2,500 pivot irrigation systems, likely translating to $150 million to $170 million in revenue for the winning supplier. In conjunction with its fourth-quarter earnings release in February 2025, Valmont announced a new $45 million project in the EMEA region that is expected to be completed in 2025. On its second-quarter earnings conference call in July 2025, Valmont announced another $20 million project win in the region. We believe this smaller win falls under the larger Toshka project and that Valmont could announce more projects of similar size throughout the year. We understand that the bidding processes for these large projects can be quite competitive and can often result in the winning supplier earning a lower-than-normal margin. The exhibit below summarizes Egypt's irrigation projects announced over the last five years.

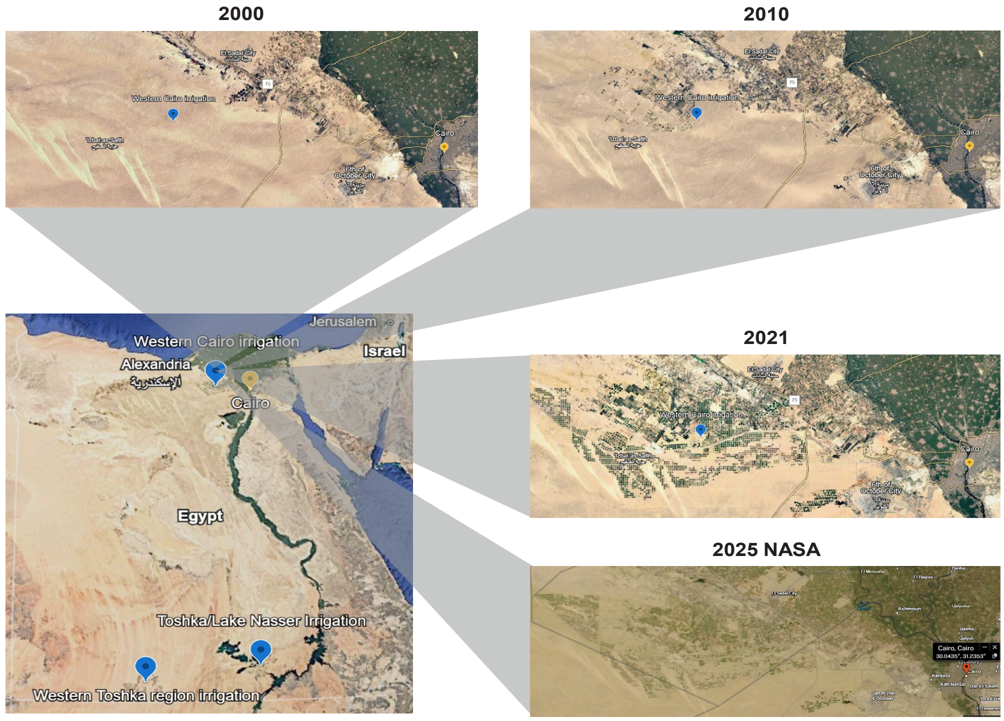
Exhibit 46
Egypt Irrigation Projects

Company	Date Announced	Delivery Timing	Order Size	Customer	Acres	No. of Pivots	ASP
Valmont	September 2020	4Q20 - 2Q23	$240M	Egyptian Army	500,000	3,000	$80,000
Lindsay	July 2021	F4Q21 - F2Q22	$36M	Air Force Authority of Egypt	93,000	1,200	$30,000
Valmont	January 2023	3Q23 - 2025	$85M	N/A	N/A	N/A	N/A
Lindsay	June 2024	F4Q24 - F2025	$100M	Future of Egypt Project	170,000 - 210,000	1,500	$65,000 - $70,000
Valmont	February 2025	2025	$45M	EMEA	N/A	N/A	N/A
Valmont	July 2025	2025	$20M	EMEA	N/A	N/A	N/A

