

Longer Term Investments

Water scarcity

Chief Investment Office GWM | 09 May 2019 9:46 pm BST

Alexander Stiehler, CFA, Analyst; James Dobson, CFA, MLP and Utilities Analyst Americas, james.dobson@ubs.com

- Water is essential to life and represents a key driver of economic growth. Unfortunately, fresh water is distributed unequally worldwide. Many countries confront the increasing challenge of water scarcity while some face overabundance.
- According to the OECD, limited access to safe drinking water, sufficient food and energy supplies, and adequate wastewater management is a widespread global problem, and water scarcity makes it difficult to improve overall health, prevent poverty and stimulate economic growth in many countries. Today, 40% of the world's population lives in regions that suffer from some water stress, a figure projected to rise to 55% by 2050.
- We see attractive long-term investment opportunities in water likely to remain valid for decades. Given the many factors involved and the long-term investment horizon, we advise investing in a well-diversified investment vehicle that offers global exposure to the entire water value chain.

Our view

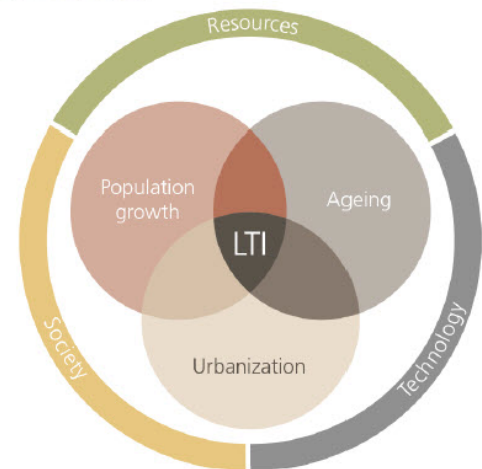
The importance of water worldwide is undisputed. Potential changes in its supply-demand balance put it at the forefront of longer-term development goals. So it should come as no surprise that water security is one of the UN's 17 Sustainable Development Goals and one that fits well with our sustainable investing framework.

As the world's population grows, the planet's limited natural resources are subject to increasing strain, which in turn can detract from social and economic prosperity. Population growth alone is a problem, but how and where it takes place can make resource management that much more of a challenge. While urbanization provides a major boost to GDP growth, it also requires vast amounts of scarce water. As it continues apace in Africa and Asia, it places an even greater burden on the environment. Rising living standards and ongoing industrialization in emerging markets (EM) also increase the pressure on global water allocation.

The OECD estimates that around 1 billion people worldwide have no access to a safe water supply, and basic sanitation unavailable to 2.6 billion. To increase access to both, major investment is needed to upgrade water infrastructure. Importantly, the return on investment could be attractive at 5-10 times the initial outlay (source: OECD). A failure to manage the planet's limited water resources will carry huge social and economic costs. Conversely, if the world can harness them wisely, the benefits to mankind are likely to be considerable.

Introduction to the Longer Term Investments (LTI) series

- **The Longer Term Investments (LTI)** series contains thematic investment ideas based on long term structural developments.
- Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- These investment opportunities are influenced by the interplay of technological advancement, resource scarcity, and the societal changes.
- Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



Urbanization and population growth: Water demand rises, both in magnitude and complexity

This report discusses the "expanded water nexus," which captures the inter-relationships between the main water consumers and demonstrates the critical interplay involved in the water issue worldwide. Although the global water cycle is a closed system and our blue planet seems to offer water in superabundance, the supply of it is in fact limited in many areas because it is unevenly distributed. The direct and indirect effects of water scarcity can be seen in such events as mass migration, civil conflict and drought.

Comparing the demand for water worldwide to its supply reveals that scarcity is a real threat. The water imbalance in China and India is enormous (see Fig. 1). The two countries represent 35% of the world's population yet have access to less than 10% of its freshwater resources. Further, the ongoing global trends of urbanization and population growth exacerbate this imbalance as their effects are more and more concentrated in the developing world.

The threat of climate change and global warming compounds these effects. A study by Gerten et al. (2013) estimates that, for each one degree of global warming, renewable freshwater resources could decline by 20% for another 7% of the global population. All of which suggests that global water scarcity will worsen without sufficient action and investment.

