March 24, 2008

# Americas: Multi-Industry

## The Essentials of Investing in the Water Sector; version 2.0

### Water: Pure, refreshing defensive growth

The $425 billion global water sector remains at the forefront of industrial, geopolitical, and social agendas because of worsening supply/demand imbalances at regional and national levels and the heightened megatrend catalysts of water scarcity, quality, and safety issues. We remain bullish on the global water sector's defensive long-term 4%-6% growth drivers.

### The petroleum for the next century

The demand for water – the life-sustaining natural resource that has no substitute – continues to escalate at an unsustainable rate, fueled by population growth and industrial expansion. The world's fresh water supply is also shrinking due to pollution, draining of underground aquifers, and climate change. As a result, we expect to see a sustained focus and investment in the global water sector for years to come.

### Growth outlook: Developed mkts 3%-5%; developing mkts 10%+

The US has an estimated backlog of $300 billion-$1 trillion of infrastructure replacement/upgrade that should drive 1X-2X GDP or 3%-5% growth. Developing countries, especially China and India, should continue to see 10%+ growth as they build out basic water and wastewater systems.

### Investment strategies should include takeout candidates, baskets

Several of the top Multi-Industry companies, including GE, Danaher, ITT, and Siemens, have market-leading water equipment businesses, but investors remain frustrated by their relatively small percentage of water revenues. We advise investors include potential water takeout candidates and baskets as part of a broad strategic investment in the water sector.

### Surging toward a global water oligopoly in equipment & services

We expect to see further consolidation in the water sector over the next five to ten years that should result in a global water oligopoly, including a convergence of water equipment and service business models.

### Risks center on execution and regulations, not demand

Water businesses are predominantly less cyclical and product cycles are relatively modest and incremental; the key risks would be mostly execution, M&A-related, and regulatory compliance.

**NEW IN OUR UPDATED WATER PRIMER**

- "Next Big Things" in water
- Updated takeout candidate list
- Profile of the global desalination market
- Updated top global companies in water

Goldman Sachs is acting as financial advisor to Gaz de France in an announced strategic transaction.


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*The prices in the body of this report are based on the market close of March 20, 2008.*

# Overview: Water: pure, refreshing defensive growth

**We continue to be bullish on the long-term defensive growth opportunities in the $425 billion global water sector. Developed markets should see steady 1X-2X GDP or 3%-5% growth, mainly from required upgrades to the existing water and wastewater infrastructure. In developing markets such as China and India, the build-out of new water and wastewater infrastructure should drive 10%+ growth for at least the next five to ten years.**

## Our global water sector investment thesis

We continue to be bullish on the long term 4%-6% defensive growth opportunities in the $425 billion global water sector. In developed markets such as the United States and Western Europe, the water sector should generate steady 1X-2X GDP or about 3%-5% growth, mainly from the required upgrades to the existing water and wastewater infrastructure. Estimates for the backlog of water infrastructure replacement/upgrades in the United States range from $300 billion to $1 trillion at the current pace of capex. By 2020, an estimated 60% of all water main pipes will be classified as substandard. In developing markets such as China and India, the build-out of new water and wastewater infrastructure should drive 10%+ growth for at least the next five to ten years.

## Water, purely positioned as the "petroleum for the next century"

Demand for water – the natural resource with no substitute – continues to escalate at unsustainable rates, driven by population growth and industrial expansion. At the same time, the world's fresh water supply is shrinking due to pollution, draining of underground aquifers, and climate change. At the risk of being an alarmist, we see the parallels with the Malthusian economics applied to water supply and demand. In the United States, water demand has tripled in the past 30 years, while the population growth has been just 50%. Globally, water consumption is doubling every 20 years, more than 2X population growth. Given current trends, by 2025, it is estimated that about one-third of the global population will not have access to adequate drinking water.

## How we define the $425 billion global water sector

**In total, we size the global water sector at $425 billion, growing 4%-6%, with the US market representing about $95 billion.**

For practical purposes, we like to say there is no single global water sector. Instead, the water market is composed of at least ten distinct subsectors, including the equipment, and services for pumps, valves, water test, filtration/desalination, drinking water, wastewater, industrial water treatment, infrastructure, automation, and consulting/engineering services. Each of these subsectors, as defined in our primer, has its own demand drivers, embedded technology, competitive dynamics, etc. In developed countries, such as the United States, we expect consistent 3%-5% growth, driven by increased maintenance stemming from aging infrastructures and tighter regulation. The estimates for the backlog associated with upgrading the US water infrastructure range widely from $300 billion to $1 trillion (and two-thirds of that spending is for distribution network/pipes/pumps). For developing countries, we expect to see 10%+ growth, driven mostly by installing water infrastructure for the first time. Many sectors of China's water system should see 20%+ growth over the next several years.

## Focus on the higher growth, higher technology segments of water

With regard to what areas of the water sector we find especially attractive, we believe investors should be focused on the higher-technology segments of water equipment and services, including filtration, ultrafiltration, desalination, reuse, and water test. These businesses should see the highest growth with stronger pricing and higher barriers to entry. In contrast, we are far less excited about the lower-tech, more commodity products, such as pipes, pumps, and valves. While these products should continue to see healthy demand from all the required infrastructure replacement, they are becoming increasingly commoditized, with pricing pressure and competitive threats from China.

## What we see as the "Next Big Things" in water

The global water sector continues to made headline megatrend news at the same time the sector is undergoing a renaissance of technology advances and consolidation. We expect the drivers for the so-called "Next Big Things" in water to emanate from a worsening of the global water supply/demand imbalance, advances in water equipment/filtration technologies, a tightened regulatory environment, market consolidation, and global political water activism. As developed further in this report, we consider the Next Big Things to include water reuse, filtration technologies displacing chemicals, accelerated acceptance of desalination systems, consolidation of US water utilities, adoption of methodologies for measuring water efficiency across industries, emergence of Chinese competitors in water equipment, a backlash against bottled water, and more awareness of water rights as a value driver.

## Regulatory drivers creating market opportunities

Established in 1970, the Environmental Protection Agency (EPA) is the US government agency responsible for protecting the public health in water safety across the 50,000-plus water-regulated entities. In the United States, the Safe Drinking Water Act sets the water test standards for acceptable levels of nearly 100 known contaminants. New worries about micro-pollutants showing up in the US water supply, such as pharmaceuticals and animal growth hormones, are sure to spur more contaminant testing. The other primary law governing water quality is the Clean Water Act, which protects the surface water resources from pollutant discharges and maintains standards for wastewater treatment. Following the event of 9/11, the Department of Homeland Security has focused on the needs for increasing the security of the US water system. Overall, the trend continues toward increased Federal and state regulation of water quality and safety, which directly benefits the companies providing test equipment and services, such as Danaher. Importantly, the water regulation market is becoming more global. For example, China has adopted much of the US regulatory framework, calling it SEPA, or State Environmental Protection Agency.

## Water cycle basics: Go with the flow

As described in this report, water undergoes a wide range of treatment processes during its life cycle from the process of drawing feed water from surface reservoirs, underground aquifers or the ocean, through its eventual discharge. Water has to be treated to specifications depending on whether it is intended for municipal use, food & beverage, industrial, semiconductor, or pharma. The largest component of this expense involves installing/replacing pipelines. In the end, water has unique chemical properties with local supply and demand challenges. As a measure of the decentralized network in the United States, there are over 70,000 water and wastewater municipal systems relying on 700,000 miles of pipe systems, many of which are 60-80 years old. Water treatment includes the

systems for filtration and disinfection to change the chemical composition, and increase the purity and clarity of a water supply to make it suitable for residential, commercial, and industrial uses.

## Surging toward a global water oligopoly

We expect to see further investment and consolidation in the water sector over the next five to ten years to where a global water oligopoly should emerge. Importantly, the consolidation has started first among the leading equipment manufacturers, including GE and Siemens, but we are now increasingly seeing more of a presence by the top service companies, such as Veolia and Suez. In fact, we expect to see more convergence in the business models of the traditional large equipment manufacturers and the service providers. The winners will be those who can offer vertically integrated, turnkey solutions. For example, GE is taking on a service role in many projects and Suez and Veolia are each now partnering with equipment manufacturers to build desalination plants. Looking ahead, we expect the cycle of consolidation is likely to be uneven, as water valuations periodically ebb and flow from merely "expensive" to "frothy". We expect the well-capitalized global water equipment companies, such as GE, Danaher, ITT, and Siemens to continue to be selective acquirers of strategic water assets.

## Water investment strategies should include selective investments in Multi-Industry names, takeout candidates, and baskets

One of the common frustrations expressed by investors making their initial inquiries for ways to play the global water theme is the relative scarcity of pure-play stories. The fact is that several of the top Multi-Industry companies have market-leading water businesses (think GE) but in many of these instances, water represents a relatively small percentage of their overall revenues. GE may indeed have the market leading water and desalination business, but water is still only about 2% of total GE revenues. Danaher is the market leader in water test equipment and consumables, but water in total is still only about 12% of Danaher's revenues. Among the large cap names, ITT has the distinction as having its water businesses totaling the sector's highest percentage – 39% – of total revenues. As a result, we recommend that investors include a basket of potential takeout candidates as part of a broad investment in the water sector.

## Takeout candidates have been evaporating and remain expensive

**Top takeout candidates include BMI, CCC, CLC, PNR, PLL, INSU, HFLY.SI, TTEK, WTR, and WTS.**

As described in this report, we have identified a list of what we see as the top-12 best positioned water pure-play or near pure-play public companies. Scarcity value and proprietary technology have driven valuations to expensive levels in levels in many cases. This list includes Badger Meter, Calgon Carbon, Clarcor, Pentair, Pall, Insituform, Hyflux, Tetra Tech, Aqua America, and Watts Water. Valuation hinges on growth and the water technology content of the business.

# Next Big Things in water and their implications

**In our view, the key issues on the water sector horizon for investors to monitor range from changes in the supply/demand imbalances, to regulatory shifts and further market consolidation. Based on our conversations with the leading water company managements, regulators, equipment manufacturers, service companies and utilities, we have listed the following trends/developments that we see emerging as the "Next Big Things" in the water sector.**

## Water reuse

**Given the political and behavioral aversions to a "from toilet-to-tap" reuse concept, we expect stringent water test standards to be critical to widespread acceptance of water reuse as a source of new potable water supply.**

We expect to see continued regulatory and behavioral changes over the next several years regarding water reuse. The practice of pumping the finished product – treated potable water – from wastewater utilities back into the ground or into rivers or the ocean seems outdated and highly inefficient. We believe that for many inland and coastal regions facing water scarcity, water reuse will become an increasingly attractive source of new supply, especially for irrigation, heating, cooling, and other non-direct potable uses. The city of San Diego has been a leader in investing in water reclamation projects, having invested over $300 million in new treatment and distribution systems for water reuse.

*Widespread water reuse for potable use will require further infrastructure investment at the wastewater level, including advanced membrane and filtration technologies like MBR, UV disinfection, and micro, ultra, and nano filtration.*

## Accelerating investment of desalination systems

Given continuing trends in emerging market urbanization and industrialization, desalination ("desal") is gaining recognition as an economically justified and drought-proof supply solution to address growing water scarcity in coastal regions globally. Advances in pre-treatment systems, membrane efficiency, and energy recovery systems have reduced the cost of desal to the point where it is becoming cost competitive with alternative water sources. Desal operating costs are 3X-4X lower than 30 years ago. While desal has traditionally been focused in water-scarce regions like the Middle East, North Africa, and Spain, we have noted increased investment in new desal capacity in non-traditional markets like the United States (15 new plants under construction), China, and India.

*Globally, the top desalination companies include GE, Suez, Veolia, Doosan Heavy, Acciona, IDE Technologies, ACS, Ferrovial, and Hyflux. Further regulation of desalination systems addressing disposal of the effluent byproduct is expected to create new market opportunities in zero-discharge systems.*

## Filtration technologies displacing chemicals

Filtration and ultrafiltration technologies have been displacing chemical treatment, especially in industrial applications. Advances in material sciences and nanotechnology are being used to filter more complex contaminants, such as animal growth hormones stemming from farmland water runoff and pharmaceutical byproducts in residential wastewater. Since the late 1990s, EPA rules have favored alternative methods of disinfection given outbreaks of cryptosporidium, a parasitic disease resistant to chlorine.

*This trend should benefit the primary filtration and membrane manufacturers, especially Dow FilmTec, Pall, GE, 3M (Cuno), and Koch (private).*

## Further consolidation of US water utilities

We expect to see continued consolidation in the US water utility market, which totals 54,000 standalone regulated systems and 16,000 municipal wastewater treatment plants. The vast majority of these utilities are municipal or state-owned. There are only 10 publicly traded US water utilities, but we expect to see more consolidation and roll-up strategies going forward. A key driver of this trend has been the acceptance on the part of state regulators for rate increases and system improvement surcharges to fund additional investment in the aging water infrastructure.

*Aqua America (WTR) has been the most aggressive in pursuing a strategic roll-up of water utilities. WTR is also seeing increased competition from infrastructure funds.*

## Initiatives for measuring industrial water efficiency

Regulators and non-government organizations such as the United Nations Environmental Program Finance Initiative (UN EPFI), are exploring ways for companies to calculate and disclose their "water footprint" or water use and efficiency. This could pave the way for industry rankings of water efficiency, which would be another leverage point toward efficiency, conservation, and investment. Many companies in oil-producing markets, which are high consumers of water, already disclose their water usage. This should help apply more pressure on demand-side conservation initiatives.

*Major metering companies, such as Badger Meter, Itron, and Neptune (Roper), who primarily serve the municipal market, should all benefit from initiatives to more precisely measure water usage.*

## Emergence of new Chinese and other Asian competitors

It should only be a matter of a couple of years before domestic Chinese and other Asian companies begin to take greater share in the global water equipment and service markets.

*We expect to see Asian companies such as Hyflux, Epure International, and Doosan Heavy Construction benefit from the faster growth in this region.*

## Focus on the deteriorating quality of national water supply

Today, the EPA requires the 54,000 US water utilities to test for nearly 100 known contaminants. Looking ahead, there are also a disturbing number of household compounds being detected in water systems, including aspirin, caffeine, and even animal growth hormones from farmland water runoff. These "emerging contaminants" are also called PPCPs (pharmaceuticals and personal care products). The present water treatment systems were never intended to filter these new micro-pollutants but changes need to be made. First the EPA has to set standards and then the utilities have to be equipped to filter out these contaminants. This trend toward increased water testing standards directly benefits the companies providing test equipment and services. Importantly, the water quality and regulatory market is also becoming more global.

*Water test companies should continue to be a focus, with Danaher's Hach as the market leader. Tighter quality standards also favor the membrane manufacturers like Dow, Pall, and GE. Alternative disinfection systems such as ozone purification systems may be necessary to treat endocrine-active components.*

## New paradigm for valuing water rights

As water becomes scarce in many regions, we expect to see water increasingly viewed as an asset similar to real estate and mineral rights that can be bought and sold. The western United States and the Colorado River Compact are already driving the creation of local and regional markets for water rights. We believe cooperation / compromise, and not litigation, will be key drivers of water rights adoption and recognition.

*One of the most progressive companies we have seen in the area of water rights has been Pure Cycle Corp. (ticker: PCYO).*

## Integrated solutions are becoming the strategic focus for multi-national water companies, like GE, Veolia, and Suez

One of the strategies that GE Water is pursuing aggressively is to market an integrated package of products, services and financing resources to its customers globally. In this case, we see GE's global scale and reach as a competitive advantage. It can offer a customer a complete solution: plant design, planning, financing, equipment and service.

*This trend favors the well capitalized, vertically integrated water equipment companies such as GE and Siemens. We also see Veolia and Suez entering this integrated solutions model, broadening their competitive offering from historically a service model to increasingly include plant design and equipment.*

## More investment in water conservation/water-friendly products

We expect to see a proliferation of water-friendly products and services emerge addressing their conservation advantages. There will undoubtedly be more emphasis on point-of-use filtration and other decentralized solutions rather than reliance on large-scale, vulnerable municipal systems.

*Pressure to manage water more efficiently will drive additional investment in water "derivative" products such as water-free toilets being installed in new stadiums (Geberit), front-end loading clothes washer from GE, efficient micro irrigation systems (Jain Irrigation, John Deere), and dry cooling technology from SPX for power plants in arid regions.*

## Backlash against bottled water

As the environmental issues with bottled water mount (including landfill, oil/plastic, and energy considerations) and the reliability of municipal drinking systems improve, we expect to see an increased backlash against bottled water. A standard half-liter bottle of water sold on the street in New York City costs about 4,000X the same volume of municipal tap water, with little-to-no actual quality difference between the two sources. The US consumer today has a dizzying array of over 500 different domestic water brands from which to choose.

*Major beneficiaries will include those companies supplying residential and point-of-use / commercial filtration products, including Pentair, Culligan, EcoWater Systems, Kinetico, and BWT.*

# Why we consider water to be "the petroleum for the next century"

**The demand for water continues to escalate globally from population growth and industrial expansion. At the same time, the world's fresh water supply is shrinking due to pollution, draining of underground aquifers, and climate change. The water sector encompasses issues of these supply and demand imbalances, infrastructure challenges in both developed and developing markets, pollution control, conservation, regulatory compliance, water quality and safety, homeland security, and systemic under-pricing.**

**Water is an essential natural resource with no substitute**
Water is the natural resource for which there is no substitute. In many respects, water is a life sustaining resource, a commodity, and, as thought by some, a natural right like air.

**Water has never been priced efficiently, leaving little incentive for conservation**
Water has historically been consumed as if it were a permanently abundant commodity. As the lowest-cost utility, water has been systemically under-priced in nearly all countries, which limits the ability of governments and municipalities to fund necessary upgrades. There is increased recognition that water cannot be the same low-cost utility everywhere for everyone. The argument is that if water were to be priced correctly, economically sound decisions could be made about how this resource is allocated.

**US water infrastructure is aging and underfunded**
In the United States, total water usage has tripled in the past 30 years, while population growth has been just 50%. Estimates for making the necessary upgrades to the US water works range from $300 billion to $1 trillion. Further, we have seen estimates that the US is on an inconceivably long 900-year pipe replacement cycle.

**Water is ultimately a local issue, with acute shortages spread around the world**
North America has an enviable position of having access to 15% of the global water supply that supports just 8% of the world's population. In contrast, China has only 7% of the renewable water supply, but 21% of the population.

**Lack of adequate water supplies in emerging markets could impair growth.**
Expanding industrialization in developing countries is stressing already-limited water resources. In many cases, access to adequate water supplies will be a limiting factor to the shift of manufacturing resources to low-cost countries. Developing markets today only use 11% of water for industrial use versus 42% for developed countries.

**Potential source of geopolitical conflicts**
There are more than 240 water basins in the world that cross national borders, many of which could become flash points for conflict. For example, Egypt has longstanding threats to take military action against any country making unauthorized withdrawals from the Nile. Canada has specific laws against exporting any water to the US, and India and Bangladesh have had many tense ongoing disputes over the Ganges.

**Climate change is adding further stress to the water equation**
Climate change is adding further tension to the water equation, triggering changes in hydrological systems in many regions of the world. The effect varies by region, from additional rainfall increasing water runoff in tropical zones, to receding glaciers and snowpacks reducing snowmelt and freshwater supplies.

# Highest growth subsectors of global water market

**We believe investors should expect to see accelerated investment in the higher-technology water sectors, including filtration, ultrafiltration, reverse osmosis/ desalination, ultraviolet (UV) disinfection systems, and water test. As the supply and demand imbalances become more severe, these high-end water treatment technologies are expected to see increased focus and investment.**

**Desalination is one of the many examples of the interdependencies between water and energy.**

**Desalination.** The equipment and systems for producing fresh water from salt water is the answer to the worry as to whether the world could ever run out of fresh water. Desalination ("desal") is a $5-$10 billion market growing at 10%+. Advances in membrane technology have cut the energy use in desalination systems in half in the last 10 years. Total operates costs today in desal are 3X-4X lower than 30 years ago. New desal facilities are becoming cost competitive with traditional water sources, typically operating at less than $1 per cubic meter, on par with conventional water sources. GE, Suez, Veolia, Dow Chemical, Hyflux, and Acciona Agua are among the leading designers, equipment providers, and operators for desal facilities around the world.

As desalination technology becomes more widespread, we expect to see more focus on these desal-related businesses and systems:

- **Energy recovery systems** to recapture the high water pressure in the desal process and loop it back into the system, led by private companies Calder AG, Energy Recovery Inc., and Pump Engineering.
- **Zero discharge** regulations are spawning investment in solving this problem.
- **Water Standard** looks to have patent-protection advantages in its business model to retrofitted ocean vessels as floating water desalination plants.

**Filtration/ultrafiltration.** Advances in nanotechnology and materials science are producing more efficient membranes, enabling more efficient and effective water filtration. Key membrane manufacturers include Dow FilmTech, GE, Pall, and 3M (Cuno) and Koch (private). The focus on water reuse is going to put even more emphasis on the membrane technology to ensure adequate filtration is performed. The task of treating the deteriorating US water supply will put even more emphasis filtration technologies in the coming years. Chemical treatments are not considered cost-effective.