Source: Company reports and William Blair Equity Research

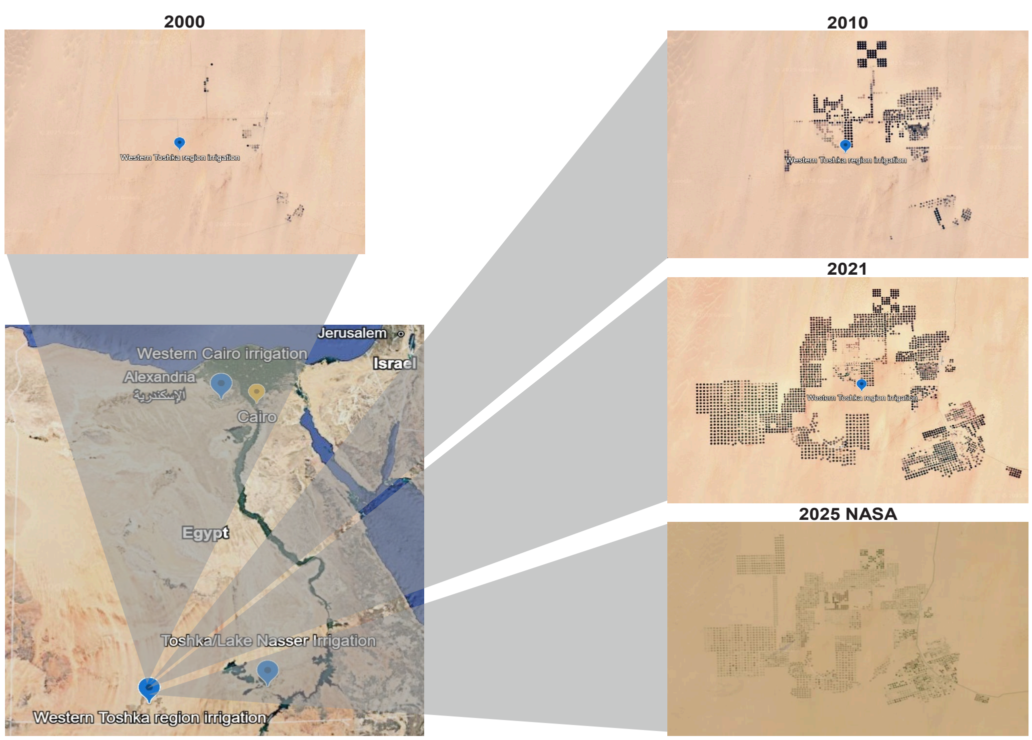
To illustrate the scale of the projects taking place across Egypt, we gathered satellite images of various regions over time. West of Cairo, near 6th of October City, there is a large-scale irrigation development that is part of the Future of Egypt project. In southern Egypt, there are two more large irrigation developments. The developments around Toshka and Lake Nasser have grown from almost nonexistent 25 years ago to what we estimate collectively represents hundreds of square miles of irrigated land.