Population growth: Direct and indirect effects on water demand

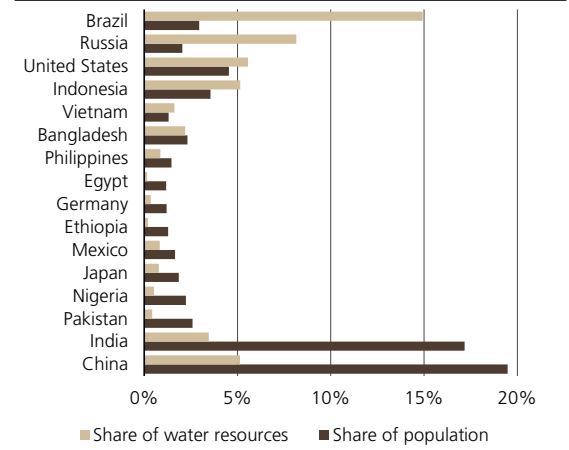
A larger global population increases the overall consumption and demand for water. By 2025, the UN estimates that the world will be home to eight billion people, a figure that will rise to nearly 10 billion by 2050. The obvious direct effect is a need for more drinking water, but the indirect effect (food production) is a more daunting challenge. The ever-larger population will require sufficient caloric intake. These higher quantities, as well as changing dietary preferences, will increase the demand for water.

Agriculture currently accounts for 70% of global fresh water demand. Protein-rich nutrition based on animal products will likely push that figure up. The Swiss Federal Institute of Aquatic Science and Technology (EAWAG, A. Zehnder et al) compared a pure vegetarian diet with one that includes meat consumption. Due to the need for more water when producing meat and cereals (see Fig. 2), a diet containing 20% meat almost triples the amount of water used by an individual to 1,000-1,300 cubic meters per year. Improved living standards raise not only dietary standards but the "personal water bill" as a greater emphasis on personal hygiene and other types of household cleaning and maintenance causes water use to climb.

Combining these population growth-driven trends, we expect water demand to soar due to the effects of direct and indirect sources.

Fig. 1: Extreme water imbalances by country: China and India are two extreme cases

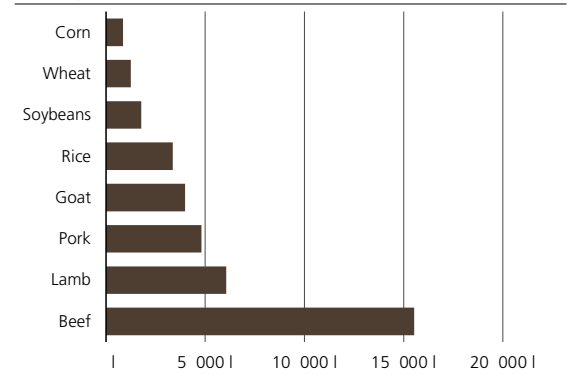
The graph shows the 16 most populous countries



Source: The World Factbook (CIA) as of April 2019, UBS

Fig. 2: Water quantities used in food production

Liters of water needed to produce 1 kg of the food item specified



Source: UNESCO, UBS

Urbanization: A growing thirst for water and energy

In 1950, just 29% of the world's population lived in cities. By 2008, urban dwellers exceeded rural ones. The UN expects this trend to continue, with nearly 70% of people around the globe living in urban settings by 2050 (see Fig. 3). While the population in most developed countries has been concentrated in cities since the mid-20th century, emerging markets still have a lot of urbanizing potential.

In our view, this trend toward city living will create major challenges as well as investment opportunities when it comes to water exploration, treatment and distribution. Most industrialized countries built their water mains in the early part of the 20th century and have not invested extensively in upgrading them since. Some of New York City's water mains date to 1910. The average lifespan of water pipes is 50-100 years, depending on what they're made of and how much pressure they handle. Such aged infrastructure means that, on average around the world, countries lose some 28% of their water through pipe leakage, theft and inappropriate distribution (Northeast Group, 2016).

Kingdom, Liemberger and Marin discovered that many cities surrender more water through leakage than they deliver to households. This non-revenue water (NRW) diminishes cities' ability to distribute fresh water in an efficient and economically sound manner.

Limited public budgets illustrate why the private sector will play a much greater role than it has in the past. Rising tariffs, taxes and transfers can be used to compensate companies and make water delivery and other related businesses profitable for them. Although it is widely recognized that water scarcity is an issue that requires urgent attention, the price of water in many countries does not reflect this fact. We consider it inevitable that prices for the resource will rise since demand for it is inelastic and the risk of it becoming scarce for many countries, sectors and companies is climbing.

Urban industrialization

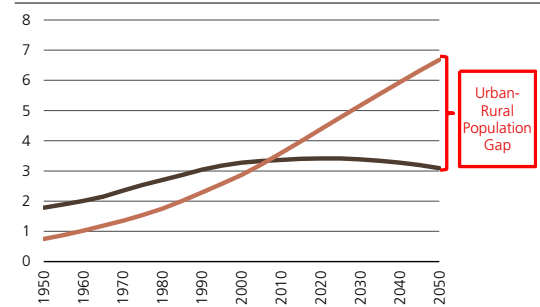
A growing urban population is not only upping the demand for water, so is the increasing size and number of industrial parks. Most emerging markets pursue a strategy of industrialization, which accounts for their disproportionately higher use of fresh water. Aside from the electricity sector, which we discuss below, other industry groups in the value chain also have major direct or indirect water needs.