**Ultraviolet (UV) light disinfection.** As a cost-effective alternative to chlorine for water disinfection, UV is an attractive $500 million global water subsector that is seeing increased demand. Danaher's Trojan business is considered the market leader, followed by ITT's Wedeco business. We estimate the market is growing 15%-20% and potentially faster. New York City is spending $600 million on its infrastructure upgrade, including new UV treatment systems that will process about 10% of the city's water treatment needs, using Danaher's Trojan equipment. Our survey of the 200 largest US water utilities in 2006 indicated that the growth rate of UV should increase 50%-plus over the next several years, which should translate into 15%-20% annual growth.

**Water test.** Danaher is the number-one manufacturer of the equipment and consumables used to test the quality and safety of water. Federal, state and local governments dictate the frequency and precision of water testing. Danaher's Hach business commands the leading share, estimated at about 25% globally and is about five times larger than its next closest competitor. In a razor-and-razor-blade model, Danaher's high margin consumables drive attractive returns. Homeland security issues with water are also an important market opportunity with its GuardianBlue product-line.

**Automated water meters.** Automated meter technologies are the "cash register" for water utilities. The leaders are Badger, Neptune (Roper), and Itron.

# Determinants of value in the water sector: not all water is equal

**The days are over when a company could just say that it competes in the "water sector" and expect a 20X P/E multiple. Instead, the market now recognizes the spectrum of growth opportunities and water technology content across various water businesses and has become far more discerning in assigning valuation.**

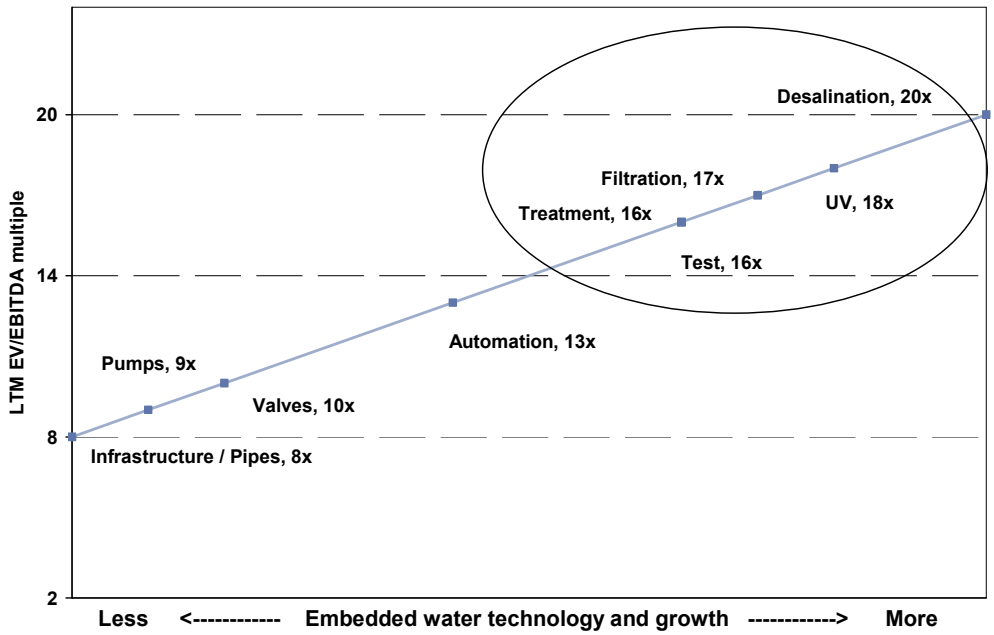
## Goldman Sachs Water Technology Valuation Continuum

**Water valuations have become more application/end market specific.** Today, water valuations hinge on sector-specific growth and water-technology content. Companies can no longer simply say that they compete in the water sector broadly and expect a 20X P/E multiple. The market has become far more discerning about specific water businesses. It factors in the spectrum of growth opportunities and water technology content across various water businesses. For example, pumps and pool and spa are important markets but do not warrant the same valuation as filtration, industrial, test, UV disinfection, reverse osmosis, or desalination. Exhibit 2 details public company valuations across different water segments.

**Technology and growth factors drive value in water.** We have developed our Goldman Sachs Water Technology Valuation Continuum which depicts where each major water subsector resides on an implied valuation continuum. In the past two years, the market has become more discriminating, awarding higher multiples to water businesses with higher growth opportunities and other more proprietary, higher-embedded water-related technology. The implied trailing EBITDA multiples across the water sector have been in a range of 8-20+. In Exhibit 1, we have highlighted the EBITDA multiples for the various water subsectors.

**Exhibit 1: Goldman Sachs water technology valuation continuum**
Implied spectrum of EV/EBITDA for key water technologies

**We see the highest implied valuation ranges for companies positioned at the higher end of the water technology spectrum.**




*Source: Goldman Sachs Research.*

## Exhibit 2: Selected water valuations

| Subsector/company | Ticker | Rating | Price 3/20/2008 | Market Cap ($mil) | Performance YTD | Performance 2007 | Price vs 52-Wk High | EPS Growth 2007 | EPS Growth 2008E | P/E 2008 | P/S 2008 | EV / EBITDA 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Filtration / Treatment** | | | | | | | | | | | | |
| Clarcor Corporation | CLC | NC | $36.97 | $1,818.6 | -2.6% | 12.3% | 84% | 12% | 9% | 18.9X | 1.7X | 10.4X |
| Millipore | MIL | NC | $67.11 | $3,680.1 | -8.3% | 9.9% | 81% | 16% | 7% | 18.6X | 2.3X | 11.4X |
| Pall Corporation | PLL | NC | $37.06 | $4,493.9 | -8.1% | 16.7% | 76% | 22% | 17% | 16.8X | 1.8X | 9.2X |
| Watts Water Technology | WTS | NC | $28.18 | $1,079.2 | -5.4% | -27.5% | 68% | -6% | 10% | 12.1X | 0.8X | 6.6X |
| Calgon Carbon Corporation | CCC | NC | $15.14 | $575.1 | -4.7% | 156.3% | 80% | NA | 28% | 38.3X | 1.5X | 11.5X |
| Layne Christensen | LAYN | NC | $33.68 | $626.3 | -31.6% | 49.9% | 57% | 24% | 10% | 15.2X | 0.7X | 4.9X |
| NALCO | NLC | Neutral | $20.68 | $2,854.5 | -14.5% | 18.2% | 67% | 39% | 10% | 16.1X | 0.7X | 7.7X |
| Kurita Water Technologies | 6370.T | Neutral | $35.84 | $4,513.7 | 24.2% | 31.9% | 90% | 21% | 15% | 24.5X | 2.1X | 10.3X |
| BWT AG | BWTV.VI | Sell | $50.54 | $923.5 | -4.9% | 10.4% | 61% | 12% | 2% | 20.7X | 1.5X | 13.6X |
| Christ Water Technology | CWTE.VI | Buy | $17.44 | $314.1 | 0.4% | 11.5% | 73% | 127% | 102% | 23.7X | 0.6X | 13.0X |
| Hyflux | HYFL.SI | Neutral | $2.36 | $1,240.0 | 6.4% | 46.0% | 46% | 131% | 14% | 37.8X | 5.8X | 26.1X |
| Epure International | EPIL.SI | Buy | $0.38 | $489.0 | -21.8% | 49.3% | 62% | 1% | 43% | 16.3X | 3.7X | 12.4X |
| Sinomem | SINO.SI | Neutral | $0.52 | $241.7 | -15.7% | -5.1% | 44% | -8% | 52% | 10.2X | 1.6X | 5.1X |
| **Filtration / Treatment Mean** | | | | | **-6.7%** | **29.2%** | **68%** | **33%** | **25%** | **20.7X** | **1.9X** | **10.9X** |
| **European Utilities** | | | | | | | | | | | | |
| RWE | RWEG.de | Neutral | $122.45 | $64,093.2 | -12.8% | 27.5% | 54% | 21% | 30% | 11.3X | 0.9X | 4.9X |
| Suez | LYOE.PA | Not Rated | $64.76 | $85,193.2 | -4.7% | 31.4% | 86% | 15% | 7% | 15.4X | 1.1X | 8.5X |
| Veolia Environnement | VIE.PA | Buy | $66.45 | $27,246.1 | -27.0% | 20.9% | 45% | 17% | 12% | 16.9X | 0.5X | 6.6X |
| Severn Trent | SVT.L | Neutral | $27.53 | $6,609.5 | 0.0% | 0.0% | 86% | 7% | 15% | 14.2X | 2.0X | 8.5X |
| **European Utility Mean** | | | | | **-11.1%** | **19.9%** | **68%** | **15%** | **16%** | **14.5X** | **1.1X** | **7.1X** |
| **Large Cap / Diversified Water** | | | | | | | | | | | | |
| General Electric | GE | Buy | $37.49 | $355,458.6 | 1.1% | -0.4% | 89% | 18% | 11% | 15.4X | 1.9X | NM |
| Siemens | SIEGn.DE | Buy | $104.93 | $96,208.7 | -33.3% | 59.7% | 65% | 75% | 6% | 12.6X | 0.8X | 7.1X |
| Danaher | DHR | Neutral | $76.39 | $23,832.9 | -12.9% | 21.1% | 86% | 19% | 14% | 17.5X | 1.9X | 11.3X |
| ITT Corp. | ITT | Neutral | $52.76 | $9,600.8 | -20.1% | 16.2% | 72% | 24% | 10% | 13.6X | 0.9X | 7.9X |
| Pentair | PNR | Neutral | $31.55 | $3,113.6 | -9.4% | 10.9% | 80% | 8% | 8% | 14.0X | 0.9X | 8.3X |
| Roper Industries | ROP | Neutral | $56.68 | $4,981.2 | -9.4% | 24.5% | 80% | 26% | 16% | 18.2X | 2.1X | 9.4X |
| **Large Cap / Diversified Water Mean** | | | | | **-14.0%** | **22.0%** | **79%** | **28%** | **11%** | **15.2X** | **1.4X** | **8.8X** |
| **Pumps / Valves** | | | | | | | | | | | | |
| Crane Co. | CR | Sell | $39.50 | $2,395.5 | -7.9% | 17.1% | 77% | 19% | 7% | 11.6X | 0.8X | 6.4X |
| Flowserve | FLS | NC | $99.63 | $5,598.2 | 3.6% | 90.6% | 89% | 110% | 29% | 18.5X | 1.3X | 10.0X |
| Tyco International | TYC | Sell | $43.48 | $21,027.0 | 9.7% | -16.8% | 80% | 6% | 34% | 15.4X | 1.0X | 7.1X |
| Mueller Water Products | MWA | NC | $8.35 | $897.4 | -12.3% | -36.0% | 43% | -1% | -3% | 15.0X | 0.5X | 6.9X |
| **Pumps / Valves Mean** | | | | | **-1.7%** | **13.7%** | **72%** | **33%** | **17%** | **15.1X** | **0.9X** | **7.6X** |
| **Automation** | | | | | | | | | | | | |
| Emerson Electric | EMR | Buy | $49.07 | $38,216.2 | -13.4% | 28.5% | 83% | 18% | 12% | 15.9X | 1.5X | 8.8X |
| Honeywell | HON | Neutral | $54.29 | $41,142.6 | -11.8% | 36.1% | 87% | 25% | 17% | 14.8X | 1.1X | 8.0X |
| Rockwell Automation | ROK | NC | $54.43 | $7,991.3 | -21.1% | 12.9% | 72% | 12% | 15% | 12.3X | 1.5X | 7.7X |
| **Automation Mean** | | | | | **-15.4%** | **25.8%** | **81%** | **18%** | **14%** | **14.3X** | **1.4X** | **8.2X** |
| **Water Meters / Pipes** | | | | | | | | | | | | |
| Badger Meter | BMI | NC | $42.05 | $592.9 | -6.5% | 62.3% | 91% | 31% | 19% | 28.1X | 2.3X | 13.7X |
| Insituform | INSU | NC | $13.60 | $374.5 | -8.1% | -42.8% | 52% | -77% | 169% | 24.1X | 0.7X | 8.8X |
| Itron | ITRI | NC | $93.63 | $2,807.2 | -2.4% | 85.1% | 83% | 18% | 19% | 27.9X | 1.5X | 14.7X |
| **Water Meters / Pipes** | | | | | **-5.7%** | **34.9%** | **75%** | **-9%** | **69%** | **26.7X** | **1.5X** | **12.4X** |
| **Total water sector mean** | | | | | **-8.9%** | **25.9%** | **72%** | **25%** | **23%** | **18.4X** | **1.5X** | **9.6X** |
| **S&P 500** | **SP50** | | **1,329.51** | | **-9.5%** | **3.5%** | **84%** | **3%** | **6%** | **14.0X** | | |

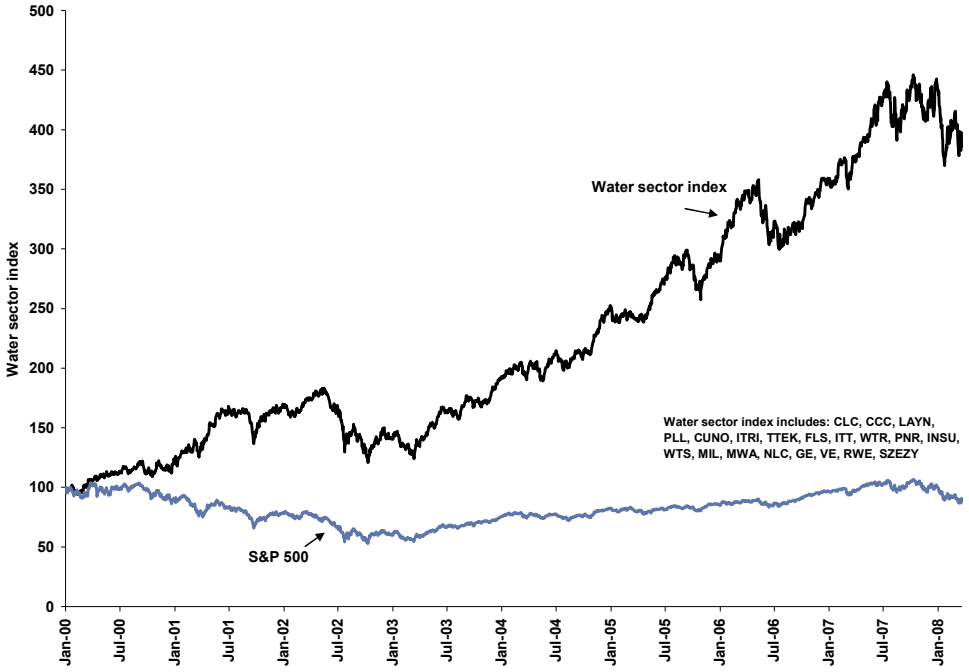
All prices in USD
NC=Not Covered; Estimates for all non-covered companies from Thomson FirstCall
Deane Dray's coverage - General Electric, Danaher, ITT, Pentair, Roper, Crane, Tyco International, Emerson Electric, Honeywell
Bob Koort's coverage - Nalco
Kunio Sakaida's coverage - Kurita Water Technologies
Christina Hee's coverage - Hyflux, Epure International, Sinomem
Deborah Wilkens' coverage - RWE, Suez
Jenny Ping's coverage - Veolia Envrionnement
James Moore's coverage - Siemens
Rudolf Dreyer's coverage - Christ Water Technology, BWT AG
Source: Goldman Sachs Research Estimates, FactSet, Thomson FirstCall

*Source: Goldman Sachs Research estimates, FactSet, Thomson First Call.*

**Making the case for water as defensive growth.** We view the water industry as a key strategic defensive growth sector (i.e., consistent, non-cyclical demand) for many industrial companies. Long-term positive secular trends include worsening supply / demand imbalances and consistent demand through the economic cycle because water is essential to life. Increased maintenance in developed countries, stemming from aging infrastructures and capital projects in developing countries, expanding underdeveloped infrastructures should create a healthy, consistent, demand environment for the industry in the future. There are few pure-plays, but many Multi-Industry companies have a presence in this sector. As shown in Exhibit 3, the equal weighted water sector index has outperformed the S&P 500 in each of the past eight years, with an average outpeformance of 20.2%.

**Since January 2000, the water sector has outperformed the S&P 500 by 299 pp.**

**Exhibit 3: Water sector outperformance relative to the S&P 500**
January 2000 = 100; Equal-weighted performance




*Source: FactSet, Goldman Sachs Research.*

# Goldman Sachs water baskets

We have constructed two equally-weighted tradable indices that provide differentiated opportunities to invest in the water sector. The first basket (perhaps more aptly named "bucket") is an index of the top global water companies with the highest water-related revenue in absolute dollars and is under the Bloomberg ticker GSCBGWAT. The second basket includes the top-tier potential water acquisition targets, in our opinion, and is under ticker GSCBWTCC. The performance of these two baskets relative to the S&P 500 year-to-date and over the last year is outlined in Exhibit 4.

- Top water companies (GSCBGWAT): Veolia Environnement, RWE, Pentair, Mueller Water, ITT, Siemens, GE, Tetra Tech, Watts Water, Danaher, Aqua America, Pall, Rockwell , Millipore, Flowserve, Roper Industries, Emerson Electric, Clarcor, Itron, Crane, Honeywell.

- Potential acquisition candidates (GSCBWTCC): Badger Meter, Calgon Carbon, Clarcor, Pentair, Tetra Tech, Aqua America, Watts Water.

**Exhibit 4: GS Water baskets GSCBGWAT AND GSCBWTCC relative to the S&P 500**

| | Absolute performance | | | Relative performance | |
|---|---|---|---|---|---|
| Period | Top water companies | Acquisition candidates | S&P 500 | Top versus S&P 500 | Acq versus S&P 500 |
| Year-to-date | -11.0% | -8.0% | -9.5% | -1.5pp | 1.4pp |
| 1-year | 9.9% | 2.7% | -5.8% | 15.7pp | 8.4pp |

*Source: Bloomberg, Goldman Sachs Research.*

# Flood of new water ETFs and dedicated water funds

The scarcity of water pure-plays has led to a flood of exchange traded funds seeking to capitalize on water as an investment theme. Within the past two years, we have noted the emergence of at least four exchange traded funds, with assets under management totaling $2.7 billion focused on investing in the water sector. We have also noted several water-only mutual funds. These funds include:

- PowerShares Water Resource Portfolio (PHO).
- PowerShares Global Water Portfolio (PIO).
- Claymore S&P Global Water Index Fund (CGW).
- First Trust ISE Water Index Fund (FIW).
- Pictet Global Water Fund ($5 billion in assets).
- Summit Water Equity Fund.

There are also an estimated $13.5 billion invested in dedicated water funds today, with the Pictet fund as the largest, with $5 billion under management.