Exhibit 47
Map of Western Cairo Irrigation Projects



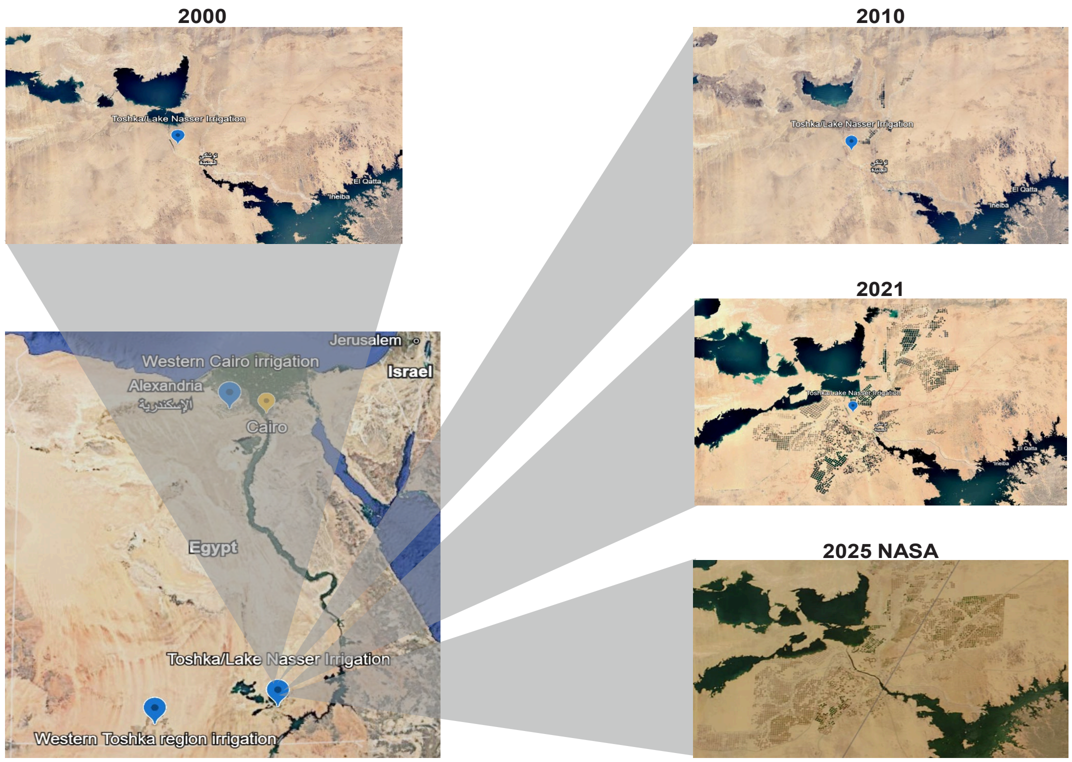
Sources: Google, NASA, William Blair Equity Research

Exhibit 48
Map of Western Toshka Region Irrigation Projects



Sources: Google, NASA, William Blair Equity Research

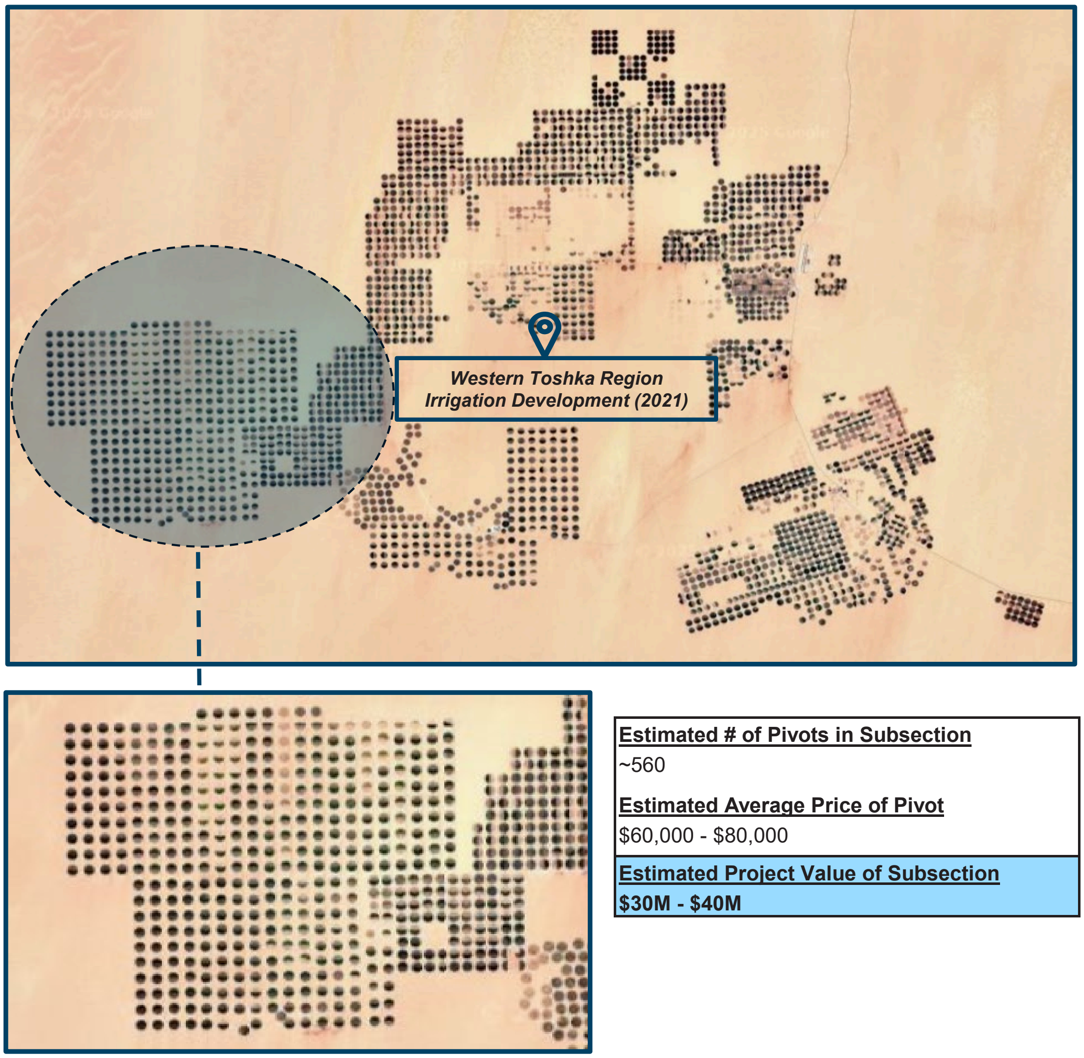
Exhibit 49
Map of Toshka and Lake Nasser Irrigation Projects