The challenge for emerging markets differs from that of developed markets (DM) but is no less severe. Many developing nations have to build infrastructure from scratch, while DM countries need to repair their existing systems. New water infrastructure costs on average three times more than new electricity infrastructure, according to IBM estimates. Compared to DM governments, which have postponed major outlays to water infrastructure for decades, EM ones have little choice: they must invest.

Consequently, we see the biggest opportunity there. Around two-thirds of cities with a population in excess of one million people are found in Asia, Latin America and Africa. Kinshasa in the Democratic

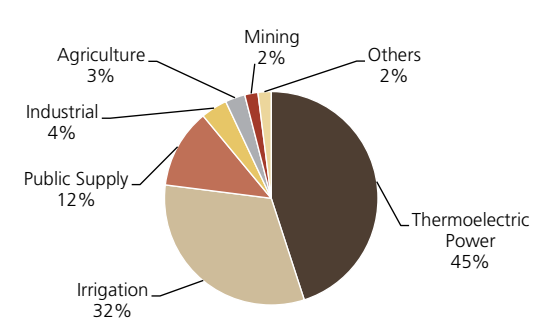
Fig. 3: Urban and rural populations (in billions, 1950-2050)

By 2050, a significant majority of the world's population will live in urban areas



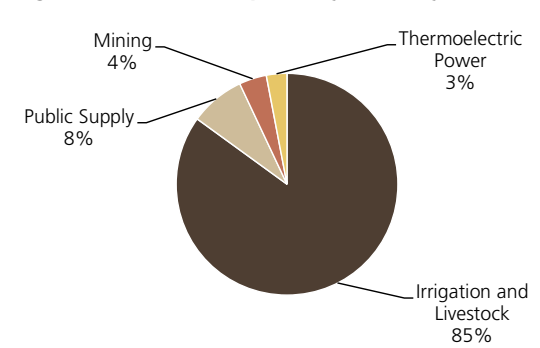
Source: United Nations, Population Division – World Population Prospects, the 2018 Revisions; Note: including long-term forecasts

Fig. 4: Water withdrawal by industry in the US



Source: US Geological Survey

Fig. 5: Water consumption by industry in the US



Source: US Geological Survey

Republic of the Congo offers a telling, if extreme, example of EM population trends. The number of its inhabitants rose from less than four million in 1990 to 11 million by 2014 to what is projected to be 20 million in 2030, according to the UN (World Urbanization Prospects 2014 revision).

Thirsty utilities

Another result of urbanization and industrialization is the growing energy demand from big cities. Many large-scale electricity-generation technologies need vast amounts of water (see Fig. 4). Large thermal power plants, found extensively, for example, in China, use it in their cooling operations. Though the amounts they use are significant, thermoelectric utilities are not regarded as big consumers of water because they return it into the hydrological cycle (see Fig. 5), unlike, say, irrigation or livestock operations, where much of the water used goes into the end-product itself. Still, thermoelectric utilities need water for their cooling operations, so they are in direct competition for it with the agriculture sector and other industries, a reality that may affect the investment case for them.

Climate change: Effects on water supply and GDP

EM countries that depend heavily on water to fuel GDP growth (e.g. those with a significant agricultural sector) and encounter severe shortages of it suffer the effects of scarcity acutely. Population growth, industrialization and the convergence of living standards in them toward those of the Western world have already caused water demand in them to soar. The latest research about the effects of climate change on water and the economy suggests this situation may become even more severe.

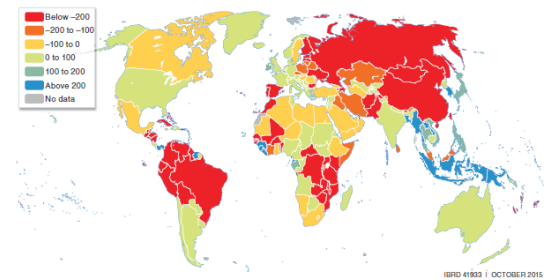
The water shortage in South Africa (Western Cape in 2017-18) serves as a recent cautionary tale. In February 2018, Capetonians were asked to limit their daily water use to 50 liters per person per day, down from 87 liters on 1 July 2017 and from more than 200 liters on average over the last 20 years. The stipulated amount is falling toward the minimum required for short-term survival by the World Health Organization (20 liters per day). The adverse effects triggered by a rising average global temperature are highly uneven but tend to affect already stressed developing countries most.

Water cycle as the primary channel of climate-driven changes

Global climate models indicate that a change in average global temperature plays havoc with the hydrological cycle. The amount of surface water in the world is static (because it is a closed system), so climate-driven changes occur mainly through the allocation, availability and quality of water.