# Top global companies in water

**Exhibit 5: Top global companies in water**
Ranked by 2007E water revenues

| | | | | | End market | | | | | | | | | Leverage to water themes | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Company (ticker) | Country | Market Cap $mil | Water as % of Total Revs | 2007E Water Revs $mil | Pumps | Valves | Water test | Water treatment | Industrial treatment | Filtration | Automation systems | Engineering/ consulting | Other water | Aging water infrastructure | Emerging markets | Advanced treatment | Regulatory drivers |
| Veolia Environnement (VE) | France | $27,246 | 34% | $15,180 | | | | 30% | | | | 1% | 3% | | ✓ | ✓ | ✓ |
| Suez (SZE) | France | $85,193 | 16% | $10,800 | | | | 14% | | | | 2% | | | ✓ | ✓ | ✓ |
| Grupo Ferrovial (FER-ES) | Spain | $10,731 | 20% | $4,451 | | | | | | | | 20% | | | ✓ | | |
| Sabesp (SBS) | Brazil | $5,171 | 100% | $3,197 | | | | 100% | | | | | | | ✓ | | |
| Severn Trent (SVT-GB) | UK | $6,610 | 100% | $3,083 | | | | 95% | | | | 5% | | ✓ | | | ✓ |
| RWE (RWEOY) | Germany | $64,093 | 23% | $3,077 | | | | 12% | 11% | | | | | | | ✓ | ✓ |
| ITT Corp. (ITT) | US | $9,601 | 32% | $2,850 | 15% | | | 13% | | 4% | | | | ✓ | | ✓ | ✓ |
| Pentair (PNR) | US | $3,114 | 75% | $2,500 | 30% | | | | | 23% | | | 22% | ✓ | | ✓ | ✓ |
| General Electric (GE) | US | $355,459 | <2% | $2,300 | | | | <1% | <1% | <1% | <1% | | | | ✓ | ✓ | ✓ |
| Mueller Water Products (MWA) | US | $897 | 100% | $1,849 | | 41% | | | | | | | 59% | ✓ | | | |
| Siemens (SI) | Germany | $96,209 | 2% | $1,800 | | | | <1% | <1% | <1% | | | | | ✓ | ✓ | ✓ |
| Kurita (6370.T) | Japan | $4,514 | 88% | $1,566 | | | | 28% | 60% | | | | | | ✓ | ✓ | |
| Nalco (NLC) | US | $2,854 | 40% | $1,550 | | | | | 40% | | | | | | ✓ | ✓ | ✓ |
| Watts Water Technologies (WTS) | US | $1,079 | 100% | $1,382 | 42% | 20% | | | | 18% | | | 20% | ✓ | | | ✓ |
| Danaher (DHR) | US | $23,833 | 12% | $1,200 | | | 8% | 2% | 2% | | | | | | | ✓ | ✓ |
| Ebara (6361.T) | Japan | $1,126 | 25% | $1,180 | 15% | | | | | 10% | | | | ✓ | | ✓ | |
| Copasa (CSMG3) | Brazil | $1,797 | 100% | $1,000 | | | | 100% | | | | | | ✓ | ✓ | | |
| Acciona (ANA-ES) | Spain | $16,728 | 9% | $965 | | | | | | | | 9% | | | ✓ | | |
| Tetra Tech (TTEK) | US | $1,059 | 85% | $850 | | | | | | | | 85% | | ✓ | | | ✓ |
| Organo Corp. (6368.T) | Japan | $497 | 100% | $815 | | | | 80% | | 20% | | | | | | | |
| Tyco International (TYC) | US | $21,027 | 6% | $765 | | 4% | | | 2% | | | | | ✓ | | | ✓ |
| Doosan Heavy (034020.KS) | South Korea | $12,672 | 18% | $750 | | | | | | | | 18% | | | ✓ | ✓ | |
| Guangdong Investment (270.HK) | China | $3,113 | 87% | $714 | | | | 87% | | | | | | | ✓ | | |
| AECOM Technology (ACM) | US | $2,356 | 15% | $650 | | | | | | | | 15% | | ✓ | ✓ | | |
| Aqua America (WTR) | US | $2,477 | 100% | $600 | | | | 100% | | | | | | | | ✓ | ✓ |
| Insituform (INSU) | US | $375 | 100% | $560 | | | | | | | | | 100% | ✓ | | | ✓ |
| BWT AG (BWTV.VI) | Austria | $924 | 100% | $552 | | | | | | 100% | | | | | | | |
| Layne Christensen (LAYN) | US | $626 | 75% | $532 | | | | 6% | | | | 31% | 38% | ✓ | | | ✓ |
| Cardo (CARD.ST) | Sweden | $791 | 29% | $450 | | | | 29% | | | | | | | ✓ | ✓ | |
| Itron (ITRI) | US | $2,807 | 30% | $430 | | | | | | | | | 30% | | | | ✓ |
| Dow Chemical (DOW) | US | $34,239 | <1% | $400 | | | | <1% | | <1% | | | | | | ✓ | ✓ |
| Pall Corporation (PLL) | US | $4,494 | 18% | $400 | | | | | | 18% | | | | | | ✓ | ✓ |
| Valmont Industries (VMI) | US | $2,060 | 26% | $389 | | | | | | | | | 29% | | ✓ | | |
| Christ Water Technology (CWTE.VI) | Austria | $314 | 100% | $370 | | | | 32% | 68% | | | | | | ✓ | | |
| Roper Industries (ROP) | US | $4,981 | 17% | $350 | 4% | 3% | | | | | | | 12% | ✓ | | ✓ | ✓ |
| GLV Inc. (LVG.A-CA) | Canada | $369 | 49% | $330 | | | | 32% | 17% | | | | | | | ✓ | |
| Millipore (MIL) | US | $3,680 | 20% | $310 | | | | | | 20% | | | | | | ✓ | ✓ |
| Flowserve Corporation (FLS) | US | $5,598 | 7% | $255 | 3% | 3% | | | | | | | 1% | ✓ | ✓ | | ✓ |
| 3M (MMM) | US | $56,357 | 1% | $250 | | | | | | 1% | | | | ✓ | | ✓ | ✓ |
| Bio-Treat Technology (BIOT.SI) | Singapore | $367 | 100% | $228 | | | | 100% | | | | | | | ✓ | ✓ | ✓ |
| Lindsay Corp. (LNN) | US | $1,062 | 76% | $217 | | | | | | | | | 76% | | ✓ | | |
| Clarcor (CLC) | US | $1,819 | 22% | $200 | | | | | | 22% | | | | | | ✓ | ✓ |
| Rockwell Automation (ROK) | US | $7,991 | 4% | $200 | | | | | | | 4% | | | | | | ✓ |
| Jain Irrigation (500219-IN) | India | $937 | 45% | $200 | | | | | | | | | 45% | | ✓ | | |
| Badger Meter (BMI) | US | $593 | 75% | $175 | | | | | | | | | 75% | | | | ✓ |
| Crane (CR) | US | $2,396 | 6% | $175 | 1% | 5% | | | | | | | | | | | |
| Calgon Carbon Corporation (CCC) | US | $575 | 50% | $175 | | | | 40% | | 10% | | | | | | ✓ | ✓ |
| Emerson Electric (EMR) | US | $38,216 | <1% | $170 | <1% | <1% | | | | | <1% | | <1% | ✓ | ✓ | | ✓ |
| Hyflux (600.SI) | Singapore | $1,240 | 100% | $145 | | | | | | 100% | | | | | ✓ | ✓ | ✓ |
| United Technologies (UTX) | US | $67,629 | <1% | $135 | <1% | | | | | | <1% | | | ✓ | | | ✓ |
| Honeywell (HON) | US | $41,143 | <1% | $135 | | <1% | <1% | | | | <1% | | | ✓ | | | ✓ |
| Tianjin Capital (1065.HK) | China | $634 | 100% | $126 | | | | 100% | | | | | | | ✓ | | ✓ |
| Shanghai Raw Water (600649-CN) | China | $4,074 | 77% | $117 | | | | 77% | | | | | | | ✓ | | ✓ |
| Beijing Capital (600008-CN) | China | $5,046 | 75% | $105 | | | | 75% | | | | | | | ✓ | | ✓ |
| Sinomem (SINO.SI) | Singapore | $242 | 100% | $65 | | | | | 100% | | | | | | ✓ | ✓ | ✓ |

*Source: Goldman Sachs Research estimates, company data, FactSet.*

# M&A activity in the water sector should continue to ebb and flow

**Because of its compelling defensive growth characteristics, we view the water industry as a key strategic imperative for many multi-industry companies and we expect to see further investment and consolidation in the sector. That said, valuations remain elevated by historical standards, which may limit near-term consolidation activity.**

## Water sector should continue to have healthy deal flow

The well-capitalized global companies, such as GE, Danaher, ITT, and Siemens, have all been active acquirers in water assets over the past five years. As a consequence, there are few attractive water pure-plays left in the market.

**Watershed transactions.** Key transactions in the water sector include:

- GE's $700 million acquisition of Zenon in 2006.
- 3M's acquisition of Cuno in 2005 for $1.35 billion.
- Pentair's purchase of WICOR for $875 million in 2004.
- Clayton, Dubilier & Rice's purchase of Culligan for $610 million in 2004.
- GE's purchase of Ionics for $1.4 billion in 2004, and Siemens acquisition of USFilter for $1 billion in 2004.
- Blackstone's purchase of Nalco for $2.6 billion in 2002.

Multiples have ranged from 0.8X to 3.6X price-to-sales and 7.2X to 27.0X price-to-EBITDA, depending on the level of proprietary, higher-embedded water technology and growth prospects. Exhibit 6 details some of the key deals in the sector.

## Exhibit 6: M&A Transactions in the water sector

| Date | Target | Acquirer | Target Description | Market Presence | Ent Value ($mm) | LTM Multiples Sales | LTM Multiples EBITDA |
|---|---|---|---|---|---|---|---|
| 2007 | Chemtreat | Danaher | Chemtreat is a leading provider of industrial water treatment products and services. | Treatment | $435 | 1.9X | 10.0X |
| 2006 | Thames Water | Kemble Water | Thames Water is the largest water and wastewater services in the UK. It provides drinking water to eight million people and sewage services to 13 million customers. | Infrastructure | $9,600 | NA | NA |
| 2006 | Jacuzzi Brands | Private Equity | Manufactures bath and plumbing products for residential, commercial, and institutional applications. | Infrastructure | $1,250 | 1.0X | 9.8X |
| 2006 | AWG | Private Equity | One of the largest UK-based publicly traded water and wastewater utilities. | Water utility | $4,210 | 1.4X | 7.2X |
| 2006 | Omex Environmental | Dow Chemical | Omex Environmental manufactures pure and ultrapure water treatment technologies, including ultrafiltration, microfiltration, and reverse osmosis systems. | Treatment | $60 | 3.0X | NA |
| 2006 | Pridesa | Acciona | Pridesa is a leading spanish designer and operator of water and wastewater treatment facilities, including the largest installed desalination capacity in Spain. | Desalination | $210 | NA | NA |
| 2006 | Marsh-McBirney | Danaher | Marsh-McBirney provides flow measurement solutions for water and wastewater applications. | Measurement | $25 | 2.5X | NA |
| 2006 | Zenon Environmental | GE | Zenon's proprietary, cost-effective, microfiltration and ultrafiltratrion membranes are used in municipal water and wastewater treatment, industry, and land development. | Filtration | $700 | 3.2X | NA |
| 2005 | Aquafine | Danaher | Aquafine is a manufacturer of systems and equipment for treatment of water using ultraviolet light and ozone for both industrial and commercial applications. | Treatment | $45 | 3.0X | NA |
| 2005 | National Waterworks | Home Depot | Leading distributor of products used to build, repair and maintain water and wastewater distribution systems. | Infrastructure | $1,300 | 0.9X | 10.0X |
| 2005 | Cuno | 3M | Cuno, headquartered in Meriden, Connecticut, is a leader in commercial and residential. | Filtration | $1,350 | 3.6X | 18.0X |
| 2004 | Ionics | GE | Ionics, headquartered in Watertown, Massachusetts, is a leader in water desalination. | Desalination | $1,400 | 3.0X | 15.9X |
| 2004 | Trojan Technologies | Danaher | Trojan Technologies, headquartered in London, Ontario, specializes in the design and manufacturing of ultraviolet water treatment systems for municipal water and wastewater disinfection and for industrial, commercial and residential users. | Treatment | $189 | 2.0X | 27.0X |
| 2004 | Culligan | CD&R | Culligan provides bottled water, vended water, home water treatment and commercial water treatment systems for business and industry. | Filtration | $610 | 0.8X | NA |
| 2004 | US Filter - Industrial Sltns and Services Group | Siemens | US Filter - Industrial Solutions and Services Group provides equipment and water systems for municipal drinking water and wastewater, industrial process water and wastewater treatment. | Treatment | $993 | 0.8X | NA |
| 2004 | WICOR Industries | Pentair | WICOR, a subsidiary of Wisconsin Energy manufactures pumps, water treatment products and fluid handling equipment with three divisions: Sta-Rite, SHURflo, Hypro. | Pumps, treatment, and fluid handling | $874 | 1.2X | 9.9X |
| 2004 | WTC Industries | Cuno | WTC Industries designs and manufactures water filtration products for point-of-use applications. | Filtration | $110 | 3.3X | 15.6X |
| 2003 | Everpure | Pentair | Everpure makes water filtration products for commercial and consumer sectors and sells them throughout North America, Europe and Asia. More than 70% of revenues come from the sales of replacement cartridges. | Filtration | $215 | 3.6X | NA |
| 2003 | Ecolochem | Ionics | Ecolochem, a privately held company headquartered in Norfolk, VA, is a leading provider of emergency, short and long-term mobile water treatment services to power, petrochemical and other industries. | Treatment | $338 | 3.1X | 8.4X |
| 2003 | WEDECO | ITT | WEDECO is a leading manufacturer of systems and equipment for treatment of water using ultraviolet light and ozone. | Treatment | $268 | 1.6X | 19.3X |
| 2002 | Osmonics | GE | Osmonics manufactures water purification and filtration equipment and components including process water (42% of revenue), filtration and separations (40%) and household water (18%). | Treatment | $278 | 1.3X | 11.8X |
| 2002 | US Filter Corp – Filtration and Separation Group | Pall | US Filter – Filtration and Separation Group makes filter elements (78% of sales), housings (8%) and systems (14%) for filtration of liquids & gases. Customers: Industrial (49%), Food & Beverage (36%), Healthcare (9%) & Electronics (7%). | Filtration | $360 | 1.3X | NA |
| 2002 | BetzDearborn | GE | BetzDearborn is the second largest industrial water treatment service business in the world, providing engineered chemical treatment of water and process systems for industrial, commercial, and institutional customers. | Treatment | $1,800 | 2.1X | 12.0X |
| 1999 | Essef | Pentair | Essef is in three segments: Swimming Pool and Spa Equipment (44% of sales), Water Treatment and Systems Equipment (23%) and Swimming Pool Sales and Installation (33%). | Pool | $404 | 1.3X | 8.8X |
| 1999 | Hach | Danaher | Hach manufactures lab instruments, including reagents and chemicals (32% of sales), laboratory and portable instruments (31%), process analyzers (15%), test kits (12%) and other (10%). | Test | $363 | 2.7X | 13.4X |
| 1999 | US Filter Corp | Vivendi | US Filter designs, manufactures, operates, distributes and services equipment and supplies for filtration, water and wastewater treatment for industrial, municipal, commercial and retail clients. | Filtration and treatment | $7,728 | 1.9X | 15.4X |
| 1998 | Culligan | US Filter Corp | Culligan provides bottled water, vended water, home water treatment, and commercial water treatment systems for business and industry. | Filtration | $1,587 | 3.5X | 16.2X |
| | | | | | **High** | **3.6X** | **27.0X** |
| | | | | | **Mean** | **2.2X** | **13.7X** |
| | | | | | **Median** | **2.0X** | **12.7X** |
| | | | | | **Low** | **0.8X** | **7.2X** |

*Source: Goldman Sachs Research, FactSet.*

# Supply & demand dynamics of water

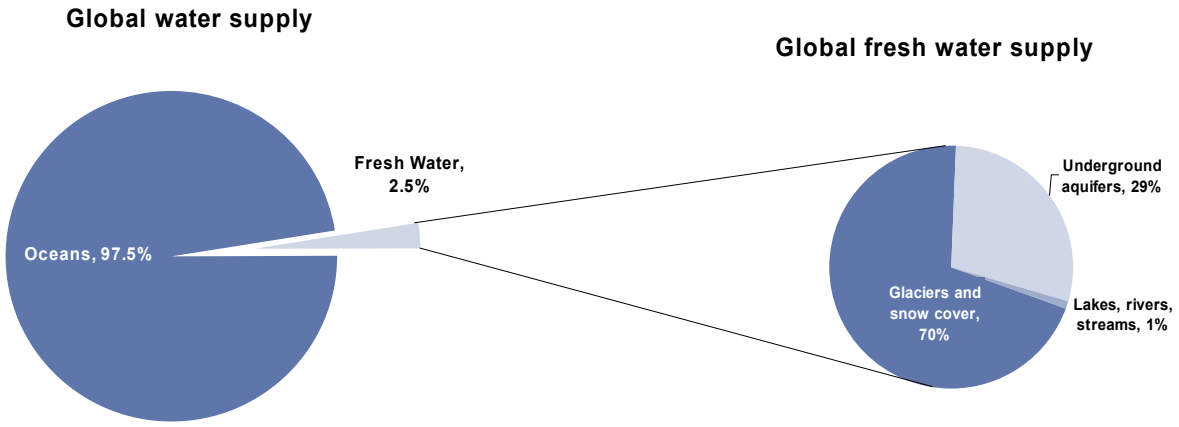
**Demand for water, the natural resource with no substitute, continues to outstrip the ability of the natural water systems to recharge it. In the United States, water demand has tripled in the past 30 years while the population has grown just 50%. The world's fresh water supply is shrinking due to pollution and the draining of underground aquifers. The Malthusian economics are simple but alarming. Given current trends, by 2025, it is estimated that about one-third of the world's population will not have access to adequate drinking water.**

## Water, water everywhere but....

In a world three-quarters covered by water, an alarmingly 20% of the population does not have access to fresh drinking water. Further, according to the United Nations (UN), 40% of the population today is subject to the sanitation health risks associated with inadequately treated wastewater. Fresh water is facing acute supply and demand imbalances that are being strained by the world's growing population. At the same time that demand for fresh water is increasing, the supply is decreasing from biological and industrial contamination.

As shown in Exhibit 7, water covers nearly three-fourths of the Earth's surface, but over 97.5% of the Earth's water is salt water. This means that only 2.5% of the Earth's total water supply is fresh water. However, 70% of this fresh water supply is permanently frozen in the polar ice caps and glaciers. Another 29% of the fresh water supply is stored in underground aquifers (also referred to as ground water). **This means that the surface water in lakes, rivers, and streams constitutes less than 1% of the world's fresh water supply.**

**Exhibit 7: Global sources of water**



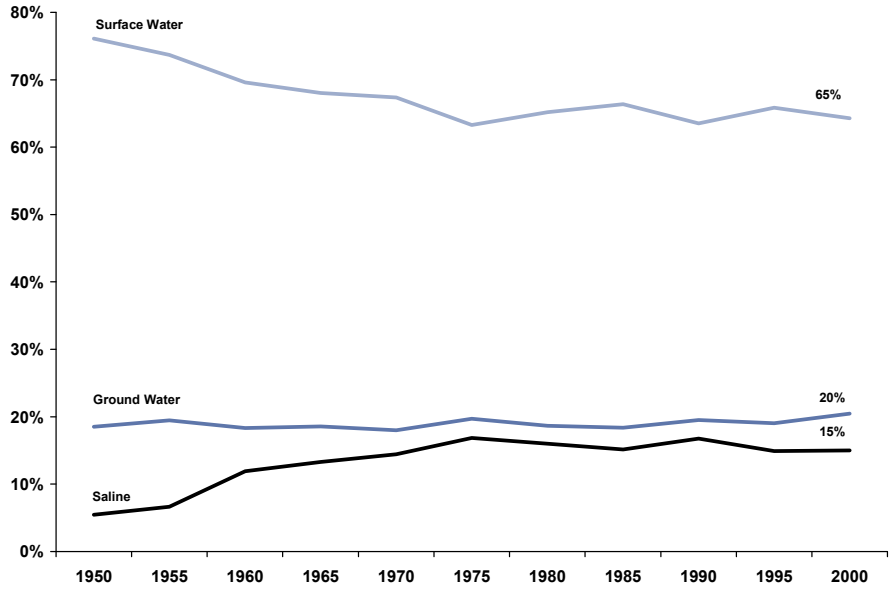

*Source: United Nations.*

The common misperception is that surface water is more abundant than ground water, simply because it is visible to the eye. The fact is that ground water is about 30 times more plentiful than surface water. But ground water is often not economically accessible, as it can lie in aquifers thousands of feet below the surface. Ground water is also an important source of surface water as it populates streams, lakes, and wetlands.

## Supply of fresh water

Even though ground water in aquifers is 30 times more plentiful that surface water, more fresh water in the United States is supplied from surface water than from ground water. Exhibit 8 details the composition of sources of water in the United States since 1950.

**Exhibit 8: Change in source of US water supply since 1950**




*Source: US Department of the Interior.*

**Surface water (65% of total water withdrawal in the United States).** Water in US rivers, streams, creeks, lakes and reservoirs provided 65% of the total water and 75% of the fresh water in the United States in 2000. The biggest user of fresh surface water is the thermoelectric power industry, primarily for cooling equipment, but most of this water is returned to the environment and only a small amount is consumed (evaporated). Conversely, nearly all of the fresh water used in irrigation is never returned to the water supply, and an estimated 55% of irrigated water is lost through leaks and evaporation.

- The majority of the large cities in the United States use surface water as their primary source of water. For example, New York City draws most of its water from reservoirs in upstate New York, which store about 500 days of water.
- There are many large multi-billion water re-channeling projects currently under construction in China (Yangtze), India, and Spain.

**Ground water (20% of total water withdrawal in the United States).** Water beneath the land surface is in two principal zones – unsaturated and saturated. Unsaturated zone water cannot be accessed for the drinking water supply because it has not "pooled" into the aquifers. Saturated zone water is fresh ground water that is layered within the soil and rock of an aquifer and provides 25% of fresh water withdrawals in the United States. Most small US towns use ground water as their primary water supply. Ground water is usually cleaner than surface water because of the natural filtration and purification processes that occur in the ground. However, nature's filtration processes can be neutralized by sewage, fertilizers, or toxic chemicals that seep into the ground. The biggest consumer of fresh ground water in the United States is irrigation. This water is mostly consumed, with very little returned to the environment.

**In the United States, about 15% of the population gets its drinking water from private wells.**

- There is an increasing awareness of the problem of the draining of underground aquifers at rates far above nature's ability to replenish/recharge them. Over-exploited aquifer conditions have been documented in eleven countries, including the United States, China, India, Spain, and Israel. This negative groundwater imbalance is occurring in regions representing half the global population.
- In the United States, the Ogallala aquifer is the third largest underground water table in the world. It runs 800 miles from the Texas Panhandle to South Dakota. Through unchecked depletion, this aquifer is not able to recharge and it is reportedly on pace to be pumped dry in 20-30 years.

**Saline/brackish (15% of total water withdrawal in the United States).** Saline is an alternate source of fresh water in the United States. In 2000, fresh water withdrawals represented 85% of total water withdrawals and the remaining 15% was saline. Saline water has different levels of concentrated dissolved salts. Slightly salinated water can be used for purposes similar to fresh water, such as the feed water for some industry and power generation applications. Saline surface water has become a higher percentage of total water withdrawals, as power generation and mining continually leverage this source. Saline water is usually drawn as surface water but it can also be pumped from the ground. Either way, saline or brackish water must then undergo a process of desalination. The US Geological Survey sets the parameters for classifying fresh and saline water. Fresh water has less than 1,000 parts per million (ppm) of salt, while highly salinated water has from 10,000 ppm to 35,000 ppm. As a comparison, ocean water contains about 35,000 ppm of salt.