Sources: Google, NASA, William Blair Equity Research

We analyzed a section of the satellite imagery to aid in quantifying the revenue opportunity for irrigation companies in Egypt and provide a frame of reference for use when viewing the imagery. Based on the number of pivots in the chosen area and our estimate of the price per pivot, we estimate that the circled region represents about $30 million to $40 million in irrigation equipment. Extrapolation suggests the value of all irrigation equipment in the entire image shown in the exhibit could be more than $120 million.

Exhibit 50
Project Value Estimate for Subsection of Western Toshka Region Development



Sources: Google, William Blair Equity Research

Brazil irrigation opportunity. The irrigation industry has grown significantly in Brazil over the last five years, with industry sales roughly tripling from 2020 to 2023 before declining in 2024 and 2025. Relatively high crop prices and the opportunity to offset the downturn in agricultural production in Ukraine fueled growth from 2020 to 2023 before a decline in crop prices and rising interest rates resulted in the current slowdown. Over the long term, we expect strong growth in the Brazilian irrigation market. Irrigation offers Brazilian growers the potential to boost yields and deliver three crops per year (growing year-round). Several industry participants are increasing focus on serving the Brazilian market, including expansion of manufacturing capacity in Brazil. Growers have access to lower-interest loans for the purchase of irrigation equipment, but only if that equipment meets made-in-Brazil content thresholds. We believe that within five years, mechanized irrigation sales in Brazil could rival U.S. sales levels.

The situation in one Brazilian state highlights the broader opportunity. Mauro Mendes, the governor of Brazil's third-largest state by land area, Mato Grosso, has emphasized the importance of irrigation to his state's economy. The state of Mato Grosso, for frame of reference, produces about the same amount of soybeans as Argentina, the world's third-largest producer of soybeans. Mendes estimates that only about 2% of the approximate 30 million acres of cultivated land in Mato Grosso is currently irrigated, but that a third could ultimately be irrigated. We estimate that this level of irrigation development in Mato Grosso alone could equate to an approximate $5 billion pivot irrigation market opportunity. In our calculation, we assume an average pivot price of $80,000 for a system that irrigates about 160 acres. Cultivated land in Brazil totals about 200 million acres, and various sources indicate about 8% of the country's cultivated land is irrigated. Several Brazilian officials have said irrigation should eventually cover about 30% of cultivated land, suggesting a runway for industry for growth that extends out at least over the next couple of decades.