On the one hand, the frequency and uncertainty of floods, storms, droughts and extreme rainfall clearly affect the planet's water system. On the other, the spatial distribution of runoff becomes a major concern. According to the World Bank's latest findings, climate-driven changes in runoff will have uneven effects around the world, with those areas already suffering from water shortages likely to be hit hardest (see Fig. 6). This means that the least developed countries,

Fig. 6: Climate-driven drops in runoff* hit least-developed, agriculture-dependent countries most
Projected fall in millimeter per square meter by 2050



Source: World Bank (High and dry: Climate change, water, and the economy) as of 2016

Note: red (below -200), orange (-200 to -100), yellow (-100 to 0), light green (0 to 100), dark green (100 to 200), blue (above 200), grey (no data).

*** Definition of runoff:** Part of water cycle that flows over land as surface water instead of being absorbed into groundwater. This is a key and easily accessible water source for man, animals and particularly the agricultural sector in the least-developed regions worldwide.

where water-consuming activities such as agriculture and energy generation are particularly important, are likely to suffer most.

Groundwater is also affected by climate change. Altered recharge patterns caused by climate-driven events directly affect groundwater reservoirs and water supply. Reduced runoff increases demand for groundwater, especially for irrigation, which is responsible for 70% of global groundwater withdrawals (WWAP, 2012). Along with water levels, aquifer water quality is also at risk from global warming. Greater groundwater salinity caused by higher temperatures and rising sea levels is a primary concern. The rising seas push their water inland and the higher temperatures cause runoff to evaporate before it can replenish groundwater reservoirs.

Water's important role in global GDP growth

Fig. 7 shows the "Water-Climate Nexus" and expands on previous ideas by incorporating environmental and urbanization trends into the equation (World Bank, 2016). This concept establishes that the competition for water from the agriculture and energy sectors will intensify because of urban and environmental trends.

There are three main ways that water affects human prosperity. First, a rise in the frequency and intensity of droughts, floods and other catastrophic events can have serious economic consequences. We believe investing in infrastructure and smart warning systems could yield high returns, both socially and economically.

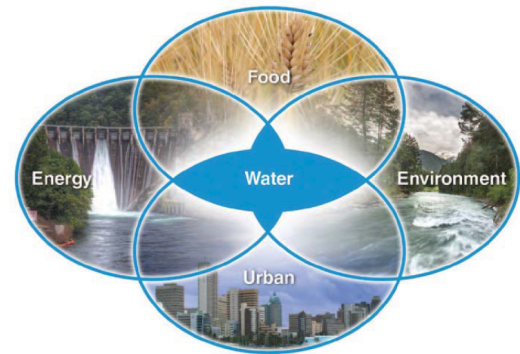
Second, whether as a direct or indirect input into the production process, water must be distributed efficiently to keep businesses and economies running. Examples where insufficient water supply has affected business processes can be found around the world, and leads ultimately to lower GDP growth. As widely mentioned in the media, whether in India, the US, South Africa or Australia, drought and water shortages have forced companies in different sectors to shut down or relocate production processes.

Finally, water-related issues have indirect long-term effects on health, nutrition, education and human capital. As a consequence of them, poverty, economic stagnation and the lack of employment prospects can increase and cause social tension and conflict. In a globalized world, such conflicts can spill across borders. Mass migration is a major danger, and is driven to a great extent by water scarcity.

These developments will be further exacerbated by the uneven impact of climate change on the least developed regions, from which a large proportion of refugees emanate. This tide of refugees is likely to continue unless living conditions in their homelands improve. As access to fresh water is a building block in this process, inaction could slow global GDP growth markedly (see Fig. 8). Many of the economic migrants coming to Europe are doing so, in part, because of the food and water scarcity they face in their homelands.

Fig. 7: The water-climate nexus

Water scarcity has far reaching consequences for different sectors



Source: World Bank (High and dry: Climate change, water, and the economy) as of 2016

Fig. 8: Estimated climate-driven water scarcity hit to GDP in year 2050

In the "business as usual policy regime" regions in North Africa and Asia could see a significantly lower GDP in the year 2050.



Source: World Bank (High and dry: Climate change, water, and the economy) as of 2016. The chart shows the business as usual scenario.

Note: blue (+8%), cyan (+2%), olive (+1%), beige (-1%), orange (-2%), red (-8%)

Beneficiaries of green shipping

The maritime transport sector is set to undergo a sea change in terms of environmental regulations. It will lead to clean tech investment in scrubbers and ballast-water treatment equipment for new and existing ships.

Though currently a tiny portion of the water-equipment industry, this sector could become one of the fastest-growing areas for the water industry over the next few years. In our water market model, we include only ballast-water treatment equipment, which thematically fits the water theme (see Fig. 10). But as other regulations simultaneously affect the same part of the value chain, we also discuss the SOx/CO2 investment implications.