**Today, there are about 13,000 desal plants generating 3% of the global water supply. This could become more than 5% by 2015.**

- **Desalination** involves removing dissolved minerals from seawater and brackish water (a mixture of fresh water and ocean water) and is an increasingly important source of fresh water. We expect desalination to be one of the primary long-term solutions to meet the needs of the costal population for water. Given the vast amounts of salt water, coupled with the stress on accessible fresh water, this is a technology that should be leveraged going forward. In the Middle East, largely in Saudi Arabia, desalination plants satisfy about 70% of the region's fresh water needs from 30 plants, half of which are run by private contractors. In California, there are 15 new desal plants in the design phase or already under construction.

**Reused water** is reclaimed water that is treated using advanced water treatment techniques, such as filtration, carbon adsorption, distillation, and reverse osmosis, that enable waste water to be reused for landscaping, irrigation, heating, cooling, and even for potable (drinking) water. This area could also become a more important future source of water. Today, only about 6% of municipal wastewater in the United States is reused.

**Ultrapure water** is often confused with fresh water, but is actually much different from a chemical and purity standpoint. Ultrapure water does not occur naturally. It requires a rigorous multi-stage treatment process to reach the chemical stage of ultrapure. These steps include membrane filtration (typically reverse osmosis, RO), ion exchange, ozone systems and electro deionization. As ultrapure, the water contains no-to-very low concentrations of salts, organic components, oxygen, and suspended solids or bacteria.

Ultrapure water is used in the semiconductor, power, steel, and pharmaceutical industries. As an example, ultrapure water is used to slice silicon wafers as a process in fabricating integrated circuits. It is also the primary solvent used to rinse away contaminants and remnants of silicon etched away in production. Integrated circuits are so minute and complex that even a small contaminant can hinder the operation of a circuit. The power industry is the second biggest consumer of ultrapure water, due to the need for the steam driving the turbines to be completely free of impurities. Water quality in power applications is controlled by monitoring resistivity/conductivity and pH. Small deviations from the mean can cause significant downtime and be costly.

## New dimensions of the water pollution equation

The US EPA now requires the nation's 54,000 water utilities to test for nearly 100 known contaminants. Today, there are also a disturbing number of household and pharmaceutical compounds showing up in water systems, including aspirin, caffeine, and even animal growth hormones from farmland water runoff. These "emerging contaminants" include endocrine-active components, and are referred to as PPCP (pharmaceutical and personal care products). Some of this is organic matter, worsened by run-off from over-fertilized farmland. Acid rain adds to the problem, too. Industrial discharge adds heavy metals to the pollution mix. The present water and waste water treatment systems were never intended to filter these new micro-pollutants and compounds. The EPA is struggling to set standards for these new pollutants and then the utilities have to be equipped to filter out these contaminants. This trend toward increased water testing standards directly benefits the companies providing test equipment and services. Water test companies should continue to be a focus, with Danaher's Hach business as the market leader. The tighter quality standards favor the membrane manufacturers like Dow, Pall, and GE. Alternative disinfection systems such as ozone purification systems may also be necessary.

## Climate change as part of the problem

Any understanding of water scarcity issues needs to include the impact of climate change. The impacts vary region by region. On the "too much of a good thing" side, there are tropical regions in the world that are expected to see 10%-40% increases in water runoff, creating a different set of water management challenges. On the scarcity side, water stored in glaciers and snowpacks is declining, leading to less melt-runoff. The Western United States have suffered several years of reduced snowmelt feeding into the Colorado River System, lowering the water levels of Lake Mead and Lake Powell to half full, 50+ feet below average. Since 1999, there has only been one year of above-average rainfall in this Southwest region. Other regions experiencing major multi-year droughts globally include Israel and eastern Australia.

## Water rights emerging as market-based supply solution

Healthy population growth and the unique water usage laws in the western United States have led to the emergence of local and regional markets for water rights. Water use in the western states is driven primarily by the "prior appropriation" system. Under this approach, a person whose appropriation is "first-in-time" is more senior than that of someone who secures a water right later. In contrast to the east, where all owners along a waterway must reduce their water use during times of water scarcity, senior rights in the west must be honored before junior rights are satisfied. During periods of severe drought, the appropriation system can lead to holders of junior rights having no water at all. In the past, conflicts over water in the western United States have been related to surface water rights. Today, disputes are also arising over water stored in deep, underground aquifers, which in the past were often not accessible.

## Water infrastructure basics

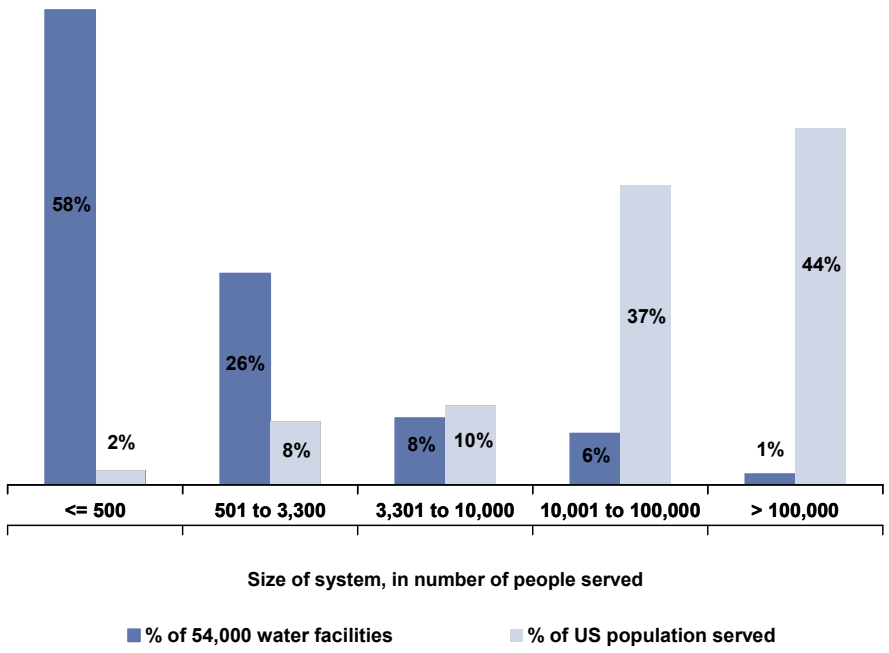
The US water network is considered the world standard, with drinking water infrastructure spanning more than 700,000 miles of pipe system, or four times longer than the National Highway System. However, aging infrastructure, chronic underinvestment, and ever-increasing volume demands threaten the health of water bodies across the country. The reality is that many US drinking water and sewage pipes were installed 50 to 100 years ago and are at, or well beyond, their expected useful life. In New York City, the travel

interruptions and street closures caused by water main breaks are nearly a daily occurrence. Many of these New York City water mains are approaching 100 years old.

**Infrastructure funding.** The funding for infrastructure projects is separate from general government budgets and is generally not impacted by tax revenue shortfalls. Municipalities usually finance capital projects with revenue bonds, which typically carry rates lower than municipal bonds.

**Role of the EPA.** The EPA regulates drinking water systems that supply a minimum of 25 people or 15 facilities. In an example of extreme decentralization, there are about 54,000 community drinking water systems subject to the EPA regulations that provide drinking water to the US population. This implies that Federal and state governments control about 80% of the US water supply. Exhibit 9 details the municipal and private water facilities relative to the population they serve. This exhibit highlights that about 3,800 of the larger municipal and private water facilities serve 80% of the population. In addition to the 54,000 community drinking water systems, there are 16,000 municipal wastewater treatment plants in the United States.

**Exhibit 9: US municipal and private water facilities relative to population served**
54,000 facilities in the US serve about 250 million people




*Source: Environmental Protection Agency.*

## Navigating the various sources of water demand

**Population and economic shifts.** Populations in some regions are growing 1% to 3% per year, while fresh water supplies remain constant or decline. It took mankind more than 10,000 years on Earth, until about 1800, to total one billion people. The two billion mark was reached 150 years later in 1950 and accelerated to 6.1 billion by 2000. A famed economist in the late 1700s, Thomas Malthus, hypothesized that population growth unchecked by environmental or social constraints could double every 25 years and that population growth would eventually outstrip the world's ability to feed itself. Perhaps Malthus could be right about the supply and demand of water. Populations double in

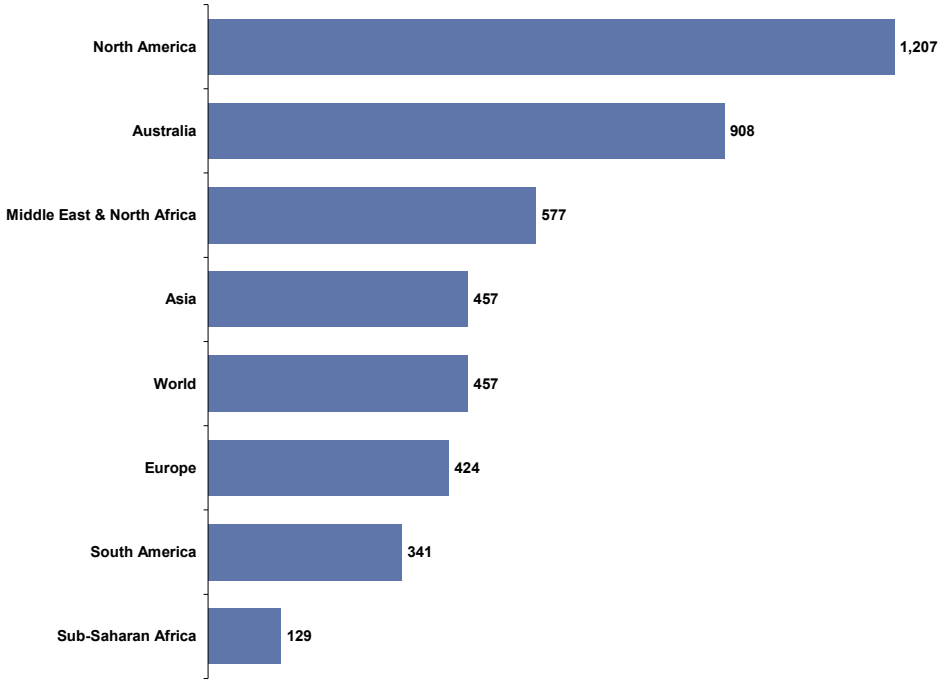
already water-stressed countries, such as Africa, every 20 years. Today, an estimated 2.4 billion people do not have access to adequate safe drinking water and sanitation.

- Urbanization is another megatrend that is stressing water infrastructure. More of the world's population is moving to cities, especially near coastal regions. According to the UN, 29% of the global population lived in urban regions in 1950 and an estimated 60% will be in cities by 2030.

**Higher standard of living also drives water consumption.** In addition to population increases, higher living standards are causing an increase in the per capita use of water. As nations shift from agrarian economies to more of an industrialized focus, per-capita water use increases. Additionally, as developing countries reach higher standards of living, per capita water consumptions typically increase. Exhibit 10 profiles aggregate daily water withdrawals per capita in certain regions (in gallons) for residential, industrial, and agricultural use. This analysis also highlights the disparity between regions and level of development. North America uses about nine-times as much water as Sub-Saharan Africa, mostly in agriculture and industrial demand, and three times as much as Europe. Agriculture accounts for about 40% of North America's use, but 80% of Africa's water use.

**Exhibit 10: Aggregate daily water withdrawal per capita for all uses**
gallons per day

**Aggregate daily water withdrawal per capita in certain regions (in gallons) includes residential, industrial, and agricultural withdrawals.**



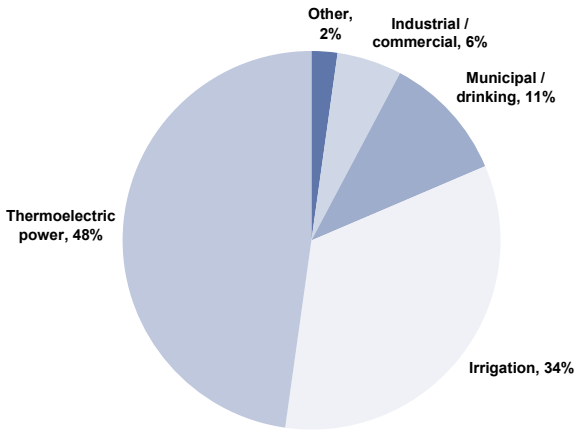

*Source: World Resources Institute.*

**Globally, water consumption is doubling every 20 years, more than 2X population growth.**

**US water demand has tripled in 30 years, while the population has grown just 50%.** The western US region uses more water than any other region because of agriculture. For example, in 1985, daily water usage per person in Idaho was 22,200 gallons versus 152 gallons in Rhode Island. This gap is almost entirely due to irrigation. Exhibit 11 details the sources of water demand in the United States. Water demand in the United States over the last 20 to 30 years has shifted with the economy. As the economy becomes more service-oriented, thermoelectric power represents a greater percent of demand. Conversely, as the US manufacturing base continues to shrink, industrial demand

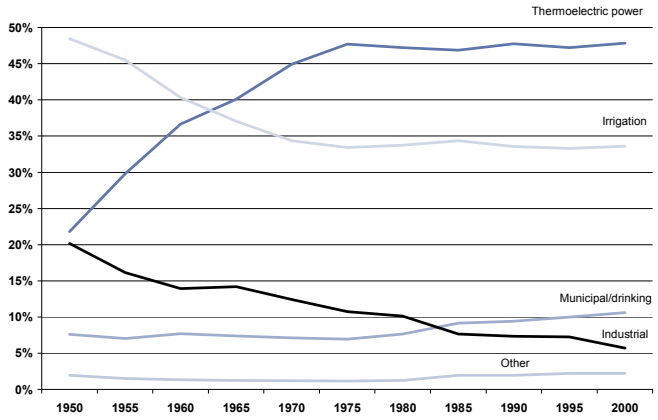
for water should decline. Exhibit 12 details changes in sources of water demand in the United States since 1950.

**Exhibit 11: Sources of water demand in the United States**




*Source: US Department of the Interior.*

**Exhibit 12: Changes in source of water demand in the US**

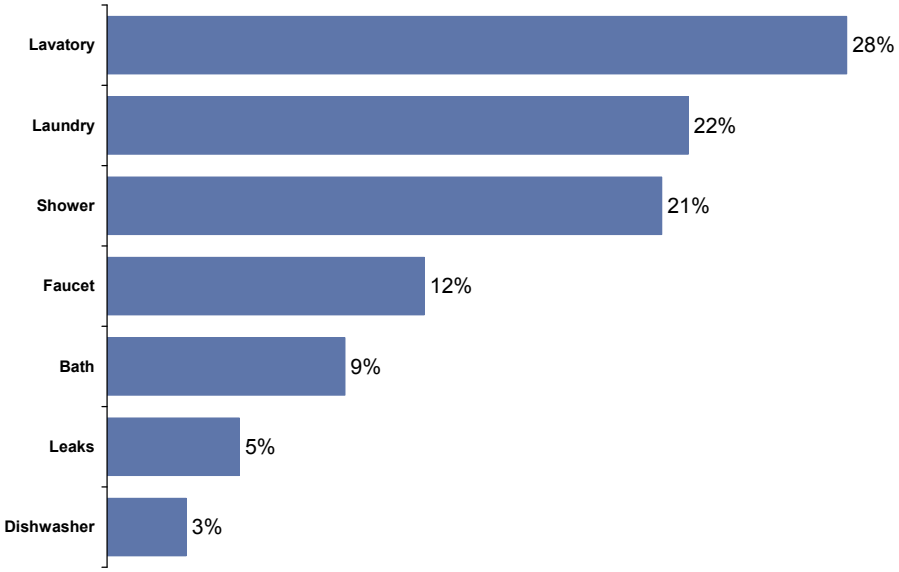



*Source: US Department of the Interior.*

**More efficient toilets and washers offer significant opportunity to reduce household water consumption.**

**According to the EPA, an average US residence uses about 100-150 gallons of water a day per person, Europeans use an average of 74 gallons, Africans use about 17 gallons and the Chinese about 23 gallons each.** The Swiss are recognized for being the most water-conservation conscious. The average Swiss citizen has cut personal water use to about 35 gallons daily. Usage in the United States varies by region with the West being about 50% higher than the East due to irrigation. Exhibit 13 details indoor water use in the United States.

**Exhibit 13: Indoor water use in the United States**



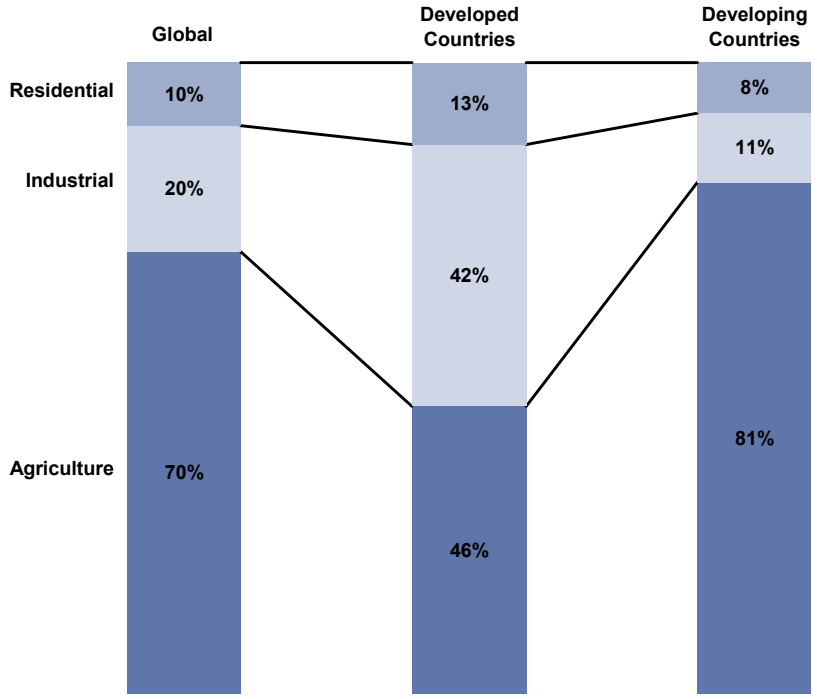

*Source: Environmental Protection Agency.*

## Global water demand

Exhibit 14 details competing water use globally, in developing and developed countries.

**Developed countries demand the most industrial water at 42%, while developing countries still have the highest-demand agricultural use.**

**Exhibit 14: Global profiles of water uses**




*Source: UN Water Development.*

## Agriculture demand

**Farmland water efficiency: bio-ag initiatives, fertilizers, irrigation systems.** Given that agriculture represents 70% of global water demand, there is a great deal of focus on improving the water efficiency of farming. There is expected to be a 20% increase in land allocated to farming by 2030, with water demand increasing 14%, according to the UN. On the bio-ag side, there are ongoing initiatives to develop drought-resistant seeds/plants and more efficient slow-release fertilizers. The heightened appetite for bio-diesel fuel is another point of demand for water. With regard to irrigation systems, the old world practice of flood irrigation is highly inefficient, with less than 55% of water reaching the plant root zone. Sprinkler irrigation is noticeable more efficient, with 50%-70% of water reaching the root zone, with micro / drip irrigation getting in excess of 90% of water to the roots.

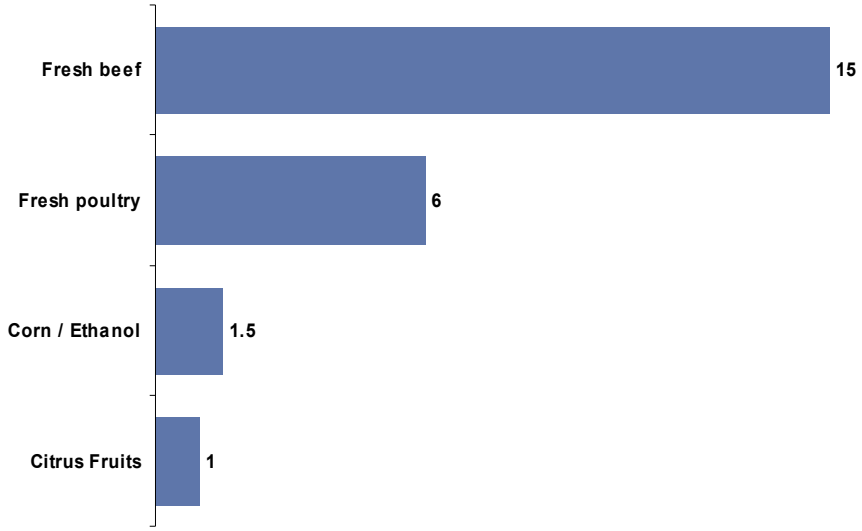
**70% of all water used globally is for agriculture and an estimated 55% of traditional irrigation water is wasted.**

**We expect 20%+ growth in micro / drip irrigation systems that are 30%-70% more efficient versus conventional ditch or sprinklers.** Irrigation is influenced by the climate, crop type, efficiency, and energy costs. Applications include filtering, sprinklers, and spray nozzles. Financing initiatives for farmers is the determining factor in how widespread these new systems can be. Micro-irrigation can cost as much as three times sprinklers per acre, making it most justifiable for fruit and other high-end crops.

> *Irrigation is a $4 billion market spanning across commercial, residential, and industrial markets. Competitors include Valmont Industries (Valley), Lindsey Corp., and Jain Irrigation. We would note recent activity by John Deere in this space, where it acquired Roberts Irrigation in 2007.*

**Embedded water analysis aimed at conservation measures and a better allocation of resources.** There is extensive research available on the amount of water used to manufacture selected products or to grow certain foods (see Exhibit 15). This includes the analysis of how it takes 250 gallons of water to produce two pounds of bread. In China, it was taking 2,400 units of water to make one unit of corn-based ethanol. And it takes 12 barrels of water to produce one barrel of oil.