Exhibit 51
Irrigation Opportunity in Mato Grosso, Brazil

Mato Grosso, Brazil—Irrigation Opportunity

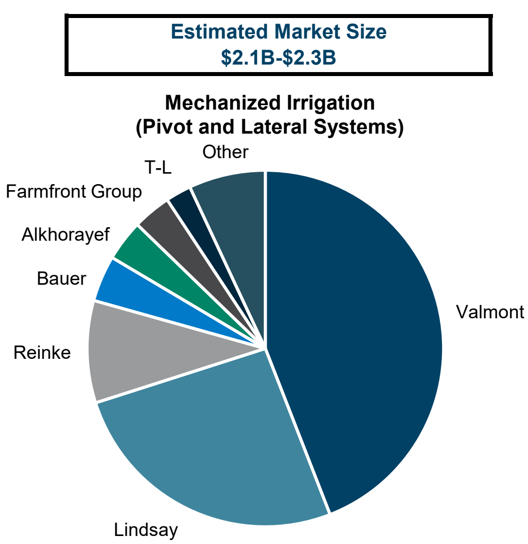
Cultivated hectares	12,000,000
Cultivated acres	29,652,000
Percent currently irrigated	1.5%
Percent that could be irrigated	33%
Potential acres for future irrigation	9,340,380
Number of pivot systems required	58,377
Pivot system selling price	$80,000
Potential pivot system sales	$4,670,190,000

Source: Comments from Brazilian Governor Mauro Mendes and William Blair estimates

Mechanized irrigation competitive landscape

Five industry competitors account for about 85% of mechanized agricultural irrigation equipment and technology sales globally, shown in exhibit 52. Descriptions of industry participants are included in exhibit 24.

Exhibit 52
Global Mechanized Irrigation Market Share Breakdown



Note: Market size estimate includes irrigation systems, components and ancillary technology, but not project engineering and services

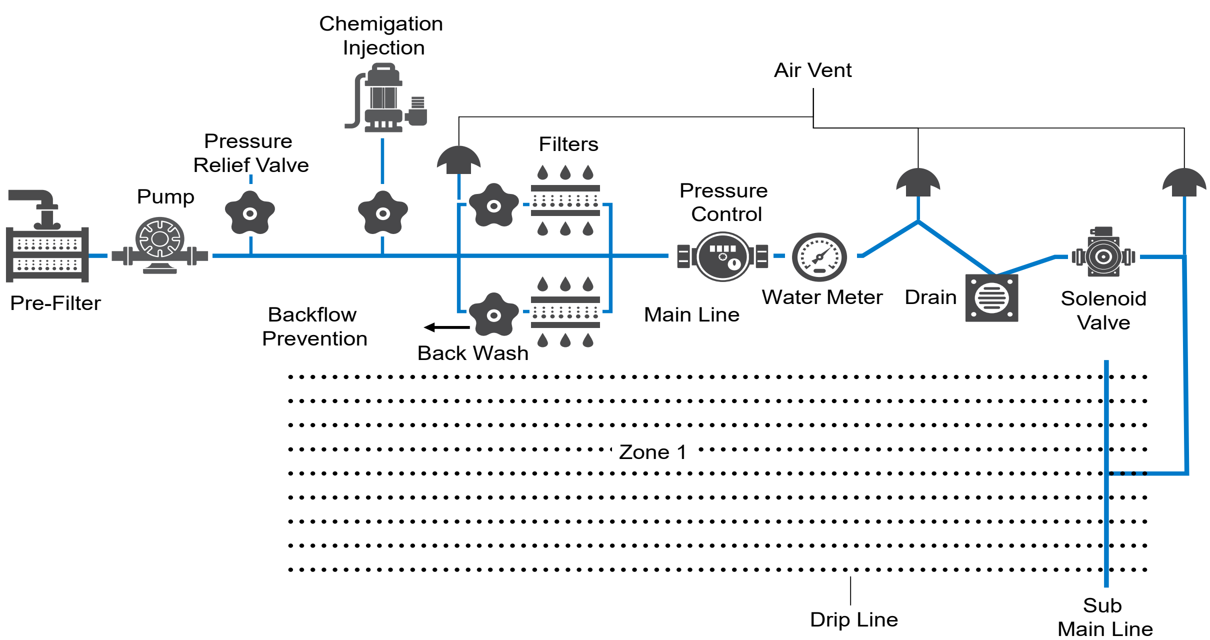
Sources: Various industry sources, company reports, and William Blair estimates

Microirrigation

Microirrigation, also called drip or trickle irrigation, is the slow and frequent application of water at low pressure to the soil in a plant's root zone through emitters or small holes in flexible or solid tubing. (Flexible drip irrigation tubing is often referred to as "tape.") Each emitter supplies a precisely controlled, uniform amount of water and nutrients, which move into the root zone of the plants, helped by gravity and capillary action (or wicking). In this way, the plant's withdrawal of moisture and nutrients are replenished almost immediately, essentially eliminating water stress, which usually leads to improved crop yields (typically better than those achieved with mechanized irrigation). Given that the emitters are in contact with the soil surface or buried in the soil, almost no water is lost to evaporation or runoff.