The International Maritime Organization (IMO) and national authorities are introducing stricter regulations to address shipping sector pollution.

- Ballast water management: Since September 2017, all new ships have had to meet stricter standards, while all existing ships will have to comply between September 2019 and 2024.
- SOx cap: All oceangoing ships have to use less sulfur fuel starting January 2020. (The current limit is 3.5% of oil fuel; the new limit is 0.5%.)
- CO2 cap: All new ships have to reduce CO2 emissions by up to 20% by January 2020 and up to 30% by 2025.

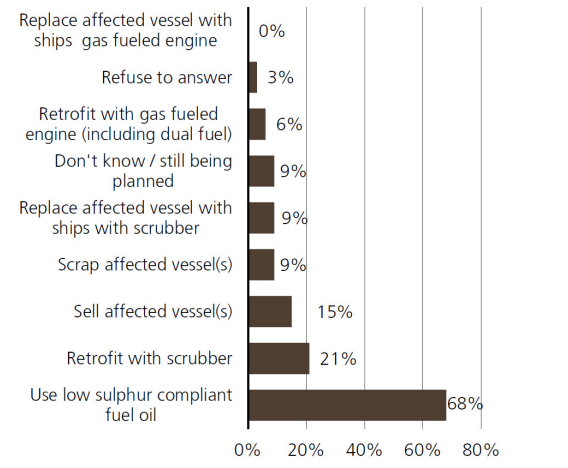
We believe that shippers are not ready for green shipping yet and estimate that 50,000–70,000 ships worldwide still need to be fitted.

Ballast water-treatment systems cost on average more than EUR 500,000 per ship, including installation. This figure falls to EUR 100,000 for smaller vessels and can rise to EUR 1m for larger ones, by our estimates. The upside in earnings growth for equipment providers is substantial.

Also, the sulfur oxide (SOx) cap provides opportunities because one way of avoiding paying for expensive, low-sulfur fuels is to scrub cheap, high-sulfur fuel oil. A UBS Evidence Lab survey asked executives how their companies will comply with the new regulations. Fig. 9 illustrates that 68% prefer to use lower-sulfur fuel to meet the regulation, but the second-most-cited option is to install scrubbers.

They cost EUR 1m per ship, with installation costs about the same. Based on comments by Wärtsilä, an equipment supplier, the payback period is less than three years. UBS estimates the scrubber market has a potential size of USD 25bn and offers a major opportunity for equipment suppliers.

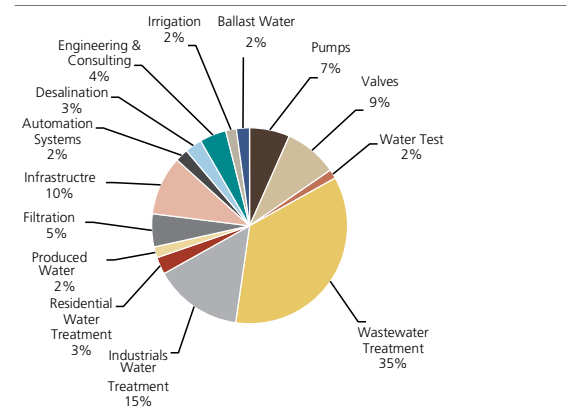
Fig. 9: How do you plan to comply with IMO's 2020 global sulfur limits (SOx regulation)?



Source: UBS Evidence Lab

Fig. 10: Global water subsectors, total market size > USD 620bn (2019E)

The water sector consists of multiple sub-sectors, each with different drivers



Source: UBS estimates based on the water market definition of RBC Capital Markets (Playbook for Investing in the Multi-Industry & Electrical Equipment Sector, November 2014), UBS adjustments as of April 2019

Market make-up

The market for water is not dominated by a single sector but comprises several subsectors and industries that can broadly be split into two groups: industrials and water utilities. Based on several market estimates and our own analysis, we value the entire water market at more than USD 620bn (2019 estimate). Fig. 10 shows each subsector's percentage of the total addressable market. The biggest category, at 35%, is wastewater treatment (water utilities). The remaining 65% consists of water equipment suppliers that provide equipment for water exploration, distribution and treatment.

Broadly speaking, one can categorize the water utility sector as infrastructure users and spenders (the demand side for equipment) and the industrial equipment providers that benefit from these investments (the supply side for equipment).

Trends like ballast water treatment (discussed above) remain niche markets, independent of infrastructure and water utility spending, but offer a regulatory opportunity. When the new regulations in the ballast-water treatment industry take full effect, this segment, in our view, should enjoy the highest growth rates over the next several years (for more details see the section about ballast water treatment), followed by desalination (>10% p.a.). The slowest-growing subsectors are filtration, pumps, valves and water infrastructure, which are expected to expand at a rate in the lower single digits (2-4% p.a.). By contrast, the growth rate for the water utility sector (water and wastewater treatment) is expected reach the mid-to-high single digits. Vibrant spending in emerging markets supports these trends.