**Exhibit 15: Water requirement equivalent of main food products**
Cubic meters of water per kg of food products




*Source: United Nations, Goldman Sachs Research.*

**It can be argued that people may use as much or even more water *indirectly* using electricity than *directly* taking showers and watering lawns.**

## Industrial water demand and uses

**Industrial/commercial** water is used for fabricating, processing, washing, cooling, transporting, and in production. This segment has declined from 20% in 1950 to 6% in 2000, due to conservation, efficiency, and new technology. The secular erosion in manufacturing has also fueled the decline in this segment. An example of a commercial application is Pentair's filtration equipment used to purify the water in Starbucks' coffee. This segment also includes water in beverages. For example, diet soda is 98% water.

**Semiconductors** need ultrapure water in its manufacturing process to treat semiconductor wafer crystals. Related services for semiconductors include the treatment of the wastewater created in the manufacturing process before it is released from the manufacturing facility.

**Pharmaceuticals** require several water applications including ultrapure water for injection, sterile water, and wastewater treatment. Related services are also required. For example, the pipes that are used to transport the ultrapure water have to be disinfected and sanitized.

**Trends in industrial water use: more conservation, more shifting to low-cost countries.** As manufacturing continues its shift to less developed countries, additional burdens are being placed on already taxed infrastructures. Compounding this trend, water supplies in less developed countries are being contaminated by industrial waste and sewage.

In developed countries, there is a sense that industrial water use is stabilizing. This is due to measures of efficiency and the ongoing trend to shift more manufacturing resources to low cost countries. The worry here is that developing markets tend to be far less committed to industrial waste water treatment. In addition, insufficient access to fresh water supplies will impede shifts of manufacturing to low cost regions, especially in water dependent industries such as semiconductor, chemical/petrochemical, and beverage. Coke and Pepsi have faced well publicized issues in their difficulties in locating some bottling plants due to contaminated or insufficient water sources.

## Power industry demand for water

**Thermoelectric power** is energy, generated from heat sources such as coal, natural gas, and oil, that converts ultrapure water into high-pressure steam that drive turbines. After the steam has been cycled, it is cooled and condensed back into water, and then reheated to drive turbines once again. Closed-cycle and once-through are two types of cooling methodologies. Cooling methods, such as closed-cycle, that require less water, enable thermoelectric power production where water is scarce. However, once-through systems require a larger quantity of water, and are better suited for less arid regions.

- **Closed-cycle** systems discharge heat through evaporation in cooling towers and recycle water within a power plant. Water consumption is low, and is limited to the amount lost by evaporation. Closed-cycle cooling systems are not as common as once-through systems, because they are more expensive.
- **Once-through systems** ingest cold water, which is returned to its source at elevated temperatures. Water demand for once-through systems is 30 to 50 times that of closed-cycle systems, because closed-cycle systems reprocess water within the plant.

**Approximately 98% of water used in power plants is returned to its source.** Since most water is returned to its source, industry regulations requiring stricter water quality for return flow have affected the power industry's approach to water treatment. However, it is important to distinguish between use and consumption. **Use** is the amount of water that passes through power plants and is eventually discharged to its original source; whereas **consumption** is water that is lost, typically through evaporation. The following profile most of the sources used to generate electricity in the United States.

- **Coal** is by far the largest source of energy used to generate electricity in the United States. In 2003, 51% of electricity in the United States used coal as its energy source. The substance is inexpensive and easy to mine. However, the fossil fuel requires expensive pollution controls and contributes to acid rain and global warming.
- **Natural gas** is another source of energy used to generate electricity. In addition to heating water for steam, natural gas can produce combustion gases that pass directly through a turbine. Gas turbines are used when electricity usage is in high demand. In 2003, 17% of the nation's electricity was fueled by natural gas.
- **Nuclear power** generates steam by heating water in a process known as nuclear fission and generated 20% of electricity in 2003.
- **Hydropower** generated most of the other electricity in the United States (7% in 2003) by engaging flowing water to spin a turbine linked to a generator. Two types of hydroelectric systems produce electricity. In the first system, water accumulates in reservoirs created by dams. In the second one, a river's force applies pressure to turbines to produce electricity.

**Dry cooling technology is a derivative water play.** One of the leading companies reducing water usage in power generation is SPX Corp., which has developed "dry" cooling technologies for which there is no direct contact between the water to be cooled and the coolant air. This effectively eliminated water from the condensing power cycle,

resulting in a 97% reduction in water consumption. We expect additional investment in similar water management technologies to continue as water use, cost, and pollution become greater concerns in power generation and industrial applications.

## Municipal

**Municipal/drinking** is water withdrawn by suppliers that furnish at least 25 people or 15 facilities. The segment represents about 11% of demand today versus 8% in 1950 and parallels increases in population served.

**Water utilities** have not been separately profiled in this report. We have listed all eleven publicly traded water utilities in Exhibit 16. The largest is Aqua America, which has about a $2.5 billion market capitalization. We expect to see more privatizations and roll-ups of water municipalities going forward.

**Exhibit 16: Top 10 public US water utilities**

| Company | Ticker | Price 3/20/08 | Market Cap ($mil) | Performance YTD | Performance 2007 | EPS Growth 2008E | EPS Growth 2008E | ROE | Dividend Yield | P/E 2008 | P/B 2008 | P/S 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Public water utilities** | | | | | | | | | | | | |
| Aqua America | WTR | $18.68 | $2,477 | -12.4% | -6.9% | 5% | 14% | 10.0% | 2.7% | 23.1 | 2.5 | 3.8 |
| American States Water | AWR | $36.02 | $598 | -7.7% | -2.4% | 3% | 9% | 9.6% | 2.9% | 20.6 | 2.0 | 2.0 |
| Artesian Resources | ARTNA | $18.05 | $134 | -2.9% | -3.9% | 6% | 3% | 8.5% | 3.7% | 19.4 | 1.6 | 2.4 |
| California Water Services | CWT | $40.35 | $808 | 5.7% | -8.4% | 7% | 14% | 8.1% | 3.0% | 23.7 | 2.1 | 2.1 |
| Connecticut Water Service | CTWS | $23.16 | $197 | 0.2% | 3.6% | -6% | 10% | 8.9% | 3.7% | 20.1 | 2.0 | 3.1 |
| Middlesex Water Company | MSEX | $18.02 | $238 | -5.0% | 1.2% | 4% | 5% | 9.1% | 3.9% | 19.7 | 1.8 | 2.6 |
| Pennichuck | PNNW | $21.95 | $91 | -19.7% | 32.0% | -35% | 3% | 8.0% | 3.1% | 24.1 | 2.0 | 3.0 |
| SJW Corporation | SJW | $31.51 | $551 | -13.4% | -10.6% | 20% | 17% | 8.3% | 2.1% | 25.8 | 2.3 | 2.8 |
| Southwest Water | SWWC | $11.51 | $275 | -9.3% | -9.0% | -4% | 62% | 4.6% | 2.1% | 22.6 | 1.6 | 1.2 |
| York Water Company | YORW | $15.07 | $170 | -2.5% | -13.3% | 8% | 20% | 10.7% | 3.2% | 22.0 | 2.5 | 5.1 |
| **Public water utilities Mean** | | | | **-6.7%** | **-1.8%** | **1%** | **16%** | **8.6%** | **3.0%** | **22.1** | **2.0** | **2.8** |

Estimates for all companies are FirstCall consensus
Goldman Sachs Research currently does not cover any of these water utilities.

*Source: Goldman Sachs Research, FactSet.*

## Other miscellaneous uses of water

**Pool and spa** is a $12 billion market spanning commercial and residential equipment including pumps, filters, heaters, automated controls and cleaners, and maintenance equipment. Applications include pool and spa construction, service, and retail. Competitors in the market include Pentair and Pool Corp.

**Other** incorporates several miscellaneous categories that have not exceeded 3% of total withdrawals since 1950. Examples are private wells, which are 1% to 2% of total withdrawals and fish farms, which are less than 1% of total withdrawals. This segment should remain range-bound.

# Emerging market's growing thirst for water

**Strains from China's population growth.** The strains of the water demand and supply equation are especially acute in China. The country's population is 1.3 billion, representing 21% of the world's population, and it increases 12 to 13 million people, or 1% per year. China's population growth stresses already limited natural resources. An estimated 300 million people in China, mostly in rural regions, have inadequate drinking water. Approximately 75% of China's population is in rural areas but the country's steady trend toward urbanization continues to strain the city water resources.

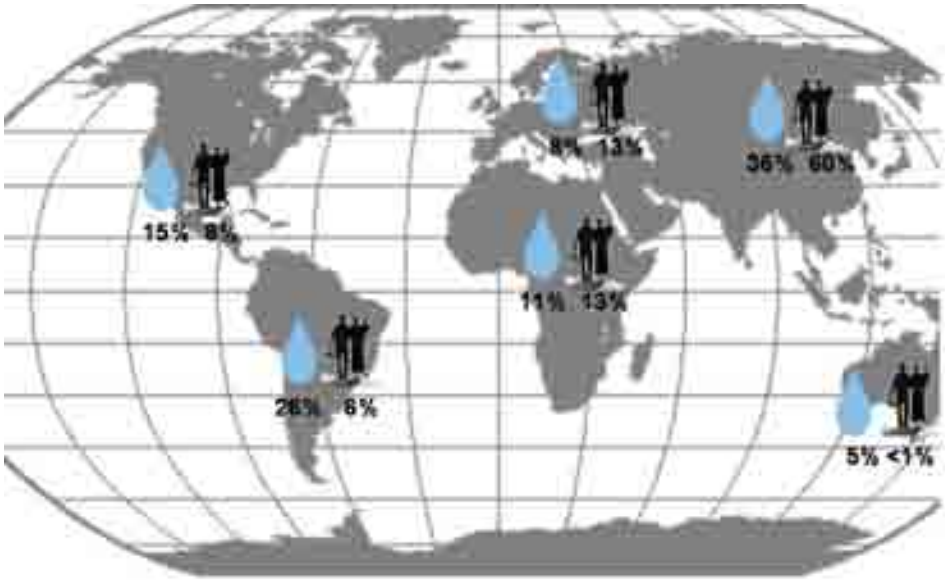
**Water pollution is evident in both rural and urban areas of China. An estimated 80% of the raw sewage in China's ten largest cities is not treated.**

China's population growth is further challenged by the uneven distribution of resources. As a measure of the supply and demand for agriculture, China has to feed 21% of the world's population on 7% of its arable land. A total of 68% of China's fresh water goes to irrigation. The inefficiencies are also notable: China employs 370 million people to produce as much food as two million people in the US.

**With 21% of the world's population, China only has 7% of the renewable water supply.** Water supplies are being depleted by diversions from rivers to cities, the drawdown of aquifers, and the pollution from industrialization. There are also water shortages in northern China, where grain production is largest. China has four-fifths of its water in the south, while two-thirds of its cropland is in the North. Further, water per acre of cropland in the north is one-eighth of that in the south. The World Wide Fund for Nature has also warned that shrinking Himalayan glaciers from global warming might cause flooding in China in the future. This process could create water shortages for hundreds of millions of people. Exhibit 17 details global water supply as compared to global population.

**North America enjoys an enviable ratio of 15% of the water supply for only 7% of the population. Asia is acutely strained with only 36% of the supply for 60% of the global population. China has the worst ratio, with 7% of the supply and 21% of the population.**

**Exhibit 17: Global water supply versus global population by region**




*Source: UN Educational, Scientific and Cultural Organization / International Health Programs.*

**In China today, 53% of the rivers, 50% of the lakes, and 35% of the aquifers are classified as polluted.**

**China's water pollution issues provide a long term investment opportunity for the solution.** China is budgeting $80 billion for water infrastructure projects as part of its 11th Five Year Plan. Part of China's solution has been to pattern itself after the US EPA, with a focus on testing and industrial and municipal treatment. China's latest budget (11th Five Year Plan) calls for $80 billion in water infrastructure spending, including accelerated investments in desalination and wastewater treatment systems. There are also many new municipal wastewater treatment plants under construction in China. In preparing for the Olympics, the Beijing City Planning Department spent $1.5 billion to built nine new wastewater treatment plants, over 600 miles of wastewater main pipelines, and four sludge digesting facilities.

**China has already made substantial investments in industrial water treatment.** We have toured Bao Steel's industrial water treatment system, which was built by ITT's Hengtong Advanced Water Treatment business. We were impressed by the steel plant's world-class system for its water treatment. The facility had multiple, advanced treatment stages for its industrial water, including the largest RO system in China. It processes 36,000 cubic meters of ultrapure water per day. The process treatment includes a two-stage media pre-filtration reverse osmosis, and electro-deionization.

**A reported nine of China's ten largest cities have unfit drinking water. The practice of boiling water before drinking is an embedded and necessary country-wide custom.**

**Many of China's municipal water systems in the east coast cities are antiquated.** We have visited a number of water and waste water systems in Shanghai and Beijing. In contrast to the spare-no-expense investment in the industrial water treatment systems we have seen at Bao Steel, for example, we were surprised at the relative underinvestment at the water municipality in Shanghai. The facility only used a single stage slow-sand filtration treatment system with some chlorine disinfection. This is essentially the type of filtration system that the United States was using in the early 1900s. We would note that these municipalities were using high-end Hach (Danaher) water test equipment, with the turbidity systems, which measure the clarity of water, as especially popular. In China, the municipal engineers are focused on the clarity of the water. From our observations, these engineers have an attitude that "if the water is clear, it's clean".

**Exhibit 18: Bao Steel's state-of-the-art industrial water treatment system shows China's willingness to invest in high-end industrial water to stay competitive.**

*Source: Goldman Sachs Research.*

**Exhibit 19: Editorial cartoon in China Daily newspaper highlight the country's drinking water crisis.**


*Source: China Daily June 11-12, 2005; Zhang Yaoning.*

# Global Aquanomics

## Price elasticity of water

The price elasticity of demand for water varies, depending on whether it is an economic good, such as for lawn watering, or a life necessity, such as for drinking. In economic applications, demand is more sensitive to price. As a necessity for life, there is no substitute for water. It is the only utility you ingest, and demand is essentially insensitive to price. There are also other exogenous variables that influence both industrial and residential water demand, such as seasonality, water use restrictions, and disposable income.

**In theory, one would expect more elastic demand for water in industrial use, because it is a cost of production.** Companies usually have more flexibility adjusting production methods to lower marginal costs. That said, production techniques for water cannot be adjusted within a short time frame. However, over the long term, industries that require significant amounts of water, such as semiconductor manufacturers and power systems, can adjust production to minimize costs. An additional factor in industrial price elasticity to consider is water quality. The cost of processing water to achieve a particular quality level is very high, so users react not only to cost per gallon, but also to quality measures.

**Water is often called the "lowest-cost utility", because it consumes less than 1% of household income.**

**Water: the lowest-cost utility.** Tap water costs about $3.60 per 1,000 gallons in the United States. Wastewater, including the expense of treatment, costs about $3.65 per 1,000 gallons to process. Costs tend to be lower for large water systems and higher for small systems because of economies of scale. The average usage levels and pricing results in an average annual residential water bill of about $475 in the United States. The water market in the United States is not subject to the traditional laws of supply and demand because of government subsidies. An estimated 50% of the cost of the US water and waste water systems are subsidized by the government. In terms of supply, the US government controls about 80% of the market share of fresh water.

**The US government subsidizes at least 50% of the cost of drinking water.**

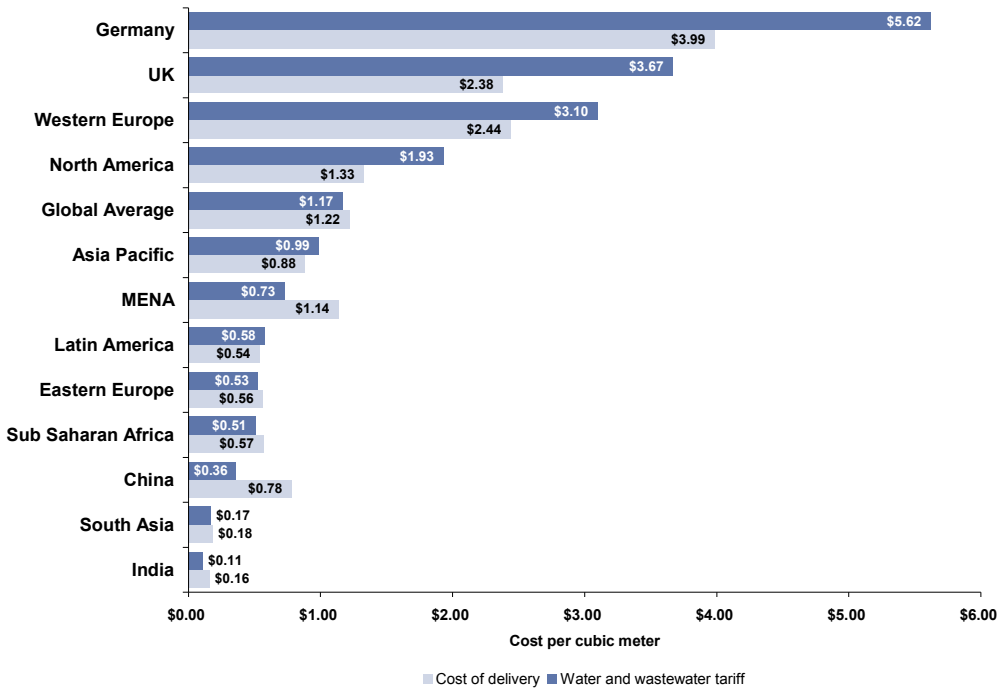
**Impact of government subsidies.** Direct and indirect subsidies are common in developed and developing countries. The impact that subsidies have on the price of water varies across residential, industrial, and agricultural uses. We have noted an increased acceptance on the part of state regulators for price increases to make tap water less subsidized in the United States. In addition, farmers who use irrigation water from federally supported projects would pay about 25% more, if their water source was unsubsidized. Exhibit 20 lists water tariffs according to the 2007 OECD / Global Water Intelligence water tariff survey.

**We treat 100% of the municipal water to precise EPA standards but only a fraction of this water is ever consumed.** One of the inefficiencies in water treatment resources is that only about 1% of treated water is ever consumed by humans.

**Leaks are the invisible costs.** It is estimated that 15%-20% of all water running through pipes in the developed countries is ultimately lost because of leaks. The situation is worse in developing markets, where an estimated 20%-40% is lost, with illegal taps a bigger factor.

**Water costs and tariffs vary dramatically across the globe, largely reflecting the impact of government subsidies.**

**Exhibit 20: Comparisons of the cost of water by major country and regions**




*Source: OECD / Global Water Intelligence.*

## Growing backlash against bottled water

**Bottled water is a lifestyle product in the United States.** Bottled water has become one of the largest commercial beverage categories, second only to carbonated soft drinks in the United States in terms of volume, surpassing beer, coffee, and milk. The US bottled water consumer currently has more than 500 different domestic brands from which to choose. In 2007, sales reached $91 billion, with consumption is up 60% since 1997.

**Bottled water still costs more than gasoline – even in times of cyclically high gasoline prices.** Because many people buy bottled water in increments of one liter or less, a gallon of Poland Spring® bottled water can cost more than $6.00. The average price for a gallon of gasoline in 2005-2007 is about $2.75-$3.00. This disparity drives home the point of what people are willing to pay for bottled water. Bottled water has also become the second largest commercial beverage category behind carbonated soft drinks in the United States on a volume basis, surpassing beer, coffee, and milk.

**In developing markets, bottled water is a necessity, not a luxury.**

**The benefits and contents of bottled water are often misunderstood**. Bottled water has not been proven to be any safer than tap water. The EPA sets the standards for tap water provided by municipal water systems. The Food and Drug Administration (FDA) sets the standards for bottled water, which are derived from the EPA's tap water standards. The Natural Resources Defense Council estimates that about one-fourth of bottled water is tap water versus water from an approved, protected, and monitored natural source. Some estimates put the rate as high as 40%. The FDA rules also allow bottlers to refer to the products as "spring water", even if it is brought to the surface using a pumped well and treated with chemicals. Some bottled water marketing is also misleading, by implying that the water comes from natural springs, when it may not.

# Water cycle basics

The first centralized water systems are believed to have been built in the Middle East over 5,000 years ago. In the United States, one of the first drinking water filtration systems that used slow, sand filtration was built in Poughkeepsie, New York, in 1872. Jersey City, New Jersey, was one of the first municipalities to use chlorination for drinking water disinfection, in 1908. The first US municipal wastewater treatment plant was built in 1907 in Gloversville, New York.

Water treatment is a series of filtration and disinfection processes that alters the chemical composition of a water supply. Exhibit 21 is a basic flowchart of the life cycle of water.