The primary components of a drip irrigation system include a water source, pump, backflow preventer, injector, filters, pressure regulator, valves, and network of distribution pipes (tubing or tape). The injector is used to add the appropriate amount of nutrients and other chemicals. Filters remove organic material and particulate (e.g., dirt and sand) from the water to prevent the clogging of emitters. Drip irrigation systems are often automated, which requires the addition of solenoid valves and a controller to the system. The exhibit below illustrates the basic design of a drip irrigation system.

Exhibit 53
Diagram of Typical Drip Irrigation System



Source: Oregon State University, William Blair Equity Research

Common applications

Drip irrigation systems can be used for any agricultural irrigation application. Labor and maintenance costs, however, are relatively high compared with mechanized irrigation, a disadvantage that is magnified when a drip system is used to irrigate hundreds of acres. As a result, in agriculture, drip irrigation systems are most frequently used to irrigate high-value crops, such as berries, grapes (vineyards), and vegetables. Drip systems are also ideal for orchards, where it is relatively difficult to maneuver a mechanized system.

In arid regions, such as the deserts of Arizona or Israel, drip systems are particularly attractive because of water loss through rapid evaporation with alternative irrigation methods. Water dispensed by drip systems can reach the root of the plant without having a chance to evaporate. As a result, the difference in water efficiency between drip irrigation and other systems is magnified in dry environments. Given that arid regions are in general under water stress, drip irrigation is often the best solution for that setting.

In addition, drip irrigation is ideal for fields with relatively steep slopes, sandy soil, and extreme variation in soil texture, as well as odd-shaped or small fields.

Advantages and disadvantages

The following is a summary of the advantages and disadvantages of microirrigation relative to surface (flood) and mechanized systems.

Advantages

- Higher crop yields
  - Estimated yield improvement of 50% to 150%, or even more, compared with rainfed land
  - Estimated yield improvement of 30% to 100%, or even more, compared with flood system
  - Estimated yield improvement of 10% to 30% compared with mechanized system
- Decreased water use
  - Estimated decrease in water use of 50% to 70%, or even more, compared with flood system
  - 90%-95% water efficient, compared with LEPA mechanized systems, which are about 80%-85% efficient
  - Less water is lost to runoff and evaporation
- Minimized fertilizer/nutrient loss due to localized application and reduced leaching
- Leveling of the field not necessary
- Ability to irrigate irregular shaped fields
- Allows safe use of recycled water
- Minimized soil erosion
- Highly uniform distribution of water (leads to more efficient harvesting since all plants grow at about the same rate)
- Relatively low labor costs compared with flood irrigation system (but higher labor costs than those associated with mechanized irrigation)
- Foliage remains dry thus reducing the risk of disease
- Usually operated at lower pressure than flood and mechanized irrigation, reducing energy costs
- Unlike flood systems, drip systems can be automated

Disadvantages

- Installation relatively expensive compared with flood and mechanized irrigation
- Risk of emitter clogging due to build-up of calcium-based scale, microbial activity in the water, and bacterial activity in the soil (bacterial activity can cause soil particles to bond and plug drip holes)
- Maintenance costs relatively high (clog prevention requires growers to employ water treatment (acidifying and chlorinating) and adequate filtration systems (require periodic filter replacement)

- Use of drip tape results in extra cleanup costs after harvest (need to plan for drip tape winding, disposal, recycling/reuse) (does not apply to permanent drip systems)