In our view, water utilities and industrials alike should benefit from rising water demand, the former through greater investment and higher water tariffs and the latter mainly through more equipment sales. It may sound counterintuitive to suggest that more investment will bring larger profits, but UK water utilities, for instance, earn their money through a regulated return on investment, based on their existing asset base and their planned investment (i.e. more investment equals more opportunity to generate profits). This means that as investment increases, the revenue base can grow, leading to a potential rise in profits.

The attractive business prospects and high revenue visibility of water utilities (local monopolies) and the well-diversified business set-up of the water-exposed industrial companies are the chief reasons we think that investors should include them in their portfolios. Based on market data, the S&P Global Water Index has materially outperformed the broader MSCI World Index for nearly two decades (see Fig. 11).

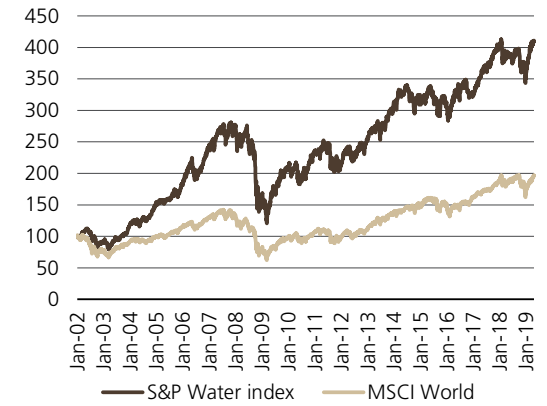
Link to Sustainable Investing

The World Economic Forum has recognized water scarcity as one of the most critical risks facing our planet. An inadequate supply of water threatens the viability of the global economy, the environment and human life. Water is a life-sustaining resource with no substitute.

In our view, numerous developments can provide investors with long-term investment opportunities in water. We believe these develop-

Fig. 11: S&P Global Water vs. MSCI World

January 2002 - April 2019, both in USD (price indices), indexed to 100 in January 2002



Source: Datastream, Factset as of 25 April 2019, UBS

ments will remain valid over the next several decades and lead to sustainable outperformance of the water theme.

However, some companies have major environmental issues relating to their water-management business lines, e.g. minimization of water leakage or, in the case of the construction business, the impact of new reservoirs and dams on flora and fauna. So investors focused on SI should be selective when investing in this theme as several listed companies show below-average ESG results. And as with all investment decisions, diversification and stock selection are important when investing through a cycle.

Water and the Sustainable Development Goals

Goal 6 of the UN Sustainable Development Goals (SDGs) is to “ensure availability and sustainable management of water and sanitation for all.” Achieving it is critical to maintaining biodiversity, reducing the burden of disease, increasing food security and improving human productivity. In short, ensuring universal access to clean drinking water and sanitation underpins almost every other goal in the Sustainable Development Agenda.

Demand for water is expected to markedly exceed supply, which has far-reaching consequences. Challenges like unsustainable population growth, resource-inefficient agriculture, urbanization and industrialization have brought global water resources to the brink while degrading the natural environment that traditionally replenished them.

The UN estimates that, if this imbalance is not addressed, 45% of global GDP, 52% of the world's population and 40% of global grain production will be at risk or compromised by 2050. By acknowledging the dire situation and the opportunity presented by it, companies with solutions that can help bring supply into equilibrium and/or increase our planet's water capacity have become particularly attractive to impact investors.

Today, 844 million people lack access to safe drinking water worldwide. Investing in water infrastructure and affordable water purification solutions could go a long way toward ensuring access to clean drinking water in developing countries. With low-income populations accounting for roughly USD 5trn in annual global spending (source: World Resource Institute 2016), providing access to affordable drinking water is also a major, unmet market opportunity. While seizing it will require substantial private and governmental investment, the social and economic payback will vastly compensate for the costs. In fact, estimates are that every US dollar invested in water generates an equivalent five dollars in societal and economic value.

Water Sharing Investment Partnerships (WSIP) can help ease water scarcity in stressed regions while conserving and restoring water ecosystems. They use investor capital to acquire water rights, which are then leased to the market or diverted back to the environment. They are prominent in countries like the US, where water rights are actively traded.

Because agriculture accounts for 70% of all freshwater use worldwide, water scarcity, as dry regions become drier due to climate change, could exacerbate global food shortages. Investing in smart irrigation technologies could reduce inefficient water use and improve food security, particularly in arid regions like sub-Saharan Africa.