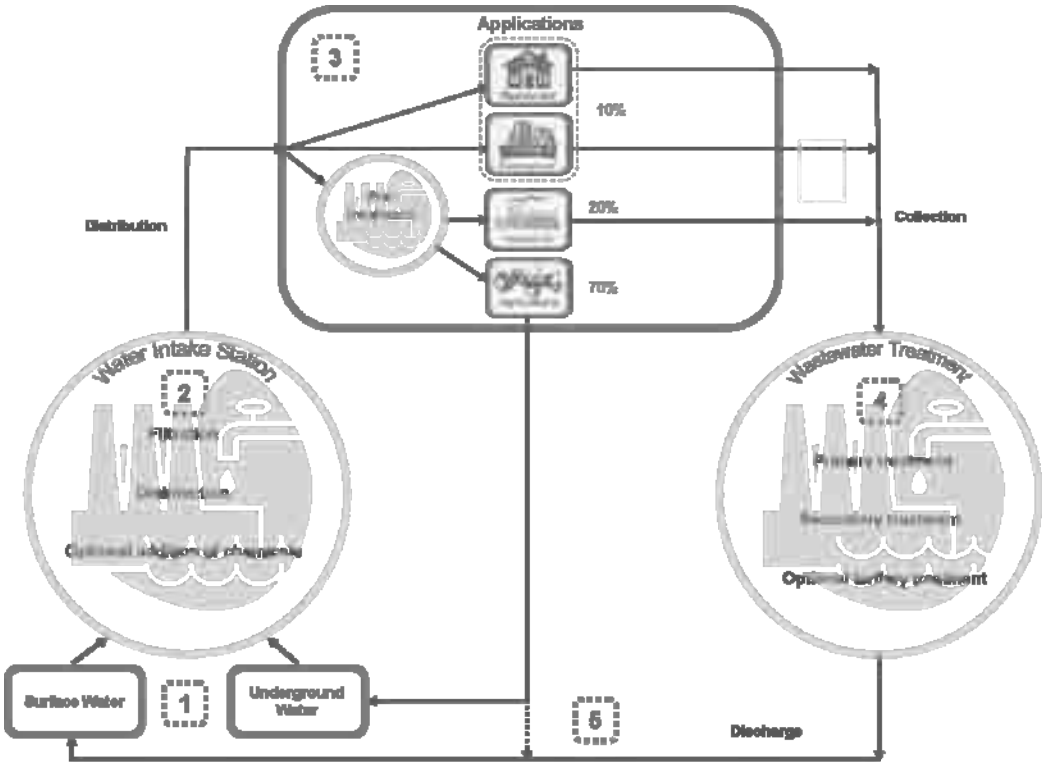
**Stage 1** highlights sources of water, either well or surface.

**Stage 2** is a treatment stage, typically filtration and disinfection.

**Stage 3** details end-users, principally residential, commercial, and industrial.

**Stage 4** handles water at the end of the cycle before discharge, **Stage 5**.

**Exhibit 21: Water cycle overview**




*Source: Goldman Sachs Research.*

**Well and surface water as "feed water."** Well and surface water **(#1)** are filtered and/or disinfected **(#2)** to make the product suitable for residential **(#3)**, commercial **(#3)**, and industrial **(#3)** applications. Certain industrial processes (shown above) need more intensive filtration. After water is used it has to be collected and treated **(#4)** before discharge **(#5)**.

**Water treatment processes.** Water treatment **(#4)** involves the removal of solids, bacteria, algae, plants, inorganic and organic compounds. Contaminants, such as metals and toxins, place greater burdens on treatment systems, because they are difficult to

process. The need to reclaim water is another challenge because it requires advanced treatments. Below we highlight the basic municipal, residential, industrial, and wastewater treatment processes.

- **Municipal drinking water treatment** systems typically take in, treat, monitor, and distribute water to households and other customers. There are, as already mentioned, about 54,000 public or private community drinking water systems in the United States.
- **Residential water treatment** enhances the quality of drinking water, softens water by changing calcium ions to sodium ions, and protects assets by reducing sediment and rust that can damage plumbing, appliances, and clothes. There are many drinking water filtration and purification technologies, including reverse osmosis and faucet mount. An example of this application is the General Electric whole home water system called SmartWater. Another example is a Culligan drinking water system, which offers a complete range of home filtration options.
- **Industrial water treatment** includes the chemicals, equipment, and services that are used to prevent corrosion, deposits from forming, microbial growth, and other problems in equipment and pipes where water is circulated. Water is an important part of the industrial process, because it is used to heat and cool most industrial plants. This process also reduces pollution when water is discharged. Pretreatment of industrial waste removes many pollutants at the beginning of the process.
- **Wastewater treatment** handles water at the end of the cycle. This process usually involves collecting, treating, and discharging wastewater after it is used. There are 16,000 public treatment systems in the United States.

**Primary treatment** is the first phase of wastewater treatment and involves the separation of solids and liquids, typically in a sedimentation tank.

- **Chlorine is used to kill pathogenic bacteria and reduce odor. Some states also require the removal of excess chlorine, known as dechlorination, before discharge.**

**Secondary treatment** is the next phase in the wastewater treatment process and is called biological treatment because oxygen is added to stimulate living microorganisms, such as bacteria. The bacteria consume the dissolved organic material in wastewater. If there are significant amounts of organic material in the water, treatment plants can employ an "activated sludge" treatment process. In this type of process, organisms are kept at high levels to stimulate consumption. The secondary treatment process is complete after the effluent from the sedimentation tank is disinfected with chlorine, before being discharged to its source. Chlorine has been used as a disinfectant for several centuries. Alternatives to chlorine, including ultraviolet light and ozonation, are used when chlorine in treated effluents could be harmful, such as to marine life.

**Advanced treatment** occurs when water is being reclaimed. This process involves passing water through sand filters to remove the remaining solids, as well as an extended disinfection process. Advanced treatment techniques range from biological treatments capable of removing nitrogen and phosphorus, to physical-chemical separation, such as filtration, carbon adsorption, distillation, and reverse osmosis. These processes, individually or combined, can achieve most levels of pollution control. Effluents treated this way can be used for industrial, agricultural, recreational, or drinking water.

**Aging infrastructure starts with neglected pipes.** In the United States, most of the water main pipes are 60-80 years old. By 2020, it is estimated that 60% of these pipes will be classified as substandard. Leaking pipes are the dirty secret of the infrastructure problem in developed markets. France and Spain estimate that 30% of their treated drinking water is lost through leaks. In London, conservative estimates state that 15% is lost. Saudi Arabia has a surprising 21% loss estimate.

## Financing and water

While it is not the purpose of this primer to detail the various financing aspects of the water sector, we will note that we are seeing more initiatives at integrated solutions for financing. There is an increase in Public-Private-Participation (PPP) projects. In addition, BOT (build-operate-transfer) options are becoming more mainstream, as customers want the turnkey solution from a single contractor. Companies like GE are in position to handle all aspects of a project: planning, design, financing, construction, and operation for a finite period before transfer. Companies that can offer all of these products and services have a competitive advantage.

# Composition of the global water sector

**The global water market addressing municipal and industrial water/wastewater equipment and services is estimated to be $425 billion. It is composed of at least ten distinct subsectors, including pumps, valves, water test, filtration, treatment, infrastructure, automation, and consulting/engineering services.**

## Water market overview

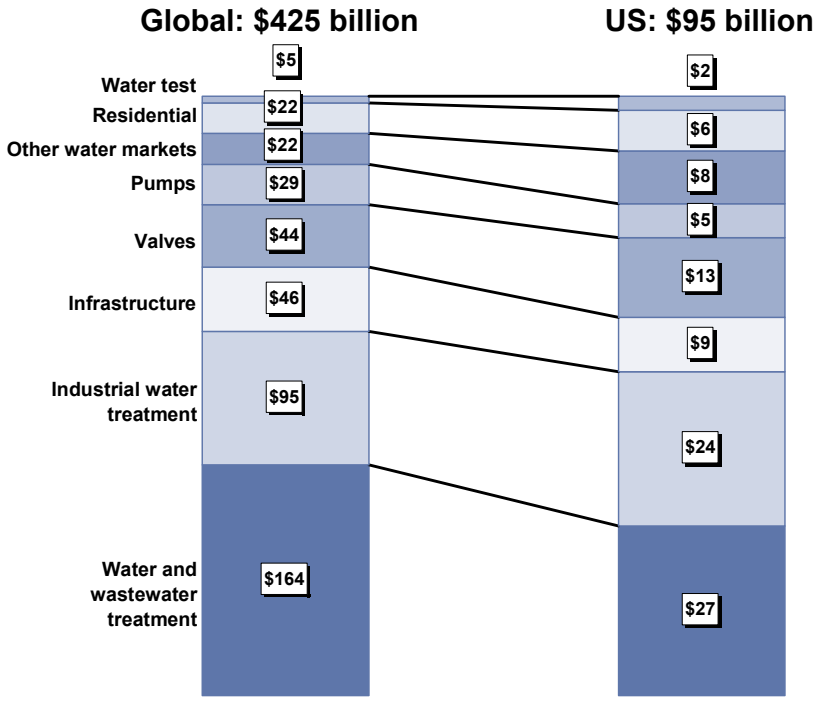
The global water industry is estimated to total $425 billion. We estimate the US market to be $95 billion. For practical purposes, we like to say there is no single water sector. The water and wastewater sector is composed of at least ten distinct subsectors, including all the equipment, services, and chemicals for pumps, valves, water test, filtration, wastewater and industrial water treatment, infrastructure, automation, and consulting/engineering services. In developed countries, such as the United States, we expect consistent 3%-5% growth across the various businesses in the water industry, driven by increased maintenance stemming from aging infrastructures and tighter regulation. For developing countries, we expect to see 10+ growth, mostly due to expanding underdeveloped water infrastructures. Many parts of China's water systems should see 20%-plus growth over the next several years.

Exhibit 22 profiles the subsectors that capture the $425 billion global water market:

- **Pumps** used exclusively for water are a $29 billion global market and coupled with valves, are integral parts of flow control. Both segments are mature, fragmented, and have some cyclical exposure to residential and commercial construction and are found in areas from municipal facilities to residential wells.
- **Valves** represent a $46 billion global market and are used to control the direction, pressure, or rate of water flow. Their size, shape, and performance characteristics vary considerably from one application to the next.
- **Water test** is a $5 billion global market that includes instruments and reagents that are used to analyze the chemical properties of water.
- **Water and wastewater treatment** is a $164 billion global market, including equipment and services for treating water pollutants at the beginning and end of the cycle.
- **Desalination** is a $5-$10 billion dollar global market that eliminates salt and from seawater and brackish water for municipal and industrial uses.
- **Industrial water treatment** is a $95 billion global market that includes the value of equipment, which we believe is $60 to $70 billion, services of $20 to $25 billion, and chemicals of $6 to $7 billion, with applications that prevent corrosion and buildup of harmful deposits in industrial processes.
- **Residential water treatment** is a $22 billion global market that enhances water quality and minimizes the elements that damage plumbing and appliances.
- **Filtration** is a $25 billion global market that employs water treatment applications for disinfection, organic carbon reduction, ozone reduction, and environmental control.
- **Infrastructure** is a $44 billion global market that includes pipes, fittings, hydrants, valves, meters, and service and repair equipment across commercial, residential, and industrial markets. The segment is mature, fragmented, and has some cyclical exposure to residential and commercial construction.

- **Automation systems** are a $4 billion global market that addresses end markets in specialized process control software for water and wastewater facilities. It should outpace conventional solutions in developed countries as industries drive efficiency.
- **Engineering/consulting services** are an $12 billion global market that capture all stages of the water cycle. Services include engineering, planning reports, operations assistance, and capex planning. Recent trends that have been gaining traction are build-own-operate (BOO) public works and turnkey build-operate-transfer of (BOT) systems.

**Exhibit 22: Water market profile**




*Source: Goldman Sachs Research estimates.*

# Pumps

| | |
|---|---|
| **Market Description** | Pumps used exclusively for water represent a $29 billion global market, with some estimates as high as $30 billion, growing at 1X to 2X GDP. The segment is mature, fragmented, and has some cyclical exposure. Companies range in size from small, privately-held firms to multi-nationals such as ITT and Pentair with billions of dollars in revenue. Small producers may specialize in finite pump products, while larger concerns offer a wide array of pumps and entire water control and automation systems. |
| **End Markets** | Pump companies tend to focus on specific product types instead of specific end markets. End markets include water, wastewater, residential, power, chemicals, pulp and paper, pharmaceuticals, and semiconductors. |
| **Geographic** | 80% international, 20% in the United States |
| **Market Leaders** | Flowserve 4.2%, Grundfos (Denmark) 4.2%, Ebara (Japan) 3.9%, KSB (Germany) 3.4%, ITT 3.3%, and Pentair 2.6%. *Source: Freedonia* |
| **Distribution** | Pump manufacturers have traditionally used a variety of distribution channels to market their products, depending on the application and end market. These channels include salaried/commissioned direct salespeople to service OEMs and engineering firms, as well as third-party distributors and independent export agents. Sales offices are usually located within geographical proximity to areas of customer concentration. These facilities also serve as aftermarket service bases. More sophisticated products may require custom orders, which are usually sold directly from the factory. These orders require more technically competent direct sales/engineering and marketing staff. Large purchases from major end-users often occur through competitive bids. Pump companies that cater to the residential/small business market also sell through do-it-yourself plumbing retailers, catalog distribution companies, hardware stores, building material outlets, and retail home centers. Pumps are also available for rental. |
| **Key products** | • Positive displacement pumps move smaller amounts of high and low-viscosity fluids at varying speeds. These pumps include reciprocating pumps, which use a flywheel to drive a piston that draws fluid in on the upstroke and out on the downstroke and rotary pumps, which operate by rotating a gear that displaces a steady volume of liquid each rotation. These pumps can be found in wastewater facilities.<br>• Turbine pumps utilize centrifugal force and mechanical impulse power via rotating vanes, similar to a jet engine, and are best at pumping low volumes of material and are often used in applications with space constraints. An example of this is a submersible pump that is used in wastewater facilities.<br>• Sealless pumps have seals but do not touch the fluid passing through and are used when leak prevention is paramount. These pumps are used by chemical and petroleum industrial facilities.<br>• Centrifugal pumps are largely high-horsepower that use an impeller to move large amounts of low-viscous fluids at low speeds. This segment captures wells, aerators, and sump pumps in basements. |
| **Pricing** | Pricing is difficult to frame given the breadth of pump uses and products. Pumps tend to be more capital intensive than valves. The cost differential is driven by the complexity of the end product. Positive displacement and sealless pumps can be in the $150 to $250 range, while turbine and centrifugal pumps can cost $3,000. Specialized pumps also command higher prices in areas like sterile environments for semiconductor manufacturing and solids and suspensions for pharmaceutical plants. |
| **Services** | Pumps typically function under harsh operating conditions, including exposure to corrosive materials, fluctuating temperatures, severe climate/hazardous conditions, and continuous periods of operation. Any failure could be costly. Hence, after-market services, including preventive and emergency maintenance, are significant. Parts, service, and energy costs can amount to five times the cost of the original pump over a 15 to 20 year lifecycle. Some companies service their pumps in-house or use companies that specialize in maintenance and repair. Manufacturers also offer aftermarket services to generate additional, more profitable revenue and gain competitive advantages. The replacement cycle is generally longer term. |
| **Regulatory** | EPA, state and local governments, ANSI pump standards, NSF 61, the National Sanitary Foundation's standard for drinking water, and ISO standards. |
| **Trends to monitor** | • Pricing pressure, competition from China, low cost sourcing, escalation of raw material costs.<br>• Multiple speed pumps increase efficiency; variable speeds can change characteristics/reduce SKUs.<br>• Increased MRO spending in developed countries, driven by strengthening economies.<br>• Capital projects in developing countries trying to strengthen underdeveloped infrastructures.<br>• Reducing lifecycle cost of pumps: 18% original purchase, 40% energy, and 42% maintenance.<br>• Selling systems, not just pumps and components, to decrease maintenance costs.<br>• Smart pumps that are connected to a company's network, including embedded sensors, including wireless and remote monitoring for early problem detection and efficiency.<br>• Commoditization of certain pumps. |

*Source: Company reports and Goldman Sachs Research estimates.*

# Valves

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|---|---|
| **Market Description** | Valves represent a $46 billion global water market, growing at 1X to 2X GDP. The segment is mature, fragmented, and has some cyclical exposure to commercial construction. Their size, shape, and performance characteristics vary considerably by application. The manufacturers in this segment span small, privately-held firms to multi-nationals with billions of dollars in annual sales. Small producers may specialize in finite lines of valves, while larger concerns may specialize in the design and production of valves and entire fluid control and automation systems. |
| **End Markets** | Valve companies concentrate on specific product types rather than specific end markets. Important valve markets include pharmaceuticals, semiconductors, power, chemical, and pulp and paper. |
| **Geographic** | 80% international, 20% in the United States. |
| **Market Leaders** | Tyco (Grinnell) 3.1%, Flowserve 1.8%, Emerson 1.8%, Dresser 1.3%, and Kitz 1.0%. *Source: Freedonia* |
| **Distribution** | Valve manufacturers use a range of distribution channels to market their products including salaried/ commissioned direct salespeople to service OEMs and engineering firms, as well as third-party distributors and independent export agents. Regions such as Europe have a much more direct sales system than does the US. Sales offices are usually located within geographical proximity to areas of customer concentration. The facilities also serve as aftermarket service bases. More sophisticated products, including custom orders, are typically sold directly from the factory. These orders also require a more technically competent direct sales/engineering and marketing staff. Valve companies for residential/small business market also sell through DIY retailers, catalog distribution companies, hardware stores, and building material outlets. Industrial and pharmaceutical companies usually require more sophisticated valve applications. |
| **Key products** | • Basic quarter-turn (or rotary) valves are used in "on-off" or throttling applications, where turning the valve 90 degrees either permits or prevents flow. The three basic types are ball, butterfly, and plug.<br>• Multi-turn (linear motion) valves are similar to quarter-turn but require multiple turns to open or close. These valves include both gate and globe valves which use a flat fence/gate and a plug to regulate the flow of fluids. Examples include gate, globe, pinch, diaphragm, and needle.<br>• Self-actuated valves open and close depending on the application; these include check (to prevent backflow) and pressure-release valves. Actuation can be manual, hydraulic, pneumatic, or by electronic actuators. Manual actuators use levers, gears, or wheels to facilitate movement. Large valves and ones in challenging environments typically do not employ manual actuators because of horsepower and deterioration. Hydraulic and pneumatic actuators are used on linear or quarter-turn valves; have minimal parts; air or fluid pressure acts on a piston to provide thrust in a linear motion for gate or globe vales; and can be applied with fail-safe features. Electric actuators have motors that provide torque to operate the valve remotely or automatically; the power source drives force/motion and is often used in locations, such as pipelines. Other types of valves include solenoid, bypass, and vortex. Water valve applications also include fire and security. |
| **Pricing** | Even though valves tend to be less expensive than pumps, some still cost thousands of dollars. Valves can range in size from a fraction of an inch to 30 feet in diameter. Pricing is difficult to frame given the breadth of uses and products. Quarter-turn valves can be $10 to $20, while a 36-inch ball valve can be $45,000 to $65,000. The cost differential is driven by the complexity of the end product and application. Further, pricing is also usually better on highly engineered or custom-specification valves than commodity valves. |
| **Services** | Valves operate under harsh conditions, are exposed to corrosive materials, fluctuating temperatures, and severe climates. Failures can be costly. After-market services, including preventive and emergency maintenance, are significant. Maintenance including replacement parts and service can be over 80% of the total cost of a valve. Companies service valves in-house or use companies that specialize in maintenance and repair. Manufacturers offer aftermarket services to generate additional, more profitable revenue and for competitive purposes. Valves typically need to be serviced more frequently than pumps. |
| **Regulatory** | EPA, state and local governments |
| **Trends to monitor** | • Pricing pressure, competition from China, low cost sourcing, and escalation of raw material costs.<br>• Healthy demand in developed countries for conventional valves, driven by strengthening economies complemented by even stronger demand for more expensive automated valves and actuators.<br>• Automatic valve demand should outpace conventional valves as manufacturers drive efficiency.<br>• Greater number of smaller capacity valves to drive plant efficiency.<br>• Larger capital projects in developing countries trying to strengthen underdeveloped infrastructures.<br>• Smart values are gaining in popularity and use; connected to a company's network, including embedded wireless sensors and remote monitoring for early problem detection and efficiency; but these are not typically found in water applications. |