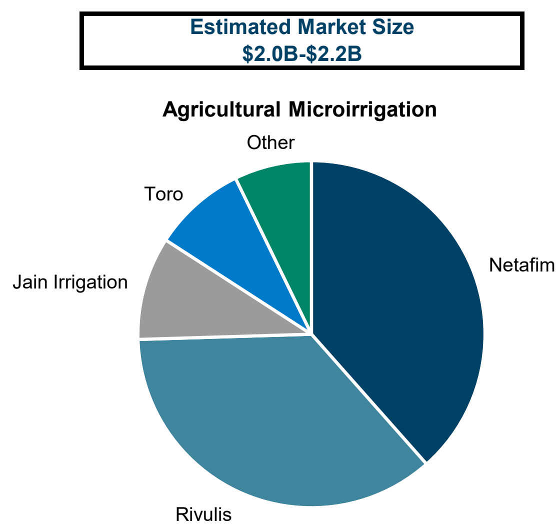
Agricultural microirrigation market size and expected growth

We estimate the microirrigation industry is $2.0 billion to $2.2 billion, growing at a midsingle-digit rate over the long term. Our market size and growth rate estimates are based on various industry sources, including historical performance of industry participants and discussions with industry experts. The primary long-term growth drivers in the microirrigation industry are similar to those driving the adoption of mechanized systems: the need to conserve water and improve crop yields. We forecast somewhat faster growth in the microirrigation market, driven in large part by strong government support of this technology in India.

Agricultural microirrigation competitive landscape

After significant industry consolidation over the last decade, we estimate that four companies account for about 90% of the global agricultural microirrigation market. Descriptions of industry participants are included in exhibit 25.

Exhibit 54
Global Agricultural Microirrigation Market Share Breakdown



Note: Market size estimate includes irrigation systems, components and ancillary technology, but not project engineering and services

Sources: Various industry sources, company reports, and William Blair estimates

Exhibit 55
Comparison of Agricultural Irrigation Systems

	Surface	Mechanized	Microirrigation
Crops[1]	Field crops, vegetables, cane, trees	Best suited for field crops, but can be used for vegetables, cane, and crops up to 16 feet tall	Best suited for short-cycle, high-value crops
Crop Yield	Moderate yield improvement relative to non-irrigated fields but depends on regional rainfall; uniformity generally lower relative to mechanized and drip systems	Can provide 10%-40% yield benefit relative to surface irrigation in most conditions, depending on crop and water stress; higher uniformity than surface systems	Typically offers similar yield benefit to mechanized systems, but has potential to generate superior yields in some high-value crops or water-limited situations
Energy Usage	Low (if gravity-fed); potentially medium or high if pumped from a source or field has low elevation	Medium to high; requires pressure to deliver water through nozzles	Medium to high; sometimes lower pressure than sprinklers, but requires continuous pumping and filtration
Field Size/Characteristics	All sizes	Best suited for large fields	Most effective on small and midsize fields Well suited for complex topography and odd-shaped fields
Filtration Required	In some cases	In some cases	Yes
Installation Cost (per acre)	\$100-\$300	\$650-\$750	\$1,000-\$3,000
Labor Costs	High	Low	Medium
Life Span	NA	15-25 years	10-15 years for central system (e.g., pumps and filters) 1-7 years for micro-irrigation lines and emitters
Maintenance Costs	Low	Low	Medium
Management Skill Required	Low to Medium	Medium	Medium to High
Water Application Efficiency[2]	35%-50%	Low-pressure systems (LEPA): 90%-98%	90%-98%

Notes:
(1) The term "field crop" refers to crops such as corn, cotton, soybeans, and wheat.
(2) Water application efficiency refers to the percentage of water applied by the irrigation system that is delivered to the crop root zone. The remainder of the water is lost to evaporation, runoff, non-uniformity,
Sources: Idaho Department of Water Resources, Kansas State University, Lindsay Corporation, Valmont Industries, and William Blair & Company, L.L.C. estimates

Conclusion

The world continues to face a host of challenges related to water, including scarcity, aging infrastructure, and contamination. About 2 billion people lack access to safe drinking water, according to UNESCO. Water systems servicing about 50% of the U.S. population have detectable levels of PFAS. Climate change is driving an increase in extreme weather events and depleting water sources. And much of the world's water infrastructure is nearing the end of its useful life.