Wastewater reuse currently accounts for less than 3% of all global water withdrawals. To put this in context, some countries, like Israel, recycle water at rates as high as 75%. Investing in water-recycling technologies and infrastructure will prove critical to preserving existing groundwater resources. This is particularly true in population-dense, water-scarce countries like China, India and parts of Brazil.

Investing in this theme provides not just an opportunity to contribute meaningfully to solving the global water crisis. It can also generate financial returns appealing to impact investors. Dedicated but smaller-scale impact investing solutions exist, primarily in private equity and venture capital funds. Most of these funds target concessionary returns, though. Impact investors who seek market rates of return may be better off accessing this theme through generalist private equity and venture funds or via direct investments. When using non-impact-specific vehicles, impact investors must assess whether they meet impact criteria, including intent, measurability, verification and additionality (i.e. proof that the impact would not have occurred had the investment not been made).

Andrew Lee , Head Sustainable and Impact Investing US

Melissa Spinoso, Senior Sustainable Investing analyst

Andrew Little, Sustainable and Thematic Investing Associate

Conclusion

As outlined in this report, the trends affecting the rising supply-demand mismatch for water are numerous and diverse. The bulk of them, though, can be subsumed under two broad structural trends: population growth and urbanization. We also highlighted that water-related investments are in the spotlight in EM and DM countries alike.

Owing to the urgency and scale of water-related issues, we see continuous sustainable revenue and profit growth prospects for the theme. In light of the global scale of the water scarcity problem and the many underlying elements and developments that affect it, we advise investing in a well-diversified investment vehicle that encompasses industrials and utilities alike to ensure reasonable exposure to all key trends.

The various trends tend to play out in different ways at different speeds and have varying market potential, as outlined above. But taken together we believe they should contribute measurably to a market with a global market size amounting to more than USD 620bn in 2019 and growing at mid-single-digit rates, based on our estimates.

Because of the large number of factors involved and the long-term investment horizon, we advise investing in a well-diversified investment vehicle that offers global exposure to the entire water value chain.

Risks

A sharp drop in oil prices that leads to correspondingly lower capital expenditure (capex) has had a negative impact on some water equipment companies exposed to this sector (e.g. you need a lot of water and also water pumps for shale gas/oil exploration). So a renewed decline in oil and gas capex clearly poses a short-term risk to our positive view on the investment theme.

Municipalities' investment activity is also linked to the theme. Despite current insufficient reinvestment cycles (see New York for example, where some city water mains date to 1910), municipalities can still attempt to postpone much-needed investment. In this context, so-called private-public partnerships come into play, in which private companies assume a certain degree of operational and financial risk, while joining the public sector in providing public services. Since the financial market crisis, total investment has risen substantially. But the participation of the private sector depends heavily on the lending capacities of the capital markets and banks. The latter in particular have been hampered since the last banking crisis, which adds a further source of risk.

Another risk stems from any potential water-related policy changes that could harm the operating environment (regulations and tariffs) in regions like Europe, the US and China. Such shifts can affect the water utility sector in particular, which relies on policy action. Equipment providers would also be hurt indirectly if utilities reduced infrastructure investment due to a lack of profitability. We follow the water sector closely and try to anticipate changes, but we cannot exclude sudden policy shifts as a risk to our positive long-term stance on the sector.

Finally, the water investment theme is less cyclical than many but not non-cyclical given its exposure to the industrials sector, which is subject to economic cycles. So our projected long-term outperformance relative to the broader market (see conclusion) is intended to be understood over the entire cycle and might deviate within phases of it.

Appendix

Terms and Abbreviations

Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
2011E, 2012E, etc.	2011 estimate, 2012 estimate, etc.	A	actual i.e. 2010A
Capex	Capital expenditures	COM	Common shares
E	expected i.e. 2011E	GDP	Gross domestic product
p.a.	Per annum (per year)	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office

UBS Chief Investment Office's ("CIO") investment views are prepared and published by the Global Wealth Management business of UBS Switzerland AG (regulated by FINMA in Switzerland) or its affiliates ("UBS").

The investment views have been prepared in accordance with legal requirements designed to promote **the independence of investment research**.

Generic investment research – Risk information:

This publication is **for your information only** and is not intended as an offer, or a solicitation of an offer, to buy or sell any investment or other specific product. The analysis contained herein does not constitute a personal recommendation or take into account the particular investment objectives, investment strategies, financial situation and needs of any specific recipient. It is based on numerous assumptions. Different assumptions could result in materially different results. Certain services and products are subject to legal restrictions and cannot be offered worldwide on an unrestricted basis and/or may not be eligible for sale to all investors. All information and opinions expressed in this document were obtained from sources believed to be reliable and in good faith, but no representation or warranty, express or implied, is made as to its accuracy or completeness (other than disclosures relating to UBS). All information and opinions as well as any forecasts, estimates and market prices indicated are current as of the date of this report, and are subject to change without notice. Opinions expressed herein may differ or be contrary to those expressed by other business areas or divisions of UBS as a result of using different assumptions and/or criteria.