*Source: Company reports and Goldman Sachs Research.*

# Water test

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| **Market Description** | Water test is a $5 billion global market, growing in the mid-single digits. This segment captures a wide range of analytical systems, instrumentation, and reagents that are used to analyze water quality and safety. Reagents are chemical testing compounds used to test for items such as chlorine, pH, alkalinity, turbidity (clarity), and calcium hardness. The products can be benchtop (lab instruments), handheld units, or in-line systems. Instrument sensitivity can be at the parts per million (PPM) and parts per trillion (PPT) basis. The equipment typically includes a complement of high margin reagents, providing an attractive "razor and razor blade" economics. By helping to meet regulatory requirements and reduce chemical and energy usage in treatment, the water test market provides users with solutions to ensure economically high-quality water. Demand for clean water by industrial, commercial, municipal, and residential markets continues to grow in developed countries. Water test in developing countries should outpace developed countries as the focus in these countries stress the health benefits of clean water |
| **End Markets** | 43% municipal water facilities, 43% industrial (e.g., beverage, electronics), and 14% environmental agencies (e.g., United States Geological Survey). |
| **Geographic** | 50% international, 50% in the United States. |
| **Market Leaders** | Danaher 18%, Thermo Electron (Orion) 5%, Emerson <1%, Veolia, and Honeywell. *Source: Danaher* |
| **Distribution** | Competitors in this market look to leverage the "direct-to-end-user" model. Vendors are also trying to sell low-end equipment online to decrease distribution costs. |
| **Key products** | Products include disposable test strips and portable test kits used to spot-check source and drinking waters. There are also sophisticated network instruments that continuously monitor plant processes. These instruments range from microbiological media that detect living parasites, such as e.coli, to spectrophotometers that measure dissolved chemicals, such as arsenic. |
| **Pricing** | Pricing varies depending on application. Testing instruments range from $10 to several thousands of dollars. Some samples from Hach (owned by Danaher), which does not guarantee results without approved reagents, include:<br>• Hach CEL/890 Advance Portable Laboratory, Price: $2,510.<br>• Hach DREL/2400 Complete Water Quality Laboratory, Price: $3,782.<br>• Hach Chlorine, Free and Total, and pH, Pocket Colorimeter II, Price: $352. |
| **Services** | Water test companies, such as Danaher, benefit from the "razor and razor blade" business model. Reagents (consumables) are used with each test, and create recurring revenue. We believe that the water test market is about two-thirds equipment and one-third consumables. Service plans are designed to ensure resources are maximized. Preventive maintenance agreements include routine maintenance checks, operator training, and scheduled parts replacement. An area of emphasis for Danaher is customized service programs, including scheduled reagent change-out with fresh reagents. |
| **Regulatory** | This market benefits from increased regulatory standards in water quality and safety. The EPA administers the two main Federal safety laws: The Safe Drinking Water Act and the Clean Water Act. The Safe Drinking Water Act protects consumable water by setting pollutant levels. The Clean Water Act protects bodies of water by regulating pollutant discharges into waters and maintaining standards for wastewater (sewage) treatment. As new regulations mandate higher purity levels, entities have to test the water to ensure that they are in compliance. Homeland Security is also involved with the advent of water system monitoring. |
| **Trends to monitor** | • Higher regulatory standards for drinking water quality and safety.<br>• Lab process analytics growth.<br>• Digital sensor plug-and-play techniques and luminescent dissolved oxygen meters replacing sensors.<br>• Accelerate non-US/Western EU growth in Asia and Eastern Europe.<br>• The increased number of household compounds being detected in the North American water system, including aspirin, caffeine, pharmaceutical compounds, farm animal growth hormones from water runoff.<br>• Computer interfaces to gather particle counts, pH, chlorine, and turbidity for easier collection/analysis.<br>• Increased use of spectroscopy and mass spectroscopy to generate more accurate results.<br>• Increased price and feature competition especially for lower-end consumers.<br>• New water-related health hazards, such as Legionnaire's disease.<br>• Pharmaceutical, semiconductor, and beverage emphasis on product quality and contaminants. |

*Source: Company reports and Goldman Sachs Research.*

# Water and wastewater treatment

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| **Market Description** | Water and wastewater treatment is a $164 billion global market that grows in the mid-single digits and consists of treating water at the beginning and end of the cycle. This process involves collecting and treating water so that it becomes environmentally acceptable, even potable (drinking) water. Water and wastewater treatment essentially expedites the natural process of water purification. In the past, sewage was pumped directly into waterways where it was purified naturally. The sheer volume of clean water could dilute waste. Bacteria and other organisms would consume the sewage and other organic matter, turning it into new bacterial cells, carbon dioxide, and other products. The population growth and volume in domestic water and wastewater require this supplement to the natural process. Key users are public and private operators. |
| **End Markets** | Municipal: there are 16,000 waste water treatment systems in the US and 54,000 drinking water systems. |
| **Geographic** | 85% international, 15% in the United States. |
| **Market Leaders** | Veolia (France), Suez (France), Siemens (Germany) and RWE (Germany). There are about eleven US publicly traded water utilities. The largest water and wastewater utility is Aqua America with about a $2.5 billion market capitalization. None of the other US utilities have a market capitalization over $1 billion. |
| **Distribution** | The United States has a vast distribution of water collection sewers, pumping stations, and treatment plants. Sewers collect wastewater from homes, businesses, and industries and deliver it to plants for treatment. Most treatment plants are designed to clean wastewater to return it to streams or other areas for reuse. The EPA has done several studies on the age, adequacy, and urgency of the existing wastewater infrastructure, including "The Clean Water and Drinking Water Infrastructure Gap Analysis", also known as "EPA-816-R-02-020", which was published in September 2002. |
| **Key products** | • Effluents are the clear treated liquids. The benefits of treated effluent include less stress on drinking water supplies, and it reduces the need to harvest and treat surface and underground water.<br>• Sludge is the solid byproduct of secondary treatment processes in wastewater plants. These products are used to naturally improve soils instead of using artificial soil conditioners and fertilizers. That said, bio-solids must be appropriately disposed or reused across a variety of land applications |
| **Pricing** | Water and wastewater prices are determined locally by the utility providing the service. Public and private utilities are constrained by local water authorities, utility boards, regulatory commissions, and/or water management districts. States usually have a "water code" that quantifies the rights of public water utilities and their authority over privately owned water utilities. Public and private ownership rates are usually based on the costs of producing and distributing water and not on the resource itself. Utilities are typically able to get annual price increases. According to the EPA, the average American household water utility bill is about $475 per year. Water is referred to as the "lowest cost utility" typically consuming about 1% of household income. |
| **Services** | Given the complex infrastructure and tight compliance requirements, services are an integral part of water and wastewater treatment. Some entities outsource the entire services function. This practice is more common in Europe. The three largest water services conglomerates are Veolia Environnement (France) Suez (France) and RWE (Germany). A typical contract is over 12 to 15 years, although some are 50 years. The provisions guarantee compliance, construction (if applicable), and facility operations. The services cover all aspects of the business, including call centers, invoicing, financing (even though they do not own the asset), meter reading, treatment, and preventive and emergency maintenance. |
| **Regulatory** | EPA, Bureau of Reclamation, state and local governments. The EPA administers the Clean Water Act. The Clean Water Act protects bodies of water by regulating pollutant discharges into waters and maintaining standards for wastewater (sewage) treatment. |
| **Trends to monitor** | • Aging infrastructure and compliance.<br>• Self-contained decentralized treatment equipment to lower the cost of treatment. Local, or on-site treatment technologies, are being considered for wastewater treatment, instead of traditional wastewater treatment facilities. Since 80% of the cost of a traditional system is the installation of pipes from point of use, local or on-site treatment options, which do not require the expansive piping infrastructure, are being viewed as a cost efficient solution for future wastewater treatment.<br>• Increased monitoring of funding for water and wastewater projects; municipal funding for water projects is usually separate from general budget. Revenue bonds can be issued to finance projects.<br>• Increased reuse/more flexibility/outsourcing.<br>• China and Eastern Europe currently have less primary water treatment but could bypass the primary and secondary treatment phases in favor of more advanced treatment.<br>• Alternate methods of delivery other than the traditional design-bid-build including design-build, build-own-operate-transfer, design-build-finance-operate-transfer, and multiple variations.<br>• State and municipal deficits/public opposition to higher fees/consolidation of smaller companies. |

- Efficiency: A study by the state of Texas suggested that utilities lose 10% to 20% of the water they treat and distribute. Most of the loss is due to leaks in the distribution systems.
- Increased privatization of water supplies for more accessibility, especially in developing countries.
- Sludge process technology including higher sludge quantities from additional treatment, regulations by the EU and EPA around carcinogen content and minerals concentration and high nitrogen and phosphorous impact on water industries, and a focus on lower quantities and increased treatment.
- Opportunities to create capture the byproduct methane gas generated at wastewater treatment plants from biogas and microbial fuel cells and use that to run turbines and fuel cells and create electricity.

*Source: Company reports and Goldman Sachs Research.*

## Water and wastewater treatment techniques

Before wastewater is returned to the environment, there are several stages of treatment that can occur, depending on the quality of the effluent needed. However, disinfection, which usually occurs through chlorination, ozonation, or ultraviolet light, is generally the final process before water is discharged back to its source. Before disinfection, there are several stages of treatment, including advanced treatment. Some of the more commonly used advanced water treatments are ultrafiltration, reverse osmosis, deionization, and distillation.

- **Chlorination** is the oldest and still the most common way of disinfecting water. Minimal amounts of chlorine are effective against most bacteria, viruses, and protozoa. The EPA has become increasingly concerned over the lasting effect that chlorine has in water versus ultraviolet disinfection treatment, which has no lingering effect. Chlorine can form byproducts which have been linked to cancer at high exposure levels. Chlorine stored in high volumes can potentially be dangerous.
- **Ozonation** leverages ozone in the atmosphere and is a form of oxygen. It is a safe, colorless gas bubbled through drinking water which then destroys organisms and reduces unpleasant tastes and odors. This process has been used for water treatment since the 1800s and causes fewer potentially harmful byproducts than chlorine. Ozonation is four times as expensive as chlorine due to the higher energy levels it requires. Ozonation can also corrode distribution systems, resulting in more frequent infrastructure replacement.
- **Ultraviolet (UV) disinfection** uses a UV light source enclosed in a transparent sleeve that enables water to pass through a flow chamber. As the water passes through the flow chamber, UV rays are absorbed into the stream. When the UV is absorbed by the reproductive mechanisms of bacteria, the genetic material is impaired and the bacteria can no longer reproduce. The common misperception is that UV kills the bacteria – it does not, it neuters the bacteria so it cannot reproduce and become harmful. At this point, the risk of disease has been eliminated. Some of the advantages of UV are that it disinfects water without adding chemicals, and it does not create byproducts or remove beneficial minerals. The key negative is that there is no residual benefit with UV. Unlike chlorine, which lingers in the water and provides ongoing treatment benefits in the days following the application, once the light is turned off, there is no disinfection benefit. UV is most effective if water has been pretreated, allowing the cleanest water to enter the flow chamber.

**Today an estimated 10% of treatment plants use membranes but this is expected to reach 70% by 2018.**

- **Ultrafiltration (UF)** is a treatment process that employs semi-permeable membranes that allow water to pass through and retain the contaminants. UF is one of four membranes that can be used to treat water. The other three membranes are reverse osmosis, nanofiltration, and microfiltration. The membranes employed depend on the matter being treated. One of the benefits of the coupling of secondary treatment and membrane filtration is a dramatic improvement in the quality of the process effluent.

**More efficient RO membranes typically use lower pump pressure.**

- **Reverse osmosis**, similar to ultrafiltration, uses highly engineered semi-permeable membranes that allow water to pass through and reject the contaminants. Most systems use a cross-flow process that allows the membrane to cleanse itself. As some of the filtered fluid passes through the membrane, the remaining liquid continues, sweeping the rejected species away from the membrane. Reverse osmosis needs pressure, usually from a pump, to push fluid through the membrane. Even though reverse osmosis is used to treat wastewater, it is more commonly thought of as a water intake process that enables the use of an alternate source of brackish or seawater to supplement, or replace, fresh water.
- **Deionization,** the second most expensive treatment process, removes impurities at the ionic level by chemically treating small beads of synthetic resin to selectively adsorb cations or anions and exchange them based on their relative activity compared to the resin. It can also be done by putting an electrical current through the water. Although important overall, deionization is usually used for making ultrapure water, water for industrial processes, such as microchip washing, or in power applications, such as boiler feed or supply water to keep systems running efficiently. There is also an electrical version of this called electro-deionization, which works via an electrical charge sent through the water.
- **Distillation** removes impurities, such as nitrate, bacteria, sodium, organic compounds, and metals. It is one of the oldest forms of water treatment and forms of desalination. This process is used infrequently because of the high cost of heating the water until it boils and then condensing the steam. Pollutants with a boiling point close to water's 100° Celsius are more difficult to remove.

# Industrial water treatment

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| **Market Description** | Industrial water treatment is an $95 billion global market that typically grows in the high-single to low-double digits and is used to prevent corrosion, contamination, and the buildup of harmful deposits in industrial water systems. This market includes the value of equipment, which we believe is $50 to $60 billion, services of $15 to $20 billion, and chemicals of $5 to $6 billion. Industrial water treatment is used in production processes to enhance process efficiency, improve quality, and improve end products. Water is the main source of heat transfer in most industrial plants. Key users include manufacturers in areas such as pharmaceuticals, pulp and paper, chemical and petrochemical, steel, power, and electronics/semiconductor plants. |
| **End Markets** | Manufacturing and transportation 33%, food and beverage 13%, metals 8%, institutional 13%, mining 10%, chemical/pharmaceutical 10%, power 8%, and other 5%. |
| **Geographic** | 70% international, 30% in the United States. |
| **Market Leaders** | Nalco (following the combinations of Nalco with Calgon and Aquazur), GE (Betz Dearborn and Osmonics), Danaher (ChemTreat), Beckart Environmental, Veolia (France), and RWE (Germany). |
| **Distribution** | Sales occur through many avenues, including a direct sales force, wholesalers, distributors, systems integrators, installers, and OEMs. |
| **Key products** | Cooling water treatment, boiling water treatment, membranes, and chemicals including corrosion control for cooling and boiler systems, raw water treatment to remove heavy metal discharge from water supply, and wastewater applications that focus on improving overall plant economics and operating efficiency. Specific examples include Nalco's ACT and Tri-Act, which condensate treatment programs designed to prevent corrosion, overheating and rupture of boilers. STARBREX is Nalco designed technology that controls biofilms caused by microorganisms in cooling tower, condenser and heat exchanger systems. Nalco's NALMET removes heavy metal discharge from raw water supply. Nalco's ULTRION clarifies wastewater more efficiently than alum with less corrosion or lime. |
| **Pricing** | A typical contract lasts one year. A customer pays based on usage and averages $60k/annually. About 80% of revenue is recurring. Large companies often compete head to head with smaller, local water treatment companies that are managed for different financial objectives, such as maximizing cash flow. |
| **Services** | Long-term, the goal is to transform this business model so that customized services have more influence than water treatment products. GE has developed a mobile water fleet with emergency, supplemental, and long-term services, which should position it to sell high margin services along with products.<br>• Water-related emergencies are unexpected and typically last 1 to 2 months.<br>• Supplemental scenarios are leveraged for replacement equipment during maintenance or for peak needs and are typically for 2 to 6 months.<br>• Long-term solutions allow clients to focus on their core business and often lasts 1 to 10 years. These arrangements require endurable, reliable and predictable synergies.<br>Nalco couples water treatment chemicals with "in-house process solutions." The company's 5,000 professionals spend time learning their customer's business models. This approach has built a less capital-intensive business model with high competitive barriers to entry and pricing leverage, given customer-switching costs are high. |
| **Regulatory** | EPA, Bureau of Reclamation, state and local governments. |
| **Trends to monitor** | • Global distribution of services.<br>• More technology, especially monitoring.<br>• Systems approach to helping clients.<br>• Restrictions and costs for industrial discharges.<br>• Pretreatment of industrial waste to remove troublesome pollutants at the beginning of the pipeline.<br>• Increased water usage.<br>• Financing opportunities.<br>• Structure of contracts including build-own-operate among other variations.<br>• Leveraging relationships with major companies as they globalize and dominate world markets.<br>• Innovative ways to serve small customers – remote monitoring, Web ordering, and on-call only service. |

*Source: Company reports and Goldman Sachs Research.*

# Residential water treatment

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| **Market Description** | Residential water treatment, which excludes the bottled water industry, is an $22 billion global market that typically grows in the low-single to low-double digits and can enhance the quality of drinking water, soften water, and protect assets (reduce sediment and rust that can damage plumbing and appliances). Treatment and conditioning are both methods that are used to improve the quality of water. Treatment systems reduce harmful contaminants in water and deal with the health and safety of water. Conditioning addresses issues that impact water taste, color, odor, and hardness. High levels of magnesium, calcium, iron, manganese, and silt are contaminants that need water conditioning. It is not uncommon to use both treatment and conditioning. Possible treatment and conditioning methods include:<br>• Mechanical or sedimentation filtration.<br>• Activated carbon filtration/oxidation filtration/neutralizing filtration.<br>• Reverse osmosis or membrane filtration.<br>• Distillation.<br>• UV treatment.<br>• Water softener.<br>• Chlorination disinfection.<br>This segment should see attractive longer-term demand trends, driven by declining confidence in tap water and increased awareness of potential water problems and treatment solutions. |
| **End Markets** | Residential. |
| **Geographic** | Varies, some entities suggest 50% international, 50% US; Others put it at 72% international, 28% US |
| **Market Leaders** | Culligan, EcoWater Systems, Pentair, General Electric, 3M (Cuno). |
| **Distribution** | Sales have historically occurred through water dealers. Most customers do not have a high degree of knowledge of residential treatment systems, so educating customers is a costly part of the sales process. Today, customers have more knowledge of the products, so the sales process is not as long. The distribution channels have also deepened to include organizations, such as Loews and Sears, which have separate contractor entrances and have helped the growth in residential treatment. |
| **Key products** | • Point-of-entry (POE) water treatment systems treat all the water entering and used in the home. Sedimentation filters, iron control treatment, water softener and chlorination systems used to control bacteria in wells are all considered POE water treatment systems.<br>• Point-of-use (POU) water treatment systems process a portion of the water in the home water distribution system, usually at a faucet or under the sink. The water is usually for drinking or cooking. Reverse osmosis, distillation and activated carbon are some of the POU water treatment systems. |
| **Pricing** | • Costs vary by product and service.<br>• Continuous chlorination ranges from $500 to several thousands of dollars depending on the size and complexity of the system being treated.<br>• UV water disinfection could cost at least $1,000 for equipment.<br>• Certain replacement filtration cartridges can cost $7 to $10 and last 6 to 9 months. |
| **Services** | After-market is more profitable than the OEM. Services vary regionally with some parts of the world, such as South East Asia, requiring more attention than the Western hemisphere. |
| **Regulatory** | EPA, Bureau of Reclamation, state and local governments. |
| **Trends to monitor** | • Customers are becoming more knowledgeable on water quality, so usage is increasing.<br>• Constant innovation to attract consumers.<br>• GE's SmartWater residential filtration system was developed by GE Consumer & Industrial.<br>• Highlight difference between competing technologies. Consumers typically do not understand the difference between a simple carbon filtration system and more sophisticated RO/UV system.<br>• Need to develop proprietary filtration to capture market share.<br>• Increase useful life of filters. Reduced frequency of change generates operational efficiencies.<br>• Develop relationships with manufacturers that are moving into water; for example, Cuno supplies GE with filters for some of their appliances.<br>• Expand on unvended market – 72% of homes in North America have no filtration system.<br>• Pricing sensitivity – end-users are reluctant to invest in an under-the-sink (POU) RO system when a Brita pitcher is available for a fraction of the price.<br>• Apprehension about installation – most people are not comfortable installing POU or POE systems.<br>• Competition from China/low cost sourcing. |

*Source: Company reports and Goldman Sachs Research.*

# Filtration

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| **Market Description** | Filtration is a $25 billion global market that typically grows in the mid-single digits. The market is fragmented and new products have been, and should continue to be, a key growth driver. Filtration employs various types of water treatment applications for disinfection, organic carbon reduction, ozone reduction, and environmental control. |
| **End Markets** | Key areas are food and beverage, fluid processing, aerospace, medical devices, and consumable water |
| **Geographic** | 55% international, 45% in the United States. |
| **Market Leaders** | Pentair (Everpure) 2%, GE, 3M Cuno, Pall, Ecolab, and Millipore. *Source: Pentair.* |
| **Distribution** | Commercial is sold through independent and vertically integrated dealers, distributors, OEMs, and food and beverage companies. Residential has traditionally occurred through water dealers as end-users did not have much knowledge. Today, distribution channels are more extensive, including Loews and Sears. |
| **Key products** | Commercial filtration systems include commercial water conditioning control valves and storage tanks, point-of-use filtration components and equipment, and filtration manifolds and cartridges for food service vending applications. For residential filtration systems, see the residential water treatment section above |
| **Pricing** | Costs vary by product. For residential filtration, see the residential water treatment section above. |
| **Services** | After-market is more profitable than OEM. Services include monthly delivery, repairs and maintenance. |
| **Regulatory** | EPA, state and local governments. |
| **Trends to monitor** | • Water safety, preference for better tasting water, and customers becoming more knowledgeable in water quality applications and solutions.<br>• Protect existing assets, such as hot water heaters, by filtering contaminants in the water that could corrode the infrastructure of the tank.<br>• Constant innovation to attract consumers. For example, P&G's PuR 3-stage filters provide clean, healthy water. Stage 1 filters sediment (dirt and rust), Stage 2 reduces harmful contaminants, and Stage 3 filters water over a natural bed of minerals for a crisp, refreshing taste.<br>• Increase useful life of filters. Reduced frequency of change generates operational efficiencies.<br>• Build long-term relationships with client/expand partnerships with manufacturers moving into water.<br>• Competition from China/price sensitivity/low cost sourcing. |

*Source: Company reports and Goldman Sachs Research.*

**Commercial filtration** employs applications, such as UV, for disinfection, organic carbon and ozone reduction, and control treatment of contaminated ground or surface water. Other types of commercial systems are reverse osmosis and softeners. For example, Pentair's filtration systems process the water at Starbucks to ensure it is clean, fresh, and free of impurities.

**Residential filtration** is used to treat drinking water, soften water, and protect assets (reduce objects that can damage plumbing and appliances). Applications include reverse osmosis, iron filtration, UV water disinfection, and chlorine filtration. Drinking water is subject to pesticides, lead, parasites, bad taste and smell caused by chlorine, and cloudiness and discoloration from sediment and rust.