Hundreds of companies are urgently developing technologies to address water problems. Governments around the world are recognizing the threats to health, economic development, and the ability to sustain growing populations caused by water problems. These governments are allocating funds and other resources to support solutions. The companies listed throughout the report, both public and private, should all benefit from growing awareness, scientific understanding, and in some cases, increased funding of water solutions. We expect further adoption of relevant technologies as they become increasingly energy-efficient and economical. The exhibit on the following page highlights public companies that we believe are well positioned to benefit from growing efforts to address the water problems we presented in this report.

Exhibit 56
Proposed Solution Leaders to Global Water Problems

					Water Problems Addressed		
Company	**Ticker**	**Market Cap**	**Total Revenue**	**Headquarters**	**Water Scarcity**	**Aging Infrastructure**	**Water Quality and Contamination**
Advanced Drainage Systems	WMS	~$9B	$2.9B (2024)	Hilliard, Ohio	X	X	
A.O. Smith	AOS	~$10B	$3.8B (2024)	Milwaukee, Wisconsin	X		X
Badger Meter	BMI	~$6B	$827M ~$650M water metering	Milwaukee, Wisconsin	X	X	X
Ecolab	ECL	~$79B	$15.7B (2024)	St. Paul, Minnesota	X		X
Franklin Electric	FELE	~$4B	$2.0B (2024)	Fort Wayne, Indiana	X	X	X
Itron	ITRI	~$6B	$2.4B (2024) ~$700M water metering	Liberty Lake, Washington	X	X	X
Lindsay Corporation	LNN	~$1B	$607M (FYE Aug 2024) $514M agricultural irrigation	Omaha, Nebraska	X		X
Mueller Water	MWA	~$4B	$1.3B (FYE Sep 2024)	Atlanta, Georgia	X	X	X
Orbia/Netafim	ORBIA.MX (Mexico Exchange)	~$1B	$7.5B (2024) ~$1B agricultural irrigation	Mexico City, Mexico	X		X
Pentair	PNR	~$17B	$4.1B (2024)	Minneapolis, Minnesota	X	X	X
Tetra Tech	TTEK	~$10B	$5.2B (FYE Sep 2024)	Pasadena, California	X	X	X
Valmont	VMI	~$7	$4.1B (2024) ~$1.0B agricultural irrigation	Omaha, Nebraska	X		X
Veolia Environnement	VIE.PA (Euronext Paris)	~€22B (~$25B)	€44.7B (2024) ($47.8B)	Aubervilliers, France	X	X	X
Veralto	VLTO	~$26B	$5.2B (2024) $3.1B water quality	Waltham, Massachusetts	X	X	X
Watts Water Technologies	WTS	~$9B	$2.3B (2024)	North Andover, Massachusetts	X	X	X
Xylem	XYL	~$32B	$8.6B (2024)	Washington, D.C.	X	X	X
Zurn Elkay	ZWS	~$7B	$1.6B (2024)	Milwaukee, Wisconsin	X	X	X

Sources: FactSet, Company filings, William Blair Equity Research

The prices (7/31) of the common stock of other public companies mentioned in this report follow:

A.O. Smith	$70.79
Advanced Drainage Systems	$114.75
Amazon (Outperform)	$234.11
Badger Meter	$188.76
Bayer AG	€27.35
Ecolab (Outperform)	$261.76
Franklin Electric	$93.95
Freshpet (Outperform)	$68.32
Google (Outperform)	$191.90
Itron	$124.54
Lindsay (Market Perform)	$136.51
Meta (Outperform)	$773.44
Microsoft (Outperform)	$533.50
Mueller Water Products	$24.76
Oracle	$253.77
Orbia	$1.31
Pentair	$102.20
Tetra Tech (Outperform)	$36.74
Valmont (Outperform)	$363.95
Veolia	€29.70
Veralto	$104.83
Watts Water	$262.32
Xylem Inc.	$144.62
Zurn Elkay Water	$44.25

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Coverage Universe	Percent	Inv. Banking Relationships *	Percent
Outperform (Buy)	71	Outperform (Buy)	11
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