In no circumstances may this document or any of the information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes: (i) valuation or accounting purposes; (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees. By receiving this document and the information you will be deemed to represent and warrant to UBS that you will not use this document or otherwise rely on any of the information for any of the above purposes. UBS and any of its directors or employees may be entitled at any time to hold long or short positions in investment instruments referred to herein, carry out transactions involving relevant investment instruments in the capacity of principal or agent, or provide any other services or have officers, who serve as directors, either to/for the issuer, the investment instrument itself or to/for any company commercially or financially affiliated to such issuers. At any time, investment decisions (including whether to buy, sell or hold securities) made by UBS and its employees may differ from or be contrary to the opinions expressed in UBS research publications. Some investments may not be readily realizable since the market in the securities is illiquid and therefore valuing the investment and identifying the risk to which you are exposed may be difficult to quantify. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS, into other areas, units, divisions or affiliates of UBS. Futures and options trading is not suitable for every investor as there is a substantial risk of loss, and losses in excess of an initial investment may occur. Past performance of an investment is no guarantee for its future performance. Additional information will be made available upon request. Some investments may be subject to sudden and large falls in value and on realization you may receive back less than you invested or may be required to pay more. Changes in foreign exchange rates may have an adverse effect on the price, value or income of an investment. The analyst(s) responsible for the preparation of this report may interact with trading desk personnel, sales personnel and other constituencies for the purpose of gathering, synthesizing and interpreting market information.

Tax treatment depends on the individual circumstances and may be subject to change in the future. UBS does not provide legal or tax advice and makes no representations as to the tax treatment of assets or the investment returns thereon both in general or with reference to specific client's circumstances and needs. We are of necessity unable to take into account the particular investment objectives, financial situation and needs of our individual clients and we would recommend that you take financial and/or tax advice as to the implications (including tax) of investing in any of the products mentioned herein.

This material may not be reproduced or copies circulated without prior authority of UBS. Unless otherwise agreed in writing UBS expressly prohibits the distribution and transfer of this material to third parties for any reason. UBS accepts no liability whatsoever for any claims or lawsuits from any third parties arising from the use or distribution of this material. This report is for distribution only under such circumstances as may be permitted by applicable law. For information on the ways in which CIO manages conflicts and maintains independence of its investment views and publication offering, and research and rating methodologies, please visit www.ubs.com/research. Additional information on the relevant authors of this publication and other CIO publication(s) referenced in this report; and copies of any past reports on this topic; are available upon request from your client advisor.

Important Information about Sustainable Investing Strategies: Incorporating environmental, social and governance (ESG) factors or Sustainable Investing considerations may inhibit the portfolio manager's ability to participate in certain investment opportunities that otherwise would be consistent with its investment objective and other principal investment strategies. The returns on a portfolio consisting primarily of ESG or sustainable investments may be lower than a portfolio where such factors are not considered by the portfolio manager. Because sustainability criteria can exclude some investments, investors may not be able to take advantage of the same opportunities or market trends as investors that do not use such criteria. Companies may not necessarily meet high performance standards on all aspects of ESG or sustainable investing issues; there is also no guarantee that any company will meet expectations in connection with corporate responsibility, sustainability, and/or impact performance.

Distributed to US persons by UBS Financial Services Inc. or UBS Securities LLC, subsidiaries of UBS AG. UBS Switzerland AG, UBS Europe SE, UBS Bank, S.A., UBS Brasil Administradora de Valores Mobiliarios Ltda, UBS Asesores Mexico, S.A. de C.V., UBS Securities Japan Co., Ltd, UBS Wealth Management Israel Ltd and UBS Menkul Degerler AS are affiliates of UBS AG. UBS Financial Services Incorporated of Puerto Rico is a subsidiary of UBS Financial Services Inc. **UBS Financial Services Inc. accepts responsibility for the content of a report prepared by a non-US affiliate when it distributes reports to US persons. All transactions by a US person in the securities mentioned in this report should be effected through a US-registered broker dealer affiliated with UBS, and not through a non-US affiliate. The contents of this report have not been and will not be approved by any securities or investment authority in the United States or elsewhere. UBS Financial Services Inc. is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the "Municipal Advisor Rule") and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule.**

External Asset Managers / External Financial Consultants: In case this research or publication is provided to an External Asset Manager or an External Financial Consultant, UBS expressly prohibits that it is redistributed by the External Asset Manager or the External Financial Consultant and is made available to their clients and/or third parties. For country disclosures, [click here](#).

Version 04/2019. CIO82652744

© UBS 2019. The key symbol and UBS are among the registered and unregistered trademarks of UBS. All rights reserved.