# Desalination

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| **Market Description** | Desalination is a $5-$10 billion global market with installed capacity expected to grow 10%+ annually over the next decade. The market consists of two main revenue opportunities, plant construction and plant operation / maintenance. Desalination removes salt from seawater and brackish water through two processes: reverse osmosis (22% share) and thermal desalination (74% share). Reverse osmosis (RO) and seawater (SWRO) involves forcing saline water through semi-permeable membranes at up to 1,000 lbs of pressure to remove salt. RO operating costs are 3X-4X lower than 30 years ago. Thermal desalination involves boiling seawater and capturing the salt-free steam. This is the most expensive method since it uses so much energy and has been losing share to RO. There are three main types of thermal desalination, Multi-Effect Distillation (MED), Multi-Stage Flash (MSF), and Mechanical Vapor Compression (MVC). MVC is most common at small-scale thermal desal plants, MSF is most common in the Middle East given its access to low-cost energy, and MED is most common in industrial applications, especially if coupled with an existing heat/steam source. |
| **End Markets** | Municipal and industrial water treatment. |
| **Geographic** | Installed desal capacity: US 11%, Asia and Middle East 60%, Europe 7%, North Africa 7%, Latin America 4%. |
| **Market Leaders** | • Plant construction / EPCs: Doosan Heavy, Impregilo Group, Veolia Environnement, ACS, Suez, Acciona, GE, Ferrovial, IDE Technologies, Hyflux, Multiplex.<br>• Membranes: GE, Dow Chemical, Koch, Sinomem, Nitto Denko, Kurita Water Technologies. |
| **Distribution** | Direct to market. Projects are generally structured in two forms:<br>• Engineering –Procurement – Construction (EPC): A company or consortium will be responsible for designing, contracting, procuring, manufacturing, assembling, and starting up a facility before handing it over to a client who will operate it. Historically, EPC has been the most common form of desalination plant commission, especially for industrial customers.<br>• Build-Operate-Transfer (BOT) concession structures: A client will tender to a development company to execute the concession agreement, who will in turn appoint an EPC contractor and / or an operations and maintenance company to run the facility. BOT contracts will generally be determined on the basis of lowest contracted price of water. Governments and utilities are increasingly using BOT structure for plant development. A result has been an increased emphasis on the part of EPCs and equipment manufacturers to provide integrated and turnkey solutions. |
| **Key products** | • Pre-treatment: The salinity and turbidity of desalination feedwater is critical for reverse osmosis plants to be effective. The most common types of pre-treatment are Ultrafiltration and microfiltration (see Water and wastewater treatment section above).<br>• Reverse osmosis membranes: RO membranes form the heart of a desalination plant. They are the semi-permeable membranes through which seawater is pushed at high pressure to remove salt.<br>• Energy Recover systems: Energy recovery systems capture and reuse the water pressure in an RO facility, with systems from Calder, DWEER, and Energy Recoveryl<br>• Zero-discharge systems: Zero discharge systems treat the brine effluent from a reverse osmosis process to reduce the saline concentration before being discharged into the ocean. |
| **Pricing** | The capital outlay per cubic meter of desal capacity will constitute roughly 20% of the cost of producing water over a 25 year period. In terms of technology, reverse osmosis will have a relative capex cost per cubic meter of water that is 25-50% lower than the main thermal methods. The location and specifications of the specific facility, including the quality of feedwater, play a large determinant on plant cost. Energy is the single largest component of desalination operating cost, representing 50%-75% of operating costs depending on technology. |
| **Services** | BOT contracts involve operation and maintenance agreements to run desalination facility after construction. |
| **Regulatory** | EPA, Clean Water Act, Coastal Commissions, state and local governments. |
| **Trends to monitor** | • Emerging market urbanization putting stress on traditional sources of water.<br>• Improvements in RO membrane efficiency.<br>• New applications in using solar and geothermal energy sources for desalination.<br>• Advances in pre-treatment, energy recovery systems, and nanofiltration.<br>• Technology developments in zero-discharge and brine treatment<br>• Increasingly strict zero discharge regulations, and other rules on brine emissions.<br>• BOT project structures favoring integrated /turnkey solution.<br>• Project design standardization.<br>• Renewed US investment in desalination in California (15 new plants), Texas, Florida, Georgia; London plant being constructed to supply 15% of the city's water for $400 million.<br>• Development of Seawater Desalination Vessel by Water Standard, a mobile shipboard desalination. |

*Source: Goldman Sachs Research, Global Water Intelligence, company data.*

# Infrastructure

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| **Market Description** | Infrastructure is a $40 billion global market, growing at GDP-type rates. This market consists of basic products used to build, repair, and maintain water and wastewater (sewer) transmission systems. The primary components of the water and wastewater infrastructure are pipes, fittings, hydrants, valves, meters, and service and repair equipment. The key end-markets are publicly funded municipalities and contractors and privately funded contractors. The segment is mature, fragmented, and has some cyclical exposure to residential and commercial construction, but has stable growth characteristics driven by large capital projects to support growth trends and on-going repairs and maintenance. The current rate of capital investment is so insufficient that it could take 900 years to replace the US infrastructure. There is also significant incremental demand to repair and replace deteriorating existing infrastructure. Many drinking water and sewage pipes were installed between 50 and 100 years ago and are nearing the end of their useful life. Applications include new construction, maintenance, and service. |
| **End Markets** | Municipal and public works 50% and private contractors 50%. |
| **Geographic** | 75% international, 25% in the United States. |
| **Market Leaders** | Mueller (hydrants), Tyco (valves), Kupferle Foundry Company (hydrants), Watts Water (drains, plumbing), and Texas Pipe & Supply (pipes), Badger Meter, Neptune (Roper), Itron, (meters) are leaders in infrastructure. Key distributors are National Waterworks and Hughes Supply which were part of HD Supply. |
| **Distribution** | Sales historically occurred directly from water suppliers to customers. Distribution is a healthy sub-segment of infrastructure that has been gaining traction as customers look for entities that have complete product lines, local sales force, and the ability to manage projects. Distribution companies also benefit suppliers by helping them manage their inventories more efficiently, provide greater economies of scale, and assist in more efficient working capital management. |
| **Key products** | • Pipe 45%.<br>• Fittings 15%.<br>• Hydrants 5%.<br>• Valves 10%.<br>• Meters 10%.<br>• Service and repair equipment 5%.<br>• Other 10%. |
| **Pricing** | • Costs vary by product. Some items, such as PVC pipe, are volatile in price.<br>• PVC pipe costs have increased 50% in the last two years, from $0.36 per pound to $0.54 per pound.<br>• Fittings vary in price from $1 to a couple thousand dollars.<br>• Hydrants typically cost about $1,000.<br>• Meters vary in price from $100 to a couple of thousand dollars for wireless meters.<br>• Service and repairs vary by scope of services and potential solutions. Projects are either time and materials or fixed-fee. Hourly rates range from forty to several hundred dollars and vary by region. |
| **Services** | After-market is usually more profitable than the OEM. Services vary by product, but typically range from 5% to 10% of the original cost of the product. |
| **Regulatory** | EPA, Bureau of Reclamation, state and local governments. |
| **Trends to monitor** | • On-going repair and maintenance of large water and wastewater infrastructure.<br>• Government funding gaps for infrastructure projects.<br>• The current rate of capital investment is so insufficient that it could take 900 years to replace the existing infrastructure.<br>• New infrastructure necessary to support economic and population growth.<br>• Stress on existing infrastructure.<br>• Commercial and residential construction activity.<br>• Average age of water and wastewater pipe infrastructure.<br>• Innovation and useful life, particularly in products such as meters, to attract consumers.<br>• Increase in the use of automatic meters; the current market is 88% manual and 12% automatic.<br>• New construction; the market opportunity for meters is 6 million units, 25% new and 75% replacement.<br>• Consolidation of the nation's water and wastewater treatment systems.<br>• Competition from China/low cost sourcing. |

*Source: Company reports and Goldman Sachs Research.*

# Automation systems

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| **Market Description** | Automation systems are a $3 billion global market specializing in process control software systems for water treatment plants. These water systems should outpace conventional methods of monitoring water in treatment plants in developed countries as industries like manufacturing search for efficiencies. The demand trend is healthy, growing in the mid-to-high single digits, as water treatment continues to face challenges such as tougher water quality standards and rising costs. |
| **End Markets** | Markets include municipal water facilities, industrial (e.g., beverage), power (e.g., coal, gas, nuclear), pulp and paper, marine, semiconductors, as well as environmental agencies. |
| **Geographic** | 65% international, 35% in the United States. |
| **Market Leaders** | ABB, Emerson, GE, Siemens, Rockwell Automation, Honeywell, Andover Controls, Nalco. |
| **Distribution** | Sales occur through many avenues, including a direct sales force, wholesalers, distributors, systems integrators, installers, and OEMs. |
| **Key products** | • Automation software.<br>• Energy efficient electrical motors and drives.<br>• Controls and instrumentation.<br>• Robotics and peripherals.<br>• GE's Fanuc automation system is for process controls of water and wastewater systems, water security, flow control instruments, and industrial water treatment businesses.<br>• Emerson has a well-coordinated array of businesses in plant automation in water applications under the names of PlantWeb, Ovation, and DeltaV.<br>• Nalco offers 3D TRASAR. The Trasar technology is an automated water treatment system designed to protect water systems from corrosion, bicrobial fouling, and contamination. This system is automated and remotely managed. This feature enables Nalco to minimize its service stops at the site, ultimately reducing the total cost of operations for the customer. Clients can also operate their systems under more stringent conditions with this type of technology because of the closer monitoring and tighter controls over the system. All these factors lead to greater productivity and efficiency. |
| **Pricing** | Contracts vary by scope of products, services, and solutions. Although, we believe that costs incurred are at a minimum break-even. Savings driven by efficiencies, asset preservation, and quality more than offset any expenditure. An analysis by ABB Industries suggested that the initial outlay for a project is about 25% of the total cost. |
| **Services** | • Automation has healthy services not only in the implementation but also on a perpetual basis. We estimate that the services component is three times the original investment.<br>• Before a system is implemented, an engagement needs to be assessed. This process includes framing objectives and helping identify specific processes and systems. The installation, from network infrastructure through software, needs to be managed to ensure that the installed system works efficiently and communicates effectively.<br>• On a perpetual basis, follow up training and full-service support should be provided to ensure that systems are working at maximum capacity. Perpetual services should experience healthy growth as the installed base of business continues to grow. |
| **Regulatory** | EPA, state and local governments. |
| **Trends to monitor** | • Continued emphasis on driving future efficiencies in developed countries.<br>• Market trend towards the outsourcing of automation and maintenance services.<br>• Expanded service offerings, which should be helped by a larger installed base of clients.<br>• Services should become a larger percent of total revenue.<br>• Less lumpiness as services grow.<br>• Computer interfaces to gather particle counts, pH, chlorine, and turbidity for easier collection/analysis.<br>• Strong demand in Asia.<br>• Continued shift from preventive to predictive maintenance.<br>• Smart pumps that are connected to a company's network.<br>• Remote monitoring of pumps for early problem detection and efficiency.<br>• Networked valves, remote operations, and sensors. |

*Source: Company reports and Goldman Sachs Research.*

# Engineering & Consulting services

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| **Market Description** | Engineering/consulting services are a $12 billion global market that captures various stages of the water cycle. Services consist of infrastructure design, financing, and facility operations. Transportation engineering and consulting are two other areas of focus. The scope of services is broad, as many companies offer solutions across the entire water spectrum while others offer specific areas of specialization. On one end of the spectrum is Tyco (Earth Tech), a leader in water, environmental, transportation, and construction consulting. On the other end is Bolton Photosciences, which is a consulting firm that offers consulting services in the area of UV and treatment technologies. |
| **End Markets** | Markets include global wastewater, municipal water facilities, industrial (e.g., beverage), power (e.g., coal, gas, nuclear), transportation, facilities, pulp and paper, marine, semiconductors, as well as environmental agencies. |
| **Geographic** | 65% international, 35% in the United States. |
| **Market Leaders** | AECOM (including Earth Tech acquired from Tyco), Tetra Tech, CH2M Hill, Black & Veatch, and URS. |
| **Distribution** | Sales occur through a direct sales force and/or the consultants themselves. |
| **Key products** | Deliverables include recommendations and solutions that address whatever the engagement warrants. |
| **Pricing** | Fees vary by scope of services and potential solutions. Consulting engagements are typically time and materials or fixed-fee. Hourly rates range from forty to several hundred dollars and can vary meaningfully by geography. |
| **Services** | • Sample engagements include:<br>• Earth Tech's global water management solution– provide a full complement of program management, engineering design, construction, operation, and project financing services to its customers. Their approach is to raise the value and lower the liability from water and wastewater systems.<br>• Engineering consulting– assisting an engineering consulting firm in the selection of a UV water disinfection system for a drinking water treatment utility.<br>• Water utility company– helping a water utility design a UV system for the removal of certain pollutants |
| **Regulatory** | EPA, state and local governments. |
| **Trends to monitor** | • Regulatory compliance.<br>• Budgetary constraints.<br>• Influencing purchasing decisions.<br>• Design and engineer projects for utilities in developing countries that are shifting towards the privatization of their major infrastructure facilities.<br>• Trend towards build-own-operate public works which have been awarded to French and UK interests in consortia with local companies. US-led consortia have been largely absent from these projects. |

*Source: Company reports and Goldman Sachs Research.*

# Regulatory drivers

**The trend continues toward increased Federal and state regulation in water, which benefits the companies providing test equipment and services. Importantly, the water regulation market is becoming more global. For example, China is adopting some regulatory systems that mirror the early practices of the EPA.**

## Background

Major water suppliers must comply with Federal, state, and local laws. The EPA, which was established in 1970, is the government agency in the United States responsible for protecting the public health in water safety across the 50,000-plus water-regulated entities. In the United States, the Safe Drinking Water Act sets the water test standards for acceptable levels of 90 contaminants. The other key law governing water quality is the Clean Water Act, which protects the surface water resources from pollutant discharges and maintains standards for wastewater treatment. More recently, the Department of Homeland Security has focused on the needs for increasing the security of the US water system.

## Regulation and legislation impacting the industry

The EPA reviews drinking water standards every six years. It administers the following water infrastructure programs:

- **The Safe Drinking Water Act of 1974** protects consumable water by setting pollutant levels.
- **The Clean Water Act of 1977** protects bodies of water, like rivers and coasts, by regulating pollutant discharges into waters and maintaining standards for wastewater (sewage) treatment. This could impact drinking water, as most treated wastewater is returned to its source.

Other examples of EPA administered legislation and regulations include:

- **EPA initiatives** continue to focus on increased safeguards. One initiative announced in March 2005 is to strengthen protection from lead in drinking water. From 1995-2004, individual states concluded 1,800 compliance actions with lead and copper rules. The EPA concluded 570 actions in that period. Under the Safe Drinking Water Act, states have the primary role in enforcing these rules.
- **Stage 2 Disinfectants and Disinfection Byproducts Rule (DBPR)** was written to reduce disease incidence from disinfection byproducts that form when public water supply systems add disinfectants, such as chlorine. DBPR supplements existing rules by requiring systems to meet disinfection byproduct maximum contaminant levels at each monitoring site in the system. DBPR also employs a risk-based approach that identifies sites to monitor where customers are exposed to high levels of disinfection byproducts. This rule could reduce DBP exposure.
- **The 2003 Long Term 2 Enhanced Water Treatment Rule (LT2ESWTR)** should be finalized in 2005. The intent is to provide health protection from organisms like cryptosporidium in drinking water. The regulation is applicable to all systems that use surface or ground water supplies under the influence of surface water. The EPA believes that approximately 1,000 UV installations could be designed and constructed in the United States when LT2ESWTR is fully implemented.

Important international water-related regulations and laws include:

- **Integrated Pollution and Prevention Control (IPPC)** was passed in 2000 and has been a focus of industrial wastewater and municipal water and wastewater treatment

equipment markets in Europe. The required 2007 phase-in mandates industries to implement best-in-class processes for treating wastewater discharge. The goal is to promote water conservation by reusing and recycling treated wastewater. This strategy should enhance growth prospects for secondary and tertiary treatments.

- **The 1996 Amendments to the China Water Pollution and Control Law** were modifications to the original law, which was enacted to address water pollution. The legislation also protects the environment to safeguard human health. The law governs standards for the quality of the environment and discharge of water pollutants. The edict also captured the prevention and control of surface and ground water pollution. This law was enacted in 1984 and amended in 1996.
- **EU Accession Countries, Urban Wastewater Directive 91/271/EEC was passed in 1991** in an effort to protect the environment from the adverse effects of the collection, treatment and discharge of urban wastewater, and the treatment and discharge of wastewater from certain industrial sectors.

The demand-supply disequilibrium is another significant challenge facing the industry, which highlights the importance of investment. Over the last ten years, government spending on water grew by 2%. The EPA projects that $138 billion is required by 2016 to get the infrastructure compliant with safety standards mandated by the Safe Drinking Water Act.

# Appendix

**Exhibit 23: Select private water companies**

| Company | Water end market presence | Website |
|---|---|---|
| Andover Controls | Automation | **Andovercontrols.com** |
| Automation Controls, Inc. | Automation | **Automationcontrols.com** |
| Beckart Environmental | Wastewater treatment | **Beckart.com** |
| Besco Water Treatment | Residential, commercial, and industrial treatment | **Bescowater.com** |
| Black & Veatch | Engineering/consulting | **Bv.com** |
| Bolton Photosciences | Engineering/consulting | **Boltonuv.com** |
| Calder AG | Energy recovery systems | **calder.ch** |
| CH2MHILL | Engineering/consulting | **Ch2m.com** |
| CHEMetrics | Water test consumables | **Chemetrics.com** |
| Checklight | Automation | **Checklight.co.il** |
| Culligan | Residential, desalination, commercial and industrial | **Culligan.com** |
| Ecowater Systems | Residential and commercial water treatment | **Ecowater.com** |
| Energy Recovery Inc. | Energy recovery systems | **energyrecovery.com** |
| Eureka Forbes | Residential and commercial water treatment | **Eurekaforbes.com** |
| Excel Water | Commercial and industrial filtration | **Excelwater.com** |
| Frost and Sullivan | Engineering/consulting | **Frost.com** |
| Hayward | Pool and spa | **Haywardnet.com** |
| HD Supply | Distributor of water & waste products and services | **Hdsupply.com** |
| Hunter Industries | Irrigation | **Hunterindustries.com** |
| IDE Technologies | Desalination | **ide-tech.com** |
| Irritrol Systems | Irrigation | **Irritrol.com** |
| Kinetico | Residential and commercial filtration | **kinetico.com** |
| Koch Membrane Systems | Industrial and municipal treatment | **Kochmembrane.com** |
| Marsh-McBirney | Flow monitoring | **Marsh-McBirney.com** |
| McCarthy | Water and wastewater facility construction | **Mccarthy.com** |
| NSF International | Environmental protection | **NSF.org** |
| Pump Engineering | Energy recovery systems | **pumpengineering.com** |
| Professional General Mgt Svcs | Water and wastewater management services | **Pgms.net** |
| Rain Bird | Irrigation | **Rainbird.com** |
| ResinTech | Deionization | **Resintech.com** |
| Texas Pipe & Supply | Pipes | **Texaspipe.com** |
| TriSep Corporation | Municipal, industrial and commercial treatment | **Trisep.com** |
| Water Standard | Seawater desalination vessels | **Waterstandard.com** |
| Weathermatic | Irrigation | **Weathermatic.com** |

*Source: Company reports, Goldman Sachs Research.*

**Exhibit 24: Other public companies with a presence in water**

| Company | Ticker | Market Cap $ mil | Water as % of Total Revs | Water end market presence |
|---|---|---|---|---|
| A.O. Smith | AOS | $1,001 | 45% | Motors for pumps & pools, water heaters |
| Basin Water | BWTR | $106 | 100% | Groundwater treatment |
| Consolidated Water | CWCO | $281 | 100% | Caribbean desalination and water distribution |
| Franklin Electric | FELE | $789 | 80% | Motors for well pumps and wastewater |
| Gardner Denver | GDI | $1,907 | 5% | Pumps and wastewater treatment |
| Gorman Rupp | GRC | $479 | NA | Pumps and pump products |
| Illinois Tool Works | ITW | $24,633 | <1% | Coatings and linings for pipes |
| Kelda Group Plc | KEL-GB | $5,860 | 96% | Water and wastewater treatment |
| Pico Holdings | PICO | $561 | 50% | Water rights |
| Pure Cycle | PCYO | $132 | 100% | Water rights |
| Rohm & Haas Company | ROH | $10,378 | NA | Deionization |
| SCP Pool | POOL | $919 | 100% | Swimming pools and related equipment |
| Toro Company | TTC | $1,686 | NA | Irrigation |
| URS Corporation | URS | $2,823 | 10% | Engineering/consulting |

*Source: Goldman Sachs Research estimates; FactSet.*

**Exhibit 25: Conversion table**

| Old Unit | New Unit |
|---|---|
| 1 liter | 0.264 gallons |
| 1 cubic meter | 264.2 gallons |
| 1 acre-foot | 325,850 gallons |
| 1 barrel of oil | 42 gallons |
| 1 cubic foot per second (cfs) | 448.8 gallons per minutes |
| 1 Million gallons per day (1 MGD) | 1,120 acre-feet per year |

*Source: Goldman Sachs Research.*

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